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CSIC

P1.1.001

Inactivation of Anisakis in a real scenario and numerical simulation when applying Pulsed Electric Fields

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Aim:
Larvae of the nematode family *Anisakidae* are capable of causing parasitic infections in humans associated with the consumption of fishery products. *Anisakidae* larvae are widely distributed geographically with rates of parasitism close to 100% in certain fish species. Currently, legislation requires, among other processes, freezing fish products that may contain *Anisakis* and would be eaten raw or undercook. The disadvantage of this technology is the deterioration of the fish quality. Recently, pulsed electric fields (PEF) technology has been demonstrated to be effective to inactivate Anisakis showing the the electrical conductivity of the treatment medium influence in a great extent its lethality. Therefore, the objective of this work was to evaluate the effect of this parameter on the *Anisakis* inactivation at lab level and on the field strength by numerical simulation when treating fish fillets immersed in media of different conductivities.

Method:
Anisakis larvae were treated in water solutions of different electrical conductivities (0.6 to 8 mS/cm) and in natural parasite hake bellies also immersed in this solutions of at distinct electric field strength (1 to 5 kV/cm) and its lethality was evaluated. Results were compared with the field strength simulated by numerial simulation with Comsol Multiphysics tool when applying PEF treatments in similar conditions than that carried on in the lab: inactivation of *Anisakis* in saline solution and inactivation of *Anisakis* in fish muscle.

Results:
Inactivation of *Anisakis* increased when the same PEF treatment (in terms of selected field strength and specific energy) was applied in media of higher electrical conductivity in both saline solution and in fish. However, lethality was always higher when *Anisakis* were treated in saline solution. Numerical simulation analysis indicated that the field strength generated in the larvae was more intense the higher the electrical conductivity of the treatment medium, and when larvae were treated in the saline solution. These simulations would explain the observed differences in the lethality of *Anisakis*.
Conclusion:
Electrical conductivity resulted a significant parameter in the inactivation of *Anisakis* enabling its inactivation at lower field strengths when increasing the electrical conductivity of the media even in fish meat where larvae resistance to PEF was higher.

P1.1.002

Turning Swedish yellow peas into a tasty and nutritious alternative protein source

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Abstract:
Yellow pea is a sustainable and non-allergic plant-based protein source with great potential contribution to our transition to a future sustainable food system. However, it cannot currently compete with soy in terms of price, flavor and functionality which barricades its widespread application. Engineering of pea value chain starting from the cultivation steps and optimizing fractionation technologies can be an effective approach towards producing qualified proteins in terms of yield, techno-functionality and possibly flavor. In addition, a wholistic biorefinery approach, rather than exclusively focusing on protein acquisition will increase economic revenue of the industry and improve its competitiveness and sustainability.
As part of 100%PEA project, six different local (Swedish) pea varieties have been compared in terms of dehulling and protein isolation efficiencies as well as protein functionality to find best varieties for industrial application. For dehulling, minimum cotyledon loss with the highest hull fraction have been aimed while for grinding, optimum parameters to isolate proteins without compromising the starch

granules physical integrity have been in focus to result in both good protein yield but also starch and fiber outcome which will be presented.
In addition, results on the effect of the six Swedish pea varieties on the protein extraction yield, protein functionality, nutritional value, antinutrients and flavor components will be presented.
Different strategies for tunning the fractionation technology for mitigating off-flavors in yellow peas will be also presented.

P1.1.003

Effect of UV treatment on the chemical composition of white, black, green and pink peppercorns.

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Aim: Pepper is one of the most common spices used in many dishes. Volatiles and other flavour components are a key asset to the value of pepper, as its main use is to provide flavour and aroma, but they are very sensitive to heat. Despite its inhibitory effect on bacterial growth and low water activity, cross-contamination and other sources of post-harvest contamination pose a risk to consumer health and it is often consumed raw. As minimal chemical impact is desired when treating pepper, heat treatment is not the most suitable option for disinfection purposes and UV light has been proposed as a non-thermal, energy-saving alternative that could reduce food waste due to microbial contamination. The aim was to monitor the chemical effects of UV treatments on different pepper varieties.

Method: Fenol and flavonoid content, antioxidant capacity, colour, piperine and volatile compounds were measured for 4 pepper varieties, each with 2 different geographical origins: black, white and green pepper (Piper nigrum) and pink pepper (Schinus terebinthifolius). The UV treatments were carried out in a static plaque and in a dynamic reactor in order to generate movement in the sample and irradiate the whole surface of the pepper evenly. Treatment times ranged from 5 to 60 min and were compared with a control (0 min).

Results: A progressive change in piperine and volatiles was observed in the first minutes, which was later attenuated. A progressive change in fenolic and flavonoid content and antioxidant capacity was also observed at longer exposure times. The UV treatments altered the colour of the peppercorns, with black pepper being the least affected. Treatment with the dynamic reactor resulted in a greater volatile change.

Conclusion: UV treatment was observed to alter the physicochemical properties of all types of pepper after prolonged exposure, but to different degrees.

P1.1.004

Acrylamide Mitigation by Pulsed Electric Fields in Potato French Fries

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Aim: The utilization of Pulsed Electric Field (PEF) technology is explored as a sustainable approach for improving the safety and quality of food. By employing electroporation, PEF facilitates the release of AA precursors, making them more easily accessible. The objective of this study is to examine the application of PEF technology in reducing AA levels in late-field potatoes. Through this investigation, the objective is to gain insights into the efficacy of PEF and its potential applications within the food industry, thereby contributing to advancements in food quality and safety practices.
Method: To investigate the impact of different intensities, the potatoes underwent treatment using four distinct parameters. The treatment involved applying voltage levels of 20 and 30 kV, with field strengths of 2 and 3 kV/cm, along with specific energy values of 100 and 300 kJ/kg. After the treatment process, the potatoes were fried for 4 minutes at a temperature of 180°C. Subsequently, AA extraction was performed using liquid extraction and Solid Phase Extraction (SPE) techniques. Finally, the sample extracts were analysed using Liquid Chromatography coupled to tandem Mass Spectrometry (LC-MS/MS).
Results: The results demonstrated that as the treatment intensity increased, there was a noticeable increase in AA reductions. The range of reductions up to a significant 82% (30 kV, 300 kJ/kg).
Conclusion: The potential application of PEF technology in reducing AA levels in potatoes is evident; however, further studies are required to fully explore its effectiveness and feasibility.

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P1.1.005

Development of agricultural encapsulated bioproducts for sustainable food production

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Aim:

The world's population is predicted to significantly grow in the incoming years. As a result, food production needs to increase by about 75% by 2050 to meet demand. Consequently, it is urgent to enhance agricultural productivity to ensure food security for this population while using safe and sustainable environmental strategies. The use of biocompounds of agricultural interest, such as Plant Growth Regulators (PGRs) and Plant Growth Promoting Bacteria (PGPBs) can be a great strategy to achieve this. They can promote plant growth and development through a variety of mechanisms, thereby increasing food productivity. Salicylic acid and *Bacillus* are good examples of these compounds, respectively. However, their application in the field faces limitations, such as the uncontrolled release, which leads to the need of successive applications and increases costs. A solution could be their encapsulation by appropriate techniques such as spray drying. The main objective of this study was to encapsulate salicylic acid and *Bacillus* as PGR and PGPB compounds in order to obtain innovative agricultural products that enhance the sustainability of food production.

Method:

Encapsulation was carried out by spray-drying using maltodextrin of different dextrose equivalent (DE) as encapsulating agent. The capsules were characterized in terms of particle size and morphology. The encapsulation efficiencies and release profiles of both salicylic acid and *Bacillus* were evaluated by colorimetric measurements and plate count method, respectively. The biological effect of the encapsulates was evaluated *in vitro*.

Results:

The encapsulates obtained presented spherical morphology with a wide particle size distribution. The DE value affected the encapsulation efficiency and profile releases. The biological effect of the encapsulates will be discussed.

Conclusion:

Efficient and promising encapsulation procedures of biocompounds were developed. Our results show that is possible to modulate the characteristics and release properties of encapsulated products by modifying the encapsulating materials, which contributes to the development of more effective and profitable products, with long-term effects in the field. Therefore, the encapsulates developed in this study are sustainable and efficient agricultural products that might contribute to increase food productivity and thus meet the global food demand for the coming years.

Comparing the environmental performance of container farming to conventional agriculture

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Aim:

The effects of urban population increase on food and resource needs are a topic of concern and have been essential to emphasize. Furthermore, localizing the food system is a way to reduce the distance between the origin and endpoint of food supply chains and for cities to be more inclusive, safe, resilient, and sustainable. Urban agriculture (UA) has been suggested to increase food supply and lessen urban areas' adverse environmental effects.

The main objective of this research is to appraise the environmental performance of lettuce production shipping container farm using controlled environmental agriculture (CEA) in cold climates compared to conventional agriculture.

Method:

This study will employ Life Cycle Assessment (LCA) methodology to compare the environmental impacts of lettuce production in shipping container farms using controlled environmental agriculture (CEA) and conventional agriculture in companies growing leafy greens vegetables. The LCA will enable the quantification of resource inputs and environmental footprints for both production systems, including greenhouse gas emissions (GHG), embodied energy, and water use. The environmental impacts of both systems will be estimated across multiple dimensions to provide a comprehensive assessment of their sustainability performance. The shipping container farm used in this study will be located in Montreal, QC, providing a case study for urban agriculture in a northern climate.

Results:

The intended results of this study are to provide a comprehensive assessment of the environmental impacts of lettuce production in shipping container farms compared to traditional agriculture. By using Life Cycle Assessment (LCA) methodology, this study aims to quantify the environmental footprint and resource inputs of shipping container farms using controlled environmental agriculture (CEA) and estimate their impacts across multiple dimensions, including greenhouse gas emissions, embodied energy, and water use. Ultimately, this study will contribute to our understanding of CEA's environmental performance and help inform decision-making around sustainable food production.

Conclusion:

This study addresses existing knowledge gaps in urban agriculture by comparing the environmental impacts of lettuce production in shipping container farms and traditional agriculture. Specifically, the study aims to evaluate the environmental performance of controlled environmental agriculture (CEA) by using Life Cycle Assessment (LCA) methodology to quantify resource inputs and environmental footprints across multiple dimensions. Ultimately, the study aims to inform attendees about the relative contributions of traditional agriculture and CEA to environmental impacts, highlighting the potential benefits of CEA as a sustainable alternative.

P1.1.007

Effects of PLA-PHB biobased coatings for the preservation of pork fresh meat

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Aim:

The aim of the study was to analyze the effect of biobased PLA/ PHB coatings, like alternative to petroleum conventional films packaging, for fresh pork meat preservation. In particular, the effect on color, lipid and protein oxidations, as well as microbial loads in fresh pork were measured in loin fillets throughout 9 days of refrigerated storage.

Method:

PLA/PHB coatings were prepared at laboratory from dilution of PLA/ PHB in chloroform, with the addition of glycerol, and dried until obtain polymerisation. Total antioxidant activity of biopolymer was measured for 24 hours. Fresh fillets of pork loin were vacuum-packed, without (control samples) or with biopolymer coating, and conserved in refrigeration for 9 days. Colour was measured instrumentally, by determining CIELAB values. Lipid and proteins oxidations were determined spectrophotometrically according to TBA-RS method and the carbonyls/proteins assay, respectively. For microbiological analysis, mesophilic and psychrophilic aerobic microorganisms, total molds and yeasts, *Escherichia coli*, total coliforms and *Staphylococcus aureus* loads where determined according to ISO normalized technics.

Results:

Antioxidant activity of coatings showed the maxim activity at 6 hours, however no effect was found for meat preservation. In control samples, CIE L* and CIE b* values increased during storage and no significant effect was observed with the application of PLA/PHB coatings. An increase of lipid and protein oxidations occurred during storage, and the application of the developed biopolymer neither showed a significant effect. Regarding to microbiological loads, *Escherichia coli*, and *Staphylococcus aureus* loads were under detection limit, and mesophilic and psychrophilic aerobic microorganisms, and total molds and yeasts showed a significant increase throughout the conservation period, whereas total coliforms counts kept constants for 9 storage days. Use of PLA/PHB coating did not affect to microbial loads during the refrigerated storage.

Conclusion:

Globally, despite antioxidant activity showed in PLA/PHB biobased polymers, its application like coating in fresh pork fillet did not show a significantly effect on meat color and oxidation status. In addition, the biobased polymers did not reduce the microbiological development of meat. Future studies should be focused on the development of active-packagings in order to increase the shelf-life of fresh meat.

P1.1.008

Assessing the efficacy of accelerated solvent extraction for the valorization of Pleurotus ostreatus mushroom

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Aim: The mushroom *Pleurotus ostreatus* has been consumed for hundreds of years in eastern countries, becoming popular in western countries for its gastronomic and nutritional properties. However, it is also considered as an agri-food co-product of special interest due to their proteins with high biological value and its high content of carbohydrates such as beta-glucans, which have immunomodulatory and antitumor properties. For this reason, accelerated solvent extraction (ASE) could be an useful method to extract macronutrients in a sustainable way. **Method:** To study the effectiveness of this technology, optimization of protein extraction in *P. ostreatus* was performed using Response Surface Methodology considering three factors: temperature, pH, and time. Then, the optimal conditions (50 °C, pH 10, 15 min) for obtaining extracts were applied and compared with those obtained by conventional aqueous extraction (50ºC, pH 10, 15 min, with agitation) to study carbohydrate and protein yields. All analyses were performed in triplicate. **Results:** The results showed that treatment time was the factor most affecting macronutrient yield, with an optimal value of 15 min (3 complete cycles). In comparison with conventional methods, an increase in the recovery of both macronutrients was observed, especially in carbohydrates (84.8%). The results obtained indicate that the pressure exerted by ASE extraction is effective in recovering proteins and carbohydrates from the mushrooms and releasing them to the external environment. **Conclusion**: The ASE technology is of great interest for obtaining extracts rich in macronutrients from mushrooms, thus contributing to the valorization of this agri-food by-product in a sustainable process.

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P1.1.009

Ciprofloxacin-resistant Salmonella Typhimurium exhibits cross-tolerance to food preservation methods

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Aim:

Antimicrobial resistance (AMR) to Critically Important Antimicrobials for Human Medicine is frequently reported. Specifically, ciprofloxacin (CIP) resistance in *Salmonella* spp. isolates from food-producing animals reached very high levels, and a moderate occurrence in humans in 2021. This suggests prevention and control protocols in the agri-food chain are insufficient. In this sense, AMR influence in food preservation methods remains uncertain, as similar bacterial resistance pathways might induce cross-tolerances.

The objective of this study was to evaluate the presence of cross-tolerance to heat treatments (HT), lactic acid (LA) and carvacrol (CAR) of *Salmonella* Typhimurium LT2 (SeWT) CIP-resistant variants ($SeRV_{1C}$-$SeRV_{5C}$).

Method:

CIP-resistant variants were obtained via cyclically exposing SeWT to CIP doses during growth phase for 10 days. LA and CAR treatments were conducted in flasks with 10 mL of tryptone soya broth at a concentration of 1.0% and 200 µL/L, respectively. For liquid-whole egg (LWE) and skimmed milk treatments, a lethal HT at 54 °C up to 40 min in a thermoblock was selected. HT in orange juice was carried out at 50 °C.

Results:

$SeRV_{1C}$ was the most tolerant variant to all inactivation treatments conducted. LA inactivated 0.55 ± 0.41 log_{10} cycles of $SeRV_{1C}$ in contrast to SeWT (5.78 ± 0.65). CAR resulted remarkably ineffective against $SeRV_{1C}$: no inactivation was detected under conditions that reduced 4.42 ± 0.57 log_{10} cycles of SeWT.
Moreover, after 15 min at 50 ºC in orange juice, 1.76 ± 0.38 log_{10} cycles of $SeRV_{1C}$ were inactivated, in contrast of SeWT, with 4.86 ± 0.56. A similar output upon HT in LWE was described, inactivating 1.91 ± 0.61 log_{10} cycles of $SeRV_{1C}$ and 4.91 ± 0.57 of SeWT. Major HT tolerance was observed in skimmed milk: 0.59 ± 0.09 log_{10} cycles were inactivated compared to SeWT (4.47 ± 0.39).
Whole-genome sequencing of $SeRV_{1C}$ revealed a single-nucleotide polymorphism in STM0580, an insertion in *rpoD* and a deletion in *cyaA*, which might be involved in direct- and cross-resistance.

Conclusion:
Mutations conferring CIP resistance to $SeRV_{1C}$ enhanced tolerance to LA, CAR and HT. Validation in food matrixes suggested AMR should be considered in risk assessments, especially of minimally processed foods, as pasteurised LWE.

P1.1.010

Valorization of avocado seeds by developing functional powdered ingredients by freeze-drying and spray-drying

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Aim:

In today's food industry, there is a notorious trend to valorize plant waste to develop natural ingredients and additives, in some cases with high market value. Avocado seeds, which are major by-products of the fruit processing, are rich in bioactive compounds like carotenoids, tocopherols, and phenolic compounds known for their antioxidant, antimicrobial, anti-inflammatory, antidiabetic and blood pressure reducing effects. However, many times they are discarded at the industrial level. There are several approaches to valorize food wastes including advanced drying techniques to enhance the retention of valuable bioactive compounds as well as prolong the shelf-life of the final products. In this study supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK-Project# 221O358), the aims were to valorize avocado seeds by using spray-drying or freeze-drying after properly conditioned them to attain powders to be used as additives in food preparations, and to investigate specific characteristics relevant for the valorization, i.e., the antibacterial activity, GC-MS profile and the microstructure of those powders.

Method:

Avocado (*Persea americana*) seeds were spray-dried using a Buchi Mini B-290 spray drier (Switzerland) with inlet air temperature of 180°C, 10% maltodextrin rate, and 15% feed flow rate. Freeze-drying of chopped and frozen seeds (-80°C for 24 h) was performed in a Labconco FreeZone (Kansas City, MO, USA) lyophilizer at -54°C for 48 h, followed by grinding in a laboratory mill (Fakir, Germany). Antibacterial activity of the powders was determined against *Escherichia coli* ATCC 25922, S*taphylococcus aureus* ATCC 43300, *Salmonella enterica* subsp. *enterica* serovar Enteritidis ATCC 13076 and *Listeria monocytogenes* ATCC 7644 pathogens, and recorded as growth free inhibition zones (diameter) around the well. GC–MS (6890/5973N), Agilent Technologies (Santa Clara, CA, USA) with a Restek RTX5MS (30 m × 0.25 mm i.d. × 0.25 µm) (Bellefonte, USA) capillary column was used to determine GC-MS profile of the avocado seed powders. To determine and identify the compounds, Mass Hunter software (Qualitative Analysis B.07.00) and NIST Mass Spectral Library (2014) were used. The microstructure of the samples were observed by scanning electron microscopy (SEM; JSM-6060LV, JEOL).

Results:

Both spray-dried and freeze-dried AS powders showed antimicrobial activity against *L. monocytogenes* (zone diameter=17.7±1.5 mm) and *S. aureus* (zone diameter=19.0±2.6) while only spray-dried AS powder exhibited antimicrobial activity against *E. coli* (zone diameter=9.4±0.3), there was no antimicrobial effect of the AS powders against *Salmonella* pathogen. In the GC-MS analyses of the spray-dried and freeze-dried AS powders, a total of forty four and thirty six compounds were identified, respectively, including several organic acids, sugars, sugar alcohols and phenolic compounds. SEM images of the AS powders dried with the two different methods indicated that in spray-dried samples, maltodextrin yielded small particles adhering to the surface of large ones as a result of agglomeration and there was shrinkage at the surface of the large particles. Freeze-dried AS powders exhibited irregular morphology including smooth cylindirical and shpherical particles.

Conclusion:

This valorization study shows that the bioactive compounds attained depend on the drying method utilized as evidenced by the analysis of the antibacterial activity, GC-MS profile, and structure. Therefore, at the time of identifying which technique to be used, it should be necessary to identify which bioactive compounds are a priority.

P1.1.011

Life Cycle Assessment of an optimized agricultural value chain

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Aim:
The agricultural value chain includes a complex series of activities that can result in a severe impact on the environment. The key stages in the agricultural value chain that can largely affect the environmental footprint include the land use, the crops processing and transportation and the management of the crops wastes. The utilization of land is mandatory for crops cultivation, thus clearing land for agricultural purposes can lead to deforestation and loss of biodiversity. On the other hand, crops processing and transportation results in the generation of greenhouse gas emissions and crops wastes can also pose a severe environmental hazard if not managed appropriately. The main objective of the present work was compare the total environmental impact of a use case crop across the whole agricultural value chain (scenario case) with optimized land use (i.e. intercropping), processing and transportation processes (i.e. on farm processing and novel methods of processing) and appropriate wastes valorization methods (i.e. anaerobic digestion for energy production) to a typical use case (base case). For this purpose, the total environmental impact of both scenarios was evaluated via performing LCA.
Method:
The whole process chain of a use case crop was studied, and data inventory for both cases was performed. LCIA was conducted using Gabi ts, the selected impact assessment method was ReCiPe 2016 (H), and as functional unit, 1 kg of final processed crop was selected.
Results: (heading must be in bold)
According to the obtained results, the optimization of land use, crops processing and transportation along with the incorporation of appropriate techniques for crops wastes valorization resulted in an improvement in the environmental footprint across the whole agricultural value chain, contributing towards environmental sustainability.
Conclusion:
Results derived from the present work suggest that the proposed methodology could be used for the transition towards a sustainable agricultural sector. Finally, the approach proposed in this work can be broadly extended to numerous other food systems to analyze their environmental footprints and consequently highlight the main areas that require significant improvement.

P1.1.012

Production of a novel 'full fat olive powder (FFOP)'

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Aim: Olive fruit has an important place in Mediterranean Diet and is rich in oil and phenolic compounds. Production of new, free-flowing, and sustainable "Full Fat Olive Powder (FFOP)" without reducing the oil content and adding any additives by using high pressure homogenizer (HPH) and freeze dryer is the main objective of this study. Moreover, it is aimed that drying time during freeze drying is decreased by changing temperature parameters of the freeze dryer.
Method: The sample preparation was made by mixing green pitted olive and water followed by passing through HPH two times at 1,200 bar. The obtained suspension was dried with freeze dryer and then ground. Pitted green olive was directly dried with a freeze dryer as the control group. Two different freeze dryers were used during the drying process. Different tray temperatures (0, 30 and 50 °C) were tested during the freeze drying process to produce a product with high phenolic and low oxidation rates by reducing the drying times. The homogenized full fat olive powder and the control group that are dried at the same drying processes were compared to analyze effects of HPH. Microstructures of the 2 olive powders were analyzed by using scanning electron microscope (SEM). Their surface oil contents and flowability were analyzed.
Results: It was observed that HPH had a significant effect on the surface oil content and flowability of the powders as the structure of the polymers within the olive matrix were affected and size of the oil droplets decreased. When the freeze drying conditions were compared, it was seen that the different temperature settings in the freeze dryer resulted in shorter drying times to achieve the desired moisture content.
Conclusion: To conclude, effects of HPH and freeze dryer temperatures on the final product quality of FFOP were examined. High pressure homogenization and higher freeze drying temperatures enabled a sustainable production approach to produce a free flowing, value-added, new olive powder.

P1.1.013

Quantitative proteomics to explore viable but non-culturable Listeria monocytogenes induced by slightly acidic electrolysed water

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Aim:
Slightly acidic electrolyzed water (SAEW) is a sanitizer widely used in food industry. If sanitization is incomplete could induce *Listeria monocytogenes* to enter viable but non-culturable (VBNC) state.
Method:
We used a low concentration of SAEW to trigger the VBNC state of *L. monocytogenes* and used the plating method in combination with flow cytometry to detect the VBNC bacteria and observed the morphology with scanning electron microscopy (SEM). The global proteomic profiles of the VBNC bacteria were established by tandem mass tag (TMT) labelled-LC-MS/MS technique.
Results:
The chlorine concentration of SAEW to induce the VBNC state was 8-10 mg/L, and bacteria showed shrinkage of the cell membrane under SEM observation. The proteomic results indicated 203 differential expressed proteins (DEPs), including 78 up-regulated and 125 down-regulated DEPs. After gene ontology (GO) functional annotation with Kyoto encyclopedia of genes and genomes (KEGG) metabolic pathway analysis, the significant DEPs were related to the ribosome, biosynthesis of secondary metabolites, and aminoacyl-tRNA biosynthesis. This study further identified 31 chlorinated peptides in the 22 chlorinated proteins to validate that SAEW induced the protein chlorination. The most prominent chlorinated proteins were identified as the elongation factor Tu and chaperone proteins showing a significantly enriched sequence motif Rxxxxx(ch)Y.
Conclusion:
These findings provide insights into the potential mechanisms of SAEW treatment on *L. monocytogenes* and highlight the importance of monitoring and controlling bacterial VBNC states during food processing and preservation.

P1.1.015

Combination of machine learning with mid-infrared spectroscopy for sensory quality assessment of roasted cocoa-based products

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Aim:
Quality control of roasted cocoa-based products is crucial for evaluating their composition, rheological properties, and sensory attributes. Particularly, sensory quality inspection is time-consuming and requires expert panelists, which makes it difficult to be effectively applied online as a routine analysis for quality control. In this sense, the development of rapid and non-destructive systems for online inspection of the entire production is a challenge to be overcome. Mid-infrared (MIR) spectroscopy could be considered as a fast and non-destructive technique for suitable evaluation of food ingredients, and its integration with machine learning algorithms could be of high interest. Thus, the main aim of this study was to test the feasibility of using MIR information combined with machine learning techniques for the rapid prediction of the sensory quality of roasted cocoa.
Method:
Roasted cocoa samples were infrared analysed using Attenuated Total Reflection Fourier Transform Infrared (ATR–FTIR) technology in the range of 4000-650 cm^{-1}. While, sensory attributes (odor and flavor) were assessed by trained panelists. Spectral information was preprocessed using Multiplicative Scatter Correction (MSC) and projected on a latent structure using a Principal Component Analysis (PCA) to obtain uncorrelated regressors to serve as input to the supervised machine learning algorithms. Support Vector Machines (SVM), Random Forest (RF), Principal Component Regression (PCR), and Artificial Neural Networks (ANN) on latent variables were used to predict the overall quality of roasted cocoa samples. Training (75%) and validation (25%) of the machine learning techniques were performed 1000 times, and optimization of the best configuration was performed using multifactor analysis of variance (ANOVA), minimizing the residuals mean square.
Results:
The results revealed the potential of FTIR coupled with SVM to predict the overall quality of roasted cocoa-based products (R^2_{adj}>95% and MRE<10%). Analysis through multifactor ANOVA allowed to define the most appropriate configuration of each machine learning model.

Conclusion:
The methodology proposed in this study is of interest for the reliable, rapid, and accurate prediction of sensory quality of roasted cocoa products based on non-destructive measurements and its further industrial application.

P1.1.016

Lipid oxidation during processing of dry fermented hybrid meat sausages containing texturized pea protein

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Aim: The manufacture of dry fermented meat analogues is a complex process due to the presence of alternative ingredients which affect the sensory acceptability (Flores & Piornos, 2021). Among ingredients, texturized plant proteins and vegetable fats, are used to reduce the consumption of ingredients from animal sources. The effect of these ingredients as precursors of aromas should be elucidated not only in the raw materials but also during the processing. In hybrid dry sausages, texturized plant proteins can affect the aroma by the presence of residual amounts of phospholipids in pea proteins (Zhang et al., 2020), while vegetable oils may affect the oxidation process (Amaral et al. 2018). Therefore, the aim of this study was to reveal the effect of texturized plant pea protein and coconut oil on the oxidation process of dry fermented hybrid meat sausages.
Method: Hybrid sausages where 50 % of meat protein was replaced by texturized pea protein and including coconut oil as animal fat substitute were manufactured in the absence (EG50) or presence (EG50A) of oat flour and a control including 100 % animal composition (pork lean and back fat) was employed (EC). The fermentation and drying process were controlled and samples collected at different times of the process 0, 6 and 41 d. The oxidation process was studied by TBARS analysis and the evolution of volatile compounds derived from the oxidation by SPME-GC-MS.
Results: The initial oxidation values (TBARS) were higher in hybrid than in control sausages and in all of them increased during processing as expected. Nevertheless, the hybrid sausages showed the highest oxidation values. Among the hundred of volatile compounds extracted from the headspace of sausages, 24 compounds derived from lipid oxidation reactions. Hybrid sausages were characterized by the presence of furan compounds and acids (hexanoic and octanoic acids). Linear aldehydes (pentanal, hexanal, octanal, nonanal) did not show an increase with drying time in any of the sausages.
Conclusion: These results indicates that the oxidation process in hybrid sausages is affected not only by the presence of texturized plant proteins but also by the fat used as replacement.

P1.1.017

SUBSTITUTION OF TEXTURIZED PEA WITH TENEBRIO MOLITOR L.: NUTRITIONAL AND PHYSICOCHEMICAL CHARACTERISTICS OF MEAT ANALOGS.

Dra Laura Buendía Moreno[1], Mr. Daniel Jordán Villazala[1], **Dr Maria Dolores Garrido Fernández**[1], Dra. Macarena Egea Clemenz[1]
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Aim: The consumption of non-conventional protein sources, such as insects, and the growing awareness of consumers towards sustainable, innovative, and more nutritious food products, has led to increasing research focused on the development of new foods incorporating insect larval meal in their formulation. In general, *T.molitor* larvae are considered a good source of proteins, but also contain large amounts of lipids. So, the extraction of which, by defatting, is essential to obtain a concentrated product with better nutritional properties and characteristics. Therefore, the aim was analyze the effects of partial substitution of texturized pea (TP) by *T.molitor* meal not defatted (IM) and defatted (IMD), on the nutritional and physicochemical profile of meat analogs.
Method: burgers were produced with the treatments Control (30 g TP + 0 g IM), TM_1 (27.25 g TP + 7 g IMD), TM_2 (27.25 g TP + 7 g IM), TM_3 (14.92 g TP + 10 g IMD), TM_4 (14.92 g TP + 10 g IM). The nutritional and physicochemical properties were studied.
Results: Protein content gradually increased with increasing IM content, from 10.695% in the control sample to 21.915% in the hamburger formulated with 10 g of IMD. Defatting significantly affected the protein content of the samples ($p \leq 0.05$). Meanwhile the fat content of hamburgers formulated with 10 g IMD showed a significant decrease (12.580%), with respect to the samples formed by 10 g IM (24.309%). A darkening of the samples was observed with the incorporation of IM, accompanied by a reduction of about 20% of the L*values. However, defatting had no significant influence ($p \geq 0.05$). The control burger a* and b* values are significantly higher than the rest of the treatments ($p \leq 0.05$).

Conclusion: the results of this research confirm the possibility of using edible insects to enrich foods by increasing their nutritional value while developing more sustainable and equally balanced diets.

P1.1.018

SEASONIGS ELABORATION FROM FISH ROE BY-PRODUCTS: PHYSICOCHEMICAL PROFILE

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Aim:

Fishery products are noted for being an important source of animal protein of high biological value, high levels of fat-soluble vitamins, essential micronutrients and omega-3 fatty acids. Many products are discarded in this practice due to damage suffered during capture and processing, as in the case of fish roe. The valorization of these by-products for the production of other foods has become a necessary activity both economically and environmentally due to the problems involved in their management. In addition, the difficulty in preserving this type of product has led the fisheries sector to focus on the production of non-perishable foods that can be preserved for a long period of time and at the same time preserve nutritional characteristics.
Thus, the objective was to evaluate the physicochemical profile of four types of seasonings made from fish roe that did not have an integrated gonad membrane.

Method:

Four types of seasonings were made with ling roe (*Molva-molva*) by-product (three replicates of each): L.24: seasoning obtained from roe that has been dried by a freeze-drying process for 24 hours; L.48: seasoning obtained from roe that has been dried by a freeze-drying process for 48 hours; S.32: seasoning obtained from roe that has been dried in an oven drying process for 32 hours; S.48: seasoning obtained from roe that has been dried in an oven-drying process for 48 hours. After drying, all the samples were crushed. The Aw, moisture, protein, fat, ash and carbohydrates were determined in triplicate according to ISO standards: 18787(2017), 1442 (1997), 1871 (2009), 1443 (1979), 936 (1998) and by difference respectively. The results were performed by one-way ANOVA and Tukey tests with SPSS 28.

Results:

According to the results, it was observed that the seasonings subjected to a freeze-drying process (L.24 and L.48) presented lower moisture and water activity values than those subjected to an oven-drying process (S.32 and S.48), however, they showed a higher fat content. As for protein content, the seasoning agent L.48 presented the highest values.

Conclusion:

The freeze-drying process preserves the nutritional value of fish roe better than other dehydration methods such as oven drying.

P1.1.019

Use of air-coupled ultrasound in combination with machine learning to detect insects in gelled desserts

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Aim:

Foreign bodies in foods are considered a physical risk for consumers, which involves quality and safety concerns. Automatic and reliable foreign object detection is a challenge for the food industry in light of the digital revolution that comes with the concept of Industry 4.0. Current techniques are useful to detect metallic elements as well as those with very different density than the food material, such as rocks. However, the detection of plastics, wood and small biological bodies, such as insects, represents a great challenge for food industry. Air-coupled ultrasound is a promising non-invasive technology as it offers several advantages, including non-contact measurement, faster inspection, cost efficiency, versatility, and easy inline application. Machine learning (ML) algorithms enable the analysis of acoustic signals and the detection of anomalies. Therefore, the aim of this study was to evaluate the feasibility of combining air-coupled ultrasound technology with ML for the rapid detection of houseflies in commercial gelled desserts.

Method:
Commercial gelled desserts (diameter 8 cm, height 6 cm) packaged in plastic containers were characterised by ultrasonic measurements taken in the center of the samples by using contactless ultrasound sensors (0.25 MHz) in through-transmission mode. Gelled desserts without and with the presence of houseflies (*Musca domestica),* with approximate long of 0.5 cm and wingspan of 0.7 cm, were analyzed. Signal processing included seven energy-related ultrasonic parameters computed in the time domain (peak-to-peak voltage, square norm, integral, signal variance, skewness, kurtosis, and entropy), and principal component analysis (PCA) was used to extract the latent eigenspace that summarised 100% of the experimental data variability. Support Vector Machines (SVM), Random Forest (RF), and Naïve Bayes (NB) were then used to distinguish between control and contaminated samples. The dataset was divided by 75% and 25% for training and validation, respectively.

Results:
The SVM and RF showed the highest accuracy for the training dataset (overall accuracy>94%). However, their classification performance for the validation of dataset was poor (<90%). This result suggested that both techniques have overfitted the observations from external dataset. Thus, the NB model delivered the highest classification performance with an overall accuracy of over 90% for both dataset.

Conclusion:
These results show that the methodology of using air-coupled ultrasound in combination with ML is a promising tool for reliable, rapid, and accurate detection of small insects in gelled desserts.

P1.1.020

Labeling control of cephalopod products in the Greek market, with DNA barcoding methodologies.

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Aim:
When one species is traded under the name of another is considered mislabeling (Rasmussen & Morrissey, 2008) and it can be intentional (i.e. substitution of lower value for higher value products) or unintentional (i.e. marketing practices and low consumer awareness). Mislabeling of seafood products remains a worldwide issue and is far more common than most consumers think, despite the strict labeling regulations set at local, European and International level. Food authenticity is a topic of increased concern for both consumers and food authorities (Barnett et al., 2016). The aim of this studywas to use DNA barcoding to investigate the labeling practices for cephalopod products, available in the seafood market of Greece.

Method:
A total of 140 tissue samples were collected from various retailers and markets across four Greek cities. In an effort to cover the highest range of products possible, different market presentations were targeted (fresh, frozen, canned and cooked). In most cases, DNA barcoding has proven to be the preferred and most accurate method for the detection of fraudulent seafood products. Genomic DNA was extracted, usinga modified Cetyl-Trimethyl Ammonium Bromide (CTAB) extraction protocol. In case the first extraction method failed, the QIAamp DNA mini kit Extraction Kit (Qiagen, Hilden Germany) was used instead. Two mitochondrial genes were the targeted regionsof the analysis, the cytochrome c oxidase subunit I (COI) and the 16S ribosomal RNA (16S).

Results:
For the most samples, species level identification was possible, with the use of dual markers. The results revealed high levels of mislabeling (40%) for the identified samples. Mislabelling was most commonly detected in fresh products, with 55% of the samples in this category labelled incorectly.

Conclusion:
Until now, no scientific study that investigates substitution and mislabeling rates in cephalopods products has been conducted in Greece. Overall, the mislabeling rates detected by our study probably relate to some degree of unintentional misidentification and confusion surrounding the legal designations in Greece. However, cases of substitution between octopuses and squids identified among the mislabeled samples, whichin some extent, indicates deliberate substitution.

P1.1.021

Subcritical water extraction of beer bagasse to obtain fractions for active packaging development

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Subcritical water extraction of beer bagasse to obtain fractions for active packaging development

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Aim:
Beer bagasse constitutes the main solid residue in beer brewing, being an important and cheap source of cellulose, protein, fiber and phenolic compounds such as ferulic, p-coumaric and caffeic acid, among others. The phenolic fraction can give rise to products with high functional value (e.g. with potential antioxidant and antimicrobial activity) of great interest for the development of active packaging materials. On the other hand, the cellulosic fraction can be of interest for obtaining cellulosic fibers, after a purification process.
Method:
In the methodology, the active compounds were extracted by a non-polluting process of subcritical water extraction at different temperatures (110, 130, 150, 170ºC) and characterized in terms of total phenolic content, antioxidant and antimicrobial activity. The remaining solid fraction was purified by using a more sustainable treatment to a suitable degree of bleaching and characterized in terms of hemicellulose, cellulose and lignin content.
Results:
The results obtained showed that during the subcritical extraction process at different temperatures, an increase in the extraction temperature allowed an increase in the yield of the soluble solids (SS) fraction (rich in phenolic compounds), while lowering the insoluble fraction. This was more marked at 130°C and above, although there were no notable differences between the SS yield (%) obtained at 150 and 170°C. The antioxidant activity of these bioactive extracts increased when using higher extraction temperatures, in line with the higher extractive power of water and with the generation of Maillard compounds with antioxidant character. Bleaching of cellulose fibers was performed on the defatted material, using consecutive cycles with 4% hydrogen peroxide at pH 12.
Conclusion:
Both soluble and insoluble fractions obtained have a high potential to be used as reinforcing material (cellulose fibers) and as antioxidant compounds (phenolic fraction) during the production of biodegradable active packaging materials for food preservation, in line with a circular economy using more sustainable process from an environmental point of view.

P1.1.022

Study of the antipolymerization properties of plant sterols

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Aim:
When exposed to high temperatures, fats undergo a series of physicochemical transformations leading to their degradation. So far, several studies have found that plant sterols such as Δ5-avenasterol and its isomer fucosterol can protect vegetable oils subjected to high temperatures from oxidative degradation (Winkler & Warner, 2008). Phytosterols with an ethylidene group are referred to as "antioxidants" and "polymerization inhibitors," but Onal-Ulusoy et al. (2006) proved that terpenyl oleate, both with and without the ethylidene group, exhibits similar antioxidant activity, hence it follows that this action cannot be attributed solely to this group.
The aim of this study was to investigate the antipolymerization properties of Δ5-avenasterol during its heating in model systems (OOO and LLL) and sunflower oil.

Method:
To 10g of glycerol trioleate, glycerol trilinolate and sunflower oil were added 0.4, 0.8, 1.2 and 1.6mg of Δ5-avenasterol. The prepared samples were then heated at 180C for 8 hours in the presence of oxygen.

The content of plant sterols and their oxidized derivatives (oxyphytosterols), the percentage of polar and non-polar fractions, as well as the content of triacylglycerols and polymers in the tested samples were determined using chromatographic methods.

Results:

No statistically significant differences in the percentage of polar and non-polar fractions were observed in the study. The degradation of TAG during heating was greater in samples with addition of Δ5-avenasterol compared to samples without its addition. TAG polymers formed during heating of the samples were identified in the tested samples.
The increase of oxyphytosterols in sunflower oil without and with addition of Δ5-avenasterol was similar and was 1.5-fold times higher than before heating.

Conclusion:

The conducted studies did not show anti-polymerization, antioxidant and protective effects on Δ5-awenasterol fats. Further studies are needed to confirm these results for higher addition of Δ5-avenasterol and shorter time of heating.

Onal-Ulusoy B., Hammond E., White, P. (2006). Effect of some terpenyl oleates on soybean oil oxidation at 180° C. Journal of the American Oil Chemists' Society, 83(12), 1027-1032.
Winkler J. K., Warner K. (2008). Effect of phytosterol structure on thermal polymerization of heated soybean oil. European journal of lipid science and technology, 110(11), 1068-1077.

P1.1.023

Oilseed press cakes in extruded meat alternatives – linking process interactions with product properties

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Aim: **Evaluate process and product properties of extruded oilseed press cakes**

As protein rich side stream of oil production, press cakes (PCs) possess a notable potential as nutritionally beneficial and resource efficient raw material for plant protein products. However, the remaining oil and fibre contents in the PC bring about challenges for the low-moisture extrusion process used to structure plant proteins for meat alternatives. Therefore, this study evaluates the properties of PCs during extrusion processing and in the resulting texturized vegetable proteins (TVPs).

Method: Low moisture extrusion and TVP characterization

Fifteen different PC flours (almond, coconut, flaxseed, pumpkin seed, rapeseed, and sunflower seed) were mixed with pea protein isolate (PPI) at three different concentrations (25% to 100% PC) and extruded in a co-rotating twin screw extruder with a short 2.5 mm hole die. The TVP obtained was dried and density, expansion, colour, dry hardness, rehydrated texture properties and micro-structure were measured by gravimetry, diameter, image analysis, Kramer shear test and texture profile analysis, and microscopy and solubility assays, respectively.

Results: Press cake TVP structure is dominated by fibre and oil content

Press cake proteins form networks largely based on hydrophobic interactions and hydrogen bonds, similar to pulse proteins. The higher the PC concentration, the higher the fibre and oil contents in the mixture, which impair protein network formation and lead to a reduced expansion and increased density and hardness as the mechanical energy input in the extrusion process is decreased. The altered microstructure leads to a less cohesive and less springy texture response, thereby making the TVP appear more meat-like than pure PPI based and commercially available TVP products. However, the botanical type of PC influences the TVP properties as well.

Conclusion: Press cake can enhance acceptability of TVP-based meat alternatives

Although elevated fibre and oil contents of PCs influence the extrusion process, all inspected PCs are suitable to replace min. 45% of PPI in a low-moisture extrusion formulation. The resulting TVP has more meat-like texture properties than TVP without PC, highlighting the potential of this raw material type as ingredient in extruded plant-based products.

P1.1.024

Optimization of lipids extraction from Arthrospira (Spirulina) platensis-A comparative study among solvents

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Aim: The use of different solvents and processing parameters for the optimization of lipids extraction from Spirulina, was investigated. The aim was to select an extraction technique for obtaining food-grade lipids, combining the highest extraction yield and the minimum impact on fatty acids.

Method: *Arthrospira* (Spirulina) *platensis* biomass (fat content: 3.1 g/100 g dm) as a fine powder was provided by a Greek leading company. Three different solvents: chloroform/methanol (2/1 v/v), n-hexane and ethanol were used for spirulina lipids extraction. The fatty acids profiles, derived through gas chromatography analysis, were evaluated, and compared. Process optimization included as parameters the different solvent (n-hexane or ethanol), the temperature during extraction (20-50^{o}C), the ratio mass of spirulina/volume of solvent (1/3-1/10) and the extraction cycles (1 or 2). Extraction efficiency was evaluated quantitatively comparing the data derived through the gravimetric method and a colorimetric method based on the sulpho-phospho-vanillin reaction, as well as qualitatively through analysis of fatty acid profiles.

Results: Through a comparative evaluation of the fatty acids profiles obtained by different solvents, no significant differences were observed in the percentages of the total, saturated, mono-unsaturated, and poly-unsaturated fatty acids ($p>0.05$). Therefore, chloroform/methanol was rejected for further study since the received lipids would not be food-grade. Ethanol was the most efficient solvent leading to a maximum oil yield of ~73.0% (50^{o}C, 1/3 spirulina/solvent ratio, 2 extraction cycles) compared to a ~37.7% maximum yield when the solvent was n-hexane (50^{o}C, 1/5 ratio, 2 cycles). For both solvents, temperature increase (in the range of 20-50^{o}C) led to increased lipid extraction yields. For the ethanol and n-hexane the optimum spirulina/solvent ratio was 1/3 and 1/5, respectively. Process parameters of increased intensity, led to parallel extraction of other components resulting in a significantly reduced amount of oil compared to other components in the residue. For ethanol, the oil purity in the final residue was significantly lower than n-hexane. Thus, n-hexane was selected for a 2-cycle lipid extraction of spirulina at 30^{o}C, 1/5 ratio.

Conclusion: The obtained results could be applied for the efficient lipids extraction from spirulina biomass, allowing for their use as additives in food products for functionalization.

P1.1.025

Novel technologies assisted extraction of bioactive compounds from orange peels waste

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Aim:

Orange peels waste is a rich source of bioactive compounds, including flavonoids, carotenoids, and phenolic acids. These compounds are known for their antioxidant properties, as well as their potential health benefits. They can be extracted using solvents and incorporated into a range of foods providing functionality. From an industrial point of view, solvent extraction is inefficient, due to the low extraction yields, long process duration and large solvent consumption. Novel technologies could replace or assist the solvent extraction improving the efficiency, selectivity, and sustainability of the extraction process.

The aim of this work was to evaluate the effect of microwave (MAE), ultrasound (UAE) and pulsed electric field (PEFAE)-assisted extraction of high added value compounds from orange peel waste.

Method:

Orange peels were subjected at different PEF (2.5-6.0 kV/cm, 0-1500pulses, 20 Hz, 15 μs), ultrasound (50, 70 and 90% amplitude for 30, 60 and 90 min) and microwave (250 and 400 W for 60, 120 and 180 s) conditions as pretreatments. Solid-liquid (1:10) solvent (methanol/H_2O equal to 50:50 and 80:20) extraction followed, approximately for 1 h after each pretreatment. Conventional solvent extraction was also carried out at 80 °C for 2 h. All extracts were analyzed for their total phenolic compounds, total flavonoids (quercetin, hesperidin, hesperetin, naringin) and antioxidant activity.

Results:

Microwave pretreatment (all conditions applied) led to a significant increase (up to 33%) of the intracellular compounds extraction in significantly shorter time compared to the conventional one. Ultrasound pretreatment at 90% amplitude for 30 min increased the total concentration of bioactive compounds from 276.5 mg/100 g wet mass (w.m.) to 494.5 mg/100 g w.m. More intense ultrasound conditions resulted also in improved extractability of total flavonoids. The yield of bioactive

compounds by PEF assisted extraction had no significant difference compared to the corresponding value of conventional extraction.

Conclusions:

Overall, these novel assisted extraction technologies offer advantages such as improved extraction efficiency, reduced extraction time and decreased solvent usage compared to the conventional method. These pretreatments led to enhanced extractability of high added value compounds from citrus waste increasing recovery yields and making byproduct valorization commercially attractive for the industry.

P1.1.026

Underutilized plants increase biodiversity,sustainability, and improve nutrition security. Let's bring them back on the plate!

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Underutilized plants increase biodiversity,sustainability, and improve nutrition security. Let's bring them back on the plate!

Background

The global food system depends on a limited number of plant species. Plants with unsatisfactory nutritional value are overproduced, while the wide variety of nutrient-rich plant species used in the early days remains neglected. Basing our diet on a few crops only had wide-ranging negative consequences on nutrition and food security.

Aim

Although still under-researched, underutilized plants are slowly starting to receive increased recognition. These plants have superior nutritional content and immense potential to contribute to food and nutrition security and increased sustainability. This narrative review aims to provide evidence to encourage the promotion, domestication, and commercialization of underutilised plants.

Method

The Web of Science and Scopus databases were searched using the keywords 'underutilised, 'plants,' 'health' and 'health benefits'. Of the 350 research articles and 112 review papers identified, only the most relevant to the topic were considered to provide appropriate data for a narrative review focusing mainly on papers published in the last decade.

Results

The anti-inflammatory, anti-diabetic, and anticancer effects of some of underutilised plants are presented. The outstanding ability of forgotten plants to increase food and nutrition security, boost dietary diversity, reduce malnutrition, and enhance human health and well-being is demonstrated. The main barriers and obstacles to reintroducing underutilized foods are reviewed and recommendations for overcoming nutrition and dietary-related challenges for re-establishing underutilized plants into the global food system are presented.

Conclusion

The expansion of underutilized plants for human use is of paramount significance. The exceptional nutritional properties, bioactive potential, and proven health benefits of underutilized plants indicate that increased promotion, domestication, and commercialization of these plants should be strongly supported. Besides health benefits, marginalised plants have the potential to enhance human well-being and improve people’s lives in many ways, retain biodiversity, improve quality of life, and develop local economies. Therefore, underutilized plants should be used in the broader context of well-balanced and healthy diets.

P1.1.027

OPTIMIZATION AND CHARACTERIZATION OF FILM PRODUCED FROM BUCKWHEAT STARCH-MYRISTIC ACID COMPLEX

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Edible films are defined as a thin layer that is produced from safe and suitable biopolymers and other ingredients and is used to create a barrier between food and the environment. Among biopolymers, starch is a low-cost renewable polysaccharide which is regarded as a potential source for the manufacturing of these type of films. However, starch based films have poor mechanical and low water vapor barrier properties which make those films be insufficient to be used as food packaging material. In order to improve mechanical and vapor barrier properties of the films, many physical and chemical modifications are done to starch molecules. Amylose-lipid complex formation is one of those modification methods based on the interaction between the hydrocarbon chain of the lipid and the hydrophobic moiety of the amylose chain resulting in the filling the central cavity of the amylose single helix.
In this study, it was aimed to develop an edible film from an amylose-lipid complex with better mechanical properties and water vapor barrier. For this purpose, the buckwheat starch (BS) is modified with myristic acid (MA) and the edible film production process was optimized by using central composite design with 5 center points where film forming solution's glycerol concentration, pH, and the temperature of as dependent variable and tensile strength (TS), elongation at break value (EAB) and Young's modulus (YM) as response. The models were significant for TS and YM, and the glycerol concentration and temperature had a significant effect on the TS of the films. The edible film produced in validated optimized conditions had better EAB (149%) and TS (1.064 MPa), water solubility (44.7%), and water vapor permeability (0.39 g×mm/m^2×h×kPa) than control film ($P < 0.05$). There was no significant change in color values, but an increase in opacity (2.14). With the formation of the BS-MA complex, increased surface roughness and more hydrophilic (Contact angle=92.4°) films were obtained. This results revealed that BS-MA complex film has the potential to be processed as edible film in practical applications. This study was supported by TUBITAK #119O031

P1.1.030

Ohmic heating effect on the shelf-life, quality and inhibition of enzymatic browning of fresh-cut potatoes

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Aim:

Potato (Solanum tuberosum) is the third most produced crop after rice and wheat and it is ranked as the world's fourth most popular food worldwide. Among the potato products, fresh-cut potatoes consumption has increased significantly in recent years due to increasing consumer demand. However, fresh-cut potatoes are prone to browning after cutting resulting in short shelf-life and quality degradation.This turns out to be the major limitation for their shelf life and prevents fresh-cutpotatoes from being a more popular consumer choice. Therefore, prevention of enzymatic browning in fresh-cut potatoes is a major concern of the food industry. A promising technique which is used for the inactivation of enzymes is the ohmicheating (OhH) technology. OhH of food products involves the passage of alternating electrical current through them, thus generating internal heat as the result ofelectrical resistance. This technology provides rapid and uniform heating reducing thermal damage of the products. The aim of this study was the development of innovative fresh-cut potato products with superior sensory characteristics, extended shelf-life and inhibited enzymatic browning activity, using the technology of OhH in combination with the use of the mild pre-treatment method of osmotic dehydration.

Method:

The OhH parameters, including the OhH power and the processing time, were optimized using the response surface methodology (RSM) and central composite design (CCD). The OhH processed fresh-cut potatoes were evaluated in terms of color, weight loss, texture, PPO activity and microbiological stability. In addition, the quality and shelf-life of OhH processed fresh-cut potatoes were determined periodically during 7 days of storage at 4°C.

Results:

The results showed that all the parameters tested improved with OhH. Moreover, the shelf-life of the OhH-processed fresh-cut potatoes increased significantly.

Conclusion:
This study proves that OhH is a suitable technique for the extension of fresh-cut potatoes shelf-life and for the inhibition of enzymatic browning of the developed products

P1.1.031

Characterisation and microwave stabilisation of residual streams from the agro-food industry

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[1]Ctic Cita

Aim
Characterise residual streams from seasonal agri-food industries and stabilise it using microwave technology for storage and subsequent revalorisation. This characterisation will be the basis for a decision support system to predict the nature of the waste and the best method for its valorisation.

Method
Residual streams from different agri-food industries are physically and chemically characterised to determine the components to be extracted and the type of organic matter to be used to produce value-added compounds by fermentation. For stabilisation, residual streams are dehydrated in a microwave. Different powers, frequencies and treatment times are tested until a dehydration is achieved that does not allow microbial growth and the by-product can be stored at room temperature.

Results
The results of the characterisation have shown the majority compounds of each residue and/or the most interesting ones and have allowed their stabilisation by microwaves using different powers and times, obtaining products with less than 6% moisture, and therefore stable at room temperature.

Conclusion
The results of the characterisation have made it possible to analyse the physico-chemical potential of the by-products from the agri-food industry, which will allow the selection or analysis of the best ways of valorisation, obtaining products that are stable and available all year round at room temperature thanks to microwave technology.

P1.1.032

Assessment the dietary changes of Iberian pigs using stable isotopes in the blood fractions

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Aim:
The aim of this stuty was to demonstrate that the stable isotope ratios of carbon and nitrogen from blood plasma and erythrocytes can be used to infer the dietary background of the Iberian pigs and becomes an useful tool for the authentication of this sustainable animal production system in the dehesa ecosystem.

Method:
In this study, forty castrated iberian pigs were fed maternal milk and received commercial feeding until the beginning of the 'montanera' period. Then, They were divided in 5 groups receiving different diets from completely fed with acorns (G1 group) passing for groups G2, G3, and G4 with different days of feeding concentrates until the group fed only concentrates (G5 group). Blood was sampled in 8 different times during the montanera period. The $\delta^{13}C$, $\delta^{15}N$ analysis of the blood fractions (erythrocytes and plasma) were performed using an EA-C-IRMS.

Results:
We observed changes in the $\delta^{13}C$, $\delta^{15}N$ values determined in blood plasma and erythrocytes according to the sampling days in the different groups following the dietary switch. In this sense, The ANOVA analysis demonstrated that the sampling date had a statistically significant effect on $\delta^{13}C$ of plasma and $\delta^{15}N$ of the plasma and erythrocytes (p=0.003), except for the

$\delta^{13}C$ of the erythrocytes ($p=0.595$). The isotopic values for the plasma samples were always higher than those for erythrocytes samples.

Conclusion:
This study shows that plasma and erythrocytes have different kinetic for the stable isotope ratio variations in blood samples. The different data can allow a clear discrimination in the dietary changes. The $\delta^{13}C$ values for the plasma fraction can be used to identify the modification of the isotope fingerprinting after 7 days of feeding concentrates. This fact could contribute to control the feeding regime followed by the Iberian pigs and to avoid misleading techniques such as, concentrates feeding complementation in the dietary used. The capability of fighting against fraud in the Iberian pig system of production that provide high quality products with an important added value can contribute to maintain the dehesa ecosystem and the sustainable animal production systems linked to it.

P1.1.033

Surface morphology of sodium alginate films incorporated with olive and laurel leaf extracts

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Aim: Due to environmental concerns, there is an increasing need to reduce the use of synthetic and non-renewable packaging materials. The study aimed to study the surface morphologies of sodium alginate (SA) films incorporated with laurel (*Laurus nobilis*) leaf extract (LLE), and olive (*Olea europaea*) leaf extract (OLE).

Method: The lyophilized extracts were obtained by Ultrasonic-Assisted Extraction using 70:30 (v/v) of ethanol:water. The films were obtained by mixing 1% (w/v) of SA and 0.5% (w/v) of glycerol in distilled water under agitation overnight. The extracts were dissolved in distilled water, stirred for 1h, filtered under a vacuum, and added at 1 and 2% of LLE or OLE, and a mixture of 0.5% or 1% of each LLE and OLE. All solutions were stirred (1h), homogenized with an Ultra-Turrax at 10000 rpm (2 min), and degassed under a vacuum. The solutions were cast in polystyrene petri plates, dried at 35 °C (convection oven) for 24h, and conditioned in desiccators containing a saturated solution of $Mg(NO_3)_2.6H_2O$ at 53% of relative humidity and 20°C before analysis. Films were examined using scanning electron microscopy (SEM) with an accelerating voltage of 5 kV. Before analysis, all samples were mounted on aluminium stubs using carbon adhesive tape and sputter-coated with gold.

Results: SA films exhibited a uniform surface with some visible cracks. SA+OLE1% films are rougher and irregularly distributed, otherwise, SA+OLE2% films form a more compact and uniform structure. SA+LLE films showed some granular vesicles with spherical shapes and smooth surfaces free of visible cracks, although, they are more uniform and formed a homogeneous network mainly at 2%. The mixture of LLE and OLE extracts resulted in a linear and smooth structure with greater uniformity than LLE or OLE individually, however, cracks were observed more frequently.

Conclusion: Films with higher concentrations of extracts were more compact, smooth, and had linear surfaces compared to lower concentrations where it is possible to observe upper irregularities on the film surface such as roughness and granular vesicles. LLE or OLE addition individually allowed to obtain more compact structures and a reduction of cracks, probably due to their ability to act as a plasticizer.

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P1.1.034

Moderate Electric Fields (MEF) assisted extraction of lupin protein

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Aim:
Environmental concerns and sustainability are urgently requiring to obtain alternative protein resources. *Lupinus luteus* has gained increasing interest in recent years due to its high protein content (around 40%). However, lupin seeds contain several anti-nutritional (ANF) and anti-technological (ATF) factors that could affect the protein extraction efficiency. One of the most important ANF in lupin seeds are polyphenols due to its high ability to associate with proteins during its isolation and reducing the further digestibility of the isolated protein. This work explores how the moderate electric field (MEF) assisted extraction of lupine protein isolate (LPI) could affect the protein yield, fat, saponins and polyphenol content and antioxidant capacity of the isolate.

Method:
MEF-assisted protein extraction experiments were carried out using two different control systems (proportional and ON-OFF) during alkaline solubilization (45 min, 10.3 pH) to reach 60ºC, the maximum voltage applied during control was of 200 V, which corresponds to an electric field strenght of 25 V/cm. After solubilization, proteins were precipitated by changing the pH to isoelectric point of protein (4.7). Protein isolates were freeze-dried for 48 hand stored at -20ºC until further analysis. Finally, protein, fat, saponins and phenolic content and antioxidant capacity were determined.

Results:
MEF lupin isolates presented a slight drecrease in protein yield compared to standard LPI of approximately 2% (dry basis). As for the protein content of the protein isolates, it was not influenced by MEF treatment ($p > 0.05$). However, compared to conventional treatment, MEF-assisted solubilization reduced the phenolic content (by 27.4%) and antioxidant capacity (by 10.3%) of the isolate when proportional control system was employed. MEF treatment reduced fat content in protein isolates compared to conventional experiments (8.25 and 10.49 % dry basis, respectively), but the effect of the control system was not significant ($p > 0.05$).

Conclusion:
MEF-assisted extraction could be considered a feasible technique to decrease the content of ANF and ATF of lupin protein isolate. This decrease could be linked to pore formation in cell membranes and ohmic heating during MEF treatment. Despite the protein yield was not increased by this technology, further work should elucidate the potential of MEF to enhance protein digestibility and technological functionality.

P1.1.035

Plasma-activated water – effect on antimicrobial efficacy of generation conditions and reactor design

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Aim: Various considerations, from environmental sustainability to health concerns, have led to the development of emerging technologies in the food industry. Plasma-activated water (PAW) has emerged as a promising alternative for the decontamination of food processing environments and improve food microbiological quality. However, the optimal generation conditions, including input voltage, discharge frequency and discharge time used to produce PAW, remain unclear. Thus, this work aims to study the influence of the main plasma processing parameters on the inactivation of Listeria monocytogenes in planktonic state. Then, the most effective generation conditions were selected to compare the efficacy of PAW generated by two novel plasma reactors.

Method: A response surface methodology (RSM) was used to identify 26 experimental conditions to determine the optimal settings for L. monocytogenes inactivation in 500 mL of sterilized Milli-RO water using a plasma bubble spark discharge (BSD) reactor. The explanatory variables included the following parameters in the ranges of 150-200 V, 1200-2000 Hz and 400-700 s for voltage, discharge frequency and time, respectively. The response variables were the physico-chemical properties of PAW and the log reductions of L. monocytogenes after 30 s, 15 and 30 min of treatment time. Optimal conditions were subsequently employed to test the antimicrobial efficacy of 2000 mL-PAW produced by the BSD reactor and a dielectric barrier discharge-diffuser (DBDD) reactor during a discharge time of 30 min.

Results: For the BSD reactor, six optimal conditions were found which could reduce L. monocytogenes by more than 3-log units within 30 s. The analysis of PAW physico-chemical properties revealed a high coefficient of regression (R2=0.76) between log reductions and the ORP values. In general, no significant differences were observed between the two plasma reactors studied. Both, BSD-PAW and DBDD-PAW were able to reduce pathogen counts by more than 4-log units after 30 s when the following generation conditions were employed: 1) 150 V, 1200 Hz; 2) 175 V, 1600 Hz; 3) 200 V, 1200 Hz.

Conclusion: The two novel plasma reactors allowed obtaining PAW with potential as a rapid antimicrobial solution using water and air, which makes it a feasible and cost-effective strategy to be applied in the food industry.

P1.1.036

Effect of oat protein extraction method on performance in oat drink systems

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Aim:

Oat drink is a popular dairy milk alternative, but low in protein. Oat protein isolate (OPI) can be used as a potential candidate for protein enrichment. However, native oat proteins have compact molecular structure, and low solubility. The functionality of a protein isolate is greatly influenced by the extraction processes and conditions used. β-glucanase cut the β-glucan and increase the protein interaction with water. Meanwhile, ultrasound is a promising processing technique known to increase the functionality of plant protein extract by altering the protein structure. Hence, this study aims to evaluate the use of ultrasound and β-glucanase of OPI to fortify oat drinks.

Method:

The study followed a 2^2 factorial design with α-amylase as a fixed factor, ultrasound and β-glucanase as independent variables at alkaline extraction (pH 9.5) condition. The OPIs were characterised to determine the protein yields (%) and protein types. The dependency of pH & ionic strength on OPI solubility, as well as the performance in oat drink systems were studied. The separation tendency of the protein-enriched drink systems was used to evaluate the OPI performance.

Results:

Ultrasound has significant effect to the protein yields and solubility, whereas β-glucanase had significant effect only to drink stability. No marked changes in protein types were found after the different extractions. Ultrasound treatment decreased the protein yield by approximately 60%, but significantly increased the solubility compared to OPI without ultrasound. In the simulated oat drink system (pH 6.5 and ionic strength of 0.1M), OPI with β-glucanase and ultrasound-assisted extraction showed the highest solubility (44.36%). The OPI with β-glucanase-assisted extraction showed excellent stability (100%) after 7-days storage at 5ºC. Though the ultrasound-assisted extracted OPI exhibited similar protein yields and solubility to the OPI obtained with both β-glucanase and ultrasound applied, the viscous texture made it not suitable for oat drink applications.

Conclusion:

The OPIs obtained by different extraction methods differ significantly. The results of this study can contribute to improved oat protein extraction, hence ensure a sustainable oat beverage production.

P1.1.037

Sustainability Assessment of Pulsed Electric Fields (PEF) Technology for Anisakis Control in Hake

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Aim: The presence of *Anisakis* larvae in hake is a major concern in the fishing industry due to the risk of severe gastrointestinal illnesses in consumers. Finding effective and sustainable methods to control *Anisakis* in fish is crucial. Freezing is commonly used for control, but it may affect the quality of the fish. Pulsed Electric Fields (PEF) technology has shown promise in killing parasites without compromising product quality. However, it is unknown if PEF could have additional environmental benefits in the fishing industry, as it is considered eco-friendly in other applications. This study aims to assess the environmental sustainability of two approaches through a Life Cycle Assessment (LCA): one using conventional freezing and the other substituting it with PEF.

Method: Data from pilot-scale are used in a simulation with SuperPro Designer to model the scenarios. Energy consumption and environmental impacts are evaluated and compared.

The simulation results are then input into SimaPro, an LCA software, for a gate-to-gate LCA analysis. Resource consumption, greenhouse gas emissions, and other relevant environmental impacts are considered. The sustainability of the scenarios is assessed and compared.

Results: The findings show that using PEF treatment instead of freezing leads to greater sustainability. CO2 emissions are significantly reduced, 41% less CO2 is emitted for a batch scale of 720kg. This reduction represents about 4kg of CO2 equivalents that are not produced due to the change in technology based on Spain electricity mix. The primary reasons for this improvement are the substantial decrease in energy consumption associated with PEF and the elimination of fish freezing storage, which can last for several days. Water consumption is also reduced by around 20% saving 100l/batch based on the LCA analysis.

Conclusion: The LCA reveals that the PEF scenario reduces environmental impacts compared to the conventional freezing scenario supporting the concept of PEF as an eco-friendly technology. Thus, this work shows that PEF technology would represent a very interesting alternative for guaranteeing the safety of fish products not only because its ability to inactivate Anisakis but also because of its lower environmental impact compared to currently employed methods for the same aim.

P1.1.038

EFFECT OF METHYLCELLULOSE REDUCTION BY FRUCTOOLIGOSACHARIDES IN VEGETAL BURGERS

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Aim:

In view of the need to ensure a new, more sustainable form of food production, the European Union is focusing on alternative protein sources of plant origin for the production of meat analogues to help meet the protein needs of the population and thus promote sustainable development (SDGs). In recent years, the consumption of meat analogues, especially soy burgers, has increased, but they contain a large number of additives to imitate meat, especially hydrocolloids such as methylcellulose to improve stability. To bring alternatives to the sector and meet current consumer demands for healthier products, the use of other plant components such as fibre, especially fructooligosaccharides (FOS), could contribute to the reduction of these carbohydrates, improving their nutritional value and technological properties. The objective was to evaluate the sensory profile of methylcellulose-reduced vegetal burgers by incorporating FOS.

Method:

Three vegetable burgers were produced with different concentrations of methylcellulose and FOS (in triplicate): Control (C) (50% soy, 1.5% methylcellulose solution, 2.5% spices, 9% olive oil), Reduced 1 (R1) (50% soy, 1.25% methylcellulose solution, 2% FOS, 2.5% spices, 9% olive oil) and Reduced 2 (R2) (50% soy, 0.75% methylcellulose solution, 6% FOS, 2.5% spices, 9% olive oil). The quantitative descriptive profiles (QDA) of the vegetal burgers were analysed by a panel of 6 trained judges. Data analysis was performed by ANOVA with SPSS 28.

Results:

The results showed that the higher concentration of FOS in the soy burgers, the higher soybean odour, sweet and umami odour/flavour, and the lower salty flavour, as these are fructose monomers, with R3 having the highest sweet and umami flavour score and C the lowest. For texture, vegetable patties C, with the highest percentage of methylcellulose, were harder, cohesive and chewier, while R2, with the highest percentage of FOS, had the lowest values for these attributes and the highest for adhesiveness.

Conclusion:

The soya burgers made with FOS, especially R1, showed adequate sensory properties, which demonstrates the possibility of incorporating this ingredient as a substitute for methylcellulose to improve the nutritional quality of this product.

P1.1.039

Application of artificial intelligence for cheese making

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Aim:

This study aimed to evaluate the potential of a compressive control system in the critical stages of cheese production using optical sensor technology and artificial intelligence tools. The system tends to optimize production, increase final product standardization, and reduce energy and water consumption.

Method:

Skim milk enzymatic coagulation was performed in a 10 litters cheese vat. Real-time coagulation monitoring was performed using a near-infrared light scattering (NIR) sensor at 880 nm for 30 min, and the inflection point of the curve was multiplied by a constant factor to estimate the optimal cutting time of the curd. To monitor whey separation, a digital camera and a light source were placed on the vat and constant images of the mixture were taken. A moisture curve was constructed by taking curd samples at 5 or 10-minute intervals. To predict the humidity, a convolutional neural network was applied and validated using the obtained data. Five pieces of cheese (1 kg) and one cheese (3 kg) were placed in a controlled chamber (T:13 °C and RH:85%) to carry out ripening with *Penicillium candidum* and *P. album*. Digital images of cheeses of both sizes were taken periodically for 60 days. The images were analysed using artificial intelligence (AI) models to predict the time the cheese has been ripening.

Results:

Real-time monitoring during coagulation by the NIR sensor allowed the objective estimation of the curd cut time. To predict the humidity and ripening time, convolutional Neural Networks were applied, transfer learning techniques based on the EfficientNetB0 architecture, and pre-trained weights in ImageNet were used with freezing/unfreezing layers. The models were validated with the obtained data, resulting in RMSE <0.02% and < 24 h for the whey moisture content and the time the cheese has been ripening, respectively.

Conclusion:

The proposed system has provided promising results for monitoring the process and predicting the humidity of the curd to stop draining and the best ripening time to optimize the use of resources for the cheese industry and identify the ripening time.

P1.1.040

Healthy and sustainable eating in fast-food restaurants: How do young consumers perceive this trend?

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Aim: Fast-food consumption is a major concern when considering its impact on consumer health, as well as on the environment. Although in recent years we have seen the emergence of new healthier fast-food concepts, and main stream brands seeking to improve the health and sustainability of their offer, little is known as to how consumers perceive these trends, and the extent to which they value healthy and sustainable fast food. This paper therefore aims to understand young consumers' perceptions towards healthy and/or sustainable eating in fast-food restaurants, and to identify potential barriers to healthy and/or sustainable consumption in these types of restaurants.

Method: Our empirical study is based on a qualitative approach involving a series of semi-structured interviews with 21 young French consumers, aged 18 to 25, with varied profiles in terms of gender, level of education and status, type of study, and frequency of consumption in fast-food restaurants. The total duration of the interviews was 16 hours 12 minutes, with an average duration of 46 minutes, a minimum of 27 min, and a maximum of 1 hour 15 minutes.

Results: Our findings highlight a difference between the trend of healthy and/or sustainable eating in fast-food restaurants, often promoted by the press and the fast-food brands themselves, and consumer behavior. Even though brands are increasingly promoting their healthy and/or sustainable options, young consumers are not necessarily attracted to them. On the one hand, they don't go to fast-food restaurants to eat healthy and/or sustainable food, they go to them to "eat

fat," to have a good time, or for convenience, speed and low cost. While they are not averse to healthy and/or sustainable eating in fast-food restaurants, the respondents identified several obstacles to adopting these new behaviors: lack of suitable options, the expense of those options that are available, and lack of clear information about healthy and/or sustainable options. Moreover, fast-food brands promoting healthy food options are rarely found outside of big cities.
Conclusion: Fast-food brands will not only have to work on these obstacles if they wish to inform customers about their healthy and/or sustainable options, but they will also have to encourage young consumers to adopt new eating behaviors.

P1.1.041

Governance Innovative Actions: Key actions for a transitions to a sustainable Food system

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[1]Cartif

Aim
To create a knowledge community of food practices focused on improving food system (FS) through Governance Innovative Actions (GIA).
Method
12cities were involved: San-Sebastian/Nilufer-Bursa/Oslo/Kolding/Turin/Castelo-Branco/Differdange/Rijeka/Kharkiv/Tampere/Athens/Rome. They represent a wide European geographical/climate/social-economic/cultural situations. GIA focus on food governance involvement and creation of food policies (FP). 9GIA were proposed. 2interconnected heading the rest: Food Policy Council (FPC) and Municipal Food Commission (MFC). FPC and MFP address city food challenges including sustainability, nutrition, food access, urban agriculture to draft a Food Policy Plan (FPP). MUFPP indicators were used for the assessment.
Results
Results of the first 2years (out of 4):
GIA1:FPC: 10cities have created FPC: 8started during the study, Turin&Rome had begun before. In 2years, only Castelo-Branco achieved a multi-stakeholder body although its representation is moderate.
GIA2:FPP: 12cities have developed their plans and are public (https://fusilli-project.eu/outcomes/eu-project-reports/). Only San-Sebastian had FPP before. In 2years, all cities have one.
GIA3:MFC: Every city has created a MFC, Only Oslo counted with an interdepartmental coordination body on urban food within the municipality. In 2years, Tampere/Rome/Turin/Athens achieved it. None on the cities had a monitoring/evaluation mechanism. In 2years, San-Sebastian/Castelo-Branco/Turin/Rome/Athens developed one to design, review and improve policies and programmes. Making data available to decision-makers and budget-holders supports resource allocations.
Urban Planning&Zoning(**GIA4**), Agriculture(**GIA5**), Environment(**GIA6**), Health-food(**GIA7**) and Education(**GIA8**) interconnected with GIA1&GIA3. Every city had some policy/regulation on nutrition, food access for vulnerable groups, agriculture production and processing in the municipal area, GHG emission, food safety or waste prevention. The presence of FPC&MFC integrates them into FS regulation allowing to identify improvement areas.
Being part of an international initiative (MUFPP) facilitating clustering activities and sharing knowledge is also relevant (**GIA9**). San-Sebastian/Rome/Turin/Athens were already MUFPP members. In 2years, Kolding also joint.
Conclusion
FPC/FPP&MFC are favouring to have an active municipal interdepartmental government body for advisory and decision making, a multi-stakeholder planning structure and a municipal urban FP.
Policy development for FS transformation requires more than specific GIA in a short 2-year period. Besides, political elections are a challenge in most cities. However, everything is making great strides.
GIA assessment allow to identify areas of improvement, new worth-analysing indicators (advocacy) and challenges (engagement).

P1.1.042

Effects of single – and two -cycles of high hydrostatic pressure treatment on chicken burgers

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Aim:
Microbiological spoilage contamination of fresh poultry products causes serious economic losses. Hydrostatic High Pressure (HHP), is a non–thermal technology, that reduces microbiological risks. For the inactivation of bacterial and fungal spores, multi-pulse HHP treatment effectiveness is being studied. It consists of repeated cycles of compression, holding time and decompression. However, HHP can also modify the appearance and other quality parameters of fresh meat. The aim of this study is to evaluate the effect of HHP (one and two cycles) on fresh chicken burgers.

Method:
Chicken burgers were prepared with minced chicken breast with pepper, onion, parsley and salt. They were vacuum packaged and treated by HHP. The following treatments were applied: HHP-1: a single cicle of 600 MPa/1 s; HHP-2: two cycles of 600 MPa/1 s with 20 hours of difference between both cycles. Treated burgers were compared with non-treated ones (control). After processing, packages were stored under refrigeration (4 ºC) for 15 days. Microbiological counts, instrumental color and lipid oxidation parameters (TBA-RS) were evaluated.

Results:
Non-treated burgers did not reach 15 days of shelf-life, as they presented high microbial counts. In contrast, the applicaction of both, one and two-cycles (HHP-1 vs. HHP-2), preserved burgers for at least 15 days. The application of two-cycles (HHP-2) presented significant reductions of microorganisms respect to one single cycle (HHP-1), so their shelf-life must be longer. Instrumental color of fresh burgers were importantly modified after HHP (increses of lightness and reductions of redness), and changes in those parameters were slightly more intense in HHP-2 than in HHP-1. Lipid oxidation did not increase after HHP (at day 1), however, after 15 days treated burgers presented higher levels of TBA-RS of storage than control burgers.

Conclusion:
The application of two-cycles improved the safety and the shelf-life of chicken burgers respect to the application of one single cycle. However, the changes in the appearance and lipid oxidation in treated burgers should be also taken into account. The economic profitability of doubling the use of the HHP equipment will have to be valued by each company, according to the shelf-life reached in the product.

P1.1.043

Effect of Plasma Activated Water (PAW) on myrosinase-glucosinolate system in fresh-cut Eruca sativa

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Aim:
The enzyme myrosinase catalyzes the hydrolysis of glucosinolates after tissue damage in plants of Brassicaceae (Travers-Martin et al., 2008). This study aimed to investigate the effect of Plasma Activated Water (PAW) on glucosinolate (i.e., glucoerucin and glucoraphanin) content and that of their hydrolised forms (isothiocyanates, such as erucin and sulphoraphane), then on myrosinase activity in Arugula (*Eruca sativa*, Brassicacea).

Method:
PAW was generated by using distilled water from a high-power atmospheric pressure corona discharge plasma source. Immediately after PAW generation, rocket sample (20 g) was dipped in 400 mL of PAW (product: liquid ratio of 1:20 w/v), and kept under constant agitation at room temperature for 20 min. PAW-treated rocket salad (PAW-20) was compared with untreated samples (UNT).
Glucosinolate compounds, such as glucoerucine and glucoraphanin, and its isothiocyanate derivative sulforaphane, were determined in the methanolic extracts of rocket salad (PAW-20 and UNT) by liquid chromatography/mass spectrometry (UHPLC/MS). The same methanolic extracts were performed for erucin analysis by GC-MS.
Proteins were extracted from PAW-20 and UNT samples, to assess myrosinase activity by a UV method, using sinigrin as substrate (Sørensen et al., 1999). Moreover, myrosinase protein levels will be evaluated by western blot analysis.

Results:
The UHPLC/MS analysis indicated an increase of glucosinolate (glucoraphanin and glucoerucin) relative percentages (around 44 and 50%, respectively) in PAW-20 extracts compared to the UNT extract. On the contrary, a significant lower concentration (t-test, $p<0.05$) of sulforaphane (precursor ion m/z 178.100) was determined in PAW-20 (134±2 µmol/L) than in UNT extract (365 ±7 µmol/L). Also, the relative abundance of erucin peak detected in the scan mode in PAW-20 extract was about 20% lower than that detected in the UT sample.

Conclusion:
The results from glucosinolates and their products (isothiocyanates) suggested that PAW could affect the enzymatic hydrolysis by myrosinase inactivation, thus being an interesting strategy for stabilizing enzyme activity in fresh-cut vegetables. The results of mirosinase activity assay will be able to support this hypothesis.

P1.1.044

Pilot scale treatment of industrial potato blanching water using evaporation, centrifugation and/or membrane filtration

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Aim:
Potato processing companies are continuously looking for innovative solutions to reduce the water consumption at the blanching step. During blanching, the continuous addition of water (of potable quality) and thermal energy (to heat the water to temperatures above 65°C) are required. Therefore, the implementation of a proper blanching water treatment that is able to cope with the challenging water matrix (i.e. high organic load) would result in an economic and sustainable improvement of the water management.
Within this study (a combination of) different water treatment technologies on a pilot scale were evaluated for water reuse aiming towards potable water quality, heat recuperation and sidestream valorisation.

Method:
Four different case studies for the treatment of industrial potato blanching were performed. The pilot-scale treatment set-up consisted of (i) an off-site falling film evaporator, (ii) consecutive on-site centrifugation, nanofiltration and double reverse osmosis (RO), (iii) combined on-site centrifugation with ultrafiltration and (iv) on-site ultrafiltration followed by off-site RO. Water samples before and after every treatment unit were physicochemically and microbiologically characterized to evaluate the treatment efficiency of every technique. This characterisation was also performed on the sidestream obtained by the water treatment to investigate the valorization potential thereof.

Results:
From the four case-studies, two (evaporation and RO) showed a physicochemical quality close to the potable water quality, with only the pH, COD and/or conductivity above the drinking water limits (2020/21/84/EC). In addition, evaporation also resulted in microbiological safe water, while water after RO still contained a microbial load. Also water can be treated at the blanching temperature by an evaporator, while using membrane filtration requires the implementation of a heat exchanger to treat the water at lower temperatures and protect the used (RO) membranes. All obtained (concentrated) sidestreams were microbiologically unstable and very aqueous (max. dry matter content of 4.49 m%), except for the concentrate stream from evaporation which had a dry matter content of 42.51 m% and thereby poses potential for further valorisation.

Conclusion:
Evaporation seems to be the most suitable technique for the physicochemical and microbiological treatment of potato blanching water considering water reuse, energy recuperation and sidestream valorisation.

P1.1.045

Generating synergies between apiculture and sustainable agriculture. The case of citrus agroecosystems.

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Aim:
The benefits of sustainable farming combined with the use of flowering cover crops at the level of crop production, insect biodiversity and pollination services are highly demonstrated. However, conventional agriculture is not friendly for bees or other pollinators and therefore the combination of agriculture and apiculture in the same area is often hindered. The long-term objective of the project will be to evaluate the capacity of a citrus agroecosystem managed under sustainable production to support a non-transhumance apiculture. The present study, as a first approach, try to assess if honeybees use the selected ecological infrastructures through the visual observation and the analysis of the pollens present in the honey.

Method:
Two apiaries were placed in the border of two citrus farms, one (21 ha) managed under conventional agriculture and the other (65 ha) under sustainable farming-system. Both farms are in Valencia (Eastern Spain). In the groves of the conventional farm all weeds were eliminated. In the sustainable farm a mix of herbaceous flowering plants targeted at pollinators were sown, the spontaneous herbs maintained and additionally selected melliferous plants were planted at the beginning of each tree row. The pollen of the honey from both apiaries were analyzed (melissopalynology) at different periods of the year.

Results:
A higher pollen biodiversity was observed in the honey collected from sustainable farming compared to the hives of the conventional agroecosystem. As expected, pollen from citrus was predominant in all the samples. However, pollen of some species which were abundant in the sustainable farming honey such as the spontaneous plant *Diplotaxis erucoides* (Brassicaceae) or the sown *Vicia cracca* (Fabaceae), were absent in the honey from conventional farming. Curiously, the pollen of some ground cover flowers that were highly foraged by honeybees were not present in the honey sampling.

Conclusion:
(Cover cropping with flowering plants in sustainable agroecosystems is demonstrated to be beneficial for honeybees and honey production. The presence of pollen in honey analyzed by optical microscopy can be utilized to identify the use of some plants by honeybees, however it should be combined with other methods such as direct observation to determine the optimal cover plants mixture.

P1.1.046

Characterization of different lupine varieties to obtain protein isolates for food applications

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Aim
Due to the increase in protein demand, there is a need to identify plant-based sources that are nutritious and sustainable. Lupine is a legume native to the Mediterranean region, with a high protein content. Its nutritional profile and potential to reduce Europe's reliance on soy make lupine an interesting area of research. The objective of this study was to characterize the seeds of various *Lupinus spp.* and identify those with the greatest potential from both a nutritional and technological point of view.

Method
Three cultivars of *L. albus*, three of *L. luteus*, and two of *L. angustifolius* were characterized to determine their nutritional and technological interest. This included the analysis of the proximate composition, fatty acid composition, and the content of different antinutritional factors (alkaloids, phenolic compounds, phytic acid, and saponins).

Results

The protein content of the different varieties of *Lupinus spp.* studied was between 38-44% d.m. which is close to that of soybean. From those*, Lupinus albus* var. Celina was the cultivar with a higher protein content (44.27%).

The fat content of the different varieties of *Lupinus spp.* studied ranged from 5,5 – 9,9% d.m. Compared to soybean, *Lupinus spp.* had significantly lower fat content. *Lupinus luteus* var. Acos and var. Tremosilla had the lowest fat content among those studied.

Lupinus luteus var. Acos and var. Tremosilla also showed the highest protein:fat ratio. This ratio may serve as an indicator for selecting the most suitable cultivar for obtaining a protein isolate in terms of protein yield, sustainability, and technological procedure convenience.

The content of antinutritional factors in the flours of the different lupine varieties were as follows: alkaloids (0,731-0,004%), saponins (4,25-2,67%), total phenolic compounds (0,32-0,16%) and phytic acid (1,39-0,74%).

Conclusion

L. luteus var. Acos and var. Tremosilla were the cultivars that exhibited the highest protein:fat ratio. Nevertheless, it is essential to consider the concentration of antinutritional factors present in these cultivars, which may impact food quality and safety. Therefore, it is important to minimize the levels of these compounds during the technological processing.

P1.1.047

alpha-Glucosidase inhibitory peptides characterisation of thermally treated and gastrointestinal digested legumes

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Aim:

Legumes contain 15-40 % of proteins which are hydrolysed after consumption by gastrointestinal enzymes. The obtained peptides has been proved to be bioactive and previous α-amylase inhibitory activity was evidenced. The achieved degree of hydrolysis is highly dependent on the previous thermal treatment applied as it impacts protein denaturation and thus, the accessibility of gastrointestinal enzymes. Then, the aim of this study was to evaluate how thermal treatment affects the peptide profile of gastrointestinal digested legumes in relation with their potential α-glucosidase inhibitory activity, related with the antidiabetic properties of the samples.

Method:

Samples of chickpea, green pea, navy bean, and soy bean after three different types of household cooking (conventional, pressure and microwave cooking) and simulated gastrointestinal digestion (GID) were analysed using reversed-phase HPLC. The α-glucosidase inhibitory activity of the different collected fractions was measured. The fractions responsible for the main activity were analysed by mass spectrometry in tandem to identify main potential peptides, and *in silico* studies were performed.

Results:

Results showed an increased amount of peptides in digested samples due to the intense action of gastrointestinal enzymes, with non-significant differences between the types of cooking. Main inhibitory activity was detected in fractions 2-3 of the chromatogram in all samples, probably due to the higher hydrophilicity of the α-glucosidase inhibitory peptides. The *in silico* study of the identified peptides showed that most of the sequences have a high potential to be bioactive according to PeptideRanker tool, being also non-toxic and non-allergenic.

Conclusion:

The experiment proved the α-glucosidase inhibitory activity of legumes after GID as well as the differences generated in their peptide profiles by thermal treatments. As a conclusion, peptides generation is highly affected by the action of gastrointestinal enzymes in all tested thermal treatments, although microwave seems to significantly affect in positive the GID of soy bean and chickpea. Chickpea showed the highest value of α-glucosidase inhibitory activity in the most hydrophilic fraction of peptides

P1.1.048

Towards the development and application of green extraction technologies: the concept of EXCEL4MED

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Aim

The excellence hub EXCEL4MED is an initiative to strengthen Mediterranean innovation excellence in innovation ecosystems focusing on the production of nutritious food products and the valorization of food industrial side-streams. The project aims at identifying high-impact strategies and establish lines of resilience for producers, processors, consumers and policymakers. Overall, EXCEL4MED will offer an adaptive capability in the Mediterranean supply chain preparing for novel waste valorisation strategies, production of added value fruit products following a holistic commerce, and the implementation of green innovative technological methodologies. EXCEL4MED will develop and demonstrate the solution in Mediterranean high-value perishable food supply chains: pomegranate and citrus fruits.

Method

EXCEL4MED will develop a conceptual design and pre-planning for pilots and demonstrators of electrochemical and sonochemical technologies in the food industry. Proof of concepts and scale-up validation assessments will be developed for the pomegranate and citrus food chains. This will be achieved by consolidating academic business linkages and providing evidence for strategy building and investment. Application of green processes for improved extraction of bioactive compounds from pomegranate seed oil, citrus and pomegranate pericarps will be carried out

Results

Experimental studies are cunrrelty carried out to characterize the bioactive compounds of different pomegranate and citrus varieties. The effectiveness of Electric Field (PEF), Ultrasound (US) and Hydrodynamic Cavitation (HC) as pre-treatments are compared to standard methods e.g., using enzymes, as well as to hybrid treatments. The bioactive compounds are extracted using standard methods, following characterization and quantification. The antioxidant capacity of the bioactive substances are determined through the radical scavenging method (DPPH), the Ferric Reducing Antioxidant Power Assay (FRAP) and the ABTS radical- cation reduction test. The best-performed treatment conditions will be identified and selected.

Conclusion:

EXCEL4MED will create 4 pilot projects in Malta and Greece; 3 on added value products and 1 on valorisation. At the end of the project, partners will provide the pilot regions specific recommendations for a joint policy in food processing, taking into consideration already identified innovation strategies for smart specialization.

P1.1.049

Plasma Activated Water as a green strategy for wash water and leafy vegetables decontamination

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Aim:

Given the increased health and environmental concerns for the use of chemicals in food production, new technologies such as Plasma-Activated Water (PAW) are being sought to make industrial processes less impactful. The objective of this study was to test the efficacy of PAW in decontaminating green leafy vegetables and their wash waters. In addition the effects of the tretments on the fate of indigenous microbiota were evaluated in order to understand if this processes can be comparable to the procedures currently used in the industry.

Method:

Samples of rocket leaves and salad wash waters were treated with PAW produced by corona discharge. The vegeable samples were soaked into PAW for different times up to 30 minutes and stored at 4°C up to 10 days after the treatments. Microbiological analyses were performed to enumerate the surviving mesophilic, psycrophilic bacteria and the *Enterobacteriaceae* and changes in main quality parameters. The washing waters were analysed for the decontaminating effect of plasma treatments against both indigenous spoilage microbiota and pathogens also in relation to the content of organic matter. The efficacy of treatments was compared with reference sanitization technology currently in the industry.

Results:
Decontamination of the vegetable wash waters was strongly affected by the organic matter similarly to the reference sanitizer. A significant decrease in pH reaching values close to 3.5 was observed for PAW. Overall, washing treatments with PAW reduced the cell loads of all the target microbial groups, and in particular the longest treatments (20 and 30 minutes) resulted in the highest immediate cell load reductions. On the other hands, samples treated for 30 minutes presented lower contamination levels after refrigerated storage. No relevant differences were observed in the visual qualiy of the samples.

Conclusion:
PAW treatments allowed inactivation of the inidigenous microbiota and inhibition of its growth during storage. Moreover, the use of plasma on wash water promoted the decontamination from pathogenic species, making its reuse possible and the process more sustainable.
This work was carried out in the framework of the CO-FRESH project which has received funding from the European Union's Horizon2020 research and Innovation programme (GA n 101000852).

P1.1.050

Microwave cooking applied to 3D food printing

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Aim: The aim of this work is to develop a new process that uses microwaves (MW) to cook food material during the 3D printing process.

Method: A printer that integrates a system that allows cooking the food material during the printing process has been developed and tested. For the study of the most suitable printing parameters, both the printing speed and the nozzle displacement speed are considered, as well as the shapes given to the samples for the tests. The most suitable position of the microwave emitter (height with respect to the food matters), the speed at which it moves, and the power at which the MW are emitted were also evaluated. A thermographic camera was used to know the temperature reached by the samples during the cooking process.

Results: Different forms (geometry, wide of lines, the separation between lines, food material) were printed and cooked using the system developed. The thermographic images obtained during the printing-cooking process showed that the temperatures achieved by samples ranged between 30 to 80ºC in function of the conditions used (MW power, speed, and height of MW nozzle). The characteristics of the material used as ink (composition and water content) affected considerably the temperature achieved by the sample. Likewise, once the power that allowed and adequate cooking of the food has been selected, the correct distance between the MW nozzle and the samples, as well as its displacement speed, were established to prevent the samples from burning.

Conclusion: The system developed to cook food samples during the 3D food printing process based on MW was validated. The temperature reached by samples can be controlled by means of the MW power applied, the distance to the sample, and the speed of the MW nozzle. The adaptation of the distance of the MW nozzle with respect to the food sample and its displacement speed are the parameters that, together with the control of the MW power, make it possible to carry out the cooking of the ink food during the printing process.

P1.1.051

Mild extraction & fractionation of plant proteins: a potential to control functionality

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Aim:
Plant proteins play a crucial role as functional ingredients in our foods. Currently, the major focus is to perform extensive purification, yielding high-purity ingredients. But a problem here is the impact of the extraction/fractionation processes on the protein's functionality. This work aims to show how intensive processing affects plant proteins, and how mild processing can be a suitable alternative.

Method:
In this presentation, we will show a series of works, where the plant protein extraction/fractionation method is altered, which will change protein molecular and functional properties. Here, we will discuss the advantages and drawbacks of specific process steps and how the processes can be used to control the performance of the final protein ingredient. Additionally, we will highlight gaps in current research and show our vision on plant protein functionality-driven processing.

Results:
We identified several protein molecular structure-changing steps in the extensive (conventional) extraction processes: defatting, alkaline extraction and isoelectric point precipitation. These steps can give significant protein aggregation and complexation, thus lower solubility, which might strongly impact the functional properties (e.g. foaming, emulsifying and gelling). Milder extraction methods reduce these drawbacks, but a potential consequence is the presence of impurities, such as anti-nutrients and phenols. We also show how the processing is a tool to control the plant protein composition by, for instance, creating pure globulin ingredients or globulin/albumin mixtures.

Conclusion:
The main message, here, is that we need to consider changes in protein properties due to ingredient processing. If we understand this relationship, we can use processing to control protein functionality; thus performing functionality-driven protein extraction. Thereby, generating new opportunities to produce highly functional plant-based ingredients.

P1.1.052

Food-chain residues in biobased foam trays development for packaging uses

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Aim: Biodegradable starch foam trays are an environmentally friendly alternative to petroleum-based single-use packaging, especially polystyrene foams. However, starch foams lack flexibility and tensile properties, which can be improved by lignocellulosic reinforcement. This work reports biodegradable cassava starch foam tray development filled by six food-chain residues as reinforcement fillers.

Method: The corncob, cassava hull, soybean straw, Araucaria seeds hull, yerba mate thin stalks, and leaves petiole stems were used as filler in cassava starch foam trays. Each food chain residue was collected, dried up to 11% moisture, and grounded with a size smaller than 250 mm. Magnesium stearate and guar gum (1% w/w of starch) were used to improve tray demolding, while glycerol (6.25% w/w of starch) was added as plasticising. The starch foam trays were filled with 10% (w/w of starch) of each residue and produced by baking moulding at 180°C for 4 min. Density (kg/m^3), breaking stress (N/mm^2), fracturability (mm), by three-point breaking tes and tensile strength (MPa) elongation (%), and elasticity modulus (MPa) by tensile test were examined.

Results: Corncob, cassava hull, soybean straw, Araucaria seeds hull, yerba mate thin stalks, and leaves petiole stems residues have between 20-55.25% of cellulose and 19-42.7% of lignin. Unfilled foam trays have a lower density than filled ones. Cassava and pinhão hulls were the highest dense trays, followed by yerba mate stalks> cassava hull> corncob=soybean straw> Araucaria seeds hull> yerba leaves petiole stems. The cassava hulls have high cellulose content (55.25%), while pinhão hulls have high lignin content (42.68%). All reinforcements improved the breaking stress from 0.02 N/mm^2 (unfilled) up to 1.8 N/mm^2 (cassava hulls), also increasing the fracturability (8.8-9.5 mm) compared to unfilled trays (12.3 mm). This behaviour is probably due to cellulose content in the residue and, consequently, the thickness of the trays. Moreover, tensile strength and elasticity modulus were impaired by adding any filling, while elongation at break was doubled.

Conclusion: All food-chain residues have high cellulose and lignin content. Biodegradable foam trays from cassava starch filled with lignocellulosic residues result in an excellent alternative to petroleum-based packaging with suitable density, improved breaking stress, and reduced fracturability.

P1.1.053

Innovative High-pressure process to increase the preservation of ready-to-eat Organic FOOD, HO-FOOD Project

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Aim: The project aims at developing and implementing a new mild food process, based on the use of high pressure CO_2 at low temperature, to improve the safety and extend the shelf-life of ready to eat (RTE) organic fresh products. The technology also aims at preserving food bioactive components, thus contributing to the maintaining of the healthy asset exerted by organic fruits and vegetables for a longer time.

Method: Small and medium equipment have been designed, set-up and validated to treat fresh food packaged with CO_2 modified atmosphere. The process works at low temperature (≤50°C) and uses a water driven pump to reach the desired pressure necessary to bring the CO_2 to the sub-supercritical phase. The process has been tested on three food categories: (fruits, vegetables and seeds) by screening over 40 different products. Analysis for the microbial, chemical and enzymatic stability overtime will be used to demonstrate the increment of the product shelf life, together with sensorial analysis by trained and untrained panellists. LCA and LCC will support the project to demonstrate sustainability.

Results: The preliminary screening based on the maintenance of the overall appearance and color of the processed product demonstrated a good compatibility of the technology with strong firm food products. Three case products (fresh cut melon, squash and almonds) were selected for the validating at small and medium scale. The process was optimized to select the most suitable pressure, time and temperature to be used. The inactivation of natural present microorganisms is achieved up to 3 log CFU/g after the process. Shelf life studies will demonstrate the potential of the technology for a better preservation of RTE food.

Conclusion: The project will develop new food processes to be used by local organic farms, SMEs and retails to develop innovative wholesome products, to reduce the food waste, energy costs and support the development of a sustainable supply chain.

P1.1.054

Heating behavior of tomato-based products during radiofrequency and microwave processing

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Aim:

Tomato-based products, often combined with salt and oil, are a staple of the Mediterranean diet. Dielectric heating technology can overcome some limitations of conventional thermal treatment for these products. However, its widespread industrial application is currently limited by a lack of understanding of how different process conditions affect heating rates. Analytical solutions of one-dimensional approaches can be of help in a way that does not require specialized software and is not time-consuming. Therefore, the aim of this study was to analyze the effect of different ingredients and product thickness on the heating rates of tomato puree using analytical techniques for radiofrequency (RF) and microwave (MW) heating.

Method:

Different tomato homogenates were obtained mixing tomato puree, salt and oil. Their dielectric and thermal properties were measured, and a one-dimensional approach was used to obtain analytical solutions for heating rates at four frequencies allocated for ISM (Industrial, Scientific and Medical) applications: 27.12 MHz, 40.68 MHz (RF), 915 MHz, and 2450 MHz (MW), and two different values of thickness (5 and 10 cm). For the RF treatment, a parallel-plate applicator working at 5000 V with an air gap of 1.5 cm was assumed. For the MW treatment, a plane wave incident normally on the top and bottom of the sample with an energy flux of 30 kW/m2 was assumed.

Results:

At RF frequencies, heating rates decreased with temperature and salt content. At a fixed air gap, changes in sample thickness had little effect on heating rates due to the large penetration depth in the RF region. At MW frequencies, increasing the salt content and the sample thickness caused power dissipation to accumulate on the external layers of the sample. At 2450 MHz higher heating rates were obtained, but with much lower penetration in the internal layers of the product. For both technologies, the addition of oil was associated with slightly higher heating rates, possibly due to a decrease in specific heat.

Conclusion:
Changes in the products's dimensions and composition affect its behaviour during dielectric heating applications. To attain efficient processes, appropriate operating parameters must be selected for each technology.

P1.1.055

Acid whey protein concentrate coating with indigenous antifungal L.helveticus strain for acid-curd cheese quality maintenance

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Aim: edible coatings as carriers for protective lactic acid bacteria (LAB) can enhance hygienic quality of dairy products. Thus, the aim of this study was to improve the quality of artisanal acid-curd cheese by applying liquid acid whey protein concentrate (LAWPC) based edible coating with entrapped indigenous antimicrobial *Lactobacillus helveticus* MI-LH13.
Method: the edible coating was composed of LAWPC, apple pectin, sunflower oil, and glycerol containing 6 $\log_{10}$ CFU/mL of strain biomass and applied on fresh acid-curd cheese by dipping. Cheese spoilage was observed over 21 days of cold storage.
Results: the immobilisation of *L. helveticus* cells into the coating had no negative effect on their viability throughout 14 days of storage at 4 °C and 23 °C. The application of coating with *L. helveticus* decreased the counts of yeast up to 1 $\log_{10}$ CFU/g ($p < 0.05$) for 14 days of storage and suppressed growth of mould for 21 days.
Conclusion: our findings indicate that LAWPC-pectin coating supported *L. helveticus* cell viability thus acting as protective barrier against spoilage of fresh cheese.
Acknowledgements: the project "The edible coating formulated with liquid acid whey protein and bioactive compounds, and biopackaging for safety and quality of probiotic cheese" (Biocoat) benefits from a 974 thousand € grant from Iceland, Liechtenstein, and Norway through the EEA Grants. The aim of the project is to develop an edible coating formulated with liquid acid whey protein concentrate and bioactive compounds, in combination with biodegradable packaging to ensure safety, extend the shelf life, and enhance functionality of probiotic cheese. Project contract with the Research Council of Lithuania (LMTLT) No is S-BMT-21-10 (LT08-2-LMT-K-01-046).

P1.1.056

High-pressure and pullulanase as pre-treatment to tailor starch-based films properties?

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Aim:
Thermoplastics are widely used in our daily lives, but their non-biodegradability is a huge threat to the environment. Biodegradable packaging made from renewable and low-cost biopolymers like starch is a potential solution. Starch-based films are appropriate because they are odorless, colorless, visually attractive, can act as an antioxidant/antimicrobial carrier, and are edible. However, they present some limitations, like high hydrophilicity and retrogradation, that may be addressed by modifying the starch through physical, chemical, or enzymatic techniques improving its properties and industrial applications. Some alternative processing techniques, such as high-pressure processing (HPP), can induce physical properties changes on starches with potential to tailor starch film properties, in a structure/function relationship interesting approach. Therefore, to obtain starch-based films with possible different and better characteristics the aim of this work was to evaluate the suitability of HPP combined with pullulanase as a pre-treatment of starch film forming solution and study its influence on the developed films.

Method:
HPP during 350 or 500MPa for 5 or 15 minutes, in combination with pullulanase incubation for 30 or 165 minutes was used as starch pre-treatment. The developed films were compared with the control films (pre-treatead with pullulanase) using FTIR, XRD, TGA, SEM and in terms of mechanical properties (elongation at break, tensile strength, young's modulus), hydrophobicity, color, transparency, moisture, water solubility and water vapor permeability.

Results:
The combination of pressure and pullulanase results in substantially more transparent and smoother films. Although the elongation at break is reduced, the tensile strength increases by up to 75%, demonstrating the suitability of these films for more robust applications; the film produced by 500MPa/15 minutes treatment followed by 165 min pullulanase incubation had the highest stiffness value. Moreover, as expected, the application of pressure increases the amylose content and decreases the crystallinity. In addition, both the water vapour permeability and hydrophilicity of the films are increased.

Conclusion:
It can be concluded that starch pressure and pullulanase pre-treatments are effective for modifying starch-based films and can be used to produce films with enhanced properties and ultimately could enable the tailoring of starch-based films to achieve better properties for food applications.

P1.1.057

Attitudes and behavior of consumers with and without a planetary diet

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Aim: The planetary diet is considered a diet healthy for people and the environment. The study aimed to investigate the consumer's behaviours among respondents that define eating according to planetary health guidelines and those who don't follow its guidelines.

Method: The online survey was performed among volunteers of the general adult population of Poland. The valid questionnaire, adapted to a planetary diet, assessing consumers' perceptions of the healthiness of their diet, the main characteristics of the product they focus on during groceries and intentions toward selected food products in the following year. U Mann-Whitney test was used to assess the associations the distinguished groups – planetary diet (PD) and others (O) .

Results: A total of 216 respondents (81,9% women) with an average age of 33,4±12,55 years old were examined. There were 85 (40.3%) participants on a planetary diet. For respondents that follow the PD, healthy diet is significate more important compared to those that don't. They are also assessing their current diet as being significantly healthier. For both groups, during groceries, the taste of the product was the most important characteristic and there was no significant difference between investigated groups ($p>0.05$). Sustainable agriculture as a source of product ($p<0.000$) and health benefits of the products ($p<0.001$) are significantly more important for participants that follow PD during groceries. Those on the PD were more likely to exclude meat from their diet, while O believe they consume an adequate amount ($p<0.000$). Non PD consume twice as many fish products as those on PD ($p<0.000$). People that follow PD already excluded or want to

reduce the consumption of dairy products compare to O (p=0.001). People on the planetary diet would like to consume less eggs in the following year (p=0.005). Both groups want to consume more legumes (60.31% vs. 49.41%), this result is not statistically significant (p=0.288).
Conclusion: Those following the planetary diet see it as a healthier eating model that also involves purchasing decisions that are not only conducive to health but also to the planet.

P1.1.058

Enzymatic modification of pea proteins to improve their functional properties

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Aim:
Plant-based proteins are gaining increased attention because of their potential sustainability and health benefits. Plant proteins are widely used to develop alternatives to meat, dairy, egg, and fish. The main challenge with plant proteins is their poor functional properties. This can limit their usage in formulating food products. Enzymatic modification of plant proteins can be an efficient way to improve functional properties due to their high selectivity and specificity. This study investigated the effect of different proteases on the functional properties of pea protein isolate and the effect of transglutaminase in improving gel texture.

Method:
Pea protein isolate suspensions were pre-heated at 90 °C for 10 min and controlled protein hydrolysis was performed using four different endopeptidases with different enzyme concentrations (enzyme: 0-0.18 % v/w of protein). The hydrolysed proteins were subsequently analysed for their particle and molecular size distribution, suspension stability, emulsion properties, and Glucono Delta-Lactone (GDL)-induced gelation in the presence of transglutaminase.

Results:
Controlled hydrolysis of pea protein isolate resulted in particle size reduction in the range of 10-14 µm and hydrolysis of high molecular weight proteins (about 50 - 200 kDa) into smaller peptides (3 – 50 kDa). Besides, the protein hydrolysis improved suspension stability with all four tested proteases and at all enzyme concentrations except for the lowest (0.006 %). The emulsions prepared with hydrolysed pea proteins showed higher creaming than non-hydrolysed proteins after 24 h of storage at 4 °C. Transglutaminase in combination with GDL significantly increased the gel hardness and cohesiveness in the range of 118 – 152 g and 0.2 – 0.3, respectively, compared to the gel prepared with GDL alone. In general, partial hydrolysis of the pea proteins resulted in gels with reduced hardness.

Conclusion:
Controlled protein hydrolysis significantly reduced the particle size and molecular size of pea proteins, which resulted in improved suspension stability and creaming ability. Transglutaminase significantly increased the hardness and cohesiveness of pea protein gels, whereas treatment of the proteins with endopeptidases reduced the gel hardness. Thus, enzymes can be used to control the gel hardness to develop desired food functionalities using pea protein isolates.

P1.1.059

Development of highly stable phytosterol oleogel particle-based emulsions with improved bioaccessibility of β-carotene

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[1]Faculty of Biotechnology and Food Engineering, Technion, [2]Russell-Berrie Nanotechnology Institute, Technion

Aim:
Oral administration is the most preferred route for drug and bioactive delivery, although it raises great challenges due to the involvement of the gastro-intestine (GI) system and limited bioavailability. In this research, gelled oil particle-based emulsion was formulated using β-sitosterol and γ-oryzanol (SO) mixtures, as structuring agents, to improve the β-carotene bioaccessibility.
Method:
The effect of SO concentration was analyzed under simulated GI conditions and changes in their particle size, zeta potential, and morphology was assessed. Furthermore, these differences were examined with respect to the oleogel particle susceptibility to gastrointestinal digestion and β-carotene bioaccessibility kinetics.
Results:

Increasing SO concentration led to significant decrease in the oleogel particle size. GI digestion tests revealed that unstructured oil particles-based emulsions incubation in the stomach phase promotes particle aggregation and consequently leads to particle size increase in comparison to the structured oil particles-based emulsion. In the small intestine phase, the extent of lipid digestion was correlated to the particle size and the oleogel-network mechanical strength. More specifically, higher SO concentration led to stronger network that impeded the lipolysis process, while simultaneously, higher SO concentration resulted in decrease in particle size, leading to a greater extent of lipolysis overall. It was shown that smaller mixed micelles are formed during the lipolysis process when particles were prepared using higher SO concentration, implying on the ability to control micelle size during digestion. The β-carotene bioaccessibility significantly increased from 27.79±1.33 to 41.09±0.60% when the SO concentration increased from 0 to 10 %wt., but then a significant decreased to 32.60±0.38% was observed at 15 %wt. SO concentration. Such behavior is related to the original particle size, and the network mesh size that fixes the β-carotene position and acts as a physical barrier that restricts their release.

Conclusion:

The results suggest that combination of solid texture and liquid lipid core in the oleogel particles offers mechanical protection and micellization ability during digestion. Therefore, the obtained oleogel particles-based emulsion has the potential to be utilized as effective encapsulation systems for hydrophobic molecules with controllable release by manipulating the biophysics of the chosen lipid and structuring agent network.

P1.1.060

Extrusion effect on the physicochemical characteristics and composition of cold-pressed oilseed by-products.

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Aim:

Large amount of by-products are generated after the oil extraction from soybean (*Glycine max* L.) and rapeseed (*Brassica napus* L.). The evaluation of the physicochemical and proximate characteristics of these byproducts is relevant to diminish the environmental impact, to combat nutritional problems in the population, and to develop new products and applications.

Method:

In this work the effect of the extrusion (CPE), applied after the oil extraction from the oilseeds by cold pressing (CP), on the physicochemical characteristics, proximate composition, and the amino acid and sugar profile, was evaluated.

Results:

Both oleaginous by-products presented a high protein and carbohydrate content. L-tryptophan and L-proline were the most abundant amino acid in soybean and rapeseed, respectively. D-(+)-sucrose was the main sugar in both by-products representing more than 50% of the total content. Extrusion changed the amino acids and sugar content in the samples.

Conclusion:

CP and CPE oilseed by-products are a rich source of protein and carbohydrates, two valuable nutrients used in human nutrition and other technological applications. CPE was adequate to increased the content of some sugars, which could be used as substrate to obtain other valuable compounds.

P1.1.061

Exploring the application of UV light on poultry meat: decontamination effectiveness and impact on quality

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Aim:
UV-light emitting diodes (LEDs) may be used as more effective decontamiantion strategies than conventional mercury UV lamps. This study aimed to compare the effectiveness of conventional UV lamps and UV-LED technologies to reduce total viable counts (TVC) and total Enterobacteriaceae counts (TEC) in chicken meat and maintain this reduction (as compared to the untreated control) over a 7-day storage period at 4 °C and the impact of these technologies on product quality and sensory attributes.
Method:
Skinless chicken fillets were obtained 1-day post-mortem, cut into ~10 g cubes, and treated with a 280 nm UV-LED device for 6 min, followed by a 254 nm UV conveyor lamp for 6 min at the pilot plant level. Untreated samples served as controls. Samples were packed in plastic trays to simulate retail conditions and stored at 4°C for 7 days, with sampling at day 0, 1, 3, and 7. Microbiological analysis was conducted on blended samples using maximum recovery diluent after serial dilution. Diluted samples were inoculated onto Petrifilm plates for TVC and TEC determination, incubating for 48 h at 30°C and 24 h at 37°C, respectively. Chicken meat's color, pH, lipid, and protein oxidation were assessed for all treatments at day 0, 3, 7, and 10 at 4°C. Sensory analysis involved a consumer panel assessing treated and untreated chicken stored at 4°C for 3 days.
Results:
Both technologies showed similar effectiveness in reducing TVC and TEC levels (>1 log CFU/g) as compared to the untreated control and this difference was maintained during the 7-day storage period of chicken meat. Moreover, colour, pH, protein and lipid oxidation of fresh chicken meat were not affected by the action of UV-LED, unlike conventional UV lamp, which significantly promoted lipid oxidation. Alterations in quality parameters of chicken meat caused by the UV lamp treatment did not decrease overall acceptance in the sensory analysis. UV-LED did not affect quality parameters of chicken meat and was the preferred chicken meat, even when compared to untreated chicken meat.
Conclusion:
UV-LED technology was shown to reduce TVC and TEC in chicken meat during the 7-day storage period without impacting quality and sensory attributes of the meat.

P1.1.062

Beyond isotope analysis - threats within the regional authentication of cheese

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[1]MCI I The Entrepreneurial School®

Beyond isotope analysis - threats within the regional authentication of cheese.

Topic: Responsible consumption and production

Aim: (heading must be in bold)
(Introduction text - align left, 10 point, Times New Roman, single line spacing)
The European Union suggests several schemes for the quality control of traditional foods. One of these is the Protected Designation of Origin (PDO) that is granted to traditionally produced foods. This traditional production method is often reflected in the price of the food. Therefore, products with a PDO label, such as cheeses, are prone to food fraud. Currently, the authenticity of food with PDO is controlled primarily by time- and resource-intensive isotope analysis. This project aims at finding resource-saving alternatives for the authentication of PDO cheeses.
Method: (heading must be in bold)
(Methods text - align left, 10 point, Times New Roman, single line spacing)
The methods involve a meta-analysis of data that was collected for quality control purposes of cheeses with and without PDO in two different alpine regions and the appropriate institutions over the last five years in Tyrol and South Tyrol. To supplement that data sets we performed sensory-, physico-chemical analyses, and analysis of free amino acids on protected and non-protected cheeses from Tyrol and South Tyrol
Results: (heading must be in bold)
(Result text must - align left, 10 point, Times New Roman, single line spacing)
Through multiple triangle tests (BS ISO 4120:2004), it was demonstrated that panelists are able to distinguish not only the cheese types but also “Tiroler Bergkäse” PDO from the non-PDO counterpart. But on the other hand, when using a check

and rate-all-that-apply method (CATA, RATA), panelists were unable to classify the PDO cheese differently from the non-PDO.
The meta-analysis of the data provided by the food monitoring institutes, the additionally collected physico-chemical parameters, and the free amino acid profile did not provide a means to differentiate between PDO cheeses and the non-PDO counterparts. However, as expected it was possible to discriminate between different cheese types.
Conclusion: (heading must be in bold)
(Conclusion text must - align left, 10 point, Times New Roman, single line spacing)
Our study shows that sensory analyses might indicate a distinction between different cheese types and in a few cases as well between PDO and non-PDO cheeses. However, there are inconsistencies in the results of the sensory analyses, which we attribute to differences between the methods. A triangle test made the analysis for untrained panelists easier than the CATA/RATA. Nevertheless, the CATA/RATA test is more similar to the consumer behaviour.
We conclude that a combination of various physicochemical and sensory methods might offer a potential alternative to isotopic analysis for distinguishing PDO from non-PDO cheeses, although further research is needed to replace costly isotope analysis as a standard method.

P1.1.063

Ultrasound-assisted protein extraction from faba beans: impact on protein yield and structural- functionality.

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Aim: Faba beans are an important legume crop from a nutritional, ecological, and economic point of view (Xiao *et al.*,2021). Faba beans is nutritionally beneficial in terms of its high protein-carbohydrate ratio, fibre, and mineral content. Food application of faba ingredients has been limited by its techno-functional properties and unpleasant aroma profile. Traditional extraction processes such as alkaline extraction and salt extraction employed in isolating proteins may generate unsatisfactory protein yield and purity and undesirable functionality. The goal of this research was to investigate the impact of ultrasound-assisted protein extraction on faba bean protein isolate. Physicochemical and structural functionality was determined to investigate the impact of ultrasound treatment on the reduction of antinutrients and the relationship between these properties.

Method: Dehulled faba bean was milled into flour. Faba bean protein isolate was obtained by alkaline extraction followed by precipitation at the isoelectric point. Alkaline treatment was subjected with ultrasonic treatment using a high-intensity ultrasound for specific durations up 60 min and temperatures (25-40^oC). The nutritional, and physicochemical composition was determined in addition to the process yields. Structural and functionalities was also determined, and their impact correlated using principal component analysis.

Results: Traditional alkaline-isoelectric extraction and ultrasound-assisted extraction showed differences on the yield, physicochemical, functional properties, and structural properties of protein isolates. Results from the analysis showed significant compositional variation and observable difference in functionalities and structural properties. Chemometric was used to compare and optimize various parameters.

Conclusion: Ultrasound-assisted extraction represents an effective method in influencing physiochemical properties. Ultrasonicated alkaline extraction resulted in improvement in protein yield and techno-functionalities of the isolates. Structural studies using Infrared spectroscopy, fluorescence spectroscopy as well as thermal properties also revealed changes in protein amide regions. Ultrasound-assisted extraction could thus be applied to maintain and/or modify functional properties of faba bean protein isolate with varying applications.

P1.1.064

The effect of edible insect processing on milk analogs development

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Aim:
Edible insects have been recognized as a sustainable potential food alternative; safety and consumer acceptance remain the highest obstacles to human consumption. However, insect processing can decreases the microbial load and improves

their acceptability. Insect-based food products mainly using insect flour have been developed; this study aimed to evaluate the effect of chemical and thermal pre-treatments on *Tenebrio molitor* larvae to produce insect milk analogous.

Method:

Insect larvae were starved for 48 hrs, sieved, and subjected to thermal pre-treatments: A) 100 °C x 1 min and B) 60 °C x 5 min with and without the addition of citric acid (1 %) and chemical treatments using P_1) sodium metabisulfite and P_2) ascorbic acid, no pre-treated samples were used as control. Afterward, larvae were frozen until their use. For milk analogous, frozen samples were blended (1:5) with drinking water, filtered (slurries), and homogenized with lecithin (emulsifier) and carrageenan gum (stabilizer).

Results:

A darker brown color was observed on control insect slurries and B samples compared to the other treatments, and in the case of A, P_1, and P_2, the coloration significantly decreased. Milk analog's color remained similar to slurries; however, in the case of B samples, a more brownish-grey color was developed. Control and B emulsions showed higher viscosity but also lower stability (~83 %) after two weeks as well as P_2 (~78 %) compared to A and P_1 (~90 %). Higher temperatures for a shorter time allowed for inactivated enzyme reactions and prevented the generation of pigments. Emulsions stability was negatively affected by lower pH values (4.3), which caused protein precipitation (P_2), and in the case of P_1, higher ionic strength (6 mS/cm) could improve their stability.

Conclusion:

Insects' conditioning and processing have a significant influence not only on food safety but also on their physical and chemical characteristics. To develop stable milk analogs, starting material, additives, and environmental conditions are determinant factors in this molecular system interaction.

P1.1.065

Effect of formulation and extrusion conditions on physicochemical properties of fava bean-based high-moisture extrudates

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Aim:

One of the challenges in the elaboration of plant-based meat alternative products is to mimic animal muscle texture. High-moisture extrusion cooking (HMEC) is being studied as an approach to achieve this challenge. However, HMEC is a complex process in which product formulation and extrusion conditions play a key role in fibre-like structure formation. The aim of this work was to study the effect of formulation and HMEC conditions on the physicochemical and textural characteristics of fava bean-based extrudates. Product characteristics were also compared with cooked chicken breast to define the best formulation and extrusion conditions combination to achieve a similar texture.

Method:

High-moisture extrudates (HME) obtained from five different formulations (fava bean protein concentrate and its combination with oil, gluten, and pea protein isolate) were elaborated using a laboratory-scale twin-screw extruder. All formulations were elaborated at different extrusion conditions, combining different barrel temperatures (145 ºC / 155 ºC) and liquid/powder feed rate ratios (1.5 / 1.22 / 1). Chicken breast cooked at 75 ºC was used as a reference sample. All samples were submitted to a shear test, both longitudinally and transversally to the extrusion flow. Shear force, area, and gradient were recorded. The anisotropy index (AI) was calculated from the ratio between the transversal shear force (F_T) to the longitudinal shear force (F_L). Moisture content was also analysed. Effect of oil, gluten, and pea protein isolate addition on the development of HME from fava bean protein concentrate at different extrusion conditions was studied separately.

Results:

All the formulations studied had a significant effect ($p<0.05$) on both physicochemical and textural characteristics of HME. Moisture content, shear textural parameters and AI also showed significant changes at different barrel temperatures and liquid/powder feed rate ratios. All HME presented significantly ($p<0.05$) lower moisture content than cooked chicken breast. However, some formulations at specific extrusion conditions lead to similar textural parameters to the reference sample.

Conclusion:

Formulation and extrusion conditions have a significant effect on the characteristics of the final product. Fava bean-based HME with similar textural characteristics to chicken can be achieved, however, further sensory analysis would be interesting to support it.

P1.1.066

Advancing insights in feed processing to facilitate re-use of food co-products in the circular bioeconomy

<u>Msc Thomas Bastiaansen</u>[1], MSc Richard Benders[2], Dr. Joshua Dijksman[2,3], Dr. Menno Thomas[1,4], Prof. dr. ir. Wouter Hendriks[1], Dr. ir. Sonja De Vries[1], Dr. ir. Guido Bosch[1]

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Aim:

To feed the growing human population, demand for food is expected to increase in the coming decades. To reduce food-feed competition, it is desirable to reduce the inclusion of cereal grains in livestock feed an increase the use of inedible co-products (e.g. from the food industry). The majority of livestock feed, however, is pelleted to improve its handling properties and inclusion of co-products can impair physical pellet quality due to their high fibre content. We investigated the effects of the inclusion of different co-products and mean residence time in the die (MRT) of the mash on pellet manufacturing.

Method:

Three mash mixtures consisting of 50% (w/w) maize and either 50% oat hulls (OH), soya bean hulls (SH) or sugarbeet pulp (SB) were conditioned to 70 °C by steam addition and pelleted using a ring-die press, fitted with three dies varying in geometry (Ø 3mm, thickness 12mm; Ø 6mm, thickness 56mm; Ø 6mm, thickness 84mm), at various production rates (120, 190, 260, 330, 400, 470 kg/h). The MRT (in sec) was calculated based on die geometry (e.g. hole diameter, thickness, number of holes) and production rate. Energy consumption of the press was logged, and physical pellet quality was determined through three-point bending and holmen durability analysis. Data were analysed through linear regression analysis, with MRT and included co-product, and their interaction, as model parameters.

Results:

Net energy consumption of the pellet press increased per unit of MRT (i.e. per sec) with 1.3 kWh tonne^{-1} ($P<0.001$) for OH, 0.3 kWh tonne^{-1} ($P<0.001$) for SB, and 0.4 kWh tonne^{-1} ($P=0.003$) for SH. Bending stress increased per unit of MRT (0.018 MPa; $P<0.001$) and was comparable for all co-products ($P=0.505$). Pellet durability tended to increase by 1.6% per unit of MRT ($P=0.065$) and was unaffected by co-product inclusion ($P=0.611$).

Conclusion:

Net energy consumption in pellet manufacturing is determined by both the type of co-product and MRT. Physical pellet quality increases at higher MRT. Physical pellet quality of pellets containing food co-products can be improved by increasing MRT, however this should be balanced against a possible associated increase in energy costs for specific co-products.

P1.1.067

Impact of centrifugation- assisted block freeze concentration on the aqueos extract of ora-pro-nóbis (Pereskia grandifolia)

<u>Doctor Silvia Benedetti</u>[1], Doctor Isabel Achaerandio[1], Doctor Patricio Antonio Orellana-Palma[2], Doctor Eduard Hernández[1]

[1]Universitat Politècnica de Catalunya, [2]Universidad de La Serena

Aim: Ora-pro-nóbis (*Pereskia grandifolia*) leaves are an interesting source to be explored due to their nutritionally rich matrix and biological properties associated. The greatadvantage of freeze concentration is their low temperatures apllied with no vapor/liquid interface. Furthermore, nutrients and antioxidant compounds are preserved upon utilization of this technique. The main aim is to evaluate the use of centrifugation-assisted block freeze concentration (CABC) to obtain concentrates rich in bioactive compounds from aqueous extracts of ora-pro-nóbis.

Method: The aqueous extract was prepared by maceration of ora-pro-nóbis leaves dried flour, followed by centrifugation and filtration. Then it was frozen at -20 ºC in Falcon tubes isolated to produce an axial freezing. The cryoconcentrated solution was separated from the ice fraction by centrifugation according to factorial experimental design 2^2 with two independent factors: centrifugation time (10 and 30 min) and rotational speed (750 RCF (2600 rpm) and 2360 RCF (4600 rpm),). The impact of CABC on the total phenolic content (TPC), antioxidant activity (AA), soluble solids (SS) and process parameters applied to ora-pro-nóbis extract was studied.

Results: The concentrates obtained under 10 minutes of centrifugation showed approximately 20 times more ($P < 0.05$) for SS and AA, than the initial extract. Time and time xRCFinteraction presented significant effect in the AA and TPC on concentrates. In the content of SS, only the centrifugation time had a significant effect ($P < 0.05$). Concentrate yield (Y) as function of SS was not significantly affected by time and rotational speed of centrifugation. The TPC showed a significant effect ($P < 0.05$) between different rotational speed at the same time of centrifugation. The efficient concentration of soluble solids was high in all experimental conditions (> 96%) and the Y increased with the centrifugation time (26.88-86.86).

Conclusion: The present study showed that (CABC) allows obtaining concentrates with a high content of soluble solids. Therefore, the present results can provide important information on the improvement of the CABC process through the recovery of cryoconcentrated extracts from the ice fractions and its incorporation to the feed solutions due to the high quality in nutraceutical properties, bioactive compounds, and antioxidant activity.

P1.1.068

Effect of pulsed electric field and deep eutectic solvent on bioactivity of cocoa residue extract

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Aim:

The aim of this study was to determine the effect of pulsed electric field (PEF) treatment on the solid-liquid extraction (SLE) efficiency of bioactive compounds from cocoa bean shell (CBS) and biological activity of the extract.

Method:

Pulsed electric field was applied using two medias: water and a NaDES. Electric field strength and number of pulses were studied in the range of 1000-3000 V/cm and 100-200 respectively. Solid-liquid extraction of the sample without prior treatment and ultrasound assisted extraction were the control methods used to compare. Folin Ciocalteau and aluminum chloride colorimetric methods were used to determine total polyphenols content (TPC) and total flavonoids content (TFC), respectively. Theobromine, caffeine, catechin and epicatechin were determined by High Performance Liquid Chromatography. Antioxidant activity of the extract was determined by the DPPH and ABTS radical scavenging capacity, and ferric reducing/antioxidant power (FRAP). Antimicrobial activity was performed by disk diffusion method.

Results:

The highest extraction of TPC and TFC was 117.91 mg GAE/g and 16.42 mg TE/g, respectively, and was achieved with an electric field strength of 2000 V/cm and 200 pulses applied to the sample suspended in aqueous medium. The antioxidant capacity of the extract showed a good correlation with the variables TPC (R^2=77%) and TFC (R^2=63%). NaDES used has an antibacterial power similar to that of the antibiotic gentamicin. The extract obtained by the most efficient methodology showed growth inhibition of Staphylococcus aureus, Listeria monocytogenes, Escherichia coli and Salmonella typhimurium bacteria, with halo diameters of 26, 27, 16 and 21 mm, respectively. As expected, growth inhibition of Gram-positives bacteria was higher than inhibition of Gram-negatives ones. The extracts with higher content of polyphenols and flavonoids showed lower antibacterial activity. Therefore, inhibition is related with NaDES properties

Conclusion:

It can be concluded that the combination of PEF treatment and subsequent SLE using NaDES is an efficient methodology to extract bioactive molecules from CBS.

P1.1.069

Global Trends in Consumer Food Safety - Insights from Scientific Literature

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Aim:

The aim of this study was to examine the global trends in consumer food safety through a review of scientific articles. Although food safety has significantly improved in recent years, foodborne diseases remain a global problem. Every year foodborne diseases cause nearly one in 10 people to become ill after consuming contaminated food. Every year according to the World Health Organization hundreds of thousands of people die due to foodborne diseases [1]. According to Foodborne outbreaks - dashboard of the European Food Safety Authority data from 2016 to 2021 have concluded that domestic premises were the primary place of exposure [2]. Restaurants were secondary [2]. This data shows that consumers have an important role in ensuring food safety and signals to food safety experts and other experts that interventions are needed to improve the applied food safety knowledge and thereby enhance consumer food safety culture.

Method:
Searches in Web of Science and Scopus bibliographic databases revealed a number of scientific articles discussing consumer food safety culture. For purposes of this study articles published since 2020 were evaluated. Those that fulfilled the criteria for the study were selected for the final review.

Results:
The food safety culture of consumers has been evaluated in many countries using different methods (questionnaires, interviews, etc.) to examine consumer knowledge, attitudes and practises regarding various key topics such as hygiene, food storage, food preparation and cross contamination.

Conclusion:
Most of the scientific articles included in this study provided an overview of the most problematic actions that can lead to foodborne outbreaks, strongly suggesting that consumers are still quite susceptible to unsafe food handling. Global efforts need to be directed towards development of more effective communication with consumers and activities that will help improve consumer food safety knowledge and consequently food safety culture.

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P1.1.070

Evaluation of the potential of different species of the Roystonea palm genus for the industrialization

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Aim:
The predatory exploitation of some species of native palm trees, in addition to decimating their reserves, caused a drop in trade, mainly with regard to exports.The introduction of the Roystonea palm in this scenario as a viable and profitable crop in agricultural terms, may represent a new alternative for the early production of hearts of palm. However, there are no studies that guide the form of cultivation, as well as the peculiar characteristics of this heart of palm, its industrialization and consumer acceptance. The aim of this research study was to evaluate the potential of different species R. oleracea; R. regia, R.borinqueana, R. altissima for the production of canned hearts of palm.

Method:
In the raw material analyzes were performed of moisture content and acidification curve. The process consisted of harvesting, peeling, cutting, packaging in glass jars (600ml), adding the acidified brine, packaging closure, pasteurized (98ºC/50min.), cooling and storage at room temperature (25ºC). The samples was submitted to analyzes of microbiological, head space, vacuum, net and drained weight, equilibrium pH, objective color and texture instrumentally. For the sensorial evaluation, tests of structured scales with 12 points and 15 trained tasters were performed. The attributes of appearance, slice color, odor and characteristic taste, salty taste and texture were evaluated.

Results:
The results found for the palm heart in natura varied in terms of moisture content between 89.77 and 91.89 g of water per 100g. To lower the initial pH of the raw material to 4,2 - 4.3 was required 0,450g e 0,525g (oleracea), 0,525g e 0,450g (altíssima), 0,525g e 0,60 (régia), 0,675g e 0,525g of citric acid/100g palmito (borinqueana). The canned hearts of palm have shown equilibrium pH values between 4,0 -4,2 under 4.5, 15 - 22inch Hg medium vacuum and head space from 11,5 -16 mm, being inside the security line require for this kind of product, according to the Codex Alimentarius. Commercial sterilization assessment has shown that, for canned heart of palm, no acid-tolerant thermophilus aerobic microorganisms (B.coagulans and Alicyclobacillus), acid-tolerant mesophilic microorganisms (butyric anaerobes and lactic bacteria), molds, or yeasts were found. The average texture values of the stalks indicated differences regarding the softness of the product and are lower than those found for Pupunha heart of palm (Bactris gasipaes). In the sensory evaluation, no significant difference was found between the analyzed attributes and the scores obtained corresponded to the

terms “moderate” and “great” of the scale used, indicating acceptable sensory quality in terms of appearance, color, texture, odor and characteristic taste and texture.

Conclusion:

Heart of palm of the genus Roystonea, of the R. Altissima species; R. Régia; R. Oleracea; R. Borinqueana processed in acidified and pasteurized preserves has acidification and sensory characteristics similar to palm hearts already processed industrially in the state of São Paulo and in different regions of Brazil. These results are promising and justify the continuation of research with the genus Roystonea for the production of canned heart of palm.

P1.1.071

Numerical and experimental analysis of the food freezing and airflow distribution in domestic-scale freeze-dryer

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Aim:
The innovative idea behind the small-scale freeze-dryer presented in this paper is the combination of freezing and freeze-drying processes into a single unit. This integration allows for a compact, cost-effective, and adaptable system. However, the primary issue with batch-type systems lies in uneven air distribution inside the product chamber, resulting in prolonged freezing time and negatively impacting subsequent stages of the freeze-drying process. For this reason, prediction of the freezing and lyophilization processes is crucial for maximizing the efficiency of the drying process.
Method:
The objective of this study was to develop a prototype vacuum chamber for a freeze-dryer unit along with a natural refrigerant based refrigeration system. This study involved the development of a coupled 3-D CFD model to analyse the freezing process and airflow within a freeze-dryer vacuum chamber. The above-mentioned model was validated using experimental data collected from the reference device. Moreover, to reduce the freezing time, the refrigeration system has been improved. The evaporator design was modified to maximise the performance of the ice trap. The propane (R290) has been chosen as a working fluid and all the components were adjusted to this refrigerant.
Results:
The computational results were utilized to modify the internal design of the freeze-dryer chamber, which lead to nearly 50% decrease in the average freezing time. The estimated freezing time for a product placed inside the reference device, showed the maximal difference of 100 min between various shelves. In comparison for the prototype design maximum time difference was equal to 18 min. Additionally, experimental investigation confirmed, that the refined chamber design and propane-based refrigeration system, ensured a more homogeneous air distribution. The total freezing time was reduced from 9 h to 4.5 h and discrepancies in freezing time for samples placed on different shelves were reduced.
Conclusion:
The created CFD model was used to redesign the freeze-dryer chamber. In addition, a new refrigeration system for the prototype chamber was developed and introduced. As a result, the airflow inside the prototype device was improved, resulting in a more sustainable freezing process.
Acknowledgements:
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P1.1.072

Active antimicrobial food packaging using biological potential from Malaysian medicinal plants

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Aim: To develop an active antimicrobial film packaging from zein with the incorporation of the active plant extracts, *Gnetum gnemon*, *Colubrina asiatica*, and *Garcinia atroviridis*, as a greener substitute for plastic packaging for fresh produce and meat products.
Method: To achieve this, plant extracts were obtained from dried plant material via solvent extraction and microwave-assisted extraction (MAE) processes using varying ratios of aqueous ethanol solvent (0–100%). The biological activity of selected plant extracts was evaluated *in vitro* through total phenolic content (TPC), 2-diphenyl-1-picrylhydrazyl (DPPH), ferric reducing antioxidant power (FRAP), and antimicrobial activity assays. These results will be used to incorporate effective plant extracts into zein film packaging via the electrospinning method. Film properties, such as thickness, water vapour permeability (WVP), water solubility, opacity, mechanical properties, and microstructure of film using a scanning electron microscope (SEM) will be evaluated. To ensure the reliability and stability of the packaging, physicochemical analyses will be conducted on the colour, texture, and total bacteria count of the packaged food.
Results: Initial results show that different extraction methods (solvent and MAE) did not influence the recovery of yield from the plant extracts but partly influenced the biological activity for TPC and DPPH. However, varying solvent ratios greatly influenced the yield and biological activities of the plant extracts. The biological activities can be ranked in the following order: *Gnetum gnemon* extract (GGE) > *Colubrina asiatica* extract (CAE) > *Garcinia atroviridis* extract (GATE). The solvent extraction method resulted in the highest activities for GGE (50%) and CAE (0%), whereas the highest activities for GATE were observed when MAE extracts were used at a solvent ratio of 100%. Using these results in combination with data

obtained through the antimicrobial analysis, the plant extract with the highest activity will be selected for incorporation into the zein film packaging.
Conclusion: At the end of this study, a novel and sustainable packing material that can reduce the growth of pathogenic and food spoilage microorganisms, extending the shelf-life of fresh meat and vegetables by combining the antimicrobial activity of plant extracts with zein film packaging, is expected to be developed.

P1.1.073

Exploring emotional responses resulting from haptic animalistic stimuli in a live meat-eating experience

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Aim
This paper aims to contribute to the growing body of knowledge on the role of emotions in a meat-eating experience, to offer a broader view on the emotions evoked in participants when the animal-meat link is made salient with the help of haptic animalistic stimuli. We anticipate that the learnings of this study could contribute towards more sustainable food experiences.
Method
This study uses a qualitative approach to gain a deeper understanding of the animal-meat link salience and resulting emotional responses elicited by haptic animalistic stimuli. Participants are seated on fur-covered chairs within a dining setting and are served a small portion of wild boar stew which they consume with fur-covered cutlery. Immediately after they have finished their meat-eating experience, a semi-structured interview is conducted using questions relating to their emotional responses and level of enjoyment during the experience while being presented with haptic stimuli. The transcribed data is processed in LIWC-22 semantic text analysis program, which measures the emotional tone based on textual data. Emerging concepts are clustered and merged into categories representing emotional responses.
Results
We anticipate several contributions resulting from our study. First, we are conducting a live study, where participants consume actual meat while animal-meat salience is triggered, whereas most studies within the body of literature surrounding this topic are online.
Second, we offer insights into the effect of animalistic haptic stimuli, in contrast to prior studies that were based on verbal or visual cues as stimuli.
Third, as we are adopting a qualitative approach, our study establishes a deeper understanding of the emotions surrounding a complex and ambiguous topic. By exploring the entire spectrum of emotions, rather than focusing on key negative emotion categories presented in earlier quantitative studies, we uncover how animalistic haptic stimuli could possibly enhance or diminish a meat-eating experience.
Conclusion
Despite previous literature leaving little room for the possibility of positive emotions evoked when the animal-meat connection is made clear, historical and industry data suggest otherwise. Our study sheds light on the full range of emotions elicited as a result of animal-meat link salience beyond disgust, guilt and empathy.

P1.1.074

Data-driven supply chain optimization for the upcycling of food by-products

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Aim: Supply chain optimization for food by-products
In the upcycling of by-products to extract residual valuable components, supply chain design and partner selection are key aspects to scale up operations from laboratories to industrial scale. The transport and processing of food by-products from the manufacture generating by-products to the distribution of the extracted components, and along a network of various stakeholders, must be efficient and timely, especially for non-dry products. A main question is thus to determine to which extent a company aiming to valorize by-products should rely on subcontractors vs integrate its activity along the supply chain. We focus here on the example of brewer's spent grain process, where the product goes through the collecting, pressing, drying and grinding steps before delivery.
Method: Mathematical algorithms based on linear programming
We propose a mathematical framework based on operation research tools and including several heuristics to study the feasibility of various networks. Linear programming techniques allow to determine the maximal quantity to process with minimal costs. Multiple objectives can be pursued, such as cost optimization, but also time or ecological impact objectives. Heuristics allow to control the timing issues.
Results: Comparison of business models and sensitivity analysis
Numerical results show the feasibility of several business models and supply chains, including (or not) subcontractors, initial investments, or partners exclusivity. A sensitivity analysis allows to discuss the relevance of working with various stakeholders, depending on the desired volume of production. The question of vertical integration of the supply chain is discussed. A large range of production regimes is considered.
Conclusion: Data-driven decision making
We show in this work that data-based models can be valuable tools to help the managers' decision-making. The choice of a business model (typically subcontract vs integrate the activities) can be quantified and linked to business variables. Obtaining an efficient model is particularly important when considering by-products and aiming at upcycling and reducing time-to-market.

P1.1.075

ASSESSMENT OF TECHNO-FUNCTIONAL PROPERTIES AND POLYPHENOLIC PROFILE OF DATE SEED FLOUR WITH DIFFERENT PARTICLE SIZE

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ASSESSMENT OF TECHNO-FUNCTIONAL PROPERTIES AND POLYPHENOLIC PROFILE OF DATE SEED FLOUR WITH DIFFERENT PARTICLE SIZE
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Aim: The objective of this work was to analyse the effects of different particle sizes on the techno-functional and polyphenolic profile of flours obtained from date seeds *var.* medjool, a coproduct of date fruit industrialization.
Method: To obtain the flours, the date seeds were dried during 48 h at 55 ºC. Then, they were grounded into powder by a knife mill during 5 mins. After that, the samples obtained were passed through the different meshes. Then, the date seeds powder obtained was separated in two sizes: HDSF (0.417 > Ø > 0.210 mm) and LDSF (Ø < 0.210 mm). For techno-functional properties the water and oil holding capacities (WHC and OHC, respectively) as well as swelling capacity (SWC) were determined. The polyphenolic profile was determined by High Performance Liquid Chromatography
Results: As regards to the technofunctional properties, particle size reduction had a significant effect ($p<0.05$) on WHC, OHC and SWC of date seeds flours. The values obtained for WHC and OHC decreased significantly ($p < 0.05$) when the particle size of date seeds was reduced with values of 2.55 and y 2.18 g water/g flour for HDSF and LDSF, respectively for WHC. Whilst for OHC the values obtained were1.65 and 1.40 g oil/g flour for HDSF and LDSF, respectively. On the other hand, the SWC increased when the particle size decreases with values of 23.15 and 25.12 mL/g flour for HDSF and LDSF, respectively. In reference to polyphenolic profile, for all compounds identified, the highest amount corresponded to those of smaller particle size; in other words, an increase in the extraction rate of polyphenolic compounds was obtained with the decrease of particle size. In all samples analysed six compounds were identified, which were classified as flavan-3-ols (catechin, and epicatechin); flavone (luteolin-7-*O*-glucoside); flavanone (eriocitrin) and flavonols (rutin and isoquercitrin) being catechin and epicatechin in highest concentration.

Conclusion: Date seeds flour is a valuable coproduct from the date industry with a high potential for the food industry not only due to its techno-functional properties but also to its bioactive compounds content

P1.1.076

Novel biotechnological approaches to grow Medicinal Mushrooms on maize residues and their application in breadstick

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Aim:
The increasing attention towards innovatives food processing, aimed at valorizing agro-food residues and improving the nutritional quality of foods, is the driver of the study. Medicinal mushrooms (MMs) are gaining attention for their interesting content of bioactive compounds whose biological activities are relevant for human health.
The research aims at developing a high value-added ingredient with interesting nutritional properties, obtained by growing MMs on maize residues. Investigation focused on the analysis of MMs growth in solid state fermentations (SSFs) and how bioactives are maintained up to the production of the functional ingredient (FI) and the final gluten-free breadstick.

Method:
Cobs from four maize landraces cultivated in Northern Italy and the reference B73 inbred line were used to set up Solid State Fermentations systems (SSFs) for the growth of two MMs strains: *Pleurotus ostreatus* ATCC96997 *and Ganoderma annularis* DSMZ9943. Fungal growth was measured by image analysis techniques. Proximate composition and bioactive compounds of FI were determined after sample stabilization and powdering. Breadsticks with FI (obtained using *Ganoderma* on either Rostrato Rosso di Rovetta and B73) and without were produced and characterized from a tecnological and nutritional point of view.

Results:
Pleurotus and *Ganoderma* were able to grow on all corncobs but the type of cobs affected the Mycelial Growth Rate (0.57-10.4% MGR week^{-1}). The image analysis technique proved appropriate to monitor the surface mycelial growth in SSFs. The cob-MM matrix showed high protein and low free sugar contents; the presence of β-glucans was also detected.
The addition of FI resulted in well-structured breadsticks, characterized by lower total starch, higher protein, fiber and phenolic contents, as well as higher antioxidant capacity than reference breadsticks. Product with the cobs can boast the Nutritional Claims "high in fibre" (9 g/100g of fibre).

Conclusion:
These study is of practical importance for the recovery of a lignocellulosic by-products that can be successfully utilized by MMs to grow. Results proved that FI could be used to develop healthier food with interesting technological and nutritional features.

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P1.1.077

Ultrasound and PEF-assisted extraction of diamine oxidase (DAO) enzyme from Peas

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Aim:

Histamine is a biogenic amine found in many foods being its intolerance a disorder caused by an imbalance between ingested histamine and the body capacity for its degradation. Thus, dietary histamine can be quickly degraded by amine oxidases, such as diamine oxidase (DAO. However, there is significant percentage of population that have a low-level capacity of its production or activity. In these cases, a low-histamine diet and oral DAO supplementation are the main alternatives proposed. The sources of DAO used are porcine kidneys, the most extended, and certain legume sprouts, being this last option the most sustainable. However, the extraction process is key to not only regarding the yield but also the DAO activity. The aim of this work was to assess the application of ultrasound and pulsed electric field in the extraction of DAO from pea sprouts.

Method:

Pea sprouts (6 days of germination) were freeze-dried, ground and vacuum packed until processed. Extraction experiments were carried out using water as solvent at different temperature (4, 10, 20 and 37°C) and time (10, 20, 30 and 40 min) with (300 W; 50 kHz) and without ultrasound application and PEF pretreatment (1.2 kV/cm and 20, 50 and 100 pulses). For each condition, DAO activity was measured by colorimetric DA-67 enzyme assay per triplicate using histamine (1mM) as the substrate.

Results:

As expected, temperature affected the extraction of DAO from pea sprouts. Thus, in the range of temperature tested, the greater activity of DAO was observed at 37 ºC after 20 min of extraction. Ultrasound application enhanced the extraction. Due to the low level of power applied, ultrasonic effect was probably linked to the microagitation at interfaces induced by the mechanical waves. The application of PEF as pretreatment also affected the extraction being treatments with 20, 50 pulses were more effective than with 100 pulses.

Conclusion:

In this work, different extraction methods to obtain DAO from pea sprouts were examined. The application of ultrasound and PEF significantly intensified the extraction. Both of them could be interesting alternatives to enhance the process.

P1.1.078

Influence of high-pressure processing on the quality and sensory attributes of pre-packaged melon during refrigeration

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Aim:
Fresh-cut food products have become more popular in recent years because of their high nutritional and sensorial properties. However, native microorganisms and oxidative enzymes cause fast spoilage and nutritional compound degradation during storage. To extend the shelf life, high-pressure carbon dioxide combined with a modified atmosphere package was used.

Method:
1.5 cm melon cubes (8 cubes) were packed with plastic film in an air (MAP-air) or a carbon dioxide (MAP-CO_2) environment. In addition, some parts of MAP-CO_2 samples were treated with a high-pressure system at 60 bar and 45℃ for 40 min (HPMAP-CO_2). All packaged samples were stored at 4 ℃ for 21 days. The polyphenol oxidase (PPO), peroxidase (POD), total phenolic contents (TPC), antioxidant capacity, carotenoids, sugar profile, and sensory quality of fresh-cut melon were investigated.

Results:
The PPO and POD activity of samples treated with HPMAP-CO_2 decreased by 31 % and 36 %, respectively, compared to the MAP-air. The PPO and POD activity of the HPMAP-CO_2-treated samples was lower than MAP-air and MAP-CO_2-treated samples during storage.
The TPC and antioxidant capacity (ABTS and DPPH) of the HPMAP-CO_2-treated melon cubes increased slightly after high-pressure treatment. Compared to the treated samples at 0 days of storage, the TPC, ABTS and DPPH of the HPMAP-CO_2-treated samples at 21 days of storage were insignificantly changed, while the TPC, ABTS and DPPH of MAP-CO_2-treated samples at 21 days of storage decreased significantly. Insignificant changes were noted in the carotenoids and total sugar contents detected in melon cubes after HPMAP-CO_2 processing. Furthermore, the color and smell of the samples treated by HPMAP-CO_2 were more intensive than MAP-air and MAP-CO_2 treated samples.

Conclusion:
HPMAP-CO_2 processing effectively inhibited the changes in the enzyme activity of melon samples during storage. Furthermore, the HPMAP-CO_2 processing allows for better retention of bioactive compounds during storage in comparison to MAP-CO_2.

The project entitled "Innovative high-pressure process to increase the preservation of "ready to eat" organic food, acronym HO-FOOD, selected under ERA-NET SUSFOOD2 and CORE Organic Cofunds Joint Call 2019: "Towards sustainable and organic food systems" financed by the National Center for Research and Development, contract no. SF-CO / HO-FOOD / 4/2021.

P1.1.079

The effect of sorghum flour on bread staling: from the macroscopic to the molecular properties

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Aim:
Sorghum is a cereal of a great interest due to its climate resilience and valuable nutritional profile (high content of bioactive compounds). The inclusion of sorghum flour in staple foods such as bread is a strategy to improve breads nutritional value but, at the same time, a technological challenge. Bread staling phenomenon evaluation is an important task to assess the overall quality of sorghum-composite breads. To date, the literature on this topic is scarce. Therefore, the aim of this work was to study the effect of sorghum flour on staling phenomenon in composite bread.

Method:
Conventional wheat bread (STD) and breads in which 10 (S10), 20 (S20) and 30% (S30) of wheat flour was substituted with sorghum flour were studied over storage, at 0 and after 2, 5 and 7 days. Bread staling was studied considering macroscopic (specific volume, texture, moisture content and water activity), mesoscopic (frozen water content and retrograded amylopectin) and molecular (^{1}H NMR molecular mobility) properties.

Results:
An increase of hardness and a reduction of specific volume, cohesiveness and springiness were found in S-breads. Moreover, both a higher frozen water content and ^{1}H T_2 mobility (for the population at highest mobility), and a lower ^{1}H FID mobility (for the population at lowest mobility, related to rigid starch domain) were found in S-breads. The presence of the biopolymers such as kafirin proteins, fiber, and poorly accessible starch, may have weakened the solids-water interactions in fresh S-products. These changes were evident during all storage time. Generally, S10 bread was the sample behaving more similarly to STD.

Conclusion:
Sorghum flour biopolymers weakened the water-gluten and water-starch interactions at molecular and mesoscopic level in composite breads if compared with the control. These weaker water-solids interactions were related to higher hardness of composite breads than that measured in the control. 10% sorghum flour inclusion appeared the proper level to limit physico-chemical changes during storage, if compared with those measured in the control. Alternative strategies could be applied to improve sorghum bread quality and stability during storage, such as fermentation with proteolytic and EPS-producing LAB strains.

P1.1.080

Vacuum freezing of food products in a transport container utilising cold thermal energy storage system

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Aim:
Safe food transportation and sustainability strongly depend on freezing technology which is an essential stage of the cold chain. Vacuum freezing is an alternative method of rapid food freezing, in which the water content of food products is evaporated by decreasing pressure in the food chamber up to a near vacuum. Due to latent heat of evaporation and sublimation, energy is released from the food product resulting in its temperature reduction. In addition, this method's energy and exergy efficiency is considerably higher than popular freezing methods. For this reason, the main objective of this study is to investigate the fundamental processes that occur during the vacuum freezing of food products in a small-scale food transport container equipped with a cold thermal energy storage system in the form of phase change material.

Method:
A 3-D numerical model of vacuum freezing was established and validated with experimental data. The model has been formulated using an enthalpy-based energy equation to simulate the food product's temperature profile and evaporation rate. In the model, heat and mass transfer processes were analysed for various food products as well as pressure-driven evaporation and sublimation and phase change interface dynamics. The experimental investigation was conducted in a phase change material-aided vacuum chamber. The measured temperature profile and evaporation rate were compared with simulated values to validate the model.

Results:
Temperature profiles and evaporation rates obtained from preliminary experiments show good agreement with results from a 3-D numerical model.

Conclusion:
In this study, the vacuum freezing process inside a novel transport container integrated with the cold thermal energy storage system based on phase change material was investigated. The findings will result in a better understanding of the vacuum freezing process dynamics for various food products. That will contribute to a design strategy for new vacuum freezing systems combined with a proposed transport container in new state-of-art cold chains. The detailed numerical and experimental results will be presented during the 37th EFFoST International Conference 2023 in Valencia.

P1.1.081

Effects of nano-foamed structure film packaging and supercooled storage for the quality maintenance of kimchi

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Aim:
Commercial kimchi products are characterized by a limited refrigerated shelf life of approximately 30 days, rendering it crucial to prevent over-ripening during storage and distribution. This study attempted to develop a hurdle strategy using a different nano-foamed structure (NFS) film packaging and supercooled storage conditions to maintain the quality of Korean cabbage kimchi (KCK).

Method:
The effects of NFS film packaging and supercooled storage temperatures on the quality parameters of KCK were monitored while discerning the gas composition of the packaging headspace. Total lactic acid bacteria (TLAB) count, pH, titratable acidity (TA), and reducing sugar content (RSC) were selected as the main quality parameters of KCK. KCK samples were packaged in polyethylene terephthalate/aluminum foil/low-density polyethylene lamination (PAL, as the control), and two different NFS films with different O_2 permeability (NFS-1 and NFS-2, as treatments), and stored at refrigerated (4 and 10 °C) or supercooled (−3 °C) conditions for 36 days.

Results:
The TLAB counts in both the control and the NFS treatment groups remained below 5.8 log CFU/g during supercooled storage at −3 °C over 36 days without reaching the over-ripened fermentation stage. A pH of 5.3–5.8 was maintained in both the control and the NFS treatment groups under supercooled storage conditions for up to 36 days. The TA values of both the control and NFS treatment groups increased over time under refrigeration conditions, while no significant ($p > 0.05$) increase in TA was observed in the control or the NFS treatment groups following supercooled storage. Additionally, the RSCs of the KCK samples were 43.3 and 39.2–45.5 mg/g before and during storage, respectively, at −3 °C, with no significant differences among samples packaged in different film types. The headspace CO_2 concentrations of the NFS film packaging containing KCK were below 6.0 % under both supercooled and refrigerated storage conditions.

Conclusion:
NFS packaging combined with supercooled storage at −3 °C can effectively prevent over-ripening and package distension associated with CO_2 production during long-term kimchi storage without requiring CO_2 absorbent sachets or degassing valves.

P1.1.082

Water (re)use in the food industry: technology and monitoring for pesticides removal

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Aim:
The increasing water stress emphasize the need for smarter water reuse in the vegetable- and potato industry. The presence of pesticides (plant protection products - PPPs) in (re)used process water or reused secondary treated wastewater can cause cross contaminations and may be in conflict with the European drinking water directive (2020/2184/EC). As a reliable solution, an ozone-based tertiary treatment, whether or not combined with active carbon, is put forward. Allthough proven its worth by removing similar components in municipal water, there are still a lot of unknowns (i.e. water matrix effects, monitoring possibilities) before a successful application can be guaranteed.

Method:

Grab samples of secondary effluent were taken at Belgian companies and physicochemically characterised for quality parameters (e.g. COD, pH, UV-VIS, etc.) according to standard methods. Pesticides were determined by a validatied LC-MS/MS analysis. Activated carbon and ozonation were performed in (semi-)batch mode for a wide range of doses.

Results:

For both the vegetable as the potato processing industry, a total of 12 PPPs from 111 screened PPPs, were found above 0.1 µg L^{-1}, in violation with the directive (2020/2184/EC). Boscalid, terbuthylazine, tebuconazole, and azoxystrobin were consistently present with a 91.6% , 75.0%, 58.3%, and 58.3% respective presence in all samples. The results of the physicochemical characterization (n= 30) showed a higher prevalence of organic and anorganic components for the vegetable processing industry, indicating towards a more ozone recalcitrant water matrix than for the potato processing industry. Consequently, even economical infeasible ozone doses (100 mg O_3 L^{-1}) were not able to sufficiently reduce PPPs. Combination techniques of ozone and activated carbon (30 mg O_3 L^{-1} + 0.01 mg AC L^{-1}) were able te reduce all the PPPs below the European drinking water level apart from terbuthylazine. In addition, using spectroscopical techniques, the removal of pesticides could be correlated with online measurable parameters in view of monitoring purposes.

Conclusion:

The combination of ozone with active carbon provides a solution for most pesticides. Specific pesticides as e.g. terbuthylazine require a source-based approach to limit its use and presence. Also, after ozonation, a mixture of PPPs metabolites remain present for which human- and ecotoxicological consequences are not sufficiently known. This requires further research to understand the human (i.e. reuse) and ecotoxicological (i.e. discharge) risks.

P1.1.083

Revalorization of a winery by-product in fermented sausages: A strategy towards food safety and sustainability

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Aim:

In dry-fermented sausages, food safety can be compromised by the occurrence of food-borne pathogens as well as by the accumulation of biogenic amines, bioactive compounds of bacterial origin. Cava lees consist of inactive cells of *Saccharomyces cerevisiae*, and though regarded as a valueless winery by-product, they are rich in fiber and phenolic compounds. The aim of the current study was to assess the effect of cava lees on the behaviour of technological microbiota and the foodborne pathogens *Salmonella* spp. and *Listeria monocytogenes* during the fermentation and ripening of pork sausages using a challenge test. Moreover, it was investigated whether the use of cava lees can help to control biogenic amine formation in this fermented product.

Method:

Ten batches of fermented sausages were prepared with and without cava lees, and with or without different stater culture consisting of *Latilactobacillus sakei* (strain CTC494 or BAP110). Meat batter was inoculated with a mixture of three *L. monocytogenes* and three *Salmonella* strains at a level of ca. 6 log_{10} CFU/g. All batches were submitted to a process of fermentation (2 days at 23°C) and drying (19 days at 15°C). Along the process, the pH and a_w were monitored; lactic acid bacteria and pathogens were enumerated on MRS and selective chromogenic agar. The biogenic amine content was analyzed by UHPLC-FL.

Results:

The addition of cava lees reduced the pH values of the meat batter, and remained below the control sausages throughout the fermentation and ripening process. No effect on spontaneous lactic acid bacteria or the starter culture was observed. In contrast, the presence of cava lees prevented the growth of the tested pathogens, as did the starter culture, resulting in significantly lower counts compared to the control batch ($p<0.05$). Noteworthy, the combination of cava lees with *L. sakei* CTC494 had a bactericidal effect on *Salmonella*. Moreover, the addition of lees in fermented sausages significantly reduced the formation of cadaverine and putrescine by 62 and 78%, respectively ($p<0.05$).

Conclusion:

The revalorisation of cava lees as a natural ingredient to improve the microbiological safety of fermented sausages is a potential strategy that would promote circular economy.

P1.1.084

In vitro digestion of protein/polysaccharide gel structures

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Aim:
For the correct administration of bioactive compounds, it's necessary to protect them through complexes that protect their characteristic properties. Encapsulation techniques for bioactive compounds have been developed using complexes from different sources, for example dripping technology, being able to control aspects of size and dispersion. However, this work by itself is not enough for the supply of nutraceuticals, therefore, the objective of the study is to evaluate in vitro gastro – intestinal digestion of plant-based protein/polysaccharide complexes.

Method:
Mixtures of alginate-PPI were dropped in 200 mM CaCl2 at pH 7 for bead preparation. Apparent z-potential was measured in the mixtures and macro- and microstructure was evaluated. Encapsulation efficiency was estimated using BCA assay kit. Static in vitro GI digestion was performed and then protein release and structures assessed.

Results:
Confocal laser scanning microscopy (CLSM) allowed to see the protein incorporation into alginate beads. Firstly, apparent z potential showed PPI would be retained by the beads at gastric environment due to electrostatic attraction, but released at intestinal enviroment due to electrostatic repulsion. Subsequently, encapsulation efficiency for the beads from different mixtures resulted in 40-79%. Highest encapsulation efficiency was reached at the lowest protein concentration in the mixtures. During GI digestion, PPI release during gastric digestion was delayed by keeping up to 75% of the total protein in the beads unreleased. However, higher rates of protein release occured during intestinal digestion at higher alginate concentrations.

Conclusion:
PPI enables the production of high-protein gel beads using alginate as the structuring polysaccharide. Modulation of protein release by alginate gel beads with PPI represents a crucial opportunity for new food applications using plant protein sources.

P1.1.085

Addition of maltodextrin to improve the powder quality of spray-dried oat drink

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Aim:
The final objective is to produce a powdered oat drink that exhibits good physical characteristics and remains stable during storage, using the pulse combustion spray drying technology.
Pulse combustion drying (PCD) is an emerging technology with the potential for better productivity compared to the traditional drying method (spray drying). A preliminary screening was performed using oat and spray drying to improve the powder quality with the addition of maltodextrin. The subsequent step of this research will be to apply the known conditions to PCD and verify its feasibility.

Method:
Oat Drink Control (*ODC*): an enzymatic treatment with *Biobeta P 100* and *Bialfa CA* (Cygyc Biocon S.L.) was applied to the water-oat flour mixture, followed by the drink filtration with a decanter centrifuge (Lemitec MD 80) to achieve a final total solids concentration of ~27.5%. *Oat Drink Maltodextrin* (*ODM*): the same previous treatments, with the addition of maltodextrin after filtration to reach a final total solids concentration of 35%.
Atomization was performed in a GEA Niro MOBILE MINOR™ equipment, operating at inlet and outlet temperatures around 180 and 80 °C, respectively. The moisture content of spray-dried oat drinks was determined gravimetrically using an oven at 102 °C, and their flow properties were examined. The color was measured using a Chromameter CR-410 Konica Minolta. Finally, powder solubility was found by blending it with water, followed by centrifugation and weighing of the dried supernatant.

Results:
The powder water content was 3.62% in *ODC* and 4.89% in *ODM*. Both samples showed similar color characteristics (L* around 85, indicating high lightness; a* and b* around -0.17 and 13.8, respectively, denoting a slight tendency towards greenish and yellowish). *ODC* presented solubility of 74.4%, and *ODM,* 81.8%. Also, it was observed a mild trend to better flow traits in *ODM*.
Conclusion:
The addition of maltodextrin as a carrier increased the moisture of the final product, leading it to a value close to the acceptable limit (about 5%). On the other hand, powder drink solubility was enhanced by its use, suggesting that we can exploit these findings in the pulse combustion dryer with few adjustments on drying parameters.

P1.1.086

Protective cultures based on indigenous microbiota as innovative technology to improve safety of fresh-cut produce

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Aim: There is increasing attention to *L. monocytogenes* contamination on ready-to-eat fresh-cut produce. The lack of chemical or physical control strategies leads to an increasing interest for biological alternatives such as protective cultures. It is hypothesized that competitive interbacterial interactions on (cut-) surfaces of vegetables may decrease the potential for persistence and proliferation of foodborne pathogens. The objective of this study was to investigate the potential growth-suppressing effect of the indigenous microbiota of Romaine lettuce on *L. monocytogenes*.
Method: Fifty high-abundant bacterial isolates obtained from 7-days stored Equilibrium Modified Atmosphere Packaged (3% O_2, 10% CO_2) fresh-cut Romaine lettuce at 7°C were tested for their interaction with *L. monocytogenes*. All isolates were individually co-inoculated with a cocktail of three *L. monocytogenes* strains on the surface of a lettuce-juice agar (LJA), in a co-inoculum ratio of 6:2 log CFU/plate. LJA-plates were incubated at 7°C in a modified atmosphere incubation system (3% O_2, 10% CO_2). Concentrations of isolates and *L. monocytogenes* were determined via plate counts on day 0, 4 and 7, both in mono- and coculture.
Results: A growth potential of approximately 3 log CFU/plate was observed for the *L. monocytogenes* monoculture on LJA during the 7-day incubation period under modified atmosphere. The effect of the bacterial isolates on *L. monocytogenes* ranged from no growth suppression (less than 0.5 log CFU/plate decrease in growth potential compared to monoculture) to almost complete inhibition (more than 2.5 log CFU/plate decrease in growth potential compared to monoculture). Growth of the test strains to high concentrations (up to 9 log CFU/plate) was necessary to exert these competitive effects. These results are in line with the Jameson effect, i.e. non-specific growth suppression by a dominant strain when reaching the stationary growth phase.
Conclusion: The growth-suppressing isolates may have the potential to be included in a protective community, functioning as an innovative preventive food safety intervention for fresh-cut produce. By strengthening the indigenous microbiota and as such increasing the competitive interbacterial interactions, such a protective culture may decrease the potential for proliferation of *L. monocytogenes* on fresh-cut produce and thus increase the safety of this product.

P1.1.087

Gelling capacity and potential use in meat substitutes of pressure-triggered cell-disrupted Chlorella vulgaris

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Aim:
Microalgae attract increasing interest in enhancing the nutritional values of plant-based foods. However, alterations in the final product's colour by green algae and mushy texture can be induced. In this study, we incorporated yellow *Chlorella vulgaris* (Cv) in pea protein-based meat substitutes and aimed to minimize properties alteration by using wet and disrupted Cv biomass.

Method:
The cell wall disruption was done by high-pressure homogenization (HPH) at 150 MPa and initial biomass temperature below 10 °C. Rheology and imaging were performed on 14 % (w/w) Cv suspensions and 9:1 (w/w) pea protein isolate (PPI) – Cv gels.

Results:
HPH treatment significantly increased gelation capacity. The effect was confirmed with (i) a 10x increase in the apparent viscosity of Cv suspensions and (ii) a 2x increase in the elastic modulus (G') of PPI - Cv gels. Furthermore, the HPH-treated Cv was successfully incorporated (10 % (w/w)) in PPI-based meat substitutes produced with high-moisture extrusion cooking. The Cv addition did not alter the visual appearance and hardness of the extrudates. Finally, spray drying or further fractionation of Cv did not improve protein gels, or meat substitutes produced thereof.

Conclusion:
The study demonstrated that disrupted Cv is a promising nutritious and sustainable ingredient for meat substitutes.

P1.1.088

Encapsulation of Mediterranean Essential Oils for food applications, using three encapsulation techniques

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Aim:
The use of natural bioactive agents in modern nutrition, consist a very promising approach towards the replacement of synthetic food additives, such as artificial preservatives. In order to incorporate such sensitive compounds into food matrices, while protecting them from environmental conditions, extending their shelf life, and reserving their health-promoting properties, encapsulation processing was investigated. The present research, focuses on the development of micro/nano-structures including natural bioactive compounds from medicinal plants and herbs, suitable for food applications. In particular, a blend of oregano, rosemary, chamomile and hypericum essential oils (EOB), was studied and further encapsulated in a protein based matrice, through innovative and conventional techniques.

Method:
Three different methods were employed for the encapsulation of EOB, namely electrohydrodynamic processing, spray drying, and freeze drying, in the aqueous biopolymeric matrice of whey protein isolate (WPI) and pullulan (PUL). Electrospinning was perfomed coaxially using a blend of WPI at a weight ratio of WPI:PUL 30:70. For the rest techniques investigated, an emulsion of EOB and the matrice (WPI:PUL, 80:20 w/w) was primarily prepared, and then subjected into encapsulation, by spray drying and freeze drying accordingly. All techniques composed microstructures of different morphology, bioefficacy, and controlled release. Bioactivity was evaluated by the total phenolic content (TPC) of the samples, determined by the Folin–Ciocalteu method.

Results:
A full morphological and structural characterization was carried out. The formulated structures were observed using scanning electron microscopy (SEM). Thermal, and payload release analysis were performed. Simple mathematical models were developed in order to correlate the structures characteristics, with the encapsulation process applied. Encapsulation efficiency was calculated and a storage stability study was executed. Comparative results showed that the electrospun encapsulated agents, succeeded more gradient release rates, and a higher encapsulation efficiency than the spray and freeze dried microparticles. However, the spray dried microstructures presented the more satisfactory results overall, in terms of bioactivity, morphology and shelf life.

Conclusion:
The present study, demonstrates the feasibility of developing bioactive microparticles containing the essential oil blend (EOB) studied, by three encapsulation techniques. The aforementioned results, contribute to the scientific effort towards a more sustainable nutrition, free of synthetic residues.

P1.1.089

Sustainable alternative to synthetic antioxidants in fried snacks for shelf-life extension using Rosemary extract

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Aim:
Evaluation of a natural alternative to synthetic additives for the reduction of rancid off-note development and shelf-life extension of deep-fried savoury snacks.

Method:
For this purpose, we have used commercial potato-based pellets that were deep-fried in regular sunflower oil containing polydimethylsiloxane (PDMS) at 5 ppm or two types of rosemary extracts (RE1

& RE2) at 50 ppm of carnosic acid and carnosol, and without any antioxidant as control. Each frying session (PDMS, RE1, RE2, without antioxidant) consisted in a series of 25 batches with fresh oil replenishing after each batch in a 7L fryer at 200°C. All frying sessions were carried in triplicates. Deep-fried snacks were then stored in sealed aluminum bags for 12 months at room temperature. Fried pellets oxidative stability was evaluated by induction time measurement (Rancimat®). In parallel, sensory analysis (quantitative descriptive analysis with at least 12 expert panelists) was carried on the fried pellets during storage.

Results:

On freshly deep-fried pellets, all samples (without antioxidant, RE1, RE2 and PDMS) were rated as similar by an expert panel on the rancid attribute. After 4 months of storage, sensory analysis showed a significant decrease of the rancid attribute with samples containing rosemary extract, RE1 and RE2 compared to samples fried without antioxidant or with PDMS. After 12 months of storage, samples that have been deep-fried in the presence of RE2 were similar on the rancid attribute to freshly made samples. Those results were supported by Rancimat® analysis: snacks that have been deep-fried in an oil containing either RE show a greater induction time than samples with PDMS or control.

Conclusion:

The addition of rosemary extract to frying oil decreases the development of rancid off-notes in deep-fried snacks by increasing their stability towards oxidation. This suggests that RE active molecules, carnosic acid and carnosol, have been absorbed by the pellets during frying and still perform their antioxidant properties in the finished product during storage. This property could be used to extend the shelf-life of deep-fried snacks by maintaining their organoleptic properties. Moreover, it could support the use of a more sustainable packaging thanks to this higher oxidative stability.

P1.1.090

Shelf life extension of ready-to-eat meals based on combined nonthermal processing of tomatoes and spinach

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Aim:

Nutritional quality and shelf life extension of fresh fruits and vegetables based ready to eat products is of commercial interest. In this study, we investigated the application of two nonthermal technologies, High Pressure Processing (HPP) and Pulsed Electric Fields (PEF), to facilitate osmotic dehydration of cherry tomatoes and spinach. Subsequently, the dehydrated vegetables were incorporated into ready-to-eat salad meals, and their shelf life was evaluated.

Method:

Fresh-cut cherry tomatoes and spinach were subjected to HPP, PEF and OD treatments, and the effects of different processing parameters (treatment time, pressure, field strength, OD formulation) were investigated. Water loss, solid gain, and changes in texture and color were assessed to determine the optimal conditions for achieving efficient dehydration while preserving the desired product attributes. The OD dehydrated cherry tomatoes and spinach were further incorporated into ready-to-eat salad type products. These were formulated to provide a nutritious meal option with extended shelf life, while also incorporating other dehydrated raw materials such as nuts and feta cheese. All product samples were stored under isothermal conditions, and key quality parameters such as microbial growth, texture, color, and sensory attributes were monitored.

Results:

Nonthermal processing was able to significantly improve the outcomes of osmotic dehydration by improving mass transfer. OD times were shortened up to 1 h, while achieving the same parameters as untreated samples. For both vegetables, the reduced water activity (below 0.9) led to chilled storage shelf life exceeding 20 days, compared to untreated vegetable samples which perished within a few days. Under chilled conditions samples were practically microbially stable during their shelf life, which was determined by sensory evaluation and was likely limited by enzymatic reactions.

Conclusion:

This study provides insights into the application of HPP and PEF nonthermal processes and osmotic dehydration and subsequent utilization of treated vegetables in ready-to-eat salads.

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P1.1.091

Energy assessment of ultrasound assisted extraction from dry tomato peel

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Aim:
Tomatoes are the most often grown and consumed vegetables worldwide. During its processing, a significant amount of by-products are created, which are commonly called tomato pomace and represent an exceptional problem for the industry due to insufficiently efficient ways of waste management. According to the current hierarchy of waste management, the most desirable option is to prevent the generation of waste due to its more favorable impact on the environment, but it is also considered the most challenging option due to economic and technological limitations.

Method:
In order to utilize by-products from tomato processing, in this work, the influence of non-thermal ultrasound treatment and conventional thermal treatment (60 °C) on total phenolic content (TPC) from dry tomato peel was investigated. The energy consumption of ultrasonic extractions was expressed as the power used to perform the extractions. Furthermore, the stability of phenolic compounds during storage time (7 days at + 4°C) was monitored. The ultrasonic extraction conditions were the proportion of ethanol (0, 25, and 50%), treatment time (3, 6, and 9 min), and amplitude (50, 75, and 100%), and for conventional thermal extractions were the proportion of ethanol (0, 25, and 50%) and treatment time (3,6, and 9 min).

Results:
As expected, higher TPC was recorded in ultrasonically treated samples. In particular, the highest TPC (4.9220 ± 0.56 mg/$g_{d.m.}$) was recorded at 100% amplitude, 9 min treatment time and water as the extraction solvent (0% ethanol). During storage, a drop in the concentration of TPC was observed in most samples, as a consequence of the degradation of the structures of phenolic compounds.The highest power consumption of ultrasonically treated samples (59.2175 ± 0.41 W) was recorded at 100% amplitude, 9 min treatment time and 25% ethanol solution as the extraction solvent.

Conclusion:
In accordance with all of the above, extraction assisted by ultrasound is imposed as a very good alternative method of extracting phenolic compounds from the by-products of tomato processing with more acceptable consumption of power, i.e. energy.

P1.1.092

Refining of pea protein and rapeseed using Natural Deep Eutectic Solvents

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Aim

The objective of this study was to extract off-taste and off-flavor components of plant proteins using a novel class of food grade solvents, Natural Deep Eutectic Solvents (NADES) for plant protein refining. This study was conducted to explore the solubility difference of polyphenols and protein in NADES for protein refining from pea protein concentrate (PPC), dehulled rapeseeds, and rapeseed press cake (RPC).

Method

NADES was prepared from food grade chemicals, a ternary amine, e.g., choline chloride or betaine as hydrogen bond acceptor (HBA) and a polyol, e.g., 1,2-propanediol or glycerin, as hydrogen bond donor (HBD) and used for extraction. Extractions using ethanol and 1,2-propandiol and ethanol were used as a reference. In addition, physico-chemical properties which are most relevant for extraction efficiency, i.e., viscosity, water activity, pH, density, refractive index, and dielectric properties of selected NADES were determined. A bicinchoninic acid (BCA) assay was used to determine both, the amount of extracted total polyphenols and soluble protein.

Results

The water content in NADES significantly ($p < 0.05$) affected all NADES physicochemical properties regardless of NADES temperature. In turn, NADES physico-chemical properties significantly ($p < 0.05$) affected the extraction efficiency of polyphenols and phytochemicals from PPC and RPC. A maximum solubilization of phytochemicals at around 55-90 mg L-1 quercetin equivalents (QE) for pea protein concentrate at a 1:10 NADES-solids-mixture and 600 mg L-1 QE for rapeseeds was achieved. Minimal solubilization of proteins (< 5 g L-1) was achieved at low water content of NADES in the range of 10-20%. Processing windows could be established based on correlations of NADES composition, its physico-chemical properties, and the results for the solubilization of proteins and polyphenols in NADES.

Conclusion

This pioneering study was able to establish a protein refining process based on the differential solubility of proteins and phytochemicals in NADES. In current and future studies, a circular process will be developed to recover NADES and polyphenols after extraction. Further studies on subsequent processing steps are needed to yield a functional, plain tasting, and colorless plant protein that can be applied in a broad range of foods.

Keywords

Natural deep eutectic solvent, NADES, pea protein, rapeseed, polyphenols, extraction

P1.1.093

Binary collisions of drying maltodextrin droplets and glass beads to mimic agglomeration in spray dryers

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Aim: Spray drying is often used in combination with agglomeration to produce powders with good functional properties. Agglomeration inside the nozzle zone has been proposed, yet the mechanistic understanding of collisions leading to this agglomeration is limited. This research aims to increase the mechanistic understanding of binary collision behaviour in spray dryers, thereby contributing to the production of good quality powders.

Method: This research makes use of a sessile single droplet dryer that can dry droplets with temperature-time trajectories and that can generate collisions between a drying droplet and dry glass beads. The drying droplets investigated in this research were solutions of maltodextrin with a dextrose equivalent (DE) of 6, 21 or 38. Collisions with the glass beads were performed at different time points in the drying process. By altering the drying air temperature, the drying speed was also varied.

Results: During the drying of a maltodextrin droplet, a shift in collision outcome was observed. The transition from coalescence, to agglomeration, to bouncing was linked to the locking point of the drying droplet. The locking point is related to the formation of a skin around the droplet, altering the droplet's surface properties and collision behaviour. Droplets with a later locking point, like maltodextrins with a higher DE, show coalescence longer into the drying process and consequently also show a later transition from agglomeration into bouncing. A higher drying speed was found to shorten the periods where coalescence and agglomeration are observed.

Conclusion: Our single-droplet drying approach can successfully determine the outcome of binary collisions under realistic temperature-time trajectories. The locking point of a droplet, which depends on the feed solution and the applied drying temperatures, is a key factor determining the collision outcome. Only for a short period of the drying process agglomeration was observed, therefore precise timing of the collision between drying droplets and dry fines is needed to optimize agglomeration.

P1.1.094

Numerical and rheological analysis of the twin-screw extrusion process for the production of meat substitutes

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Aim:
In the early days of high moisture extrusion, the main focus of research was on the production of meat-like structures, the current attention is also on "formulation engineering". There is interest in transferring existing processes based on gluten, pea protein or soy protein to other plant proteins and blends.To simplify this step and thus save resources, a mechanistic understanding of the processes both in the screw section and in the die section of the extruder is necessary. In this conference contribution, we demonstrate how numerical and rheological methods can help to obtain a better mechanistic understanding of the processes in the screw section of the extruder.
Method:
A particle-based simulation method (Moving Particle Simulation, Particleworks) was used to simulate the complex flow in the screw section of the extruder. This allows the rotating, intermeshing screws and free surfaces to be represented. To obtain important rheological data, a closed-cavity rheometer was used. Thus rheological properties can be obtained under extrusion-like conditions.
Results:
By means of rheological measurements, important material properties of the raw materials used could be determined under extrusion-like conditions (gel strength, recativity, viscoelasticity, ...). Moreover, it has been possible to describe the flow properties of the materials in order to implement them in the numerical simulations. The numerical simulations of the screw section makes it possible to obtain information about the local filling degree, as well as to create time-temperature profiles. In addition, it has been shown that local temperature peaks and maximum shear stresses, which are important in the processing of food systems, can be determined.
Conclusion:
Using numerical and rheological methods, we have succeeded in analysing the high moisture extrusion process of plant proteins. Thus, targeted product design, process transfer and process optimization are possible. Furthermore, the data can be used to perform a targeted scale-up.

P1.1.095

High-intensity ultrasound pretreatment on the exopolysaccharide concentration and biomass increase of cheese whey kefir

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Cheese whey (CW) is the liquid by-product of cheese and yogurt-making. This potential pollutant has a high chemical oxygen demand (50-102 g/L) and high biological oxygen demand (27-60 g/L). However, it has high-quality nutrients exploitable through fermentation processes. Using high-intensity ultrasound on dairy products has shown several technological advantages for bioprocesses. Therefore, this study aimed to investigate the effect of high-intensity ultrasound (HIUS) on kefir grains biomass increase and specific metabolites in CW kefir. Fresco-style cheese was made to get fresh CW. It was ultrasonicated at 9.0 ± 2.7 and 18.0 ± 3.0 W/cm^2 for 30 and 180 s, inoculated with milk kefir grains, and fermented for 40 h. Total exopolysaccharide (TEPS) production, kefir grains biomass increase, titratable acidity, pH, and soluble solids were analyzed every 8 h. CW pretreated with HIUS and fermented with kefir grains significantly increased kefir grains biomass and TEPS. The 18.0 ± 3.0 W/cm^2 for 180 s HIUS treatment fermented for 16 h had significantly higher ($p < 0.05$) TEPS concentration than the control; 212.7 ± 0.0 and 186.6 ± 0.0 mg/L, respectively. Ultrasonicated CW at 18 W/cm^2 for 30 and 180 s at 24 h fermentation time had significantly higher kefir grains biomass ($p < 0.05$) than the control; 44.2 ± 0.8 and 43.6

± 0.9 g/L, and 40.5 ± 0.4 g/L, respectively. No significant HIUS effects were observed on pH and titratable acidity at the end of the fermentation. However, these two parameters were correlated with kefir grains biomass increase. An inverse relationship was observed between kefir grains biomass increase and soluble solids concentration. In conclusion, HIUS pretreatment is a novel emergent technology able to enhance the biosynthesis of TEPS concentration and kefir grains biomass on fresh cheese whey kefir.

P1.1.096

Development of Transparent Models of Fruit preparations for Optical Flow Visualizations in Pipe Flows

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Aim:
Fruit preparations are widely used in the dairy and beverage industry. They usually consist of a liquid, and a particle phase. Due to preservation reasons, the fruit pieces are often pasteurized, which results in viscoelastic behaviour. The fluid phase typically consists of juices or purées that show a pseudo-plastic characteristics and a yield point. These complex material characteristics complicate the numerical prediction of flows in pipes and valves. Therefore, optical flow visualization is a viable option for the validation of numerical approaches. As flow visualization must be done in transparent media, a two phase imitate for fruit preparations has been developed. These model fluids were used in particle image velocimetry (PIV) trials to demonstrate their usability.
Method:
The development of the model fluids was divided into the liquid and the particulate phase. The liquid phase consists of recipes based on sodium carboxymethyl cellulose (CMC) and Laponite as a rheology additive to implement a yield point. The particulate phase was developed on hydrocolloid gels. κ-Carrageenan was used to imitate the material characteristics of the fruit pieces. Refractive index matching is necessary for the usage of multiphase fluids in PIV experiments. This was accomplished using saccharose, which also could be used to match the density of both phases.
Results:
Blended solutions of CMC and Laponite in a ratio of 60 / 40 were comparable for different flow behaviours of the fluid phase. The consistency index and the flow index can be adjusted by the CMC concentration, whereas the Laponite concentration mainly affects the yield stress and implements a thixotropic behaviour. Using ratios of less than 40 % v/v during the blending process can lead to a loss of a yield point. The hydrocolloid gels are suitable for the imitation of the fruit pieces without mimicking the anisotropic material characteristics.
Conclusion:
Imitates for fruit preparations could be created by solutions based on CMC and Laponite and the use of κ-Carrageenan. They could be successfully used in PIV measurements, but the experiments indicated that high yield points and high viscosities could lead to the occurrence of air bubbles, which should be avoided.

P1.1.097

FitNESS 2.0_project: a non-linear e-learning platform on knowledge on food packaging

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Title: FitNESS 2.0_project: a non-linear e-learning platform on knowledge on food packaging
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Aim:
The ambition of the new project (FitNESS 2.0, from 01/11/2021 to 31/10/2024) www.fitness-foodpackaging.com, is to reach a broader audience in the food packaging value chain, from the chemical industry to recyclers, and to offer certified courses validated by online tests.
FitNESS 2.0 will contribute to accelerating the digital transformation of education and training systems by bridging education, research, and innovation, as well as by creating a global community within the field and offering new training paths for current and future professionals. In addition to expanding the current set of courses, FitNESS 2.0 is committed to implementing the possibility of multilingual courses and the innovative approach of personalised learning (using an artificial intelligence-based assistant and guided curriculum). FitNESS 2.0 project has as main target food and packaging engineers, recycling and processing professionals, and circular economists.
Method:
The project relies on creating up-to-date content with mutual recognition between countries, universities, and prominent research and technological institutions. The material is available on a clonable platform that uses a decentralized architecture (no login, no tracking on the server), which can be duplicated easily by an institution or a company, and which already proposes several months of free teaching and training, including video, quizzes, webinars, etc.
Results:
The platform includes over 80 lectures, one book, ~3000 searchable slides, >30 interactive activities, and 48 hours of recorded videos, and it is designed to support environmental and anti-waste official papers laws. The content covers emerging topics such as packaging materials and processing methods, food-package interaction, recycled, biodegradable, and bio-sourced materials, optimal packaging design, life-cycle analysis, and risk assessment. The platform offers a variety of highly interactive online courses, webinars, quizzes, and case studies and is suitable for both students, professors, and professionals in the industry. Additionally, the platform includes a common repository for developing new educational content and online resources. Six intellectual productions were created as part of the project, including an interactive platform, courses, guidelines, case studies, webinars, and targeted training sessions. The platform is available online on any screen and can be downloaded for offline use in low-bandwidth areas.
Conclusion:
Rethinking packaging for the future should consider a free access to the knowledge on packaging, for both student and professional, from basic to advanced concepts, data, examples etc.. The food industry has been particularly affected by the crisis caused by pandemic COVID-19; innovation and training will also accelerate the economic recovery.

P1.1.098

Modeling the inactivation of Bacillus cereus during cold oxygen plasma treatments

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Aim:

Bacillus cereus is a spore-forming foodborne pathogen that could be resistant to conventional thermal treatments in the food industry. It is considered a potential microbiological hazard and it has been frequently isolated from raw soybeans and soy powders. In this respect, cold plasma technology can play a key role in acting as a non-thermal and sustainable decontamination mechanism that consists in treating the food with ionized gas that produces the inactivation of microorganisms, including sporulated forms. The aim of this work is to study the inactivation of *B. cereus* in soy powder by low-pressure cold plasma technology, using oxygen as process gas and applying mathematical modelling of inactivation kinetics.

Method:

The soy flour was treated with oxygen (0.35 mbar), using different power intensities: 100W, 125W, 150W, 200W and 300W and different exposure times (10, 15, 20, 25 and 30 minutes). Predictive modelling based on Weibull model is used to describe *B. cereu*s inactivation.

Results:

The model predictions show significant effects of inactivation kinetics at higher power intensities and longer treatment exposure times.

Conclusion:

Cold oxygen plasma treatments are useful to inactivate *B. cereus* in soy powder and the kinetic study carried out in the present work allows the application of cold oxygen plasma treatments in a more assertive and effective way for the inactivation.

P1.1.099

Effect of pulsed electric fields on techno-functional properties of Zophobas morio flour

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Aim:

Due to the population’s need for food, new food alternatives with nutritious profiles, such as edible insects, must be considered to decrease Greenhouse Gases (GHG). *Zophobas morio* (ZM) is a neotropical beetle species belonging to the Tenebrionidae family, that is eaten in different Mexican regions. In its larvae form, its lipids content ranges from 35- 43%, while the protein content goes from 20-40%, making it a highly nutritious food. Pulsed electric fields (PEF) have been studied to change technological functionality by increasing their oil-holding and emulsifying capacity, possibly due to the enhanced extractability of proteins to water and electroporation phenomena. This research aimed to apply PEF on ZM larvae meal and evaluate the techno-functional properties of the flours.

Method:

PEF treatments (1-5.6 kV/cm, 10-200 pulses of 4 µs at 200 Hz; EPULSUS®-LPM1A-10-System) were applied to ground ZM with tap water (1:1 ratio) in a parallel treatment chamber using stainless steel electrodes and then freeze-dried. Proximal analysis was determined. Techno-functional properties such as water and oil holding capacity (WHC & OHC), water and oil emulsifying capacity (WE & OE) and foaming capacity (FC) properties were performed.

Results:

The composition of the control sample was: 34.5% of lipids content, 28.9% protein, 24.3% carbohydrates, 7.3% insoluble fibre, 3.5% ashes and 1.6% soluble fibre. No significant difference was observed in protein content between the treated samples and the control, ranging from 33.3-34.1%. Amongst the techno-functional properties, mid-intensity treatment (3 kV/cm, 10 pulses 4 µs at 200 Hz) reduced WHC by 8% compared to the control sample. OHC increased for low-intensity treatment (1 kV/cm, 10 pulses of 4 µs at 200 Hz). WE (66.7%), OE (95.6%) FC (53.5%) resulted in no significant difference when compared to control (WE 66.7%; OE 95.6%; FC 53.3%).

Conclusion:

As WHC and OHC were the main techno-functional properties affected, low-intensity treatment could be proposed as an alternative to increasing the OHC, whilst mid-intensity treatment could be used to reduce WHC. PEF can be used as a treatment to improve the techno-functionality of ZM flour and its utilisation as a food ingredient while maintaining a sustainable process treatment.

P1.1.100

Extrusion process and incorporation of insect meal for sustainable feed manufacturing via experimental and modeling

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Aim:
Despite the considerable attention given to evaluating the nutritional impact of insect meal on fish performance as a sustainable protein source for fish feed production, there exists a notable scarcity of research exploring the technological challenges associated with incorporating insect meal into fish feed pellets and its effects on their physical characteristics.
This work aims to mathematically model the influence of extrusion process conditions and the incoperapartion of insect (Black soldier fly (BSF), Mealworms (MW)) levels on the final pellet quality parameters such as bulk density (BD), hardness, water stability (WS), water absorption capacity (WAC), oil absorption capacity (OAC), etc.
Method:
Two modeling approaches are employed, including data-driven techniques (such as response surface methodology, RSM) as well as empirical or phenomenological models. Experimental tests were performed using a twin extrusion system at different screw speeds, die temperatures, moisture levels, and at different inclusion levels of insect meal. The samples were cut and dried, and final pellet quality parameters were evaluated, which can be used in mathematical model development.
Results:
The experimental data and models were compared with similar results obtained. The results have uncovered intriguing nonlinear effects in the parameters under investigation, yielding new insights. Some of the findings: WAC increases with increasing higher BSF levels (dominant effect), reaching peak values before declining. On the other hand, WS rises significantly with increased temperature (dominant effect) and BSF levels. The BD in the presence of MW is nonlinear, influenced by both MW and temperature. The impact of MW on oil absorption is highly reliant on temperature, while the hardness of pellets increases notably with rising MW content (dominant effect) up to a critical level. However, beyond this threshold, the hardness gradually decreases. Achieving the optimal replacement level entails adjusting process conditions accordingly.
Conclusion:
With established models, optimum replacement levels and process conditions were identified and tested. The established model provides better insights that can be used to improve the pellet feed quality with insect incorporation level by modulating the extrusion conditions. Results demonstrate the promising impact of insect inclusion in fish feed, enhancing pellet properties with optimized process conditions.

P1.1.101

Impact of processing of legume protein powders on functional properties

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Aim:
To advance the quality of plant-based food, we need to understand the important relationship between protein structure and functional requirements, and one way is to investigate raw material and ingredient processing. For optimal functionality the ingredient processing needs to be controlled and fine-tuned, which in turn can be done best if the relationship between functional and physico-chemical properties are understood. Such a knowledge-based tool for tailoring protein ingredients may assist producing industrially relevant ingredients in a sustainable manner.
Method:
10 fava bean and 10 pea cultivars from a local organic farmer were processed into concentrates (LPPC, dry fractionation in pilot scale) and isolates (LPPI, wet extraction in lab scale comparable to industrial processing). Powder suspensions were made following foaming using Ultra Turrax at native pH and adjusted pHs using a phosphate buffer. Foam volume was recorded manually to calculate the foam capacity and stability. Coarse and fine emulsions were produced and analysed for emulsion capacity and stability by droplet size with stability indicies and creaming indices as a function of storage time calculated.Various molecular characterisation analyses, electrophoresis, particle size distribution, solubility, surface hydrophobicity, and surface charge, were conducted to explain differences in the foamability and emulsification.

Results:

Initial results show that the foamability of powders are different depending on both cultivar and processing technology, concentrate versus isolate, and pH of the system. Foaming results thus far have indicated higher foaming capacity at a acidic pH. The emulsifiying properties of the powders also differ by cultivar and processing technology, oil capacity and coarse vs fine emulsion. The analyses and interpretation are ongoing and will be presented at the conference.

Conclusion:
In the increasing global market for plant-based foods, both the control of raw materials and ingredient processing technologies is crucial for technical functions in the quality and stability of food products and at the same time ensure sustainability, supply, and demand.

P1.1.103

Erythromycin resistant Salmonella Typhimurium mutants show cross-resistance against carvacrol

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Aim:
Currently, antimicrobial resistance (AMR) poses a significant challenge to public health. *Salmonella* spp., the main pathogen involved in foodborne outbreaks, has exhibited AMR to antibiotics employed in both human and veterinary medicine, including erythromycin (ERY) among others. The impact of these emerging AMR on the effectiveness of food preservation methods, such as the use of essential oils (EOs) and their individual constituents (ICs), remains uncertain.
The aim of this study was to isolate resistant variants (RVs) of *Salmonella enterica* Typhimurium LT2 (WT) against ERY and to evaluate their cross-resistance against carvacrol (CAR), the main IC of *Thymus vulgaris* EO.
Method:
To this end, evolution assays were conducted at increasing concentrations of ERY, increasing 1.85-fold in concentration daily for 10 days. To assess the acquired resistance, broth microdilution was employed to determine the minimum inhibitory concentrations (MICs) for each RV. RVs were exposed to lethal treatments with CAR (200 µL/L, 30 min) and compared with the WT strain. Whole genome sequencing (WGS) was conducted to determine the mutations involved in the AMR of the RVs.
Results:
Seven RVs of *Salmonella* Typhimurium were isolated after evolution assays with ERY. RVs showed MICs against ERY 4-8 times higher (256-512 µg/mL) than WT (64 µg/mL). Four of the RVs acquired cross-resistance to CAR. While the WT strain showed 4.29 log cycles of inactivation to CAR treatments, RVs exhibited a decrease of at least 2.5 log cycles in their inactivation levels. WGS analysis identified two common candidate genes in two of the RVs that potentially contribute to AMR, STM0580, a putative regulatory protein involved in the expression of AcrAB efflux pumps; and *rfbI*, involved in the synthesis of catalytic enzymes targeting CDP-D-hexoses biosynthesis.
Conclusion:
Thus, the feasibility of evolution assays for obtaining RVs of *Salmonella enterica* Typhimurium LT2 with significant resistance increases has been demonstrated, allowing the isolation of RVs with AMR to ERY with up to 8-fold MIC increase. Cross-resistance against CAR treatments was detected in four of the ERY evolved strains. A comprehensive and detailed analysis of the WGS data would enable the identification of specific pathways involved in AMR within *Salmonella*.

P1.1.104

The technological potential of Pulsed Electric Fields: tailored food processes by modifying tomato pectin nanostructure

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Aim:
Pulsed Electric Field (PEF) technology is a non-thermal food processing technique that is gaining popularity for the treatment of fruits and vegetables. However, research on the effects of PEF on the biomolecular components of plant tissues is lacking. This study aims to evaluate the effect of PEF at low and medium intensities on the physicochemical properties of pectin fractions extracted from tomatoes at two different maturity stages. The ultimate goal is to collect information on the PEF-pectin interactions to develop sustainable and specifically tailored food processes dependent on the functional properties of the pectin (i.e., the peeling process).
Method:
Monopolar exponential decay pulses, with an electric field strength of 1.0 and 10.0 kV/cm (specific energy input = 1.5 and 151 kJ/kg, respectively), were applied on alcohol insoluble residue (AIR) extracted from tomatoes at two different maturity stages (green and red). Atomic force microscopy (AFM) was used for topography and recognition imaging of three pectin fractions: water-soluble pectin (WSP), chelator-soluble pectin (CSP), and diluted alkali-soluble pectin (DASP). Geometrical parameters of pectin fibres and aggregates were characterized based on the AFM images. Additionally, the monosaccharides composition of the three pectin fractions was determined using an HPLC-UV/VIS system.
Results:
The application of PEF treatments caused significant structural changes in all three pectin fractions; however, the effect differed depending on the tomato maturation stage. In red tomatoes, the WSP fibres statistically decreased their length as the intensity of the electric field increased (up to 30% shorter). The opposite effect was observed in green tomatoes, where the length of the WSP fibres tends to increase with the increase of the applied electric field. The monosaccharide composition analysis showed that applying PEF reduced pectin linearity, regardless of the fruit ripeness stage.
Conclusion:
The study demonstrated the potential use of PEF for nanostructure modification to enhance specific food processes. Depending on the fruit maturation stage, PEF can reduce pectin length, mimicking the natural ripening process. This effect becomes evident at the macroscopic level when PEF is applied to whole red tomatoes, resulting in improved peeling ability, while such effects are not observed in whole green tomatoes.

P1.1.105

Environmental viability of new models of circular economy, extraction of biocompounds from broccoli by-products

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Aim: Validate the environmental viability of new circular economy models in the agri-food sector focused on the revalorisation of by-products reducing food waste. The study focuses on the water footprint related to the use of broccoli by-products to obtain a high value bioactive compound, glucosinolate.
Method: A cradle-to-gate water footprint assessment was performed, including the broccoli cultivation phase and the extraction of glucosinolate from non-marketed by-products, of the current agro-industrial sector in Navarra, Spain. Two possible scenarios were compared: Scenario 1 (current agribusiness scenario) discards broccoli by-products, using only the broccoli inflorescences for human consumption. Scenario 2 (revalorisation scenario) uses the broccoli inflorescences for human consumption and the by-products (stems) are destined for a glucosinolate extraction process.
The water footprint of both scenarios was assessed. In both cases, the environmental impact generated was calculated for obtaining 1000 g of glucosinolate, either naturally present in the broccoli or isolated. Therefore, 1kg of glucosinolate is the functional unit of the study.
Results: The scenario 1 showed the largest water footprint (34.33 m^3), whereas the water footprint of scenario 2 was somewhat lower (26.76 m^3). This result seems to be reasonable as in scenario 1 more broccoli needs to be produced than in scenario 2 to obtain the same amount of glucosinolates. As regards the two phases evaluated (extraction and cultivation), in the 2 scenario the cultivation phase involves the highest freshwater use (98,5%).
Conclusion: The amount of water needed to produce the same amount of glucosinolate in the business as usual scenario (scenario 1) was 1.3 times higher than the amount needed to produce the same amount in the revalorisation scenario

(scenario 2). This indicates that the reuse of broccoli by-products to obtain glucosinolate biocompounds can be defined as sustainable, in terms of impacts on water resources.

P1.1.106

Interfacial characterization of an emulsion derived from seafood wastes processing

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Abstract

Aim:
The waste materials from poultry/seafood processing industry (e.g., viscera) are used for production of aquaculture feed. This application requires hydrolysis of the waste materials, which commonly leads to generation of a secondary waste, i.e., an emulsion. Breaking the waste emulsion to recover the lost food compounds requires a thorough knowledge of the emulsion properties. The present study aimed to characterize the emulsion and in particular the surface-active agents responsible for stabilizing the emulsion.

Method and Results:
The fish viscera was hydrolyzed by endogenous enzymes under optimum conditions (temperature, time and agitation speed) to form the emulsion. The emulsion separated from the viscera hydrolysates was subjected to a series of physical and chemical treatments to isolate the interfacial layers. The interface was then analyzed qualitatively (i.e., NMR) and quantitatively (e.g., SDS PAGE analysis, mass spectrometry, OPA assay, phospholipids content, etc.) for chemical compositions. The compositional analyses were also carried out for the oil and aqueous phases of the emulsion. The surface activities of the interfacial agents were studied by interfacial tension, interfacial rheology and ζ potential. Furthermore, the emulsion was investigated for droplet size distribution and static and dynamic rheology.

Conclusion:
This study provides information for selecting an effective demulsification technique for the recovery of food components from the waste emulsion formed during hydrolysis of fish viscera.

P1.1.107

Application of high-moisture extrusion cooking for the development of fibrous structures from alternative vegetable proteins.

Project Manager Alba Gozalbes Sanz[1], Beatriz Pérez Graells[1], PhD Marta Gisbert Viguer[1], Mariana Valverde Belda[1]
[1]AINIA

Aim
The production of palatable meat analogues using high moisture extrusion cooking is a complex process that depends on the properties of the protein ingredients and the extrusion conditions (Sandoval et al., 2019). This study aims to gain a better understanding of protein texturization and its physical properties in extrudates containing alternative proteins from different vegetable sources obtained by this technique.

Method
The behavior after high moisture extrusion of different alternative proteins such as rice, sunflower, oat and microalgae, when incorporated as a secondary ingredient (15%) in a pea protein-based formula, was compared with a control formula based on soy protein. Soybean is used as a reference because it is the most widely employed protein in the development of meat analogues. Extrusion experiments were performed using a co-rotating and intermeshing twin-screw extruder with a cooling die. To describe the physical characteristics of the extrudates, transversal texture tests, color and fibrousness-external appearance analysis were performed.

Results
The results of the texture analysis showed that all samples have significantly higher maximum shear force values than the soybean control sample (F0), except for pea-oat (F3) sample which showed no significant difference. The pea-sunflower extrudates (F1) had the highest maximum shear force and work of shear values. In addition, the pea-oat samples presented a significantly lower work shear than the control sample, while the pea-rice (F2) and pea-microalgae (F4) extrudates showed no significant differences. Color analysis showed that all samples denoted lower brightness than the control sample, except for pea-oat extrudates, which presented no significant differences. The pea-sunflower formula was the least luminous of all the samples. Furthermore, colour differences were observed between all the formulas when compared to the control

sample. On the other hand, all samples showed an adequate fiber elongation and an overall external appearance and no differences were observed in this parameter.

Conclusion

Our findings prove that sunflower, rice, oat and microalgae proteins when added to a pea protein-based formula are valuable raw materials for the development of fibrous structures by high-moisture extrusion cooking. This may be suitable to obtain improved palatable meat and fish analogues after the application of different post-extrusion culinary operations.

P1.1.108

Development of an innovative laser cooking system applied to a 3D Food Printer

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Aim:

An innovative cooking system based on infrared radiation (IR) using a CO_2 laser (CO_2 IR Laser) has been developed considering that the absorbance of electromagnetic infrared radiation by water at CO_2 laser wavelength is very high. The new cooking system has been adapted into a 3D food printer and has been designed with the following requirements: 1) ability to cook in a delimited area; 2) control of the cooking temperature; 3) physical dimensions that fit inside the 3D Food Printer; 4) energy consumption below the power supply limits; 5) software-controlled system; 6) versatility to cook while printing the food or to cook once the food is printed.

Method:

The cooking system consists of a CO_2 laser lamp, a system of galvo mirrors that direct the laser beam to the cooking area, and a software that allowed controlling the position and the frequency of movement of galvanometers. With this new system, a chosen area could be homogenously cooked, due to the rapid movement of the galvo mirrors. The food products cooked inside the 3D food printer were beef burgers and vegetarian patties prepared with legumes, vegetables and egg as main ingredients. To demonstrate that cooking had been achieved, food products were cooked with the CO_2 IR laser systems and different traditional cooking systems (flat and barbeque grills; IR, convection, desk and microwave ovens). Microbiological, physico-chemical and sensory characteristics of the cooked foods were evaluated. The formation of polycyclic aromatic hydrocarbons was analyzed in beef burgers to evaluate toxicological safety, and the thermal effect in the count reduction or survival of *Salmonella* Typhimurium, *Salmonella* Senftenberg and *Escherichia coli* O157:H7 inoculated in beef burgers and vegetarian patties was studied.

Results:

Microbiological and toxicological analyses showed that food products cooked with the new CO_2 IR Laser system were as safe as food cooked with traditional methods. Sensory analyses showed that consumers had the same, or even higher, level of preference for foods cooked with CO_2 IR laser system in comparison with foods cooked with traditional methods.

Conclusion:

CO_2 IR Laser system can be integrated in a 3D printer to cook during the printing process or to cook once the food is printed.

P1.1.109

A comparison of a range of nutrient profiling models as applied to cooked meals

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Aim:
A variety of different models for assessing the nutritive value of foods and ingredients exist, but all can be subject to criticism in not adequately assessing the full complement of nutrient components in a food or meal. This work was carried out in conjunction with an expert review panel comprised of technical experts from industry, academia, and policy, and aimed to compare some of the most prominent nutrient profiling methods when applied to a range of cooked meals.

Method:
Three different models were considered: the Ofcom Nutrient Profiling Model (NPM) which is based on a point system that includes 4 nutrients to discourage and 3 nutrients/food components to encourage; the Nutrient Rich Foods (NRF) Index, which ranks foods based on only their nutrient content (usually includes 9 nutrients to encourage and 3 to limit); and finally the SAIN,LIM model, which classifies foods into four healthiness classes based on separate indexes, the SAIN (which includes 5 nutrients to encourage) and LIM (which includes 3 nutrients to discourage). These models were applied to a variety of meals– meat based and vegetarian, rice based and pasta, dairy and dairy alternatives.

Results:
The Expert panel expressed a concern that the Ofcom NPM didn't take micronutrients (e.g., iron, selenium) into account. However, Ofcom NPM considered food groups (i.e., percentage of fruit, vegetable and nut content) which will be micronutrient-rich and are regarded as a good way for testing if diets align with national dietary guidance. NRF9.3 was the most flexible index regarding the reference amount (e.g., 100grams, 100kcal and portion size). Comparing different cooked meals, vegetarian meals performed better than meat-based meals (e.g., spaghetti Bolognese made with beef versus Quorn); and meals that included dairy seemed to score more poorly than those which didn't.

Conclusion:
Assessing the "healthiness" of meals using different methods is dependent on the choice of profiling model used. Scores should be considered under the lens of each model's characteristics. Nutrient profiling models that are selected to influence consumers' food choices and preferences should also align with both sustainability targets and nutritional guidelines.

P1.1.110

Adapting to Protein 2.0: How Established Dairy Companies Launch Plant-Based Alternatives

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Aim:
Even though plant-based food technologies have been opening new frontiers for so long, the adaptation of incumbent companies has been relatively recent. This research aims to enhance our understanding of the market growth of plant-based dairy products by shedding light on the adaptation process of dairy enterprises to these new technologies. The outcomes of this study will explore the intricacies of the dairy sector and furnish significant perspectives on the determinants propelling the acceptance of plant-based dairy substitutes. This comprehension is crucial as incumbent adaptation expands the market for new technologies, and implementing innovations will create a more sustainable and forward-thinking food industry.

Method:
This study employs a qualitative methodology and examines data from two case companies as part of a pilot study carried out in the spring of 2023 as the first step of a four-year project.
Data collection includes interviews with representatives from a dairy company that recently launched plant-based products and a plant-based food processing firm. Interviews with field specialists and researchers provide further insights. Corporate documentation and strategy workshop observations supplement data collection. A case study method provides an in-depth examination of emerging business strategies to help understand food technology commercialization.

Results:
Findings suggest that established enterprises have a tendency to postpone market entry until a sufficient level of market volume and validated consumer demand have been attained. They often navigate periods of uncertainty by engaging in exploratory activities aimed at comprehending the practical application of emerging technologies and the market potential. The primary challenges include the resource allocation associated with adjusting to novel technological advancements, high product prices, and the unpredictability of consumer preferences. The primary motivators are the competitive

pressures exerted by the growing plant-based industry and the incumbent's aspiration to function as a full provider of dairy alternatives.

Conclusion:

This study explores established companies' strategy processes and implementation in the plant-based market, with further insights from industry stakeholders.

The identification of drivers and obstacles to the adaptation of incumbent companies to novel food technologies will pave the way for facilitating knowledge sharing and fostering innovation towards a more sustainable food industry.

P1.1.111

Durum and freekeh flours in flatbreads: impacts of partial substitution

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Aim: Flatbreads are an interesting category of baked or cooked bread products that have been enjoyed by diverse cultures throughout history. Their distinctive qualities such as convenience of use, versatility and nutritional profile made them a staple food in many regions of the world and therefore an excellent vector for diet. One approach is the partial substitution of wheat flour with other flours such as oats in order to increase their fibers content for example.

With the intention of using locally sourced ingredients from the Mediterranean basin, this study aims to assess the supplementation of wheat flatbreads with durum or freekeh (charred immature green wheat) flours in comparison to oats.

Method: To this purpose, oat, durum and freekeh flours were separately added at a 30% wheat flour substitution rate in a double layered flatbread and were compared to the control recipe of 100% wheat flour. Chemical analysis (moisture, ash, wet and dry gluten content, gluten index, falling number), rheological analysis (extensograph, farinograph), colorimetric analysis (L* a* b*), sensory evaluation (descriptive and hedonic analysis), physical evaluation (texture profile analysis) and dietary fibers content test were carried out on flours, doughs and breads, when applicable.

Results: Results showed that durum and freekeh flours have higher ash content (1.69 and 1.87% respectively) compared to wheat (0.74%) and oat (1.45%). Freekeh flatbread showed the highest ash content amongst all other breads (1.4%). Regarding the rheological properties of doughs, recipes with 30% freekeh had the highest water absorption (72%), whereas the dough energy, extensibility and elasticity of the 30% durum recipes were very similar to the control dough. Color variations in dough and final breads showed that durum and oat flatbreads were very similar to the control recipe, but not flatbreads with 30% freekeh. Sensory evaluation results showed that durum and oat flatbreads obtained similar preference results in comparison with the control flatbread, whereas freekeh showed a lower acceptability by the panelists.

Conclusion: Durum and freekeh flours are interesting alternatives for improving wheat flatbreads nutritional profile, however, their inclusion requires in-depth optimization of the recipe in order to achieve advanced rheological and sensorial properties.

P1.1.112

Mapping unrefined vegetal powders emulsifying potential: towards multifunctional natural food emulsifiers

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Aim:
Emulsions are ubiquitous among processed food (mayonnaise, margarine, dairy products…). Their stability is ensured by emulsifiers, many of them being highly refined ingredients, whether bio-based or not. In an eco-design approach, less purified natural ingredients have to replace pure molecules. Tackling the food waste challenge being essential to build a sustainable food system, using unrefined vegetal by-products as novel emulsifiers might increase simultaneously products' naturalness, healthiness and sustainability. Indeed, unrefined by-products still contain functional and nutritious components usually lost during extraction of pure fractions from their original matrix. This work introduces the feasibility of stabilizing emulsions by unrefined vegetal by-product powders from varied sourcing through mapping plant material according to their emulsifying potential.

Method:
About 20 food by-products were selected as a representative panel of plant material diversity and compared in terms of chemical composition and emulsifying properties. Groups of plant materials were statistically obtained from this mapping. One by-product per group was then deeper studied to understand and prioritize the emulsion structuring mechanisms of its different constituting components.

Results:
1) The emulsions stabilized by the 20 vegetal by-products displayed a broad range of properties: droplets size ranging from 25 to 170 µm and different stabilities; 2) 3 main groups of plant materials were obtained, based on their composition and emulsifying potential; 3) A broad range of textures was reached with emulsions only composed of oil, water and vegetal powders, by varying their respective ratios; 4) Vegetal powder stabilized emulsions with oil content varying from 10 to 60%; 5) Both insoluble solid particles and soluble compounds of the powder played key roles in the hybrid stabilization of emulsions and their effects were either synergistic or competitive depending on their ratio; 6) Surface activity measurements brought insights into hybrid stabilization mechanisms of these complex powders

Conclusion:
This work provides in-depth insight into the mechanisms involved in the physical stability of emulsions stabilized by vegetal powders. This plant material mapping enables a better prediction of unrefined vegetal by-products potential as stabilizing agents to tackle the major issue of food waste by promoting the sustainable use of up-cycled ingredients.

P1.1.113

Potential for environmental load abatement of soy sauce produced from edible crickets

Potential For Environmental Load Abatement Of Soy Sauce Produced From Edible Crickets Ayuka Hoshino[1], Takahiro Orikasa[2], Shoji Koide[3]
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Aim：Edible insects are attracting attention as a new animal protein amid concerns about food shortages due to global population growth. Compared to conventional livestock and soybeans, edible insects have extremely high protein conversion efficiency. Since the United Nations published its report in 2013, many insect foods have been developed around the world. Most insect foods are primary processed products, and higher processing is essential to reduce the repellency. Therefore, our project focused on the soy sauce production from edible insects. The purpose of this study is to apply Life Cycle Assessment (LCA) as an environmental impact assessment method to evaluate a potential for environmental load abatement of soy sauce produces from edible crickets compared with conventional soy sauce.

Method：In this study, the LCA analysis software MiLCA ver. 3.1 was used to evaluate the environmental impact based on the LCA method. The functional unit is mass (ton) of soy sauce. Each inventory data was derived from interviews with companies and literature values. LIME2 method was applied to the environmental impact assessment.

Results：As a result of LCA for conventional soy sauce, the hot spot of environmental load was the raw material production stage. In this stage, large amounts of water, pesticides, insecticides are consumed. The prosses (water, pesticides, and insecticides) materials are not used to soy sauce production from edible crickets. It was shown that low energy input in the process contribute to construct environmentally friendly soy sauce production process.

Conclusion: We concluded that soy sauce from edible crickets have a potential for environmental load abatement compared with conventional soy sauce due to the low energy input in cricket production. In the future, environmental impact analysis based on different functional units should be conducted.

P1.1.114

Applying computer vision and artificial intelligence for quality assessment and fault detection in rice milling

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Aim:
This research work is to develop an artificial intelligence (AI)-based automated real-time approach to evaluate the quality of rice products produced during the rice milling process by extracting milled rice physical features for quality analysis and anomaly detection. Due to the flow volume of milled rice during milling processes, real-time image processing of rice milling frequently produces indistinct segmentation and classifications, which reduces the accuracy of the image analysis. However, real-time analysis can be accomplished by utilising AI, computer vision, and machine learning (ML) approaches.

Method:
Computer vision and image processing techniques have had great success in the food and drink industry. These technologies will be used to acquire real-time rice images; the acquired images will be converted to grayscale, labelled frames for processing and extracting numerical data from the images. ML techniques such as the supervised and unsupervised algorithms are used for image feature extraction, pattern segmentation, image detection, and grain classification. This technique evaluates the real-time physical characteristics of the milled rice, such as the length, width, and colour. A deep learning-enabled model (convolutional neural network) is applied to the real-time analysis by using mathematical operations to process the pixel data of the image to identify good rice and predict broken rice. It further produces high-dimensional data for training the ML model and creating a closed-loop path to the milling process.

Result:
First-stage image processing, segmentation, and classification do not perform well under ideal operating conditions, but with AI and deep learning, real-time analysis results were satisfactory with 98% accuracy.

Conclusion:
This research work will assist industries in evaluating the real-time physical characteristics of the milled rice, such as the length, width, and colour. It will be able to distinguish between good rice and broken rice and further provide additional data stream that can be used for real-time process optimisation as well as early-stage anomaly detection. This project is critical to running an optimal operation for the rice milling process. It will enhance the long-term viability of the food processing business and boost the operational effectiveness of the milling processes.

P1.1.115

Model based advanced control design for ohmic heating system

Miss Tasmiyah Javed[1], Dr. Muhammad Akmal[1], Dr. Timofei Breikin[1], Dr. Hongwei Zhang[1]
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Aim:
The UK's net-zero 2050 goals have prompted the food industries to look for alternative food processing technologies to reduce carbon footprints. As a result, industrial food processes using ohmic heating methods are gaining prevalence because of reduced carbon emissions and higher energy efficiency. Ohmic heating process is dependent on the product's electrical conductivity and other physical characteristics. Various mathematical ohmic heating models have been developed to study the behaviour of food products during the ohmic heating process. However, the non-linear behaviour of different materials' physical parameters upon heating poses a challenge for mathematical modelling. Hence, the objective of this research is to establish a physical model of continuous flow ohmic heater. The model was developed considering the dynamicity of the product's non-linear physicochemical parameters of the product. This model was then utilised to design advanced controllers to achieve a desired output temperature while optimising the system's total energy and power consumption.

Method:
The controller designs were developed and simulated using MATLAB/Simscape and were validated against both an established mathematical model and an experimental pilot plant setup at the National Centre of Excellence for Food Engineering (NCEFE). Moreover, an automatic system for tuning the gains of the controllers was developed using the real-time data from the pilot plant.

Results:
The results showed that the designed controllers are efficient and capable of achieving the set reference temperature. It is shown that physical model closely mimics the behaviour of the real-time ohmic heating system, as compared to the mathematical model. Additionally, variations in the performance of the developed controllers in terms of overall energy consumption to reach and maintain the food product's desired temperature were analysed.

Conclusion:
The developed physical Simscape model with designed controllers shows improved results as compared to mathematical model. Although different controllers have capability of optimising the power consumption of the system, significant variations in their performance relative to energy consumption were observed.

P1.1.116

Valorization of wheat bran to obtain ingredients with antioxidant properties

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[1]LEITAT

Aim: Valorization of wheat bran to obtain ingredients with antioxidant properties
Wheat bran is a by-product resulting from part of the grinding of cereal grains. Wheat bran contains cellulose, hemicellulose, carbohydrates, proteins, fats and minerals.
The use of antioxidants to protect raw materials for human nutrition is essential, not only to guarantee their organoleptic and nutritional quality, but also to avoid the negative effects of oxidation products on health.
The objective of the study is the valorization of the bran to obtain ingredients for human nutrition with antioxidant properties.

Method: Method for extraction of antioxidant compounds were established, antioxidant effect were performed by ABTS and Folin analysis
Extraction process was studied by means of: Pretreatment of bran with ultrasound and solvent; Extraction of antioxidant compounds with temperature; Centrifugation; Filtration for recovery of supernatant; Washing of residual solids, followed by centrifugation and filtering and Rotevaporation of total filtrate to dryness.

Results: Extraction process and antioxidant results
A screening was designed with the type of solvent (ethanol, acetone, methanol, water), concentration and time were significant variables. Ethanol was selected to optimize the process due to its higher process yield and advantages at industrial level.
Optimization of extraction process using the ANOVA model was not significant. Numerical optimization was carried out with the software, maximizing the antioxidant activity based on economic criteria, minimizing the ethanol concentration and time. It was concluded that ultrasound pre-treatment or solvent change during the process was not necessary.
Polyphenol extraction yield was 25% (g GAE in extract / g GAE in bran *100) and the process yield was 10% (g of dry extract / g bran*100). Antioxidant activity was 252 mmol trolox/Kg extract (ABTS) and polyphenols 18155 mg GAE/Kg extract (Folin).
Sunflower oil formulated with 4% extract presented a slight decrease in peroxide value and a slight increase in Rancimat stability.

Conclusion: Extract with antioxidant activity and polyphenols is of interest for human nutrition
This stuy confirms that through circular economy applied to the valorization of the wheat bran by-product with extraction techniques, is feasible to develop a promising extract to be used as ingredient in food formulations.

P1.1.117

Improved fatty acid profiles and antioxidant capacity from edible insect extracts by SC-CO2 and ASE

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Aim
Edible insects are gaining attention as new protein and fat substitutes, but the main hurdle is low consumer acceptance. Therefore, it is necessary to recover high-added-value compounds from insects and apply them as functional components. In this context, this study aimed to evaluate the effect of two defatting processes (supercritical CO_2 (SC-CO_2) and accelerated solvent extraction (ASE)) on the lipid recovery from four edible insects, as well as to obtain the optimal defatting parameters and the bioactivities of the extracts. Results were finally compared with those obtained by traditional methods.

Method:
Four species were selected as the research objects, namely *Tenebrio molitor*, *Acheta domesticus*, *Alphitobius diaperinus* and *Locusta migratoria*. For the sake of comparison, two different experimental conditions were applied to both ASE and SC-CO_2. Afterwards, the defatting ability of the two techniques, as well as the bioactivity and fatty acid profiles of the extracts, were analyzed.

Results:
Both ASE and SC-CO_2 can be considered as efficient defatting technologies, and the highest defatting rate (100 %) can be reached. The extraction yield rates of four edible insects ranged from 24 to36 %, which is not only related to the defatting process, but also to the insect species. In addition, the use of two technologies can improve the bioactivities of the extracts, including stronger antioxidant and richer fatty acid profiles.

Conclusions:
Insects demonstrated to be a valuable source of novel high-added-value compounds, showing a great potential for food industry. Moreover, ASE and SC-SO_2 can be considered as effective technologies to the development of insect-derived bioactive compounds, providing support for the sustabinable exploitation of insect resources.

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P1.1.118

Development of new product concepts from Finnish unutilized protein sources

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Aim: To maintain sustainable food systems, it is essential to have a variety of protein sources in our diets. There is a growing interest among researchers and the food sector in exploring new and non-traditional protein sources. In recent years, plant protein products, like meat and milk alternatives have been developed and commercialized, with predicted growth in the protein markets. Unutilized side streams of the traditional food industry have a growing interest in the source of proteins. Large quantitative such side streams can be found, e.g. meat and milk processing industry. Although demand for plant protein ingredients has been significant, there is still a need to effectively utilize animal-based proteins, preferably for human consumption

Method: The chemical properties of the ingredients were determined by analyzing their protein, fat, moisture, and ash contents. The carbohydrate and energy contents were calculated based on these determinations. A sensory profile was conducted to gather information about the appearance, odor, texture, taste, and flavor properties of two commercial protein ingredients (A and B) and two protein ingredients under development (C and D). Technological properties were determined by an experimental method and design thinking process was used in the development of product concepts.

Results: When developing new food ingredients for product concepts, it is important to consider various quality parameters, including technological, nutritional, and sensory qualities. By obtaining comprehensive data on the ingredients, it is possible to guide the development process of new consumer products. The results from this study was achieved with experimental test of the technological properties of selected protein ingredients currently under development. Such properties are water holding capasity (WHC), water binding capasity (WBC), oil holding capasity (OHC), solubility, structure formation characteristics (stability), and emulsification.

Conclusion: The project developed and tested product concepts combining strengths of different protein sources. The presentation examines new product concepts where Finnish unutilized protein sources has been used as ingredients for new product concepts.

P1.1.119

Development and Utilization of Glucan-Coated Porous Starch Granules for Encapsulating Probiotics

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Aim: This study aimed to develop glucan-coated porous starch particles using starch hydrolyzing enzymes and glycosyltransferases, and to assess the stability of probiotics in these modified starch granules

Method: corn starch was hydrolyzed using alpha-, beta-, and glucoamylase enzymes to produce porous starch. The reaction was carried out at 40°C for a duration of 4 hours to produce the desired porous starch. The morphology of the resulting porous starch granules was examined using Field-Emission Scanning Electron Microscopy (FE-SEM) and Confocal Laser Microscopy (CLSM). Subsequently, the porous starch, treated with alpha-amylase (α-PSGs), was loaded with probiotics like *Lactobacillus rhamnosus GG* (*LGG*) and *Bifidobacterium longum* (*B. longum*), and the surface of the starch was coated with α-glucan produced by the amylosucrase from *Neisseria polysaccharea* (*Np*AS) reaction. The survival rate of the encapsulated probiotics under various environmental conditions was evaluated.

Results: FE-SEM and CLSM analysis confirmed the encapsulation of probiotics (*LGG, B. longum*) within the pores of the porous starch. For *LGG*, the number of viable cells significantly increased from 6.82 log CFU/mL to 11.1 log CFU/mL when using starch hydrolysate as a carbon source and being coated on the porous starch. For *B. longum*, the number of viable cells on the coated porous starch increased

from 5.24 log CFU/mL to 9.43 log CFU/mL, using both starch and starch hydrolysate as carbon sources. Additionally, both *LGG* and *B. longum* were subjected to conditions of acid, bile, and heat, with *B. longum* also exposed to an additional oxygen condition. The survival rate was highest in the coated porous starch under all conditions. The survival rate of *LGG* was 87.0% in acidic conditions, 84.7% in bile conditions, and 85.2% in heat conditions. The survival rate of *B. longum* was 72.0% in acidic conditions, 79.1% in bile conditions, 63.9% in oxygen conditions, and 58.0% in heat conditions.

Conclusion: The results of this study demonstrate that α-glucan-coated porous starch can serve as an ideal encapsulating carrier for colon-specific delivery systems. This finding suggests its potential application in the food and pharmaceutical industries.

P1.1.120

The effect of α-galactosidase treatment on properties of meat analogues by high moisture extrusion

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Aim:

Plant protein concentrates are good ingredients for texturization with high moisture extrusion, however antinutrients like raffinose family oligosaccharides (RFOs) accumulate into protein concentrates in the fractioning process. The first aim of the study was to optimize α-galactosidase treatment to achieve 80% reduction of RFOs in faba bean protein concentrate (FPC) suspension and to utilize it in high moisture extrusion. The second aim was to study the effect of α-galactosidase treatment on the mechanical and physicochemical properties of the meat analogues.

Method:

FPC was treated with optimized conditions (α-galactosidase dosage: 7000 nkatal/g RFOs; treatment time: 5 h; water content: 65%) and extruded with a mixture of pea protein isolate (PPI) and oat fibre concentrate (OFC) at two water contents (62.5 and 60%) in high moisture extrusion and a long cooling die. FPC (90 and 80% of solids) was immediately after enzyme treatment fed to the extruder as a wet mass to avoid drying of the material before extrusion and PPI/OFC mixture (10 and 20% of solids) was fed as powder. Control samples were prepared with same extrusion conditions, feeding systems, and raw material ratios but without enzyme treatment. Oligosaccharides, mechanical properties, water absorption capacity and colour were analysed from the samples.

Results:

Enzymatically treated samples had approximately 80% lower RFO content compared to control samples. No differences in mechanical properties were observed between enzymatically treated sample and the control sample extruded at 62.5% water content. In the sample extruded at 60% water content, the enzyme treatment resulted in increased springiness, hardness and chewiness. Additionally, enzymatically treated samples had lower water absorption capacity and were redder compared to control samples. All samples had similar layered and fibrous structure observed by visual examination.

Conclusion:

α-Galactosidase treatment is a promising tool to produce meat analogues that are suitable also for consumers sensitive to RFOs. A high reduction of RFOs was achieved with a feasible enzyme treatment that did not affect the fibrous structure of the samples. However, slight effect was noticed in mechanical properties, colour and water absorption capacity. More studies are still needed to develop the enzyme treatment optimization and extrusion conditions.

P1.1.121

Characterization of Sugar Beet Leaf Proteins as an Alternative Food Protein

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Aim: Sugar beet leaves (SBL), by product of sugar industry, contain an average of 22.8% crude protein on a dry matter basis, which may be an alternative plant-based protein source.Leaves consist of both soluble and insoluble proteins. The RubisCO enzyme makes up almost half of the solute. The aim of this study is to characterize and purify the proteins in the soluble and insoluble part of the Sugar Beet Leaf. Using proteomic analyses and sequence-based comparisons with equivalent proteins obtained from other edible plants, potential plant protein sources are searched.
Method: The soluble and insoluble parts of SBL proteins were characterized by chromatographic methods, and SDS-PAGE (Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis), spectrophotometric measurements were made with UV-VIS spectrophotometer, protein quantification were performed using various protein assays, the identification and quantification of RubisCO and membrane proteins were performed using Mass Spectrometry (MS). A sequential comparison of abundant proteins in SBL with other edible green leaf plants is ongoing. Also, the solubility of protein powders obtained by various precipitation methods were investigated.
Results: The effect of sonication on extraction of proteins from plant cells was investigated, and the sonicated and non-sonicated supernatants were obtained as 2.010, and 1.674 mg/ml. Both cell lysates were analyzed by Anion Exchange Chromatography. SDS-PAGE analyses of samples indicated both large (~ 53 kDa) and small (~ 14 kDa) subunits of rubisco bands. Proteomics studies also show the RubisCO is the most abundant protein in SBL samples. Solubility analyses of protein powders of SBL show that pH 10 Sodium Bicarbonate Carbonate Buffer, 1:1 powder:buffer ratio, ultrasound sonication - 80% Amplitude (2 sec on, 8 sec off, Pulse: 4 min), heating (10 minutes at 60°C with stirring) give the most soluble proteins.
Conclusion: For the extraction of SBL proteins from both raw leaves and precipitated powders it was observed that sonication had a significant effect on the protein amount, as well as pH, heat, and the amount of buffer used. L RubisCO were clearly observed in SDS-PAGE results, and proteomic analyses. Our study will guide the food applications utilizing alternative proteins such as SBL proteins and their equivalents.

P1.1.122

Kinetics of pulsed electric fields assisted extraction of docosahexaenoic acid from

Crypthecodinium cohnii biomass

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Kinetics of pulsed electric fields assisted extraction of docosahexaenoic acid from *Crypthecodinium cohnii* biomass

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Aim:
In recent years, food industry is looking for alternative natural sources of bioactive compounds. Various microalgae are cultivated on an industrial scale to produce high added value ingredients, such as carotenoids, proteins, and polyunsaturated fatty acids. *Crypthecodinium cohnii* is an heterotrophic marine microalga producing significant amounts

of omega-3 fatty acids, mainly docosahexaenoic acid (DHA). DHA is important for human nutrition, with many industrial applications in high nutritional value product formulations. Pulsed electric fields (PEF) is a technique based on exposure of cells to high strength electric fields, enhancing mass transfer due to membrane permeabilization. The aim of this work was the improvement of DHA recovery from *C. cohnii* biomass by applying PEF as an extraction pretreatment.

Method:
C. cohnii (ATCC 30772) was cultivated in modified ATCC 460 A2E6 medium with 27 g/L glucose at 27°C for 10 days. After harvesting C. cohnii biomass, PEF treatment (0-13.5 kV/cm, 100 pulses) was applied on cells suspension. Untreated and PEF-treated C. cohnii wet biomass was mixed with the extraction solvent (chloroform-methanol, hexane-isopropanol, and ethanol) and left under constant stirring at ambient temperature for up to 6 h. The samples were centrifuged, and the organic extract was collected and evaporated under vacuum. DHA extraction yield was determined via Gas Chromatography with Mass Spectrometry. The kinetics of DHA release were mathematically evaluated using a first order exponential model.

Results:
The results showed that PEF pretreatment (13.5 kV/cm, 100 pulses) significantly increased the final extraction yield of DHA in ethanol, up to 75%. The increased permeabilization of PEF-treated cells resulted in a reduction of DHA characteristic extraction time in hexane-isopropanol 2:3, up to 73%. Maximum recovery of DHA from untreated biomass (20.3% w/w) was achieved using chloroform-methanol 1:2 as solvent, after 2 h of extraction. Alternatively, 1 h of extraction from PEF-treated biomass with pure isopropanol and hexane-isopropanol 2:3 resulted in similar DHA extraction recovery.

Conclusion:
The extraction of DHA from *C. cohnii* can be significantly enhanced by PEF as a pretreatment step, increasing extraction yield and overall process efficiency, with solvents of lower toxicity than conventional ones.

P1.1.123

Quality enhancement of osmotically dehydrated potato cuts by pulsed electric fields and high pressure-pretreatment

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Quality enhancement of osmotically dehydrated potato cuts by pulsed electric fields and high pressure-pretreatment

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Aim:
Osmotically dehydration (OD) is proposed to increase the shelf-life of fresh-cut high value vegetables, such as potatoes from Naxos Island which have the protected geographical indications certification proving their unique characteristics. During OD foods submerge in a hypertonic solution to reduce water content, while solutes from the solution counter-diffuse into the cellular tissue. Due to the tissue structure, OD is inhibited by slow water transport. Non-thermal processing methods i.e Pulsed Electric Fields (PEF) and High-Pressure (HP) is proposed before OD to enhance mass transfer. The effect of PEF and HP pre-processing on the quality and shelf-life of OD potatoes was studied.
Method:
Fresh-cut potatoes from Naxos island were processed (i) at 0.5-2 kV/cm (pulse number 20-1000) (PEF), and (ii) at 200-600 MPa (HP), and osmotically dehydrated (OD) using a solution of (wt) 40% glycerol, 10% sodium chloride, 1% ascorbic acid, and 0.025% papain at a liquid to food ratio 5:1, at 40°C for 0-180 min. PEF-OD, HP-OD and OD samples were stored at 4°C. Water loss, solids gain, water activity (a_w), texture, color and microbial stability (total viable counts-TVC, yeasts/moulds) were evaluated.
Results:
Both PEF and HP accelerated OD by increasing water and solid diffusion while maintaining potato quality. The optimum PEF and HP conditions were 0.5 kV/cm-200 pulses, and 400 MPa, respectively. The combined application of PEF/HP and OD (120 min) resulted in high-quality potatoes (reduced browning/discoloration) of lower a_w (0.82). The shelf-life of PEF-OD, HP-OD, and OD potatoes was approximately 7 days based on browning compared to the shelf-life of fresh-cut potatoes (3 days). PEF/HP-OD potatoes were microbiologically stable for 10 days at 4°C (TVC<4 logCFU/g, no yeasts/moulds), while the TVC of non-processed samples were 6 logCFU/g after 4 days.
Conclusion:
Mild processes are sought to improve quality and shelf-life of fresh-cut fruits and vegetables. Results highlight that the combined application of PEF/HP and OD can extend shelf-life and improve commercial value of fresh-cut potatoes.

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P1.1.124

Microwave and ultrasound extraction for up-cycling of marine by-products

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Aim:
This study aimed to utilize green extraction methods to recover value-added products from by-products originating from European plaice. Moreover, the objective was to optimize extraction and recovery, as well as to identify the quality of up-cycled products.
Method:
Microwave and ultrasound-assisted extraction from different by-product fractions was conducted. The fractions included backbones, skins, and heads. Both Microwave and ultrasound-assisted extractions were performed on untreated, pre-treated (salt-washed), and pre-treated (enzymatic hydrolysis) fractions. After extraction, the quality and yield of products were evaluated. Salt-washing was conducted subsequently by Sodium chloride, and enzymatic hydrolysis was performed by using the peptidase Alcalase 2.4 L to catalyse the reaction, in total for 60 minutes at 50°C with subsequent enzyme inactivation at 95°C. Both microwave and ultrasound-assisted extraction were performed for 15 and 35 minutes, and a water bath extraction of 150 minutes was used as a control. The quality was evaluated by considering yield and purity of the products. Protein and collagen concentration, amino acid profiles, and molecular size of the products were measured. SDS-page was applied to detect molecular size, Kjeldahl analysis for total proteins (%) and amino acid profile included total and free amino acid distribution (%) by High-performance liquid chromatography (HPLC) of the products.
Results:
Collagen was identified as the main product after extraction. Skin delivered significantly higher yields than heads and backbones ($p<0.05$). Enzymatic hydrolysis resulted in the highest yields, while salt-washing gave the lowest, across all by-product fractions. Longer extraction durations with microwave and ultrasound resulted in increased collagen yield ($p<0.001$), with extractions for 35 minutes yielding significantly more collagen than extractions for 15 minutes. The collagen content in samples extracted for 35 minutes using microwave and ultrasound did not differ significantly ($p<0.001$) from that of samples treated for 150 minutes in water bath. Microwave extraction led to higher collagen yields than ultrasound ($p<0.001$).
Conclusion:
The results showed that microwave and ultrasound-assisted extraction technologies are suitable for generating high-value collagen and further gelatine from marine by-products. Green extraction protocols suggested that longer extraction times could improve yield and purity, providing an alternative to long, extensive water bath extractions.

P1.1.125

Acrylamide(aa) Monitoring in Korean Processed food For Exposure Assessment

Acrylamide(aa) Monitoring in Korean Processed food For Exposure Assessment Jeong Min Kim[1], Acrylamide(aa) Monitoring in Korean Processed food For Exposure Assessment Dongjune Kee[1], Acrylamide(aa) Monitoring in Korean Processed food For Exposure Assessment Juhui Kang[1], Acrylamide(aa) Monitoring in Korean Processed food For Exposure Assessment Gunyoung Lee[1], Acrylamide(aa) Monitoring in Korean Processed food For Exposure Assessment Jea-En Mun[1]
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Aim: AA is formed when certain foods are prepared at above 120 ℃ and low moisture, especially in foods containing asparagine and reducing sugars. AA is classified as a Group 2A(probably carcinogenicity and reproductive toxicity). Korean MFDS(Ministry of Food and Drug Safety) set a maximum concentration of 0.3 mg/kg in foods for infants and toddlers as a recommendation Specification. In this study, we verified the AA test method and monitored the AA contamination level of 30 Korean processed foods for infants and toddlers to provide basic data for acrylamide management in processed foods.

Method: Analytical method of AA is a test method certified by the Ministry of Food and Drug Safety, which is analyzed by liquid chromatography-tandem MS(MSM) after extracting with water, and performing SPE (Solid Phase Extract). Potatoes, milk, and grain flour were selected as a representative matrix for monitoring foods. And the MDL(method detection limit) was estimated for each matrix.

Results: As a result of method verification, the linearity was upper R2=0.999 in the concentration range of 0-1500 μg/kg of the AA standard solution. Accuracy was % for fortified AA in each matrix, recovery rate 95.2~107.0%, precision (%RSD) 1.6~6.9 %, and MDL(Method Detection Limit) is lowered to 1.71 μg/kg from 8.28 μg/kg. As the result of monitoring AA was detected in all products. Dairy products (8 cases) were below the MDL, retort foods (7 cases) averaged 15.7 μg/kg, and sweets (15 cases) averaged 94.61 μg/kg.

Conclusion: The Analytical method verification result satisfies the AOAC guidelines for SMPR. And as a result of monitoring, AA was detected below 0.3 mg/kg, the maximum concentration of 0.3 mg/kg in foods for infants and toddlers as a recommendation Specification of Korea, in all cases.

P1.1.126

Unlocking the potential of anthocyanins from black carrots in emulsions by selecting the appropriate pH

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Aim:

The popularity of foods and beverages greatly relies on the use of colorants. Azo dyes, which belong to the group of artificial colorants pose potential health risks and are perceived negatively by consumers. Coloring foods can be obtained from plants by non-selective mechanical extraction. Anthocyanins play a central role in the area of red pigments, as they are abundant in numerous vegetables, fruits and flowers. Their color stability is limited by several factors such as the pH and the ability to act as radical scavengers. The aim of this study was to obtain detailed understanding of the antioxidative potential and color stability of anthocyanin-rich black carrot extracts in omega-3-fatty acid rich oil-in-water emulsions as a function of pH.

Method:

High-pressure homogenization was used to prepare 1% linseed oil-in-water emulsions, stabilized by 0.1% sodium dodecyl sulfate (SDS) in 10 mM citrate buffer solution at pH 2, 4 and 6. 0.73 g/L black carrot extract was added to half of the emulsions and all samples were stored at 35 °C. To compare emulsions with aqueous systems black carrot extract (0.73 g/L) was diluted in 0.1% SDS in a 10 mM citrate buffer solution. Anthocyanin concentration and the formation of primary lipid oxidation products, lipid hydroperoxides, were analyzed spectrophotometrically. GC-MS was used to determine the formation of secondary lipid oxidation products.

Results:

The concentration of anthocyanins in linseed oil-in-water emulsions decreased significantly faster than in aqueous SDS in citrate buffer solutions. In addition, the formation of lipid oxidation products is accelerated in emulsions without added black carrot extract. Both effects are associated to the antioxidative potential of anthocyanins. The stability of anthocyanins decreased in the following order pH 4, 6, 2 which is related to the fact that lipid oxidation is increased at lower pH values. This is in contrast to the common behavior of anthocyanins, being more stable with decreasing pH.

Conclusion:

Unlike in aqueous solutions, the stability of anthocyanin-rich plant extracts is enhanced at a pH of 4 in oil-in-water emulsions. It shows that the use of anthocyanins to color food emulsions, which usually have a natural pH range of 3 to 6, is promising.

P1.1.127

Baking with gas hydrates: low-acrylamide cookies as a healthier delight

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Aim:

The present-day diet contains a variety of breads and confectionary types, making bakery products an essential component. Ammonium bicarbonate, a chemical leavening agent used in black-and-white cookies can, however, have unfavourable side effects, such as the production of acrylamide which is a carcinogen. This research aims to use carbon dioxide gas hydrate (CO_2-GH) as a leavening agent in black-and-white cookies.

Method:

Standard recipe protocol was followed for the black-and-white cookies, except that CO_2-GH was used as the leavening agent and kneaded in a farinograph kneading unit, which was set at 42 °C, followed by baking for 12 minutes. Once baking was done, the texture profile, volume, moisture content, and size of pores on the cookies were measured to compare the leavening effect of gas hydrates with the standard cookies. By varying the proportion of CO_2-GH from 20 % to 40 % and 50 %, an analysis of the performance of GH as a leavening agent was carried out. The acrylamide content was evaluated with LC-MS-MS.

Results:

In comparison to the cookies made without a leavening agent, the GH cookies were notably able to attain a higher volume than the former. The specific volume produced when employing 50 % GH as a baking agent was more than half that produced when using ammonium bicarbonate. When ammonium bicarbonate was replaced with GH, the springiness and hardness, quality-determining textural characteristics of the pastry, remained in an acceptable range. The analysis shows that the amount of acrylamide was reduced from 24.8 µg/kg to around 18 µg/kg because of the replacement of ammonium bicarbonate.

Conclusion:

The recipes of black-and-white cookies with GH as a leavening agent are in the process of replacing conventional baking agents such as ammonium bicarbonate. The presented study demonstrates that it is possible to use CO_2-GH as a leavening agent for this application and possibly for other baked goods. Despite the numerous trials on CO_2-GH in other disciplines, additional research is required to understand the various uses of GH in food production.

P1.1.128

In vitro gastrointestinal release of bioactive compounds from starch based HPP hydrogels

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Aim:
Three-dimensional (3D) polymeric biomaterials so-called "natural hydrogels" has been a great matter of interest in the past years, because of their great potential in achievable applications. Among these up-trending materials, starch-based hydrogels are the most promising alternatives for producing polymeric biomaterials due to their excellent biocompatibility, biodegradability, and ability to enable the controlled release and target delivery of associated ingredients. Therefore, due to their mechanical and physical properties and promising stability and functionalization, starch-based hydrogels can be used as smart carriers for encapsulating bioactive compounds deriving from natural extracts. The aim of this work was to evaluate the ability of starch HPP hydrogels to vehicle bioactive compounds through the gastrointestinal tract.

Method:
Tapioca starch (20% w/w) and natural extracts were suspended in distilled water and subsequently processed by HPP at 600 MPa for 15 min to achieve starch gelatinization of starch. Gel formation was assessed by analysing the gelatinization extent and the sample structure. The release of bioactive compounds loaded into hydrogels was investigated through an in vitro human gastrointestinal model including oral, gastric, and intestinal phases.

Results:
The results showed that the processing conditions utilized allowed the formation of stable hydrogels even when natural extracts were added in the starch suspension. Moreover, the encapsulation of natural extract in the hydrogel structure allowed their controlled and prolonged release, providing the required stability to the bioactive compounds. It was demonstrated that the bioavailability of bioactive compounds can be increased through their incorporation in highly structured materials such as hydrogels and that their release in target organism can be controlled as shown by the results of the simulated human digestion.

Conclusion:
Tapioca starch HPP hydrogels could be envisaged as a suitable structure to be applied in food product design for the delivery of bioactive compounds in the intestinal tract. Nevertheless, further investigations should be performed to study the effect of bioactive compounds on starch digestibility, the physical and microbiological stability of these structures as well as their performance during shelf life.

P1.1.129

Influence of fluidized bed process parameters on plant-based milk powder characteristics

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Aim:

Food products in powder form are widely produced industrially due to advantageous properties including easy preservation, weighing, processing, transport and storage. Milk powder in particular has numerous applications in various products, but a growing number of consumers are tending towards plant-based alternatives. The Plant-Based Milk Alternative (PBMA) powder has a tendency to form lumps during reconstitution. This lump formation is most likely correlated with the powder bulk structure as well as the viscosifying and swelling properties of the plant ingredients. For more efficient wetting behaviour and facilitated water penetration due to capillarity between individual particles, the fine food powders are often agglomerated to design targeted particle structures.

Material & Method:

The PBMA model powder investigated in this project, consists of maltodextrin, plant protein, vegetable oil and a soluble fiber source. Different formulations are used to examine the influence of the model system components. The focus in this project is particularly on the plant protein and fiber source.
To obtain an optimized powder structure for subsequent applications, PBMA is produced by spray-drying of homogenized emulsions followed by fluid-bed agglomeration process. The effect of the interaction between material properties and process parameters on the formation, structure and qualities of the agglomerated powder is analyzed. Therefore, the

approach of statistical Design of Experiments (DoE) has been chosen. The fluidized-bed parameter used in the response surface design is the liquid spray rate, spray pressure, inlet temperature and nozzle position. The influence of the material components is included in the DoE by the powder formulations. As responses, the particle properties and reconstitution behaviour are investigated.

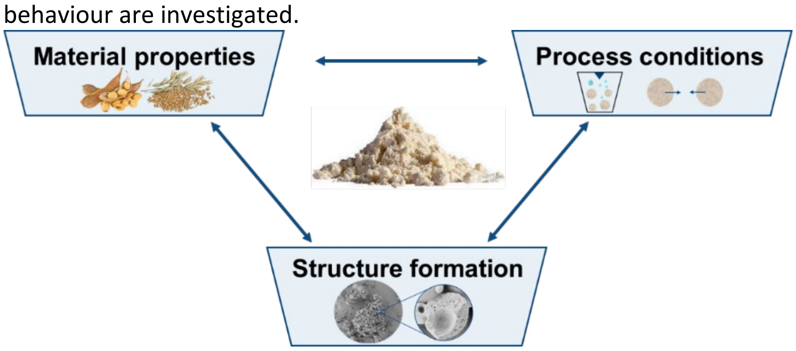

Figure 1: Overview of interactions between material properties and process conditions for targeted structure formation

Results:

The interactions between the material properties, fluidized-bed process conditions and structure formation of the powders could be highlighted through DoE. High liquid spray rates, low spray pressures and low inlet-temperatures leads to the best agglomeration results. An increasing concentration of plant proteins results in the smallest Sauter diameters whereas higher amounts of carbohydrates leads to the greatest agglomeration performance. The fiber source has, similar to the plant proteins, a negative impact on the particle growth due to agglomeration. The reconstitution analysis evince a connection between the contact angles of the different powder formulations and the size of the lumps formed after the dissolution. The results also show that smaller particles are more spheric leading to the formation of higher lump concentrations.

Conclusion:

The plant proteins and fibers show a predominant influence on the process and product properties. The agglomeration process enables the optimization of powder reconstitution properties and a connection could be shown to the particle characteristics. Further agglomeration analysis shall be conducted based on the DoE results for generating knowledge how the particle properties in dependency of the material characteristics change during processing. For the investigation the best and worse DoE trials regarding reconstitution behaviour of the particles will be analysed with different probes in the fluidized-bed process. The results will also be used for the validation of the micromechanism examined by a numerical approach.

P1.1.130

Application of vacuum microwave treatment to a concentration of apple puree

Application Of Vacuum Microwave Treatment To A Concentration Of Apple Puree Daisuke Kurata[1], Ph.D. Takahiro Orikasa[1,2], Ph.D. Shoji Koide[1,2]

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Aim:

Vacuum microwave (VMW) is one of the new technologies of high value-added to processed foods. VMW can shorten processing time because decreasing pressure during microwave heating reduces the boiling point of water, thereby lowering the drying temperature, and microwaves stimulate the vibration of water by penetrating an entire sample. There have been many reports on applying VMW to the drying of agricultural products, but there are few cases of applying VMW to processing methods other than drying, especially in a concentration process. Therefore, we applied the VMW treatment to the concentration process of apple puree and we investigated the effects of VMW treatment on some components of concentrated apple puree.

Method:

1. Materials

Fresh 'Fuji' apples were purchased from a local market in Morioka, Japan. The apples were peeled, cored, grated with a food processor (TK441, Tescom Denki Co., Ltd.), and pureed with a strainer (N3004BG, Louis Tellier).

2. Concentration method

The VMW experiments were conducted in a vacuum microwave instrument. The system consisted of an oil rotary vacuum pump (TSW-100; Sato Vac Inc, Japan), a cold trap (UT-3000; EYELA, Japan), a vacuum control unit (NVC-2100L; EYELA, Japan) and a microwave oven (µReactor Ex; Shikoku Instrumentation Co., Ltd., Japan). The samples, weighing a total of 100 g, were poured into a vacuum chamber, which was constructed of borosilicate glass and contained within the microwave oven. The samples were subjected to different microwave treatments at different levels of power (200W, 400 W, and 600 W) and absolute pressures (3 kPa, 10 kPa, and 20 kPa). The samples were concentrated until a soluble solids content (20-24 °Brix) was achieved.

3. Measurement items

The measurement items were soluble solids content (Brix), color, and ORAC.

Results:

Under the tested conditions of 3 and 20 kPa, processing times of concentration took from 5 min to 20 min to reach a final soluble solids content and low pressure and high microwave power accelerated the moisture transfer.

Conclusion:

The results suggested that the VMW treatment has the potential to obtain high-quality concentrated apple puree.

P1.1.131

Macroalgae: Study on impact of drying on composition, determination of sensory profile and consumer behavior

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Aims: Macroalgae, as new sustainable foods in the West, are attractive for their healthy aspect, with a high nutritional value, interesting bioactive molecules and distinctive flavor. In order to promote responsible consumption, it is necessary to study them in a global way, starting from the product to the consumer. Thus, the objective of this study was to evaluate the impact of drying on Quebec seaweeds, to determine aromatic profile and to study consumer behaviour towards them.

Methods: Fresh Quebec macroalgae *Saccharina latissima* (Sl) and *Palmaria palmata* (Pp) were frozen (control condition) or oven-dried (40 °C, 5 h). The chemical composition and potential bioactive compounds were characterized. Then, a sensory analysis of rehydrated commercial dried specimens Sl and Pp was conducted with 28 chefs. Sensory descriptors were collected and the aromatic profiles of macroalgae were established. Finally, Quebec consumers were recruited and randomly assigned to a control group (n=51) and a group that participated to a single chef-supervised culinary workshop (CW) on seaweed (n=48), and both groups received a gift bag containing seaweeds. At the beginning and the end of the study, participants completed questionnaires on culinary skills towards seaweeds and on the introduction of seaweeds into food habits.

Results: The drying only slightly affected the chemical composition of Sl and Pp. A significant loss of polyphenols were detected for both species, while carotenoids were significantly concentrated in Pp and lost in Sl. For the aromatic profiles, differences were detected between the two seaweeds, with descriptors such as "sweet", "iodized" or "earthy" rather attributed to Sl and "nuts-like", "fatty" or "floral" rather awarded to Pp. The Quebec consumers who participated to the CW significantly improved their seaweeds cooking skills and both groups (without difference between them) introduced more seaweed into their food habits.

Conclusions: In summary, the drying of the macroalgae Sl and Pp from Quebec seems to maintain their food quality. These two species present different aromatic profiles that should be taken into account in order to democratize seaweed as a food. The culinary workshop appears to be a promising strategy to develop seaweed consumption in Quebec.

P1.1.132

Characterizing germination enzymes for extraction of pea protein – a molecular biology approach

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Aim:
Peas (*Pisum sativum*) are a valuable source of plant proteins and pea protein isolates are commercially available. These products are already widely used for production of plant based foods as a competitor to soy. Pea has advantages to soy as they can be grown in colder climates, and are less allergenic. However, commercial pea protein isolates still lack functional properties demanded by industry, partly due to the extraction process that favours quantity to quality. Additionally, the extraction process requires large amounts of water, energy and harsh chemicals, counteracting the goal of sustainability. In this study, we aim to study enzymes naturally active during germination with the goal to use these enzymes to make the extraction of pea proteins more sustainable.

Method:
Pea seeds are germinated to a variety of stages and total RNA was extracted from the whole seed as well as the hypocotyls and radicals. The quality of the RNA extraction was determined by gel electrophoresis and by reverse transcription and amplification of reference genes. The transcription profile was evaluated by untargeted transcriptomics with help from a commercial partner and by targeted transcriptomics on cDNA in house.

Results:
In this ongoing study, preliminary results have shown successful extraction of RNA from different stages of germination and different tissues. This is seen both from direct gel electrophoresis and by amplification on cDNA. When the data of the untargeted transcriptomics have been evaluated further, we will select transcripts that appear play a role in the natural extraction of plant proteins during germination. We will validate these results using in silico analysis of the sequences as well as targeted transcriptomics to link their transcription to events in germination.

Conclusion:
With the results above, we intend to produce and isolate these enzymes using heterologous expression in *E. coli* and test their effect on pea protein extraction efficiency. We thereby aim to produce a protein product that can be used commercially that both has better functional qualities and is more sustainable than what is available today.

P1.1.133

FOODPathS, transition towards sustainable food systems; a presentation of co-creation cases

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Aim: The United Nations Sustainable Development Goals and the European Commissions' (EC) Green Deal and Farm-to-Fork strategy fuel the development of the Partnership on Sustainable Food Systems (P-SFS). Together with the 10 FOOD2030 pathways of HorizonEurope, the P-SFS set the scene for future food science and technology topics in Europe.
Method: The Strategic Working Group Food Systems of the Standing Committee on Agricultural Research together with EC-DG RTD had created a taskforce to define the Strategic Research and Innovation Agenda (SRIA) of the P-SFS. The taskforce had organized expert working group sessions, interviews and open consultations. Thanks to all input, the SRIA has been published in January 2023. The translation of the SRIA in a first prototype P-SFS is currently carried out in the CSA FOODPathS project (in which EFFoST is partner), financed by the EC since June 2022 for 42 months.
Results: The SRIA has defined four scientific priority areas. Two of them are directly related to food science and technology (FST) themes, namely 'change the way we process and supply food' and 'change the way (what) we eat'. The SRIA also proposes four transversal areas, all relevant for the EFFoST community, namely R&I funding, a SFS observatory, SFS living labs and knowledge sharing. FOODPathS has mapped first food system cases in these areas.
Conclusions: The SRIA proposes that future FST trajectories will target enlarged diversity (in resources and diets), circularity (including re-utilisation of main and co-products in food designing processes), fairness (food and nutritional security for all, everywhere), one health concepts, guaranteed safety, scalability (e.g. of technologies in different contexts) and robustness (of for examples processes facing shocks). The mobilization of digitalization – in widest sens – is strongly recommended, as well as the connections with socio-economic sciences. The latter are highlighted by first examples of food system cases

reviewed in FOODPathS[1]. The SRIA and FOODPathS underline the crucial role of FST in changing the patterns of our, current, linear food chains, towards sustainable ones balancing between planetary and societal limits.

[1] A detailed overview will be given in a proposed Special Session organized by EFFoST itself.

P1.1.135

EFFECT OF STABILISING AGENTS ON THE TEXTURE OF PATES MADE FROM LING ROE BY-PRODUCTS

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Aim:

Nowadays, a large number of by-products suitable for human consumption and with a valuable nutritional profile are discarded by the fishing food industry because they are discarded pieces or because of a visual defect. This is a resource problem as well as an ecological problem. An example of this is fish roe intended for salting, which is discarded from the market because the membrane surrounding the gonad is not intact. Therefore, in order to make room for these by-products, which implies a more responsible production and consumption adapted to the new consumer demands, an alternative could be the elaboration of preserves or prepared dishes with fish by-products, as it is a more economical and ready-to-eat product.

Therefore, the objective was to evaluate the effect of different stabilising agents on the texture of pates made with fish by-products.

Method:

Three types of pate were produced with ling roe (*Molva-molva*) without integrated gonad membrane (three replicates of each): control (C) (56% roe, 18% olive oil, 11% tomato, 11% water, 4% spices, no stabilising agent), formulation 1 (F1) (56% roe, 18% olive oil, 11% tomato, 9% water, 4% spices, 2% milk powder as stabilising agent) and formulation 2 (F2) (56% roe, 18% olive oil, 11% tomato, 4.5% water, 4% spices, 6.5% starch as stabilising agent). Texture profile analysis (TPA) was performed in quintuplicate using a texture analyser (Brookfield) using a 4500g load cell and TexturaPro CT V1 software. 8. The parameters measured were hardness 1, hardness 2, gumminess, chewiness, adhesiveness, cohesiveness and elasticity. One-way ANOVA and Tukey tests were performed with SPSS 28.

Results:

The results showed how the use of milk powder (F1) and starch (F2) gave less hard products, more typical of this type of product, and more adhesive, elastic and cohesive. F1 was the one with the most cohesive emulsion.

Conclusion

In general, the pates made with ling roe by-product showed good textural properties.

P1.1.136

Improving the efficiency of radio-frequency heating in whole-peanut using a mixing method under stationary-continuous processing

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Improving the efficieny of radio-frequency heating in whole peanut usuing mixing method under stationary and continous processing

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Keywords: *Radio Frequency, heating uniformity, mixing method whole peanut, coating,*

Aim:. This study aimed to improve RF heating uniformity in whole peanut products using a sample mixing method while investigating the coating effect of peanut (skin/peeled) with salt on heating efficieny and uniformity during stationary and continous processing.

Method: Whole peanuts samples (salted-skin, unsalted-skin and unsalted-peeled) were used to determine the effect of coating, peanut skin, and sample mixing method on heating efficiency and uniformity. A rectangular polypropylene (PP) container filled ≈ 500 g whole peanut placed at the center of system were processed using a RF system, 10 kW-27.12 MHz at 12 and 14 cm electrode gaps. The temperature-time heating profiles were obtained using a fiber optic sensor placed in a single peanut in the center of the container while determining the surface (bottom, middle and top) temperature distributions using an infrared thermal camera. The sample mixing method was physically applied by flipping over and shaking the container after 30 min to reach 80°C across the container at the cold heating areas. The same experiment were carried out using continous system with 0.0025 m/s carrier band speed for 60 min while apllying sample mixig method.

Results: Flipping over and shaking the container in the middle of processing ≈ 30 min resulted in a significant improvement in temperature uniformity across the container at stationary and continous processing. However, the skin peanut samples showed less uniform heating than the peeled peanut samples although there was not any significant difference between temperature-time heating profiles. Coating of peanut with salt resulted in an increase of sample temperature up to 5°C ± 2. There was no remarkable temperature difference at the stationary and continious system with lower band speed rates under the optimized electorade gap (12 cm) and power level at the end of the process.
Conclusion: Results indicated that coating the peanut samples with salt further enhaced heating efficieny of RF heating at both stationary and continous processing. However, the peanut skin leaded the non-uniform heat distribution across the container while mixing sample method improved heating uniformity for all samples. The results of this research can further help to optimize the process parameters of continous RF heating to pasteurize whole peanut for indusrtia applications.
Acknowledgement:
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P1.1.137

The effect of container geometry and particle size on heating efficiency of radio-frequency processing peanuts

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Determining the effect of container geoemtry and particle size on heating efficiney of radio frequency procesings peanuts

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***Keywords:** Radio Frequency, heating uniformity, peanut, particle size, 3D printed container*
Aim:
Radiofrequency (RF) treatment is an effective and promising method for disinfestation of low-moisture agricultural commodities. Non-uniform temperature uniformity, however, is a major challenge for industrial applications. This study aims to investigate the impact of container geoemtry, electrode gap distance, physical flipping over of the containers on temperature unfiformity during processing with particle size effect.
Method:
Various geometry (square, rectangular and cylindrical) 3D-printed containers with equal volumes were prepared to determine the RF heating uniformity in peanut samples with different particle sizes. Roasted whole peanuts were grounded with a cooled miller, sieved (2, 1.4, 1, and 0.71 mm size sieves), vacuum-sealed and stored for further RF processing in a 10 kW-27.12 MHz staggered electrode system. Containers filled with ≈160 g peanut samples were placed at RF system center and processed at 10, 12 and 14 cm electrode gaps. Temperature changes were recorded with fiber obtic sensors at three different locations, and containers were flipped over after 30 min. The expected temperature to reach at the slowest heating sections was to reach to 80 °C.

Results:
Cylindrical geometry container filled with 1 mm ground peanuts heated faster with a more uniform heating. Flipped overing the container after 30 min resulted in a significant improvement in temperature uniformity while daresing electrode gap substantially shortened the heating time while increasing electrode gap had no noticeable effect on heating uniformity. Smaller particle sizes (0.71< particle size <1.0 mm) showed a negligible effect on heating time while increasing heating uniformity across differently shaped containers.
Conclusion:
This study provided valuable insights into the heating efficiency of RF processing for container geometry, electrode gap, physical flipping of the containers and particle sizes. Optimizing the electrode gap provided further improvement in processing time with uniform heating feature while reducing the gap between peanut particles across the containers by using the smaller particle significantly enhanced the heating efficiency of the RF system.These are expected to contribute to optimizing RF processing conditions for the food industry.
Acknowledgement:
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P1.2.001

Bovine lactoferrin - intensively studied compound

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Aim:
A major legislative action (Regulation (EU) 2015/2283 of the European Parliament and of the Council) allowed the placing on the market of bovine lactoferrin (LF) as a novel food ingredient from 2018. Industrial production from skimmed milk or whey has made bovine LF a commercially available product and has enabled its application to be expanded into a number of fields – e.g. food and beverage production, infant milk formula, sports nutrition, food supplements, animal nutrition, pharmaceuticals, cosmetics. The widespread and increasing use of LF in health promotion and restoration is supported by a number of new studies.
As far as the milk chain is concerned, it is an endogenous protective substance that belongs to the soluble component of the udder immunity of the dairy cow, the protection of the newborn calf and the protection of milk especially against microbial deterioration by positively influencing the microbiome of raw milk. Given all these aspects, a set of factors affecting its concentration in milk is intensively studied.

Methods:
In raw cow's milk samples, the effect of lactation factors and individuality of the dairy cow on the concentration of lactoferrin determined by liquid chromatography was verified.
Cow's milk taken from farms in the Czech Republic was defatted by fat centrifugation and then precipitated with acetic acid to pH 4.6. The proportion of lactoferrin in the centrifuged whey was determined by means of a liquid chromatograph with a photodiode array detector.

Results:
The average lactoferrin content in cow's milk of 123.73 ± 58.51 mg/L is comparable to the results of other works, but no discernible statistically significant ($p>0.05$) trend in the change in lactoferrin concentration depending on the order or phase of lactation was found.

Conclusion:
The pilot study shows that for a relevant assessment of these factor effects (order or phase of lactation), targeted monitoring of lactoferrin levels in milk from the same dairy cows at the same lactation stages is needed.

Acknowledgment:

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P1.2.002

Sustainable Solutions for Phytochemical Detection: Employing HPLC and Modern Sample Preparation Techniques

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Aim:
Among flavonoids, anthocyanins and catechins are well-known phytochemicals with an increasing interest in the food industry, not only for their application as food colorants but also for the positive health effect through their antioxidative capability. These compounds are commonly extracted using polar organic solvents and spectrophotometrically determined. Nevertheless, current methods require high volumes of organic solvent, produce high volumes of organic waste, and are time-consuming. Along with this, their lack of specificity leads to inaccurate quantification.
Therefore, having current analytical methodologies for sample preparation and selective determination of phenolic compounds is crucial for the characterization of foods to enhance their antioxidant qualities and, on the other hand, facilitate the study of the stability of these compounds in different food products.
Here, green approaches are presented for the simultaneous extraction and determination of anthocyanins and catechins from tea and wine samples. Using high-performance liquid chromatography (HPLC) and different detection systems (PDA, MS, MS/MS).

Method:
Instrumental determination was performed using Thermo Scientific TSQ Quantis LC-MS equipment for the HPLC-PDA and HPLC-MS analysis. Reverse-phase HPLC (RP-HPLC) was performed with C18 columns, comparing the core-shell technology with traditional fully porous particles.
Catechins were extracted from tea and wine samples using a new salting-out assisted liquid-liquid extraction with reduced organic solvent and waste. Acetonitrile and ammonium sulfate were used as extractive solvent and salting-out agent.

Results:
The salting-out effect allows the simultaneous extraction of these compounds from complex matrices with reduced organic solvent and waste. Analytical features of the developed method achieved excellent results in terms of linearity (r22>0.999), accuracy and precision, matching the requirements of FDA validation guidelines. The use of Core Shell technology allows the separation of the compounds with better resolution, shorter time and less mobile phase volumes than traditional packing columns.

Conclusion:
RP-HPLC solves the lack of specificity. MS analysis and PDA determination are powerful tools for identifying flavonoids without needing standards. Coreshell technology is an outstanding alternative for achieving a better analyte's peak resolution. This is the first time HILIC chromatography has been used to analyze flavonoids. Red wine and tea analysis showed specific profiling for each sample group.

P1.2.003

Reduction of histamine content in cheese by addition of animal and plant-based Diamine Oxidase

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Aim:
Histamine is a biogenic amine produced by decarboxylation of L-histidine. Fermented and cured foods, such as cheese, sausages and fish, have an overgrowth of bacteria with decarboxylase activity which can promote the degradation of L-histidine into histamine. This compound reaches the body through food consumption, and its accumulation can provoke histaminosis, with adverse effects, such as migraines, headaches and asthma. Moreover, when ingested amounts are higher than 500 mg/Kg intoxication can be produced. The enzyme Diamino Oxidase (DAO, EC.1.4.3.6) is responsible for degrading the histamine. DAO is found mainly in the walls of the intestine and acts during digestion. A low Diamine Oxidase content in the body can cause histaminosis. To solve this problem, there is supplementation with DAO from pig kidney protein

capsules. Nonetheless, these capsules have low enzymatic activity and are obtained from animal sources. It would be interesting to study other DAO sources and possibilities to face this intolerance. The objective of this work was to decrease the histamine content in cheese by the addition of animal or plant-based DAO.

Method:
For this investigation, different cheeses were treated. Diamine Oxidase from two different sources was used: animal (porcine kidney protein extract) and vegetable (*Pisum sativum L* protein extract) sources. The histamine content was analyzed by HPLC. The addition of DAO was proposed as a pre-treatment of the cheese before consumption.

Results:
Although cheese matrix tends to reduce DAO activity as pH levels are low and salt content is high, a good histamine reducing capacity was observed for both, animal and plant-based DAO. Plant-based DAO exhibited a greater histamine degradation percentage than animal-based DAO.

Conclusion:
The addition of Diamine Oxidase in food products before consumption could be a good option in order to confront histamine intolerance. Furthermore, the utilization of plant-based DAO improves the histamine degradation, an could be included in vegan and vegetarian diets.

P1.2.004

SENSORY ENGINEERING APPROACH: DRIVING PRODUCT FORMULATION THROUGH CONSUMER PERCEPTIONS AND PREFERENCES

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Aim: During food formulation products, consumer perception is essential to the development of optimal prototypes. Nielsen (2014) highlighted that 76 % of products developed are failures in the first year. Consumers' intervention often comes at the end of the development process, whereas it could be useful at all stages of formulation. The project aims to achieve a sensory engineering approach, based on experimental design, that integrates consumers perceptions and preferences at each stage of product development. To illustrate this approach, we chose to work on the formulation of a hybrid minced steak: mix of beef and soy proteins. The objective was to find the recipe that would get closer to perceptions of a pure beef steak while reducing meati proportion in the product. This objective was set in relation to current environmental issues.

Method: To integrate consumers' perception in the formulation process, a five steps methodology was proposed: (i) the choice of design factors with a consumers' approache to create a relevant product area/zone regarding consumers expectations for steak (ii) Desing of 10 steaks according to a design of experiments and a fast sensory characterisation of each steak to validate sensory differences between each steak developed (iii) Carrying out a sensory profile and a consumers' preferences test for the prototypes (iv) tChoice of the best receipe with a statistical approach (v) Validation of the optimal receipe found during the step (iv) with a consumers' evaluation.
Results: The method deployed allowed the definition of two key factors for the design of the optimal steak : the cooking time and the percent of soy protein. The results of the sensory characterisation highlights the differences between the products for 9 sensory dimensions. By combining sensory data with consumer preference, we identified a new optimum.
Conclusion: This study was a proof of concept to deploy a sensory engineeringmethodology. At each stage of the methodology, an approach to integrate consumers' perception was proposed and allowed us to identify levers to improve the methodology. The hybrid steak developed is optimal as its scores are close to the "classical beef steak in terms of appreciation and authenticity.

P1.2.005

Exploring gastronomic formulations with chitin extracted from Tenebrio molitor insects for sustainable and healthy diets

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Aim:
The use of insects as a protein source is becoming an increasingly popular and sustainable alternative to conventional protein sources as they produce fewer greenhouse gas emissions and require less water and land than traditional livestock. In addition to the protein, different fractions of insects can be utilized in the food industry. Chitin is a structural polysaccharide that is mainly found in the cuticle of insects and can be a valuable ingredient in the formulation of healthy foods. The aim of this study was to develop healthy gastronomic formulations for senior population that included chitin extracted from Tenebrio molitor insects.

Method:
Chitin was obtained as the first product of an enzymatic hydrolysis process that digests the protein components of the insects. The separation and obtaining process of chitin was carried out using a 200 µm sieve and subsequent washing processes. Microbiological testing of the extracted chitin batches was performed to ensure their microbiological suitability as an ingredient.

A team of chefs developed six different formulations, three semi-solid and three liquid, each of which contained 0.6 grams of chitin per serving. The goal of designing products with gastronomic value was to create recipes that are not only delicious but also visually stunning and emotionally satisfying. A combination of technical skill, creativity, and a deep understanding of consumer preferences and trends were considered for formulations. Physicochemical and instrumental characterization was performed on each formulation by determining pH, moisture, acidity, consistency, instrumental texture, and color. Nutritional fact was carried out on each developed prototype using Diet Creator© software.

Results:
The designed prototypes were: Apple white garlic soup, Cordoban salmorejo with blood orange, Black bean hummus, Creamy mushroom and fungus soup, Onion soup, and Pumpkin and banana smoothie.

Conclusion:
The utilization of different fractions of insects can provide additional opportunities for the development of sustainable and functional foods in the food industry.

P1.2.006

Encapsulation of beet residue concentrate extract using dynamic membranes

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Introduction
Discarded red beet (*Beta vulgaris* L.) peel, leaves, and stalks contain bioactive compounds with demonstrated anti-inflammatory, anticancer, and antioxidant properties in *in vitro* studies. However, the susceptibility of these compounds to light, pH, and temperature variations limits their effectiveness. This study explores membrane emulsification, specifically dynamic membranes of tunable pore size (DMTS), to preserve these compounds. Double emulsions ($W_1/O/W_2$) were prepared with concentrated beet residue extract (CBE) and insect protein as a stabilizer.

Method
The beet residue extract (BE) was obtained through water infusion and concentrated using forward osmosis. The BE and CBE were characterized based on total phenolic content (TPC). Primary emulsion was produced mixing CBE (W1) in linseed oil (O) with PGPR as emulsifier. Coarse double emulsion was prepared by mixing the W1/O emulsion into aqueous solution (W2) containing insect protein. The double emulsions ($W_1/O/W_2$) were then refined in three cycles using DMTS. The encapsulation efficiency (EE), droplet size and distribution, as well morphology, were evaluated. The emulsion from the last cycle (C_3) was stored at 4 °C and 25 °C for 7 days and assessed on days 0 and 7 in terms of zeta potential (ZP), size distribution, and morphology.

Results
Forward osmosis concentration of EB led to a five-fold increase in TPC, from 386.59 to 2036.24 µgGAE/mL. The emulsions produced in different cycles (coarse, C_1, C_2, and C_3) exhibited EE of 97 %, 86 %, 83 %, and 77 %, respectively. Diameter [4.3] and span values for the coarse emulsion were 62.22 µm and 2.20. In C_1, the values reduced to 8.98 µm and 0.91, while in C_2, they were 7.90 µm and 0.93. In C_3, the values further decreased to 7.39 µm and 0.98. On day 7, the C3 emulsion at 4 °C

showed a ZP of -27.18 mV, a diameter of 7.37 µm, and a span of 0.93, while at 25 °C showed a ZP of -25.46 mV, a diameter of 12.04 µm, and span of 1.82.

Conclusion

Emulsions containing encapsulated CBE were prepared. During the refining process, EE and size distribution were decreased while C_3 was stable at 4 °C for 7 days.

P1.2.007

Yacon syrup – a prebiotic source for reducing the sugar content in food

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Aim: Chronic diseases such as diabetes and obesity are steadily increasing in the Western diet, which has led to growing interest in the use of sweetening alternatives. The aim of the Cornet research project "293 EN YaRup" funded by AiF and SPW-EER was the development of processing strategies for yacon syrup as a sugar alternative, its investigation on the influence of sweetness perception and its release of glucose as well as its application in cereal bars or praline fillings.

Methods: Saccharide content was determined by means of HPLC for yacon syrup and commercial sugar products. An in-vitro model was used to investigate glucose release, whereby glucose content over time was determined by subsequent photometric measurement. To quantify prebiotics, fructooligosacchairdes (FOS) and fructans were determined by UPLC-MS and according to the AOAC 999.03 method, respectively. Modell recipes for cereal bars and praline fillings were defined and product quality was evaluated by texture profile analysis, sensory evaluation and color measurement by DigiEye system.

Results: Sugar analysis revealed that rice syrup had the highest glucose content (25 g/100 g), whereas elevated fructose content was quantified in yacon syrup (14 g/100). Fructooligosacchrides achieved up to 30% on dry basis and fructans revealed up to 50% on dry basis in yacon syrup. Rice syrup had a significantly higher glucose release with 1000 mg/L over 300 minutes than did yacon (200 mg/L). Independent of the applied syrup, hardness of cereal bars didn't significantly differ. The application of glucose syrup resulted in a high sweetness perception in cereal bars, whereas panelists primarily rated yacon syrup containing products with a significantly lower sweetness. Regarding its applicability, agave or maple syrup for instance showed bright color, whereas yacon syrup revealed a brownish color. Thus, in cereal bars a slight darkening of the products was detected.

Conclusion: The findings showed that yacon is a suitable sweetening alternative for the production of cereal bars and praline fillings without significant limitations in product quality. In particular, the lower glucose release and its positive influence in the course of regulating type 2 diabetes will gain in importance in future research projects.

P1.2.008

Co-delivery of chlorogenic acid/curcumin in double emulsions with the outer interface stabilized with cellulose nanocrystals

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Aim: To evaluate the storage stability of linseed oil Pickering water-in-oil-in-water ($W_1/O/W_2$) double emulsions (DEs) with the outer interface stabilized by cotton cellulose nanocrystals (CNC), as well as the bioaccessibility of co-encapsulated chlorogenic acid (CA) and curcumin (Cur) during an *in vitro* gastrointestinal digestion.

Method: DEs were prepared by two step homogenization. Linseed oil, containing Cur (0.3% w/w) and polyglycerol polyricinoleate as lipophilic emulsifier (6% w/w), was homogenized with the internal aqueous phase (W_1) containing CA (0.1% w/w) (20:80 W_1:O) with an ultrasonic processor (30 KHz, 100% amplitude, 3 min). DEs stabilized with CNC (DE-CNC) as hydrophilic emulsifier were obtained by adding the W_1/O to an external aqueous phase (W_2) containing CNC (8.3% w/w) using a rotor-stator homogenizer (40:60 W_1/O:W_2, 13,000 rpm, 1 min). A control DE for comparative purposes was formulated with sodium caseinate (0.5% w/w) as hydroplilic emulisifier and high-methoxy pectin in W_2 (3% w/w). Encapsulation efficiency (EE) of CA and Cur, droplet size and creaming stability of DEs were determined. DEs were subjected to *in vitro* gastrointestinal digestion (INFOGEST method; Brodkorb *et al*., 2019) and the bioaccessibility of the bioactive compounds was evaluated.

Results: Both DEs were very stable to creaming during storage at 4 ºC, showing values of 7% and 5% for DE-CNC and control DE, respectively, after day 21 day of storage, whereas $D_{4,3}$ values were in the range 20-27 µm. The encapsulation efficiency (EE) of CA was significantly higher in DE-CNC (92.6%) than in control DE (26.0%), together with the retention of W_1 evaluated by confocal microscopy, demonstrating the stabilizing role of CNC at the outer interface. Both DEs showed EE values above 97% for Cur. The bioaccessibility of CA was higher in DE-CNC (~57%) than in control DE (~35%), but the DE-CNC showed lower Cur bioaccessibility (~65%) than control DE (~90%), suggesting the bonding formation between CNC and curcumin (Yuan *et al.*, 2022).

Conclusion: The use of CNC as hydrophilic emulsifier in DE is a promising strategy to increase the stability of these systems, and to design co-delivery vehicles with a significant release of bioactive compounds in the intestinal phase of digestion.

P1.2.009

Chitosan, from the identification of origin by a multidisciplinary approach to the application in oenology

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Aim:

Chitosan is a promising antimicrobial agent, capable of providing control of a wide range of spoilage microorganisms. To guarantee the fugal origin of chitosan, the only authorized for oenological practices, a multidisciplinary approach based on the measurement of the stable isotope ratios, Fourier transform infrared spectrometry and thermogravimetric analysis was proposed. In addition, the activity of chitosan against food related microorganisms was evaluated by different experiments aimed to discriminate between chemical and physical action of chitosan vs. the microorganisms.

Method:

The measurement of the stable isotope ratios (SIR) of carbon δ13C, nitrogen δ15N, oxygen δ18O and hydrogen δ2H of 35 samples of chitosan and the data of maximum degradation temperatures (obtained by TGA) combined with those of the peak areas of amide I and NH2/Amide II (obtained by FTIR) were employed to discriminate chitosan different sources (fungal grown on different substrates vs crustacean). The antimicrobial activity was tested in static and stirred conditions, in a synthetic media, using type strains of most common technological or spoilage microorganism. Viability was evaluated by Petri plate counts. The activity of the soluble portion of chitosan was checked by inoculating microorganisms in the media after chitosan removal.

Results:

The Kruskal-Wallis test showed that δ13C and δ18O were the most significant parameters able to classified chitosan into three different groups (from fungus grown on C3 photosynthetic cycle plant substrate, from fungus on C4 substrate and from crustacean). HCA and PCA analysis based on TGA, FTIR and SIR data successfully distributed the tested samples into informative clusters. Tests of chitosan antimicrobial activity highlighted the different sensitivity of microorganisms to chitosans, allowing selective control of spoilage agents. However, yeast and bacteria involved in fermentation were damaged by chitosan, and the synthetic media treated with this molecule showed a less fermentative aptitude.

Conclusion:

A robust analytical strategy for the correct identification of chitosan samples from crustaceans or fungi was presented, based on the observation that diverse biosynthetic pathways during the formation of the chitin influenced the isotopic composition of chitosan. Results of toxicity tests suggest that chitosan is a promising tool in fermented beverage production, but an in-depth study of the biochemical interaction between chitosan and food microorganisms is necessary.

P1.2.011

Incoroporation of apple pomace in chocolate mousse: from formulation to consumers' perceptions

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Aim:
By-product valorisation is a key lever towards a more sustainable food system. Food reformulation is a rising trend, due to considerations such as vegan alternatives to milk and eggs, as well as lowering the environmental impact with vegetal ingredients. However, the major part of the fortified products in literature are cereal-based. The aim of this study was to develop a vegetal chocolate mousse only stabilized with vegetal by-products (aquafaba and apple pomace).

Method:.
Classical chocolate mousses rely on egg white proteins for their foaming properties. In this study, we proposed 6 different foams: a reference with egg white, 2 commercial vegan mousses (coconut based) and 3 mousses formulated in the laboratory (1 without apple pomace, 2 with apple pomace incorporated either in aquafaba or in chocolate phase before foaming). Foams were instrumentally characterized (microstructure and texture) as well as consumer' acceptance. 120 participants blindly assessed the 6 foams according to their preferences and gave free comments.

Results:
The incorporation of apple pomace in the aquafaba phase led to a higher air incorporation compared to its addition in the chocolate phase with a density of 0.62 and 0.46 g.m^{-3}, leading to a firmer texture. Both foams where firmer than the mousse formulated without pomace but 3.4 times less firm than the egg-based reference. Apple pomace is thus helping to decrease the gap between vegetal chocolate mousses and classical ones (5.7 times firmer).
Regarding consumers acceptance, this study highlights that the 2 least appreciated foams with apple pomace: the problem mainly lies with aromatic and flavor intensity rather than texture. In any case, the profile of the scores shows that one of the 2 apple pomace foams was not consensual, as it appreciated by a part of the surveyed population.

Conclusion:
This first study constitutes a proof of concept, showing the interest and the texture fortification role of apple pomace in the formulation of vegan chocolate mousse. Further work is needed to improve the aromatic quality of the mousse. This result underlines the potential obstacles regarding consumers acceptance, in the formulation of foodstuffs based on by-products that differ from the conventional products.

P1.2.012

Plant-based analogues: market trends about antimicrobial formulations and impact on L. monocytogenes growth

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Aim: The consumer demand for plant-based cooked meat analogues has pushed the food industry to release a variety of innovative products. As ready-to-eat (RTE) products, L. monocytogenes is a highly relevant hazard, being recently involved in some RASFF alerts affecting plant-based meat analogues. The aim of the present study was to benchmark trends in antimicrobial ingredients and additives and to evaluate the behaviour of *L. monocytogenes* through challenge testing in different commercial meat and dairy analogues.
Method: The Mintel-Global New Products Database was used to gather information from the labels of meat and cheese analogues and tofu from the last 3 years. Additionally, growth potential and growth rate-type challenge tests were conducted to characterize the growth of *L. monocytogenes* in plant-based cooked ham, mortadella, frankfurter-type sausages, cheese, and tofu packaged in air, vacuum and/or MAP atmospheres during refrigerated storage. Growth kinetic parameters were estimated and used to simulate the growth of the pathogen under different temperature profiles to determine its impact on the safe shelf-life of the products.
Results: According to the list of ingredients, a considerable number (>75 %) of plant-based products were formulated without antimicrobials. Among the antimicrobials used in the evaluated plant-based products organic acids salts, mainly lactate and especially acetate (labelled as vinegar) were the most frequently used. Challenge test results revealed that *L. monocytogenes* was able to grow in plant-based frankfurters and tofu formulated without antimicrobials and with high a_w (0.99) and pH (>5.9). In contrast, its growth was inhibited in analogues containing antimicrobials (lactate and/or vinegar), high levels of lactic acid bacteria or MAP packaging with CO_2. Storage temperature had a remarkable impact on the growth rate of *L. monocytogenes* and consequently on the safe shelf-life of plant-based analogues supporting its growth.
Conclusion: A safety-by-design approach considering the presence of antimicrobials, pH value, packaging atmosphere, presence of LAB and the length of the shelf-life is essential for the development of safe plant-based analogues.

P1.2.013

Sym'Previus, a user-friendly predictive tool for the food industry

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Aim: Sym'Previus is a complete tool for microbiological data prediction. Recognized by the scientific community for more than 20 years, it helps manufacturers to guarantee food safety and quality. Thanks to the expertise provided by its partners, Sym'Previus tools provide users with customized solutions to their industrial issues. The aim of this communication is to give examples (case studies) where different modules of the tool can be applied.

Method: The Growth/No growth interface module for *L. monocytogenes* and *Salmonella* was applied to experimental pH and aw data from dry fermented sausages. The Growth simulation module was applied to the outgrowth of *Clostridium perfringens* in a post-pasteruization refrigeration profile of beef slurry and *L. monocytogenes* in cooked ham stored at different temperatures. The thermal inactivation module was applied to predict the inactivation of *L. monocytogenes* and type II *C. botulinum* in cooked meats, evaluating the impact of different pH and aw. All the modules are available at https://symprevius.eu/en/.

Results: The outputs of the Growth/No growth interface showed that in all the evaluated fermented sausages the probability of growth of *L. monocytogenes* and *Salmonella* was below 10%. Only two of them showed a 50-90% probability of growth of *L. monocytogenes* at room temperature (21ºC) that decreased to <10% under storage at 6ºC. The prediction of the growth of *C. perfringens* in beef slurry during refrigeration and *L. monocytogenes* in cooked ham during shelf life showed growth was affected by the physicochemical properties of the products. In the case of *L. monocytogenes*, predictions allowed to compare the safe shelf-life under different foreseeable storage temperature scenarios. With the predicted thermal inactivation of *L. monocytogenes* and type II *C. botulinum*, the impact of modifications in the formulation (pH and aw) was quantified.

Conclusion: Sym'previus is a predictive tool providing outputs that be used to support decision making during the design of products and it is frequently updated with new tools as the prediction of fungal growth or bacterial growth under modified atmosphere.

P1.2.014

A sex-based digestion model highlighting differences in breakdown trajectories of animal and plant proteins

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Aim: Processed and innovative foods are increasingly confronted by the need to elucidate their impact on consumer health and wellness. Thus, there are numerous studies underpinning the elements that delineate food's digestibility in different individuals. This study aimed to develop and implement sex-based in vitro digestion models based on human clinical trials and implement them to study digestive proteolysis.

Method: Adapting a Food enginomics approach, we sifted through clinical trials to identify 40 different studies which quantified the physicochemical parameters distinguishing the gut functions of healthy adult males and females. This enabled generating an in vitro digestion (IVD) model to study the differential proteolysis of various animal and plant proteins via SDS-PAGE and LC-MS proteomic analyses. In silico analysis of the digestomics data enabled further comparison with databases of food bioactive peptides and localization of peptides in the 3D structure of some of the proteins.

Results: Extensive review of clinical trials enabled extraction of sex-based differences in digestive parameters: e.g. differences in gastric pH gradients, emptying rates and levels of enzymes and bile acids. In silco analyses of data gathered from digestive effluents collected form the IVD models highlighted sex-based differences in digestive proteolysis breakdown patterns. Gastric effluents show differences in generation of bioactive peptides, such as the satiety-affecting peptides LIVTQTMKG (lacto-ghrestatin) and VAGTWY (DPP-IV inhibitor). These have also been localized to specific

secondary elements on the outer rims of the globular proteins: beta-lactoglobulin, alpha-lactalbumin and lactoferrin. Moreover, we will show possible differences in the behavior of milk and milk-alternatives in the stomach and small intestine.

Conclusion: Engineering future foods mandates in depth insight into their digestive fate. This work presents a new tool to probe sex-based differences in food digestion. Moreover, we describe herein the differential proteolysis of whey and soy proteins that could facilitate design of foods optimized to the needs of men and women.

P1.2.015

An approach for the classification of Mediterranean honey pollen grains using convolutional neural networks

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Aim:

The classification of the pollen grains according to its botanical origin, is currently a mandatory task to catalogue honey as monofloral, which is of great importance in terms of marketing. The melissopalynological analysis is a visual procedure, based on optical microscopy, performed by highly skilled technicians who identify the morphology, count and classify the pollens. This is a difficult, time-consuming task and sometimes subjected to observer variability. Therefore, automated methods are required to overcome the limitations of this conventional procedure.

Method:

To deal with the automatic classification of honey pollens, the use of seven pre-existing convolutional neural networks (CNNs) (VGG16, VGG19, InceptionV3, Xception, ResNet50, DenseNet201, EfficientNetV2M and MobileNetV2) was studied. Transfer Learning with Fine Tuning using the coefficients of these CNNs, obtained for the ImageNet Challenge, was performed. Our Ground-Truth has been built using a specific application developed in this work (HoneyApp) for the labelling and annotation of the pollen grains. This dataset consists of 38,494 samples belonging to 26 pollen classes, including non-pollen particles, such as background, bubbles and starch. The CNNs were trained with 80% of the samples, 10% of them were used for validation and the remaining 10% for testing. Accuracy and other metrics, such as Precision, Recall, F1-Score, and MCC, were calculated for each CNN in a 5-fold cross-validation fashion.

Results:

The best accuracy result was achieved by the InceptionV3 with 98% accuracy. The rest of the CNNs also reached good precision results, such as VGG19: 97.10%; VGG16: 97.11%; ResNet50: 97.70%; Exception: 97.52%; DenseNet201: 97.78%; EfficientNetV2M: 97.59% and MobileNetV2: 96.13%. The other metrics were consistent with these results. Except for MobileNetV2, the difference between these networks was less than one point, with an adequate distribution of precision by class. It is important to mention that most errors were the result of some pollen families composed of very different particles but were presented as a single type.

Conclusion:

This research constitutes an advancement in by facilitating the cataloguing of honey. The results have proven the efficacy and efficiency of the automatic pollen recognition developed in this work.

P1.2.016

Effects of pre-frying treatments on acrylamide content and quality attributes of purple sweet potato chips

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Aim:

Snacks are popularly consumed around the world. Beyond potato chips, other vegetables such as sweet potatoes, carrots, or beetroots are currently gaining a position in the market. The present work aims to reduce acrylamide formation and decrease fat absorption in purple sweet potato chips through common and innovative pre-frying treatments.

Method:

Four pre-frying treatments were studied: Soaking (S-T) (30 min in tap water), blanching (B-T) (85ºC; 3 min), pulse electric fields (PEF-T) (8250 V; 155 pulses), pulse electric fields plus blanching (PEF-B-T), and non-treatment (Control). Frying was carried out in a deep fryer with high-oleic sunflower oil at 180 ºC for 3 minutes. PEF was carried out with a semiconductor-based positive Marx modulator Epulsus-PM1-10 equipped with a batch treatment chamber. Acrylamide content was determined by LC-MS-MS using acrylamide-d3 as an internal standard. Fat content was determined in an Ankom XT10 extractor following the AOCS Official procedure. Fracturability was measured in a texture analyser TA.XTplus.

Results:

Acrylamide content ranged between 504.1-6350.0 g/kg in the studied batches. The lowest values were obtained in PEF-B-T chips (1233±420.5 g/kg), while the highest were in the control chips (5236.1±831.7 g/kg) ($p<0.05$). The studied pre-frying treatments, except for S-T, were effective to reduce acrylamide content ($p<0.05$). However, their values were higher than EFSA's recommended values (<500 g/kg). Regarding fracturability, only the blanching significantly reduced the force to break purple sweet potato chips ($p<0.05$), since both B-T and PEF-B-T reported the lowest fracturability values (298.4±103 and 319.22 ±81 N, respectively) compared to those of the control (437.6±88 N). Nonetheless, all batches showed adequate fracturability. The blanching also promoted the absorption of more oil than the other pre-frying treatments, showing the highest fat content (41.06±0.7 and 39.82±0.39 g/100 g for B-T and PEF-B-T, respectively).

Conclusion:

Pre-frying treatments are effective to reduce acrylamide content in purple sweet potato chips. The combination of PEF and blanching was the most effective. However, blanching increases the ability of chips to uptake oil, while PEF and soaking do not. Nevertheless, other pre-frying combinations and frying conditions should be studied to generate good-quality snacks with lesser acrylamide content.

P1.2.017

Stability of an innovative egg product in terms of texture and microbiology

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Aim:

For many people, pursuing a healthy and sustainable diet has become the focus of interest. Since high meat consumption in particular is considered problematic from the perspective of a sustainable and healthy diet, vegetarianism is becoming increasingly popular as an alternative dietary option. However, essential amino acids are considered a critical nutrient in a vegetarian diet because they are often present in lower amounts in plant-based substitutes than in meat. Eggs, in particular, are considered a valuable alternative protein source for vegetarians because the content and ratio of essential amino acids correspond to the human body's needs. Eggs that do not meet grade A represent a critical point in terms of sustainability. These eggs do not meet the standard and, despite their enjoyment ability, may not be sold at retail and are disposed of. However, in the context of sustainability, it makes sense to further process the eggs that do not meet Grade A. By using the secondary commodity, unnecessary losses of edible food can be avoided and the environment and its resources can be conserved. Due to their high protein, low fat, and carbohydrate content, eggs are ideally suited for producing health-oriented foods. In addition, the high biological value of egg white proteins positively affects nutrition. Based on this, this research aims to develop an innovative egg white-based product to better utilize the side streams of the egg industry and ensure more sustainable production.

Method:

In this study, an innovative product was developed from eggs. Egg formulation was mixed with ingredients, pasteurized, and homogenized to create an innovative egg product. The finished product was filled into cups and subjected to analysis. On the one hand, the microbiological stability of the product was examined, as this is an important factor for consumer health and retail. For this purpose, the samples were subjected to microbiological analyses over 8 weeks; they were analyzed for the total bacterial count, *Enterobacteriaceae*, *Enterococci*, and *Bacillus.* Furthermore, the textural stability was examined for 8 weeks.

Results:

This study has shown that it is possible to produce an innovative product from egg that remains microbiologically and texturally stable over the period of 8 weeks. Over the period of 8 weeks, no growth of *Enterobacteriaceae*, *Enterococci*, and *Bacillus* could be detected. The texture of the product also remained mostly stable over the period. No syneresis could be detected, the product became slightly firmer over the storage time.

Conclusion:

This opens up new possibilities for the refinement of egg products. In particular, side streams of the egg product industry can be used for value-added products. In addition, high-quality protein sources are created for vegetarians or lactose-intolerant people for whom a conventional protein source based on soy or nuts is unsuitable due to allergies.

P1.2.018

Utilization of white wine pomace as an ingredient for the preservation of pork burgers

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Aim:
White wine pomace (WWP) is a by-product of the winemaking industry that contains dietary fiber and polyphenols, with antimicrobial and antioxidant activity, and could be used for the preservation of meat products. The aim of this work was to investigate the effect of the incorporation of three different levels of a valorised by-product obtained from WWP on the microbiological, physicochemical, and sensory properties of pork burgers stored for 7 days and to compare it with the protective effect of sulphite.

Method:
The minced pork meat was acquired in a local market. Five formulations were manufactured: negative control (salt and spices, without additives), positive control (MTB-burgers, the same formulation as control with sulphites) and WWP-burgers with three levels of WWP (0.5, 1 and 3%, w/w). Burgers were individually vacuum packaged and were analysed at day 1 (the day after the manufacture) and after 7 days of refrigerated storage (6ºC). Instrumental color, lipid oxidation (TBA-RS), and total mesophilic aerobic, moulds and yeasts and total coliform counts were evaluated.

Results:
At day 1, the instrumental color and initial counts of the microorganisms analyzed were not affected by the addition of WWP or sulphites; however, TBA-RS values were the lowest in WWP-burgers. After 7 days of storage, total mesophilic aerobic and total coliform counts increased in all formulations. Molds and yeasts count remained stable in control and WWP-burgers, while they increased in MTB-burgers. Redness and yellowness decreased with storage time in control and WWP groups, while they showed stable in MTB-burgers. The lipid oxidation values were significantly lowest in WWP-burgers.

Conclusion:
WWP prevented the development of lipid oxidation during the refrigerated storage of burgers, but it did not avoid microbial development or meat discoloration. However, sulphites prevented discoloration during storage, but it did not have any other positive effect.

P1.2.019

Dietary fiber and bioactive compounds of clementine pomace powders obtained using different physical treatments

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Aim:
Clementine (*Citrus clementina* Hort. ex Tan.) pomace (CP) obtained after juice extraction means about 50% of the whole fresh fruit. It has been used for animal feed or fuel production but has also been discarded into the environment. CP contains dietary fiber and biologically active compounds, such as polyphenols or carotenoids. Therefore, valorizing CP is essential not only to avoid environmental pollution but also to increase the overall production and profit of the industry. Physical treatments like hot air drying (HAD), homogenization (HOM), freeze-drying (FD), and extrusion (EXT) can be used to obtain stable powders from fruit pomace, taking advantage of their beneficial compounds for food formulation. This work aimed to compare the effect of HAD, HOM, FD, and EXT treatments on CP powders' fiber fraction and some bioactive compounds.

Method:
HAD, HOM, FD, and EXT treatments were applied to CP. Total, insoluble, and soluble dietary fiber (TDF, IDF, and SDF, respectively) were measured by AOAC 991.43 method. Neutral sugars and uronic acids were measured using GC-FID and spectrophotometry. Total phenolic compounds (TPC) and total carotenoid content (TCC) were measured by colorimetric methods. Antioxidant capacity of the phenolic fraction was determined by DPPH and FRAP methods.

Results:
TDF content was higher after applying HOM treatment, and SDF content increased after HOM and EXT treatments. Among neutral sugars, galactose predominated in CP after the four treatments, and glucose, rhamnose, and arabinose were also found in high percentages. TPC and antioxidant capacity were significantly higher after EXT treatment, followed by FD and HAD treatments, whereas TCC was significantly higher after FD treatment.

Conclusion:

The obtention of CP dried powders is a good way to valorize the by-products from juice extraction as they represent a good source of dietary fiber and bioactive compounds. Among the treatments used in this work, HOM increases the dietary fiber content, whereas EXT and FD treatments lead to better retention of bioactive compounds. Therefore, CP can be used as an ingredient to prepare food enriched in fiber and antioxidant compounds.

P1.2.020

Effect of starch concentration of different origins on the oscillatory rheological parameters of their gels

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Aim:

This work aimed to determine the effect of the starch concentration of the gels tested on the frequency sweeps and deformation sweeps parameters obtained by oscillatory rheology essays.

Method:

Gels of wheat, normal and waxy maize, normal and waxy rice, potato, and tapioca starches were tested using a Kinexus Pro+ rheometer (Malvern Instruments Ltd., Malvern, UK) Using conditions described in Deriu *et al*. (2022) and Ronda *et al* (2014). Concentrations were: 6.4, 7.8, 9.2, 10.6, and 11.9 g starch/100 g gel.

Results:

Wheat starch gels showed the largest increases in G'_1 and G''_1 with increasing concentration followed by normal maize starch gels. In all cases, the waxy maize gels had the lowest viscoelastic moduli, showing little variation with changes in gel concentration. In rice samples, the higher modulus was for waxy rice, but higher concentration dependence was registered in normal rice

With increasing concentration, a considerable increase in stress at the crossing point was registered for wheat, followed by normal maize, but the strain reached did not show large variations concerning concentration. Potato and tapioca starch gels showed higher deformations at the crossing point than the other samples, with little dependence on concentration. The wheat starch and normal maize starch gels showed the greatest change of maximum stresses with concentration.

Conclusion:

Changes in the concentration of the starch gels had different effects on the samples. Variations were most marked in wheat starch gels, followed by normal maize. Potato and tapioca showed a distinctive rheologic profile, while wheat starch gels and normal corn starch gels had some similarities, so the latter could be used in some foods as a replacement for wheat, such as gluten-free formulations.

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P1.2.021

Food 3D printing in the hospitality industry: current state of the art and research agenda

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Aim: In recent years, 3D printing (3DP) has received increasly more interest in various disciplines ranging from, but not limited to, construction, health care, and food production. In food production, 3D printing is used both in manufacturing of mechanical parts, e.g. nozzles for extruders, and the actual production of food and creation of dishes by so-called 3D food printing (3DFP). For food business, the implications of creating gastronomic experiences for consumers through 3DFP has only been discussed to a limited extent. Advancing this area offers opportunities for generating new types of food experiences that are not only esthetically pleasing but can also contribute to environmental sustainability by reusing food waste, or activate consumer interest and desire for healthy food to tackle societal issues such as obesity. Further, experimental studies focussed on linking the technical and gastronomical properties of 3DFP in a gastronomical setting are limited. Our study, provides directions for much needed further research that aims to address current shortcomings in our understanding, technological limitations and embedding of 3DFP for richer gastronomic experiences.

Method: We provide an overview of identified opportunities and challenges related to the implementation of 3DFP in the food business to date. We build on Mantihal et al.'s (2020) review of 3DFP which focused on the novelty in the preparation of food for various business sizes. Our paper extends the food production perspective by providing a discourse on adoption factors in the food business and hospitality industry.

Results: In the food business and hospitality industry, 3DFP provides opportunities beyond customization (level 1), towards personalized gastronomy e.g. adaptation to personal nutritional needs, taste etc. (level 2). We posit that 3DFP provides additional opportunities to generate gastronomic experiences through storytelling (level 3) to activate consumer attitude and behavior.

Conclusion: 3DFP provides added value to consumers in the existing food business and hospitality industry if it is used for storytelling and personalized gastronomy. Furthermore, it can contribute to a more future-proof industry by addressing and tackling societal and environmental issues, like (the reduction of) food waste. In order to do so, technical challenges need to be overcome.

P1.2.022

The effect of pre-treatment and fermentation on novel platform foods properties based on side-stream products

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Nowadays, the increase in sustainability during food production is of high importance. Application of plant- and animal-origin side-streams can be a new approach ensuring complementarity of nutritional value in the form of novel platform products from the oil and dairy industries.

Aim: Sunflower seed cake (SSC) is recognised as a good source of plant proteins; however, a relatively high phenolics content negatively affects its taste and chemical properties. Therefore, the aim was to evaluate the effect of pre-treatment methods (green de-phenolization by water; microwave drying) and controlled fermentation on phenolics content and antioxidant capacity of fermented platform products in the form of pastes and powdered blends composed of SSC and whey.

Method: The SSC, SSC microwave dried, SSC and whey blend microwave dried, pastes based on SSC washed with water/whey (de-phenolization) were fermented by mixture of *Lactococcus lactis* (inoculum 1x10^6 CFU/g) and

Kluyveromyces lactis (inoculum 1x10^5 CFU/g) strains in water and whey suspensions for 48 h at 26 °C in static conditions. Products were examined in terms of phenolics content and antioxidant capacity (TEAC ABTS and FRAP assays).

Results: Water washing significantly reduced the initial content of phenolics, as well as, TEAC ABTS and FRAP values. Fermentation had a slight effect on these parameters. However, in the case of SSC likewise microwave dried and microwave dried blends, fermentation caused a substantial decrease in phenolics and antioxidant capacity. Fermentation performed in a whey solution was less effective in terms of phenolics minimization as compared with water solutions.

Conclusions: Fermentation can be applied as a new strategy for reduction of high phenolics content in SSC, however water washing was more effective in phenolics removal from the compositions. Consistently, the presented approach sheds a new light on the potential of oil and dairy side streams usage towards designing novel nutritional foodstuff.

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P1.2.023

Evaluation of the possibility of using microwaves to prepare coffee infusions with high antioxidant activity

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Aim:

The aim of the work was to assess the possibility of using microwave radiation generated by a traditional microwave oven to produce coffee infusion and to determine the bioactive properties of the obtained infusion.

Method:

The infusion was prepared by pouring a portion of coffee (Coffea arabica L. and Coffea canephora L.) with low-mineralized water at room temperature and heating it in a microwave oven for the designated time. The obtained infusions were tested for antioxidant and redox properties (DPPH, ABTS, FRAP) and the content of polyphenolic compounds and reducing sugars.

Results:

A significant increase in the content of polyphenolic compounds, reducing sugars and total antioxidant and redox activity in the obtained infusions (by heating in a microwave oven) was confirmed in comparison to coffee prepared by pouring hot water over it.

Conclusion:

The coffee brewing process has a significant impact on the antioxidant and bioactive properties of the obtained infusions. The observations made suggest that the microwave method of brewing coffee results in more efficient extraction of ingredients (e.g. polyphenolic compounds) from beans compared to infusions obtained in a traditional way.

P1.2.024

INFLUENCE OF TEMPERATURE AND PH IN DIAMINE OXIDASE ACTIVITY

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Aim:
Biogenic amines such as histamine are usually present in many foodstuffs (cheese, wine, fish). Their ingestion could induce health disorders such intoxications or intolerance. Diamine oxidase (DAO) is one of the main enzymes responsible of their degradation. This fact has increased the interest in DAO as dietary supplement or as food additive for people that present a deficit of this enzyme. Thus, the aim of this study was to assess the influence of temperature and pH during storage in the DAO ability to histamine degradation.

Method:
DAO from porcine kidney (20 mg/ml) was incubated (4 ºC) in buffers at different pH (3, 5, 7 and 9) for 1 h and 7 days. At each condition, DAO activity was measured by colorimetric DA-67 enzyme assay per triplicate using histamine (1mM) as the substrate. The effect of treatments was evaluated by estimating the residual enzyme activity (%) compared with DAO activity measured in the reference conditions (PIPES, pH 7,2 at time 0). Afterwards, it was selected the buffer condition which presented the higher DAO activity and, using this buffer, a new set of experiments were carried out at different storage temperatures (-18, 4, 20 ºC) for 1 h and 7 days.

Results:
DAO incubated in buffers at pH 3 and 5 showed a significant lower ($p<0.05$) enzymatic activity than those maintained at pH 7 and 9. In these cases, it was observed an increase of the enzymatic activity after 7 days of storage. This fact is very interesting because, if DAO is added in a food matrix, it could lead to a reduction of the histamine generated during storage time. Regarding the influence of storage temperature, DAO activity was almost constant at freezing temperatures (-18 ºC), while it was observed a slight activity reduction at 20 ºC.

Conclusion:
The present study shows the activity of DAO from porcine kidney is able to be maintained during storage, mainly at pH 7-9. Thus, the introduction of this enzyme in basic-pH food matrices at refrigeration temperature could be an alternative to reduce histamine content in food, which can substitute the need of the consumption of DAO supplements for histamine-intolerant population.

P1.2.025

Methodology for the reutilization of red plum by-products

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Aim:
Fruit Sector in Extremadura constitutes one of the pillars of the regional economy, accounting for around 50% fruit production. High hydrostatic pressure (HHP) technology is a recent technology utilized for food preservation which could be also used for the valorization of by-products. HHP allows an integral utilization of by-products and no solvents are utilized. For this purpose, the stabilization of red plum by-products by the inactivation of the enzymes activity, with previous thermal blanching, and the reduction of microbial counts was analysed by the application of HHP.

Method:
Plum by-products (*Crimson Globe* cultivar) were used in purée form. Firstly, a thermal blanching was applied to optimize the inactivation of the polyphenoloxidase (PPO) enzyme. Different temperatures and times were applied to reach a maximum reduction of the enzyme activity. The proximate composition of the plum purée initial purée was studied. The effect after the thermal blanching and HHP were analysed on the microbiological counts and bioactive compounds content (total phenolic compounds).

Results:
The chemical composition of investigated plum ingredient showed that percentage moisture, fibre and protein were 88.1%, 1.5% and 0.5%, respectively. In the thermal blanching of the plum purée, the polyphenoloxidase (PPO) enzyme activity was not reduced with the less intense treatments (70ºC for 1, 3, 5 min) however the PPO activity was totally inactivated at 80ºC/1min. Respect to the effect after HHP, no significant differences in total phenolic compound content were observed in the plum ingredient after processing and the microbial counts were significantly reduced after the treatment.

Conclusion:
Thermal blanching at 80ºC/1min inactived the polyphenoloxidase (PPO) enzyme activity. In addition, the application of HHP (600 MPa/5min) reduced the microbial load while maintaining phenolic compounds content. Therefore, the application of a thermal blanching before HHP allowed to obtain a stable by-product from red plums.

P1.2.026

Influence of aeration on the rheological properties of dysphagia-oriented food foams.

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Aim: Air bubbles can provide texture, enhanced sensory properties, and originality to food products, essential elements all of them in the design of dysphagia-oriented products. Moreover, since foam texture increases the residence time of food in the mouth, the use of this type of aerated structure may be a suitable alternative to facilitate the swallowing process in patients with dysphagia, while allowing an adequate supply of liquids and nutrients.
Despite all these advantages, there is a lack of studies related to the characterization of food foams from the perspective of oral processing and dysphagia.
Method: In this study, the impact of different foam structures on textural and rheological properties related to swallowing mechanisms has been studied. For this purpose, a model product, based on dairy cream, was aerated using aerosol technology. This technology made it possible to produce foams with different levels of aeration (4 levels).
Results: The results showed that the hardness of the samples increased as the level of aeration increased. In addition, sample cohesiveness, which is considered a key factor in dysphagia products as it is related to the prevention of food aspiration during swallowing, increased with the level of aeration.
Conclusion: A better understanding of the impact of food aeration on swallowing management in patients with dysphagia could be useful for the development of new and more attractive foam-based products suitable for this population.

P1.2.027

Changes on Morphological, Techno-Functional, Thermal, and Rheological Properties of Tef Flours Induced by Microwave Radiation.

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Aim:
Tef [*Eragrostis tef* (Zucc.) Trotter] is a gluten-free (GF) cereal rich in fiber, minerals, vitamins, and antioxidants, which offers a promising alternative for new food development. The GF products currently available in the market have less nutritional value and often poorer physical and sensorial quality than their gluten-containing counterparts. For improving the functionality of flours different methods of physical modification have been employed including hydrothermal treatments. The use of microwave radiation (MW) to carry out these treatments provides a faster and environment friendly technology than conventional heating. The aim of this study was evaluated the impact of the microwave-assisted thermal treatment on morphological, techno-functional, thermal, and rheological properties of tef flours as a function of its moisture content (MC) and ecotype used.
Method:
Tef flours (white and brown) were moistened to reach 15%, 20%, and 25% ± 0.5% of MC. 50 g of each tef flour was exposed to microwave (MW) radiation for 480 s in cycles (10 s radiation/50 s of rest) for a total time of 48 min for each treatment, in a hermetic container. Once treated, the flours were dried at 35 °C and sieved for further analysis.
Results:
The morphological structure of tef flours was affected by microwave treatment (MWT), and hydration properties (water absorption capacity, water absorption index, water solubility index and swelling power) increased after the treatment. Lower peak, breakdown, and setback viscosities, up to 45%, 96%, and 67% below those of the control (untreated) samples, and higher pasting temperature, up to 8 °C in the 25% MC samples, were observed. DSC confirmed an increased stability of starch crystallites. Rheological analysis of the gels made from the treated samples revealed that MW had a structuring and stabilizing effect on all samples, leading to higher viscoelastic moduli, G´ (elastic) and G´´(viscous), and the maximum stress the gels withstood before breaking their structure, τ_{max}.

Conclusion:
The MC of the flours during the MWT drove the modification of the techno-functional properties of the tef flours and the gel rheological and thermal characteristics. These results suggest that MW-treated tef flours are potential ingredients for improving the technological, nutritional and sensory quality of food products.

P1.2.028

Improvement of techno-functional properties of gluten-free flours through high hydrostatic pressure and moderate temperatures

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Aim:

High-pressure processing (HHP) technology has recently attracted attention for their ability to physically modify food ingredients that can meet the requirements of producers aiming to develop products with fewer chemical additives or even free of them. This could be particularly relevant in the gluten-free food industry as commonly baked goods ingredients manifest limited native functionality compared to those with gluten.

The effect of HHP technology on the main components of the flour, protein and starch, depends on the processing conditions, namely pressure, holding time and temperature. It is assumed that heat is a key factor in starch gelatinization and triggers molecular motions. However, few studies have investigated the synergistic effect of combining pressure and temperature to modify the techno-functional properties in a gluten-free flour. The aim of this study was to investigate changes in the functionality of buckwheat flour by the combined application of high pressure and moderate temperature (HPMT).

Method:

HPMT treatment was applied to pre-soaked or un-soaked whole buckwheat grains. Processing conditions were set at 600 MPa and 5 minutes. The effect of a temperature (between 40 and 70ºC) on the resulting flours was studied in terms of hydration, interfacial, pasting and thermal properties and gel rheology behaviour.

Results:

All HPMT-treated samples showed higher water absorption capacity (WAC) and water solubility index with increasing treatment temperature. Pre-soaked samples were found to have higher WAC than unsoaked samples. An increase in chroma was also observed with increasing temperature treatment while flour lightness decreased in all HPMT-treated samples. HPMT treatment resulted in a decrease in the interfacial (emulsion and foaming) properties of the samples. An overall decrease in the peak and setback viscosity values with increasing temperature was observed when analysing the pasting profiles of the HPMT-treated samples. The effect of the HPMT treatment on the starch structure was confirmed by the lower gelatinization enthalpy found with increasing temperature. Significant differences in the viscoelastic moduli of gels obtained from pre-soaked and un-soaked samples were also observed.

Conclusion:

HPMT treatment could be an alternative technology to obtain gluten-free flour with the necessary functional properties for use in different industrial processes.

P1.2.029

The Effect of Storage and Pasteurization on the Stability of Phycocyanobilin and Phycobiliproteins

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Aim:

Usually, utilization of natural blue pigments in foods is challenging as they are unstable during processing and the commonly applied pH. This study focuses on phycobiliproteins, the natural blue pigments found in *Spirulina*. These pigments are a complex of conjugated protein and non-protein components, known as phycocyanobilin. Protein denaturation and color deterioration during pasteurization (both thermal and high-pressure) limit phycobiliproteins application. The dye itself, phycocyanobilin, might also be liable to oxidation during pasteurization and storage resulting in color deterioration. However, the contribution of phycocyanobilin oxidation to the phycobiliproteins instability at high-temperature and storage conditions was never studied. To study the role of phycocyanobilin degradation in color loss, the phycocyanobilin extract stability under high temperature and pressure was studied and compared to phycobiliproteins degradation kinetics. The phycocyanobilin extract stability at different storage conditions was also explored. Understanding the mechanisms and kinetics of pigment stability is essential for better utilization of Phycobiliproteins as food pigments.

Method:

Phycocyanobilin was extracted using reflux extraction, the color deterioration of phycobiliproteins and phycocyanobilin extract at high pressure and temperature was spectrally studied *in situ*, the phycocyanobilin extract stability at 25°C was detected with LC-MS analysis and phycocyanobilin extract aggregation was studied using microscopy.

Results:

Phycobiliproteins denaturation occurred during high pressure and heat treatment. An increase in both pressure and temperature resulted in an increased color deterioration rate. Considering the temperatures and pressures with the time required to achieve pasteurization level microbial inactivation, the phycobiliproteins color deterioration rate at 70–80 °C was higher than at high-pressure (300–600 MPa). While phycocyanobilin extract remained stable during processing. During storage at pH 7, phycocyanobilin was oxidized, and the oxidation rate increased with increasing pH, while at lower pH phycocyanobilin had low solubility and resulted in aggregation.

Conclusion:
The color deterioration kinetics during processing suggest that there are some advantages to high pressure over thermal pasteurization. The phycocyanobilin extract stability during processing confirms that protein denaturation and not pigment oxidation is the main factor for chemical instability. To utilize the pigment itself, its solubility and extraction efficiency should be taken into consideration.

P1.2.030

Use of Baru by-product for the development of a plant-based hamburger

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Aim: Baru (*Dipteryx alata*) is a fruit of the Brazilian biome Cerrado with ecological importance and interesting functional and nutritional contents. Due to its high lipid content, Baru almonds are currently used for oil extraction and, after pressing, a partially defatted by-product is obtained. This by-product contains part of the macro and micronutrients of the almonds. In the present study, the use of this by-product to obtain an extruded ingredient for application in a plant-based hamburger (PBH) formulation was investigated.

Method: Blends of soy protein concentrate, defatted Baru flour, and vital gluten (E1-92:4:4; E2-80:16:4; C:90:0:10) were prepared. The mixtures were extruded in a twin-screw extruder and afterward, plant-based hamburgers were prepared (HE1, HE2, HC). The physical-chemical and instrumental texture parameters of PBH prepared with the different formulations were evaluated.

Results: The values obtained for the centesimal composition (g/100g) were 58.5-62.1 (moisture); 47.06-77.75 (proteins); 5.47-6.71 (ashes); 24.18-26.65 (lipids); and 0-20.59 (carbohydrates), the pH-values were 6.3-6.7. The control hamburger (HC) presented the highest content of proteins and ashes. Higher cooking yields and juiciness were also observed in the HC (91.2% and 6.2%, respectively), while lower shrinkage was observed for the HE1. Hamburgers from the treatment HE2 presented higher hardness (16.94 N), lower values of elasticity (0.428 mm), cohesiveness (0.286), and resilience (0.087) when compared to the treatments HE1 and HE2.

Conclusion: The results showed that it was possible to obtain plant-based hamburgers with different proportions of Baru in their composition, however, the treatment HE1 presented the most similar technological characteristics to the control hamburger.

P1.2.031

Intra-specie distribution of resistances to plasma treatments of food-borne pathogens

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[1]Cnta

Aim:
The interest for Cold Atmospheric Plasma (CAP) has rised during last years as food decontamination alternative technology. Many researches has evaluated the lethal effectiveness of this technology against different foodbourne pathogens. However, comparison between different researches is difficult due to different plasma conformations and ways of application have been used. The aim of the present work was evaluate the lethal efetiveness of plasma technology against 4 of the main foodbourne pathogens under standard conditions.

Method: This work was developed using a CAP generator prototype, designed and built in CNTA. The protype uses a dielectric barrier discharge electrode with a cooper Hv electrode and stainless steel square mesh with a PTFE dielectric layer of 1,5 mm thinner. All trials were performed using atmospheric gas, peak voltage of 20 Kv and frequency of 500 Hz. Once produced, plasma activated atmosphere was inyected in hermetic boxes of 6 L capacity at a flow rate of 5 L/min during 2 minutes; achieving a final mix atmosphere of 50% air and 50% activated plasma atmosphere. Boxes contained 6 TSA plates surface inoculated with 4 strains of Salmonella spp., E. coli, L. monocytogenes or S. aureus at different

concentrations. After injection, mix atmosphere was maintained 10 minutes inside the boxes before open and remove inoculated plates for its incubation under appropriate conditions.
Results: The results obtained in this research shows inactivation levels for *E.coli* around 3.2 log cycles for the four strains tested; between 3.5 and 2.4 log cycles in case of the different strains of *Salmonella* spp.; between 2.5 and 1.5 log cycles for *S. aureus* strains and between 2.3 and 2.9 log cycles in case of *L. monocytogenes* strains.
Conclusion: With the results obtained can be concluded that among the 4 foodbourne pathogens tested *S. aureus* is the most resistant against plasma activated atmosphere followed by *L. monocytogenes* and *Salmonella* spp. being *E. coli* the most sensitive. Though more research is necessary for optimizing plasma generation conditions, the present work shows the potential use of paslma activated atmosphere as an effective alternative for ensuring food safety and enhance the self-life of food stuffs.

P1.2.032

Milk thistle as nutritional booster for wheat bread

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Aim:
Bread consumption has been declining in recent years, which is why new solutions in bread production are being sought to encourage consumers for buying, while creating functional bread with the addition of herbs and medicinal plants like milk thistle. Milk thistle (*Silybum marianum*) is a plant that has been used for centuries as a natural remedy for liver problems and is known for its antioxidant and anti-inflammatory properties and can be added to popular wheat bread to create a new and unique food product. The aim of the study was to investigate the effect of milk thistle on the quality of blends, dough and the quality and nutritional value of bread depending on the type of wheat flour (type 650 and 750), the share of the additive (0/100; 2/98; 5.5/94.5; 8/92; 10/90 ratios) and the method of bread baking (one-phase and two-phase).
Method:
Total protein content, amylographic features and rheological properties (Mixolab) of the blends were evaluated. The bread quality features were determined as crust and crumb color, volume, overbake, crumb porosity, moisture content, total protein and dietary fiber content and organoleptic characteristic.
Results:
Blends prepared from wheat flour type 650 were characterized by higher values of amylographic features (lower amylolytic activity), higher retrogradation and lower water absorption than blends from flour type 750. Breads baked from flour type 750 were characterized by a higher overbake and moisture content. Bread baked from flour type 650 was characterized by a higher crumb porosity and its brightness. Along with the increasing share of milk thistle in the test, the final gelatinization temperature and gelatinization time, the content of total protein and total dietary fiber increased, the crumb porosity and the crumb color improved, but the water absorption decreased.
Conclusion:
The optimal share of milk thistle in flour blends was 5.5%. Breads baked with flour type 750 and the two-phase method were rated higher than those made with flour type 650 and the direct method.

P1.2.033

Optimization of a traditional porridge with chia seeds and oyster mushrooms within the CHIAM project

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Aim:
The challenges of the FOSC call are addressed within this contribution. The deployment of the networked chia-mushroom-pig biogas value chain (CHIAM project) contributes to the diversification and resilience of African food systems to the impacts of climate change. The goal of the contribution is to develop nutritionally valuable foods by fortifying staple foods used locally in Kenya with chia seeds and oyster mushrooms.
Method:
For the production of traditional porridges in Kenya is the use of white maize, sorghum and pearl millet are used. Different standard recipes for traditional porridges can be found in the literature and approaches to increase the nutritional quality. In this contribution we would like to present the effects of the substitution of the used cereals for the preparation with the impact on the nutritional quality and technological effects of the porridges. Therefore, the Rapid Visco Analyzer (RVA) and rheological measurements as well as texture profile analysis on the porridges are applied. Recipes consist of 1 part

maize/sorghum/pearl millet flour and 2 or 4/5 parts water (thick or thin porridge respectively). The substitution levels are 3 %, 6 % and 9 % of the cereals by ground chia seeds or oyster mushrooms each as well as the combination for thick porridge.
Results:
The substitution of the maize flour with increasing amounts of oyster mushrooms leads to a reduced peak viscosity determined by RVA. Higher amounts of chia seeds have an increasing effect on the viscosities, although these still remain below the standard. First results of the cutting tests to determine the strength of the tick porridge indicate that the time required to reach the max. peak strength is lower when substituting maize flour was substituted as well. Here, again, the higher the chia content, the higher the strength, which suggests again an increased water binding capacity. Experiments are ongoing, further results will be presented at the conference.
Conclusion:
The resulting porridges are more nutritionally valuable compared to the traditional ones. However, the product quality has to be evaluated and the consumer acceptance is yet to be determined.

P1.2.034

Hemp drying – influence of different drying technologies on the cannabinoid content and composition

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Aim: Fast and mild drying is necessary for freshly harvested hemp plants first due to its perishable nature, but also due to heat sensitivity of cannabinoids (CBNs). In this work, different drying technologies were investigated for obtaining high-quality, storage-stable dried hemp product with high concentration of natural Cannabinoids.
Method: Three drying technologies were compared: belt, climate chamber and radio frequency (RF) drying for preserving the natural content of cannabinoids in hemp variety Futura 75. As a target value for the drying target, an a_W value below 0.6 was set. The concentrations of CBNs were determined using HPLC-DAD, which makes it possible to distinguish between the individual cannabinoids CBD, CBDA and 9-THC. The ratio between them and the conversion rate from CBDA to CBD and THC can provide valuable information on how gentle the drying process is.
Results: Regardless of the technology, low drying temperature of around 40 °C delivered the most promising results. The total concentration of cannabinoids CBDA+CBD+9-THC after the belt drying was comparable to the ones in freshly harvested material – around 5 % based on dry matter (DM). Slightly lower was the content for RF drying (3.6 %(DM)), but with a significantly shorter drying time (35 min). Drying in a climate chamber lasted 8 h and resulted in a total cannabinoid content of 2.7 %(DM). The conversion rates for cannabinoids were the lowest for the belt drying. The CBDA content in the sum of total cannabinoids was 96.1 %. RF drying and drying in the climate chamber resulted in 92.2 %, and in 90.3 % CBDA content in the total sum of cannabinoids.
Conclusion: The most promising results were delivered by belt drying with a dehumidifier in this study. Despite the longest time, it results in the best maintenance of natural CBDA. Accelerated drying was possible in the climate chamber, but at the cost of quality loss. RF drying seems to be a suitable alternative to belt drying, in particular considering the economical side (excluding investment costs) and the least time needed for drying. Due to the time factor, this drying technology is absolutely in the lead economically.

P1.2.035

Plant protein isolates from selected by-products as emulsifiers in anthocyanin double emulsions

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Abstract

Aim: Anthocyanins (ACNs) are prominent flavonoid family members that are hydrophilic and found in plants. They are great antioxidants and possess anti-cancer, anti-obesity, anti-diabetic, and anti-inflammatory properties. The aim of this study is to evaluate the potential of plant protein isolates derived from Nigella sativa(NS), Canola cake (CC), and maize Distillers Dried Grains (DDGS) as emulsifiers for the microencapsulation of anthocyanin-loaded double emulsions.

Method:

In the methodological approach of this study, plant protein isolates were extracted from selected plant by-products using an optimized extraction process. The proteins' structural properties were then characterized using spectroscopic and

chromatographic techniques. Subsequently, the proteins were used to formulate anthocyanin double emulsions using a two-step homogenization process. The stability of these emulsions, the efficiency of anthocyanin encapsulation, and the release behavior were evaluated using rheological measurements, droplet size analysis, and in vitro digestion models. Finally, correlations between the proteins' structural characteristics and their performance as emulsifiers were investigated using multivariate data analysis.

Results: The results of this study showed that the plant protein isolates from NS, CC, and DDGS exhibited substantial total phenolic content (TPC) and total anthocyanin content (TAC). These values suggest a strong antioxidant potential, which was further corroborated by the ABTS and DPPH assays. Beyond their antioxidant properties, the plant protein isolates demonstrated a remarkable ability to stabilize anthocyanin-loaded double emulsions. This was reflected in the controlled particle size distribution, optimal droplet size, and appropriate rheological properties of the emulsions. Additionally, the microencapsulation efficiency (MEE) and loading capacity metrics pointed to an efficient conservation and distribution of anthocyanins within the double emulsion droplets. These findings underscore the potential of these plant protein isolates as proficient emulsifiers for anthocyanin microencapsulation, showcasing their potential in applications aimed at leveraging the health benefits of anthocyanins.

Conclusion: This study confirms the potential of plant protein isolates from NS, CC, and DDGS as effective emulsifiers in anthocyanin-loaded double emulsions. Their strong antioxidant characteristics and proficiency in stabilizing the emulsions and encapsulating anthocyanins emphasize their potential for use in applications that aim to harness the health benefits of anthocyanins. These findings suggest promising avenues for developing eco-friendly and cost-effective emulsifiers from plant-based by-products.

P1.2.036

Curled octopus (Eledone cirrhosa) protein nanoparticles crosslinked with grape seed polyphenols solubilized in NADES

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Aim:

Protein nanoparticles are emerging as nanocarriers of great interest due to their biocompatible, nontoxic and biodegradable nature. The objective of this work was to solubilize a grape polyphenolic extract with natural deep eutectic solvents and use them as crosslinkers to produce antioxidant protein nanoparticles from curled octopus muscle.

Method:

A grape polyphenolic dried extract was solubilized under different conditions of temperature (20ºC or 60ºC) and time (1h or 3h), using ethanol:water (70:30) and two different natural deep eutectic solvents (NADES), i.e. choline chloride:lactic acid (1:2) (CCH-LA) and choline chloride:citric acid (1:2) with 30% of water (CCH-CA). All extracts were sonicated at 50% amplitude for 5 min.

The protein concentrate was obtained by isolelectric precipitation from curled octopus (*Eledone cirrhosa)* solubilized muscle.

Nanoparticles were produced from the protein concentrate (previously dissolved at 60ºC for 1h) with/without soluble grape polyphenols as crosslinkers, followed by probe-tip sonication at 50% amplitude for 5 min. Particle properties (ζ-potential, size and polydispersity index) was analyzed by DLS using a nanosizer.

The anthocyanin content was evaluated by the differential pH method. Total polyphenols content and antioxidant capacity were determined by Folin-Ciocalteu and FRAP methods respectively.

Results:

The solubilization with CHCL:CA at 60ºC for 3h gave rise to a grape soluble extract with the highest anthocyanin content. However, the soluble extract obtained with CHCL:LA at 20ºC for 3h showed the greatest total polyphenol content and antioxidant capacity (5 and 2-fold higher than the ethanolic extracts respectively).

The CHCL:LA soluble extract was used as crosslinker for the production of curly octopus protein nanoparticles. The size of nanoparticles was reduced when they were crosslinked with the polyphenolic extract (302 *vs* 174 nm), while the ζ-potential value increased (+12 *vs* +32 mV), the polydispersity index was similar (0.25) and the antioxidant power was 9-fold higher.

Conclusion:

The natural deep eutectic solvent CHCL:CA can be used to solubilize anthocyanin from grape extracts, while CHCL:LA is more efficient to solubilize other phenolic compounds with high antioxidant power.
The CHCL:LA soluble extract can be used as crosslinker for the production of curly octopus protein nanoparticles with smaller size, greater stability and antioxidant power.

P1.2.037

Evaluation of thermal damage in pizza baked at high temperature in electric oven

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Aim:
Home-made pizza is on the rise, especially after the covid pandemic, due to quarantine requirements driving to simple and comfort foods. Thanks to new cooking appliances, it's easier to reproduce at home the process of pizza baking in a wood-fired or electric pizza oven, which typically work at high temperature. The formation of a browned and flavoured crust is the most evident result of the Maillard reaction in pizza baking. This study aims to evaluate and compare quality characteristics such as weight loss (WL%), color development (Browning Index, BI and Intensity Mean, IM) and thermal damage (Hydroxymethylfurfural, HMF and Maillard Reaction Products, MRPs) of pizza baked using high temperature conditions (< 300°C) in home-cooking appliances.
Method:
Three different ovens and temperature were used: an electric high temperature pizza oven (HiT) working at 450°C for 2.5 min, a commercial oven with an automatic pizza function working at 310°C for 8 min (MeT), both compared to the conventional baking at 250°C for 14 min (LoT). Each appliance was preheated before the baking tests. A typical Neapolitan pizza recipe was used. WL% was evaluated gravimetrically; color indexes BI and IM were evaluated by image analysis; HMF was determined by HPLC; MRPs were quantified spectrophotometrically.
Results:
With regard to weight loss, HiT and MeT pizza reached similar values (10.6% and 9.1%, respectively), lower than that obtained at LoT (15.0%). HiT cooking resulted in higher levels of HMF and MRPs, while similar values were detected in LoT and MeT cooking. Concerning color development, both BI and IM indexes showed the highest values in HiT and the lowest values in LoT, with significant differences between the samples and a noticeable deeper color at the highest cooking temperature.
Conclusion:
Baking at 310°C resulted in a pizza with a weight loss similar to that obtained in cooking at 450°C but with a slightly paler colour, similar to the one cooked at 250°C. HMF and MRPs levels at 310°C were definitely lower than those detected in the pizza cooked at 450°C. These data indicate that very high temperatures can produce significant thermal damage, potentially harmful for health.

P1.2.038

Development of healthier puff pastries olive pomace oil-based margarines

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Aim:
Designing healthier lipids is a current approach to developing potential functional foods. Olive pomace oil (OPO) has beneficial effects on human health attributed to its high oleic acid content and unique bioactive compounds. Two puff pastry margarines (PP-M) based on OPO (M1 at 40.8% and M2 at 30.8% and cocoa butter at 10%) combined with organogelators were prepared and compared to both commercial puff pastry (PP) butter (CB) and fatty preparation (CFP). Subsequently, four baked PP counterparts were elaborated.
Method:
Dynamic rheological properties from amplitude and frequency sweep tests and melting behavior by differential scanning calorimetry (DSC) were analyzed in M1 and M2, while mechanical properties (textural cutting test), lipid profile, baking performance and sensory analysis were carried out in the PP-M1 and PP-M2 counterparts.
Results:
Rheological measurements indicated that all four margarines had similar fat-crystal network structures, although both M1 and M2 were more viscoelastic than controls CB and CFP. Elastic modulus (*G′*) of M1 and M2 samples was between that of controls CB and CFP, although a higher OPO content (M1) reduced viscous modulus (*G″*). The firmness of baked PP made with M1 was similar to that of PP containing controls CB and CFP, while the highest hardness of PP-M2 was attributed to a lower OPO content (30.8%) and a complete crystallization of cocoa butter fat crystals at 4 °C. Cooling at 4 °C during lamination negatively affected spreadability of M2, resulting in a negative layering effect that influenced either texture or

performance of the baked PP. In addition, PP-M1 had 36.8% less saturated fatty acid (SFA) content than baked PP-CB, and its overall acceptability was similar.

Conclusion:

Formulated margarine M1 with high OPO content (40.8%) showed adequate firmness, spreadability and plasticity. The firmness of PP-M1 was similar to that of PP-CB and PP-CFP, and the better spreadability and plasticity of M1 positively favored PP puffing. OPO has an excellent low SFA to UFA ratio (0.184), and, consequently, M1 and M2 had 37% and 28% less saturated fat than control CB, respectivelyTherefore, PP elaborated with this margarine had similar performance and sensory quality to those elaborated with milk fat.

P1.2.039

Bioaccessibility of phenolic compounds in dried apple bagasse during in vitro gastrointestinal and colonic digestion

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Aim: Apple processing can result in a significant quantity of waste that could be introduced into the food chain as dried apple bagasse, promoting sustainability. It should be note that apple waste is a source of bioactive components such as phenolics, which possess antioxidant and anti-inflammatory properties. However, these benefits are related to their solubility, integrity and release from the food matrix in the gastrointestinal tract, which affects their bioavailability for intestinal absorption. Thus, this work aimed to evaluate the bioaccessibility of phenolic compounds in dried apple bagasse.
Method: Gastrointestinal digestion of the dried bagasse was conducted according to the standardized INFOGEST protocol, followed by *in vitro* colonic digestion, using human faecal microbiota. Free phenolic compounds were extracted with 70% methanol from (i) dried apple bagasse; (ii) the soluble fraction in the intestine, therefore potentially absorbed; (iii) the insoluble gastrointestinal fraction that passed to colonic digestion and (iv) the colon bioaccessible fractions. All of them were determined by UPLC-MS/MS.
Results: The concentration of free phenolic compounds in the dried apple bagasse was 463 mg/kg. A total of 32 compounds were detected, being phloridzin the most abundant found in the initial dried bagasse (1402 mg/kg). Gastrointestinal digestion had a positive effect on the concentration of free phenolic compounds, representing a bioaccessibility value of over 120%. Regarding individual phenolic compounds, the most bioaccessible was p-coumaric acid (1850%). Thus, this enhancement in bioaccessibility may be related to the breakdown of matrix-bound phenolic compounds during gastrointestinal digestion. In the insoluble intestinal non-bioaccessible fraction, the flavanol hyperoside was the most abundant free compound (1038 mg/kg), but it was not detected after colonic digestion. In fact, there were a significant reduction (98%) in the amount of phenolic compounds found after these stage, probably due to chemical transformations of these compounds by gut microbiota.
Conclusion: The release of phenolic compounds from the dried apple bagasse after gastrointestinal digestion, as well as their metabolisation by the gut microbiota, suggests that the dried bagasse has great potential as a functional ingredient.

P1.2.040

Formulation engineering of protein-rich fat emulsions for elderly population: relating tribology to microstructure

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Aim: Aging is associated with a loss of muscle mass and strength and if allowed to advance, this condition may proceed to sarcopenia, early loss of independent living, and several comorbidities1. Acute studies have shown promising results for high leucine or leucine-enriched protein sources in terms of stimulating muscle protein synthesis2. Furthermore, protein hydrolysates have been seen to be a promising method to obtain easily digestible proteins. However, increasing protein levels whilst reducing fats as a food formulation strategy for the elderly to address food-linked diseases often affects the taste, flavour, and texture of the foods.
Method: The aim of this research was to identify optimized high protein ingredient combination for designing food with just-right texture to provide novel insights for food industries to formulate foods for older adults. The effect of protein type and processing condition on the tribological properties of emulsions made with high protein concentration (10 wt%) was studied. Oil-in-water emulsions stabilised by whey protein isolate (WPI) or hydrolysed whey protein (HWP) were produced using two different processing routes, a) emulsifier-rich, b) emulsifier-poor followed by continuous phase enrichment. We characterised the tribological behaviour using soft tribopairs consisting of polydimethylsiloxane (PDMS) and protein adsorption studies were performed with a quartz crystal microbalance with dissipation (QCM-D) equipment.

Results: HWP emulsions presented lower friction coefficient values across all tribological regimes compared to WPI emulsions when using an emulsifier-rich processing route, whereas no changes were observed between proteins when using an emulsifier-poor followed by continuous phase enrichment. Adsorption studies show that HWP forms a less viscous/more elastic film when adsorbed onto the PDMS surface, thus resulting in lower friction coefficients. The combination of WPI and HWP (1:1 w/w ratio), as well as model saliva addition, negatively affected the lubrication properties of the o/w emulsions. However, formation of an emulsion-filled gel bolus of the combined protein systems made thought both processes resulted in ultralow friction coefficient in the boundary lubrication regime, as compared to single protein systems suggesting disintegration and release of oil droplets from the gel.
Conclusion: The knowledge generated here is important for designing foods with high protein concentrations with pleasurable sensory characteristics for the elderly population highlighting the potential use of protein hydrolysates.

P1.2.041

Formulation and characterization of functional tomato (FunTomP) sauce enriched with pea protein and olive powder

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Tomato and olive are important in Mediterranean diet and functional tomato products are in scope due to their health promoting effects and revival of interest. In this study, a novel tomato sauce was developed using olive powder and pea protein isolate as the functional ingredients. The juice was named ***FunTomP*** (**F**unctionalized **T**omato **P**roduct) *sauce*. Tomato peel powders were also used to include the tomato as much as possible in the formulations.
Tomato purees were prepared by peeling, hot break (85^{o}C, 3 minutes) and sieving. Peels were also subjected to hot break, dried (55^{o}C, 24 hours), and pulverized to obtain the powder. In the formulations, effects pea protein isolates (0 to 2%) and tomato peels (0 to 5%) were investigated with constant percentages of olive powder (2%) and salt (1%). Ingredients were mixed using a high-shear homogenizer. Soluble protein (determined by *Lowry* method) and lycopene content, viscosity, color, pH, brix, and NMR T_2 relaxometry experiments were conducted to understand the effects of different ingredients. Results were used to obtain a formula for a marketable juice by the evaluation of a sensory panel.
Addition of pea protein increased protein content (~50% more than control) but the low solubility of pea proteins was observed as 1% and 2% protein samples had the same protein content. pH, brightness (L^*) increased but a/b value decreased with increasing protein content. Tomato peel significantly improved the color, texture, increased the lycopene content and brix but decreased the pH. Viscosity measurements showed that the sauce followed a shear thinning behavior explained by the Herschel-Buckley model with n values ranged from 0.5 to 0.9, and K values from 0.1 to 5 and yield stress from 8-25 Pa. NMR results are correlated with brix and T_2 decreased with both protein and peels.
Preliminary formulations of **FunTomP** sauce were determined based on protein content, consistency, color, and sensory analysis. It was shown that low solubility of pea protein is a problem and further processing is required. Tomato peel has proved to be a valuable ingredient to provide viscosity and color without the need for thickeners. Olive powder did not have a negative effect either on the appearance or on the physical properties.

P1.2.043

Buckwheat as an ingredient to improve the nutritional aspect of wheat bread

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Aim:

Gastrointestinal hormones play a significant role in modulating several physiological processes, such as regulating glucose levels and controlling appetite. Buckwheat flour is a pseudocereal with satiety-enhancing potential when added to food such as bread. However, integrating new food ingredients effectively without compromising the desirable textural properties and internal structure is challenging. This study aimed to investigate the effect of buckwheat flour on flour satiety and composition, internal structure, and textural profile of bread.

Method:

The murine enterendocrine cell line, STC-1, was treated for 4 hours with <10kDa fraction of each digesta (produced by INFOGEST). Active GLP-1 was measured in the supernatant using ELISA. For bread, 20% of wheat flour was substituted with buckwheat flour. A 100% wheat bread was used as the control. The dough was manually shaped and a 2-stage proofing was applied, followed by baking at 180 °C for 18 min. The bread was assessed for its composition (protein, ash, fat, dietary fibre and starch), internal structure using C-Cell and crumb texture using a Texture Analyser.

Results:

The buckwheat flour significantly increased active GLP-1 secretion from enterendocrine cells post-gastric and post-gastrointestinal digestion compared to digesta controls ($p<0.05$). Including 20% buckwheat flour in the bread increased in dietary fibre content from 4.2% to 6.0%, particularly the soluble fibre (<0.08% to 3.1%). As a result, the starch content was reduced. No difference was noticed for ash, fat and protein content. There was a slight increase in bread firmness with the inclusion of buckwheat on test days 1 and 3 post-baking ($P<0.01$). The decrease in firmness can be related to the slight reduction in the number of cells and cell wall thickness. A reduced number of cells led to a dense structure which increase the firmness.

Conclusion:

Incorporating 20% buckwheat flour enhances the nutritional profile of the bread, which is attributed to its higher dietary fibre and lower starch content than a control wheat sample. Including 20% buckwheat flour in bread can reduce the glycemic index, making it a valuable option for individuals with diabetes or obesity. Despite these improvements, the bread's technological quality undergoes minor changes, which may not be noticeable to consumers.

P1.2.044

Protein profiling and modulation of digestive proteolytic enzymes by NADES extracts of citrus by-product

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Aim: Food processing generates high waste causing significant disposal expenses. Many of these biomaterials, including citrus wastes, are a source of valuable compounds that could be used in food industries. Recently, "green" novel extraction techniques have been used to optimize the extraction of bioactive compounds and nutrients. NaDES are composed of two or more components that interact each other's and form a eutectic mixture. The advantages of NaDES are biodegradability, low costs, and low toxicity. Anyway, considering the extraction recovery of nutrients and bioactive compounds, the NaDES formulation should be deeply evaluated. Aim of this study was to characterize the protein profile of extracts from citrus peel obtained using 4 NaDES formulation (choline chloride:fructose, choline chloride:xylose, choline chloride:glycerol, choline chloride:glycerol:citric acid) and 1 hydroalcoholic solution. Moreover, since the orange peel is a considerable source of polyphenols which possess an enzymatic modulating activity, the effect of extracts on the proteolytic activity of pepsin, trypsin, and chymotrypsin was evaluated.

Method: Proteins were collected mixing extracts with acetone. After phases separation, acetone parts were mixed with PBS and loaded on 12% SDS-PAGE for protein profile separation. Enzymatic activity was determined measuring spectrophotometrically the release of aromatic aminoacids after protein cleavage using hemoglobin as substrate.

Results: Results indicated as protein recovery and profile is depending by NaDES formulation, where choline chloride:glycerol:citric acid seems to be the most promising formulation with several bands associated to proteins with a Mr comprised between 66 and 45 KDa. Similarly, NaDES modulated the proteolytic activity of digestive enzymes, indicating as these innovative green solvents may exert a pivotal role in digestive tract.

Conclusion: The data obtained indicate how NaDES may be a viable alternative to organic solvents in the extraction of nutrients from food by-products for their direct use in food preparations. Further studies are needed to evaluate their biological effects by considering NaDES as active ingredients thus bypassing the difficulties of solute recovery.

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P1.2.045

GELLED EMULSIONS AS FAT REPLACER IN PÂTÉ: EFFECT ON SENSORY AND PHYSICOCHEMICAL PROPERTIES

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Aim:

This study aims to investigate the use of a gelled emulsion made from buckwheat flour and hemp oil as a fat replacement in pork liver pâté.

Method:

In this study, pork liver pâté with 65:25:10 ratio of dewlap, liver pork and pork backfat was used as the control (PC). For the production of another batch, the 10% pork fat was fully replaced with gelled emulsions made from buckwheat flour and hemp oil using a 40:40:15:5 ratio of water, oil, flour, and gelatine resulting in sample PGH10. The other batch was made by replacing 10% of back fat and 10% of the pork dewlap used in the base formulation for the same gelled emulsion (PGH20). Sensory evaluation was performed by a consumer panel, physico-chemical measurement (texture, pH and water activity) was evaluated and the total liquid expelled was measured to compare the emulsion stability between the samples.

Results:

The results indicated that PGH10 and PGH20 had similar overall acceptability to the PC. The replaced samples showing no significant differences ($p>0.05$) in pH (6.18-6.21) and water activity (0.891-0.893) with control sample. Additionally, the pâté replaced (PGH10 and PGH20) presented lower firmness (2.06 and 1.76 N respectively) and shear work (2.16 and 1.86 N respectively) than the pâté control (3.72N for firmness and 3.92 N.s for shear work). The decreasing of firmness was in 44% and 52% respectively for PGH10 and PGH20 compared to the PC ($p<0.05$). Regarding the stability of the emulsion in the three batches, as more gelled emulsion was added, the emulsion stability decreased with significant differences between the substituted samples and the control with values of 2.89%; 7.05% and 11.52% of total fluid expelled for PC, PGH10 and PGH20 respectively.

Conclusion:

This study suggests that gelled emulsions made from buckwheat and hemp oil can be a potential method for reducing the fat content of pâté, resulting in a softer texture with lower firmness and shear work, which could appeal to some consumers.

P1.2.046

Insect rearing as a means for better use of residual streams: pre-processing of substrates

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Aim:

Insects can be used to increase the circularity of agriculture and diminish food waste. Residual streams that contain animal products or manure currently can't be used as feed, including feed for insect rearing, according to EU legislation. We aim to contribute to possible adaptation of legalization on the permitted use of these residual streams to enable better valorisation through insect rearing. Within this topic, we specifically looked at pre-treatment of these streams to increase suitability as insect feed.

Method:

Within the project SAFE INSECTS, black soldier fly larvae (*Hermetia illucens*) and yellow mealworms (*Tenebrio molitor*) were reared on supermarket mix (food products that passed the expiration date or are unsaleable for other reasons), category 2 meat meal from animal rendering, organic waste from household kitchens, and poultry manure. These materials were collected and different means of pre-processing were applied. Pre-processing was either applied to increase storage time of the feed and/or to obtain structural changes that made them better suitable as insect feed.

Results:

An overview of pre-treatment methods was made and several were applied to decrease the microbial load or to adapt the size and water content of the feed. These techniques include (spontaneous) acidification, drying and milling. Pre-treated single streams and mixtures were tested as substrates for insect growth and growth performance was studied to see if these residual streams are promising substrates for insect rearing. Also, chemical and microbiological data of the residual streams and insects grown on them was obtained and used to assess potential absence or presence of contaminants.

Conclusion:

Pre-treatment and mixing of the substrates was specific for black soldier fly larvae and yellow mealworms as they have different requirements. In the end we were able to grow both of them on most of the substrates or combinations thereof. With the obtained safety data, we aim to contribute to possible adaptation of legalization on the permitted use of these residual streams to enable better valorisation through insect rearing.

P1.2.047

Processing-induced changes in Rosa canina L. powdered formulations with functional carriers

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Aim: Although plant powders are a rich source of numerous bioactives, their quality may be questionable due to processing level. Therefore, in this study the effect of pre-treatment (pasteurization) on the loss of nutrients and health prompting compounds during drying of rosehip (Rosa canina L.) juice after addition of functional carriers was monitored. The aim was to establish the process conditions to preserve health-promoting constituents and to avoid unwanted changes during powdering.

Method: The unpasteurized and pasteurized juices from rosehip were freeze- and spray dried with inulin, trehalose, palatinose and maltodextrin (20% w/w) and compared to lyophilized control (without any encapsulant). The assessment of processing-driven alterations was monitored by analysis of selected chemical components, total phenolics content (Fast Blue BB assay) as well as fructosamine (NBT assay) and free amino groups (OPA assay).

Results: Carrier addition resulted in powders with approx. 60% lower quantity of total phenolics compared to controls (dilution due to carrier addition), however, its application allowed for considerable fructosamine reduction. Powders from pasteurized juice led to about 20% lower fructosamine content compared to unpasteurized variant. Amongst carriers tested, inulin added to the pasteurized juice ensured the lowest fructosamine content after spray drying. Application of trehalose as carrier to pasteurized juice significantly reduced the level of free amino groups as indicator for the sensibility to glycoxidation. Based on the analyzed parameters, spray dried powders had a comparable or even better quality than lyophilized ones.

Conclusion: The study showed that by an appropriate pretreatment of juice and a reasonable selection of a carrier, it is possible to influence powder quality. Inulin considered healthy dietary fiber applied to pasteurized rosehip juice gave the most desirable features of final product. Fruit juice powders with functional carriers can be considered as promising food additives with demanded health benefits.

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P1.2.048

A natural salivary substitute: from development to its applications in vivo and in vitro

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Aim:
Saliva is an essential physiological fluid involved in different functions such as moisture retention and lubrication. Consequently, a change in saliva secretion or composition can induce a perceived dryness in the mouth, also known as xerostomia. This study links the development of a natural salivary substitute inspired by human saliva rheological characteristics and its further applications as an oral lubricant and ingredient to tailor food hydration for xerostomic patients.

Method:
The shear and extensional rheological properties were considered as criteria to select the closest formulation to human saliva. Flaxseed extracts at different concentrations (0.25% and 0.7% w/w) and temperatures (20 and 37 ^{o}C) were appraised. These extracts were assessed using steady shear rheometry in a shear rate range of 0.5 to 1000 [s^{-1}] and using capillary break-up extensional rheometry. Furthermore, a healthy trained panel (n=16) evaluated hydration perceptions of the following samples; water, flaxseed at 0.25%, flaxseed at 0.7%, and saliva.
In the second part of the study, Greek yogurt was implemented as a control soft food to tailor food hydration. Four formulations were compared at different concentrations of water or flax at 0.7%. *In vivo* and *in vitro* oral residues were quantified by sensory perceptions and by employing a novel soft robotic *in vitro* device.

Results:
The flaxseed extracts show shear-thinning behavior, with the 0.25% concentration closer to human saliva. The relaxation time of both concentrations are close to those reported in the literature for human saliva. Sensory results show that mouth hydration was perceived higher lubricated for flaxseed extracts when compared to saliva. *In vivo* and *in vitro* results showed that oral residues decreased when the flaxseed formulations were compared against the reference food (greek yogurt). In addition, flaxseed extracts used as ingredients display no taste impact and increase mouth hydration and slipperiness.

Conclusion:
Flaxseed extracts enhance perceived oral hydration and reduce perceived post swallow residues. These samples were also shown to reduce post-swallow residues in *in vitro* tests using soft robotics to imitate the oral phase of swallowing. These results suggest a strong potential to develop flax seed- based salivary substitutes and ingredients to reduce oral residues and provide oral hydration.

P1.2.049

Pulsed ultrasound-assisted extraction of polyphenols from tomato by-products generated during its industrial grated processing

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Aim: The aim of this study was to optimize the extraction of total phenolic compounds (TPC) from tomato by-products by ultrasound-assisted extraction (USAE) with a probe. Therefore, the effect of operating conditions (temperature, time, and amplitude) was studied.

Method: *Valkirias* tomato by-products were obtained from Bonnysa Group (Alicante, Spain). The extraction was carried out using a sonicator with probe -387 x 203 x 216 mm- (Fisherbrand™ Q705, Madrid, Spain). To optimize the TPC extraction by pulsed US with probe, Central Composite Design (CCD), useful in response surface methodology, was carried out using the following *fixed variables*: i) particle size (< 56 µm), ii) solid:liquid ratio (2:25), iii) solvent (ethanol), iv) duty cycle (30:30) v) frequency (20 kHz), and *continuous variables*: i) temperature (50-70 ºC), ii) time (15-25 min); and iii) amplitude (55-75 %) being nominal power 700W. CCD consisted into 2 blocks with a random order of sample combinations with 4 samples replicates set as the centre based on previous studies. A third block was carried out to test the results obtained. Once the samples extraction was completed, they were centrifugated to separate the solid from the extract. The extracts were stored at -80ºC until analysis.

Results: Tomato by-products in the industrial grated tomato processing is characterized by 59 % peels, 9 % seeds, and 32 % free water. It was found that the replicates of the centres had a deviation of 0.02, which indicates that the experiment has a correct reproducibility. The results obtained ranged from 1.23 to 1.44 g gallic acid equivalents/kg dried weight.

Conclusion: USAE with probe demonstrated to be a clean, efficient, and a green alternative for the extraction of TPC from tomato by-products, which can be potentially applied to new food products as healthy and preservative ingredients. Further experiments should be conducted for monitoring other bioactive compounds like carotenoids and study the up-scaling for industrial applications.

P1.2.050

Use of meat by-products as a sustainable source for the production of bioactive peptide extracts

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Aim:
Meat industry generates hundreds of by-products rich in proteins that could be reused to obtain value-added products such as feed and food ingredients supporting the circular economy of the sector. This study aimed to utilize dry-cured ham bones as a substrate to produce hydrolysates showing antioxidant and DPP-IV inhibitory activities.

Method:
The bones were cut, defatted, freeze-dried, and crushed to a powder. Subsequently, the bones were pre-digested with pepsin enzyme (PEP) and then sequentially hydrolyzed with Alcalase (PA) and Alcalase + Protana prime (PAPP). The degree of hydrolysis, antioxidant activity, and DPP-IV inhibitory activity were measured. The elution profile of the peptides generated in each hydrolysate was characterized by RP-HPLC and HILIC chromatography. The peptides of the hydrolysates were identified by mass spectrometry in tandem (LC-MS/MS).

Results:
Predigestion with pepsin did not significantly affect the degree of hydrolysis although it might promoted the cleavage of certain bonds for subsequent protease action. All three samples, PEP, PA, and PAPP showed antioxidant and DPP-IV inhibitory activity; however, the highest values in both bioactivities were obtained in the PAPP hydrolysate. The free amino acids contents were 54.62, 88.12, and 668.46 mg/100 mL of PEP, PA, and PAPP hydrolysates, respectively. With the data obtained in LC-MS/MS, a total of 550 peptides were identified in the PEP hydrolysate, 1087 in the PA hydrolysate, and 1124 in the PAPP hydrolysate. The identified peptides were grouped according to their protein of origin using ProteinPilot™ software and results showed that the majority of peptides in PA and PAPP samples were derived from collagen protein.

Conclusion:
Peptide extracts of ham bone hydrolysates showed a significant antioxidant and DPP-IV inhibitory activity. Such bioactive compounds could be used as ingredients in feed, functional food, pet food, or as food supplement. This could represent an improvement in the management and sustainable use of by-products in the meat industry.

P1.2.051

Wheat-based 'magdalenas' suitable for people with celiac disease: nutritional and sensory properties and purchase intent

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Aim:
The aim of this work was to develop 'magdalenas' (Spanish muffins) suitable for people with celiac disease by using wheat flour processed by a biotechnological process to further evaluate their nutritional and sensory properties and determine their purchase intent.

Method:
Wheat flour (10% protein) was treated by a biotechnological process to reduce its gluten content and subsequently used for preparing novel gluten-free magdalenas. Control magdalenas were prepared with non-treated wheat flour and conventional gluten-free magdalenas with a mixture of rice and maize flour (50%, w/w). Gluten content was assessed in the treated wheat flour and the novel magdalenas by R5 antibody-based competitive ELISA. Proximate composition was also determined. Sensory evaluation of the magdalenas was performed by a panel of 49 consumers on the same day of their preparation. A triangular test was used to determine the existence of differences with the control, followed by a blind hedonic test using a 5-point hedonic scale to determine the acceptability of the samples. Panelists were also asked for their willingness to buy the magdalenas and to compare them to the currently available gluten-free products.

Results:

Gluten content was 29.9 mg/kg for treated wheat flour and 15.4 mg/kg for the novel magdalenas, which could be labelled as gluten-free according to the requirements of the Codex Alimentarius Standard and the EU Regulation 828/2014. The novel magdalenas had 405 kcal/100 g, 20.9% moisture, 19.0 % total lipids, 5.9% protein, 52.6% carbohydrates and 1.6% ash. The triangle test revealed significant differences ($p<0.05$) between the developed magdalenas and the control, although these differences were moderate for most panelists. Appearance, aroma, taste, texture and overall acceptability of the developed magdalenas were acceptable. Moreover, the products were appreciated to be better or much better than the currently available gluten-free products by 77% of habitual consumers of gluten-free products. 68% of them were willing to buy them.

Conclusion:

Novel magdalenas suitable for people with celiac disease were successfully developed by using wheat flour treated by a biotechnological process. This could be an interesting alternative to improve the nutritional and sensory properties of the gluten-free products currently available in the market.

P1.2.052

Vegetable Nitrate Sources and Fruit Extracts on the Instrumental Color of Iberian Dry Sausages

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Aim:

To evaluate the effect of the addition of vegetable nitrate sources (dried chard and dried spinach) and colorant fruit aqueous extracts (cherry and black currant) on the instrumental colour changes of dry sausages during drying.

Method:

Dry sausage batters were prepared using nitrite (N), dried chard (C), and dried spinach (S) as natural nitrate sources, and cherry (Ch) and black currant (Bc) aqueous extracts as natural colorants: **0N**: 0 mg $NaNO_2$/kg; 2. **150N**: 150 mg $NaNO_2$/kg; **CCh**: C 344.7 mg KNO_3 eq/kg + Ch 5 mL/kg; **CBc**: C 356.4 mg KNO_3 eq/kg + Bc 5 mL/kg; **SCh**: S 307.9 mg KNO_3 eq/kg + Ch 7.56 mL/kg, and **SBc**: S 600.0 mg KNO_3 eq/kg + Bc 8.54 mL/kg. The ingredient levels were determined through response surface methodology optimization, considering CIE a*-value and NOMb concentration maximization and lower malondialdehyde content. The batters were stuffed into natural casings (34-36 mm diameter) and dried for 26 days. Samples were collected at 1, 14, and 26 days of processing. CIE L*a*b* coordinates were measured following AMSA guidelines. Data analysis was performed using a mixed effect model (batch, drying times).

Results:

Compared to cured sausages, the addition of chard and spinach significantly decreased CIE L*. Spinach significantly reduced CIE a* irrespective of cherry and black currant addition. Chard, along with cherry and black currant extracts, had significantly lower CIE a* values than cured sausages and showed no differences compared to uncured sausages. Higher levels of spinach resulted in lower CIE a* values. CIE a* and b* values, as well as C* and Hue, were significantly lower at the end of the drying process.

Conclusion:

Incorporating plant extracts as nitrate sources and colored fruit extracts alters the color of uncured sausages but does not achieve instrumental color values similar to cured products.

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P1.2.053

Bio-functional activities of Cannabis sativa L. seeds and sprouts: perspectives for their application as nutraceuticals

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Aim:
Sprouts derived from germinated seeds of herbaceous plants contain higher levels of bioactive compounds and micronutrients than adult plants. The daily consumption of sprouted seeds in diets has increased in recent years, with interest in exploring their potential beneficial effects on human health. This study aimed to evaluate the germination rate and nutraceutical properties of *C. sativa* cultivar "Futura 75" seeds under standard and enrichment conditions, using the microalga *Chlorella* sp. strain C2 and the endophytic bacterium *Sphingomonas* sp. strain CAN S-11, as bio-stimulants. Additionally, the anti-inflammatory potential of *C. sativa* seed and sprout extracts was evaluated on a tumor necrosis factor-alpha (TNF-α)-inflamed human pulmonary cell line (A549).

Method:
The phytochemical profile and antioxidant activity of hemp sprouts were evaluated by detecting bioactive compounds such as polyphenols and flavonoids and performing *in vitro* assays (DPPH, ABTS, FRAP, ORAC, and Fe^{2+}-chelating activity). The gene expression of inflammatory markers IL-8 and COX2 was analyzed by Real-Time PCR and immunoblot analysis in A549 cells exposed for 4 hours to TNF-α, after 1-hour pre-treatment with C. *sativa* extracts.

Results:
Significantly higher levels of polyphenols (2.95 vs 2.20 ± 0.02 GAE/g FW, p<0.01), flavonoids (2.68 ± 0.01 vs 1.63 ± 0.01 CE/g FW, p<0.05), and antioxidant activities such as DPPH (27.01 ± 0.35 vs 22.60 ± 0.68 % ARA, p <0.01) and ORAC (81.83 ± 14.55 vs 41.29 ± 1.94 µmol TE/100 g FW, p <0.01) were observed in hemp sprouts obtained from treatments with dry C2-microalgal biomass and with the bacterium CAN S-11 than in standard conditions. Moreover, the pre-treatment with *C. sativa* seeds extract (100 µg/ml) significantly reduced the expression of IL-8 and COX-2 in TNF-α inflamed cells, showing fair anti-inflammatory effects. However, treated sprout extract (C2-microalgal biomass and the bacterium CAN S-11), at the highest concentration (100 µg/ml), slightly reduced the expression of IL-8 under inflammation conditions.

Conclusion:
C. *sativa* seeds and sprouts represent valuable nutraceutical products with potential medical and nutritional applications, useful in the prevention of inflammatory and oxidative stress-associated diseases.

P1.2.054

Nutritional quality and digestibility of proteins from red seaweeds and impact of processing methods

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Aim:
Although seaweeds are consumed as a food source in many parts of the world and they represent a potential source of alternative non-animal proteins, currently there is very limited knowledge on the nutritional properties of their proteins. Therefore, this study aimed to assess the nutritional quality and digestibility of the proteins present in two red seaweeds, *Gelidium corneum* and *Gracilariposis longissima*, evaluating the impact of their cell wall structure and composition, as well as the application of processing methods on their digestibility.

Method:
Raw and processed seaweeds were characterized. The processing methods involved extrusion and a subsequent pressing step to obtain biofilms. The Infogest protocol was used to carry out *in vitro* gastrointestinal digestions and the digestibility of all samples was analyzed by three different methods: nitrogen analysis by Kjendahl; total amino acids and the quantification of free amino groups using the OPA protocol. Furthermore, a detailed analysis of the structure, composition and amino acid profile of the different samples was also carried out.

Results:

Both seaweed species presented an initial protein content of 16%. The amino acid profiles of the seaweeds were affected by processing, although in all cases essential amino acids constituted more than 34% of the total amino acids, pointing towards the high quality of the proteins. The results obtained after the *in vitro* gastrointestinal digestions indicated that processing improved the digestibility of the seaweed proteins by up to 70%; however, the first extrusion processing step was sufficient to improve digestibility. Differences were also noticed between the two seaweed species, with *G. corneum* and its processing products showing a higher digestibility.

Conclusion:
The findings of this study provide evidence for the potential of seaweeds as a promising alternative sources of plant-based proteins that could be incorporated into the human diet and demonstrate that processing methods can be useful to improve their protein digestibility.

P1.2.055

Use of agro-food residues as ingredients for the production of a “Primo Sale” cheese

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Aim:
Up to 14% of food produced globally undergoes quantitative food loss and waste (FLW), affecting the sustainability of food systems. FLW is an important global issue and is linked to many SDGs such as 12 (Responsible Consumption and Production) and 2 (Zero Hunger). However, FLW still contains valuable compound which may have different bioactivities, e.g. antimicrobial, antioxidant, antitumoral. The aim of this work was to valorise agro-food residues by evaluating their functional properties to use them as ingredients directly added to “Primo Sale” cheeses to improve their quality and shelf-life.

Method:
Pomegranate (peels and seeds) and orange residues (Citrus), and a weed plant, *Equisetum arvense* (Eq) were characterised for their potential use as food ingredients. Their methanolic extracts were tested for total phenolic content (TPC), DPPH (0.1 mM) scavenging activity and antimicrobial one against 48 microbial strains (pathogens, spoilage bacteria and yeasts, starters/probiotics). Furthermore, Citrus (2% w/w) and Eq (1% w/w) were used as ingredients to produce "Primo Sale" cheeses which were analysed over 1 month of storage at 4°C for the fate of the microbial starters and spoilage microbiota, colour and antioxidant activity.

Results:
The best data for TPC and antioxidant activity were observed for pomegranate peels. The results of the antimicrobial activity were strain and substance-dependent, and pomegranate was generally the most active one against all the tested microorganisms. Lactic acid bacteria were resistant to most of the compounds especially Citrus and Eq. This outcome was confirmed also by the viability data of the starters added to the cheeses with Citrus and Eq. On the contrary, the growth of spoilage bacteria such *Pseudomonas* spp. was inhibited by their presence and remained 3 log units lower than the control samples. Additionally, the antioxidant activity increased with the addition of these substances, especially Citrus, as well as with storage time.

Conclusion:
The addition of such residues can improve the safety and the quality of “Primo Sale” cheeses. Moreover, they may be used to replace common preservatives without compromising the product safety and overall quality, while providing additional properties, e.g. antioxidant activity, richness in dietary fibres or prebiotic activity.

P1.2.056

Characterization of Flavor Compounds in Seasoning Sauce Developed from Anchovy Sauce by Reaction Flavor Technology

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Aim: Aim of this study was to develop a seasoning sauce using an anchovy sauce by a reaction flavor technology to reduced the off-flavor and to identify and compare key flavor compounds in reaction flavor product (RFP).
Method: To manufacture RFP, based on the optimum reaction flavor condition obtained from previous study, threonine 0.5707% (w/v), glycine 0.8008% (w/v), and proline 0.5354% (w/v) were mixed with 1 g of glucose and 100 mL of the anchovy sauce (control) in 250 mL of erlenmeyer flask and reacted at 110°C for 2 h using a water bath. The volatile flavor compounds were identified using a GC/MS. To measured volatile compounds, SPME fibers were injected in a vial with the sample, heating at 50°C for 40 min with a magnetic stirrer and injected into GC injection port set at 220°C for 10 min.
Results: Total content of nitrogen-containing compounds in RFP was 2,465 ng/g. It was higher than the control (1,890 ng/g). Key flavor compounds of RFP were dimethyl trisulfide (backed potato), 3-methylbutanal (dark chocolate), 2-ethyl-3,5-dimethylpyrazine (nutty), 3-ethyl-2,5-dimethylpyrazine (roasty), trimethylpyrazine (roasty), and 2-methylbutanal (dark chocolate). These compounds were 2.41, 3.32, 1.17, 1.39, 1.16 and 3.44 times higher than that in the control, respectively.
Conclusion: The developed RFP has been enhanced nutty, sweet, and savory flavors compared to that in the control, and masked off-flavors. Therefore, the developed RFP has a high potential to be used as seasoning sauce with savory flavors. However, research on sensory has not been conducted, so additional research will be needed to improve the sensory.

P1.2.058

Potential of using pressure-driven membranes for the fractionation of fish protein hydrolysates:application for bioactive compounds

<u>Potential Of Using Pressure-driven Membranes For The Fractionation Of Fish Protein Hydrolysates:application For Bioactive Compounds Nattawan Chorhirankul</u>[1], Associate Professor dr.ir. Anja Janssen[1], Professor dr.ir. Remko Boom[1]
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Aim:
This study aims to investigate the use of pressure-driven ultrafiltration membrane processes to fractionate a commercial fish hydrolysate. The <4 kDa peptide fraction was the target as it contains bioactive compounds for functional and pharmaceutical purposes. We determine the influence of pH and salt concentration on membrane performance (permeate flux and retention) and the selectivity of <4 kDa peptides.
Method:
The filtration experiments used four spiral-wound membrane modules with differences in molecular weight cut-offs (10, 5, and 3 kDa) and materials (polyethersulfone and polyamide). The solution pH was set at pH 5 and 8, whereas the concentrations of NaCl were 0 and 0.6 M. The permeate flux was calculated from the recorded flow rate of the permeate stream and the effective membrane area. The retentate and permeate concentrations were quantified by a chromatographic method. Then, the concentrations (C) were used to estimate the retention (R) with $R = 1 - C_{permeate}/C_{retentate}$. The selectivity was calculated from the transmission ratio of desired and unwanted fractions.
Results:
The permeate flux and retention at pH 8 were higher than those values at pH 5. Adding salt to the hydrolysate improved the flux and selectivity but decreased the retention. Moreover, the addition of salt changed the slope of the retention profile to be steeper and smoother when compared to the case of no salt containing. The changed slope implies that salt ions might affect the transfer of specific peptides in the hydrolysate through the membranes.
Conclusion:
The polyethersulfone membranes can fractionate the mixtures containing charged components such as fish protein hydrolysates. In contrast, the polyamide membrane is likely to get permanent fouling, so it might not be suitable for the fractionation. Modifying the pH of solutions and adding NaCl could improve the membrane performance and selectivity. The change in the charge state of the charged molecules influences the transfer of some peptides through a membrane. This study is a step forward in the design of membrane processes for the fractionation of protein hydrolysates.

P1.2.059

Effect of pea protein and maltodextrin on the production of a spray-dried tomato powder

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Aim: The objective of the study is to investigate the effectiveness of carrier materials, pea protein and maltodextrin, and high-pressure homogenization on the yield and quality of spray-dried tomato powders that will be used as an instant tomato sauce.

Method: Diced tomatoes was homogenized using a high shear mixer and exposed to hot-break treatment for 3 minutes at 85℃ followed by quick cooling to room temperature within an ice bath. Tomato juice was filtered by sifting through a strainer to remove the suspended pulp and seeds and was mixed with pea protein and maltodextrin at two different ratios (1% and 3%), both separately and in combination. All samples were subjected to high-pressure homogenization at 50 and 100 MPa for 2 passes prior to spray drying. Spray drying was conducted at an inlet air temperature of 150 ℃, aspirator rate of 80% and feed flow rate of 8-10 ml/min to keep air outlet temperature at 85 ℃. Spray-dried tomato powders were characterized in terms of powder recovery, moisture content, water activity, bulk tapped density, dispersibility and morphology.

Results: It was determined that the product yield and the density of the powder increased with an increase in the concentration of carrier materials and homogenization pressure. Scanning electron microscopy experiments also showed that high-pressure homogenization resulted in powders with smaller and more uniform particle sizes. Dispersibility of the powders was also tested at different temperatures. Higher temperatures increased the dispersibility which was proper for the final use of the products as an instant sauce.

Conclusion: A tomato powder with increased protein content was formulated. Dispersibility was still low and needs to be improved for a potential commercial application. Effect of other hydrocolloids as the coating materials will be tested for further studies.

P1.2.060

The effect of pulsed electric field and ultrasound treatment on the properties of osmodehydrated strawberries

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Aim: The aim of the research was to assess the effect of pulsed electric field (PEF) and ultrasound (US) treatment on the properties of osmodehydrated strawberries. PEF and US treatments can disrupt the cell membrane structure of fruits, facilitating the entry of the osmotic solution into the fruit tissue, which can influence the properties of the final product.

Method: The osmotic dehydration (OD) process was carried out in sucrose solution for 2 hours at 30 °C. The ratio of the mass of the solution to the mass of the raw material was 1:4. Before OD samples were subjected to the ultrasound using an ultrasonic probe operating at 400 W and 24 kHz for different durations: 30 and 90s. Also, PEF treatment was employed, applying energies of 1 and 2.5 kJ/kg. The strawberries subjected to OD without pretreatment were a reference sample. The osmotic kinetics based on changes in total mass, water mass, and solids mass were evaluated. Additionally, the chosen properties of the strawberries were analyzed (total polyphenol content, vitamin C, antioxidant activity, sugars content).

Results: PEF as well as US pre-treatment led to a significant increase in weight reduction and water loss in all osmodehydrated strawberries. The samples after the OD process, pretreated with PEF and US were characterized by higher total polyphenols content, lower vitamin C content, and the same level of antioxidant activity in comparison to a reference sample. Furthermore, the sugar content for PEF and US treated samples after OD was similar to or higher than in fruits subjected only to osmotic dehydration.

Conclusion: The utilization of PEF and ultrasound treatments can enhance the mass transfer during the osmotic dehydration process. However, the selection of the specific parameters should be done to obtain the high quality of the final product, which can be characterized by a high amount of bioactive compounds and moderate sugar content.

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P1.2.061

Development of hybrid cooked pork sausages with added protein from rice and pumpkin seeds

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Aim:
Hybrid meat products represent a nutritional and more sustainable alternative to traditional meat formulations, especially by using by-products from the plant supply chain. The purpose of this study was to investigate the influence of rice and pumpkin seed proteins recovered from by-products and replacing meat at different levels, on the quality of cooked meat hybrid sausages.

Method:
The replacement of pork meat was made with commercial rice and with pumpkin seeds proteins obtained from cakes after oil extraction, bleached with sodium bisulphite, solubilised at pH = 9, precipitated by pH-shift and freeze-dried. Twelve formulations of cooked sausages were obtained according to a Mixture Design (Unscrambler V9.3, CAMO): meat content ranged from 60% to 100%, rice and/or pumpkin seed proteins varied between 0 and 40% including the hydration water. Salt (1.5%), sodium nitrite (100 mg/kg) and ascorbate (500 mg/kg) were also added. Colorimetric indices CIE a* and Hue angle, instrumental texture parameters Hardness and Springiness and sensory score of pink and green color intensity and of hardness and springiness were the response variables. Proteins were assayed by the Kjeldahl method ISO 937:1991.

Results:
Average protein of the cooked sausages was 25.7 ± 1.8. Response variables were predicted by PLS models with Rsq values ranging from 0.80 (Springiness) to 0.97 (Hue angle). Meat and rice protein contributed positively to a*, Hardness, Springiness, sensory pink color, hardness and springiness. Pumpkin seed protein increased Hue and sensory green color. By means of the isoresponse surfaces, the mixtures corresponding to specified values of the response variables were predicted. At 60% meat content, a* and pink color approach intermediate values when pumpkin seed protein is low (1-3%), while instrumental and sensory hardness and springiness require 27-30% rice protein. To predict more favorable scores of response variables, a meat content exceeding 60% is required.

Conclusion:
The impact on color of the pumpkin seed proteins is due to the traces of green nuances in the isolate. Rice proteins increased instrumental and sensory hardness and springiness. If the goal is to achieve high protein concentrations without increasing the meat content, these features could become a drawback and shall be addressed.

P1.2.062

Enhanced and greener extraction of grape seeds oil by 2-Methyloxolane: a biorefinery approach

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Aim: Almost all solvents approved for food use in Europe (Directive 2009/32/EC) are totally or partly derived from petroleum such as hexane. After more than fifty years of extensive use, a valid alternative to hexane is nowadays offered by 2-methyloxolane (2-MeOx), a bio-based solvent that provides high-quality oils and defatted, stable protein-rich ingredients for food and feed. Based on a comprehensive survey of scientific studies, 2-MeOx was included in the list of permitted solvents for food and feed production in Europe on January 26th, 2023 (Directive 2009/32/EC).

Method: In this study, 2-MeOx, both dry (dry 2-MeOx) and saturated with water (2-MeOx 95.5%), were compared with hexane for the extraction of grape seed oil, commonly used in food and cosmetics. The entire extraction process using 2-MeOx, including the downstream steps and chemical refining of the crude oil, was further investigated on a pilot scale. The potential recovery of high-value secondary metabolites during oil refining was investigated.

Results: The oil extraction yield, total tocopherol and tocotrienol content, and total polyphenol content in the crude oils were similar or higher with both dry 2-MeOx and 2-MeOx 95.5% compared to hexane. The fatty acid profile was not affected by the extraction solvent, while the oil extracted with hexane had a slightly higher sterol concentration. Full characterization of both the crude oil and the refined oil confirmed the excellent scalability of the process. In addition, polyphenols extracted with 2-MeOx have shown strong antioxidant activity in various cellular models.

Conclusion: 2-MeOx has proven to be an excellent candidate to replace hexane in grape seed oil extraction, thanks to its high extraction efficiency, safer toxicological profile, and reduction of CO_2 footprint up to 97% compared to petrochemical solvents.

P1.2.064

Bioactive peptides from yoghurt enriched with milk serum proteins and buttermilk concentrate released after digestion

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Milk is a rich source of essential nutrients and also bioactive peptides. Biopeptides from milk proteins, can be generated by gastrointestinal digestion after consumption.

Aim: Yoghurts enriched with milk serum proteins mixed with buttermilk concentrate (MSPB) with and without lactose can show different bioactivities.

Method: The research material consisted of the following dairy beverages: JK 6 - control yoghurt, JMSPB-P6 - yoghurt with the addition of MSPB and lactose, JMSPB-PL6 - yoghurt with the addition of MSPB without lactose. The *in vitro* digestion method according to INFOGEST consisted of the following steps: "oral", "stomach" – 1 hour, pH = 3, "duodenal "- 1 hour, pH = 7.0. Hydrolysates were analyzed for their enzyme inhibitory (ACE, DPP-IV, α-glucosidase, and lipase) and antioxidant activities. The hydrolysates were used in a screening for bioactive peptides by RP-HPLC-ESI-MS/MS method.

Results: Hydrolysates of analyzed yoghurts showed ACE, DPP-IV, α-glucosidase, and lipase inhibitory activity, as well as antioxidant activity. Among all yoghurt samples subjected to simulated digestion, the most active towards ACE inhibition was JMSPB-P6 (IC_{50} = 1.556 mg/ml), and the preparation with the lowest activity was JK6 D. Comparing the DPP-IV inhibitory activity of samples before and after digestion, the most active was JMSPB-PL6. The highest α-glucosidase inhibitory activity was shown by digest of JMSPB-P6 yogurt (IC_{50} = 0.0530 mg/ml). JMSPB-P6 showed the highest lipase inhibiting capacity (IC_{50} = 0.409 mg/ml). In the case of the ABTS test, it was shown that JK6 digest is the digest with the highest antioxidant activity (IC_{50} = 3.911 mg/ml). The DPPH test showed that JMSPB-PL6 digest had the highest antioxidant activity (IC_{50} mg/ml). Of the total 52 identified, 33 peptides have known IC50 values. These are mainly ACE and DPP IV inhibitors. Examples of identified peptides include: the ACE inhibitory (eg. IPA, IR), DPP-IV inhibitory (eg. IPA, IR, PW) and antioxidant fragments (eg. IR, PW).

Conclusion: Yoghurts enriched with MSPB are considered as an interesting sources of peptides with biological activity, including enzymes inhibitors, as well as antioxidant peptides released after digestion.

P1.2.066

Microalgal triacylglycerols: a potential source of lipids for infant formulation

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Title:

Microalgal triacylglycerols: a potential source of lipids for infant formulation

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Aim
Infant formula is manufactured using plant-based oil to mimic the fatty acid profile of human milk and achieve similar nutritional outcomes in infants. Fat provides most of human milk's energy content and comprises a complex mixture of lipid types of which approximately 98% are triacylglycerols (TAGs). Microalgae are a valuable renewable source of TAGs with potential for nutritional applications such as in infant formula.
Method
In this study, we evaluated the TAG content of different microalgal species grown under normal, nutrient limiting, and altered growth conditions (buffer, medium composition and light exposure). Accelerated solvent extraction was used to extract intracellular lipids form *Chlorella vulgaris, Chlamydomomas reinhardtii, Scenedesmus obliqus, Nannochloropsis ocenica* and *Nannochloropsis occulata* and the TAG content in the extracted lipids was determined by high-performance liquid chromatography with evaporative light scattering detection.
Results
Nitrogen starvation significantly elevated the TAG content in all microalgae (two-way ANOVA $p< 0.05$): *S. obliqus* exhibited the highest amount of triacylglycerol accumulation (295.5 ± 0.9 mg/g dry biomass) followed by *C. vulgaris* (252 ± 9 mg/g), *N. ocenica* (212 ± 19 mg/g) and *C. reinhardtii*; (173 ± 19 mg/g). Phosphate starvation was also associated with TAG accumulation in *N. ocenica* (210 ± 42 mg/g), *N. occulata* (96 ± 23), and *S. obliqus* (94 ± 4 mg/g). Although altering growth conditions (buffer and medium composition) enhanced the total lipid content, this did not increase TAG content compared to nutrient limiting growth conditions. The fatty acid profile of the extracted TAGs from the microalgae under standard conditions was rich in palmitic (C16:0), stearic (C18:0), oleic (C18:1,9), *cis*-12-octadecenoic (C18:1 cis12), linoleic (C18:2n6), and α-linolenic (C18:3n3) acids. Under nutrient limiting conditions the fatty acid profile of the microalgae was maintained as observed in standard growth condition, consequently the quantity of palmitic acid increased up to three-fold for most of the microalgae species tested.
Conclusion
Thus, the fatty acid profile along with the increase in TAG content of *S. obliquus*, *C. vulgaris*, *N. ocenica*, and *C. reinhardtii* cultivated under nutrient limitation could be promising candidates for infant formula production.

P1.2.067

Homogenization technique and wall materials influence on quality characteristics of fish oil emulsions and microcapsules.

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Aim:
Microencapsulation of fish oil seems to be an appropriate strategies to obtaid stables vehicles of omega-3 polyunsaturated fatty acids to enrich food. For that, a fish oil emulsion is firstly prepared, followed by a dessication stage. Rotor stator and high-pressure homogenization (HP) are usually applied for the emulsion preparation. Regarding the wall material of the microcapsules, whey proteins and maltodextrin have been principally used. However, the current trend in microencapsulation studies of fish oil is to evaluate the use of less experienced materials, such as animal and vegetable proteins, and homogenization techniques, such us ultrasound (US). The present work represents a further advance, testing the use of different techniques for the homogenization (HP *vs.* US) of emulsions and wall materials (calcium caseinate (CAS) *vs*. soy protein (SP)), not evaluated so far in this type of microcapsules.

Method:
Firstly, fish oil emulsions were prepared with CAS and SP, which were homogenized by HP and US. Then, the emulsions were spray-dried to obtain the microcapsules. Creaming index, pH, viscosity, density and optic microscopy were determined in the emulsions, and microcapsules were analysed by means of yield, moisture, water activity, instrumental color, density, solubility, efficiency, lipid oxidation, fatty acid profile, size and morphology.
Results:
It was observed an increase in the size of the wall of the oil drops in the emulsion with CAS, leading to a significant increase in the yield (51.12% and 46.35%, respectively in CAS and SP emulsions). Moreover, the efficiency of the microencapsulation and the morphology of the microcapsules were also favored with the use of CAS and HP, finding the higher percentage of efficiency when using CAS-HP (74.03%) compared to SP-US (26.86%). Microcapsules images from Scanning Electron Micrococopy showed a polyhedral structure with pronounced vertices when using US, while those homogenized by HP have a smooth and more flexible surface. The use of SP as wall material lead to microcapsules with cracks, some breaks and multiple irregularities on the surface.
Conclusions:
The option of CAS and HP is the most suitable to achieve higher performance and microencapsulation efficiency, although they should be evaluated after adding to foods.

P1.2.068

FUNGAL BIOFACTORIES FOR THE PRODUCTION OF ENZYME COCKTAILS OF FOOD INTEREST FROM RICE BRAN

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Aim: Filamentous fungi are widely recognized for their ability to colonize virtually any environment and to produce large amounts of metabolites, organic compounds, enzymes, and other proteins of industrial interest. Moreover, they present great advantages due to their ability to grow in diverse and economically viable culture media, including agri-food residues. Recently, the revalorization of agri-food waste has aroused great interest in the scientific community within the so-called 'circular bioeconomy' as a nutritional source and raw material for obtaining high value-added compounds. The objective of this study is to use filamentous fungi for the production of enzymatic cocktails of agri-food interest from rice bran, a by-product of the rice industry.
Method: We isolated the mycobiota present in rice bran and characterized it by (i) growth in distinct culture media (PDA, CYA, MEA, YES) and by (ii) Sanger sequencing of ITS and tubulin genetic regions. Fungal isolates of distinct taxonomic classes were chosen, and we analysed enzyme production in Minimal Medium (MM) supplemented with rice bran as sole carbon source by SDS-PAGE and zymography assays. Finally, (hemi-)cellulolytic and amylolytic activities present in the secretomes of the chosen strains were quantified by means of miniaturized colorimetric methods.
Results: Different filamentous fungal species were isolated from rice bran, which included species of the genera *Aspergillus, Penicillium,* and *Mucor* with great potential for the production of enzymatic cocktails. Phylogenetic analysis of the different fungal species will be shown, as well as their ability to degrade and grow on rice bran as sole carbon source. Finally, we will show the secretome characterization of the chosen fungal isolates by SDS-PAGE, zymography, and enzymatic activity assays.
Conclusion: We present an example of circular bioeconomy in which we apply the potential of filamentous fungi to degrade crude substrates and renewable biological resources, such as rice bran, in a sustainable and efficient manner to reduce and revalorize agri-food waste and minimize environmental impact.

P1.2.069

Improve nutritional value of gluten-free bread using hemp seed flour by-products

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Aim
In recent years, there has been an increase in the number of individuals following a gluten-free diet which has generated a growth in the demand for gluten-free products. On the other hand, it has to be underlined that sometimes gluten-free products are characterized by low nutritional quality (protein and other nutrients) compared to their corresponding traditional food, as bread. Hemp flour is a by-product obtained from the hemp plant's seed (*Cannabis sativa L.)*, and there was growing interest from the food industry in using it as a source of nutrients for human nutrition. This work aims to investigate the potential use of hemp flour in gluten-free breadmaking as source to increase its nutritional profile and antioxidant activity (AO).

Methods
Three different commercial gluten-free bread mixes were purchased by the Italian market and for each one, 15% of hemp seed flour was added. Crude fat, protein, and humidity determinations were performed. Extraction and determination of total phenolic content (TPC) and antioxidant activity (AO) were evaluated using FOLIN, DPPH and ABTS assays, respectively. Total amino acids and fatty acids profile was performed using GC-MS. The HS-SPME/CG-MS technique was used in order to evaluate the volatile organic compounds (VOCs).

Results
Regarding the TPC, it was observed a significant increase ($p < 0.05$) in Gluten-free breads (GFBs) enriched with 15% hemp flour compared with related controls without hemp. Crude protein was significantly more abundant ($p < 0.05$) in hemp flour fortified GFB, with an increased essential amino acid concentration. Concerning TPC and AO, GFBs enriched with hemp flour showed higher phenolic amount and antioxidant activity than the control, emphasizing how hemp seed derivates may be an excellent source of antioxidant compounds. The fortification with hemp seed flour provided the GFB with distinctive VOCs (hexanal, heptanal, 2-octenal, 1-octen-3-ol).

Conclusion
For this reason, hemp flour could be an interesting ingredient for Gluten-free breadmaking.

P1.2.070

Osmodehydrofreezing of tomatoes: Optimization of Osmotic Dehydration by Response Surface Methodology and Desirability Approach

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Aim: Tomato is a high quality product with health benefits. Traditional freezing is not considered as an appropriate preservation method, due to texture degradation, color alteration, nutritional loss. Poor quality of frozen tomatoes can significantly be improved by means of the cryoprotection by a preliminary step of osmotic dehydration-OD. Added benefits can include nutritional or functional properties, attributed to uptaken solutes. In the study, the application of OD as a pre-freezing step of tomatoes was investigated. The quality and shelf-life of OD-frozen (at optimized process conditions) tomatoes were kinetically studied and mathematically modelled.

Method: Peeled oval shaped tomatoes were osmodehydrated in 50-70% (wt/wt) glycerol, 3.5% NaCl and 1.5% $CaCl_2$ at 25-45°C for 5-180 min (food/syrup 1:5). OD was studied and optimized using Response Surface Methodology-RSM, while selected desirability functions were implemented in order to define the optimum process parameters. Mass exchange (water loss-WL, solid gain-SG, water activity reduction-a_w), color and texture changes were measured during process. After OD at the optimal conditions, samples were frozen and packed. L-ascorbic acid, lycopene (HPLC measurements), color (CIELab) and texture (texture analyzer TA-XT2i) of dehydrofrozen and conventionally frozen samples were measured during storage at isothermal and non isothermal temperatures from -5 to -20°C. Sensory evaluation was also conducted.
Results: Mass exchange, color and firmness changes were adequately modeled using a second order polynomial model describing the effect of the most important OD processing factors (temperature/time of osmotic treatment, glycerol concentration). RSM coupled with desirability functions was applied to optimize OD in terms of color retention, maximum WL and a_w reduction (36°C-72 min, 61.5% glycerol). Results were validated by an independent experiment. Based on the comparative kinetic study of the quality degradation, the protective effect of OD on ascorbic acid, lycopene and color was demonstrated. OD-frozen tomatoes presented bright color, good texture and pleasant taste (e.g. 6 months at -12°C), whereas the untreated tomatoes suffered from a detrimental texture and taste deterioration during storage. The effects of temperature deviations were quantitatively evaluated.
Conclusion: The results suggest that osmodehydrofrozen compared to conventionally frozen tomatoes show improved quality and functional characteristics for prolonged storage period.

P1.2.071

Portable Hyperspectral Imaging for Non-invasive and Real-time Prediction of Plant-based Meat Analogues Quality

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Aim:
In the context of a growing market for plant-based meat analogues (PBMA) as sustainable alternatives and the dearth of research concerning their quality, a critical need regards devising accurate and rapid quality assessment methods for PBMA has risen. Most existing wet-chemistry approaches for quality monitoring are laborious, destructive, time, and energy-consuming. Conversely, with the advent of Industry 4.0, non-invasive and smart sensing approaches have received widescale research interest for real-time food quality monitoring. As a novel attempt, this study reports the use of non-invasive portable hyperspectral imaging (HSI) in the visible-near-infrared (VNIR) range (400-1000 nm) coupled with multivariate analysis for simultaneous prediction of quality traits (colour, moisture, water activity, pH, and hardness) of plant-based meat burgers (PBMB).

Method:
Ten different formulations of PBMB with ingredient concentrations (w/w) ranging from 10-30% textured vegetable protein (TVP) and 5-25% pea protein (PP) were fabricated. HSI and reference quality measurements of the fabricated PBMBs were recorded during a 14-day storage period. Spectral pre-processing was optimized to minimize the artifacts. Principal Components Analysis (PCA) was applied to explore both spectral and measured quality data. A global data matrix of 140×204 (samples × vector of spectra) were split into calibration and test sets and analysed by Partial Least Squares Regression (PLSR) to build robust prediction models.

Results:
Unsupervised PCA model on spectral data pre-processed with Savitzky–Golay 1st derivative and mean centering showed successful spatial separation of PBMB samples based on storage days, TVP, PP concentrations. The established PLSR models

possessed good prediction accuracies for redness (a*) with an R^2 of 0.95 (RMSEC: 0.20), 0.94 (RMSECV: 0.23), and 0.95 (RMSEP: 0.27); yellowness (b*) with an R^2 of 0.97 (0.24), 0.95 (0.28), and 0.94 (0.45); moisture with an R^2 of 0.92 (0.65), 0.89 (0.76), and 0.92 (0.74); and hardness with R^2 of 0.86 (0.87), 0.82 (0.97), and 0.81 (0.88) for calibration, cross-validation, and prediction, respectively.

Conclusion:
The obtained results indicate that VNIR-HSI in combination with multivariate analysis is a valuable analytical tool for accurate and real-time quality inspection in plant-based food production. This unified heuristic approach unravels the potential of digital technologies in promoting sustainable foods.

P1.2.073

Polysaccharide-protein hybrid hydrogels to modulate the digestion of food proteins

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Aim:
Controlling protein digestion is a promising strategy to modulate hormonal responses involved in satiety and appetite regulation. The digestibility of proteins is determined by their intrinsic properties and gastrointestinal conditions such as pH and enzymes. Moreover, the presence of physiological surfactants such as bile salts is crucial in the digestion process. In this context, the aim of this work was to develop polysaccharide-protein hybrid hydrogels structures as a strategy to modulate the degree of hydrolysis undergone by food proteins at the gastric phase, with the objective of maximizing the release of larger peptide fragments in the intestinal phase to exert their bioactive functionalities.

Method:
Hybrid polysaccharide-protein hydrogels were developed by using agar as the gelling matrix and casein as the labile protein. These were then subjected to *in vitro* gastrointestinal digestions using the harmonized Infogest protocol and their behaviour was compared to agar-casein blend solutions and to micellar casein. The obtained digestion products were characterized in terms of molecular weight distribution, microstructure and peptide profile. Moreover, the effect of different bile salts concentrations on the intestinal digestion of the three different formulations was also investigated.

Results:
Hybrid agar-casein structures have been proven to limit the degree of hydrolysis of casein after the gastric phase, while simultaneously enhancing the release of larger peptide molecules during the subsequent intestinal phase. Although the presence of the polysaccharide in the blend solutions presented a certain protective effect, this was maximized when hydrogel structures were developed. Furthermore, the presence of the polysaccharide had a strong impact on the effect of bile salts on the proteolysis process.

Conclusion:
Hybrid agar-casein hydrogels show a great potential to reduce the proteolysis of casein during the gastric phase while promoting the release of larger peptides during the intestinal phase. Furthermore, the action mechanism of bile salts in the digestion process is affected by the presence of the polysaccharide, which is expected to have strong implications on the type of structures formed by the digestion products and their intestinal transport. Thus hybrid polysaccharide-protein hydrogels could have potential benefits for appetite and satiety modulation.

P1.2.074

Innovative pretreatment technologies for caffeoylquinic acids extraction from forced chicory roots juice

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Aim:
The aim is to develop a novel route for the extraction of caffeoylquinic acids (CQAs) from a low value by product of the Belgian endive culture, forced chicory roots. Extraction have to be as green as possible and economically viable. The main objective is to produce a highly concentrate solution of CQAs to further purified and functionnalized the desired products.

Method:
Innovative technologies such as pulsed electrical field and microwave heating are used as pretreatments to enhance CQAs extraction by pressing. Time and energy consumption are follow for each extraction. Optimisation of working pressure, electrical field strength and temperature have been performed. Furthermore, mechanisms of CQAs degradation have been investigate and some solutions to prevent it have been sought.

Results:
Compared to conventional solid liquid extraction, optimized pressing leads to a higher content of molecule of interest with lower energy consumption. Heating have a positive effect on CQAs extraction with an increase of juice yield and extraction of CQAs whereas electrical field influence is contrasted. By one side, electrical field can enhance juice yield during pessing but degradation of CQAs is also increasing caused by reactive oxygen species. To avoid this, adding a solution of ascorbic acid in the medium leads to total oxidative prevention of CQAs.

Conclusion:
Pressing is an innovative and interesting extraction technique to produce a highly concentrate solution of CQAs. This is a green solventless extraction that meets many challenges of sustainable process and chemistry.

P1.2.075

Spectroscopy-based investigations on the interaction between spent brewer’s yeast peptides and anthocyanins from Aronia pomace

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Aim: Spent brewer’s yeast proteins represent an excellent sustainable source of bioactive peptides with numerous health properties. The study aimed to evaluate the interaction between size-selected extracted spent brewer’s yeast peptide fractions and anthocyanins from Aronia pomace using a spectroscopic approach.

Method: The peptide hydrolysates were obtained after hydrolysis of spent brewer’s yeast suspension with bromelain, neutrase or trypsin at 50°C for 67 h. Structural particularities were analysed based on the fluorescence spectra of peptide fractions separated after ultrafiltration with membranes of 30 kDa, 10 kDa and 3 kDa cut-offs in the absence and in the presence of anthocyanins.

Results: The fluorescence of tryptophan and tyrosine residues of yeast peptide fractions and maximum emission was strongly dependent on the type of enzyme used for hydrolysis and less dependent on the molecular weight of the separated fractions after ultrafiltration. Compared to control, represented by the extract of the yeast autolysate, peptide fractions showed blue shifts of the maximum emission of 2.5 nm for peptides obtained by hydrolysis with bromelain, and of 4 nm for peptide fractions obtained by hydrolysis with neutrase and trypsin. These results indicate that hydrolysis changed the polarity of tryptophan residues to a more hydrophobic region. The fluorescence maximum emission in the presence of Aronia anthocyanins showed significant red shifts when compared with corresponding peptide fractions without anthocyanins, indicating the change of polarity of microenvironment around the tryptophan residues from yeast peptides toward more hydrophilic regions, which were associated to peptides-anthocyanins interactions. Regardless of molecular weight of the peptides tested in this study, the static quenching mechanism explained the interaction of yeast peptides with anthocyanins from Aronia pomace.

Conclusion: The findings provided by this study are useful for the knowledge based development of an efficient procedure for the joint encapsulation of the bioactives like spent brewer’s yeast peptides and anthocyanins from Aronia pomace.

P1.2.076

Formation of casein nanoparticles by enzymatic cross-linking

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Aim:
Based on previous research we build the hypothesis that by means of casein concentration, ionic strength and incubation temperature both self-association and cross-linking of non-micellar casein can be controlled. The resulting hydrated nanoparticles differ in size and density and are therefore suitable for different applications.

Method:
In this study, β-casein-rich acid casein was produced from reconstituted skim milk by diafiltration, followed by acid precipitation (pH 4.6) from the permeate and subsequent freeze-drying. Solutions of β-casein-rich acid casein (β-NaCn) or commercial acid casein (cNaCn) with 10 g/kg, 27 g/kg and 50 g/kg in demineralised water were adjusted to pH 6.6 by NaOH. The effect of monovalent (Na^+) and divalent cations (Ca^{2+}) was studied in the range of 0 – 1 mol/L and 0 –0.008 mol/L, respectively. The formation of casein nanoparticles was induced by enzymatic cross-linking with microbial transglutaminase (3 U mTGase per g protein, 40 °C). Incubation time was 0 h (control), 1 h, 3 h, 6 h and 24 h. Acid-induced gelation of the cross-linked samples was monitored in time-based small amplitude oscillatory shear rheometry and the maximum storage modulus was taken for evaluation. SDS-PAGE was used to roughly follow changes in the particle size and selected samples were analysed by SEC-MALS.

Results:
In general, higher storage moduli representing gel stiffness were observed with increasing casein concentration. In case of cNaCn longer incubation time resulted in an increase of the size of casein nanoparticles, which was, however, not accompanied by an increase in gel stiffness. Gels made from β-NaCn solutions exhibited higher gel stiffness with prolonged cross-linking with a concomitant increase in particle compactness, which was confirmed by SEC-MALS analyses. An increase in ionic strength caused faster cross-linking with different effects of monovalent and divalent ions on maximum storage moduli and nanoparticle size.

Conclusion:
Our findings indicate that besides incubation time, casein concentration and ionic strength the formation of casein nanoparticles by cross-linking with mTGase is significantly affected by the composition of the casein preparations.

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P1.2.077

Sunflower oil emulsions as fat replacers in reduced-fat ice cream: physical and sensory properties

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Aim: Ice cream is one of the oldest dairy products consumed. However, its high fat content and people's health concerns have boosted the market for reduced-fat products. The industry's challenge is to achieve low-fat ice creams without affecting physical and organoleptic quality. The objective of this work was to investigate the suitability of sunflower oil in water emulsions as a fat replacers in reduced-fat ice cream, evaluating its effect on physical properties and sensory acceptance. These ice creams, besides reducing the total fat content, will improve the lipid profile of the final product.

Method: Initial emulsions were composed of sunflower oil (47%), food stabilizer and water. Three different emulsions were formulated: xanthan gum-soy lecithin (XG-SL); cellulose ether-xanthan gum (HPMC-XG); and cellulose ether (HPMC). Three chocolate ice creams were prepared with the different emulsions and compared with a control containing coconut fat in the same proportion (100% replacement). Physical and sensory properties were studied. Texture was assessed by penetration test and thermal properties was evaluated by Differential Scanning Calorimeter (DSC). The amount of air incorporated during freezing and melting rate first dropping time were aso determined. Finally, a Check All That Apply (CATA) and acceptability sensory analysis were performed.

Results: All ice creams showed similar appearance. Regarding texture, control was the softest sample, and ice cream formulated with HPMC emulsion was the hardest one. HPMC-XG ice cream was the most similar to the control. All emulsion-based ice creams showed lower melting rate than the control. HPMC ice cream showed higher air incorporation,

which may confirm its higher hardness. Sensorially, all ice creams had the same visual appearance, although in taste and texture the one that most resembled the control was HPMC ice cream. In overall acceptability and purchase intention, HPMC ice cream was the most valued, even more than the control, and HPMC-XG ice cream was the least valued.
Conclusion: The addition of sunflower based emulsions to replace solid fat in ice creams proved to be a good way to reduce total fat and also improve lipid profile without deteriorating the physical and sensory properties of the final product.

P1.2.078

Artisanal Gelato 4.0: Enhancing Quality and Efficiency with Digitalization and Artificial Intelligence

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AIM: The study aimed to assess whether digitalizing the batch plant to produce Italian-style artisanal gelato could help assess the technological quality of starting blends and control dynamic process conditions. At present, producers use a trial-and-error approach, which leads to varying quality of the finished product. Relationships between blend composition, technological performance, and physical mechanisms during the water crystallization and air emulsification process were understood using sensing, digitalization, and numerical analysis.

METHOD: IoT sensors were utilized to monitor bulk temperature variation, electrical conductivity, and shear stress acceleration throughout the freezing process. The final quality of the ice cream was evaluated based on texture profile and rheological properties under controlled flow conditions. Numerical analysis of cooling curves was conducted to identify the time-temperature domains of water crystallization and compare the effects of different sweeteners. The temperature profile in the cold zone was calibrated to ensure precise analysis.

RESULTS: The study revealed that ice cream blends exhibit a sigmoidal decrease in electrical conductivity during three cooling phases, indicating cooperative mechanisms involved in water crystallization and air incorporation. These mechanisms contribute to the exponential increase in the viscoelastic properties of the ice cream blend's microstructure. Shear stresses increase at a variable rate depending on the kinetics of internal structure formation. Mechanical vibration sensors provide more detailed information than electrical conductivity and temperature signals and can divide the freezing process into four distinct phases based on internal structure evolution. Emulsifiers and stabilizers interact during the third cooling phase to form a consistent viscoelastic network, reducing the size of air cells and retaining emulsified air. Shorter process times result in smaller ice crystals and lower sensory quality, as the quality of ice cream is closely related to its structural consistency.

CONCLUSION: Digitalizing freezing and whipping processes can effectively evaluate the technological quality of starting premix under real processing conditions. Machine and deep learning analysis can be used to create an artificial intelligence platform able to recognize significant freezing and whipping events, to trigger alarms, and to allow decision making on technological variable modulation and extrusion times to obtain tailor-made final quality of the Italian-style ice cream.

P1.2.079

Formulation of functional dairy foods with halophytes: Assessment of health benefits

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Aim:

There is an increasing interest in the consumption of functional foods worldwide. Halophytes as edible, salt-tolerant plants can be used to create these novel food products, as they contain health-promoting bioactive compounds, a result of their adaption to saline environments. These bioactive compounds can have anti-inflammatory, antioxidant, anti-obesity, cardioprotective, and neuroprotective properties if included in human nutrition. Consequently, in this work the formulation of food products containing the halophyte *Salicornia europaea*, using biomass as well as extracts is described. Additionally, the microbial safety of these products is addressed, as the salinity and antimicrobial compounds in the biomass can prevent contaminations. This research is part of the EU Horizon 2020 project AQUACOMBINE (Grant Agreement No 862834) in which an integrated halophyte biorefinery is demonstrated.

Method:
In-vitro assays are used to investigate the enhanced properties and health improvement of the consumption of these products. The assays include an analysis of antioxidant activities as well as the measurement of anti-inflammatory properties. The microbiological analysis is also performed to estimate the shelf life and investigate the antimicrobial properties of the addition of halophytes in food products. Furthermore, the sensory evaluation of the products with halophyte biomass is evaluated.

Results:
The in-vitro analysis of the dairy products shows positive results. Inhibition rates of inflammation are comparable with anti-inflammatory drugs on the market. Also, antioxidant activity is detected. Further, the microbiological analysis reveals better bacterial safety, while mould contamination is comparable with those of conventional products on the market. The sensory evaluation exposes the maximum acceptable concentration of *S. europaea* to be added to the food products.

Conclusion:
The formulation of functional dairy products with halophytes showed promising results. Infused products exhibit anti-inflammatory, antioxidant activity and antimicrobial properties while having acceptable sensory properties. These make it of special interest for bringing this functional food to the market.

P1.2.080

Unlocking Sustainable Bioactives for Cardiovascular Health: Harnessing the Potential of Legume Processing Water

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Aim:
Legume has been considered a good plant food source as it contains carbohydrates and proteins but few lipids, offering energy and health benefits in glucose lowering, cholesterol-lowering, and tumour prevention. Consuming raw legume can be tedious and less effective in nutrient absorption and digestion, due to the presence of antinutritional factors like phytic acids, tannins, and oligosaccharides. Thus, some thermal or non-thermal treatments are usually applied in legume processing domestically and industrially.
Past studies on chickpea cooking water (Aquafaba), have shown the potential of utilizing legume processing water in bakery food production to substitute egg white, because of the desirable emulsifying and foaming capacities it presents. Other research on soaking water and cooking water of some other types of pulses (soybean, lentil, pea, etc.,.) also proves the positive textural functions when incorporated in bakery food making. However, with certain bioactive compounds leached from the raw pulses, the nutritional properties of legume processing water haven't been investigated. Therefore, this study aims to study the compositions and cholesterol-lowering effect of faba bean blanching water (FBBW).

Method:

- Composition analysis
- Chromatography: amino acids and minerals.
- Antioxidant property analysis
- In vitro gastrointestinal digestion
- Cholesterol micellirization inhibitory test
- HMG-CoA reductase inhibitory test

Results:

- 34% saponins, 30% proteins, 12% total phenolics, and 10% water-soluble carbohydrates are presented in FBBW with some other minor components including 4% dietary fibre, 4% phytic acids, 0.16% ash, and no lipid (on dry matter basis).
- Amino acids: FBBW is rich in alanine, aspartic acid, arginine, and taurine.
- Minerals: FBBW is high in K and P.
- FBBW exhibits antioxidant properties, with DPPH scavenging ability at 326 µmol TE/g and FRAP at 127 mmol Fe^{2+}/g (on dry matter basis).
- After digestion, digested FBBW presented cholesterol-lowering effects through two tested mechanisms:
    - inhibiting cholesterol micellirization (by saponins) to reduce cholesterol absorption;
    - inhibiting the HMG-CoA reductase (by proteins) to decrease cholesterol synthesis.

Conclusion:
FBBW has presented promising cholesterol-lowering effects with the presence of bioactive compounds inside. This clean technology unlocks the health potential of legume water, reducing industry footprint (less waste, no treatment), increasing its productivity (extraction of bioactives) and improving human health.

P1.2.081

Screening of microfungi for solid-state fermentation of faba beans

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[1]Slu

Aim:
Locally produced faba beans and oat are promising novel raw materials for the production of nutritious and palatable fermented food. However, the presence of antinutrients, such as phytate, oligosaccharides, vicine, and convicine as well as off-flavours and poor texture, can pose a challenge for desirable nutritional and sensory caractheristcs. The aim of this study is to perform functional screening of beneficial microfungal strains and consortia with a good ability to ferment faba beans and oat and to break down FODMAPs and antinutrients present in them.

Method:
Novel methods of high-throughput screening were used to test a variety of microbial strains, and provide information if it contains the desired functional activities as cultures for solid-state fermented food production. A variety of zygomycetes for example *Rhizopus oligosporus, Mucor circinelloides, Mucor plumbeus* and *yeasts* such as *Wickerhamomyces anomalus, Blastobotrys adeninivorans, Rhodotorula toruloides*, and *R. babjevae* were tested. Model cultivation media were developed, based on the protein- and starch-fractions isolated from faba beans. High-throughput screening systems were developed to test a variety of microbial strains and components to facilitate the design of the suitable starter.

Results
A majority of the tested strains was able to grow on the isolated protein- and starch fractions from faba beans, indicating that they are appropriate for tempeh-production from this material. In some cases, decrease of “beany” smell was noticed. The selection of strains were further tested for their abilities to degrade dietary fiber and antinutrients such as FODMAPs.

Conclusion
Locally-sourced novel ingredients from Europe have the potential to serve as the primary raw materials for the production of nutritious, sustainable, and tasty foods by fermentation. The tested microbial consortia are promising for solid-state fermentation in food prototypes, such as tempeh, and suggest the possibility of utilizing multi-species consortia for the production of various food products. More research is needed to optimize the process.

P1.2.082

House cricket (Acheta domesticus) flour as ingredient for the fortification of meat burgers

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Aim:
Edible insects have gained relevance in last years because of their high nutritional value (source of protein) and sustainable production (low emissions of greenhouse gases and reduced use of natural resources) in line with the goals required by the agrifood chain for a more efficient and sustainable food production. In this way, the aim of this work was to evaluate the

feasibility of including edible insects (*Acheta domesticus* flour, CF) as ingredient in meat burgers and its effect on their nutritional, technological and sensory properties

Method:

Burgers with 80% pork lean meat, 20% pork backfat (meat ingredients 100%), water, salt and black pepper were elaborated (CONTROL). CF was added at 10% (CF10) and 20% (CF20). Proximate composition, pH, color (CIELAB color space) and texture (TPA) were evaluated. Consumer panelist scored the samples for flavor, texture, color and overall acceptance

Results:

The fortification of meat burgers with up to 20% CF was a strategy technologically feasible although it was necessary to optimize it increasing the water added (from 7 to 15%) due to the high water holding capacity of CF (approx. 2 g water/g CF). CF20 and CF10 burgers showed slight lower pH values than control (5.65, 5.52 and 5.46, respectively). Nutritionally, the addition of CF resulted in burgers with higher protein, dietary fiber and ash content than control ($p<0.05$). All the color parameters were affected (reduced, $p<0.05$) by the CF addition, except a* values in CF10 that were the same as those obtained in control burgers. Regarding texture, the addition of CF make burgers harder (the higher the CF added, the greater the hardness) and less cohesive (independently of the amount of CF added) than control. CF10 burgers received the same overall acceptance than control in spite of the evident changes in the sensory profile of the final product. CF20 received the lowest scores for all the evaluated attributes.

Conclusion:

The use of CF for the fortification of meat burgers is a strategy technologically feasible. The limits of incorporation do not exceed 10% without causing undesirable changes in the burgers. Innovative strategies to facilitate its addition at higher proportions should be explored.

P1.2.083

Properties of casein emulsion gels formed by thermo-mechanical processing

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Aim: The structure cheese consists of fat globules embedded in a protein matrix and determines cheese texture and taste. New technologies to create cheese structures are of great importance for the industrial manufacturing of cheese. In this context, the incorporation of milk fat into concentrated casein gels such as skim milk curds, using a thermo-mechanical process, offers opportunities for the development of new routes for cheese manufacturing and creation of new cheeses products.

Method: The objective of this study was to understand the thermo-mechanical process of skim milk casein gels emulsification on composition, microstructure, and rheological properties of the resulting emulsion gels. For this purpose, renneted and acidified casein curds and butter, with an initial protein concentration of 36 % (w/w) protein and 12 % (w/w) fat, were emulsified at temperatures ranging from 55 –75 ˚C, mixing speed of 200 – 3100 rpm, and mixing time 10 – 18 minutes.

Results: Our study revealed that the thermo-mechanical process applied was successful in creating stable emulsion gels and the composition and rheological properties were affected by the processing parameters studied.

The microstructure analyzed by confocal laser microscopy showed that fat could be well incorporated into the protein network, but at the lowest temperature and longest processing time (55 ºC, 18 min), the formation of protein fibers occurred. Increasing temperature and mixing times led to a decrease in the size of the fat droplets. The rheological characterization of the gels showed that all casein emulsion gels behave as weak solid viscoelastic materials with $G' > G''$ having with significant differences in gel strength. The crossover point temperature ($G'= G''$) ranged from 73.3±3.4 to 64.2±1.9 °C and was most affected by the mixing time. Correlations between rheological properties and composition of the emulsion gels indicate that structural changes are likely to explain the different properties observed.

Conclusion: In conclusion, this study provided new insights for optimizing the emulsion stability of casein emulsion gels. The results can be used for development of new processes for cheese manufacturing.

P1.2.084

Application of whey protein-pectin complexes for texture modulation in high protein dairy products

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Aim:
High protein dairy products with low fat contents like skyr are a valuable energy source for various consumer groups. Unfortunately high protein contents result in a dry sensory perception with an unpleasant mouthfeel. Whey protein-pectin complexes can be applied to increase creaminess using whey protein and pectin as side streams from cheese manufacturing and fruit juice production. Via thermomechanical treatment whey protein-pectin complexes from 1 to 40 µm are processed, suitable for the application in high protein matrices. The aim of this study was to achieve high creaminess and a pleasant mouthfeel with viscosities similar to yogurt in skry by addition of whey protein-pectin complexes.

Method:
Whey protein-pectin complexes are processed in a continuous scraped surface heat exchanger (WP:P of 5:1, 90 °C, 675 s^{-1}, pH 5.0 – 5.5, 130 L h^{-1}) via thermomechanical treatment. The resulting whey protein-pectin complex dispersions (9 % (*w/w*) protein) were mixed in different ratios with skyr (9 % (*w/w*) protein, 0.2 % (*w/w*) fat) as representative dairy product with a high protein and low fat content. For characterization of sensory perception particle sizes, texture and flow curves were studied. Additionally creaminess was evaluated in a sensory analysis comparing skyr with and without the addition of whey protein-pectin complexes with full-fat yogurt.

Results:
Skry with similar characteristics to yogurt was obtained by addition of whey protein-pectin complexes. Comparing skyr with and without whey protein-pectin complexes highest creaminess was perceived in samples containing whey protein-pectin complexes. The mouthfeel of the yogurt-like skyr was rated as pleasant but creaminess was increased compared to full-fat yogurt (3.5 % (*w/w*)), although the fat content was lower with 0.2 % (*w/w*).

Conclusion:
Whey protein-pectin complex dispersions can be applied to reduce viscosity of high protein dairy products while increasing perceived creaminess. Addition of whey protein-pectin complexes keeps the protein content constant maintaining its nutritive value. Further studies will focus on the addition of whey protein-pectin complexes at different processing steps to design a convenient production process.

P1.2.085

Effect of lipid profile of insect flour on the aroma pattern obtained by thermal process.

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Aim: The consumer's desire for healthier foods and more sustainable production has increased the consumer interest in meat analogues. However, the lack of savoury aromas and the presence of off-flavors derived from the raw materials reduce their acceptability. Alternative proteins like those derived from insect flour can be used to produce ingredients to improve and enhance aroma and flavour. However, many factors affects flavor generation like the amino acids present and sugar type, as well as temperature, pH, water content, and time and also the lipid profile. The aim was to determine the effect of enzymatic hydrolysis, lipid profile and thermal treatment on the generation of savoury aromas.

Method: The factors affecting the reaction to obtain a process flavour from mealworm (*Tenebrio molitor*) protein were investigated. The chemical composition of the flour was determined and the lipid profile was characterized by extracting the lipid content and analysing the fatty acids methyl esters (FAMEs) using a gas chromatograph equipped with a flame ionization detector. The process flavours were obtained using different insect degree of hydrolysates and process conditions using different sugar types (xilosa and glucose). The hydrolysis degree was controlled and the production of aromas was followed by HS-SPME Gas Chromatography and mass spectrometry analysis.

Results: The insect flour composition included 26,1 % fat, 47,7 % protein, 2,6 % humidity and 3,1 % ashes. The fat profile was constituted by 25.4 % SFA, 47.1 % MUFA and 27.5 % PUFA. The most characteristics fatty acids were palmitic (16,4 %), oleic (44.6 %) and linoleic (25.7%) acids. The degree of hydrolysis of the *Tenebrio molitor* protein affected the aroma compounds generated after the thermal process as well as the sugar type which affected the profile and quantity of volatile compounds. Several volatile compounds derived from amino acids and oxidation reactions were produced mainly by the presence of the unsaturated fatty acids.

Conclusion: The aroma of *Tenebrio molitor* changed after the hydrolysis and by reaction process in the presence of different sugars types. The lipid profile affected the flavor characteristics of the resulting product derived from the insect protein.

P1.2.086

Peptidomic profile, bioactive peptide identification and biological activity of grape pomace protein hydrolysates

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Aim: Grape pomace (GP) is the main by-product resulting from the wine industry and consists primarily of the grape skins and seeds. GP is particularly rich in phenolic compounds that have been extensively studied due to their bioactivities. Proteins are another component of GP that have not received much attention. Bioactive peptides can be released from these proteins and may be used as components of functional foods which may exert regulatory activities in the human organism, irrespective of their nutritive functions and potential antimicrobial activities. In this work, the peptidomic profile of GP protein hydrolysates was determined and their bioactivity evaluated. *In-silico* tools were also used to identify those responsible for the bioactivity of hydrolysates.

Method: GP proteins were extracted and hydrolysed by Alcalase (A), Flavourzyme (F) and Protease (P). The bioactivity of hydrolysates was evaluated by an angiotensin I converting enzyme inhibitory (ACEi) activity assay. The peptides in hydrolysates were determined by UHPLC-Orbitrap-MS/MS. The potential bioactivity of identified peptides in the digests was predicted using PeptideRanker. The 10 peptides with higher scores for each hydrolysate were evaluated by different *in-silico* tools to determine which of them might be responsible for the ACEi activity and other bioactive properties.

Results: The A, F and P hydrolysates showed ACE inhibitory activities of 60, 58 and 18 %, respectively. The number of peptides identified were 2915, 3304 and 2197 for A, F and P. The A hydrolysates were characterized by a high proportion of peptides <1 KDa, usually associated with higher bioactivities. The scores for bioactivity prediction obtained by PeptideRanker showed 64, 35 and 24 peptides with scores higher than 0.90 for A, F and P. The average size of peptides resulting from A hydrolysis was 7.5 units compared to 20.6 for F and 14.8 for P. From the identified peptides, based on the molecular characteristics and the predictions, GPAFFNHF, DYFHPF, and LFPW, among others, are proposed to be significantly contributing to ACEi activities because they contain hydrophobic amino acids in the C terminal region.

Conclusion: Peptidomics analysis of GP proteins hydrolysates revealed the presence of bioactive peptides associated with bioactive properties like ACEi activity.

P1.2.087

Crop yield forecasting using remote sensing: from low to high spatial resolution

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Aim

NASA Harvest is the NASA's Food Security and Agriculture program. Its main objective is enhancing the use of Earth Observation (EO) data in decision making related to food security and agriculture. Within this context, one of the main priorities is providing valuable information on crop conditions and accurate and timely crop yield forecasts. This work presents the Agriculture Remotely-sensed Yield Algorithm (ARYA), a new EO-based empirical winter wheat yield forecasting model and how it can be applied to enhance precision agriculture.

Method

ARYA is based on the evolution of the Difference Vegetation Index (DVI) from the Moderate Resolution Imaging Spectroradiometer (MODIS) at 1 km resolution, the Growing Degree Days (GDD) from reanalysis MERRA2 data, and the accumulated daily difference of the Land Surface Temperature (LST) from MODIS. The model is calibrated at subnational level using historical yield statistics from 2001 to 2019. The model was applied to forecast the national and subnational winter wheat yield in the United

States, Ukraine, Russia, France, Germany, Argentina and Australia (over 70% of global wheat exports) from 2001 to 2019. Besides, field level wheat yield data collected over Castilla y Leon from 2017 to nowadays is leveraged to build crop yield models based on Sentinel-2 satellite data.

Results

The results show that ARYA provides yield estimations with 5-15 % error at national and 7-20 % error at subnational level starting from 2 to 2.5 months prior to harvest. Preliminary results at field level show better performance metrics when using linear combination of different spectral bands compared to using solely the DVI.

Conclusion

EO data is a global, objective, timely and cost-effective tool that can contribute to increased food security, greater sustainability, and greater resilience in the agriculture sector.

P1.2.088

Frictional performance of plant protein-phenolic covalent conjugates

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Aim: The covalent conjugation of phenolic compounds with plant proteins is currently acknowledged as an efficient methodology to improve the technofunctionality of plant proteins such as emulsifying, foaming etc. However, whether such conjugation with phenolic compounds, which is known to be astringent, leads to impairment of sensory perception of plant proteins remains elusive in the literature. To shed light on this, the current study aims to understand how covalent conjugation between a model plant protein i.e. lupin protein (LP) and a model phenolic compound i.e. grape seed extract (GSE), affects the astringency perception of phenolic compounds using tribology as a quantitative proxy.

Method: Covalent LP-GSE conjugates were produced with different LP:GSE ratios (25:1, 50:1, 83:1, 167:1 w/w) and degrees of conjugation (DC, 1-48 hours of reaction) and analyzed using soft tribology in the presence and absence of human saliva.

Results: In the absence of saliva, GSE dispersion presented similar friction coefficient (μ) values to water at the boundary regime, whereas the increase of LP concentration reduced the frictional dissipation curves of conjugates up to 50:1, but no difference was found between conjugates with different DC, indicating LP dominating the lubrication behaviour. However, in the presence of saliva, GSE showed the highest μ values in the boundary regimes, whereas μ of LP-GSE conjugates was dependent on the DC, indicating that conjugation of GSE with LP hindered the interaction of the GSE with saliva. The lower affinity of the conjugates to saliva was also quantified using quartz crystal microbalance with dissipation monitoring (QCM-D).

Conclusion: Preliminary findings from this study indicate that covalent conjugation between LP and GSE improves the lubrication performance of otherwise astringent phenolic compounds.

P1.2.089

Influence of ethanol on water migration from filling into chocolate shells

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Aim:

Although filled chocolate products, like pralines, are very stable with respect to microbial deterioration, the migration of filling components can cause undesired quality changes in appearance (fat bloom) and mechanical properties of the chocolate shells. This happens not only in products with fat based-fillings, but also in pralines with aqueous or ethanolic-aqueous fillings, like truffles. So far, only few research results are available about water migration from the filling into the hydrophobic chocolate matrix. The addition of ethanol makes it even more complex, since ethanol is a solvent for both fat and water. Moreover, the industry needs methods to predict the shelf life of such filled chocolate products to adapt their market strategies and product labelling.

Method:

Migration of water and ethanol into chocolate was investigated using model systems composed of flat fillings and chocolate disks, which were in close contact. Thereby the migration is reduced to only one dimension and the kinetic can be easily obtained by analysing several layers within the chocolate to follow the migration. Fillings differed in water activity as well as ethanol content. Furthermore, different storage temperatures were applied.

Results:

Kinetics of water and ethanol migration within the chocolate disk could be successfully determined. Specifically adapted diffusion models were used to describe the migration process. Temperature dependency was characterized by activation energy. Presence of ethanol in the filling dramatically changed the water migration within the chocolate, although only a very small amount of the ethanol migrated into the chocolate itself. Model parameters and their temperature dependency as well as observations about fat bloom development during storage were used to develop a software tool to predict storage stability of filled chocolate products based on forced storage tests.

Conclusion:

Because of the ability of ethanol to interact intensively with both water and fat, its presence in fillings forces water migration into the chocolate in a non-linear migration behaviour. The modelled influence of storage temperature and ethanol content in the filling on fat bloom development of filled chocolate products can be used to predict their stability at different storage temperatures.

P1.2.090

Valorisation of bovine liver to obtain antioxidant peptides by sustainable hydrolysis processes

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Aim:

Meat processing industries generate large amounts of co- and by-products that entail great economic and environmental costs. Among co-products, internal organs such as liver are high nutritive products that are consumed in certain countries, but their consumption is not extensive. So, other valorisation approaches such as their use as potential source of bioactive peptides are of current interest. This work evaluated the antioxidant activity of bovine liver hydrolysates obtained from different sustainable hydrolysis processes such as ultrasounds and enzyme treatments.

Method:

Beef liver was minced, homogenised with water (1:1), and subjected to different pretreatments for 2 h: digestion with pepsin enzyme (1%), ultrasounds (20 KHz), and assisted hydrolysis using pepsin and ultrasounds. Samples were then hydrolysed with flavourzyme enzyme (1%) for additional 2 h before heating for enzyme inactivation. Control samples were only hydrolysed with flavourzyme. The degree of hydrolysis (by the OPA assay), and the antioxidant activity (by DPPH, FRAP, ABTS, and ORAC methods) of the liver hydrolysates were determined.

Results:

The degree of hydrolysis was similar for the samples treated with pepsin and assisted hydrolysis, whereas the samples treated with ultrasounds showed the lowest values, comparable to controls. The same trend was observed when evaluating the antioxidant activity by FRAP and ORAC methods. However, the values of the ultrasound-treated samples were higher than those of controls in the ABTS assay, and DPPH method showed non-significant differences in antioxidant values for all the samples.

Conclusion:

Ultrasounds pretreatment showed lower efficiency than pepsin digestion in protein hydrolysis. However, the obtained results showed the potential of both ultrasounds and enzymatic treatments to obtain antioxidant peptides from bovine liver, being sustainable strategies for the valorisation of this co-product.

P1.2.091

Kinetics based shelf life prediction of packed fish by-product powders in real food chain

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Aim: Aquaculture side-streams, besides representing the second largest food loss commodity (waste of 35% of the catches), are rich in bioactive compounds. The aim was the study of a powder obtained from salmon filleting by-products that can be used as ingredient in novel products such as instant fish broths or soups. The stability of this material, rich in PUFA (polyunsaturated fatty acids) was studied as a function of storage temperature, relative humidity (%RH) and packaging material. A tool based on the kinetic study and modeling of PUFA oxidation was developed allowing the prediction of the effect of food chain conditions and packaging material properties on the quality and shelf-life of the powder.

Method: Salmon filleting residues were processed into a freeze dried powder and packed in pouches from conventional high-barrier polyethylene (PE) or polylactic acid (PLA), a low-barrier biopolymer. Accelerated shelf-life tests (ASLT) were performed at a range of 20-50˚C, at controlled environments of selected a_w (0.22-0.53) and lipid oxidation of powders (expressed as Peroxide Value) was monitored during storage. Kinetic modelling of the oxidation, sorption isotherms and packaging material properties were built in a tool (in the form of software or app) that allows the calculation of the shelf-life at any combination of storage conditions in the food chain.

Results: Sorption isotherms were modelled by GAB equation and a zero order equation was found to describe product lipid oxidation, in which degradation rate was a function of temperature and %RH, using an Arrhenius-type equation. Additionally to the developed kinetics, the numerical solution of the differential equation, expressing product water activity evolution as a function of storage conditions and package permeability, was applied for the calculation of lipid oxidation with time, allowing the prediction of its shelf-life.

Conclusion: Based on the kinetic models and the prediction tool developed, the optimum initial a_w and the barrier requirements of the packaging material can be determined. In this case study, the biopolymer film could be used as a potential packaging materialfor powders prone to oxidation, provided that an additional oxidation barrier would be implemented, through incorporation of antioxidants prior to use (active packaging).

P1.2.092

The Effects of Minor Components on the Stability of Vegetable Oil: Molecular Organizations Study

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Aim:

Oil refining process is used to remove pigments, traces of metals, and impurities to increase oil stability and improve its taste and aroma. Other minor components (MCs) such as free fatty acids (FAs), mono- and di-acylglycerols and alcohols are not removed during this process. The current research aims to investigate the influence of these components on the stability of canola oil. Specifically, the interactions between the polar head group with the primary oxidation products and their effect on oil stability were explored.

Method:

Canola oil was subjected to a stripping process to remove all MCs. Subsequently, glycerol-monostearate, stearic acid, stearyl-alcohol, and octadecane were added to the oil while their effect on the stability of the two primary unsaturated FAs in canola oil was examined. Molecular dynamics simulation was employed to gain insights into the molecular interactions between the MCs and oxidation products, aiming to elucidate their effect on the stability of unsaturated FAs. All the MCs used in the study had an 18-carbon alkyl chain with different polar head groups.

Results:

Analysis of peroxide value curves revealed three distinct regions: induction, exponential, and decomposition periods in all samples. However, the different MCs influenced each of these regions differently. Moreover, within the exponential region, two sub-regions were identified based on low and high peroxide values, indicating a change in the rate of oxidation. The presence of MCs affected the transition time between these sub-regions, which was attributed to the formation of mutual hydroperoxide-MC micelles. This transition was accompanied by a significant increase in viscosity and a decrease in the content of unsaturated FAs. Molecular dynamics simulations demonstrated that hydroperoxides formed hydrogen bonds with the polar head groups of the MCs, exhibiting varying bonding tendencies. This suggests that these molecules can impact the formation, organization, and decomposition kinetics of the oxidation products.

Conclusion:

This study provides a molecular understanding of the effect of MCs on the stability of unsaturated FAs in canola oil. Understanding these interactions can aid in the development of refining and processing techniques that enhance the shelf life and nutritional benefits of vegetable oils, ultimately benefiting human health.

P1.2.093

In-situ crystallised lipid particles for oil-in-water emulsion stabilisation

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Aim:
Solid lipid particles have the potential to create barriers around emulsion droplets to inhibit coalescence. The overall aim of this research is to create these particles in-situ for the stabilisation of oil-in-water emulsions by exploiting cooperative behaviour between monoglycerides and triglycerides within the dispersed oil phase. Due to their amphiphilic character monoglycerides adsorb at the oil-water interface. The fatty acid chains of the triglyceride will then interact with the adsorbed monoglycerides, and kinetic trapping of this arrangement through cooling will create a Pickering particle shell. Here the impact of monoglyceride and triglyceride chain length on emulsion microstructure and stability is reported.
Method:
O/W emulsions with a volume fraction of 10% medium chain triglyceride with added mono- and triglyceride and water without additive as the continuous emulsion were processed above the melting temperature of the lipids using turbulent shear, followed by cooling below the crystallisation temperature. Amount and chain length of added mono-/triglyceride were varied. Differential scanning calorimetry, emulsion creaming and droplet size data, and microstructure images will be presented.
Results:
Both, amount and chain length of added mono-/triglyceride affected the overall appearance of the processed emulsions. A coalesced oil layer, a creamed layer of large but crystal stabilised droplets and sub-phase of crystal stabilised droplets small enough to resist creaming over the observation period could be distinguished. Formulating with a monoglyceride and a triglyceride of the same chain length provided enhanced stability against droplet coalescence. The ratio of mono- to triglyceride had no significant impact but the overall amount added was critical.
Conclusion:
Formulation engineering of an emulsion oil phase enables emulsion stabilisation through lipid particle crystallisation without the need to add emulsifiers to the continuous emulsion phase. This could mean the removal of unsustainable and consumer-adverse ingredients in emulsion-based foods.

P1.2.094

New food concepts to improve protein digestibility in the older adult: an in vitro study

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Aim: Aging entails physiological changes affecting the digestive process, resulting in low absorption of nutrients, especially of protein, that can lead to sarcopenia. Therefore, targeted dietary or supplementation strategies are needed to tackle this challenge. Developing products made of fermented legumes could be a solution to incorporate vegetal protein with improved digestibility. At the same time, this approach would contribute to reducing the consumption of animal protein and its negative environmental impact. This study evaluated the macronutrient digestibility of new food prototypes in the altered digestion environment of older adults.
Method: Ten new food prototypes based on fungal fermented quinoa and/or lentil were developed as gel-like or muffin-like. The INFOGEST protocol for simulating gastrointestinal digestion in older adult conditions was applied to the product prototypes, and lipolysis (free fatty acids kit) and proteolysis (TCA-soluble protein) were determined after the gastric and intestinal stages.
Results: Data collection is ongoing, and study results will be available by the time of the Congress. The expected results will allow for assessing the proteolysis of the new food prototypes. In addition, the results will enable the identification of those prototypes, improving the digestibility of proteins.
Conclusion: This approach contributes to offering a new dietary option for the older adult population that meets the characteristic problems of aging by providing the necessary amount of protein.

P1.2.095

Antioxidant and antimicrobial activity of underutilized products and by-products of carob

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Aim:
Carob tree is a traditional crop of the Mediterranean arch. In the last years, this crop is gaining importance due to the high value of the locust bean gum, being thus the economic yield of this crop dependent of the prize of this thickening and gelling agent. In this sense, this study aims to investigate the antimicrobial and antioxidant activity of bioactive compounds present in other fractions of the carob: leaves, immature pods, and by-products derived from the gum processing flow sheet (i.e. shell and germ).

Method:
Bioactive compounds of carob products were first extracted using different methods (ultrasounds and ultrasounds-reflux heating) with different solvent combinations (water, methanol, and acetone). Different extracts were freeze-dried prior to analysis. The antioxidant capacity of different extracts was quantified by two methods: DPPH radical scavenging activity and Oxygen Radical Absorbance Capacity. The antimicrobial activity was measured against gram-positive (*Listeria innocua, Staphyloccocus aureous*) and gram-negative bacteria (*Escherichia coli* and *Salmonella enterica*) using the microdilution method.

Results:
Results revelated that carob fractions were a good source of components with both, antioxidant and antimicrobial activity. Of all of them, leaves and immature pods showed the highest antioxidant activities (16.15 ± 1.91 and 15.80 ± 0.80 g E Trolox/100 g of product, respectively), meanwhile shell and germ by-products had a moderate antioxidant activity (ca. 1 g E Trolox/100 g of product). On the other hand, the study of the antimicrobial activity indicated a correlation with antioxidant activity values, and a greater susceptibility to gram-positive bacteria. In particular, 7.5 mg/mL of freeze-dried leaves extract were able to decrease *Listeria innocua* population from 5 $\log_{10}$ CFU/mL to under below of the detection limit.

Conclusions:
Taking into account the broad antioxidant and antimicrobial capacity together with the fact that the use of products derived from industrial processes must be implemented, this work shows the potential use of carob by-products as a good source of ingredients that might be used in the food industry for the design of new functional products or to extend their shelf-life.

P1.2.096

Technological impact and improvement of the nutritional properties of fresh pasta with carob flour

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Aim:

The carob tree, belonging to the leguminous family, is a typical species widely cultivated in whole Mediterranean basin, especially in the Valencian Community. Its fruit, called carob, has very interesting nutritional properties while it is rich in dietary fiber, antioxidants, and other beneficial compounds for health. In addition, it possesses antibacterial, antifungal and antiparasitic properties.

The present work deals with the study of fresh wheat pasta formulations with different substitutions of carob flour to improve its nutritional and technological properties. The feasibility of the partial substitution of wheat flour by carob flour in the development of fresh and cooked pasta will be evaluated.

Method:

Five fortified pasta products were prepared using wheat flour with partial replacements of carob flour (CF) at levels of 0%, 10%, 20%, 25%, and 30%. The mechanical properties, color, moisture content and baking properties both in fresh and cooked pasta with the different degrees of incorporation of carob flour were analyzed. Additionally, the texture of the raw dough was assessed using a three-point bending test (firmness).

Results:

In terms of technofunctional properties, the study found that the increase in fiber content through the addition of carob flour had significant impacts on both fresh and cooked pasta as well as on the dough. In terms of moisture, the study found that a greater amount of carob flour led to higher moisture content in the pasta. The presence of carob flour, being rich in dietary fiber, contributed to increased water retention capacity in the pasta, as well as it led to a firmer texture in the pasta. This suggests that the incorporation of carob flour contributed to a denser and more structured pasta texture. Regarding color, it was observed that the pasta became darker as the amount of carob flour increased.

Conclusion:

In summary, this study highlights the potential of carob flour as a functional ingredient in fresh pasta production, offering improvements in the physical and nutritional quality of the final product. These results may be of interest to the food industry in search of healthy and nutritious alternatives in food product development.

P1.2.097

Recovery of polyphenols from NADES extracts of orange peel by three resins' solid phase extraction

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Aim: In recent years, the use of Natural Deep Eutectic Solvents (NADES) as a green substitute for organic and traditional solvents has increased. NADES are sustainable solvents consisting of two or more components in a specific molar ratio, giving them unique polarity and conductivity properties. Despite being non-toxic solvents, their low pH makes them unsuitable for direct addition to the food matrix, so separating bioactive compounds and re-using NADES has become necessary. The present study aims to separate phenolic compounds from NADES, to have a polyphenol-enriched extract, and at the same time, to re-use the NADES, following the principles of green chemistry.

Method: Assays to recover polyphenols from 2 NADES extract (Choline chloride: Glycerol (ChChl:Gly) and Choline chloride: Lactic Acid (ChChl:LA)) of orange peel were carried out with 3 resins (DIAION HP-20, DIAION HP-2MG, or XAD7HP) by solid phase extraction (SPE). Resin (g)/NADES (ml) ratio, NADES/resin stirring time, Milli Q water (ml) clean up, and EtOH 0.1% formic acid (ml) elution were optimized. The yield of polyphenols was evaluated using the Folin-Ciocalteu assay.

Results: Due to no differences achieved, the shortest stirring time (30, 60, 90, and 120 min), was selected, and the highest NADES volume for the same amount of resin (1g/0.8ml, 1g/1.12ml and 1g/2ml) was used. Clean-up was performed using 4.5ml of water (tested 4.5 and 6.0ml), and polyphenols elution with 10ml of EtOH 0.1% formic acid (tested 6.0 and 10ml). Under these conditions, the recovery of polyphenols in the EtOH fraction from ChChl:Gly was 62.6, 62.5, and 38.3% for DIAION HP-20, DIAION HP-2MG, and XAD7HP, respectively. From ChChl:LA, with a lower yield of polyphenols than ChChl:Gly, the percentage of recovery was 51.3, 39.0, and 41.7%, respectively.

Conclusion: SPE with resins could be a promising method to recover polyphenols from NADES extracts of orange peel.
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P1.2.098

DIAAS and contribution to RDI: optimization criteria for plant-based protein mixtures

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Aim:
The promotion of underutilised crops contributes to agrobiodiversity. Additionally, there is a trend to shift animal-based protein consumption toward plant-based proteins. Therefore, the development of underutilised crops-based foods can contribute both to promote these crops and to the shift toward plant-based proteins. However, attention must be paid to the nutritional qualtiy of proteins. The aim of this study was to compare different nutritional criteria for protein mixtures optimization coming from underutilised crops.

Method:
Digestible Indispensable Amino Acid Score (DIAAS), recommended by FAO to evaluate the nutritional quality of proteins, were averaged from literature for oat, triticale, barley, buckwheat and lupine flours and for fava bean protein concentrate (FBPC). DIAAS of protein mixtures were calculated as detailed by FAO and according to the reference pattern score of 0.5-3 year-old population group.
Two criteria were used to optimize the ingredients proportions for each mixture: 1) the highest DIAAS and 2) the highest relative contribution to the recommended daily intake (RDI) for adults (60 kg bw) of the limiting IAA (LimIAA) for a daily intake of 100 g dry matter (with the restriction of a DIAAS above 75).

Results:
The LimIAA of cereals and buckwheat is Lysine, whereas the LimIAA of leguminous is sulphur-containing IAAs (SIAA). DIAAS of individual ingredients were lower than 75 (no protein quality claim applicable).
The optimal two-ingredient mixture for highest DIAAS was buckwheat:FBPC (0.83:0.17; DIAAS=88 and RDI=53%; LimIAA=Valine), whereas for highest RDI was oat:FBPC (0.73:0.27; DIAAS=75 and RDI=61%; LimIAA=SIAA). The differences in the optimal mixtures between criteria are due to the differences in protein content between flours.
The optimal multi-ingredients mixture for highest DIAAS was buckwheat:FBPC:oat (0.63:0.15:0.22; DIAAS=89 and RDI=51%; LimIAA=Valine), whereas for highest RDI was oat:FBPC:buckwheat:lupin (0.14:0.19:0.48:0.19; DIAAS=75 and RDI=66%, LimIAA=SIAA).

Conclusion:
The optimization of a mixture of proteins for highest DIAAS (criteria usually proposed to achieve the highest protein quality) does not necessarily lead to the highest contribution to the RDI of the LimIAA. Therefore, the criteria for highest RDI for optimization (including a minimum DIAAS restriction, if quality claim is pursued) is more adequate to meet the physiological requirements with minimal intake.

P1.2.099

Building process-structure-digestibility relations: the pulse protein perspective

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Aim: A shift towards more plant-based diets is necessary to feed the growing global population sustainably. Pulses like lentils, peas, and chickpeas are protein-rich and contain slowly digestible starch, fiber, minerals, and bioactive compounds. However, they are underutilized in the Western world due to sensory issues, long cooking times, and a lack of preparation knowledge. Incorporating pulse-based ingredients into foods could increase pulse consumption without major dietary changes.

Method: This study examined *in vitro* digestion kinetics of pulse proteins using various food products ranging from liquids (protein dispersion, plant-based shakes) to semi-solids (pulse puree) and solids (pulse-based pasta). Lentils, peas, and chickpeas were considered, with a special attention given to conditions which minimize waste production by including whole pulse fractions.

Results: Processing and linked food structure were found to influence the accessibility of pulse proteins to proteases during digestion. Factors such as protein solubility, protein particle size, interactions with other macronutrients, and encapsulation within intact cell walls affected the protease-substrate interaction. Notably, bio-encapsulated pulse proteins present in cellular pulse flours survived particular processing (e.g. home-made pasta production), reducing starch digestibility without affecting protein digestion. Protein digestion was quantified using size-exclusion chromatography (SEC), compared to traditional o-phthaldialdehyde (OPA) and nitrogen solubilization approaches. SEC analysis revealed pulse type-specific proteolysis patterns not identified by other methods.

Conclusion: Spanning from liquid foods over semi-solid puree systems, up to solid foods, this presentation shows potential of processing and structure to tailor pulse protein digestion kinetics with perspectives to impact satiety and satiation responses upon consumption of these foods.

P1.2.100

Towards the definition of an objective criterion of the food printing quality.

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Aim:

3D food printing is an interesting technology for offering personalized, healthy, good, appetizing and diversified food. However, it is still difficult to predict the print quality of the new printable recipes. The objective of this work was to highlight one or several criteria to evaluate and predict food printing quality in an objective way. To do so, a wide variety of food matrices for 3D printing were formulated from flours (wheat, rye, soy, lentil) and fruit and vegetable purees (potato, chestnut, broccoli) with the idea of generating a large range of printed products.

Method:

Print quality was evaluated by 2 methods:

- Pictures of the prints of each product were presented to judges and evaluated on scales according to 3 criteria (fidelity to the model, collapse, and continuity of the printed layers).
- An image analysis protocol was developed to objectively and automatically evaluate the print quality and compare it to the judges' ratings.

The rheological properties of the matrices were also evaluated (flow curves, dynamic properties, texturometry) to identify predictive criteria of the print quality.

Results:

All the food matrices were extrudable (able to hold the shape of the printed layer) except the products printed with broccoli and lentil puree. Different levels of print quality (lowest quality with lentil and highest with chesnut) were also obtained.The results suggest that:

- The image analysis protocol developed allows to describe the print quality in a reliable and objective way, and is representative of the scores given by the judges (R^2 = 0.86).
- The rheological properties are indeed at the origin of the print quality and can thus allow to predict it. Three rheological criteria were highlight (tan δ, stickiness (N),firmness (N)).

Conclusion:

A single rheological criterion is not sufficient to predict the printing quality of food matrices. In addition, food print quality can be quantified by the image analysis. In future studies, the physico-chemical properties and the process used must be mastered and optimized according to the matrix to ensure the optimal functionalization of the raw materials and to maintain the shape of the printed structure.

P1.2.101

Formulation and characterization of microwave vacuum dried tomato snack bars enriched with different proteins

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Aim:

In this study, the main aim was to investigate the physicochemical, and sensorial properties of tomato snack bars formulated with different protein types that were dried a microwave-vacuum system.

Method:

Tomato juice, pectin, salt, olive powder, tomato powder, and spices (thyme, rosemary, red pepper) were mixed with different protein types, rubisco, pea protein, and chickpea protein. Five combinations of proteins and concentrations were selected (5% rubisco-5% pea, 10% pea, 5% chickpea-5% pea, 5% chickpea-5% rubisco, and 5% chickpea-5% pea). After mixing the ingredients uniformly, snack bars were molded and placed in the refrigerator for 1-day. Microwave-vacuum dryer was run at 100% power, 20-kPa vacuum-pressure. Drying lasted for 6-minutes. A conventional oven was used at 120°C for 90-minutes to obtain the control samples. For the physicochemical analysis, color, texture profile analysis, water activity, moisture content, lycopene content, FTIR, and NMR relaxometry experiments were conducted. Sensorial analysis of the tomato snack bars was also carried out.

Results:
There were no significant differences between the samples for both water activity (a_w) and moisture content for the microwave-vacuum dried samples ($p>0.05$). Pea, chickpea, and rubisco proteins contributed to the lightness, redness, and yellowness in descending order. Lycopene amount was higher in mixed protein samples. Hardness values were found insignificant ($p>0.05$) among the different proteins samples but rubisco protein decreased, and pea protein increased the values of other textural attributes. T_2 results obtained by NMR showed that there were 3 proton population in the samples. Sensory results showed that the best formulation was the chickpea-pea mixture in terms of appearance and taste. When the conventional sample was compared, moisture content was significantly higher, the color was much darker, and chewiness was significantly higher than the microwave-vacuum dried samples. Lycopene content, hardness, cohesiveness, and gumminess did not change significantly ($p>0.05$).
Conclusion:
This study revealed that protein types and concentrations affected the properties of snack bars. Microwave-vacuum drying was much better than the conventional drying in terms of time, energy, color, sensorial, and textural properties. Despite the higher moisture contents, browning and crust formation occurred more in the conventionally dried samples which were undesirable quality characteristics.

P1.2.102

Extraction of soluble proteins from green plant leaves

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Aim: To sustainably reduce the greenhouse gas emissions from the production of animal proteins, novel alternative protein sources are explored to meet future food and protein demand for an increasing global population. Leaves from green plants contain high amounts of nutritive component – soluble Rubisco protein, showing a promising new potential for food application. The aim of the present study is to extract the soluble protein fractions from the leaves of some selected green plants (e.g., alfalfa, grass, and clover) and investigate their chemical compositions and techno-functional properties.

Method: The methods and procedure applied for extracting soluble Rubisco protein fractions comprise the following steps: harvesting fresh green plant leaves, raw juice pressing with a two-screw press, juice purification through separation of large particles and plant cell debris, protein precipitation with combined acid and thermal precipitation, protein separation and drying. Instead of the combined acid and thermal precipitation, the salting-out effect method was used in a fractionation experiment by addition of a stepwise increased amount of saturated salt solution to the purified juice followed by dialysis of the separated protein fractions.

Results: Chemical composition analysis of the samples collected at aforementioned process steps showed that, besides major components such as crude protein, dietary fiber, saccharide and carbohydrates, fat, and rest components (secondary plant substances), there also exist main minerals like Ca, K, Mg, Na and P. Achieved soluble protein fractions exhibit different colors and crude protein contents. Various techno-functional properties such as foam capacity, foam stability, gelation and emulsification were also found in different protein fractions. Foam stability of some protein fractions is comparable to that of egg protein. They are influenced by the protein mass fractions and the protein composition. Furthermore, restricted functional properties might be due to the formation of complexes between proteins, polyphenols, and carbohydrates. This needs a further study.

Conclusion: Present study indicates that various soluble protein fractions were successfully achieved from green plant leaves. Their respective various techno-functional properties suggest various potential applications. For human consumption, protein quality and safety aspects, such as reduction or removal of undesired substances from the extracted proteins, should be further investigated.

P1.2.103

Characterization of brewer’s spent grain lipids and the effect of ultrasound on extraction and quality

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Aim:

The valorization of sidestreams from plant-based food processing is of increasing importance. Brewer's spent grain (BSG), the largest sidestream from beer production, still contains protein, fiber, and lipids. However, the current utilization of BSG is mainly limited to low-value animal feed. Recent higher-value valorization studies of BSG focus on proteins and fibers, while little is known about lipids. Considering the huge quantities of BSG as raw material, we believe it is worthwhile to explore lipid extraction from BSG. As the structure of BSG might hinder lipid extraction, the potential of cell disruption techniques like ultrasound to improve extractability is examined.

Method:
In this study, the total lipid content of BSG together with the fatty acid profile and lipid class composition were determined. Furthermore, ultrasound-assisted lipid extraction (UAE) was performed with different power densities and compared with the corresponding conventional extraction (CE). In addition, the process of lipid extraction was monitored and kinetic modelling was applied. Quality characteristics including fatty acid composition, lipid composition, antioxidant content, and oxidation products of extracted lipids from UAE and CE were analyzed and compared.

Results:
The total lipid content of BSG was around 13% on dry weight (basis). Neutral lipids and polyunsaturated fatty acids were the major components of the BSG lipids. Compared to CE, UAE increased lipid extraction efficiency showing the highest extraction rate constant and equilibrium value. This effect could however be attributed to the ultrasound-induced temperature effect as UAE and CE at higher temperatures showed no significant differences in lipid extraction efficiency. Polyphenols were extracted simultaneously with the BSG lipids.

Conclusion:
1. The valorization of BSG as a lipid source holds great promise.
2. The improvement of lipid extraction efficiency by UAE can be attributed to the ultrasound-induced temperature increase.

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P1.2.104

Microalgae incorporation in baked goods to improve nutrimental intake and rheological quality.

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Aim:
Consumers within the EU are increasingly asking for natural and healthier food products, which are additives-free and environmentally friendly. Within this framework, microalgae have recently gained popularity in the nutraceutical and functional food-market, thanks to their high bioaccesible compounds content. The aim of this study was to assess dry biomass of *Spirulina, Chlorella* sp. and *Tetraselmis sp*. as innovative and healthier ingredients in baked goods (breadsticks, crackers, brioche and muffins) at flour substitution levels of 1.5-3.5%.

Method:
Crackers, muffins, grissini, and brioche were produced following a specific formulation at the IRTA Fruitcentre (Lleida, Spain). A particular procedure was assessed for each product. Products were baked on a Rational Oven (Landsberg am Lech, Germany). Physico-chemical characterization such as moisture content, color measurement, and Texture Profile Analysis were carried out at day one post-baking. Nutrimental analysis including Total Phenolic Content (Folin Ciocalteau), Antioxidant Activity (FRAP & ABTS) and Total Protein Content (Lowry Methodology), were also assessed, followed by a sensory evaluation with 30 semi-trained panelists.

Results:
Incorporation of microalgae led to increased protein and total phenolic content. Antioxidant activity was also higher in microalgae-enriched goods. A sensory analysis was carried out with 30 semi-trained panelists aiming to evaluate taste, texture and overall acceptance. According to results, Breadsticks (Grissini) with Chlorella at 3.5% and Spirulina at 2.5% levels, showed a higher overall acceptance within the panelists. Muffins and brioche had both Chlorella 2.5% and Spirulina 1.5% as higher rated levels, while for crackers the 1.5% level in Chlorella and Spirulina was the more accepted. Despite having a good nutritional contribution, Tetraselmis was rated with a "strong salty taste" and panelists found it unpleasant.

Conclusion:
Obtained Results showed that *Spirulina* and *Chlorella* could be a sustainable ingredient to formulate baked goods with an enhanced nutrimental matrix without altering the acceptability for consumers. Even though, in order to apply other microalgae such as *Tetraselmis* in food matrixes, more studies must be carried out to provide solutions for that unpleasant salty taste, and that the nutrimental contribution can be utilized.

P1.2.105

Synergistic effect of PEF during enzymatic hydrolysis of salmon by-products: yield, enzyme structure, and bioactivity.

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Aim: Peptides possess several functional and bioactive properties that are attractive components to be included in food products. They are obtained by enzymatic hydrolysis, but this process is costly and time-consuming. Therefore, emerging technologies could be used to improve process efficiency, yield, and costs. Pulsed electric fields (PEF) have been used in substrate pretreatment to enhance hydrolysis; however, the effect of PEF during enzymatic hydrolysis has not been reported, given that it could affect both the enzyme and substrate. The aim of this study was to determine the effect on peptide yield, hydrolysate bioactivity, and enzyme characteristics of PEF during enzymatic hydrolysis of salmon backbone protein.

Method: The PEF treatment was applied to a 2% w/w salmon backbone protein solution immediately after adding flavourzyme (1:100 enzyme:protein ratio) in continuous mode at electric fields of 0, 10, 15, and 20 kV/cm. Treated samples were hydrolyzed under standard conditions at 50°C and pH 7.0 for 4 h. Hydrolysates were evaluated for hydrolysis degree (HD), peptide content, and antioxidant activity. Control hydrolysis was performed with the PEF-treated enzyme to distinguish effects on the enzyme and substrate. The PEF-treated enzyme was analyzed for intrinsic fluorescence and surface hydrophobicity to determine any changes in its structure.

Results: The PEF treatment significantly improved hydrolysis of salmon protein after 4 h. Hydrolysis performed with only the PEF-treated enzyme increased its HD by 20% to 34%, whereas PEF applied to both the enzyme and protein increased HD by 20%, 24%, and 62% with the 10, 15, and 20 kV/cm treatments, respectively. The highest electric field significantly increased soluble peptide yield by up to 75%. The PEF treatment decreased surface hydrophobicity and intrinsic fluorescence of flavourzyme, indicating a change in the tertiary structure of the proteins comprising the enzyme mixture. The PEF treatment at 10 kV/cm enhanced hydrolysate antioxidant activity.

Conclusion: The PEF treatment during protein hydrolysis exerted a synergistic effect because it affected both the enzyme and substrate. It modified the enzyme structure and enhanced hydrolysis and hydrolysate bioactive properties.

P1.2.106

Cold-contact fermentation process development to produce low-alcohol marula fruit beer using non-Saccharomyces yeasts

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Aim: This study presents the development of a cold-contact fermentation process to produce low-alcohol marula fruit beer using *Metschnikowia pulcherrima*, *Pichia fermentans*, and *Pichia kluyveri*.

The last decade has seen increased consumer demand for zero and low-alcohol beverages. However, the production of these beverages often involves complex and expensive processes. Cold fermentation in combination with non-*Saccharomyces* yeasts can be an effective method for producing low-alcohol fruit beers with desirable qualities.

Method: The influence of temperature (°C), and time (h) on alcohol (% v/v), pH, total titratable acidity (% lactic acid) and specific gravity (SG) was evaluated using response surface methodology. Following a total of 13 experimental combinations, sterile 70 mL marula fruit juice was aliquoted into separate 100 mL Erlenmeyer flasks and then inoculated separately with the prepared *M. pulcherrima*, *P. fermentans*, and *P. kluyveri* at a concentration of 23 x 10^6 cells/ mL. Thereafter, fermentation was allowed to proceed at each corresponding temperature and time.

Results: The findings show that temperature and time influenced the level of alcohol produced and SG. For fermentation temperatures at and below 10 °C the alcohol content was 0.00 – 0.20% v/v. The lowest alcohol content was observed for marula fruit beer fermented at 7.93 °C for 252 h. Overall, *P. kluyveri* showed the lowest production of alcohol, followed by *M. pulcherrima* and *P. fermentans*, respectively. Higher SG values were observed for temperatures between 7.93 °C and 15 °C. Above 15 °C, the SG values decreased with increased temperature and time.

Conclusion: cold-contact fermentation by non-*Saccharomyces* yeasts was shown to be an effective biological method to produce low-alcohol marula fruit beer in line with the emerging consumer demand for low-alcohol beverages.

P1.2.107

Design and optimization of fresh pasta made of lentil flour heat-treated by turbo-cooking and extrusion-cooking

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Aim:
The increase of gluten-related adverse reactions and the benefits of consuming legumes have led to the development of new food products, such as legume pasta, tailored for an ever-larger segment of the population. In gluten-free pasta, the amount of gelatinized starch and the organization of alternative-to-gluten proteins play a crucial role in providing a well-structured product. Heat treatments can modify techno-functionalities of legume flours, allowing to avoid additives in the final product. The aim of this work was to design and optimise the formulation of legume-based gluten-free gnocchi, a typical Italian fresh pasta.

Method:
Optimization of gnocchi formulation with red lentil flour (LF) was performed by means of a two-factor I-optimal Design, considering the amount of added water (90-160% with respect to flour weight) and the heat-treatment technologies applied to red lentil flour, turbo-cooking (TC) or extrusion-cooking (EC), as main factors. Dough extrudability was considered as primary response, being related to the machinability in an equipment for artisanal loose gnocchi production. The optimized gnocchi were characterized for main quality parameters and compared with gnocchi produced using a traditional mix (STD) or a gluten-free mix (GF).

Results:
For the optimization of LF dough, an extrudability range of 5700-7100 mJ was considered as target. The highest desirability value (1.00) was reached with EC-treated flour and 125% added water, obtaining an extrudability value of 7130±771 mJ. The optimized red lentil gnocchi (GN_OPT) were characterized for moisture, texture, weight increase and amount of solid loss in cooking water, which are parameters commonly used to assess pasta quality. GN_OPT had a moisture content (57.6±0.6%) similar to STD (58.1±0.4%) and GF (57.9±0.8%), which could explain the firmness of cooked gnocchi (207±6 N) comparable to that of GF (216±19 N). However, GN_OPT showed a weight increase lower than STD and GF (3.3% vs 6.7-10.9%) and a slightly higher solid loss value (3.2% vs. 1.3-2.6%).

Conclusion:
These results demonstrated that legume flour can be successfully used in the design of new foods tailored for consumers' looking for healthy and clean-label products.
Acknowledgements:
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P1.2.109

Desiccation tolerance of Bacillus cereus: Contribution of glass transition phenomena of the bacterial cells

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Aim: (heading must be in bold)
Most bacteria are difficult to grow in low water activity (a_w) foods and/or environment, although sporadic outbreaks of foodborne illness by consumption of dried foods occur worldwide. Although the mechanism of desiccation tolerance of bacteria is still unclear, recent studies indicate that glass transition phenomena of bacterial cells may relate to resistance to low a_w stress. In this study, we aimed to describe the desiccation tolerance of dried *Bacillus cereus* cells as a function of glass transition temperature (T_g).

Method: (heading must be in bold)
The T_g of *B. cereus* prepared by different drying methods (air-dried or freeze-dried), different air-dried temperatures (10, 20, 30, and 40 °C), different air-dried humidities (20, 40, and 60%) and with different storage a_w (0.43, 0.63, 0.75, and 0.87) was determined by thermal rheological analysis. In addition, the survival kinetics of *B. cereus* prepared by different drying methods during different storage temperatures (4, 25, and 42°C) with different a_w (0.43 and 0.87) were determined and described as Weibull model.

Results: (heading must be in bold)

The T_g of air-dried *B. cereus* cells was higher than that of freeze-dried ones. Unlike air-dried cells, freeze-dried cells did not increase T_g due to the decrease in a_w. Drying temperature and humidity had little effect on T_g of air-dried *B. cereus*. Weibull model successfully described the survival kinetics of dried *B. cereus* cells regardless of the drying method, illustrating faster inactivation at higher storage temperature and a_w. Furthermore, freeze-dried cells were more rapidly inactivated than air-dried cells. To determine the effect of T_g on *B. cereus* survival, the survival ratio of *B. cereus* after three weeks storage was described as a function of the difference between T_g and storage temperature (T_s). The parameter (T_g - T_s) illustrated a clear boundary of dead or alive dried cells. Using the Weibull model's rate parameter, the specific boundary (T_g - T_s) was approximately 20°C regardless of the drying method or storage aw. When the (T_g - T_s) decreased by less than 20 °C, the dried cells were considerably inactivated.

Conclusion: (heading must be in bold)
The (T_g - T_s) will be an alternative parameter to predict the desiccation tolerance of dried bacterial cells.

P1.2.110

CRISPR-Cas9 mutagenesis of biosynthetic enzymes generates potato starch with potential interest as a healthy carbohydrate

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Aim:
There is a growing need for healthy food ingredients which can replace the conventional ones with minimal impact on dietary habits. Starch can convert to a healthy food ingredient (e.g., resistant starch) by altering its composition or molecular structure. Various gene modification approaches have been reported to generate healthy types of starch by influencing the starch branching enzymes (SBE), either to increase the amylose composition, the proportion of long-chain amylopectin, or both. In the present study, different starches from CRISPR-Cas9 mutated potato were characterized to evaluate how simultaneous mutations in SBE and granule-bound starch synthase (GBSS) enzyme contribute to altering the molecular properties of starches.
Method:
CRISPR-Cas9 DNA-free genome editing technique was used in potatoes to induce mutations in; (1) SBEs, (2) GBSS, (3) SBEs, and GBSS. Generated starches were characterized and compared for starch composition and molecular structure.
Results:
Introducing mutations to SBE could increase the amylose content by ~ 40% more relative to the wild-type potato. Knocking out GBSS produced waxy-type starch, whereas complete knocking or introducing mutations to GBSS in an SBE mutated background produced low amylose lines compared to the wild-type potato. An exception was when one wild-type allele in GBSS was present with the other three mutated alleles of GBSS in an SBE-mutated background. This particular line of interest could reach an amylose content of almost 82% more than the wild-type potato starch. The molecular structure of amylopectin of this line was altered with favorable features for resistant starch with a higher abundance of longer amylopectin fractions compared to other lines.
Conclusion:
The present study reported the possibility of using CRISPR-Cas9 technology to simultaneously influence the SBE and GBSS enzymes to tailor-make the potato starch to become a possible resistant type of starch, which could be utilized as a healthy food component. However, further studies are recommended in this regard to assess the health benefits of this novel type of starch.

P1.2.111

Development of wonky persimmon alternative sweeteners by extraction methods, characterization and evaluation of biological activity.

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Aim: This study aims to explore the possibility of alternative sweeteners using wonky persimmon (*Diospyros kaki*) fruit extracted by different types of ultrasound-and enzyme- assisted extractions.

Method: In this study, wonky persimmons were extracted using different processing techniques, namely ultrasound-assisted extraction (UAE), Pectinex-assisted extraction (PE), Pectinex-ultrasound-assisted extraction (PUAE), Celluclast-assisted extraction (CE), Celluclast-ultrasound-assisted extraction (CUAE) and compared them with the control. Then, we evaluated various characteristics such as total soluble solids (Brix), yield (%), water solubility index (WSI), biological activity (α-amylase inhibition activity), bioactive components (total phenolic content: TPC and total flavonoid content: TFC), and antioxidant activities (Trolox equivalent antioxidant capacity: TEAC and 2,2-diphenyl-1-picryl-hydrazyl radical scavenging activity: DPPH).

Results: Regarding sweetening component analysis, PE, PUAE, and CE showed higher level of total soluble solid content, amounting 60, 61, and 59 °Brix, respectively. The highest extraction yield was observed in PE, showing 14.137 ± 0.21%, while displaying the lowest (7.570 ± 0.58%) in UAE. Similarly, PE and UAE exhibited the higher WSI, showing 83.781 ± 0.51% and 83.411 ± 1.15%, respectively, compared to other samples. The highest α-amylase inhibitory activity was observed in UAE and CUAE samples (157.08 ± 4.7 mg acarbose/mL and 150.51 ± 2.91 mg acarbose /mL, respectively). In terms of TPC, PUAE and CUAE showed the highest amounts (157.55 ± 2.70 mg/g and 166.32 ± 8.48 mg/g, respectively). PE and CE displayed the greatest TPC contents at 72.87 ± 0.38 mg CE/g and 72.87 ± 1.01 mg CE/g, respectively, while other samples showed no significant differences. PE showed the strongest TEAC values (11.613 mM TE/g) and CE demonstrated the strongest DPPH activity (17.988 mM TE/g).

Conclusion: In conclusion, it was confirmed that the PUAE sample had a more significant effect on sweetening composition analysis, TPC, and TEAC compared to other samples. This also suggests that the combination of enzymes, especially Pectinex, with ultrasound-assisted extraction could provide the better sweetening action accompanying with higher levels of bioactive components and stronger antioxidant activities. Overall, this study clearly indicates that sweet persimmons might be a promising alternative source for sweetener preparation.

P1.2.112

Optimization of manufacturing process of high protein laver chips by applying air frying technology

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[1]Changwon National University

Optimization of manufacturing process of high protein laver chips by applying air frying technology

Aim: The aim of this study was to optimize the manufacturing process and develop high protein laver chip with surimi and rice flour (instead of wheat flour) by applying air frying technology to achieve a healthier snack with low fat and calories.
Method: The puffing agents ratio (NaHCO3 : NH4HCO3) and air frying time and brittleness and puffing ratio were set as independent (X_1, X_2) and dependent (Y_1, Y_2) values for optimization of manufacturing process through the response surface methodology (RSM), respectively. To determine the optimal conditions for developing high protein laver chips, several combinations were designed through central composite design (CCD). The independent variables were set as 3.5:0.5, 3.6:0.4, 3.7:0.3, 3.8:0.2 and 3.9:0.1 g for the puffing agents ratio and 110, 120, 130, 140, and 150 seconds for the air frying

time. The puffing ratio and the brittleness of the samples were measured following the seed substitution method and using a texture profile analyser, respectively. After all measurements, the optimum manufacturing condition was calculated through RSM based on the relationship beteween the independent and dependent variables.

Results: The optimum manufacturing condition was 3.5:0.5 g and 150 s the puffing agents ratio and the air frying time. Based on the optimum manufacturing condition, the predicted brittleness and puffing ratio were approximately 3.3981(N) and 211.52%, respectively. The difference between predicted and actual values was within ±5%, therefore, the model obtained from the results was validated.

Conclusion: Overall, our findings suggest that laver-based chips produced by applying the air frying technology can be a healthier alternative to traditional flour and deep oil fry based chips, with potential for commercial production as a high protein and low-fat and calorie snack.

P1.2.113

Flour particle size effect to bread quality, postprandial glycaemia and appetite sensations in healthy subjects

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Aim: Consumption of bakery products produced with finely milled flours has been associated with elevated postprandial glucose levels. In the present study the effects of flour composition (wheat, chickpea) and particle size of three whole meal breads on postprandial levels of glucose and subjective appetite ratings were evaluated. In all three samples 30% of wheat flour was substituted with larger particle size wheat d=1.8-2.0 mm (WGB), finely milled chickpea flour (LFB) and larger particle size chickpeas d=1.4-1.8 mm (CWB).

Method: Physicochemical properties (Color, Texture, Porosity, Specific Volume) of the four breads were measured by instrumental methods. A randomized controlled crossover clinical trial was conducted, where 14 healthy volunteers (9F/5M, age 23.6±3.5(SD) years, BMI 21.37±2.43(SD) kg) participated. They consumed on four different occasions amounts of each bread yielding 50g of available carbohydrates. Venous blood samples were collected before consumption and after 30, 45, 60, 90, 120, 180 min. Subjective appetite ratings were accessed by Visual Analogue Scales (VAS).

Results: LFB and CWB crumb hardness and chewiness were higher ($p<0.05$), compared to WB and WGB, whereas their porosity and cell area were significantly reduced ($p<0.05$). Lightness (L*) was lower in all samples compared to white bread ($p<0.05$). Glucose incremental area under curve (iAUC) for WB, WGB, LFB and CWB was calculated as 2320.0 ±229.5, 1901.8±294.7, 2071.6±308.8 and 1554.0±410.0 (SEM) mg*min/mL respectively. Compared to WB and LFB, CWB resulted in significantly lower glucose iAUC ($p<0.05$). Consumption of CWB resulted in significant reduction of hunger, desire to eat and increase in fullness compared to WB, as measured by iAUC ($p<0.05$). The iAUC for hunger reduction was also significantly higher for CWB compared to LFB.

Conclusion: Increase of chickpea flour particle size ameliorated glycemic response, promoted feelings of fullness, suppressed hunger and desire to eat in healthy subjects, compared to WB and LFB. In the context of the present study 30% of wheat flour substitution with larger particle size wheat (d=1.8-2.0 mm) did not exert beneficial effects. Bread quality attributes of all samples were deteriorated compared to WB, but not statistically significant differences were detected between chickpea breads of different structure in all examined parameters

P1.2.114

Sensorial evaluation of fermented fava beans-based bars

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Aim: Nowadays, the prevalence of kids obesity and overweight is one of the major concerns for modern society. Taking into consideration that snacks, which are constantly present in kid´s diets, are associated with childhood overweight, spreading the tendency to reduce fast-acting carbohydrates and to enrich their content with plant protein-rich ingredients is increasingly seen as a strategy for making shifts in kids' food choices to achieve a healthy pattern. Thus, this study aims to develop snacks based on alternative sources of protein that can be successfully included in kids' diets.

Method: The optimal ratio of ingredients to develop protein-rich snacks was achieved by sensory evaluation of the prepared samples. Developed snacks were offered to consumers for sensory evaluation using a 9-point hedonic scale on appearance, color, aroma, flavor, texture, stickiness, aftertaste, and overall liking. After that, according to the D-optimal mixture design approach, the influence of suggested protein-rich ingredients on sensory quality was determined and the rational combination for fava beans-based bars was chosen.

Results: Based on the literature review, the novelty and prospects of fermented fava beans usage as a main nutritionally superior ingredient for snack production are presented. Results from sensorial evaluation pointed out that the usage of puffed wheat or oat flakes negatively affects the texture and overall perception of fava beans-based bars compared with puffed quinoa. The optimum ratio between protein-rich ingredients (fermented fava beans: puffed quinoa: pumpkin seeds) was 62 %, 20 %, and 18 %. This indicates that the suggested mixture of fermented fava beans, puffed quinoa, pumpkin seed, and carob syrup can provide high consumer product acceptance for a legume-based bar and can be used to develop a bar with high plant-protein content for kids.

Conclusion: Considering the obtained results, the potential of fermented fava beans usage in the legume-based bars technology was shown. The basic recipe of bars enriched with plant protein-rich ingredients was developed. Sensory analysis showed a greater appreciation for the developed samples.

P1.2.115

Microfluidization as a potential technique to modify oil emulsion with milk protein preparations

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Aim: The study determines the effect of pressure homogenization and microfluidization on features of emulsions produced with whey protein concentrate (control sample), whey protein concentrate together with sweet buttermilk powder or with sodium caseinate.

Method: Pressure homogenization was carried out at pressure of 500 bar and 50 bar at the first and second stages, respectively. Microfluidization was carried of at pressure of 500 bar. The following analyzes were performed: oil phase droplet size (laser diffraction), emulsion stability (turbimetric method), images of microstructure (confocal microscope), the shear stress (rotational rheometer), color parameters (the CIELab color space).

Results: Regardless of the type of protein used, microfluidization was most effective in minimising oil droplet size and its distribution in the emulsion. Emulsions with the smallest oil phase droplet was produced by microfluidization and protein preparation composed of whey protein concentrate and buttermilk. No emulsion phase stratification was observed during turbimetric measurement of emulsions, regardless of the emulsification method and protein preparations. The addition of sodium caseinate or buttermilk as component of surfactant affected increase in the consistency coefficient of the emulsion in comparison with control sample. Both emulsification methods affected the change in flow characteristics of the emulsion with protein preparations from a Newtonian character to a shear-thinning non-Newtonian character. Modification of the oil phase droplet size in result of emulsification was reflected in the value of parameter L* (increase), a* (decrease), b*

(decrease or without changes), what contributed to color saturation (decrease) and total color difference between the sample and a white standard (decrease).

Conclusion: The method of emulsification and composition of emulsifying protein preparations affects droplet size, range of size distribution, rheological properties and color parameters of emulsions. Microfluidization and buttermilk addition as a surfactant can be used in the design of food emulsions with high dispersion of oil.

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P1.2.116

Sensory evaluation of snacks substituted with solid-state fermented wheat bran for the elderly

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Aim:

The purpose of this study was to evaluate the sensory characteristics and acceptability of snacks substituted with solid-state fermented wheat bran for the senior consumers.

Method: (heading must be in bold)

Different additional levels (2.5%, 5%, 10%, 15%) of solid-state fermented wheat bran inoculated with *Lactobacillus acidophilus* were added in extruded brown rice snacks (BS) formulation and labeled as LAS2.5%, LAS5%, LAS10%, and LAS15%, respectively. Then, the sensory characteristics and acceptability of snacks with and without milk-soaking responded by adult consumers and senior consumers were determined.

Results:

Regarding sensory descriptions, LAS15% with or without milk-soaking showed the significantly stronger sensory parameters including brown, grain odor, nutty taste, hard degree, and after taste (p < 0.05) for both adult and senior consumers. Comparing the appearance, taste, aroma, texture, and overall preference of seniors and adults, senior consumers responded the higher sensory intensities than the adult consumers. In terms of consumer acceptability, the highest overall acceptability was responded in LAS 2.5% by senior consumers, but there was no significant difference for milk-soaked snacks. Adult consumers responded the highest overall acceptability (6.69) in both milk-soaked LAS2.5% and LAS5%. Also, consumption of snacks without milk-soaking showed the highest overall acceptability in LAS2.5% (5.60).

Conclusion:

In summary, senior consumers responded the higher preference for taste, aroma, and overall acceptability in 2.5% LAS compared to brown rice snacks. Also, the acceptability of snacks with or without milk-soaking was rated higher by senior consumers than by adult consumers. Therefore, this study suggests the possibility of replacing snacks with solid-state fermented wheat bran to develop a senior-friendly food.

P1.2.117

Anti-diabetic potential of wonky persimmon : Optimization of enzyme extraction by BBD-RSM

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Aim: This study focuses on the optimal antidiabetic potential of wonky persimmon extracted with different levels of enzymes using the response surface methodology (RSM).

Method: Using the Box-Behnken Design (BBD), different levels of enzymes, Celluclast®1.5 L (0, 0.3, 0.6 mL), Pectinex Ultra SP-L (0, 0.2, 0.4 mL), and sonication time (0, 30 and 60 min) were optimized with dependent variables, total soluble solids (Brix), yield (%), and α-glucosidase inhibitory activity (%).

Results: In this design, varied extraction conditions resulted in total soluble solids contents of 38 – 60.8 Brix and yield of 7.11 – 15.24% as well as α-glucosidase inhibitory activity of 68.63 – 72.63%. Optimial conditions were achieved with 0.438 mL Celluclast®, 0.193 mL Pectinex Ultra SP-L, and ultrasonication time of 33 min at desirability index of 0.929. Under these optimal conditions, 60.625 Brix, 15% yield and 72.313% α-glucosidase inhibitory activity were achieved. A process validation was performed with experimental results of 60.1 Brix, 14.2% yield, and 65.72% α-glucosidase inhibitory activity which was under 10% of deviation.

Conclusion: In conclusion, the combination of enzymes Celluclast® and Pectinex Ultra SP-L with ultrasonication resulted the higher Brix, yield and greater α-glucosidase inhibition in persimmon extract. These findings provided an optimum conditions for enzyme extraction of persimmon as well as the potential of using persimmon extract as a sweetener substitute with antidiabetic properties.

P1.2.118

Nutritional benefits of lamb meat fed with white bottom mushrooms (Agaricus bisporus)

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Aim:
The effect of adding white button mushroom (Agaricus bisporus) to animal feed as a promoter of health and productivity of domestic animals is known. The addition of high quality mushrooms to sheep rations has been shown to lower cholesterol levels, but the effects on the qualitative characteristics of lamb meat are unknown. The aim of this study is to determine the nutritional benefits of lamb fed white bottom mushrooms.
Method:
The study was conducted on 30 lambs of the Lika pramenka breed, randomly assigned to one of three feeding options: 0% mushrooms for the control group; 1.5% dried mushrooms or 1.5% fresh mushrooms on dry matter basis. After 35 days samples of m. longissimus dorsi were collected for chemical analysis; fatty acid and cholesterol content and TBARS as indicators of oxidative stability of the meat. In addition, volatile compounds were determined by HS-SPME-GC-MS /MS and classified into the following categories: aldehydes, esters, alcohols, amino acids, peptides, lactones, ketones, fatty acids, complex organic compounds, ethers and furans.
Results:
The fat and cholesterol content of lamb increases, more vaccenic acid, omega-7 and conjugated linoleic acid precursors were found. The addition of fresh and dried mushrooms to the diet increased ($p \leq 0.05$) the amount of fat in lamb (1.10 vs. 1.62 g/100g), but was not statistically different from the control group. TBARS values increased as expected from day 0 to day 6 (0.1 vs. 1.4) and were significantly different between lamb fed a standard meal and a fresh mushroom meal from day 3 (0.97 vs. 0.86), while the dry mushroom meal showed no significant differences between the two lamb groups. Approximately fifty volatiles were identified in all treatments of lamb. The animal group fed 1.5% dry mushroom meal had better and richer chemical diversity of compounds than the animal group fed the control diet. These results suggest that more high quality flavour precursors are developed and contribute to the lamb flavour.
Conclusion:
Feeding white bottom mushrooms to growing lambs has nutritional benefits for consumers by improving meat quality, producing lamb meat with low fat and cholesterol content, and having a good flavour profile in terms of volatile compound composition.

P1.2.119

Enzymatic hydrolysis of the mixture of rainbow trout and Atlantic salmon by-products pre-treated by high-pressure

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Aim: The fish by-products generated from the fish processing industry may be a useful resource for bioactive compounds when non-thermal novel technologies are applied for their utilization. High-pressure processing (HPP) has been long used for the preservation and extension of the shelf life of seafood and constitutes a promising technology for the increased recovery of valuable compounds, such as lipids and proteins.
The aim of the current study was to evaluate the chemical composition and yield of the fractions obtained after enzymatic hydrolysis on a mixture of salmon and rainbow trout rest raw material pre-treated by high-pressure at 200MPa, 400MPa, and 600MPa for 4 and 8 minutes.

Method: A minced mixture of fresh Atlantic salmon (Salmo salar) and rainbow trout (Oncorhynchus mykiss) by-products consisting of trimmings, heads, skin, bones, and tales, in proportion 1:1 w/w, was subjected to high-pressure pre-treatment. Six different pre-treatments were applied; 200MPa x 4 min., 200MPa x 8 min., 400MPa x 4 min., 400MPa x 8 min., 600MPa x 4 min., 600MPa x 8 min. Then, the samples were hydrolysed enzymatically, and five fractions were collected; paste/solids, oil, emulsion, fish protein hydrolysates (FPH), and sludge, which were further analysed. All the fractions were analysed for protein, ash, moisture, and oil content. In addition, the free amino acid composition and degree of hydrolysis were determined in FPH. The pre-treated samples were compared to an untreated sample.

Results: Changes in the protein and oil content (g/100g dry weight) were observed in some of the fractions from the pre-treated samples compared to the control, as well as a lower amount of free amino acids in the FPH of pre-treated samples.

Conclusion: The best results were given when the applied pressure was 400MPa and 600MPa.

P1.2.120

Exploring deep eutectic solvent extraction's impact on anthocyanin degradation kinetics

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Aim:
The aim of this study was to investigate the degradation mechanisms of anthocyanins extracted using deep eutectic solvents (DES) based on acids and polyols under elevated temperatures and various storage conditions. This analysis aimed to understand the impact of DES extraction on the degradation kinetics of thermally treated and stored anthocyanin extracts.

Method:
Lyophilized red cabbage served as the anthocyanin source, extracted using DES based on choline chloride with malic acid and xylitol (1:1 molar ratio), and choline chloride with lactic acid and glycerol (1:2 molar ratio). A control sample was extracted using acidified methanol. Extracts were heated for 30 minutes at 40, 60, 80, and 100°C for thermal stability testing. To assess degradation over time, extracts were stored at 4 and -18°C up to 35 days. Methodologies included evaluating anthocyanin content via pH differential methodology, browning index, polymeric color percentage assessments, antioxidant capacity (DPPH and ABTS assays), individual anthocyanin analysis (HPLC), and chemical bonding spectra examination (FT-IR).

Results:
All samples, including control and DES, showed a decrease in total anthocyanin content as temperature increased. The control sample had the highest content at 40°C (280.86 mg/L) and the lowest at 100°C (203.09 mg/L). Malic acid and lactic acid samples showed a similar trend, with values ranging from 246.52 mg/L to 297.42 mg/L, and 231.11 mg/L to 290.29 mg/L, respectively. Xylitol samples had significantly lower content (119.69 mg/L to 140.34 mg/L), while glycerol samples ranged between 168.17 mg/L and 197.66 mg/L. Anthocyanin content decreased over time for all samples, with lower temperatures preserving more anthocyanins. The polymeric color index generally increased over time and varied with storage temperature. Control and malic acid samples displayed the smallest changes, while xylitol and glycerol samples exhibited more significant increases. Lactic acid samples showed a mixed trend.

Conclusion:

This study revealed that the choice of deep eutectic solvent and storage conditions significantly influenced anthocyanin content and polymeric color index. Malic acid and lactic acid-based solvents demonstrated better performance in preserving anthocyanins. These findings can aid the food industry in developing effective extraction and storage methods for anthocyanins and related products.

P1.2.122

Malting of wheat offers the opportunity for producing nutritious and clean label breakfast flakes

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Aim: Breakfast flakes are made through a variety of technologies such as extrusion and pressure cooking with wheat flour being a common raw material. However, consumers desire whole meal products high in dietary fibre and nutrients such as minerals and vitamins which benefit health. Regretfully, the bio-accessibility of iron and zinc ions in whole wheat is only 3–5% as they are chelated by phytic acid. A further concern is that common breakfast flakes often contain much added sugar and, as a result, on a serving portion weight basis, even less nutrients than when less or no sugar is added. To overcome the above hurdles, it is useful to malt cereal grains. Indeed, during malting, hydrolytic enzymes are activated and/or *de novo* synthesised to fuel seedling growth. Amylase action leads to (partial) hydrolysis of starch for the mobilisation of sugars to the growing embryo and therefore increases the intrinsic saccharide content in cereal grains. Further, the increase in endogenous phytase activity directly leads to phytate hydrolysis and thus to release of earlier bound minerals and improved mineral bio-accessibility.

Method: Malted whole wheat is used to manufacture breakfast flakes which are then analysed for their intrinsic saccharide contents (and aroma compounds), mineral bio-accessibilities and textural properties.

Results: The resulting flakes were of good quality with desired colour, bulk density and hardness. Further, the sweetness of breakfast flakes was enhanced and these intrinsic formed saccharides served as flavour precursors in Maillard reactions leading to caramel and toast aromas. Moreover, rational modification of a breakfast flake making process allowed optimal *in situ* endogenous phytase action. Indeed, resting the ingredient mixture at 50 °C and pH 3.8 for 1 h prior to flake production led to 45–60% phytate breakdown. This resulted in end-products with higher bio-accessibilities of iron (29–38%) and of zinc (17–32%) than noted for control flakes (8% and 8%, respectively).

Conclusion: By fully exploiting the nutritional profile of wheat, palatable whole grain breakfast flakes with a clean label (no added sugars or minerals) can be obtained which meet consumer demands and needs.

P1.2.123

The effect of high-pressure homogenization on plant protein properties and the interaction with grape-seed polyphenols

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Aim:

Consumers pay more attention to food and its effect on health. Proteins and polyphenols are increasingly used to design and develop food products with improved nutritional properties. However, many plant-based proteins have limited techno-functionality, limiting their use and diversification of protein sources. Furthermore, often protein-rich products may be formulated to include polyphenolic compounds (like yogurts with added fruits). However, polyphenols may also non-covalently interact with proteins to form complexes. One technology reported to attenuate some technological limitations is high-pressure homogenization (HPH). This work aimed to study the impact of HPH on the properties of plant proteins and their non-covalent interactions with polyphenols extracted from grape seeds (GS) to design new food products with improved health-promoting properties.

Method:

The effect of HPH treatment (200 MPa, Tin=15°C) on potato and pea protein properties (5%) was characterized by analyzing the particle size distribution, protein solubility and physical stability, zeta potential, and surface hydrophobicity. Physical stability against sedimentation and centrifugal filtration, followed by high-performance liquid chromatography were performed to assess the extent of non-covalent interactions with polyphenols.

Results:

HPH treatment of 5% pea and potato proteins resulted in smaller particle size distribution (Dv90<10μm), increased protein solubility from ~70% to ~95%, decreased sedimentation velocity [μm/s] from ~55.72±3.56 to ~0.70±0.01, and higher surface hydrophobicity values compared to the non-homogenized protein solutions. This indicates the breakup of the large protein aggregates into smaller aggregates by HPH treatment with improved stability against further sedimentation. The relative binding [RB, %] between polyphenols to plant proteins increased after HPH treatment, likely due to the increased protein surface hydrophobicity. For example, the RB of catechin to potato proteins increased from 31±2% to 53±1%, yet the sediment level after HPH treatment decreased, promoting the potential utilization. Furthermore, the RB was structure dependent; epicatechin RB was 61±1% compared to 98±1% for epicatechin gallate due to the gallate residue.

Conclusion:

The HPH treatment improved plant protein dispersibility and physical stability. The HPH treatment of potato protein and GS exhibits the lowest sediment level, implying enhanced stability against sedimentation that can be used when designing new functional food containing plant proteins and polyphenols.

P1.2.124

Prediction of Avocado Maturity Using SWIR Hyperspectral Images and Different Algorithms

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Aim: Monitoring the quality attributes of avocado is a method for determining the ripening stage and identifying the optimal consumption time. This study used a non-destructive method based on hyperspectral imaging technology.

Method: A SWIR (900-1700 nm) camera was used to observe avocados from immature to overripe stages while stored for 16 days at 15°C. During the storage period, a total of 894 samples were measured using the hyperspectral camera, and 256 spectral reflectance data in the 900~1700 nm range were obtained and used. The three stages of ripeness were classified using sensory quality characteristics based on the degree of coloration.

Results: The average spectrum of the avocados was extracted from each hyperspectral image and used to classify the samples into three classes using Partial Least Squares Discriminant Analysis (PLS-DA) and machine learning methods (SDCA, ANN, LGBM, Fast Tree). The PLS-DA model had a determination coefficient (R2) of 0.80. The determination coefficient (R2) by SDCA, ANN, LGBM, and Fast Tree were 0.99, 0.98, 0.92, and 0.90, respectively, and they were 0.99, 0.95, 0.88, and 0.87 in the cross-validation models, respectively. The samples were accurately classified at a rate of over 81% using the Confusion matrix in the SDCA algorithm.

Conclusion: This study demonstrated that hyperspectral imaging, particularly in conjunction with machine learning methods, is an effective means of predicting the optimal ripening stage of avocados and is feasible in industrial applications.

P1.2.125

Novel Gluten-Free Amaranth and Oat Flour Cookies Fortified with Soybean Hulls

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Novel Gluten-Free Amaranth and Oat Flour Cookies Fortified with Soybean Hulls

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Abstract: Recent advances in soybean processing and by-product utilization illustrate the increasingly important role of soybean in human diets as a part of the circular economy across the food chain. However, soybean hulls, an abundant soybean processing by-product, have never been used for food application. In this study, 25% soybean hulls were substituted for amaranth or whole wheat flour (WOF) in gluten-free cookies. Composition, nutritional values, water-holding capacities, correlation between properties, and pasting and rheological properties of soybean hulls, amaranth, and WOF were evaluated in comparison to wheat flour. Water loss, cookie texture, and geometrical properties of the cookies were examined. The results disclosed that soybean hulls, amaranth and WOF contain higher protein content, minerals, fiber, special amino acids, and critical vitamins (C and K) than wheat flour.

Considerably higher total amino acid content was found in soybean hulls (18.33%) than wheat flour (12.77%). Water-holding capacities increased by replacing amaranth and WOF with soybean hulls. Soybean hulls exhibited higher rheological elastic properties than amaranth, WOF and wheat flours. The soybean hulls utilized in amaranth or WOF cookies greatly improved their nutritional value, the water retention and moisture content along with acceptable physical properties when compared to wheat flour cookies. This study explored the feasibility and potential of utilizing soybean hulls with amaranth and WOF in gluten-free bakery products and potential other industrial applications.

P1.2.127

Authentication of saffron stigmas (Crocus sativus) by Hyperspectral Imaging and Chemometrics

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Aim: This study presents a rapid and cost-effective approach for the authentication of saffron, a highly valuable spice that is often subject to adulteration. The method employs near-infrared hyperspectral imaging (NIR-HSI) in conjunction with chemometrics to identify and quantify *Crocus sativus* style as an adulterant in saffron stigmas.

Method: Adulterated samples were prepared by introducing various concentrations of saffron style into pure saffron stigmas. Spectral data were subjected to multiple pre-treatment methods and variable reduction techniques, followed by classification and quantification using partial least squares (PLS), support vector machines (SVM), and multilayer perceptron (MLP) models.

Results: The HSI technique achieved an outstanding 100% correct classification rate in differentiating between genuine saffron and adulterated saffron across all models. Furthermore, the percentage style adulteration in saffron could be predicted efficiently, with all models exhibiting relative prediction values (RPD) greater than 3.5.

Conclusion: These findings demonstrate that the HSI technique is a highly efficient and non-destructive tool for the rapid detection of saffron style in saffron stigmas. The approach presented in this study provides a promising solution to the ongoing challenge of saffron authentication and has important implications for ensuring the integrity of saffron production and supply chains.

P1.2.128

What can we trap in tomato juice after ultrasound and UV-light treatment?

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Aim:
The development of innovative food processing technologies accelerated adjustment of quality screening techniques and optimization protocols. Electron spin resonance (ESR) is a very sensitive technique that directly determines free radical species and allows detection and quantification of radicals generated by novel processing technologies. Therefore, the concentration of hydroxyl radicals and superoxide radicals, which are among the most reactive and can damage cellular systems such as DNA, proteins and lipids, was studied after ultrasound treatment and combined treatment with UV light and ultrasound.

Method:
Tomato juice was prepared from fresh tomato plants (Solanum lycopersicum L.) purchased from the Croatian organic farm "Vrtni centar Baković Sveti Filip i Jakov", Croatia.

The UWave-2000 Multifunctional Microwave Chemistry Reaction Workstation (Sineo) was used for ultrasonic, UV-light and combined treatment of tomato juice. Spin-trapping ESR technique was used to monitor radical formation. 5,5-Dimethyl-1-pyrroline-N-oxide (DMPO) was used as a spin trapping agent. X-band ESR spectra were recorded using Bruker Magnettech ESR5000 spectrometer.

Results:

Our results confirm that the effect of ultrasound, UV-light and combined treatment on tomato juice is mainly expressed in its homogenizing, antibacterial effect and chemical composition change. The concentration of radicals depends on the duration of treatment, amplitude and power applied, and the most important changes concern the temperature change during treatment.

Conclusion:

The application of spin trapping method in food processing control and risk assessment can provide important information and improve the optimization process related to radical reactions that may be responsible for food quality and spoilage.

P1.2.129

Safety and Bioactivity of Olive Seed Extract for Potential Ingredient Applications in Food and Nutraceuticals

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Aim:

Olive oil production generates large amounts of olive seeds as by-products with the potential to be valorised as naturally derived value-added ingredient for food and nutrition. Olive seed oil is a potential source of biologically active compounds associated with antioxidant effects with relevance for various food and non-food applications. Furthermore, their biological safety is critical for their safe utilisation. The study aimed to evaluate the safety and bioactivity of olive seed extract.

Method:

The microbial risk was assessed using regulatory recommended standard methods to screen for the presence of pathogenic and spoilage bacteria including *Salmonella, E. coli, Enterococcus, Enterobacteriaceae*, total plate count and yeast and moulds. In addition, the prevalence of heavy metal contaminants such as Arsenic, Mercury, Lead and Cadmium was determined using the Inductively Coupled Plasma-Mass Spectrometric (ICP-MS) technique. The cytotoxicity of the extract was evaluated using the MTT and Alamar Blue assays in proliferating Caco-2 cells. In addition, the biological activities of the extract were determined using the Folin-Ciocalteau, DPPH, ORAC, and FRAP assays.

Results:

Olive seed extract did not show the presence of either spoilage or pathogenic bacteria. The heavy metal levels (Arsenic, Mercury, Lead and Cadmium) were comparable to the European regulatory limits. The extract did not show cytotoxicity (through proliferation and metabolic activity indicators) to Caco-2 cells up to doses of 100 µL/mL. The phenolic content and antioxidant activities indicated that olive seed extract could be a potential natural antioxidant ingredient for various food and cosmetic applications.

Conclusion:

Insights into the biological and chemical risks, cytotoxicity potential, and bioactivities of olive seed extract would contribute to its industrial application as a potentially safe, healthy, and sustainable alternative feedstock for the food, nutraceutical, and cosmetics sectors.

P1.2.130

Artificial intelligence in the context of sensory quality assurance of PDO products as iberian ham

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Aim:

Industry 4.0 applications to the food industry has as one of its pillars the application of Artificial Intelligence (AI) in those aspects of food manufacturing that are related to consumers' perception of the products, thus obtaining valuable information to be able to act accordingly. Here, the sensory characteristics of food play a transcendental role for consumer acceptance, particulary for . To date, the only possible way to verify the sensory quality of the products guarantee by a quality label is to performe a evaluation with a trained sensory panel. To solve this problem, AI into the field of Food Sensing is enable to reproduce the human perception, even improve the results of a trained sensory panel in terms of objectivity and regularity.

The aim of this work is to use networks to estimate the true numerical values of sensory attributes in samples of iberian ham .

Method:

This work has been caried out using Artificial Neural Networks (ANN) as a tool for the modeling and subsequent execution of this perceptive activity. To this purpose, data from physicochemical characteristics measured instrumentally and data of sensory parameters obtained by a trained sensory panel from PDO Guijuelo iberian ham, were used.

Results:

This work presents the results used to validate the technological proposal. For each of the sensory parameters, a neural network is proposed whose output estimates the value of each of the parameters of the quantitative descriptive analysis.

Conclusion:

The machine-learning methods can provide a reliable methodology for sensory quality control in a product such as Iberian ham.

P1.2.131

Pulsed Electric Fields intervention on the Anisakis Risk Assessment in anchovies in Spain

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Aim:

Pulsed Electric Field (PEF) consists on the intermittent application of high-intensity electric field pulses of short duration to a material placed between two electrodes avoiding as far as possible the temperature increase. The lethal efficacy of the different PEF treatments (always below 20 kJ/kg) was evaluated on *Anisakis* larvae located in the abdominal cavity of naturally infected anchovies. After the treatment, the viability of the larvae and their capacity to migrate from viscera to muscle was evaluated.

Method:

From these results and the systematic review of prevalence, intensity of parasitation, consumption habits, and hospital studies, a probabilistic quantitative risk assessment (QRA) of anisakiasis caused by consumption of marinated anchovies was developed. The value chain from sea to consumption was updated with recent information and data was extracted from the main official databases. The process model incorporated all the steps of a risk assessment (hazard identification, exposure assessment, hazard characterization, and risk characterization) and was implemented in @Risk software using Monte Carlo simulation.

Results:

In the base scenario, the results of simulating the probabilistic models with 100,000 iterations show a number of anisakiasis in Spain between 2,048 and 1,210,253 per year (62,157±586; mean±90% CI). To assess the impact of this parasitic incidence on public health, the prediction of the number of annual cases per 100,000 inhabitants was simulated and the result was between 4 and 2,434 (130 ± 2). These predictions are in line with published studies on real cases reported in Spain and also with the predictions estimated in other risk analyses.

Implementing in the processing chain a treatment of 4 kV/cm (20 kJ/kg) a great reduction in the annual cases in Spain would be achieved. According to the QRA, the total cases in Spain would decrease to 6,142 ± 87, which would mean approximately ten times fewer cases compared to the current situation. The predictions of the number of cases per 100,000 inhabitants drop to 12±0.2 with a minimum of 0 and a maximum of 574.

Conclusion:

PEF technology implementation in marinated anchovies processing would imply a great beneficial impact on public health.

P1.2.132

Valorizing dried carrots through instant controlled pressure drop technology

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Aim:
The aim of the work was to optimize the quality of dried carrots through instant controlled pressure drop (DIC) in order to obtain a healthy, additive free snack avoiding as much as possible production wastes.

Method:
Fresh carrots were purchased at the local market, sliced into different thickness and dried at a temperature of 35°C up to about 5% - 10% moisture content prior the DIC treatment. The residual moisture was removed at a temperature between 50 and 60°C under vacuum conditions. The pilot plant used is a prototype (DIE, Contento Trade S.r.l.) including a low temperature dryer (Dryer DEU100), the DIC reactor (Microtexturizer DIE100) and a vacuum drier (Dehydrator Thermodie 100).
The drying kinetics as function of thickness were monitored by weighting carrots every 60 minutes during pre-drying. The effect of slice thickness and DIE process parameters (conditioning time & steam temperature) on the final product quality were studied. The quality of dried carrots was evaluated in terms of chemical-physical properties through analyses of colour, texture, water activity (aw), sorption isotherm, glass transition temperature (T_g) and expansion. A consumer tasting was carried out to determine consumers acceptance of the product.

Results:
Regarding the colour, DIE treated carrots appeared less intense in colour (ΔE 7.94). Different treatment parameters only slightly affected the colour of dried carrots (ΔE 2.3). DIC treatment allow lower aw values and moisture contents to be obtained in the final product, which, in turn, exhibited a higher T_g in respect to untreated carrots.
After pre-drying, all samples showed a contraction of volume, which was partially recovered after DIE treatment.
The more performing process parameters resulted in steam temperature set to 180°C and 60 seconds conditioning time. Carrot slices with an initial thickness of 7 mm showed the highest expansion but were perceived as too hard by consumers. Slices of 2 mm thickness were perceived as crunchier, tastier and generally more acceptable.

Conclusion:
Provided the correct initial thickness and the proper processing conditions are applied, DIC technology allows the production of a friable carrot snack without the need of additives and avoiding production wastes.

P1.2.133

Influence of different drying methods on proximate composition, biocompounds and antioxidant potential of Red Cabbage.

Miss Nicol Mejias[1], Dr. Antonio Vega-Gálvez[1], Dr. Luis Gómez-Pérez[1], MSc. Alexis Pastén[1], MSc. Elsa Uribe[1,2], Javiera Camus[1]
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Aim: Red cabbage possesses important phytochemicals such as anthocyanins and glucosinolates, with important benefits to human health. However, due to its high-water content it is necessary to apply conservation techniques as dehydration to preserve its biocompounds and nutrients. The aim of this work is to evaluate the effect of different drying methods on proximate composition, biocompounds and antioxidant potential of red cabbage.

Method: Red cabbage was cut into cubes (1x1 cm) and blanched in boiling water to inactive myrosinase enzyme. Then, it was dehydrated by: Convective drying (CD), Vacuum drying (VD), Infrared drying (IRD), Freeze drying (FD) and Low Temperature and Vacuum drying (LTVD). Control sample was blanched cabbage. Proximate composition complemented with water activity, amino acid and fatty acid profiles were analyzed. Color was measured with a colorimeter. Total Glucosinolate Content (TGC) spectrophotometrically and Total Anthocyanin Content (TAC) by differential pH method. Antioxidant potential by ORAC assay.

Results: Proximate composition showed low differences among dried samples in terms of protein (15-17 %), ash (8-10 %), fiber (10-13 %) and fat (0.5-1.15 %). Total Aminoacid was higher for CD, IRD and FD, considering essential amino acids as well (2.02-2.73 %). Glutamic acid was predominant in all samples. Fatty acids presented important quantities of polyunsaturated fatty acids in all samples, being higher for LTVD. Saturated fatty acids presented high and similar quantities in IRD, LTVD and FD (27-28 %) and Monounsaturated fatty acids were lower than the others (2.32-3.35 %). Total Color Change had ΔE values among 14.41 and 27.7, where CD was the lowest and FD the highest. TAC was reduced between 32-

34 % (VD and LTVD) and 68,7 % (IRD). TGC was relatively constant with maximum value for VD (100%) and a loss of 12% for IRD. Antioxidant activity (ORAC) was higher for VD sample compared to control.
Conclusion: Drying methods applied on red cabbage may affect its quality parameters, however, drying methods in vacuum conditions as VD and LTVD obtained the best results. Hence, VD and LTVD may establish as excellent alternatives to produce dried red cabbage with high content of biocompounds.

P1.2.134

Effect of roasting and ripeness on the quality of the new brazilian coffee "Conquista ES8152"

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Aim:
The aim was to evaluate the effects of ripeness and roasting degrees on the chemical and sensory composition of conilon coffee "Conquista ES8152" by chemometric analysis.
Method:
The new cultivar "Conquista ES8152" was harvested at three different degrees of maturation (60%, 80% and 100% of cherry beans), and roasted at three different degrees (light-AGTRON 95; medium-AGTRON 55; and dark-AGTRON 35), totalling 9 samples. Chlorogenic acids (3-CQA; 4-CQA; 5-CQA; 3,4-diCQA; 3,5-diCQA; and 4,5-diCQA) and caffeine content were quantified by UHPLC-DAD, and volatile compounds profile by HS-SPME-GCMS. The sensory analysis was performed according the UCDA cupping protocol. Statistical analysis was done by Principal Component Analysis (PCA).
Results:
The chlorogenic acids (CGAs) content was affected by roasting but was not affected by the ripeness. The main isomer was 3-CQA, with values around 5.5-5.9% in light roast, 4.3-4.4% for medium roast, and 1.4-1.9% for dark roast. Total CGAs content was between 2.4 and 9.3%, negatively correlated with roast degree. Caffeine content was between 2.1 and 2.4% and was not affected by roasting or maturation. The sensorial profile of coffee was influenced by the roast process. The medium roast reached 80 points, the light roast, 78, and the dark roast, 77 points. Coffees with 80 points are classified as "Fine" by UCDA protocol. The major volatile groups were phenol, pyrazine and furans and the majority compound was 2-methoxy-4-vinylphenol in all samples. The volatile profile was affected only by roasting with a balance of compounds positively correlated with sensory profile at medium roast. Furfural, 5-methylfurfural and 2-ethyl-5-methylpyrazine was positively correlated with sensorial quality while 2-ethylpyrazine, furfuryl acetate, 1-furfuryl pyrrole, 4-ethyl-2-methoxyphenol and difurfuryl ether was negatively correlated.
Conclusion:
The new Brazilian coffee had great amounts of CGAs and caffeine and could be considered a special coffee by sensory profile, related to the volatile composition of the cultivar. The ripeness did not affect the analysed parameters, but the roast condition did. Medium roast is most appropriate for preserving the degradation of CGAs with higher sensory notes. With the PCA analyses, it was possible to discriminate the degree of roasting of the samples with the CGAs values.

P1.2.135

Effect of emulsion as a healthy fat on Rheology and sensory characteristics of cream cheese

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Effect of emulsion as a healthy fat on rheology and sensory characteristics of cream cheese

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Aim: Cream cheese has become a popular ingredient in meals because of its texture, flavor, and versatility, but with the continuous prevalence of healthy diet concepts, researchers are gradually shifting their sights toward low-fat, healthy cream cheese. However, the absence of cream will lower the texture, aroma, and taste of cream cheese products, limiting the development of low-fat cream cheese. The emulsion is a promising alternative for cream to form semi-solid gel network structures with plant oils that can enhance the nutritional content of food formulations and reduce saturated and trans fat. However, its effects on the rheological properties or texture of cream cheese products still be obscure. Hence, this work is to verify the feasibility of emulsion substitution of cream in cream cheese formulations and to investigate the effects on rheological properties, texture, sensory properties, and consumer acceptance of cream cheese.

Method: The spreadability of cream cheese with different proportions of fat substitutes (0%, 50%, and 100%) was explored. Large amplitude oscillatory shear (LAOS) and small amplitude oscillatory shear (SAOS) were conducted to analyze the rheological properties and investigate the impact of the emulsion on the cream cheese structure. Sensory evaluation was also performed to assess the appearance, texture, taste, and consumer acceptance of the cream cheese.
Results: Emulsion improved the spreadability of cream cheese. The gel strength of cream cheese in the SAOS was negatively correlated with the oleogel content and showed a slight dependence on the frequency. LAOS showed that increased emulsion content resulted in enhanced nonlinear behavior of cream cheese, with all samples showing a strain-softening followed by strain-hardening and shear-thickening followed by shear-thinning behavior. The emulsions had no adverse effects on the oral sensory properties of the cheese such as taste and texture as well as consumer acceptance.
Conclusion: HPMC emulsions can be considered as healthy fat substitutes for cream cheese manufacturing.

P1.2.136

Extract from Hibiscus sabdariffa calyx inhibits the enzymatic activity of apple polyphenol oxidase

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Aim:
The aim of our study was to endeep the inhibitory mechanisms of polyphenolic compounds from the *Hibiscus sabdariffa* calyx extract on polyphenoloxidase (PPO) from apples. The enzymatic browning in fruit and vegetable tissues has been an on-going concern in the industry with economic losses due to the negative impact on the colour, appearance, flavor, nutritive properties of food and subsequent consumer's acceptability. Therefore, natural extract is proposed as potential effective anti-browning agent, whereas the mechanism of interaction between PPO and phenolic compounds is described by means of two complementary methods, such as fluorescence quenching and molecular docking simulations.
Method:
In order to obtain an anthocyanins enriched extract, the extraction conditions for hibiscus were optimized using Response Surface Methodology. The fluorescence quenching experiments involved the successive titration of purified PPO with the polyphenolic enriched extract, whereas the binding constants (K) and the number of binding sites (n) were calculated. The sequence of amino acids of the PPO was take from the UniProtKB database and was used to predict the three-dimensional structure of the enzyme by means of I-TASSER algorithm. The enzyme model equilibrated at 25°C was further used as receptor for three ligands, such as cafestol, gallic acid and catechin representing the compounds present in the highest amounts in the extract.
Results:
The relative fluorescence intensity of PPO at 25°C decreased from 100% up to 33.5%, when the extract concentration increased from 0 to 58.55 mM on delphinidin-3-O-glucoside basis. Our docking simulations results suggested that cafestol binds to two different cavities of the enzyme. The hydrophobic contacts and the hydrogen bonds were responsible for the attraction between the enzyme and the ligands. An additional π-stacking interaction involving the His^{210} residue was observed in the complex formed with the cafestol. This aromatic-aromatic noncovalent interaction accounts as a strong attractive force to the overall binding energy.
Conclusion:
The fluorescence spectroscopy and molecular modeling data highlighted the presence of two different cavities, whereas the binding involved mainly the hydrophobic contacts and the hydrogen bonds. The results obtained in this study provide useful information for the use of polyphenolic inhibitors to prevent enzymatic browning.

P1.2.137

PRODUCTION OF PATES FROM FISH ROE BY-PRODUCTS: PHYSICO-CHEMICAL PROFILE

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Aim:
Fish products play a very important role in the human diet, providing a large amount of high biological value proteins and availability, minerals, vitamins and unsaturated fatty acids such as omega-3, which have positive effects on health. However, barriers to consumption are often price and perceived difficulty of preparation. This has led the fisheries sector to evolve, and adapt to food needs and new lifestyles, such as the production of prepared dishes ready-to-eat product, from fish by-products as a more economical and sustainable.
Therefore, the objective was to evaluate the physico-chemical profile of three types of pates made from fish roe that did not have an integrated gonad membrane.

Method:
Three types of pate were made with ling roe (*Molva-molva*) by-product (three replicates of each): control (C) (56% roe, 18% olive oil, 11% tomato, 11% water, 4% spices, no stabilising agent), formulation 1 (F1) (56% roe, 18% olive oil, 11% tomato, 9% water, 4% spices, 2% milk powder as stabilising agent) and formulation 2 (F2) (56% roe, 18% olive oil, 11% tomato, 4. 5% water, 4% spices, 6.5% starch as a stabilising agent). The pH, Aw, moisture, protein and fat were determined in triplicate according to ISO standards: 4045 (2008), 18787 (2017), 1442 (1997), 1871 (2009), and 1443 (1979), respectively. The results of the physico-chemical analyses were performed by one-way analysis of variance (ANOVA) and Tukey tests with SPSS 28.

Results:
According to the results, it was observed that the use of milk powder as an emulsion stabilising agent (F1) had higher pH and protein values than samples C and F2 and lower fat values than F2, since it was skimmed milk powder.

Conclusion:
The use of milk powder as a stabiliser helped to improve the protein profile of the pate made from the ling roe by-product.

P1.2.138

Impact of methylcellulose and silicon on structure and lipid digestibility of stabilized soy protein emulsion

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Aim:
The consumption of animal saturated fat has been associated with an increased risk of chronic disease. The incorporation of a biopolymer such as methylcellulose (MC) and silicon (Si), as a bioactive compound, in pork lard emulsions stabilized with soy protein concentrate (SPC) could offer a valuable opportunity to reduce on the one hand the animal fat content and on the other hand to limit its digestion and absorption in the development of healthy meat products. The objective of this study is to evaluate the changes in the structure and rheology of biopolymeric emulsions formulated with pork lard and enriched with Si, as well as their effect on fat digestibility during *in vitro* gastrointestinal digestion (GID).

Method:
Four emulsions containing 40% pork lard (SPC, SPC/Si, SPC/MC and SPC/MC/Si) were prepared with a final biopolymer (SPC and/or MC) concentration of 4% and 0.24% Si, and confocal laser microscopy, dynamic viscoelastic properties, and *in vitro* digestion (INFOGEST 3.0 method) were used to compare them.

Results:
The incorporation of either MC or Si are more effective than SPC alone in stabilizing the fat droplets of the emulsion and in reducing their subsequent changes as they pass along the gastrointestinal tract. The SPC-stabilized emulsion showed the highest degree of lipolysis at the end of the intestinal digestion (90 min), and when MC was incorporated together SPC (SPC/MC) a lower degree of lipid digestion was observed. Moreover, Si partially reduced fat digestion only when incorporated into the SPC-stabilized emulsion, while this effect was lost in SPC/MC/Si. This was probably due to its retention inside the matrix emulsion, which resulted in lower bioaccesibility than in SPC/Si. The flow behavior index (*n*) could be used as a predictive parameter of fat digestion, given the existing correlation with the absorbable fraction (free fatty acids + monoacylglycerides).

Conclusion:

Our results revealed that the use of MC or the inclusion of Si as a functional ingredient in SPC-stabilized pork lard emulsions offer interesting opportunities to elaborate soft-solid ingredients that can be used in the development of healthier meat derivates, based on the reduced pork lard digestion observed.

P1.2.139

Modeling the kinetics of color, lycopene, and β-carotene retention during isothermal processing of tomato sauce

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Modeling the kinetics of color, lycopene, and β-carotene retention during isothermal processing of a functional tomato sauce

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Abstract

The scope of Functionalized Tomato Products (FunTomP) project, funded by the European Union's Horizon 2020 PRIMA Programme under grant agreement No: 2032, is to reformulate traditional Mediterranean tomato products considering the current consumer trend of 'functional foods'. This study aimed to evaluate the traditional thermal treatment effect on color, lycopene, and β-carotene content of a High-Pressure Homogenized (HPH) tomato sauce formulation comprising 3.47 % tomato peel powder and 1.82 % Pea Protein powder. The product was subjected to temperatures ranging from 70 to 95 °C with exposure times of up to 20 minutes. The contents of lycopene and β-carotene were evaluated by High-Performance Liquid Chromatography (HPLC) on a C30 column. The color was quantified using the L, a, b system and Total Color Difference (TCD), was used to evaluate the total color change. A one-step non-linear regression was performed on all data using the Arrhenius model to obtain the kinetic parameters (E_a and k_{ref}) of degradation of studied parameters. The changes in lycopene followed a zero-order reaction ($R^2 > 0.86$) with estimated kinetic parameters Ea_{Lyc}=61.12±3.35 kJmol^{-1} and $kref_{Lyc}$=0.014±0.00 min^{-1} while the beta-carotene degradation followed a first-order reaction ($R^2 > 0.99$) with an $Ea_{\beta\text{-car}}$=50.58±3.09 kJmol-^{1} $kref_{\beta\text{-car}}$=0.034±0.001 min^{-1}. TCD, *L**, and *b** followed a reversible first-order model with estimated kinetic parameters Ea_{TCD} =502±38.99 kJ.mol^{-1} and $kref_{TCD}$=0.011±0.002 min^{-1} ($R^2 > 0.98$), Ea_L =358.9±29.3 kJ.mol^{-1} and $kref_L$= 0.035±0.005 min^{-1} ($R^2 > 0.99$) and Ea_b =390.8±29.8 kJ.mol^{-1} and $kref_b$=0.021±0.003 min^{-1} ($R^2 > 0.99$), respectively. The parameter *a** followed a two-fraction model, with one fraction less heat labile following a reversible first order (the decrease in the *a*-value till 80 °C) and a 2nd fraction following a first order

which denotes that the tomato sauce went from bright red to a much brown-red color when treated at temperatures above 85 °C.

P1.2.140

Effect of α-amylase and saliva incorporation ratio on the particle size distribution of bread boluses

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Aim:

Developing novel foods tailored for specific groups requires further understanding of the intricacies involved in food oral processing, particularly the crucial role played by saliva. Saliva facilitates food oral processing, bolus formation, swallowing, and sensory perception, in addition to contributing to oral health and phonation. Ageing, health affections and polymedication are among many causes of altering salivary production, modifying the food impregnation ratio, and in turn altering the characteristics of the bolus, swallowing, and quite possibly digestion.

Method:

In this *in vitro* work, using the AM^2 masticator apparatus, we investigated the effect of saliva quantity (from absence to hypersalivation) and enzymatic action on the particle size distribution (*PSD*) of boluses of Traditional French baguette.

Results:

According to previous *in vivo* data, a ready-to-swallow bolus of French baguette displays on average a d_{50} value (sieve size through which 50% of the bolus weight can pass) of 4.1 ± 0.7 mm, with saliva constituting 33% of the final bolus weight. Our *in vitro* results, performed under normal mastication, suggest that the saliva quantity in mouth is a key factor in determining both *PSD* and hydration of bread boluses during oral processing. Indeed, the absence of saliva in mouth led to deficient oral processing, forming bread boluses constituted by extremely big particles (~80% particles >7.1 mm) that likely cannot be swallowed safely, while on the contrary, an excess of saliva favoured an excessive breaking down of bread, leading to boluses constituted by smaller particles than those formed under healthy salivary conditions (d_{50} = 3.1 mm), having a higher salivary fluid content (+10%). On the other hand, the salivary fluid temperature (37°C) did not affect did not affect *PSD*, d_{50}, weight, or fluid content of bread boluses, however, the addition of human salivary α-amylase did, favouring particle size reduction.

Conclusion:

This research underscores the need of incorporating realistic salivary conditions when conducting *in vitro* studies. Moreover, it stresses the crucial role that food moisture could have in developing novel food textures tailored to individuals with compromised oral functionality (e.g., mastication, saliva production) while ensuring the formation of a cohesive food bolus that can be safely swallowed.

P1.2.141

Engineering Cellulose Properties to Increase its Colon Fermentability and Allow High Level Incorporation in Foods

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Aim:

Cellulose can be isolated from various raw materials and agricultural side streams and incorporation in food systems might help to reduce the dietary fiber gap in our diets. However, the physiological benefits of cellulose upon ingestion are limited to providing fecal bulk. It is barely fermented by the microbiota in the human colon due to its crystalline character and high degree of polymerization. These properties make cellulose inaccessible to microbial cellulolytic enzymes in the colon. Therefore, the aim of this study was to modify cellulose to increase its susceptibility to enzymatic hydrolysis and fermentation by colon microbiota. Furthermore, the techno-functional impact of incorporating modified cellulose during breadmaking was investigated.

Method:

Cellulose was amorphized and depolymerized using a combination of ball milling and acid hydrolysis. The enzymatic digestibility was determined by incubation with a cellulase enzyme blend and fermentability was investigated with *in vitro* batch fermentation experiments with pooled human fecal inoculum. Functionality in breadmaking was studied by incorporating (modified) cellulose at a substitution level of 5 to 20%, combined with ^{1}H-NMR and rheological measurements.

Results:

Cellulose samples with an average degree of polymerization of less than 100 anhydroglucose units and a crystallinity index below 30% were made from microcrystalline cellulose. This amorphized and depolymerized cellulose showed enhanced enzymatic digestibility. Furthermore, the short-chain fatty acid production during *in vitro* fermentation increased more than eight-fold due to the modification procedure and minimal fermentation degrees up to 45% were observed. However, this enhanced fermentation turned out to be highly dependent on the microbial composition of the fecal pool. Incorporation of cellulose during breadmaking at a 20 w/w% substitution level, showed that the microcrystalline cellulose decreased bread loaf volume with 36.4 ± 2.9%, while its modified counterpart reduced bread loaf volume much less (16.2 ± 1.9%). It was shown that the modified cellulose affected the water balance and gluten hydration in dough less than microcrystalline cellulose.

Conclusion:

This study showed the potential of engineering cellulose properties to increase its physiological benefits in humans and functionality in food processing.

P1.2.142

HealthFerm: Innovative Pulse and Cereal-based Food Fermentations for Human Health and Sustainable Diets

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Aim:

Fermented foods are consumed in Europe and across the globe. Especially in the past decades, fermented foods have been hailed for their nutritional and perceived health benefits. Yet little is known about the impact of fermentation on human health or how fermentation can be leveraged to enhance the use of sustainable plant-based raw materials. The new EU research project HealthFerm, a collaboration of 23 partners from across Europe, will shed light on this forward-looking topic. The project is funded through the European Union’s Horizon Europe Framework Programme for Research and Innovation and the Swiss government.

The HealthFerm project targets the societal and industrial transition from traditional to sustainable plant-based fermented foods by design for a healthy everyday diet. This will be achieved by (1) disentangling the interaction between food fermentation microbiomes, grain-based foods and the human gut microbiome and health and (2) using microbial resources and fermentation technology to develop healthy pulse- and cereal-based food and diets that cater to the desires and needs of EU citizens.

Method:

Drawing from a community science approach, HealthFerm will identify micro-organisms and metabolic pathways that may result in desired nutritional and health effects. The impact of microbial fermentation on raw materials will be examined at the molecular level. Fermentation technology will be used to develop novel, healthy and nutritious liquid and (semi-)solid foods based on legumes (pea and faba bean) and cereals (wheat and oat), with particular attention to the inclusion of side streams stemming from the processing of these grains. The impact of these foods on human health and the gut microbiome will be assessed in a number of intervention trials. Consumer acceptance of fermented foods, their technologies and their role in the transition towards a more sustainable healthy diet will be studied in different social contexts. Finally, extensive ecosystem building and training activities will contribute to HealthFerm’s strong participatory approach.

Conclusion:

HealthFerm is committed to transitioning towards a more sustainable global food system by setting new standards for individual, societal and planetary health through the increased and more resource-efficient use of plant-based raw materials in foods.

P1.2.143

Importance of Processing on the Quality of Fermented Foods: A Case Study on Sourdough Breadmaking

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Aim:
Fermented foods are consumed worldwide, making up 5 to 40% of the human diet. Fermented foods have been hailed for their perceived health benefits; however, except for yoghurt and other cultured dairy products, little concrete evidence exists for possible health benefits. This can be explained by the lack of intervention studies, but also by the enormous variety of fermented foods. In 2021, ISAPP published a consensus statement that fermented foods are "foods made through desired microbial growth and enzymatic conversions of food components". However, processing conditions will eventually determine the extent of microbial growth and enzymatic conversions and, consequently, the product quality. To demonstrate this, all wheat sourdough breadmaking procedures in the scientific literature were mapped and linked to bread characteristics in a systematic scoping review.

Method:
All scientific articles describing the study of wheat sourdough-type bread products (5080) were screened; 346 were included. Of those, 93 articles did not or inadequately describe the dough formulation. Of the remaining 253 studies, different parameters of the breadmaking process were summarised and analysed.

Results:
High variability in breadmaking procedures and bread quality parameters was noticed. The sourdough addition level varied between 0.5 and 100% of fermented flour on a total flour basis, and the bread dough fermentation time varied between 30 min and more than 20 h. In most (73%) recipes, baker's yeast was included at levels higher than 0.2%. The diversity in processing was linked to a large variety in specific loaf volume and pH, which ranged between 1.02-6.43 ml/g and 3.2-6.1, respectively.

Conclusion:
The extent of fermentation, including the type and extent of conversion of food constituents, the metabolites produced, and the resulting changes in textural properties, ultimately determine the sensory and nutritional quality of fermented foods. In the case of sourdough bread, comparing the extent of fermentation remains difficult, as processes are not always described. Moreover, not all products meet the expectations of sourdough-type bread concerning the specific volume and pH. With this presentation, we want to contribute to the dialogue concerning the legislation of sourdough-type bread and the research into the health benefits attributed to them.

P1.2.144

Co-creating new legume-based products for children

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Aim:
Childhood obesity is a health issue attributed mainly to the overconsumption of products with high fat and sugar contents. Increasing the consumption of legumes is one of the WHO recommendations for children´s diets. They are consumed in Mediterranean countries, but mainly as traditional spoon dishes and usually not much liked by children. Innovation applied to create new pulse-based products for children can be a successful strategy for improving their diet. The objective of this work was to explore the potencial of co-creation (involving consumers in the early stage of product development) to develop new legume-based products.

Methods:
First, to identify barriers and needs for a healthy diet, focus group sessions were carried out with the participation of parents of children (6-12 years old) and pediatricians and nutritionists. Then, two creative sessions were carried separately with 1) children and 2) parents and food developers to generate ideas for new products. In these sessions, different creative activities were done: emphatic design, analogies and brainstorming to generate new prototypes of products. The activities were adapted for children.

Results:

The lists of barriers for eating healthy food and the needs of children were first obtained. According to parents, the association of healthy food with boredom, lack of time of parents, healthy food prices and low satiating capacity are the main barriers. On the other hand, they indicated that children need to eat more fibre, reduce the consumption of industrial bakery and animal protein and increase the consumption of more natural products and plant-based proteins. In the co-creation, children engaged with the creative activities and provided new ideas for products made with legumes (chickpeas and lentils). Familiarity, hedonics and funny products were the aspects that children considered when designing the product. For several of the created product, children also provided creative ideas about the name, format and images that could be attractive. Parents and developers creativity sessions provided other prototype ideas focused more on the healthiness and convenience of the product.

Conclusion:
Co-creation activities including different players: children, parents, nutritionists and food developers are key for finding new concepts for healthy food that children accept and include in their diet.

P1.2.145

Unlocking the potential of brown seaweeds: structural and rheological insights for innovative food design

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Aim:
The search for sustainable food sources is increasing worldwide due to demographics and challenges associated with climate change. The interest to use seaweed in food products has raised in the last decade, partially due to their nutritional value, based on their content of dietary fibre, unsaturated fatty acids and protein. However, in order to utilise seaweeds as a whole ingredient, a fundamental understanding of the relationship between processing, cell wall structure and functional properties is required. In particular, knowledge regarding rheological properties relevant for manufacturing, food texture and nutrients bioaccessibility is needed. Brown seaweeds are a rich source of dietary fibre, with the presence of several non-digestible polysaccharides including laminarin, fucoidan and alginate. Our aim is to unravel the molecular features that determine the disassembling of brown seaweeds cell walls during manufacturing and in the gastrointestinal tract.

Method:
We investigated the impact of physical treatments, such as cooking in water and high pressure homogenisation (HPH), on the rheology of dispersions of two brown seaweeds: *Laminaria digitata* and *Saccharina Latissima*. A range of physicochemical analytical techniques were applied, *i.e* small amplitude oscillatory shear, confocal scanning laser microscopy and small angle X-ray scattering, to determine the dynamical changes occurring in wall composition and, their role on the flow behaviour and viscoelastic properties of the dispersions. Furthermore, the impact of cell wall structure on the viscosity of simulated gastric and intestinal fluids was evaluated by *in vitro* digestion experiments.

Results:
Results showed that high pressure homogenisation, as an example of intense mechanical treatment, was the main parameter affecting the rheological behaviour of the dispersions, whilst the thermal treatment and botanical origin had less impact. Flow behaviour and viscoelastic properties were explained based on the polysaccharide composition, nano- and microstructure as well as particle size distribution of the dispersions.

Conclusion:
This research gives insights into the exploitation of brown seaweeds in complex fluids and soft materials for food, pharma and other technological applications. Furthermore, it contributes to establish a toolbox to better understand seaweeds in the context of food science, which we are currently expanding to other species of green and red seaweeds.

P1.2.146

Watermelon rind pectin as a new source of ingredients with enhanced digestibility and prebiotic effects

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Aim:

Growing consumer interest in health and quality of life has led to increased demand for natural products and functional dietary ingredients. However, further research and development are needed to improve the efficiency of functional food ingredients. Watermelon rind is a potential source of pectin with distinct structural and functional applications, compared to conventional citrus or apple pectin. This study investigates modifications to pectin structure and composition during digestion and the relationship between pectin structure and prebiotic capacity.

Method:

Two types of watermelon rind pectin, with high and low branching degree, were extracted and compared to citrus pectin and arabinogalactan. The in-vitro digestion process was followed by colonic fermentation to study potential prebiotic capacity. Different aliquots from the digestion process were collected and analysed for Mw distribution, carbohydrate composition, and rheological properties. Changes in the microbiota (16S rRNA sequencing; qPCR) and production of short chain fatty acids (SCFA) were evaluated to study the prebiotic potential during the colonic phase.

Results:

Extracted pectin remained mostly intact during gastrointestinal digestion, small changes in specific samples being attributed to disruption of non-covalent interactions. Pectin extracts of watermelon rind had a higher impact in promoting the growth of Bacteroides and Bifidobacterium, as well as in promoting the production of SCFA, compared to citrus pectin. Pectin utilization and a prebiotic effect was more patent in pectin with higher branching degree. Propionate production was positively correlated to the growth of Bacteroides, and this in turn with higher abundance of arabinogalactan in the pectin samples.

Conclusion:

This study highlights how different pectin structures can define their utilization by the colonic microbiota, and the potential of watermelon rind pectin as a functional dietary ingredient with prebiotic properties.

P1.2.147

Effect of drying on physicochemical properties of avocado (Persea americana) pulp and by- products

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Aim:

Avocado agroindustrial residues generated during the commercial processing accounting for up to 30% of the total weight of the fruit and are highly perishable. The aim of this work was to examine the effect of hot air drying (HAD) and vacuum drying (VD) on physicochemical properties of the pulp of avocado and its by-products (peel, seed, seed coat and paste).

Methods:

In this work, drying of avocado pulp, peel, seed, seed coat and paste was carried out by HAD under 60°C at air velocity 1 ms^{-1} and VD under 60°C at vacuum pressure of 100 mbar. The effects of vacuum drying and hot air drying on physicochemical properties (water and oil binding capacity, total phenolic content (TPC) and antioxidant capacity (DPPH and ABTS) were investigated.

Results:

The results obtained show that vacuum dried avocado seed coat has 100% higher water binding capacity than other avocado parts studied, while hot air dried avocado peel has the highest oil binding capacity. The results determined by the

Folin-Ciocalteu method indicate that avocado peel can be considered as a promising source of phenolic compounds, since the highest TPC (38.73 mg gallic acid equivalents per gram (dry basis) was found for vacuum-dried avocado peel. The evaluation of antioxidant properties of avocado pulp, peel, seed coat and seed also revealed the highest effective concentration against DPPH radicals (84.07%) and the highest antioxidant ABTS capacity (18.46 mmol Trolox per gram (dry basis) for avocado peel.

Conclusion:

Physicochemical and antioxidant properties were used to evaluate the quality of the dried avocado by products. The obtained results showed that vacuum dried avocado peel is one of the most important by-products of avocado processing, and can be considered as a potential source of functional ingredients that can be used either in food supplements or in food products.

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P1.2.148

Effect of drying process on physicochemical properties of different pumpkin fractions (Cucurbita maxima)

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Aim:

Pumpkin is suitable for processing into various products due to its excellent nutritional profile. It is recommended to include it in the daily diet because it is rich in various bioactive compounds and functional ingredients. After harvesting, pumpkin has a shelf life of only a few months. To extend the shelf life and allow consumption of pumpkin throughout the year, drying methods are often used. Different drying methods can change the quality of the dried products. The aim of this study was to investigate the effects of two different drying process (vacuum and convective drying) on some quality characteristics (colour, phenolic content, antioxidant activity) and technological properties (rehydration capacity, oil and water absorption) of kabocha pumpkin (*Cucurbita maxima*) fractions (peel, pulp and seeds).

Method:

The fractions of kabocha pumpkin (peel, pulp and seeds) were dried in vacuum dryer (60 °C, 100 mbar) and convective dryer (60 °C, air velocity 1 ms^{-1}). The colour parameters of the pumpkin fractions were determined instrumentally before and after drying. Total phenolic content was determined spectrophotometrically by the Folin-Ciocalteu method, and antioxidant activity was determined using the DPPH and ABTS assays. Rehydration capacity was determined using method of Rojas and Augusto (2018) while water and oil absorption capacity by the method of Roongruangsri and Bronlund (2016).

Results:

Total phenolic content and antioxidant activity were higher in the peel than in the seeds and pulp. Vacuum drying better preserved total phenolics in pumpkin pulp, while convective drying better preserved in pumpkin peel. In addition, the results showed higher antioxidant activity after vacuum drying. The total colour difference (ΔE) is higher in the peel (ΔE=17.65) and seed (ΔE=11.00) after convective drying than after vacuum drying. The highest rehydration capacity had the pumpkin pulp (7.30) after vacuum drying and the lowest had the pumpkin peel after convective drying. The peel had the highest oil absorption capacity after vacuum drying, while the water absorption capacity was the highest for the pulp after convective drying.

Conclusion:

It can be concluded that vacuum drying is a promising process to maintain the quality and technological characteristics of kabocha pumpkin fractions.

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P1.3.01

Influence of Frupica® and Domark® EVO commercial formulations on the quality of Airén wines

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Aim:

The influence of mepanipyrim and tetraconazole-based commercial formulations on the volatile composition and aromatic profile of Airén-based wines was evaluated. In addition, the impact of both fungicides on the oenological parameters was analysed.

Method:

In triplicate, different vinification assays were performed in the experimental cellar using Airén grape must inoculated with the yeast *S. cerevisiae* EC1118™. The commercial formulations Frupica® (mepanipyrim 50 % w/w) and Domark® EVO (tetraconazole 12.5 % w/v) were separately added to the grape must at concentrations corresponding to 2 mg/kg of mepanipyrim and 0.5 mg/kg of tetraconazole. The aromatic composition of the final wines was analysed by gas chromatography using flame ionisation and ion trap mass selective detectors. Oenological parameters of the final wines (alcohol content, total and volatile acidity, pH, malic and lactic acid content, glucose/fructose ratio and dry extract) were determined in an Enological Multiparametric Analyser Bacchus FTIR-Vis-UV MultiSpec.

Results:

Most of the oenological parameters analysed (alcoholic degree, pH, dry extract, malic and citric acid content) were lower for the fortified wines than the control wine (without fungicides). On the contrary, the volatile acidity increased with both commercial formulations. Concerning the volatile composition, the content of higher alcohols decreased by 22 % after the addition of Domark® EVO. In comparison, the concentration of acetate esters increased by 20 % in those wines fortified with Frupica®.

Conclusion:

The changes observed differed depending on the fungicide applied to the must. However, in general, the addition of Domark® EVO has a greater impact on wine quality.

P1.3.02

Altered ntestinal conditions in lactating infants with cystic fibrosis reduce digestibility of frozen-tawed breast milk

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AIM: Low-temperature preservation of breast milk is a common practice at home and in milk banks at hospitals. However, limited information exists about the impact of refrigeration (R) and freezing-thawing (FT) on BM digestibility under gastrointestinal conditions of healthy infants such as those with cystic fibrosis (CF) undertaking supplementation with pancreatic enzymes. The aim of this study was to assess the impact of R and FT on fat and protein hydrolysis and liposoluble vitamins bioaccessibility of fresh, R and FT breast milk

METHOD: the breast milk sample was obtained from a volunteer. An aliquot was refrigerated at 4 ºC during 4 hours and another was frozen at -20 ºC followed by thawing at room temperature. Proximal composition was determined in the fresh milk sample and particle size distribution in all three samples (fresh, R and FT). All the samples were subjected to in vitro digestion models mimicking both healthy infant (HI) and CF infant conditions (reduced intestinal pH and bile salts concentration, and different doses of pancreatic enzyme supplement). Lipolysis, proteolysis and liposoluble vitamins bioaccessibility were determined at the end of the gastric and the intestinal stages. (Enzymapp Project, AICO/2021/015)

RESULTS: a significant effect of FT on increased fat globule particle size was obtained compared to R breast milk. These changes were related to a negative impact of FT process on reduced extents of lipolysis (up to 18%) and proteolysis (up to 28%) and vitamins A and E bioaccessibility (up to 12 and 10%, respectively) compared to R breast milk, only in the context of CF, but showed no significant differences in the simulation of the healthy conditions. Finally, both lipolysis and especially proteolysis were significantly lower in the CF intestinal conditions than in the healthy, but with the adequate pancreatin supplement dose (25 LU/ml of milk), lipolysis was able to reach equivalent extents (55%) than in the healthy scenario.
CONCLUSION: breast milk is the only source of energy and nutrients for the lactating infant during the first months of life, so in order to prevent from losses of nutrient absorption, lactating infants with CF should not be fed with frozen-thawed breast milk.

P1.3.03

High Hydrostatic Pressure for Inactivation of E. coli O157:H7 ATCC 43888 in Tomato Juice

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Aim
Tomatoes and tomato products are considered highly nutritious due to abundance of phrenols and carotenoids. High hydrostatic pressure (HHP) processing is a non-thermal pasteurization method proposed as an alternative to conventional pasteurization methods. The main objective of this study was to investigate the effects of high hydrostatic pressure (HHP) processing on the activity of E. coli O157:H7 (ATCC 43888) in tomato juice as an alternative to conventional pasteurization carried out at 94°C for 30 min.

Method
Juices obtained from Roma variety tomatoes were used as the inoculated media. Approximately 108 cfu/mL of E. coli O157:H7 (ATCC 43888) was inoculated. Conventional pasteurization took place at 94°C for 30 min in a hotwater bath, and HHP experiments were carried out at 150 and 450 MPa for 5 and 25 min at 25°C were conducted. Enumeration of the samples were conducted using MacConkey agar (selective) and tryptic soy agar (non-selective) supplemented with 0.6% of yeast extract. Selective media was incubated for 36-48 and non-selective media was incubated for 18-24 hours. Counts from selective media were used as an indication of sublethal injury.

Results
Conventional pasteurization provided up to 8 log reduction in bacterial load. Impact of pressure on microbial viability was found significant ($p < .001$). 150 MPa treatments led to approximately 2 and 5 log reduction after 25 min treatments in non-selective and selective media, respectively. 450 MPa treatments offered approximately 7 log reduction in viable cells after 25 min on non-selective medium, number of cells observed in selective media were below the detection limit. Five min treatments lead to 4 and 6 log reduction in microbial counts in non-selective and selective media, respectively.

Conclusion
HHP treatment lead to satisfactory reduction in viable cells. Microbial inactivation by 450 MPa/25 min treatments were satisfactory, while log reductions from 5 min treatment were below acceptable limits. Log reductions from 150 MPa treatments were insufficient.

P1.3.04

Listeria innocua inactivation inoculated on dry ham bricks by storage and by High Pressure Processing

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Aim:

The aim of this study was to calculate the inactivation of experimentally inoculated *L. innocua* (Li)*,* as a surrogate of *Listeria monocytogenes,* on cured dry ham bricks. *L. monocytogenes* is a foodborne microorganism causing listeriosis in immunocompromised individuals. *L. monocytogenes* remains a significant public health threat, is well adapted to a wide range of conditions, and could be persistent in processing environments. Ready to Eat (RTE) food is involved in outbreaks and meat products are the major associated food vehicles. Even if cured pork products have a high level of microbiological safety, due to the low water activity (a_w) reached during the seasoning (a_w<0.92), the presence of *L. monocytogenes* on dry-cured ham is described.

Method:

Li inoculum was prepared using mixed strains. Two batches of four RTE deboned ham bricks were considered. Inoculum was distributed on the ham surface (7 log CFU/cm^2). The Ham surface was divided in four areas and inoculated. Inactivation was obtained by: A) prolonged storage (30 days at 4 °C); B) High Pressure Processing (HPP) treatment (600 MPa for 5 min). Two bricks follow the A treatment and two the B one. Li concentration on meat from two areas at time 0 was determinate (N0) and from the others two areas after A and B treatment (N). Li concentration and a_w were determinate by ISO standard methods. Results are expressed as the average of log (N/N0) CFU/g (means ± standard deviation) of two technical replicates. Significance was evaluated when the p-value was lower than 0.05 by Student's t-test.

Results:

The a_w of ham bricks was 0.906±0.005 after inoculation and it decreased 0.894±0.014 after treatment A, while no significant decreases (p>0.05) were observed after treatment B (0.902±0.002). Li inactivation was 1.5 ± 1 log CFU/g and 2.9 ± 1.2 log CFU/g for treatment A and B, respectively.

Conclusion:

Even both treatments can reduce Li concentration, HPP seems a faster method. The standard deviation from inactivation data underlines the heterogeneity of the results on a complex food matrix. Results can help Food Business Operators and Competent Authorities in risk analysis.

P1.3.06

Fermentation to develop new almond plant-based products

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[1]Ainia

Aim

Fermentation is a process widely used since ancient times to improve the sensorial, nutritional, and microbiological quality of foods. Considering current food demands focused on natural, vegetal, and sustainable,fermented plant-based foods are presented as an interesting way to meet these demands. Hence, this research aimed to evaluate how the fermentation process affects to physicochemical, microbiological, nutritional, and organoleptic characteristics of a plant-based food developed from almonds.

Method

The plant-based food was obtained from raw almonds by lactic acid fermentation. Firstly, almond seeds were grinded and mixed with water at a 1:0,4 ratio (w/v) and with salt (0,1 % w/w). After homogenization, the mixture was thermally treated. Then, fermentation was carried out with *L. lactis* and *L. cremoris* at 30ºC for 8h. Finally, the physicochemical, microbiological, nutritional, and organoleptic characteristics of this food product were evaluated.

Results

The lactic-acid fermentation caused a pH decrease up to values of 5.5 in line with both the lactic acid generation, which increased during the fermentation, as well as with the reduction of the sucrose level throughout the whole process. Excellent bacterial growth was also confirmed with the high viable cell counts reached after 8 hours of fermentation (9 Log CFU/g), evidencing that this food matrix was a good substrate for the starter culture viability. Regarding the nutritional profile, the new fermented product exhibited a total protein content near 18%, a lipid content of 41%, mainly composed of unsaturated fatty acids, considerable levels of dietary fiber and carbohydrates (both 5%), with a moisture content of 28%, and a low presence of sodium (0.03%). Furthermore, this plant-based food showed good acceptability (4/5) since all the sensorial parameters studied were positively scored, and demonstrated appropriate organoleptic characteristics.

Conclusion
Using almonds as raw material, lactic acid fermentation can be used as a strategy to develop new plant-based products with good nutritional and sensorial profiles as an alternative to foods of animal origin according to consumers' current demands.

P1.3.07

Assesing the probiotic potential of Lactiplantibacillus plantarum on colonic microbiota in children with cystic fibrosis

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AIM: altered intestinal conditions, together with the frequent antibiotic administration, in children with cystic fibrosis (CF) are the main responsibles of the colonic dysbiosis found in these subjects., Dysbiosis in CF is characterized by increased levels of *Acidaminococcus* and *Megasphaera*, among other pathogens, and reduced levels of beneficial bacteria. Currently, scarce evidence on probiotics supplementation to revert dysbiosis in CF is available, so the present study aimed to assess the potential of *Lactiplantibacillus plantarum* (DSM22266) as a dysbiosis reverter.
METHOD: a dynamic *in vitro* colonic simulation system (SHIME®) was set up with bioreactors simulating the proximal colon conditions, and the faecal inoculum from an 8-year-old child with CF was incorporated. After a 2-week stabilization period, *L. plantarum* was administrated daily (10^8 CFU/mL) for 3 weeks + 2 weeks of post-treatment. Two aliquots were taken at each period to analyse the metabolites (SCFA, lactate, and ammonia) and microbiota composition by sequencing the V3-V4 regions of the 16S rRNA. ANOVA analyses were applied to assess differences in abundance between control/baseline microbiota, and after-treatment and post-treatment. Pearson correlations between bacterial genera and metabolites were also explored.
RESULTS: the supplementation with *L. plantarum* showed a maximum effect after 20 day of treatment. An increase in *Bifidobacterium* genus (from 0.5 to 2.5% relative abundance) was documented during the treatment period, while it decreased during the post-treatment up to baseline values. *Acidaminococcus* sharply decreased at supplementation onset (from 16% to 0.06-0.03%) and was maintained in negligent values in the post-treatment. *Megasphaera* also decreased (6 to 2-1%) but returned to baseline value after supplementation. The SCFA acetic, propionic, and butyric acids showed no significant changes over the study stages. However, the branched-chain isovaleric and isobutyric acids, which are produced by species from *Megasphaera* genus, showed a significant decrease during treatment (from 5.76 baseline to 0.66-3.24mM during treatment), which was correlated with *Megasphaera* relative abundance (R^2=0.579, p=0.01). Additionally, the increase in *Bifidobacterium* was correlated (R^2=0.79, p=0.001) with increased lactate (50.21 µM to 107-110 µM).
CONCLUSION: the assessed *L. plantarum* strain showed beneficial effects on colonic microbiota and metabolic activity. Further clinical studies should confirm these findings.

P1.3.08

Dry fermented meat analogues: microbial community and starter proliferation

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Aim: Manufacture of dry fermented meat analogues is a novel process where traditional ingredients are replaced by sustainable alternatives. The most common substitutes are texturized plant proteins and vegetable fats. This substitution of ingredients may affect the autochthonous microbiota and also the proliferation of the inoculated microbial starters. In this study we have explored the microbial community in dry fermented sausages, replacing animal meat and fat with texturized protein and coconut fat in different proportions.
Methods: Hybrid sausages where prepared replacing 50% of meat protein and fat with texturized pea protein and coconut oil and adding or not adding oat flour. Sausages prepared using a traditional were used as control of the process. Batter was inoculated with bacterial commercial starter TRADI 302, whereas casings were soaked in a bath containing yeast *D.*

hansenii. Fermentation and drying were done at controlled temperature and relative humidity until a reduction in weight of 35-40% was reached. Samples were taken at the beginning of the process, and at the fermentation and drying stages. Microbial counts were done on PCA, MRS, AMS, VRBGA and RB. Analysis of microbiota was done directly, without culturing, from the sausage samples. Bacterial community was explored by sequencing ribosomal regions V4-V5 16S rDNA, and fungal community by sequencing of ITS1. Bioinformatics analysis was carried using mothur and following the MiSeq SOP.
Results: Lactic acid bacteria counts were slightly higher in the hybrid sausages than in the control. The decrease of staphylococci during the curing stage was larger in the hybrid sausages. Yeast and fungi counts at the fermentation and curing stages were much higher in the control than in the hybrid sausages. Enterobacteria were present in very low numbers and only at the initial stage. Comparable results were obtained from the analysis of the microbial community using MiSeq sequencing.
Conclusions: Manufacture of dry fermented meat analogues substituting 50% of the animal meat and fat with sustainable alternatives did not have a significant effect the proliferation of the bacterial starter. However a selection of new *D. hansenii* starters seems to be necessary to ensure the colonization of the sausage surface.

P1.3.09

Bacterial inactivation potential of essential oil nanoemulsions on artificially contaminated cherry tomatoes

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Aim: Cherry tomato is a fleshy berry that is highly perishable and prone to microbial spoilage. The possible presence of pathogenic bacteria, such as *Escherichia coli*, makes this product also a potential health hazard to consumers. Due to the sensitivity of tomatoes to high temperatures and mechanical processes, their safety is most often ensured through the application of a washing step. Commercial washes contain chemical disinfectants, which can introduce an additional consumer hazard. Hence, there is a pressing interest for the development of novel decontamination strategies for this product. In this sense, antibacterial activities of plant essential oils (EOs) are well documented. Although their hydrophobicity poses a main challenge for their use at an industrial scale, their application as a nanoemulsion has proven to improve the effect of EO in other cases. Thus, the aim of this research was to assess the decontamination effect of nanoemulsified oregano and rosemary EOs against *E. coli*, as a potential washing solution for cherry tomatoes as an alternative to commercial washes based on chlorine compounds.
Method: Cherry tomatoes were purchased from a local market and rinsed with water to eliminate impurities. They were artificially contaminated by dipping them into an *E. coli* O157:H7 suspension (~10^7 CFU/mL) for 15 min and left to airdry under sterile conditions. Washing solutions of varying concentrations of oregano or rosemary EOs nanoemulsions (0.33% to 10% EO in water) were prepared. Experiments were also done with distilled water and a commercial chlorine solution for fresh produce. The effect of the washing solution was evaluated by immersing three tomatoes (~30 g) in 300 ml treatment solution for 15 min. Microbiological determinations were performed by homogenizing the tomatoes in 270 mL peptone water using a masticator. Bacterial counts were performed by serial dilution and enumerated on Luria Bertani agar media.
Results: Every washing solution based on oregano and rosemary EOs was more effective than water for the inactivation of *E. coli*. The highest concentration of oregano tested (10%) reduced the concentration of *E. coli* by 3 log CFU/g, being, at least, equivalent to the effect of commercial (chlorine-based) solution. Compared to oregano, rosemary nanoemulsions showed less reduction of *E. coli*. Lower EO concentrations resulted in an intermediate inactivation of *E. coli*, being lower than the commercial wash but higher than water.
Conclusion: Washing solutions based on nanoemulsified oregano and rosemary EOs can be an alternative to commercial disinfectants for the inactivation of *E. coli*. Nonetheless, research is still needed to evaluate the feasibility of this technology due to the strongly aromatic properties of EOs. In this sense, the results of this research will be the basis for a stochastic risk assessment model that will evaluate the minimum EO concentration that provides an acceptable level of protection.

P1.3.10

Pathogenicity of opportunistic bacteria from ready-to-eat food

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Aim:
This study aimed to assess the antimicrobial susceptibility, enterotoxicity, biofilm-forming capability and virulence markers involved in the process as well as relationship between the biofilm-forming capability and the presence of IS256/IS257 or hemolytic activity in coagulase-negative staphylococci (CoNS) isolated from ready-to-eat food from bars and restaurants.

Method:
Strains were isolated from 198 food samples. One hundred and eighteen CoNS strains were tested to five different types of classical enterotoxins (*sea, seb, sec, sed* and *see*) and the toxic shock syndrome toxin-1 (*tsst*-1) as well as to supertoxin-like genes. PCR-positive isolates were then tested using immunoenzymatic methods (SET-RPLA, Vidas SET 2) for toxin expression. CoNS were also subjected to biofilm and slime production, as well as biofilm-associated genes (*icaA, icaD, icaB, icaC, eno, bap, bhp, aap, fbe, embP and atlE*), the insertion sequence elements IS256 and IS257 and hemolytic genes. Phenotypic and molecular mechanisms of antibiotic resistance were also analyzed.

Results:
Sixty-seven CoNS isolates (78.8%) were resistant to at least one antibiotic tested, and 37 (43.5%) were multidrug resistant (MDR-CoNS). Moreover, CoNS strains contained genes conferring resistance to beta-lactams [*mec*A (29.4%); *bla*Z (84.7%)], aminoglycosides [*aac*(60)-Ie-*aph*(200)-Ia (45.9%); *aph*(200)-Ic (3.5%)], macrolides, lincosamides and streptogramin B-MLSB [msrA/B (68.2%); *erm*B (40%) and *mph*C (4.7%)], tetracyclines [*tet*K (31.8%); *tet*M (16.5%) and/or t*et*L (2.35%)]. We also found the *fus*B/C/D (17.6%) and *vga*A gene in 30.6% of isolates. In three linezolid resistant strains (2 *S. epidermidis* and 1 *S. warneri*), mutation was detected, as demonstrated by L101V and V188I changes in the L3 protein amino acid sequences. We confirmed the presence of staphylococcal enterotoxins in 72% of them, most frequently found enterotoxin-like genotype was *ser- selu*. The results showed that the most prevalent determinants responsible for the primary adherence were *eno* (57.6%) and *aap* (56.5%) genes. The *ica*ADBC operon was detected in 45.9% of the tested strains and was correlated to slime production. Among the genes encoding for surface proteins involved in the adhesion to abiotic surfaces process, *atl*E was the most commonly (31.8%) followed by *bap* (4.7%) and *bhp* (1.2%). The MSCRAMMs, including *fbe* and *embp* were detected in the 11.8% and 28.2% of strains, respectively. A high occurrence of genes involved in the hemolytic toxin production were detected, such as *hla_yiD* (50.6%), *hlb* (48.2%), *hld* (41.2%) and *hla_haem* (34.1%).

Conclusion:
The results of the present study revealed an unexpected occurrence of the genes involved in biofilm production and the high hemolytic activity among the CoNS strains, isolated from RTE food, suggesting the need to be included in the routine microbiological analyses of food. Although no production of enterotoxins was detected in the CoNS, which means that their possible role in the epidemiology of food-borne diseases is minimal, the data demonstrated that the toxigenic capacity of the CoNS should not be ignored, and that this group of microorganisms should be continuously monitored in food. The high frequency in RTE food of MDR-CoNS including methicillin-resistant (MR-CoNS) strains constitutes a direct risk to public health as they increase the gene pool from which pathogenic bacteria can pick up resistance traits.

P1.3.12

Lactate production from sucrose by the methylglyoxal pathway using engineered E. coli as whole-cell biocatalyst

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Aim:
In this work, the expression of a saccharase A from *Bacillus subtilis* (SacA) on the cell surface of *Escherichia coli* WDHA (Δ*hycA*, Δ*ldhA*) WDHFAK (*ΔhycA*, Δ*frdABC*, Δ*ldhA*, Δ*ackA*), and WDHFAKM (Δ*hycA*, Δf*rdABC*, Δ*ldhA*, Δ*ackA*, Δ*mgsA*) by the autodisplay adhesin involved in diffuse adherence system (pAIDA) was carried out with the purpose to confer the ability to *E. coli* strains to degrade sucrose and produce lactic acid by the methylglyoxal pathway.

Method:
E. coli strains were transformed with the plasmid pAIDA_SacA and a set of anaerobic batch cultures were carried out in 120 mL serological bottles using 10 g/L of sucrose and 1 g/L of glucose as carbon sources. The bottles were incubated at 37°C and shaking 200 rpm. Experiments were performed by triplicated. Samples of 1 mL were taken at different times during fermentation; then cells were separated by 5 min centrifugation at 13,000 rpm. The supernatants were filtered through 0.22 µm membranes. Cell growth was measured using a spectrophotometer at 600nm. Concentrations of sucrose and

soluble metabolites such as lactic acid, succinic acid, acetic acid, formic acid, and ethanol were analyzed by liquid chromatography.

Results:
E. coli strains harboring the pAIDA_SacA consumed sucrose and lactic acid was the main metabolite. *E. coli* WDHA had the highest production with 9.7 ± 0.15 g/L with a yield of 0.88 ± 0.02 g(lactate)/g(sucrose). When the gene encoding for the methylglyoxal synthase (mgsA) of *E. coli* was deleted to avoid the conversion of DHAP to methylglyoxal, the lactic acid production was abolished.

Conclusion:
Since the gene *ldhA* coding the lactate dehydrogenase A was deleted in some strains and they still produced lactate, we confirmed these strains produced lactate by the methylglyoxal pathway instead of pyruvate reduction. The expression of hydrolytic enzymes such as saccharase on the cell surface of metabolic engineered *E. coli* promises to be an economic and efficient process for lactate production from sucrose.

P1.3.13

Protein Extraction from Stinging Nettle Leaves: Comparison of Novel Approaches to Conventional Extraktion

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Aim: This study aimed to compare the efficiency of protein extraction methods from stinging nettle leaves. Focusing on the application of pulsed electric fields (PEF) combined with proteolytic enzymes, extraction with Fusarium spp. fermentation and conventional extraction. The objective was to evaluate the effectiveness of each method in terms of protein yield and potential applications in the food industry.

Method: Stinging nettle leaves were treated with three different extraction methods: (1) PEF treatment combined with the use of proteolytic enzymes, (2) fermentation with Fusarium spp. to extract proteins and (3) conventional extraction through alkaline solubilization and acid precipitation. The protein extraction processes were optimized, and the extracted proteins were analyzed for their yield, and functional properties.

Result: The PEF and proteolytic enzymes extraction method yielded a higher protein content (75,9% ± 1,5) compared to the extraction through Fusarium spp. Fermentation (54,5% ± 1,4). With the conventional method the proteincontent reached 53,8% ± 0,4 The combination of PEF and proteolytic enzymes efficiently disrupted the plant cells, resulting in enhanced protein release. Additionally, the proteins demonstrated functional properties suitable for various food applications, such as solubility and geling abilitys in a joghurt. In contrast, the proteins obtained from Fusarium spp. fermentation showed a slightly lower protein yield and differed strongly in the sensory profile.

Conclusion: This study highlights the comparison of three protein extraction methods from stinging nettle leaves, specifically comparing PEF and the use of proteolytic enzymes, extracting via fermentation by Fusarium spp and conventional methods. The PEF and proteolytic enzymes approach demonstrated superior protein extraction efficiency, resulting in higher protein content. The extracted proteins exhibited functional properties suitable for diverse food applications. While the Fusarium spp. fermentation method also yielded proteins, its efficiency and sensory profile were lower than the PEF and proteolytic enzymes method. This study provides valuable insights into the selection of appropriate protein extraction techniques and highlights the potential of PEF and proteolytic enzymes for efficient protein extraction from plant sources. Future research can focus on further optimizing the extraction conditions, the sensory aspects, improve the colour intensity and evaluate the sustainability aspects of these methods.

P1.3.14

Unraveling The Influence of In Vitro Colonic Fermentation of Wholemeal Rye Bread on Gut Microbiota

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Aim: Wholemeal rye bread is an excellent source of dietary fiber, containing 13.7g/100g[1]. The major non-starch polysaccharides are arabinoxylan, fructan, cellulose, and β-glucan[2]. Growth of health-related microbial species (*Lactobacillus* and/or *Bifidobacterium*) is promoted by fiber[3]. The aim is to evaluate the modulation of intestinal microbiota during a colonic fermentation replicating a regular intake of a wholemeal rye bread.

Method: *In vitro* fermentation assay during five days was performed using the dynamic multi-compartmental digestion system simgi® (CIAL-CSIC) with 80 g of bread. Fermentation liquids were collected at 0, 24, 48, 72, 96, and 120h from the ascending, transverse, and descending colon compartments (AC, TC, and DC, respectively). The microbiota composition was determined by sequencing the V3-V4 region of the 16S rRNA gene via PCR amplification.

Results: In AC at 0h, the majority phylum was Firmicutes (38.8%), followed by Bacteroidetes (29.6%), Proteobacteria (17.1%) and Actinobacteria (0.3%). At 120 h, an increase of Firmicutes was observed, particularly *Lactobacillus* (88.6%), and Actinobacteria (5.8% of *Bifidobacterium*). The remaining phyla did not exceed 5%. In TC and DC at 0h, the phyla predominance was as follows: Bacteroidetes (39.7 and 46.6%), Firmicutes (31.5 and 33.1%), Proteobacteria (12.4 and 4.9%) and Actinobacteria (0.9 and 0.2%). At 120 h, the phylum Firmicutes reached abundances of 93.1 and 91.9%, due to the increase in *Lactobacillus*. Abundances of 5.8 and 6.0% in Actinobacteria (*Bifidobacterium*) were reached, while the rest of the phyla did not exceed 2%.

Conclusion: This study provides new inshights into the use of wholemeal rye bread as a substrate for gut microbiota, positively modulating the proliferation of species considered potentially beneficial for gut health such as *Lactobacillus* and *Bifidobacterium*.

References: [1]Makran et al., 2019; [2]Åman et al., 2010; [3]Ounnas et al., 2016.

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P1.3.15

Gastrointestinal microbiota and diet in relation to diagnostic parameters

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Aim:

Assessment of the dietary intervention and its impact on the change in the intestinal microflora, causes unsealing of the intestinal mucosa after four weeks of dietary intervention with FODMAP diets and a diet based on NICE recommendations in children with functional abdominal pain.

Method:

The study was a randomized intervention and a double-blind test. 32 children were examined, patients of gastroenterological counseling center of the Provincial Specialist Children's Hospital in Olsztyn. Children were 4–12 years old, functional abdominal pain was diagnosed on the basis of Roman criteria, a positive decision of the gastroenterologist regarding the inclusion of the patient, conscious and voluntary consent of the child's guardian to participate in the study. Exclusion criteria include irritable bowel syndrome, abdominal migraine, diagnosed food allergies or food intolerance, the coexistence of chronic diseases or antibiotic therapy in the last 8 weeks. The dietary intervention lasted 4 weeks, meals were prepared on the basis of a menu developed by a dietician. Diagnostic tests were carried out before and after dietary intervention. One group of children with functional abdominal pain received the Fodmap diet, the second group, a diet based on NICE recommendations. The intestinal microflora, the level of zonulin in the stool were tested and the organic acids in the urine were determined by capillary gas chromatography/mass spectrometers (GC/MS).

Results:

Dysbiosis occurred in all 26 children (4 children did not perform the test). An increased number of Bacteroides spp. was observed in the majority of children in stool tests. Preliminary researches show that this bacterium was dominant in the examined children. In the test, an intermediate urine dysbiosis test of 24 out of 26 children was tested had at least one parameter elevated. Both dietary interventions had an effect to change the intestinal microflora, change the parameters of dysbiosis and the parameter zonulin.

Conclusion:

Diet has a significant influence on the formation of the intestinal microbiota. Scientific research indicates that some bacteria may contribute to the formation of certain disease entities and has a significant influence on the child's development, although more research is needed on a larger population to confirm the results obtained.

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P1.3.16

Application of fluorescence spectroscopy to monitor chlorine demand and pathogen survival in cabbage wash water

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Aim:

The aim of this study was to use the intrinsic fluorescence property of vegetables to monitor chlorine demand in the cabbage wash water. A spectrofluorometer was used to monitor fluorescence intensity as chlorine was allowed to fluctuate in cabbage wash water at varying chemical oxygen demand (COD) to develop a correlation with fluorescence intensity, chlorine demand and disinfection.

Method:

Buffered cabbage wash water was prepared and spiked with increasing chlorine dosages. Through the measurement of the excitation-emission matrix (EEM), a relationship could be established between the loss of the fluorescence signal and chlorine demand. Subsequently, the influence of filtered and unfiltered wash water, organic load concentration, pH, and temperature on the fluorescence signal was investigated. Then, the sensitivity of the fluorescence signal was determined in a controlled pH 6.5 cabbage dynamic experiment. Organic load and a cocktail of *E. coli O157:H7* and *L. monocytogenes* were consistently dosed, while free chlorine (FC), total chlorine (TC), oxidation-reduction potential (ORP), temperature, UV254(f), pH, turbidity, COD, fluorescence and microbial survival were monitored over time.

Results:

Filtration was not needed for fluorescence measurement, both filtered and unfiltered samples yielded similar fluorescence intensity. When there was chlorine demand; temperature, pH and organic load concentration caused a variation in the fluorescence signal, chlorine quickly reacted away and the unchlorinated fluorophores fluoresced. The inverse occurred in situations of low chlorine demand. As the chlorine demand decreased, so did the fluorescence intensity. The fluorescence signal plateaud when chlorine demand was depleted and FC increased. Of the two pathogens, *L. monocytogenes* was more resistant to the chlorine treatment, and colony counts were visible at low FC concentrations throughout the three hours duration, on the contrary, *E. coli O157:H7* survived only within the first sixty minutes of the dynamic experiment.

Conclusion:

We were able to establish a relationship between chlorine demand and fluorescence intensity in the cabbage wash water. These results provide insight into the use of the fluorescence signal as a fast and easy means to monitor chlorine demand and pathogen survival in the cabbage wash water.

P1.3.17

Characterisation of microbial communities and antibiotic resistant bacteria in blue mussels (Mytilus edulis) from Mid-Norway

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Aim:
Cultivation of blue mussels (*Mytilus edulis*) represents one of the most sustainable ways of producing food. As suspension feeders, they filter, retain and concentrate free-living and particle bound bacteria from their surrounding water. Thus, bivalve mollusks are susceptible to contamination from microbial pathogens via sewage or runoff from land, particularly after heavy rainfalls. There is a growing concern for the marine environment as reservoir for development and dissemination of antibimicrobial resistance (AMR), and mollusks are considered good bioindicators for the occurence of AMR in this environment. The main objective of this study was to assess microbiological parameters related to food safety of blue mussels by comparing the effect of depuration, cultivation locality and harvest season on the microbial community composition, and to assess the status of AMR in this environment.

Method:
Blue mussels reaching commercial harvest size were sampled from three localities over three seasons. Samples for microbial and total DNA analysis were collected before and after depuration for 24 h in UV-treated seawater. The microbial community composition was investigated using a next generation sequencing approach combined with 16S rRNA based identification of bacterial isolates from all types of culture media. Isolated *E. coli* were tested for their susceptibility for a panel of 15 antibiotics using a minimum inhibitory concentration (MIC) microbroth method.

Results:
The depuration significantly reduced the number of *E. coli* in the mussels ($p<0.05$), whereas the other bacterial groups were not reduced in this process. There were no differences in the microbial counts of any microbial parameter in mussels from the different cultivation sites nor in the different seasons (last season not completed). Changes in microbial community structure as a function of depuration, cultivation site and season will be presented in more detail at the conference. The majority of *E. coli* isolates (70%) showed limited antimicrobial restistance but a subset of the strains were classified as ESBL-producers.

Conclusion:
This study confirmed that ESBL-producting *E. coli* can accumulate in mussles, and that depuration is an efficient measure to reduce the number of *E. coli*. The reduced effect of depuration on other microbial parameters should be further investigated.

P1.3.18

Optimization of in vitro cultivation of human gut microbiota for toxicomicrobiomics studies using metagenomics/metabolomics approach

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Aim: evaluated the impact of four types of culture media to maintain human gut microbiota (GM) taxon-function stability and the utility of a suitable medium for toxicomicrobiomics studies. In the first step of the experiment, we determined whether pooled faecal inoculum can be used as an alternative for individual donor faecal for *in vitro* cultivation in tested culture media. Next, the effect of pooling on the retrieval of total ASVs and core microbiome was evaluated. Finally, integrative analysis of faecal 16S rDNA amplicon sequencing and metabolome profiling after 24 h *in vitro* batch cultivation was performed.

Method: the impact of four culture media: Gut Microbiota Medium (GMM), Schaedler Broth (SM), Fermentation Medium (FM), and Carbohydrate Free Basal Medium (CFBM) on preserving the biodiversity and metabolic activity of human GM in batch *in vitro* cultures were evaluated using PMA treatment coupled with 16S rDNA sequencing (PMA-seq) and LC-HR-MS/MS untargeted metabolomics supplemented with GC-MS SCFA profiling. Pooled faecal samples (MIX) from healthy donors (n=15) as inoculum to reduce the number of variables and ensure the reproducibility of *in vitro* cultivation was used.

Results: non-cultured MIX inoculum was characterized by higher α-diversity (Shannon effective count, and Effective microbial richness) compared to inocula from individual donors. After 24 h of cultivation, a significant effect of culture media composition on GM taxonomic and metabolomic profiles was observed. The SM and GMM had the highest α-

diversity. The highest number of core ASVs (125) shared with non-cultured MIX inoculum and total SCFAs production was observed in the SM.

Conclusion: the SM medium supplemented with 5% sheep blood preserved the GM's high biodiversity and metabolic activity. The significant enrichment of the biodegradation pathways of xenobiotics observed in the SM medium indicates its usefulness in future studies on the impact of food chemical contaminants (e.g. bisphenols, phthalates, pesticides) on human GM. Moreover, results also demonstrated the suitability of using the pooled faecal inoculum in the *in vitro* GM batch cultures. In summary, results might contribute to the development of standardized protocols for human GM *in vitro* cultivation by preventing methodological bias in the data.

P1.3.19

Investigation of biological activities of fucoidan and laminarin bioactive polysaccharides in Irish brown macroalgae

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Aim: The aim of this study was to investigate the biological activities of laminarin and fucoidan bioactive polysaccharides in Irish brown macroalgae species, *Laminaria digitata* and *Fucus vesiculosus*.
Method: The antioxidant capacity was evaluated using two complementary assays, namely the 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays. The anti-inflammatory potential was analysed using cyclooxygenase (COX) inhibition activity. Antidiabetic activity was evaluated using a dipeptidyl peptidase-4 (DPP-4) inhibitor screening assay. Additionally, the cytotoxic activity of selected compounds was investigated using the Alamar Blue™ assay on four cancer cell lines: U-251MG, A431, HepG2, Caco-2 and HEK293 as the normal cell line.
Results: Crude laminarin and fucoidan samples exhibited higher antioxidant activity ($p<0.05$) in a concentration dependent manner than purified samples and commercial standards. Similarly, the crude extracts had stronger anti-inflammatory and antidiabetic effects compared to the purified samples. The crude laminarin and fucoidan samples also had the highest cytotoxic activity. Flow cytometry analysis showed that 3D tumour spheres had significantly higher resistance to bioactive compounds compared to 2D monolayer cells of different cancer cells.
Conclusion: This study demonstrates the potential of laminarin and fucoidan polysaccharides as food ingredients for therapeutic applications. Further research is necessary to purify these bioactive compounds and improve their selectivity for targeted therapeutic use.

For Submission stage:
Title: Investigation of biological activities of fucoidan and laminarin bioactive polysaccharides in Irish brown macroalgae
Authors: Shanmugapriya Karuppusamy*, Stephen Fitzpatrick, Henry Lyons, James Curtin, Brijesh K. Tiwari and Colm O'Donnell

Keywords: laminarin, fucoidan, antioxidant, anti-inflammatory, antidiabetic, cytotoxicity, 3D tumour spheres.
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P1.3.20

Development of novel cryoprotectant and enhancing cryoprotective effect on lactic acid bacteria by sonication treatment

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Aim: Development of novel cryoprotectant and enhancing cryoprotective effect on lactic acid bacteria by sonication treatment
Freeze-drying (FD) can potentially have negative effects on the cell membrane lipids and sensitive protein structures due to the high osmotic pressure. Thus, the cryoprotectants has been widely used to enhance cryotolerance and improve shelf-life of lactic acid bacteria (LAB). This study aims to develop a novel cryoprotectant and enhance the cryoprotective properties of LAB by sonication treatment.

Method: Preparation of JA extract for cryoprotectant with different sonication treatment conditions and verification of cryoprotective property
Different sonication treatment conditions were applied to JA extract (JAE), including indirect treatment for 10, 30, 60, and 180s in an electronic ultrasonic bath, and direct treatment under different amplitude conditions of 30, 60, and 90% for 30, 60, and 120s. The sugar and amino acid contents were measured by HPLC, and the glass transition temperature (Tg) was analyzed by DSC. The cryoprotective property and storage stability of LAB with each cryoprotectant were evaluated until 24 weeks.

Results: Sonication treatment on JAE induced a decrement in monosaccharide contents, resulting in improved cryoprotective properties.
JAE showed superior cryoprotective effect compared to commercial cryoprotective agents such as trehalose and skim milk. The glucose and fructose induced critical damage on LAB during FD, and the viability of powdered LAB without sugar solution was 32%. However, the viability of powdered LAB with glucose and fructose solution of 0.25~2% was drastically decreased. sonication treatment induced the decrement of glucose and fructose contents by 46% and 15%, respectively, and increased Tg by 1.8°C. The viability of powdered LAB with JAE and sonication-treated JAE was 82% and 95%, respectively, immediately after FD, and 76% and 88% after 24 weeks of storage.

Conclusion: Sonication treatment can impove the cryoprotective effect of JAE and increase the storage stability of LAB.
This study demonstrated the mecahnisms of sonication treatment-induced cryoprotective effect improvement of JAE and verified the storage stability of LAB for 24 week. The sonication-treated JAE extract showed higher viability. Thus, sonication treatment can be a novel application for improving the cryoprotective effect.

P1.3.21

Influence of raw materials on the fermentation of low moisture extruded plant proteins

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Aim:
Plant-based meat-analogues gain greater popularity every year, however they also still face several challenges like flavor, aroma and food safety issues. These may be addressed by implementing fermentation to the production process as it is the case for raw fermented sausage, cheese, or tempeh. However, since bacterial growth is a complex biological process, it is hard to predict its outcomes in novel environments. Therefore, this study aimed to characterize growth and acidification behavior of several lactic acid bacteria within texturized plant-based protein matrices.

Method:
Low moisture extrusion cooked (LMEC) vegetable protein samples based on gluten, soy and pea protein were investigated with special concerns regarding chemical and microbiological properties. Protein samples were minced and soaked in water, subsequently analyzed for protein, fat, mineral and dry matter content. The samples were also subjected to a 72-hour period of fermentation at 25 °C with several lactic acid bacteria (*L. sakei* LTH 6767, *L. sakei* FAS 4, *L. plantarum* LTH 919, *P. pentosaceus* LTH 6726). The course of pH and viable cell counts was monitored. These experiments were repeated with addition of 0.5% dextrose to simulate more nutrient rich complex media.
Results
It was found that distinct differences occurred both in terms of chemical composition and metabolic kinetics of the starter cultures within the different protein origins. All examined samples were inoculated with about 10^6 colony forming units (CFU)/g and showed substantial growth to 10^8 – 10^9 CFU/g even without dextrose addition. TVP based on wheat gluten

showed strong acidification (Δ pH = 2.68), TVP based on pea (Δ pH = 1.38) and soy protein (Δ pH = 0.36) showed less. Substantial bacterial growth was achieved with all strains in all examined TVPs, however, growth characteristics and acidification varied significantly between strains and raw materials ($p < 0.05$). The addition of dextrose did only yield in marginally improved growth and acidification, indicating already sufficient fermentable carbohydrates within the samples.

Conclusion

All tested lactic acid bacteria showed high metabolic activity and led to distinct drop of pH. Growth and acidification kinetics, however, showed significant differences between strains and raw materials. Addition of dextrose only lead to minor improvements of metabolic activity. Samples with respectively higher protein and mineral contents also showed increased buffering capacity, resulting in reduced acidification.

P1.3.22

Influence of Prebiotics on Processability Properties on Encapsulated Lactobacillus plantarum derived from Sea Tangle Kimchi

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Aim: This research aimed to compare the processability properties of *Lactobacillus plantarum* D-12, which was isolated and identified from sea tangle kimchi, after encapsulation using spray drying with different wall materials. For encapsulation of *L. plantarum* D-12 maltodextrin (MD) and inulin (INL) and tragacanth gum (TG) were selected as commercial wall materials and prebiotics, as they are known to improve the viability and storage stability of probiotics.

Method: In a previous study, the optimum spray drying condition for encapsulating *L. plantarum* D-12 with high viability and storage stability was determined to be a wall material(MD) concentration of 10% and an inlet temperature of 86°C. This study used three different mixing concentrations of MD, INL, and TG as wall materials to encapsulate *L. plantarum* D-12. The mixing concentration of wall material was MD10(MD only, w/v), INL 3(MD: INL = 7:3, w/v), and TG 0.3 (MD:INL:TG = 70:29.7:0.3, w/v), respectively. The effects of prebiotics on the processability properties of encapsulated *L. plantarum* D-12 were investigated through proximate composition, color, flowability, density, and morphology analysis.

Results: The color of the encapsulated *L. plantarum* D-12 remained consistent regardless of the wall material and concentration. The encapsulation with TG0.3 had the largest size and higher density due to greater particle dispersion. This is beneficial for food powders as higher density is associated with better processability. Additionally, the powder with TG0.3 had lower water solubility and higher water absorption compared to the other powders. The surface structure of all powders was roughly spherical due to particle shrinkage caused by rapid moisture evaporation during spray drying with hot air heating.

Conclusion: According to the results, spray drying using prebiotics as wall materials for encapsulating *L. plantarum* D-12 is a feasible alternative to commercial wall materials. The encapsulated powders exhibited favorable properties such as processability and potential for application in the probiotics industry.

P1.3.24

Chemical markers in milk for the detection of silage addition in feed of dairy cows

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Aim:

In haymilk production, among other rules, the use of silage in feeding of cows is not allowed. There is evidence that cyclopropane fatty acids (CPFA) can be used as biomarkers to determine the authenticity of dairy products obtained without silage, especially from maize.

Method:

In this work, CPFA were quantified in milk samples from South Tyrol (NE Italy) using different amounts of grass or maize silage in the feeding ration, and in silage samples. A total of 311 bulk milk samples and 154 feed samples were collected from 29 local farms over two years. The diet of the cows as well as the quality of the feed was monitored over this period. Forage quality was analysed by Weender analysis. Moreover, milk samples were collected both from farms switching from a silage free diet to a conventional ration containing maize silage and from farms stopping grass or maize silage feeding. CPFA concentration in milk and silages was determined through gas chromatography coupled to mass spectrometry (GC-MS).

Results:
No CPFA were detected in haymilk samples, while they were found in 98% and 85% of the milk samples obtained from farms using maize and grass silage in their feed ration, respectively. CPFA were found in all maize silage samples and in 89% of the grass silage samples. Moreover CPFA were detected in the milk after three days of maize silage introduction. After maize or grass silage removal from the diet of the animals, the marker was still detected in milk after 56 and 14-21 days, respectively.
Conclusion:
CPFA have been found to be suitable markers in milk to test the absence of silage in the diet of dairy cows. Further work is needed to understand the relationship between the amount of silage in the cows' diet and the CPFA concentration in the milk and to clarify the occurrence of false negative results.

P1.3.25

THE EFFECT OF TEMPERATURE DISRUPTION DURING TRANSPORT ON THE MICROBIOLOGICAL QUALITY OF FRESH POULTRY MEAT

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Aim:
Fresh poultry meat is a significant component of the diet of most consumers. It, however, easily subjects to microbial spoilage processes and, therefore, presents a food safety risk. During transport and storage, chilled poultry meat products must be kept at a temperature below 4 °C (Regulation (EC) No 853/2004). The presented study evaluates the effect of elevated transport temperatures on the outcome of microbiological analyses of chilled poultry meat (chicken breast) in simple packaging as well as in vacuum and modified atmosphere packaging.

Methods:
Chilled poultry meat (chicken breast) was packaged in normal atmosphere (hereinafter referred to as simple packaging), modified atmosphere (MAP) and vacuum packaging for the purposes of the experiment. Model experiments simulated temperature increases during transport of the samples to temperatures of 4, 8, 11, 14, 17, 20, and 25 °C, with exposure periods of 1, 2, 3, 3.5, and 4 h. Microbiological analyses were performed immediately after the exposure to elevated temperature (0 h), 3 h, and 24 h after the return to adequate storage temperature. The following microbiological parameters were determined for each sample: the counts of total microorganisms (ISO EN 4833-1/2013), of psychrotrophic microorganisms (ISO 17410/2020), and of *Escherichia coli* (ISO 16649-2/2003). In addition, the presence of *Salmonella* spp. (ISO EN 6579-1/2020) was also assessed.

Results:
The study statistically evaluated the effects of three factors, namely (1) higher temperature, (2) the duration of cold chain disruption, and (3) the examination time after the disruption on the numbers and abundances of microorganisms in samples of all three packaging types. The results will be used to develop mathematical models describing the effects of temperature and the duration of exposure to elevated temperature on the microbial profile of fresh poultry meat. These models can serve for establishing the maximum acceptable cold chain disruption duration.

Conclusion:
The presented study helps standardize the methodology of collection and transport of chilled food samples for microbiological testing and to reduce the number of samples not accepted for processing by laboratories due to improper transport. From the perspective of the supervisory authorities, a significant benefit resulting from this study lies in providing information crucial for the defence against potential challenges of the results of analyses performed on samples taken during routine inspections. Finally, the results are useful also for producers of fresh poultry meat.

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P1.3.26

Cereals and fruits as effective delivery vehicles of Lacticaseibacillus rhamnosus through gastrointestinal transit

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Aim:
In recent years, the interest in developing functional foods with probiotic and prebiotic components, such as lactic acid bacteria (LAB) and dietary fibers, has increased significantly. Probiotics are defined as "live microorganisms which, when administered in adequate amounts, confer a health benefit on the host. According to the International Probiotics Association Europe, probiotic products need to contain an adequate amount of live bacteria to achieve a daily intake of 10^9 viable cells, able to survive the degradative conditions of the upper gastrointestinal (GI) tract and induce the health effects. Nevertheless, this requirement is not always fulfilled. Previous studies suggest that cell immobilization improves cell viability. In this vein, we investigated the impact of immobilization of the presumptive probiotic strain *Lacticaseibacillus rhamnosus* OLXAL-1, isolated from Greek olives, on cell survival, applying both *in vitro* simulated digestion and animal models.
Method:
L. rhamnosus OLXAL-1 cells were immobilized on oat and wheat flakes, as well as on apple and banana pieces. The immobilized cultures were subsequently freeze-dried and cell survival was assessed using a static digestion simulation model, resembling the conditions of the GI tract. The freeze-dried immobilized culture with the highest survival rate was selected and was further administered to male BALB/C mice for 10 days at a daily dose of 2 x 10^9 logCFU/g, in order to verify the effectiveness of cell immobilization *in vivo*. Survival rates of free *L. rhamnosus* OLXAL-1 cultures were also evaluated in both models for comparison reasons. Additionally, two control groups receiving either normal diet or normal diet supplemented with oat flakes were included in the *in vivo* study.
Results:
Notably, freeze-dried immobilized cultures exhibited significantly higher cell loads (> 6 logCFU/g) compared to free cells (3.51 logCFU/mL) after simulated GI transit, while significantly higher levels of LAB were detected in the feces of BALB/C that received the immobilized cultures compared to the control groups.
Conclusion:
Our results clearly suggested the potential of cereals and fruits as effective delivery vehicles for beneficial microorganisms, ensuring high cell viability during GI transit.

P1.3.27

In vitro effect of Mabisi on small children gut microbiota and functionality

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Aim
Fermented food is savoured and revered for centuries and is an integral part of many cultures', identity and heritage. Among scientists, it sparks interesting debates of its potential health benefits. Now accepted as functional food, it is produced by live organisms through spontaneous or controlled process. Here, we assess if exposure of traditional fermented food such as Mabisi on stool of Mabisi consumers may lead to a healthier bacteria composition and functionality. Mabisi is a traditional food produced from raw cow's milk through spontanoeuos fermentation in Zambia.
Method
We exposed stool samples collected from children (6) who were Mabisi consumers (3) and non-consumers. We digested Mabisi using the static INFOGEST digestion model prior to exposure to stool in a batch fermentation unit. Using hypervariable region (V3-V4) on 16S rRNA amplicon gene, we sequenced DNA obtained from stool samples in the

fermentation unit. We compare bacterial community composition and functionality. Functionality was determined by Short Chain Fatty Acids (SCFA) extracted using High Performance Liquid Chromatography (HPLC).

Results

Mabisi increased growth of beneficial bacteria (bifidobacteria, lactobacillus, roseburia, blautia and prevotella). Short chain fatty acids concentration in Mabisi consumers is higher compared to non-Mabisi consumers though statistically not significant ($p<0.05$).

Conclusion

Consumption of traditional dairy fermented food may have potential to modulate gut microbiota especially in children. Fermented foods produced through spontaneous process may present nutrition components that are safe to humans.

P1.3.28

Identification of antioxidant and antimicrobial peptides from Porphyra umbilicalis and Ulva lactuca

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Aim: To generate, characterise and synthesis novel bioactive peptides with antimicrobial and antioxidant activities from the red and green seaweeds *Porphyra umbilicalis* and *Ulva lactuca*

Introduction: Seaweeds or macroalgae grow in extreme environments of salinity and wave action as well as exposure to UV rays. As a result, they have developed protection and defense mechanisms to ensure their survival and are excellent candidates for bioactive peptide discovery. Few studies have used the enzyme bromelain to generate protein-rich hydrolysates with antimicrobial and antioxidant activities from these macroalga. We report for the first time, the generation, enrichment, isolation and synthesis of four bioactive peptides from these macroalgae and confirm predicted bioactivities for these peptides identified using mass spectrometry and in silico software (Peptide Ranker). *In vitro* antimicrobial and antioxidant (DPPH and FRAP) assays were used to confirm antimicrobial and antioxidant activities.

Methods: Protein hydrolysates were generated from both seaweeds using the enzyme Bromelain. Hydrolysis was performed for 24 h using a substrate to bromelain enzyme ratio of 1:50 (v/v) in triplicate where the biomass:water ratio was 1:100 (w/v). Temperature and stirring was maintained at 55°C, 200 rpm and a pH of 7 was used. A 3 kDa molecular weight cut off (MWCO) permeate fraction was subsequently made. This fraction was cleaned up using a Preomics Phoenix Peptide Cleanup Kit (Preomics, Germany) and subsequently applied to a mass spectrophotometer and the peptide amino acid sequences identified. Four peptides were subsequently selected for chemical synthesis based on their novelty, predicted bioactivity and charge. These peptides were then screened for antimicrobial and antioxidant activities using established *in vitro* bioassays and relevant controls.

Results: The peptides IAQTAVCLGAGYYLC, AGPMDVHRMK, VLPLMFLAFG, and SGVGAGGG-WSRSRRMGPGGR corresponding to proteins from *Porphyra* sp. or *Ulva* sp. were synthesised. AGPMDVHRMK, VLPLMFLAFG and SGVGAGGGWSRSRRMGPGGR had FRAP values of 181.33, 301.33, 56.33 FRAP µM/ml. Resveratrol has a FRAP value of 1881.33 µM/ml and previously *Porphyra dioica* hydrolysate had a value of 28.86-37.60 µM/ml FRAP. Two peptides also had antimicrobial action against *Escherichia coli* and *Listeria innocua* pathogens.

Conclusion: Four novel peptides with antimicrobial and antioxidant activities were generated using *in silico* and *in vitro* methods.

P1.3.29

Effect of electrolysed water on biofilm formed by Listeria monocytogenes strains isolated from meat industries

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Aim

Listeria monocytogenes is a major food safety challenge, as it can grow in different foods and persist in processing environments due to its well-known biofilm forming abilities. The control of biofilms in food industry is essentially based on the routinary application of chemical compounds. Within the novel approaches for biofilm management, electrolysed water (EW) appears promising in view of its antimicrobial activity and low environmental impact compared to conventional biocides. However, the effect of EW on *L. monocytogenes* biofilms remains an area worthy of additional research. The aim of this study was to evaluate the effect of EW on *L. monocytogenes* biofilms formed on polystyrene and stainless steel.

Method

Forty-one *L. monocytogenes* strains (40 isolated from meat industries, 1 ATCC) were clustered in weak, moderate, or strong biofilm producers by using a standard colorimetric assay. Representative strains for each group were selected to assess the antibiofilm potential of EW. Overnight cultures of strains were diluted, poured on 6-well polystyrene plates and plates containing stainless steel coupons, and incubated for 24-48 h at 37°C. Formed biofilms were washed thrice with EW with a contact time of three minutes for each washing step. Control biofilms were washed with Phosphate Buffered Saline observing the same contact time. Afterwards, adherent cells were removed by mechanical scraping and resuspended. Suspensions were diluted (1:10) and plated on Tryptic Soy Agar, incubated at 37°C for 48 h. Bacterial counts were performed to evaluate the logarithmic reduction caused by EW application.

Results

A significant logarithmic reduction of *L. monocytogenes* viable cells in the biofilm state was observed after treatments with EW. The effect was more pronounced (~ 4 Log reduction) on polystyrene, while biofilms grown on stainless steel were more resistant (~ 1.5 Log reduction).

Conclusion

These preliminary outcomes suggest that EW could be a valid alternative to conventional chemicals for the control of *L. monocytogenes* biofilms in the food industry. Further research is needed to study the antibiofilm effect of EW on other surfaces frequently used in the food industry and to investigate its potential applicability under different operative conditions.

P1.3.30

Effect of probiotics on reducing mycotoxin in vitro

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Aim:

The aim of this study was to investigate the ability of Devosia insulae, an isolate from soil, to detoxify Deoxynivalenol (DON), a mycotoxin that contaminates grains used in food and animal feed, and to evaluate the evolutionary relationship of Devosia insulae with other Devosia species.

Method:

To determine the evolutionary relationship of Devosia insulae, we compared its 16s ribosomal RNA gene sequence with that of another Devosia insulae using NCBI-BLAST. To investigate the ability of Devosia insulae to detoxify DON, in vitro experiments were conducted. DON was incubated with Devosia insulae and the degradation ability was evaluated using high-performance liquid chromatography (HPLC).

Results:

Our study showed that Devosia insulae has the ability to degrade more than 90% of DON in vitro. The 16s ribosomal RNA gene sequence analysis revealed that Devosia insulae is closely related to other Devosia species.

Conclusion:

Our study suggests that Devosia insulae has promising potential as a biological agent to detoxify DON in the pet food industry. Further ex vivo and animal studies are needed to evaluate the efficacy of Devosia insulae as a commercial mycotoxin detoxification agent in pet food industry. The evolutionary relationship analysis of Devosia insulae can provide insight into the genetic diversity and evolutionary history of Devosia species.

P1.3.31

Antibiotic resistance profile of Escherichia coli from chicken carcasses produced in conventional and antibiotic-free systems

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[1]FMVZ/UNESP

Aim:

Bacterial resistance to antibiotics is of paramount concern in public health, and meat production chain has a significant role in induction, introduction, and maintenance of antimicrobial resistance. Thus, the aim of this study was to evaluate the antibiotic resistance profile of *Escherichia coli* strains isolated from chicken carcasses produced in conventional and antibiotic-free systems.

Method:

A total of 64 chicken carcasses were obtained from supermarkets in Botucatu (São Paulo State, Brazil); 30 from "conventional" system and 34 from "antibiotic-free" certified system. These isolates were submitted to *E. coli* detection resulting in 98 isolates (48 from "conventional" and 50 "antibiotic-free"). The isolates were tested for antibiotic resistance profile with disc-diffusion against different classes according to CLSI (2022). Isolates resistant to three or more antibiotic classes were considered Multidrug Resistant (MDR). The results were presented in frequency and Chi-square test was performed to determine any association between production systems vs. MDR.

Results:

Of the 98 *E. coli* isolates tested, 64 (65.50%) were MDR. Regarding the isolates' origin, a higher frequency was observed in "antibiotic-free" chicken carcasses (48.50% of MDR isolates) when compared to "conventional" carcasses (37.50% of MDR), but no significant association was observed (P=0.2937). Concerning the antibiotic profile, isolates from the "conventional" system had 12 different combinations, being trimethoprim-sulfamethoxazole+ampicillin+tetracycline (SUT-AMP-TET) the most prevalent (7/18 MDR isolates). The antibiotic profile of "antibiotic-free" chicken had 17 combinations, and the most prevalent was also SUT-AMP-TET (5/24 MDR isolates). Considering that *E. coli* is a ubiquity bacterium, a high prevalence of MDR strains could ease the spread of genetic elements to other bacteria. Additionally, the "antibiotic-free" production system may not be able to avoid *E. coli* with high levels of resistance in final products, conflicting with what is expected, and suggesting that this matter should be tackled aiming the whole production system (primary production, slaughter, retail, etc.).

Conclusion:

The results found not only indicate a high prevalence of MDR *E. coli* strains in chicken carcasses but also suggest that the type of production does not seem to influence the frequency of resistance even in "antibiotic-free" systems, as it also had MDR bacteria strains.

P1.3.32

Compositional, nutritional, and microbial characteristics of fermented sausages produced with quail meat and autochthonous starters.

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Aim: In recent years, health and functional aspects of meat products have become increasingly important in consumer choices. Many efforts of the meat industry and food technologists are focused on the development of new products with better nutritional and functional properties than traditional ones and with improved sensory and safety qualities. Recently, quail meat has received increasing interest from consumers, due to its high nutritional value, with high protein and low-fat content. The aim of this study was to develop and characterize fermented sausages produced with quail meat and autochthonous starter cultures.

Method: Dry fermented sausages were produced in a local factory in Sardinia (Italy) using 6 combinations of autochthonous starter cultures (composed of different pediococci and lactobacilli strains), previously isolated from quail and sheep meat and selected for having the best functional properties to be used for fermented sausages production. A total of six batches were produced: three with 100% quail meat and three with 80% quail and 20% sheep meat. The physicochemical (pH, a_w, moisture, fat, protein), and microbiological parameters (*Enterobacteriaceae*, *E. coli*, Staphylococci, *L. monocytogenes*, yeasts and molds, and LAB) were evaluated along maturation. Lipid profile and sensory analysis were assessed at the final stages of ripening.
Results: Starting from 14 days maturation, high counts of LAB were detected (9 log cfu/g) without significant differences among the batches. At 21 days maturation, *Enterobacteriaceae* and *E. coli* counts were, respectively, lower than 4 and 1 log units in all batches but one. No differences were detected among the batches produced with the same meat type and different combination of starter cultures, for moisture, protein, and fat content. As for lipid profile, fermented sausages produced with only quail meat showed a higher n-3 PUFA and n-6 PUFA contents than those produced with 80% quail and 20% sheep meat. At 21 days maturation, independently of meat type and starter combination, all sausages samples were characterized by intense red color, aromatic flavor, hard consistency and good acceptability.
Conclusion: The use of quail meat and autochthonous starter cultures could represent a suitable alternative for producing innovative healthier and typical meat products.

P1.3.33

The influence of weather on aflatoxins occurrence in Croatian maize in the last 13-year period

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Aim:
Considering the global occurrence of mycotoxins, their toxicity and economic impact, one of the most important groups are aflatoxins (AFs). Registered climate changes in the last decades are recognized as the most significant factors responsible for their increasing presence across European countries. Among them, the most frequently detected in contaminated agricultural samples, especially in maize, thereby being aflatoxin B1 (AFB1). This mycotoxin has the highest acute and chronic toxicity and can have numerous negative effects on humans and animals, with teratogenic, genotoxic, immunosuppressive, and mutagenic consequences. The aim of this study was to investigate the influence of weather conditions on AFs occurrence in Croatian maize in the last 13 year-period.

Method:
In total 1825 maize samples were collected during the period 2010-2022 from four Croatian regions. All samples were analysed using the ELISA method, and if the amount of AFs content exceeded maximum limits (MLs) for maize as food, further confirmatory analyses were performed using LC-MS/MS.

Results:
AFs were not detected in four (2009–2011, 2014) out of thirteen years, whereas in two years (2016 and 2018) their presence was registered in less than or around 10% of maize samples. The following occurrence of AFs in maize was determined: 2% in 2016, between 12 and 19% in 2015, 2018, 2019, and 2020, and between 30 and 40% in 2012 and 2013. In maize of the 2012 genus, when weather was extremely warm and dry during all four months important for maize cultivation, they were present in significantly higher content, resulting with the highest level of maize contamination ever recorded in Croatia.

Conclusion:
AFs as the most important mycotoxins have become a burning concern due to their increased prevalence and significant role in the food and feed supply chain. Given that AFs elevated content are usually associated with weather as the factor critical for fungi formation and thus their production, mainly attributed to droughts, and since maize is a leading crop in many European countries, looking for climate change adaptation options, more frequent cultivation of drought-tolerant maize hybrids has a priority.

P2.1.001

Inactivation of the pasarites Anisakis by Pulsed Electric Fields (PEF)

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Aim:.
Larvae of the nematode family *Anisakidae* are capable of causing parasitic infections in humans associated with the consumption of fishery products, leading to intestinal syndromes and allergic reactions. *Anisakidae* larvae are widely distributed geographically with rates of parasitism close to 100% in certain fish species. Methods need to be established for their inactivation and elimination, especially in fishery products that are to be consumed raw, pickled, or salted, or which have been insufficiently treated to kill the parasite. Many strategies are currently available (such as freezing and heat treatment - Regulation (EC) No. 2074/2005), but further ones, such as pulsed electric fields (PEF), have hardly been investigated until now.

Method:
Application of Pulsed Electric Fields (PEF) technology (evaluation of field strength – 1 to 3 kV/cm-, pulse width - 3 to 100 µs -, and specific energy - 3 to 50 kJ/kg -) for inactivation *Anisakis* spp. from hake (*Merluccius merluccius*) in saline solutions, and validation results in hake pieces artificially parasitized with *Anisakis*.
Quality tests (water holding capacity (WHC), cook-loss, and moisture) were also carried out on hake pieces to evaluate the impact of PEF treatments.
Results:
Inactivation increase with field strength, and specific energy. Pulse width only affected at low field strengths. yA mathematical equation was developed describing the Anisakis lethatlity of PEF treated in aquous solution. Predictions of the equation were validadted in hake pieces artificially parasitised with *Anisakis*. A PEF treatment of 3 kV/cm, and 40-50 kJ/kg applying square wave pulses of 30 µs inactivated 90-100% of the parasites present in the fish pieces.
Evaluated quality parameters (WHC, cook-loss, and moisture) were not significantly affected by PEF compared to control samples, and resulted better than that of frozen/thawed samples.
Conclusion:
The lethality of *Anisakis* spp. was highly dependent on applied the parameters, mainly electric field and specific energy. Quality parameters indicate that it could be a technological alternative to freezing as it does not affect the quality of the fish.

P2.1.002

Reducing the effect of AA and mycotoxins on SH-SY5Y cell by natural by-products

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Aim:
Acrylamide (AA) is a compound formed in starchy food products during cooking at high temperatures and it has been classified as food processed contaminant. AA effects described in literature is among others as neurotoxicant. Its presence in a range of popular foods has become one of the most difficult problems facing the food industry. Bakery products (bread, crispbread, cakes, batter, breakfast cereals, biscuits, pies, etc.) are some of the major sources of AA´s dietary. In addition, filamentous fungi produce secondary metabolites, known as mycotoxins, which are toxic to vertebrates and other animal groups in low concentrations. Specifically, Beauvericin (BEA) and zearalenone (ZEA) belong to a group of mycotoxins produced by Fusarium spp. species, that are present in almost all continents, can grow under poor storage conditions, and mainly contaminate cereal grains, such as maize, wheat, oats, soybeans, and their derived food products.. Acrylamide jointly with mycotoxins, with effect at neuronal level, is becoming an important topic in toxicological studies. A review study focused on the in vitro toxicological effects of AA and mycotoxins BEA and ZEA in the neuronal system and how some food bioactive compounds from food side streams can modulate the toxic effect of this compounds is summerized.

Method:
Articles of AA and *Fusarium spp*. mycotoxins such as BEA and ZEA available on databases as Web of Science and Scopus from the last five years, have been compiled. All articles selected dealt with in vitro assays, centered in the neuronal toxicity evaluation of AA, BEA and ZEA on SH-SY5Y cells prioritizing the cytotoxicity assay (MTT assay). Other assays have been also

comprised as dihydrochlorofluorescein assay, lactate dehydrogenase assay, oxidative stress, and analysis of mitochondrial membrane potential.

Results:

Bioactive compounds from beetroot extract, coffee cilverskin and spent Coffee have neuroprotective activity against SH-SY5Y cell death by mycotoxins.

Conclusion:

Side streams of food products processing can be a source of valuable compounds with bioactive proprieties, and cytoprotection capacity in SH-SY5Y cells against dairy exposure of mycotoxins and AA.

P2.1.004

Effects of chitosan and chitosan/gelatin coatings on the shelf-life of pork fresh meat

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[1]Cicytex

Aim:

The objective of the present study was to analyze the effect of protective biobased coatings formulated with chitosan and chitosan/gelatin for the extension of the shelf-life of fresh pork meat. In particular, the effect of the biopolymers on color, lipid and protein oxidations, as well as microbial loads on fresh pork were evaluated during the refrigerated storage.

Method:

Chitosan and gelatin coatings were prepared in laboratory, from dilutions of chitosan or chitosan/gelatin in lactic acid with glycerol, and dried until films polymerisation. Total antioxidant activity of biopolymers was measured for 24 hours. Fresh fillets of pork loin were covered with biopolymers, vacuum-packed and conserved in refrigeration for 1, 5 or 9 days. Colour was measured instrumentally, by determining CIELAB values. Lipid and proteins oxidations were determined spectrophotometrically according to TBA-RS method and ratio carbonyls/proteins assay, respectively. For microbiological analysis, mesophilic and psychrophilic aerobic microorganisms, total molds and yeasts, *Escherichia coli*, total coliforms, *Staphylococcus aureus*, *Salmonella* spp. and *Listeria monocytogenes* loads were determined according to ISO normalized technics.

Results:

Antioxidant activity on both coatings was observed, especially at 24 hours. The use of both biopolymer coatings reduced the increase of lightness observed in control packages during storage. However, they modified the initial color of meat (chitosan biopolymers supposed an increase of CIE a*, and gelatin decreased CIE b*) and significantly increased TBA-RS and protein oxidations. On the other hand, a significant reduction of the development of microbiological counts during storage was observed, especially in coatings formulated only with chitosan.

Conclusion:

Globally, the application of biopolymers based on chitosan and chitosan-gelatin in fresh pork meat allowed the control of microbial development during refrigeration. However, the use of these biopolymers could significantly affect the fresh meat color and increase oxidations, thus their formulation should be adjusted to reduce undesirable effects.

P2.1.005

Revalorization of kiwi peel as a source of antioxidant compounds through pulsed electric fields technology

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Aim: Kiwifruit is a very popular product with high vitamin C content. However, kiwifruit processing generates large quantities of peels, which are particularly interesting agricultural by-products due to their antioxidant properties. For this reason, the application of innovative technologies such as pulsed electric fields (PEF) extraction could be helpful to recover the antioxidant compounds contained in this matrix. **Method:** In order to study the effect of this technology, the procedure for the extraction of total polyphenols was optimised to determine the optimal conditions for the PEF parameters: electric field strength, specific energy and time (2.4 kV/cm, 300 kJ/kg, 0h). Subsequently, the antioxidant capacity and total phenolic compounds of the optimal extracts were evaluated in comparison to conventional aqueous extraction (15 min with agitation). All analyses were performed in triplicate. **Results:** According to the results, the specific energy of the process was the most influential factor in the extraction of polyphenols, with the maximum value of 300 kJ/kg considered optimal. Moreover, an increase in the extraction of polyphenols and antioxidant compounds of 47.2% and 62.2%, respectively, was observed when PEF technology was applied. Thus, the obtained results indicate that the electroporation generated by PEF effectively delivers the target compounds to the external medium, highlighting the great influence of the applied electric field strength and specific energy on the obtained extract. **Conclusion**: In this sense, PEF technology is a promising technology for the valorization of agro-food by-products rich in high-value compounds as a new source of bioactive compounds contributing to the achievement of the Sustainable Development Goals (SDGs).

Acknowledgements:
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P2.1.006

Life Cycle assessment of osmotic-dehydrated and fermented olives

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Aim:

The Mediterenean diet is linked to a number of health benefits, including the prevention of cardiovascular diseases, increasing lifespan, and healthy aging. The modern nutritional habits of the cosumers, has led to a rising demand for new sustainable foods based on traditional healthy products. Fermented vegetables and fruits such as olives, are popular worldwide. Fruit fermentation is based on the use of common salt as the main component of brine. However, researches have proven that consumption of large amounts of salt is connected to hypertension and other severe diseases. Thus, the reduction of its intake is a modern nutritional challenge. Osmotic dehydration is a treatment applied before fermentation to increase shelf life, reduce fermentation time, and reduce salt intake. It can be utilized towards the production of sustainable food products, with high nutritional value and low salt conent. Nevertheless, apart from the health benefits of osmotic dehydration, the environmental impact of the process should be assessed. The aim of this study is to evaluate the total environmental impact of osmotic dehydration pretreatment of olives, and compare it with the conventional method, using Life Cycle Assesment (LCA).

Method:

The whole process chain of fermented olives was studied, and data inventory for both cases was performed. LCA was conducted using Gabi ts, the selected impact assessment method was ReCiPe 2016 (H).

Results:

The LCA results of the examined scenarios reveal that the environmental impact is significantly lower in the case of osmostic dehydration before fermentation. A significant reduction of fermentation time (up to 1 month) can lead to a higher productivity level, and extended shelf-life products. This results in an improvement in the environmental performance of the treatment and a major benefit in human health.

Conclusion:

This study suggests that pretreatment with osmotic dehydration before fermentation of olives can lead to high quality, eco-friendly products with high nutritional value, inducing the sustainability of the agricultural sector. Therefore, the novel functional fermented products studied, consist a very promising approach with documented sustainability regarding their total environmental footprint.

P2.1.007

Antioxidant and compostable PLA films with grape stalk extracts.

PhD Pedro Freitas[1], MS Silvia Meyer[1], **Phd Amparo Chiralt**[1]
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Antioxidant and compostable PLA films with grape stalk extracts.
Freitas, P.A.V.; Meyer, S.; Chiralt, A.

Aim:
The winemaking residues, such as grape stalks (GS) have great potential applications in the food sector on the basis of their richness in bioactive components. Obtaining these compounds by subcritical water extraction (SWE) is a green valorisation option due to their high market value. Among others, sustainable active food packaging materials could be developed by incorporating these extracts into biodegradable polymers. In this study, GS extracts from red (Bobal) and white (Malvasía) varieties were obtained by SWE, characterised as to their antioxidant and antibacterial properties and incorporated into PLA films, which were validated in their capacity to prevent sunflower oil oxidation.
Method:
GS samples dried, milled and sieved (<0.5 mm) were submitted to SWE at 160 and 180 ºC. The extracts were freeze dried and analysed in their total phenol content (TPC) and radical scavenging capacity. The antibacterial activity of the extracts against *Listeria innocua* and *Escherichia coli* was also analysed. PLA films with 6 % wt. of each extract were obtained by melt blending and compression moulding and characterised as to their water vapour and oxygen permeability and UV-Visible light transmission and colour. Sunflower oil packaged in single-dose bags of these films were submitted to an accelerated oxidation test and the peroxide index values were determined as a function of storage time.
Results:
The red GS extracts had higher TPC and antioxidant capacity than white GS extracts whereas the extraction temperature hardly affected these properties. All extracts significantly reduced the initial (10^5 CFU) bacterial counts of *L. innocua* and *E. coli* (by more than 2 Log CFU) at 150 mg/m while the white GS extract at 180 ºC provoked a complete bactericidal effect at 135 mg/mL. The extracts slightly reduced the water vapour barrier capacity of the films while enhanced the oxygen barrier capacity and provide them with UV light barrier effect. Due to these beneficious effects, oxidation of sunflower oil packaged in films containing extracts was significantly inhibited.
Conclusion:
GS aqueous extracts obtained by SWE exhibited very good properties to produce antioxidant/ antibacterial PLA films, useful to extend shelf life of packaged foods while the winemaking residue is valorised.

P2.1.008

Improvement in the detection of foreign bodies in jelly-based products through wavelet-based ultrasound-imaging

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Aim:
The food industry is facing a digital transformation and innovative food processing technologies are in high demand in the context of Industry 4.0 purposes. Research into non-destructive and non-invasive systems for real-time detection of foreign bodies in the food industry is still a challenge. In this sense, ultrasound-imaging technology has proven to be a fast, non-destructive, and accurate tool for food quality control.
The aim of this work was to evaluate the feasibility of using acoustic images obtained with contact ultrasound technology and processed with the Discrete Wavelet Transform (DWT) for the detection of foreign bodies on a jelly-based product.
Method:
Jelly-based products (bovine gelatin 1% w/v) were prepared in polystyrene and silicone molds (diameter 9 cm, height 1.5 cm). Metal washers (diameter 0.5, 1 cm) and soft and hard plastic fragments (1×1 cm, 0.5×0.5 cm) were evaluated as foreign bodies. Ultrasound measurements (1 MHz, 0.5” diameter) were performed according to a predetermined pattern (5×5 points separated 1 cm). The acoustic images were processed in the time domain using DWT-2 Daubechies considering the signal approximation level and the third scale. Subsequently, the images were created using five first-order statistics (signal variance, range, entropy, kurtosis, and skewness). Principal Component Analysis (PCA) combined with multivariate statistics (residual sum squares RSS, Hotelling's t-squared-T2) were used to detect the presence of foreign bodies. PCA calibration was performed 100 times, using a ratio of 75% and 25% of the images without foreign bodies for training and validation, respectively. All the images with foreign bodies were considered as the monitoring set.

Results:
The preprocessing approach via DWT allowed the removal of 0.8% of the signal noise and the retention of 99.9% of the ultrasound energy from the acoustic images. The PCA model provided good classification (overall accuracy > 95%). Additionally, the obtained RSS and T^2 values revealed that foreign bodies interfere with the ultrasound signal by increasing the attenuation, which was evidenced by the reduction of energy-related parameters.
Conclusion:
The methodology proposed in this work could be considered as a feasible tool for the reliable, rapid, and accurate detection of foreign bodies in jelly-based products packaged in different materials, as well as its further industrial application.

P2.1.009

Valorization of downgraded maple syrup by fermentation using a probiotic bacteria

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Aim: According to the quality standards of Quebec, a huge volume of maple syrup with defects (taste, texture, etc.) is rejected each year, which represents considerable economic losses for the sector. One type of this downgraded maple syrup, called "bud syrup" which tastes like cabbage, is rich in sugars and represents a high source of carbon. In this study, a fermentation strategy was used to develop a maple syrup-based probiotic product, which was then given as a growth promoting supplement in post-weaning piglets.
Method: *Bacillus velezensis* FZB42 was used as a probiotic strain. A fermentation media was developed using central composite design with buddy syrup to maximize the production of Bacillus strain's biomass. The fermented medium was dried using a spray-drier and this product was assessed for resistance at different pHs, temperatures, and bile concentrations. Survival, during *in vitro* digestion, was also tested. Finally, the probiotic potential of the fermented product was evaluated *in vivo* in post-weaning piglets.
Results: A high-biomass medium was obtained (9.79log CFU/mL) before being successfully dried (8.3log CFU/g). A high survival was obtained for the pHs, temperatures, and bile concentrations. The product also remained stable during *in vitro* digestion. The impact on growth performance of tested animals was significative, with an improved postweaning feed/gain ratio (1.912 vs. 2.271; P = 0.012).
Conclusion: A probiotic supplement was successfully produced using bud maple syrup. This probiotic was shown to be stable under gastrointestinal conditions and enhanced growth performance of postweaning piglets.

P2.1.011

Understandig consumer expectations and perception of sustainable food in collective catering.

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Aim: The ways by which food is produced, distributed, and consumed have an impact on the approach to food sustainability. It is important to involve all system actors, including consumers toward more sustainable systems. There is a lack of work on transitions in food towards sustainability at territorial level. The aims of this study are to better understand consumers definition of sustainable food, to explore perceptions and expectations of food at workplace and to identify important criteria in terms of a sustainable food offer.
Method: Two focus goups were performed with French people (n=20). Participants, were recruited on the basis of eating at canteen at least once a week. Focus groups were conducted in Plateau de Saclay, Ile-de-France. Discussion was conducted in 4 steps : i) introduction, ii) perception of sustainable food at home, iii) perception of sustainable food at collective catering, iv) indicators of food sustainability.
Results: For participants sustainable and healthy eating involves a balanced meal including fruit and vegetables, pulses, cereals, less processed foods as well as less environmental impact, eating less red meat, local, diminishing food waste and food packaging and fair remuneration to all the actor of the food chain. The main difficulties encountered in order to consume more sustainable were: the cost, accessibility and lack of time allowed to food preparation. Regarding the choice of meals in collective catering, participants highlighted that offer is balanced, a little weak for vegetarians. They would like to have more information about the origin of the products. For participants, criteria for having a sustainable food is eating food coming from short circuits, seasonal, few pesticides, less meat. Participants mentioned a lack of information about the origin of products and that multiple food labels leads to confusion.
Conclusion: Consumers perceptions of food sustainability involve classical pillars (health, environmental, economical and social dimensions). Regarding food sustainability, some difficulties were highlighted by participants such as time and cost issues. Collective catering might improve communication and collaboration with consumers (e.g. about the origin of the

products, labels, agricultural practices). Observational studies will allow to identify specific consumers leverages to attain sustainability.

P2.1.012

Detection of bone fragments in chicken breast using non-invasive air-coupled ultrasound imaging

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Aim:
Bone fragment detection in the poultry meat industry is a persistent problem. During the rapid mechanical deboning process, industrial machinery separates chicken breasts from the skeleton, which can result in bone fragments becoming embedded in the fillets. To ensure consumer safety, it is critical to detect these fragments in-line and real time. In this sense, air-coupled ultrasound imaging has emerged as a promising technology for non-invasive food inspection, as it is contactless, fast, versatile, and cost-effective. Thus, this study aimed to evaluate the feasibility of air-coupled ultrasound imaging to detect bone fragments in chicken breast.

Method:
Air-coupled ultrasound images of chicken breast pieces (5 cm × 5 cm × 1.5 cm) without bone fragments (control images) were taken by automatic 2D scanning of the breast surface with contactless ultrasound sensors (0.25 MHz) in through-transmission mode. A set of bone fragments of different sizes (2.0 × 1.5 cm, 2.0 × 1.0 cm, 1.5 × 0.3 cm, 1.0 × 0.3 cm, and 0.5 × 0.3 cm) were then inserted into the chicken breast pieces, and the out-of-control images were acquired. From the obtained ultrasound images (5 × 5 cm points separated by 1 mm), three energy-related ultrasound parameters (peak-to-peak distance, squared norm, and integral) were computed in the time domain.

Results:
The results showed that the inserted bone fragments modified the energy-related parameters of ultrasound images, which are directly linked to the attenuation. The obtained images corresponding to peak-to-peak distance, squared norm, and integral showed lower values in the pixels corresponding to the bone location.

Conclusion:
The presence of bone fragments and their location in chicken breast have been detected successfully by using non-invasive ultrasound imaging. These results reveal the potential of air-coupled ultrasound imaging for reliable and rapid detection of bone fragments in chicken breasts. Furthermore, the results are promising for the fast and non-destructive implementation of quality inspection in the meat industry.

P2.1.013

Almond skin valorization by applying subcritical water extraction

Phd Chelo Gonzalez-martinez[1], pHD Amparo Chiralt Boix[1], pHD Pedro Freitas[1], Ms Irene Gil[1], Ms Laia Martin[1]
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Almond skin valorization by applying subcritical water extraction

Freitas, P.A.V.; Gil, I.; Martín, L.; González-Martínez, C. Chiralt, A.

Aim

Almond skins are an underutilized by-product of the almond processing industry, removed from the nut by hot water blanching. These contain considerable amounts of flavonoids and phenolic acids with antioxidant, antimicrobial and health promoting properties and notable content of carbohydrates, mainly cellulose. The aim of this study was to obtain bioactive extracts enriched in phenolic compounds by applying subcritical water extraction (SWE) and to purify cellulose from the extraction residue, using a green process with hydrogen peroxide.

Method

The by-product supplied by an almond processing industry was dried, ground (0.5 mm particle size), defatted and submitted to water extraction (solid-water ratio: 1:4) at 160ºC and 180 ºC, for 30 min. The extracts were freeze dried and analysed as to their total phenolic content and DPPH radical scavenging capacity. The bleaching conditions to purify cellulose from the extraction residue were optimised.

Results

The SWE extracts yielded 29 and 21 g solids/100 g defatted skins, respectively at 160 and 180ºC. These had high content of total phenols (expressed as gallic acid equivalent: GAE), 71 and 104 mg GAE/g extract, respectively for 160 and 180ºC, and strong radical scavenging capacity (1.5-1.1 mg extract/mg DPPH), expressed as the amount necessary to inhibit by 50 % the radical activity (EC_{50}). Therefore, these extracts can be used as bioactive ingredients for food, pharma or cosmetic industries. Cellulose purification of the extraction residue was more effective when 1 h cycles (4) were applied at pH 12 and 8% H_2O_2.

Conclusion

SWE was very effective at obtaining bioactive extracts from almond skins with high radical scavenging capacity and phenolic content while the extraction residue was a source of cellulose fibres that could be purified with a green method using hydrogen peroxide. These integrated processes can be applied for the by-product valorisation in the framework of circular economy and sustainability.

P2.1.014

Development of alternative edible coatings from polysaccharides and proteins from Chlorella vulgaris

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Aim:

Food deterioration is caused by oxidative reactions, spoilage microorganisms, respiratory processes, and improper storage conditions. At the same time, contamination by pathogenic microorganisms is a serious threat to human health. External environmental factors play an important role in degradation, such as high percentages of O_2, CO_2, and ethylene ratios; temperature and pressure factors; and the loss of desirable compounds. Extending the shelf life of fruits and vegetables, while maintaining their nutrient profile, characteristics, as well as a desirable appearance remains a great challenge in the food industry. Edible coating is an emerging food protection procedure, as it increases the shelf life of fruits and vegetables, is a sustainable process, and can be safely consumed as part of the product. The aim of this study is to investigate edible coatings developed from polysaccharides and proteins derived from microalgae (Chlorella vulgaris) and compare them with conventional ones.

Method:

Polysaccharides and proteins were extracted from Chlorella vulgaris using an analytical extraction protocol. The recovered biopolymers were further incorporated into membrane systems containing plasticizers and other components (e.g. polysaccharides, proteins, lipids). Conventional membranes were developed using potato starch and chitosan. The developed membranes were tested in terms of their optical, mechanical and thermal properties.

Results:

The addition of the extracted compounds from Chlorella vulgaris in the researched membranes, resulted in formulations of higher quality, presenting enhanced optical and mechanical properties compared to the conventional ones. The developed coatings possessed a uniform appearance, higher durability, and were less susceptible to adverse environmental conditions.

Conclusion:
Edible coatings developed from microalgae components are more efficient, as they are more resistant to environmental changes, and are able to protect food products more effectively. Additionally, they are produced through eco-friendly, cutting-edge techniques, making use of natural ingredients that are abundant, offering valuable nutrients and remarkable antimicrobial properties.

P2.1.015

Mechanical and physico-chemical properties of sodium alginate films with olive and laurel leaf extracts

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Aim: Films and coatings based on biopolymers allow the addition of natural antimicrobials/ antioxidants that can help improving food safety and quality of food products. This study aimed to study the mechanical and physico-chemical properties of sodium alginate (SA) films incorporated with laurel (*Laurus nobilis*) leaf extract (LLE) and olive (*Olea europaea*) leaf extract (OLE).

Method: The lyophilized extracts were obtained by Ultrasonic-Assisted Extraction using 70:30 (v/v) of ethanol:water. The films were obtained by mixing 1% (w/v) of SA and 0.5% (w/v) of glycerol in distilled water under agitation overnight. The extracts were dissolved in distilled water, stirred for 1h, filtered under a vacuum, and added at 1 and 2% of LLE or OLE, and a mixture of 0.5% or 1% of each LLE and OLE. All solutions were stirred (1 h), homogenized with an Ultra-Turrax at 10000 rpm (2 min) and degassed under vacuum. The solutions were cast in polystyrene petri plates, dried at 35°C (in a convection oven) for 24h, and conditioned in desiccators containing a saturated solution of $Mg(NO_3)_2.6H_2O$ at 53% of relative humidity and 20°C before analysis.

Results: The incorporation of the extracts in films affected their mechanical and physico-chemical properties. Thickness values ranged from 63.67 (SA) and 119.03 µm (SA+LLE2%). The most evident changes in tensile strength were observed between SA and SA+LLE1%+OLE1%, with a decrease of 65.7%. An improvement of elongation at break was observed for SA+OLE2%, with an increase of 24.8%. A significant improvement in modulus of elasticity was observed in SA+LLE1% (54.8%) and SA+LLE0.5%+OLE0.5% (86.7%). A decrease was observed in the moisture content (16.48% less for SA+LLE2%) and WVP that ranged between (28.08 (SA) and 3.49 g m-1 s-1 Pa-1 (SA+LLE2%). Also, an increase in opacity was observed for all films.

Conclusion: Films with OLE are more ductile but less elastic and resistant. Films with LLE are more elastic but less ductile and resistant. Moisture and WVP values decreased, showing the possibility of improving the hydrophobic character of the films. The opacity values increased, thus reducing the passage of light that can be useful for food applications (e.g., reducing lipid oxidation).

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P2.1.016

Influence of temperature on High Power Ultrasound (HPU) assisted extraction of lupin protein

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Aim:
Global population is growing rapidly and with it comes an increased demand for protein sources. Traditional protein sources such as meat have a significant environmental impact. Therefore, there is an urgent need to find alternative sustainable protein sources. *Lupinus luteus* has been gaining attention due to its high protein content. However, lupin seeds contain

ANFs and ATFs that can reduce the efficiency of protein extraction. Polyphenols are one of the most significant ANFs in lupin seeds, as they can bind to proteins during extraction, reducing their digestibility. This work explores how high power ultrasound (HPU) assisted extraction of lupine protein isolate (LPI) could affect the protein yield, fat, saponins and polyphenol content and antioxidant capacity of the isolate.

Method:

HPU treatments were applied during alkaline solubilization (pH 10.3) for 30 min at 30 and 60ºC, applying a power density of 803W/L. After solubilization, proteins were precipitated by changing the pH to isoelectric point of protein (4.7). Protein isolates were freeze-dried for 48h and stored at -20ºC until further analysis. Finally, protein, fat, saponins and phenolic content and antioxidant capacity were determined.

Results:

In general terms, temperature and HPU application significantly influenced ($p < 0.05$) the protein extraction process. As for the process yield, HPU slightly increased the amount of isolate content at 60ºC (2 %), which probably was linked to the enhancement of extraction process and the hydrolysis provoked by high-intensity acoustic waves. Antioxidant capacity of the protein isolates decreased in HPU experiments at 30ºC, but at 60ºC, the HPU effect was negligible ($p > 0.05$). Meanwhile, in the case of total polyphenol content, HPU experiemnts presented a lower content than conventional ones at both temperatures. Sonication decreased the fat content compared to conventional process (by 62% dry basis) at 30 and 60ºC.

Conclusion:

Therefore, HPU-assisted extraction could be considered a feasible technique to decrease the content of ANF and ATF of lupin protein isolate at a wide temperature range (30-60ºC). This decrease could be attributed to cavitation phenomenom during HPU treatment, improving solvent penetration into the cell and the contact surface area for the removal of undesired compounds. Furthermore, it has to be considered that sonication seems to cause a slight increase of protein recovery yield.

P2.1.017

Plasma-Polymerized Coatings –an innovative and effective strategy to prevent the formation of Listeria monocytogenes biofilms

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Aim: The colonization of food processing facilities with biofilms contributes to cross-contamination and spoilage of food products with associated health risks for consumers. Given the limitations of traditional disinfection methods for removing mature biofilms, great efforts are being made to find new strategies to prevent bacterial adherence to surfaces. The potential of producing surfaces with physicochemical properties that prevent biofilm formation by hindering the initial attachment of bacteria, and therefore, reducing the possibility of resistance development have been investigated. The present study developed and characterized various anti-biofilm coatings applied with an atmospheric-pressure plasma jet system on stainless steel (SS) surfaces using different precursors and process parameters. Thus, the objective of this work was to assess the anti-biofilm activity of these plasma-polymerized coatings against a three-strain cocktail of Listeria monocytogenes biofilm grown for 6 days at 12 ºC.

Method: The coatings were applied on SS AISI 316, the most commonly used food industry surface. Each of the studied coatings was composed of a base coating and a functional coating. (3-Aminopropyl)triethoxysilane (APTES) and N-[3-(trimethoxysilyl)propyl]ethylenediamine (TMSPEA) were used as the liquid precursors for the plasma-polymerization of the base coatings. On the other hand, acrylic acid (AcAc) and solutions of poly(ethylene glycol) methyl ether methacrylate (PEGMA) in isopropanol at concentrations of 5 and 10 wt% were used as the precursors of the functional coatings.

Results: The best results were observed for the surfaces with a base coating of TMSPEA and a functional coating of PEGMA, at both concentrations, that reduced biofilm production by more than 95% when compared with the uncoated SS. Additionally, the morphological and physico-chemical characterization of the coatings showed a smooth surface with a higher concentration of oxygen-containing polar groups than the uncoated SS and a strong hydrophilicity, which could have been beneficial to prevent biofilm formation in two ways: (1) by diminishing the potential sheltering sites for bacteria and (2) by promoting the formation of a hydration layer that might have hindered bacterial attachment to the surface.

Conclusion: The current study shows an anti-biofilm effect on SS under similar conditions of those found in real food-processing environments through the plasma-polymerization of coatings.

P2.1.018

Impact of pea cultivars and ingredient processing on foamability

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Aim:
To advance the quality of plant-based food, we need to understand the important relationship between protein structure and functional requirements, and one way is to investigate raw material and ingredient processing. For optimal functionality the ingredient processing needs to be controlled and fine-tuned, which in turn can be done best if the relationship between functional and physico-chemical properties are understood. Such a knowledge-based tool for tailoring protein ingredients may assist producing industrially relevant ingredients in a sustainable manner.
Method:
10 pea cultivars from a local organic farmer were processed into concentrates (LPPC, dry fractionation in pilot scale) and isolates (LPPI, wet extraction in lab scale comparable to industrial processing). Six commercial pea protein isolates (CPPI) and one commercial pea protein concentrate (CPPC) were purchased from different companies. Powder suspensions were made following foaming using Ultra Turrax or a mechanical frother. Foam volume was recorded manually to calculate the foam capacity and stability. Various molecular characterisation analyses, electrophoresis, particle size distribution, solubility, FTIR spectroscopy, UV–VIS absorption spectroscopy, intrinsic fluorescence, surface hydrophobicity, and surface charge, were conducted to explain differences in the foamability.
Results:
Initial results show that the foamability of powders are different depending on both cultivar and processing technology, concentrate versus isolate, lab scale versus industrial scale. The analyses and interpretation are ongoing and will be presented at the conference.
Conclusion:
In the increasing global market for plant-based foods, both the control of raw materials and ingredient processing technologies is crucial for technical functions in the quality and stability of food products and at the same time ensure sustainability, supply, and demand.

P2.1.019

Sustainability assessment of UV-C light application to extend the shelf life of meat products.

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Aim: The meat industry is facing challenges in ensuring product quality, safety, and minimizing waste and environmental impact. Ultraviolet (UV-C) light has emerged as a promising solution. UV-C light can reduce microbial contamination in meat, potentially extending its shelf life, reducing food waste, and improving sustainability. Life Cycle Assessment (LCA) is crucial for evaluating the environmental impact of processes and technologies. By integrating UV-C treatment and LCA, we can assess the environmental implications of using UV-C technology to extend the shelf life of meat.
Method: Data obtained from pilot-scale on the UV-C treatment process and the extended shelf life of meat products were collected and analyzed. Mathematical models were developed based on these data to predict the inactivation of microorganisms during UV-C treatment and the subsequent microbial growth during the product's shelf life.
The models were then employed to estimate the amount of waste generated when meat reaches the end of its shelf life while still in production facility storage. This estimation provides insights into the potential reduction in waste resulting from the implementation of UV-C technology. Furthermore, a gate-to-gate life cycle assessment was conducted using the LCA software SimaPro to compare the environmental impact of scenarios with and without the application of UV-C light. The LCA considered factors such as energy consumption, packaging, meat waste generated among other parameters.
Results: The analysis of various scenarios showed that UV-C light application in meat processing yields more sustainable outcomes. The developed models accurately predicted microbial inactivation during UV-C treatment and microbial growth during shelf life while in the production facility, allowing estimation of end-of-life waste. Incorporating UV-C treatment in the meat production process barely increased the energy consumption of the process by 2%, when considering also the additional electricity required for extended product storage duration from 2 to 5 extra days. Furthermore, this integration resulted in reduced cross-contamination incidents and diminished water consumption during cleaning processes, thereby offering noteworthy environmental benefits.
Conclusion: Life cycle assessment confirms that implementing UV-C technology to extend meat shelf life can mitigate the overall environmental impact of the meat industry.

P2.1.021

Water extraction on several liquid food products using electrospray

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Aim:
The aim of the present study was to evaluate the potential of electrospraying technology for processing liquid food products and correlate the electrospraying conditions with the degree of water extraction.
Method:
A screening was done to determine the processing conditions for the different commercial liquid foods: apple juice, carrot juice, cranberry and grape juice, almond milk and soluble coffee. Samples were processed with a FluidNatek LE-10 under similar conditions: flow rate was 0.01 mL·min^{-1}, field intensity between 23-29 kV, and 10 cm between the tip and the collector. The environmental conditions inside the equipment were recorded during the electrospraying process, being 22-24 °C with a relative humidity of 30-40%. To calculate the level of concentration achieved (Q factor), the difference in weight between the initial and final product was measured and total solids were analysed at 105 ºC during 16 hours until constant weight, using an analytical balance.

Results:
The screening of electrospraying processing conditions for the different liquid foods tested showed that the field intensity must be adjusted for each of them due to the nature of the samples. Apple juice and cranberry and grape juice had a Q factor of ~ 2, which was very similar to that obtained in skimmed milk (Perez-Playà, 2022). However, it was higher for carrot juice and almond milk (Q factor ~ 4.5) and coffee (Q factor ~ 8.5). The significant Q factor increase observed ($p < 0.05$) was due to a higher water extraction, which could be attributed to two phenomena: the matrix of the processed food, which plays a fundamental role in water retention, and the optimisation of the environmental conditions, such as humidity control or the air renewal system, which were slightly different from those used in the previous study on milk.
Conclusion:
Electrospraying has given promising results for water extraction in different liquid food product matrices. The degree of water extraction depends directly on the product processed (B. Pérez-Playa (PCT/EP2023/025183)), electrospraying and environmental conditions. However, the optimum processing conditions to obtain food product powder have not been reached yet.

P2.1.022

Dieticians' recommendations to fast food brands for offering healthier and more sustainable menu items

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Aim: Fast-food consumption is a major concern when considering its impact on the environment and consumer health, particularly that of the young as a key target market of fast-food brands. Despite a recent and worldwide trend of offering more healthy and/or sustainable options within the fast-food sector, there is still room for substantial improvement. This paper discloses the recommendations of dieticians regarding how fast food chains could further extend their endeavors towards promoting healthy and/or sustainable consumption in these types of restaurants.
Method: Our empirical study takes a qualitative approach involving a series of semi-structured interviews with 15 dieticians in France. The total duration of the interviews was 12 hours 20 minutes, with an average duration of 50 minutes, a minimum of 27 min, and a maximum of 1 hour 08 minutes.
Results: Interviewed dieticians have observed improvements in fast-food items in terms of healthier and more sustainable products. According to dieticians, to further expand in this direction, traditional fast food brands should: 1) improve the quality of the products they serve by offering, for instance, better ingredients, more vegetables and fruits, more seasonal and local products and reducing the salt/sugar/fat content of existing offers; 2) increase their healthy and/or sustainable menu items with a larger assortment, above all in traditional chains such as *KFC*, *McDonald's*, *Pizza Hut*; 3) reduce portion sizes; and 4) communicate more – and more transparently – about healthy and/or sustainable options via not only the Nutri-Score (i.e., the disclosure of the products' nutritional score) but also other communication tools at the national level (e.g., advertisements on social media platforms) and in the restaurants (e.g., coupons to test new products). As far as new fast-food concepts centering on promoting healthy foods, dietitians see these as promising for preserving consumer health and the environment.
Conclusion: This research emphasizes a number of dieticians' recommendations that fast-food brands could consider in order to encourage young consumers to adopt new eating behaviors in their restaurants.

P2.1.023

Identifying barriers and challenges to increase sustainability of the agri-food chain through innovation practices

Julia Pinedo Gil[1], Laura Fernández Casal[1]
[1]Cartif

Aim:
To investigate challenges and opportunities for sustainability in the agri-food supply chain (FSC) under the EC's Green Deal and F2F strategy to understand how operators are transitioning towards sustainability and what factors are driving or hindering the process.

Method:
Relevant literature has been reviewed to study sustainable innovation practices in the FSC. Scopus database yielded 447 documents, of which 184 were selected for further analysis. It involved data collection, abstract screening, and full paper review. Then, 37 semi-structured interviews were conducted to operators and supporting organizations in the FSC. The interviews were based on a pre-set interview guide and lasted one hour. A representative sample of economic actors was selected, including big companies and SMEs, from different countries, EU regions and sectors.

Results:
Companies regardless size value integrate innovation into their daily activities. Large companies have a clear and organized innovation strategy, while SMEs struggle due to lack of resources, funding and communication with organizations. Large companies mainly fund innovation with internal resources and public grants, while SMEs only have access to public grants. There is a disparity of indicators used to measure innovation, with large companies using different environmental, economic, and social indicators, while SMEs lack the resources to measure innovation. Collaboration among companies and organizations is positively valued, but some stages of the FSC consider sharing knowledge about innovation with competitors irrelevant. The percentage spent on innovation and sales of innovative products vary and reliable conclusions cannot be drawn.

Conclusion:
Companies value innovation, sustainability and collaboration among them although there is a big challenge on how to homogenise the way to measure impacts. The EC's Green Deal and F2F strategy promote sustainability, but European policies are not effective at local level in South Europe. Companies agree that there is a movement towards sustainability, but it is still at an early stage. Effective transition towards sustainable production and consumption requires appropriate social awareness, legislation harmonization, and global agreements. Examples of necessary actions include raising consumer awareness, offering governmental guidance with a more aligned vision, and providing more incentives and direct funding for sustainable solutions in the primary sector.

P2.1.024

Effect of pressure and time combinations on selected qualitative parameters of pumpkin

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Aim:
Fruits and vegetables are processed using a variety of techniques; in the recent era, advanced non-thermal technologies keep fruit and vegetable quality attributes better than traditional thermal processing. Particularly, high-pressure processing method is a novel, nonthermal technology that has been investigated for use in the processing and preservation of food. In HPP, the pressure can be enforced instantaneously and evenly all around the food, regardless of its size or shape. Many studies have demonstrated that high pressure can affect the original properties of plants but it depends on the specific pressure-time combination.

Method: (heading must be in bold)
Pumpkins (Cucurbita moschata) were cut into 1.5 cm cubes and HPP treated from 100 to 600 MPa for 1, 3 and 5 min at HPP Italia s.r.l plant.The colour was measured on 10 cubes using a Minolta Colorimeter (CM2600d, Minolta Co., Osaka, Japan) equipped with a standard illuminant D65 and 10° position of the standard observer. Texture analysis was performed on 10 cubes using TA. XT2i Texture Analyzer equipped with a 25 kg load cell (Stable Micro Systems, Godalming, UK) with 35 mm diameter cylindrical probe and TPA at a speed of 1 mm/s up to 40% of the original sample height. Hardness, cohesiveness, resilience, and springiness were taken into consideration as textural characteristics. Total polyphenols and carotenoids were measured by means of LC-DAD-MS and LC-UV/VIS analysis, repsectively.

Results:
Pumpkin tissue showed great structural modifications as changes in cell size and shape, cell wall damage, increased cell wall thickness, cell detachment and dehydration, and calcium ions deposition depending on pressure-time combinations. Treatment time showed to increase total carotenoid and polyphenol content but only at intermediate pressure. Colour was affected by treatment too. All colour parameters (L*, a* and b*) decreased due tot the treatment and the best conditions seemed to be the intermediate ones.

Conclusion:
A kinetic model was developed regarding the effect of time and pressure on several qualtitative parameters of pumpkin. The developd model could be useful for process optimization by maximizing positive attributes and by minimizing negative ones.

P2.1.025

Designing an easily applicable framework for the monitoring of water characteristics during industrial potato blanching

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Aim:
Since industrial blanching water is, however, most of the time loaded with soluble components, such as reducing sugars, the extraction efficiency of these sugars from the potato products during blanching may be decreased at a certain concentration of these soluble components in the water leading to a less pronounced acrylamide reduction. So refreshment emerges, but the ratio is mainly based on subjective estimations of operators, leading to suboptimal water and energy consumption.

The aim of this study is to determine which physicochemical parameter(s) is (are) of importance to monitors, so the industry can preserve the water quality in function of the aim of blanching with a minimal water refreshment rate by using correlation analysis.

Method:
Blanching water from two full-scale operating industrial hot water blanchers was collected during production, starting from when the first potato products were processed after cleaning and disinfection until the next cleaning. The first blancher operated at high temperatures (88–91°C) with a short potato residence time (1.4–3.0 min), and the second at lower temperatures (68°C) with a long residence time (7–16 min). The water samples were characterized by analysing pH, turbidity, conductivity, COD, orthophosphates, nitrates, chlorides, dry matter, ash content, Kjeldahl nitrogen, sugars, starch, spectral absorption data, organic acids and micro-elements. Also, processing data from both blanchers were collected.

Results:
From the start of processing, a 9±5-hour build-up phase of concentrations occurs, followed by an equilibrium phase where concentrations are constant for the remaining processing time (±600 h). The ratio of processed potatoes to the consumed water affects the height of equilibrium the most.

Different linear regression models were developed and validated using an independent dataset to predict the blanching water composition based on the measurement of parameters such as conductivity, chlorides or spectral absorption.

Conclusion:
Continuous monitoring of easily online measurable parameters such as conductivity and/or spectral absorption data that are correlated to the difficult offline measurable parameters (i.e. starch) could lead to reduced water usage without neglecting the blanching functionality (i.e. sugar leaching and enzymatic deactivation) and thereby guaranteeing a good end product quality.

P2.1.026

Textural study of 3G snacks from different flours

PhD Student Diana Vicente-jurado[1], PhD José Daniel Gutiérrez-Cano[1], PhD Marta Igual-Ramo[1], PhD Purificación García-Segovia[1], PhD Javier Martínez-Monzó[1], PhD José Manuel Catalá-Civera[1]
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Aim: The aim of this work is to texturally characterize extruded and microwave-expanded 3G snacks and to compare the different flours used.

Method: The raw materials used in the extrusion were wheat starch (WS), rice semolina (RS), corn semolina (CS), and rice flour (RF). A single-screw laboratory extruder (Kompakt extruder KE 19/25; Brabender, Duisburg, Germany) with a barrel diameter of 19 mm and a length-diameter ratio of 25:1 was used, employing a compression ratio of 3:1 to obtain 3G pellets, which were expanded by heating in a conventional microwave oven. The snacks obtained were subjected to a puncture test to determine their texture parameters (crispness work (Wc), average puncturing force (Fp), average specific force of structural ruptures (Fs), spatial frequency of structural ruptures (Nsr), and the number of peaks (No)). These parameters were correlated to porosity and bulk density, obtained using a helium pycnometer, and with their expansion index.

Results: It was found that WS was the sample with the highest expansion index, while CS was the one with the lowest expansion, the latter having the lowest porosity, but the highest bulk density, resulting in higher W_c and F_s. The higher fiber content of CS with respect to the other materials would be responsible for a lower index expansion, which correlates with higher F_s and F_p. Instead, the high starch content of WS justifies its higher expansion with respect to the rest of the samples and, therefore, lower F_p and F_s. The similar composition of the RS and RF explains why there were no significant differences ($p < 0.05$) in the textural parameters, except for F_p, which was higher in the case of RF. This was because RF had higher porosity than RS, a parameter that is inversely correlated with F_p.

Conclusion: The higher fiber content gave the matter a lower expansion, which generated a crunchier texture compared to the rest of the samples. However, higher starch content favored the expansion of 3G snacks. Likewise, density was found to be inversely correlated with sample porosity, such that 3G snacks with higher density had lower porosity and were therefore crunchier.

P2.1.027

Towards a mild extraction process of rice bran protein

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Title: Towards a mild extraction process of rice bran protein

Aim:

Rice bran is a nutritional by-product from rice milling. Rice bran protein is commercially extracted by alkali extraction which might affect intact protein characteristics by hash chemical treatments. Furthermore, it consumes a lot of water. This study aims to investigate the influence of different process steps throughout the enzymatic extraction of rice bran protein and the potential decrease in water consumption.

Method:

Various process treatments including washing, enzymatic pre-treatment, defatting, alkali extraction, and combinations were applied in unstabilized and stabilized rice bran. The degree of hydrolysis(%DH) by Alcalase® was measured in the remaining insoluble fractions as an indicator of native protein conservation and as a final extraction step. High performance liquid chromatography(HPLC-SEC) was used to measure the characteristics of the hydrolysates. The protein extraction yields were determined to quantitatively compare among the different processing flows. The full enzymatic extraction process was adapted to decrease the amount of added water. Water consumption and protein extraction yields were compared to the original process.

Results:

Stabilization of rice bran had a negative effect on any of the following processes. Alkali treatment effectively extracted protein but severely denatured the native protein configuration, which made Alcalase® struggle on hydrolysis. Ultimase BWL40 as a chosen enzyme in lignocellulosic pre-treatment worked compromisingly with Alcalase®, which yielded protein as in alkali extraction by 75-80% and preserved the more native characteristic of rice bran protein. Regarding to defatted rice bran meal, defatting did not influence the activity of the enzymes used in this study. This means that both crude and defatted rice bran could reasonably be potential sources for enzymatic extraction of rice bran protein. The improving processes could save water by 58% while enzymes performed as effectively as that in the original process. However, downstream processes has to be developed to improve the extraction yield.

Conclusion:
Full enzymatic extraction of rice bran could be considered as a protein-friendly process with a yield similar to the commercial method. The process could be adapted at high solid concentration which is worth to further study.

P2.1.028

Valorisation of brewers' spent grain by fermentation with Lactobacillus plantarum

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Aim:
Brewers' spent grain (BSG) is a low-value co-product of the brewing industry produced annually in large quantities. BSG represents 85% of the by-products of beer production and the annual global production is estimated to be 39 million tonnes. BSG mainly consists of fiber and protein (up to 30%), which is a valuable source of bioactive peptides. This study aims to generate bioactive components, mainly peptides from BSG by the use of *Lactobacillus plantarum*.

Method:
Two different types of BSG which were investigated in this study were Blonde Wheat Beer, and Vanilla and Cocoa Milk Stout Beer. Each BSG was subjected to fermentation using *Lactobacillus plantarum* under 37°C anaerobic condition. The fermented BSG were collected every day within 10-day fermentation and the number of microflora on culture medium was evaluated by plate counting. The effects of the fermentation on the chemical characteristics of BSG were also investigated. Samples were measured for antioxidant properties, and the free amino acids and medium-sized peptides were determined using liquid chromatography coupled to high resolution mass spectrometry (LC-MS/MS).

Results:
The BSG characteristics of the two BSG types ranged from 2.5-3.5% moisture, 15.4-16.9% protein, 4.8-4.9% fat, 2.0-2.7% ash and 73.4-73.8% carbohydrate. There was an increase in the free amino acid in the two fermented BSG types. Proline, leucine and alanine were highest in Type 1 BSG, and lysine, glycine, isoleucine, and serine were highest in Type 2 BSG. The increase in the number of peptides was also found in fermented BSG. There was only few peptides detected in Day 0, 1, and 2 of fermentation. The number of peptides increased from Day 3, reached maximum in Day 7 and slightly decreased in Day 8, 9 and 10. The C-hordein peptides identified in this study had been reported with ACE and DPP-IV inhibitory activities in the literature.

Conclusion:
Lactobacillus plantarum had a direct effect on BSG through fermentation. The increased essential amino acids and bioactive peptides in fermented BSG showed that fermentation is an effective tool to convert a food waste e.g., BSG into a valuable food source that contain bioactive peptides.

P2.1.029

Characterization and Exploration of Utilizing Starch from Jackfruit Seeds, Avocado Seeds, and Durian Seeds for Lactic Acid Generation

<u>Ms Ngoc Tram Anh Le</u>[1], Professor Wei Ning, William Chen[1]
[1]Nanyang technological university

Title: Characterization and Exploration of Utilizing Starch from Jackfruit Seeds, Avocado Seeds, and Durian Seeds for Lactic Acid Generation

Short title: Starch from diverse seeds for lactic acid production analysis.

Aim: (heading must be in bold)

In the pursuit of sustainable manufacturing processes, the cost of resources and the efficiency of lactic acid production remain significant challenges in microbial fermentation. To tackle these issues and minimize environmental impacts, this study aimed to examine the properties of jackfruit seed starch (JFSS), avocado seed starch (ASS), and durian seed starch (DSS) obtained from fruit waste and assess the effectiveness of fermenting *Lactobacillus plantarum* and *Bacillus subtilis* using these starch as a substrate for lactic acid generation.

Method: (heading must be in bold)

JFSS, ASS and DSS were extracted and purified using the water extraction method. The amylose/ amylopectin, and resistant starch were determined using commercial kits. The morphology of starch granules was observed using a scanning electron microscope (SEM). The thermal dynamic of JFSS was measured by Thermogravimetric Analysis (TGA), and Differential Scanning Calorimetry (DSC). After the characterization of JFSS properties, the growth of each bacterium was measured to determine growth tendency. The number of cells and the efficiency of lactic acid production were determined by using plate counting and HPLC.

Results: (heading must be in bold)

ASS exhibited a substantial content of resistant starch. When utilized as a substrate in fermentation, JFSS promoted the growth of both bacteria and significantly increased lactic acid production compared to other seed starch.

Conclusion:

This study was valuable for selecting suitable sustainable substrates for lactic acid production. We believe that this finding might become a promising solution to remain a sustainable process for lactic acid manufacture.

P2.1.030

Hyperspectral imaging combined with artificial intelligence for identifying edible vegetable oils

Jeongin Hwang[1], **<u>Dr. Suyong Lee</u>**[1]
[1]Sejong University

Aim:

A variety of vegetable oils were subjected to hyperspectral imaging analysis, which was coupled to machine learning algorithms for identifying the edible vegetable oils. The classification performance of the machine learning models was compared with that of the fatty acid composition-based chemical methods.

Method:

The hyperspectral images of the oil samples were acquired, providing 224 spectral bands over a wavelength range of 900 – 1700 nm, and the fatty acid compositions of the vegetable oils were analyzed using a gas chromatograph coupled with a mass selective detector. Machine learning models for oil classification were constructed in a python programming environment with a Jupyter Notebook

Results:

The linear discriminant analysis showed that two linear discriminants were appropriate to explain 96.0% and 98.9% of the total variation in the fatty acid composition and hyperspectral imaging datasets, respectively. When the hyperspectral results were used as datasets for three machine learning models, several instances to incorrectly classify grapeseed and sunflower oils were detected in the decision tree and random forest models, while olive, palm, and flaxseed oils were successfully identified. The machine learning models showed a great classification performance that exceeded 98.9% from the hyperspectral images of the vegetable oils, which was comparable to the fatty acid composition-based chemical method in identifying edible vegetable oils.

Conclusion:

This study showed promising results of utilizing hyperspectral imaging combined with machine learning as an alternative to the conventional chemical method for oil classification. A new research framework for identifying edible vegetable oils was proposed by combining non-destructive hyperspectral experiments with machine learning analysis

P2.1.031

Investigation of Optimum Postharvest Fungal Control Condition in Ripening of Avocado Through X-ray Inspection

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Aim:

Avocados are transported across the globe as tropical fruits, but rotting often occurs during ripening, making its conditions necessary for consideration. Many researchers are attempting to research various temperature and ethylene treatments to inhibit impact the subsequent quality of avocados during ripening. Moreover, internal rot can only be detected by cutting the avocados destructively. In a previous study, an X-ray system, which has advantage of evaluating the quality of thick-skinned fruit since it can penetrate deep inside an object, is developed to visualize the internal rot of avocados. Our study aims to find the optimum ripening condition through temperature and humidity control by non-destructively monitoring the fungi contamination process inside avocados using an X-ray image.

Method:

Twenty avocados were stored each at 20, 50, 70, and 90%RH at 20 and 25°C for 6 and 7 days, respectively. Before storage, all avocados were washed, surface disinfected by immersion in 200ppm *Sodium Hypochlorite* (contain 5% free Chlorine) for 5 minutes, and air-dried. Stem-End-Rot (SER) was created artificially through the exposure of *Nectria Pseudtrichium* spore solution into the stem area of avocados without a stem. Skin appearance and value, and weight were observed daily. The internal rot is monitored through an X-ray image every day.

Results:

The result showed that rot occurrence in ripening depended on the temperature and was significantly affected by humidity. Avocados stored at lower temperatures and humidity experienced less rot. At 20°C and 20%RH, only 1 fruit has SER. In contrast, at 20°C and 90%RH, almost all fruit contains SER with some damage ratio, whereas only 2 fruits have no SER. The internal rot appearance through X-ray also confirmed this finding. However, despite the absence of SER at 20%RH, other issue, such as other disorders and high weight loss, were found. Nevertheless, weight loss issue can be managed by choosing 50%RH having lower weight loss.

Conclusion:

These findings suggest that the optimum ripening condition for preventing fungi growth occurred at lower temperature and humidity, particularly at 20°C and 20% RH. The optimum ripening condition can be developed by optimizing the temperature and humidity, and inspected non-destructively using X-ray.

P2.1.032

Quality monitoring throughout the Atlantic salmon value chain – the potential of multispectral imaging

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[1]NTNU - Norwegian University of Science and Technology, [2]Videometer A/S, [3]SCiO P.C.

Aim:

The present study aimed to map stakeholders' needs and test and validate a portable multispectral imaging prototype (VideometerLite) for non-destructive quality monitoring throughout the Atlantic salmon value chain. Moreover, the study aimed to generate input data from the Atlantic salmon value chain to develop an *intelligentFishManagementSystem (iFMS)* that incorporates quality prediction AI models built on the generated data.

Method:

The quality parameters of interest were defined by mapping stakeholders' requirements along the Atlantic salmon value chain through semi-structured interviews, literature searches, and the project groups' know-how and experience. Based on the initial mapping, a pilot plan was developed to meet the user requirement specification. Data acquisition was conducted from laboratory-designed experiments simulating different scenarios of unwanted incidents and quality issues identified in the initial mapping. Generally, multispectral images (> 500) of investigated parameters were analyzed using the VideometerLAB software segmentation, where the image transformation was fixed to fit the specific parameter and tissue of interest. To validate the multispectral prototype's potential, all investigated issues and parameters were analyzed using reference methodology commonly used by the industry and in seafood science. Data were presented as a comparison of multispectral data against data obtained by standard analytical protocols measuring chemical, physiochemical, microbiological, and sensory parameters.

Results:

The initial mapping among the salmon stakeholders identified quality parameters such as texture, color deviation, melanin spots, residual blood, and loss of freshness and spoilage. Food safety issues related to contamination of *Listeria monocytogenes* were also mentioned but were excluded due to known limitations of the multispectral technology. Some specific results to highlight are; it is possible to use multispectral images obtained by the portable prototype developed to distinguish between firm and soft fillets ($p<0.047$) and to identify color deviation ($p<0.001$), melanin spots ($p<0.001$), loss of freshness and increased spoilage ($p<0.001$). Other parameters, such as pigment concentration and muscle blood content, will be further investigated and presented at the conference.

Conclusion:

It is concluded that the tested multispectral prototype generates data that can be further used in an iFMS meeting the required specification identified among stakeholders along the Atlantic salmon value chain.

P2.1.033

Upcycling of soy whey with Ischnoderma benzoinum towards production of bioflavors and mycoprotein

Jiaqi Liang[1], Prof. Ning Xu[2], Dr. Ann-Kathrin Nedele[1], Dr. Marina Rigling[1], Dr. Lin Zhu[1], Dr. Youfeng Zhang[1], Felix Stoeppelmann[1], Lea Hannemann[1], Julia Heimbach[1], Prof. Reinhard Kohlus[1], Prof. Yanyan Zhang[1]

[1]University of Hohenheim, [2]Northeast Agricultural University

Aim:

Soy whey is a by-product contains various nutrients including proteins, oligosaccharides, simple sugars, soy isoflavones, and minerals. However, soy whey is mainly disposed into sewage, and this can pollute water bodies. The aim of this research is to recycle this by-product, for this purpose, basidiomycetes-mediated fermentation was used to tune the sensory property of soy whey sample due to their unique biocatalytic potential for natural flavor generation, good compatibility, and high consumer acceptance. Also, it brings potential to produce value-added mycoprotein which is the proteinaceous food gained from filamentous fungal biomass.

Method:

Seventeen basidiomycetes were screened for the submerged fermentation of soy whey in our preliminary study. Afterwards, by application of stir bar sorptive extraction (DI-SBSE) in combination with gas chromatography-mass spectrometry-olfactory (GC-MS-O), the odorants were identified in unfermented and fermented soy whey samples by comparison of odor impressions, retention indices, and mass spectra with those of authentic standards. In addition, the quantitative analysis of the key odor-active compounds in both samples were conducted by external standard method. Furthermore, a sensory analysis of both samples was assessed by a trained panel. Finally, the crude protein, free amino acids, and bond amino acids contents of the mycelia were determined according to European commission regulation.

Results:

After the fermentation up to 7 d, the soy whey displayed a wide range of odor profiles, whereas the unfermented soy whey as blank still described with a sourish and green odor note. Ischnoderma benzoinum (*I. benzoinum*) showed an intensely almond-like and sweetish flavor after fermentation (20 h). After the analysis of DI-SBSE-GC-MS-O, around 1.0 mg/L benzaldehyde and 1.1 mg/L 4-methoxybenzaldehyde imparting a pleasant almond-like odor note were determined in the fermented soy whey. Concurrently, a certain of amount of the dry mass of *I. benzoinum* was accumulated with 7.32 % crude protein and seven essential amino acids.

Conclusion:

In summary, in response of the sustainable use of soy whey, two promising almond-like odorants were synthesized together with the value-added mycoprotein. The flavorful soy whey performs potential to be used in industry in forms of value-added bioflavors, alternative protein, and a novel drink.

P2.1.034

Impact of pH on the microbial inactivation by hyperbaric storage of watermelon juice

Mr Vasco Lima Vasco Lima[1], Professor Jorge Saraiva[1]
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Aim:
Appropriate storage conditions are required to preserve foods by preventing or delaying microbial deterioration or quality problems. A novel technology for storing foods under mild pressures, hyperbaric storage (HS), has been proposed as an alternative to conventional refrigeration. HS can be used at uncontrolled room temperature (RT), which is a significant advantage for allowing for virtually no energy costs and substantially lower greenhouse gas emissions and has been demonstrated to preserve foods equally or better than refrigeration. This work aimed at studying the impact of pH on the preservation of watermelon juice at pH 4.0 and 6.5 (exemplifying an acidic and non-acidic food, respectively) by HS at RT, focusing on the behaviour of *Escherichia coli*, the pathogenic *Listeria monocytogenes* and *Saccharomyces cerevisiae*.

Method:
Watermelon juice's pH was adjusted to 4.0 and 6.5 and inoculated with ~6-7 log CFU/g of either *E. coli*, *L. monocytogenes,* or *S. cerevisiae* and stored up to 28 days at different pressure levels (25-100 MPa) at RT (18-23 ºC), along with control samples kept at atmospheric pressure either in RT or refrigerated conditions. Microbial counts were evaluated at different sampling points throughout storage.

Results:
The results showed that increasing the pressure levels increases the rate of microbial inactivation in both juices. The juice's pH differently impacted the inactivation depending on the microorganism tested, as for both bacteria tested, the inactivation was quicker at pH 4.0. For *S. cerevisiae*, however, juice at pH 6.5 demonstrated slightly quicker inactivation. Depending on the initial microbial load, inactivation results over 5 log CFU/g were observed, thus also pointing to HS as a possible new pasteurization methodology.

Conclusion:
While the watermelon juice is preserved, not only the growth of the studied microorganisms can be controlled but their inactivation can reach the level of pasteurization (≥ 5 logs), revealing that HS can also have great potential as a novel nonthermal pasteurization technique at uncontrolled room temperature with *quasi* no energetic costs. The behaviour of foods with different pH levels should be further studied to better select the best HS preservation conditions, for both storage and possible pasteurization during storage.

P2.1.035

Potential of Cellulose Nanofibers from Salicornia ramosissima waste as Reinforcing Agent in Chitosan-Based Films

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Aim:

This work aimed to evaluate the physical, mechanical, and biodegradability performance of chitosan-based nanocomposite films reinforced with different loads of cellulose nanofibers (CNFs) obtained from *Salicornia ramosissima* agro-industrial waste, envisioning the development of sustainable and biodegradable materials for food packaging.

Method:

CNFs were obtained, in a previous study, by an enzymatic method combining xylanase and cellulase enzymes. The films were produced by solvent casting using different proportions of CNFs (1 and 2% w/w). As control, chitosan-based film (without CNFs) were also prepared. Glycerol was used as plasticizer.

Results:

The increase in the CNFs levels reduced moisture content (46.5 ± 1.1% to 43.3 ± 0.6% and 36.7 ± 0.2%) and increased the solubility in an aqueous medium (17.4 ± 0.1% to 19.2 ± 0.1% and 18.6 ± 0.2%), and thickness (0.10 ± 0.02 mm to 0.18 ± 0.02 mm and 0.21 ± 0.03 mm), respectively for control, CNF1% and CNF2% films. The control film was colorless and less opaque than the CNF-reinforced films. The increase in nanofiber levels increased tensile strength from 2.58 ± 0.27 MPa (control) to 3.27 ± 0.45 MPa (CNF1%) and 6.15 ± 0.17 MPa (CNF2%). The reinforced films also became stiffer than the control, increasing the Young´s modulus from 0.10 ± 0.01 MPa (control) to 0.31 ± 0.03 MPa (CNF1%) and 0.58 ± 0.05 MPa (CNF2%). Meanwhile, the maximum elongation at rupture decreased from 26.3 ± 1.4% (control) to 10.5 ± 1.1%, and 10.8 ± 1.4% (CNF2%). SEM and TGA analysis of films showed that the reinforced films had a rougher surface. However, 1% of CNF was better incorporated into a chitosan-based matrix than 2%. ATR-FTIR spectra showed that CNF-reinforced films had a protective effect against UV-induced degradation. Finally, the films showed also good biodegradation capacity after 28 days in soil (around 90%), and after 60 days in seawater (fully fragmented).

Conclusion:

Overall, CNFs from *S. ramosissima* waste as a reinforcing agent improved the resistance of chitosan-based films and showed good biodegradation properties. These findings should be considered for further research using this nanofibers to produce sustainable food packaging.

P2.1.036

Acid whey valorisation via heterotrophic cultivation of Crypthecodinium cohnii microalga for DHA production

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Acid whey valorisation via heterotrophic cultivation
of *Crypthecodinium cohnii* microalga for DHA production

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Aim:
The steadily increasing global popularity of Greek strained yoghurt has necessitated alternative valorisation approaches concerning the acid whey effluents from straining process, amounting to twice the final product volume. In this context, acid whey can be utilized as nutrient substrate for microalgae cultivation. *Crypthecodinium cohnii* is a heterotrophic microalga producing high amounts of polyunsaturated fatty acids, mainly docosahexaenoic acid (DHA), with important nutritional and added value.

Method:
Crypthecodinium cohnii was cultivated in nutrient media by replacing the typical carbon source (glucose) with a) different sugars (galactose, lactose) and b) different proportions of non-hydrolysed (AW) and hydrolysed (HAW) liquid acid whey (20-100 % v/v). AW lactose hydrolysis into glucose and galactose was performed using β-galactosidase from *Kluyveromyces lactis.* The effect of carbon source, whey hydrolysis, and whey concentration on biomass growth kinetics and DHA production was evaluated. Biomass growth was measured spectrophotometrically, and DHA produced by *C. cohnii* were identified and quantified via Gas Chromatography with Mass Spectrometry and Flame Ionisation Detector, after extraction and esterification.

Results:
C. cohnii grew optimally using glucose and galactose, while exhibiting a lag phase when lactose was used as carbon source. Concerning the effect of acid whey hydrolysis on growth kinetics, similar levels of biomass concentration were achieved in both cases, though growth was faster with HAW. Acid whey concentration, hydrolysed or not, significantly affected *C. cohnii* growth kinetics. Maximum biomass growth was achieved using 60 % v/v of AW and 20 % v/v of HAW in culture medium. However, maximum DHA production yields were achieved using 20 % v/v of either AW or HAW in culture medium. Thus, the optimum whey concentration to achieve maximum DHA concentration per L of microalga culture was 20 % v/v AW.

Conclusion:
Acid whey exhibited great potential for microalga strain *C. cohnii* cultivation, producing high amounts of polyunsaturated fatty acids. Further research towards optimization of *C. cohnii* cultivation in acid whey, as an innovative valorisation method, is essential for efficient production of valuable food ingredients, like DHA from a significant dairy industry byproduct, in the framework of circular economy.

P2.1.037

Calculating environmental impact for meals: problems and implications for standardisation

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Aim:
The aim of this work is to assess the environmental impact of various restaurant and quick service meals. It will also outline different methods of environmental impact assessment, highlighting key limitations and implications for standardisation.

Method:
The environmental impact of different meals was assessed using life cycle assessment techniques. The scope and boundary of this life cycle assessment were co-created based on stakeholder inputs and scientific evidence. This resulted in an agreed system boundary of farm-to-shelf for the ingredients included in each meal, i.e. environmental impacts resulting from transport between local distribution centre and restaurant or home were not included. Where required, secondary data was used as inputs for the assessment. Environmental impact was assessed using the global warming potential (GWP) metric and Envrioscore. Enviroscore is a 5-scale label that relativizes the environmental impact of a given product based on the Product Environmental Footprint methodology. This work applies Enviroscore to complete meals for the first time.

Results:
A variety of meals, including meat based and vegetarian dishes were assessed using the GWP and Enviroscore metrics. Meals were ranked based on their GWP and also based on an Enviroscore label, ranging from A (very low environmental impact) to E (very high environmental impact). Results of the GWP and Enviroscore were then compared to determine any discrepancies between the two impact assessment techniques.
In general and as expected, vegetarian meals have a lower environmental impact than meat-based meals, however, this depends greatly on the means of production used for each ingredient assessed. In terms of impact assessment method, the Envirscore provides a more holistic approach with 13 different environmental impact metrics considered. However, there is much more data available to use when assessing the global warming potential. A detailed comparison of GWP vs Environscore when applied to a range of quick service meals will be presented.

Conclusion:
Both the global warming potential and Enviroscore are effective ways to assess the environmental impacts of meals. However, their impact will depend greatly on the availability of accurate and detailed information. A key limitation going forward will be the availability and quality of data used for meal inputs.

P2.1.038

Raw meat pasteurization without colour changes by moderate pressure pasteurization, an emergent methodology

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Aim:
Moderate pressure pasteurization, MPP, was recently propose as a new slow, pressure-based pasteurization methodology for highly perishable and heat/pressure-sensible foods, such as raw meat. MPP possesses several advantages over the currently available preservation methodology, refrigeration. It has superior energetic efficiency since it doesn’t require temperature control and it only consumes energy for compression/decompression. However, the extent of the effect of MPP in the raw meat colour, the most important parameter evaluated by consumers, it still unknow. Therefore, the aim of this work was to evaluate the impact of MPP on raw meat colour and other physicochemical parameters, while guaranteeing microbial inactivation/pasteurization.

Method:
Pork minced was preserved using MPP (125, 165, 200 MPa) at uncontrolled room (≈ 15 to 25 ^{o}C) and refrigeration (4 ^{o}C) temperatures. *Salmonella enterica* and *Staphylococcus aureus*, two of the most common pathogenic microorganisms, were evaluated. Simultaneously, the colour and other physicochemical characteristics, such as pH, drip loss and water hold capacity were evaluated to determine the optimal conditions that combine high levels of microbial inactivation with minimal physicochemical changes.

Results:

Salmonella enterica and *Staphylococcus aureus* were load up to 6.3 and 4.4 log units at 200 MPa/RT, respectively so MPP gradually reduced the inoculated microorganisms, thus enhancing meat's microbial safety, but with a significant impact in colour. At 125 MPa/RT, mild colour changes were observed, resulting in a very similar look like fresh raw meat, while a slower microbial reduction was detected up to 4.7 and 2.8 log units for *Salmonella enterica* and *Staphylococcus aureus,* respectively, thus, still improving meat microbial safety. Additionally, the combination of MPP with refrigeration temperatures neither improved microbial inactivation nor colour retention.

Conclusion:
These results validate MPP as a promising methodology for raw meat pasteurization without basically no colour changes, being such a result not possible until now with the currently available pasteurization techniques. Further studies are so on great interest on the effect of MPP on meat and other proteinaceous foods that are sensible in relation to quality issues to the current pasteurization methodologies, including nonthermal high pressure pasteurization.

P2.1.039

Assessment of (microbiological) air quality during packaging of (semi) - liquid food products

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Aim:
Although it is assumed that there is a risk of airborne contamination, establishing acceptable limits for the food industry is challenging due to variations in air sampling technique, a lack of consistent data and an abundance of speculation. Regulations and legislation, such as European Union regulation 852/2004/EC on the hygiene of foodstuffs, focus on the prevention of airborne contamination in food processing plants. This study aims to gather quantitative data towards guidelines that can justify investment costs for prevention, or prevent unexpected spoilage of products.
Method:
Air quality is assessed in fourteen diverse (semi)-liquid food processing plants in Flanders, Belgium. Microbiological air samples were collected from each plant, both indoors and outdoors, on four separate days from January to September 2022. For each sample, possible influencing factors of airborne contamination, such as as the type of ventilation system, personnel and their clothing, total particle count, relative humidity, temperature, processing and cleaning operations, and moving or rotating equipment during filling were considered in relation to the microbiological air quality.
Results:
The study revealed a broad range of mesophilic microorganisms and moulds and yeasts among companies, irrespective of their product type, location, personell, total particle count, temperature, and relative humidity. Airborne microorganism may fluctuate within a company, however, the variation indoor is less than in outdoor air. The most decisive influencing factor appears to be the type of ventilation system. The study observed a decrease in actively measured microorganisms with greater filtration efficacy towards smaller particulate matter. Mesophilic microorganism levels were higher indoors and outdoors during summer compared to winter, with the difference being more pronounced in outdoor samples. Active and passive measurements exhibited a strong correlation.

Conclusion:
It appears that the air quality of a food company, in the filling area, cannot be clearly attributed to influencing factors. It is the combination all these factors that determine the air quality of the food company, and as such the contamination on the product.

P2.1.040

The application of by-streams as food ingredients: Design of 3D printing ink with asparagus fibre

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Aim:
Agri-food by-products generated during industrial processing such as asparagus bottom can potentially be valorised as food ingredients e.g., dietary fibre concentrates (DFC). These fibre-rich DFCs can be applied in various foods, i.e., fibre fortified food. In this study we focus on the design of a food ink fortified with asparagus fibre, and specially on the use of an oil-in-water (O/W) emulsion. The aim of this study is to investigate the effect of asparagus DFC on the mechanical properties of O/W emulsions for 3-D printing.

Method:
Discarded asparagus bottom were provided by an asparagus grower and processed to separate the juice and the fibres. Subsequently, fibres were dried and milled to obtain the final DFC powders. A series of O/W emulsion gel formulas were designed with various asparagus DFC contents and oil contents. The rheological properties of these O/W emulsions were measured. The O/W emulsion gels were evaluated as an ink in a 3D food printer and the quality of the printed objects was evaluated visually. The microstructure of the O/W emulsions was visualized with Confocal Laser Scanning Microscopy.

Results:
The addition of asparagus DFC improved the rheological properties of O/W emulsion gel. Notably, an increase in viscosity, storage modulus, yield point was observed. These enhancements indicate a strengthened ability of the O/W emulsion gel to maintain its own structure. As a result, the printability of the O/W emulsion gel was greatly improved, leading to better shape stability and clearer details in the final product. The microstructure of O/W emulsion gel changed in fibre density and oil droplet size. Furthermore, the fibre can serve as a partial fat replacer while still maintaining the desired printing characteristics.

Conclusion:
This study is a showcase for the use of a an agri-food by-stream as a food ingredient. Specifically, we showed that asparagus fibre could be used as an ingredient in a O/W emulsion food ink to improve its printability. We found that the fat content could be reduced while the fibre content increased, such that the overall ink formulation is more nutritious than before.

P2.1.041

High-moisture extrusion of pea protein: effect of oat protein concentrates and post treatment on properties.

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High moisture extrusion of pea protein: effect of different oat protein concentrates and post treatment of meat analogues on selected technological properties.

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Abstract

Pea protein meat analogues were produced using high-moisture extrusion (HME) to study the effect of including 10% oat protein concentrates (OPC) of different origins, produced by wet (OATP) or dry fractionation (OATA). The physical and techno-functional properties, including water and oil absorption capacity, cooking yield, texture, and colour, as well as the microstructure of meat analogues were investigated. The impact of post-extrusion treatment (water treatment at 80°C/20 min) on texture and colour changes was also analyzed. In general, the inclusion of OATP increased the cutting force of pea protein extrudates, while OATA did not significantly impact the pea protein texture. The colour of the meat analogues was significantly affected by the type of OPC added. Microstructure images showed that OPC influenced fiber alignment and compactness of the protein network, as well as the observed differences in water absorption capacity of the extrudates. The cooking yield, however, was not influenced by the type of OPC added. Hot water treatment significantly increased the lightness of all meat analogues in colour and significantly reduced their cutting strength. The reduction of texture strength of OATP rendered it similar to boiled chicken samples, while OATA showed a more resilient fiber strength to hot water treatment.
Keywords: High-moisture extrusion, oat protein concentrates, pea protein, microstructure, texture, colour

P2.1.042

EXTRACTION OF HYDROXYMETHYLFURFURAL (HMF) USING AQUEOUS TWO-PHASE SYSTEMS BASED ON CHOLINE IONIC LIQUIDS

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Aim: The aim of this work was to develop and implement extraction procedures for isolating HMF from honey, in order to ensure its health safety and to enable the further application of isolated HMF in various branches of industry. Bio-ionic liquids are seen as an ideal extractant for both purposes, and additionally, they can be reused (recycled), which lowers the cost of the analysis/process, as well as environmental pollution.

5-Hydroxymethylfurfural (HMF) is formed as an intermediate in the Maillard reaction and directly, by dehydration of sugar in an acidic environment (caramelization) during thermal treatments of honey. In the mid-1950s, Albertsson proposed the use of aqueous two-phase systems as an alternative to traditional liquid-liquid extraction techniques, which usually require the use of volatile and toxic organic solvents. The aqueous two-phase system consists of two immiscible aqueous phases and is based on the combination of polymer-polymer, polymer-salt, and salt-salt. Among them, the most studied class is ionic liquid-salt systems due to the high ability of salt ions to induce saltation of the ionic liquid and consequently create two aqueous phases.

Method: In this study, choline ionic liquidis were used. The binodal curve construction was based on the cloud point titration method, while HPLC-DAD was used for HMF detection.

Results: By applying all tested aqueous two-phase systems based on choline ionic liquids (choline chloride ([Ch][Cl]), choline nicotinate ([Ch][Nic]), choline propionate ([Ch][Prop]) and choline butyrate ([Ch][But]) and inorganic salt K_3PO_4 for the extraction of HMF from honey, the extraction efficiency of more than 85% was achieved. Complete extraction was achieved using the extraction system with [Ch][But], while the weakest ability to extract HMF exhibited a system with [Ch][Cl].

Conclusion: Investigated aqueous two-phase systems based on bio- ionic liquids showed great efficiency in extracting HMF.

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P2.1.043

Investigation of the effect of pectin-based microgel particles on texture properties of a pea-based yogurt

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Aim:

Yogurt, a fermented milk product, is an important part of many people's daily diet. In recent years, there has been a surge of interest in a vegan diet for ethical, moral and health reasons. Typical plant-based yogurt alternatives are made of soy, almonds or rice. Due to the different molecular structure of plant proteins, gel structures differ compared to conventional yogurt. They are often described by consumers as too firm, too compact, or sandy, and thus perceived as inferior quality. The aim of this research is to modify the texture of vegan yogurt alternatives, especially those with high protein content, to match the texture of a commercial milk-based yogurt and thus meet consumer expectations.

Method:

The rheological properties of vegan yogurt can be optimized by adding dietary fiber in the form of pectin-based microgel particles (MGPs). MGPs are lyophilic, particulate biopolymer networks in the micro- to nanometer range, which exhibit properties of gels and particles as well as polymers. The addition of MGPs in different concentrations leads to a change in the gel structure and rheological properties of vegan yoghurt alternatives. Moreover, the protein concentration, the oil content and the type of pea protein in the ferment were varied.

Results:

It is shown how the addition of MGP to pea-based high protein yoghurt affects the gel structure of the vegan yoghurt alternative. To obtain a structure of the vegan yogurt alternative comparable to that of a milk-based yogurt, the ratio of protein concentration, oil concentration and MGP concentration is crucial. Furthermore, a decisive influence of different pea proteins (from various manufacturers) on the yogurt alternative was shown. Special attention is paid to the rheological as well as tribological properties of the vegan yogurt alternative.

Conclusion:

By adjusting the MGP concentration in vegan pea-based high protein yoghurts, the texture could be modified to resemble a milk-based yoghurt. In addition, the lubricating properties of vegan yogurt could be further improved. This results in a product with enhanced creaminess. In summary, it can be shown that MGP can be successfully used to improve plant-based yoghurt alternatives to meet customer expectations.

P2.1.044

Green co-extraction coupled with HPLC-UV detection of Acrylamide and 5-Hydroxymethylfurfural

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Aim: Acrylamide (AA) and 5-Hydroxymethylfurfural (HMF) are toxic substances. Maillard reaction is the primary formation mechanism of those food process contaminants. They are undesired chemical by-products formed during the thermal processing of foods rich in reducing sugars. The aim of this study is to develop a green simultaneous extraction method for AA and HMF compounds and its subsequent quantification by High Performance Liquid Chromatography (HPLC) coupled to UV detector (HPLC-UV). The proposed extraction method has the advantage of using low quantity of solvents, thus complying with the Sustainable Development Goals related to health and environmental protection.

Method: The co-extraction protocol is based on a modified QuEChERS method. 1g of grounded sample was added to 10 ml of water and vigorously stirred for 10 minutes. Following this, the solid phase was separated and discarded, while the liquid phase undergoes purification using 0.5 g of MgO and $ZnSO_4$. Then, aqueous extract was concentrated using a solid phase extraction (SPE) column. AA and HMF were recovered with 2 mL of methanol and then ~~it was~~ evaporated to dryness under a nitrogen stream. Before injection, extracts were reconstituted with 1 mL of Mili-Q Water. AA and HMF quantification was performed by HPLC-UV. The chromatography parameters were 1 mL/min of flow, and the mobile phase used was Water:ACN (95:5). UV detector was set at 210 nm for AA quantification and for HMF at 280 nm.

Results: Considering the instrumental noise recorded at 210 nm, the limit of detection (LOD) and limit of quantification (LOQ) for AA was calculated to be 10 µg/L and 30 µg/L, respectively. Regarding HMF, the estimated LOD and LOQ values are 3 µg/L and 10 µg/L.

Conclusion: The obtained results demonstrate the effectiveness of the proposed extraction technique in extracting Maillard reaction products. However, to mitigate the interferences caused by other water-soluble compounds present in the food, additional purification techniques with enhanced selectivity are required.

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P2.1.045

Functional properties of proteins from sunflower oil press cake valorised by diafiltration membrane processes

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Aim:
Sunflower seeds are used worldwide for the production of oils. Oil press cake with a high protein content is produced as a by-product. The aim of the study was to investigate the functional properties of these proteins.

Method:
Oil press cake suspended in water was adjusted to pH 9-10. The dissolved proteins were purified using a diafiltration membrane process and concentrated or dryed using an evaporator, freeze or spray dryer.
The proteins were redissolved in water at pH values between 5.5 and 10 in different concentrations between 10 and 30 % to investigate both their solubility and their functional properties. The protein solubilities were systematically modified by adding NaCl and removing polyphenols.
By means of rheological measurements, the gel formation properties were investigated based on storage modulus G', loss modulus G'' and loss tangent tan δ at different temperatures between 85 and 100 °C, which were kept between 5 and 20 minutes. In addition, foam capacity and stability were measured.

Results:
The lowest protein solubility was found at a pH of 5.5, which is close to the isoelectric point. Higher pH values resulted in higher protein solubilities. The best solubility was found at pH 10 when polyphenols were removed from the sample at the same time.

The best results for the gelling properties were obtained at concentrations of 20 and 30 %. In addition, longer holding times at the highest temperatures had a positive effect on the gel formed. Higher values for the storage modulus G' could be determined for the samples without polyphenols, while no significant influence of NaCl could be detected.
The foaming capacity was above 140% in all samples, the best foam stability after 1 h was found in the sample with 1.5% protein.

Conclusion:
In this ongoing project, it was successfully demonstrated that proteins from sunflower oil press cake purified using diafiltration membrane processes have interesting functional properties for the food and cosmetics industry. Our industrial partners are testing the products in the field of protein-enriched bakery products as well as in the production of solid personal care products and are demonstrating convincing product qualities.

P2.1.046

X-ray Imaging and Skin Color Analysis as a Reliable Indicator for Postharvest Avocado Rot Inspection

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Aim:
This study aimed to establish a reliable indicator for determining when to conduct postharvest fruit inspection of avocado. Since avocado rot development cannot be detected from its external appearance, the study used X-ray images to non-destructively detect infected regions and investigated the relationship between skin color change and rot development.

Method:
The experiments were conducted three times in the fall of 2019 using 422 unripe Hass avocados imported from Mexico. The fruit was stored under conditions of 25°C and 30–60% RH for five days until reaching the edible stage. The X-ray image of each fruit was obtained daily during the ripening period. The infected regions in the X-ray image were manually labeled to determine the changes in the severity of rot in each fruit. In addition, the skin color values (L*a*b*) were determined for each fruit daily.

Results:
During the ripening period, the average L*, a*, and b* values of the fruit skin changed from 32.9 to 28.1, -5.8 to 2.4, and 12.8 to 6.8, respectively, with the fruit appearance changing from green to dark brown. Rot symptoms were observed on 66 (16%) fruit cut surfaces on the last day of ripening. X-ray images showed that the number of rotten fruit increased exponentially as the ripening progressed, indicating the importance of timely inspection to avoid missing potentially rotten fruit. This study also showed that the skin color values of avocados with rot development were concentrated in the 0–4 and 2–6 ranges for a* and b* values, respectively. Additionally, the variety of skin colors reduced during the ripening period, suggesting that changes in skin color can be a reliable indicator for postharvest inspection to detect avocado rot.

Conclusion:
The study found that skin color change suggested the timing of rot development during the postharvest ripening processes of avocado. The results provide valuable information for vendors to determine optimal ripeness levels, reducing the risk of delivering rotten fruit to consumers.

P2.1.047

New method for pulsed electric field effectiveness assessment

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Aim:
The main action of pulsed electric field (PEF) is to induce the phenomenon of electroporation, i.e., the creation of new and/or enlargement of the already existing pores in the cell membrane. Biospeckle activity and isothermal calorimetry may allow for a precise assessment of the stress response of plant material to the action of the electric field, and an accurate description of the mechanism of the occurring phenomena. The aim of this study was to analyse the impact of PEF treatment on the metabolic processes of apple and carrot tissues.

Method:
The research material consisted of two types of plant materials, differing in anatomical structure - apple and carrot. Both raw materials were treated with a PEF, with constant values of pulse frequency, pulse duration, electrode voltage, and electric field strength. Changes were made to the specific energy input value, and three different levels of this parameter were analysed in the study. After PEF treatment, both materials were subjected to isothermal calorimetry and biospeckle activity analyses. Measurements were made in three-hour blocks, with one-hour intervals between analyses. This allowed for a comprehensive analysis of changes in plant tissues over time. In addition, apple and carrot not treated with PEF were also evaluated.

Results:
It was observed that treatment of the tested materials (i.e., apple and carrot) with a PEF caused changes in the metabolism of these tissues. These changes concerned both metabolic heat production (isothermal calorimetry), and the physical movement of particles within cells (biospeckle activity). Reversible electroporation can cause the induction of stress which is manifested by increased activity of metabolic processes. On the other hand, the irreversible electroporation can lead to the loss of cells viability.

Conclusion:
The more energy is supplied to the material during PEF treatment, the more its cell structure is damaged, which also has effect on its metabolic processes. PEF may act as an abiotic stressor, influencing the metabolism of the treated tissue.
This project has received funding from the National Science Centre (Poland) under the PRELUDIUM grant agreement No 2022/45/N/NZ9/02859.

P2.1.048

Designing an immobilisation system for amyloglucosidase using a chitosan-SDS coacervate for sustainable enzymatic beverage manufacturing

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Aim: Immobilised enzymes can be a sustainable alternative for enzymatic reaction processes. The use of immobilised enzymes in beverage manufacturing, for example, can bring many advantages to the process, such as enhancing enzymatic stability and the ability to withstand harsh processing conditions. It allows for multiple reuses of the same catalytic compound and for a controlled reaction by simple filtration. In addition, it reduces the risk of contamination and results in a more efficient, cost-effective, and higher-quality product. Therefore, targeting the benefits of enzyme immobilisation, this study aimed to design an novel immobilisation system of amyloglucosidase using chitosan-SDS coacervate.

Method: Capsules of chitosan-SDS loaded with amyloglucosidase were produced through simple coacervation by extruding chitosan-amyloglucosidase solution into sodium dodecyl sulfate solution. The enzymatic performance of free and encapsulated enzymes was evaluated for 300 minutes of gelatinised corn starch hydrolysis. The reducing sugar produced was determined by spectrophotometry, at a wavelength of 540 nm, through the DNS assay. A study of stability, kinetic properties, and morphology characterisation were also performed.

Results: Self-supporting structured, stable, and spherical chitosan-SDS reservoir-type capsules (3.17 mm ± 0.03), composed of a core (2.62 mm ± 0.05) and a membrane (0.55 mm ± 0.02) surrounding soluble amyloglucosidase were produced. Desirable sizes of capsules, allowing a simple separation step to remove capsules from the liquid phase and stop the reaction, were obtained. Moreover, coacervates of chitosan-SDS preserved (76.1 ± 2.7) % the amyloglucosidase activity after 28 days of storage at 6°C in glucose solution (1 g/L). The immobilisation process has impacted the kinetic properties and reduced the velocity of glucose production. However, difference between the amount of corn starch hydrolysed with free and encapsulated enzymes, after 5h hydrolysis reaction, was only 12%.

Conclusion: Although the encapsulated enzyme demonstrated a slower reaction rate than the free form of the enzyme, slower glucose production can result in better reaction control, allowing this high-catalytic activity enzyme to be used in broader food applications, as well as being applied in continuous reaction process due to the high stability for long reaction periods.

P2.1.049

Italian citrus fruits: from peels to essential oils; formulation and characterization of nano-emulsions

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Aim:
Kumquat (*Citrus Japonica*), Citron (*Citrus medica*), Orange (*Citrus sinensis*), Bergamot (*Citrus bergamia*), Lemon (*Citrus lemon*), and Tacle (*Citrus sinensis x Citrus clementina*) are citrus fruits specific to southern Italy. Their peels are important sources of essential oils. Citrus essential oils are complex mixtures of volatile compounds with manyfold possibilities to be used as active antioxidant and antimicrobial ingredients in food, cosmetics, or pharmaceutical products. These uses are limited by their susceptibility to external factors such as light, temperature, pH, oxygen, and humidity. In order to enhance the physical-chemical stability of citrus essential oils, they were encapsulated into nano-emulsions
Method:
Citrus peels mixed with water are subjected to microwave power (800 W) for one hour to obtain the essential oils (EOs). The obtained essential oils are nano-encapsulated in nano-emulsions to preserve and enhance the properties and stability of EOs. In this study, nano-emulsions were prepared through ultrasonication, using citrus oils as the lipidic phase and Tween 80 and ethanol as a surfactant, and co-surfactant, respectively. Their behavior was evaluated by testing the antioxidant, antimicrobial, and stability capacities.

Results:
The best extraction yield was obtained for bergamot, while the lowest was registered for citron and lemon. The PDI, turbidity, morphology, volatile profile, and bioactive properties were investigated and their stability was monitored under different environmental conditions (storage at room temperature, at 37ºC, refrigeration, freezing). Each emulsion exhibited different degrees of gravitational separation, the ones stored at 37°C being the most unstable, showing coalescence and phase separation. The antimicrobial activity was tested against Gram-positive and Gram-negative bacteria, with a better response for the Gram-negative. Bergamot nano-emulsions show the best susceptibility against *E.coli*.

Conclusion:
Our work aimed to find the best formulations to obtain stable functionalized nano-emulsions, which would be ready to be used in food as green additives or in medicine as non-invasive treatments. Therefore during method development and nano-emulsions characterization, not only the physicochemical properties but the food and human-friendly behavior have to be taken into consideration.
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P2.1.050

Classification of roasted cocoa produced in the Huila-Colombia region using unsupervised models

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Aim: This work evaluated the unsupervised classification of roasted cocoa from the Huila-Colombia region based on information on bioactive and neoformed compounds (NFCs).

Method: Twenty-four roasted cocoa samples were collected from different areas of the Huila-Colombia region. The samples were ground and sieved before physicochemical characterization of pH and color by CIE-Lab, ABTS+, DPPH, and Folin Ciocalteu determined by spectrophotometry. In addition, furfuryl alcohol (FFA), furoic acid (FA), hydroxymethylfurfural (HMF), caffeine, and theobromine were determined by high-performance liquid chromatography (HPLC). The data obtained were modeled by principal component analysis (PCA) and hierarchical clustering. The study of the information was carried out in the latent variable space.

Results: From the classification analysis, it was observed that the variables of temperature and region affect the physicochemical characteristics of the roasted cocoa beans, influencing the grouping of the samples. The PCA model showed that the most influential variables for the classification of cocoa beans were those associated with bioactive compounds such as DPPH and total polyphenols, two characteristics related to the potential effect of cocoa on consumer health. The HMF and FFA NFCs presented a positive correlation with each other and are associated with samples that were processed at temperatures of 120-140 °C. These temperatures are considered ideal for developing favorable sensory characteristics. However, the analysis shows that they also favor the formation of undesirable compounds.

Conclusion: For the first time, the characterization and classification of cocoa beans produced in the Huila-Colombia region was based on bioactive and neoformed compounds. It was found that the part of production and processing temperature are critical variables for the classification of roasted cocoa and its quality.

P2.1.051

Customizable lifecycle environmental, economic and social performance calculator of Mediterranean recipes

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Aim: The aim of this study is to deliver high-quality, holistic, and comprehensive sustainability metrics of Mediterranean recipes from Spain, Italy, Portugal, Lebanon, and Egypt.

Method: The lifecycle sustainability impacts database and calculator were built in the framework of the DELICIOUS project funded by the Partnership for Research and Innovation in the Mediterranean Area (PRIMA). A lifecycle based approach was used, considering 1) the recommended method by the European Commission (PEF method), 2) a nutritional score (Nutritional Rich Index 9.3, NRF9.3) as functional unit, and 3) the combination of primary and secondary data on foods and their cooking process. Primary data was collected after measuring the inputs and outputs of the cooking phase of 200 Mediterranean recipes. To evaluate the most relevant sources of impacts, this primary data was completed with the collection of Life Cycle Analyses (LCA) data from seconday databases, food prices, and life cycle social hotspot databases to calculate the life cycle environmental, economic, and social impacts of the recipes.

Results: The impacts of 200 recipes were calculated, identifying the most relevant sources of impacts (environmental, economic and social impact categories, life cycle stages, processes, and/or ingredients). These sustainability metrics, combined with other parameters such as acceptability or cultural context, will be used in the reformulation process of these recipes. Finally, all the information about the recipes will be uploaded into a web application to inform users on how to develop healthy, sustainable, and high accepted menus for school canteens and families.

Conclusion: The life cycle sustainability assessment database and calculator means a step forward in terms of availability of high-quality data about sustainability, allowing the calculation of user-customized results from 5 Mediterranean countries. The process could be scaled up to more countries and different user profiles in the future. Areas that need higher quality data were identified during the study, highlighting among them country specific consumer prices and products, country specific rates, and origin country information of imports and exports.

P2.1.052

Finite element simulation of the sterilization treatment by electromagnetic induction.

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[1]Ctic Cita

Aim

Simulate and optimize the sterilization treatment by electromagnetic induction using finite elements

Methods

Ctic Cita, together with IKERLAN and RIBEREBRO Group, has developed an autoclave based on the heating of cans by electromagnetic induction. Thanks to the Comsol Multiphysics software, a simulation model has been developed.

Results

In this work, a simulation model has been carried out and the heating of the can has been studied, checking the rotation effect of the can, the heat exchange by convection and conduction and the different factors that affect the heating. Specifically, Specifically, the simulation model for thistle cans has been carried out.

Conclusion

Thanks to the developed model, the sterilization treatment by electromagnetic induction can be adjusted according to the heating power, initial and final temperature, holding time or rotation speed. In this way, any treatment condition can be modified to ensure the minimum required sterilization intensity.

P2.1.053

Infrared spectroscopy and principal components analysis as a new methodology to phytopathogens determination in tomato

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Aim:

Tomato is one of the most important vegetables worldwide, however, phytopathogens presence such as nematodes, the lack of non-destructive, fast and reliable diagnostic techniques and effective solutions cause a decrease in crop yield.

Method:

To identify phytopathogenic nematodes roots of infected plants were dissected to obtain female nematodes and DNA extraction and sequencing was performed. The presence/absence of phytopathogenic nematodes was evaluated by infrared spectroscopy. In a first trial, 8 nematode infected tomato plants and 3 control plants (uninfected plants) were used, spectra were taken weekly from the adaxial side of two leaves of each plant for 16 weeks and chemometric analysis (Principal Component Analysis) was performed; following the results obtained, the experiment was repeated in a second production year for 8 weeks, but now spectra were taken twice a week. Simultaneously, three plant growth promoting bacteria (PGPB) were evaluated in two tomato hybrids under greenhouse conditions during two consecutive periods. Two days before transplanting, each plant was inoculated with 5 mL of bacteria solution at a concentration of 1×10^{8} CFU mL^{-1}; yield was evaluated by taking the fresh weight of the tomato during the first six harvest cuts with the grower's management without the application of PGPB as a control.

Results:

Meloidogyne incognita and *Nacobbus aberrans* were molecular identified. By spectroscopy, it was found that it is possible to identify nematode presence during the first 17 days post infection, the manly differences in the spectral behavior were in the region from 900 - 1200 cm^{-1} associated to the CO-C and CO-H bonds. These results were well correlate with PCA. On the other hand, the application of PGPB increased crop yield from 47-70% of V427 and 70-175% for Vikingo respect to the control.

Conclusion:

N. aberrans was found to be more abundant (80%) than *M. incognita* (20%), and the presence/absence of infection by nematodes in tomato plants was detected using infrared spectroscopy before root symptoms are visible. This non-destructive technique represents a great opportunity for early diagnosis of phytopathogens in tomato crops, besides the application of PGPB in tomato crops increased crop yield.

P2.1.054

Blue mussel as sustainable biofactory - protein properties along the extraction process

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Aim: Mussels have a high ecological value and can be considered as one of the few sustainable animal protein sources. Mussels offer a comprehensive bioeconomic utilization potential, as they can be separated into their various valuable components (shell and meat) in a resource-saving biorefinery process. Mytilus edulis is a commercial aquatic resource widely distributed in European waters. The most abundant components in mussel meat are proteins and there are limited studies on evaluation of extraction methods in mussels especially for myofibrillar proteins. However, myofibrillar proteins are considered to provide various technological function, most important, gelling properties. Therefore, we aim to utilize green extraction methods and investigate their impact on physicochemical and some functional properties of mussel myofibrillar proteins.

Method: Myofibrillar proteins were extracted from mussel meat using various aqueous solutions (distilled water, phosphate buffer and NaCl solutions) in a multistep process. After each washing step, centrifugation was done in order to separate supernatants from pellet. The retentate was considered as myofibrillar proteins fraction. ATR-FTIR and fluorescence spectroscopy were used to evaluate the structural changes of proteins. Physicochemical and functional properties were characterized by solubility test, surface hydrophobicity and turbidity test. Size exclusion chromatography was used to compare different protein fractions and visual characteristics were analyzed by colorimetric assay.

Results: Subsequent extraction washing and extraction steps are required in order to reduce the natural pigment concentration. Different yield of extraction and purity for proteins were obtained after varying the extraction process. Using a lower NaCl concentration (0.1 M vs. 0.6 M) resulted in higher protein concentration in the myofibrillar fraction. Solubility test showed no shift in isoelectric pH value of proteins and they all had the maximum solubility at 0.8 M NaCl solution. Surface hydrophobicity and tertiary structure of protein were remained intact while the secondary structure of proteins had some changes.

Conclusion: A green extraction method for myofibrillar proteins from mussel meat is available maintain their native physico-chemical properties.

P2.1.055

Novel plant-based protein biphasic gel

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Aim:

The growing global population and increased demand for plant-based food substitutes force the food industry to seek alternative food sources. The limited land for farming, depletion of water resources, and rising food prices broaden this issue even further. The current research aims to explore the utilization of a colloidal system that combines plant-protein-based hydrogel and wax crystal-based oleogel to formulate novel materials for food applications, such as alternative cheese with good nutrition and minimal environmental impact.

Method:

Various bigel formulations were prepared using a hot homogenization process at different compositions and preparation procedures. Canola protein was used in combination with transglutaminase (TG) to enhance the mechanical and rheological properties of the matrix through protein-protein chemical cross-linking. The effect of these parameters on the bigel mechanical, thermal, and structural was examined.

Results:

Bigels based on different protein type, oil/water ratio, and enzyme concentration were prepared. Addition of TG to the bigel produced a defined and stable gel structure, as observed through visual appearance. Moreover, varying effects on the protein behavior were observed as a result of TG addition to the bigels, potentially due to variations in amino acid content of the proteins. Bigels with lower oil content were brittle, leading to crumb formation upon deformation, compared to smooth and consistent texture at high oil content. The bigel type, microstructure and morphology were also investigated using confocal imaging. Thermal stability and decomposition analysis exhibited similar characteristic weight loss curves for different oil/water ratios. Surprisingly, high-pressure homogenization treatment to the water protein dispersion did not significantly affect the bigel's mechanical properties. The rheological behavior, including viscoelastic properties, recovery ability, and temperature dependence of the system, were examined aiming to explore the composition – property – structure-function relation.

Conclusion:

Bigel system demonstrates improved characteristics compared with each individual phase due to the combination of two distinct phases with different properties. The results highlight the potential of plant-based bigels as a versatile system for further development of alternative food applications.

P2.1.056

Development of a bilayer zein/chitosan film using plasma-assisted layer-by-layer (PALBL) assembly method.

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Aim: Plastics are commonly used in food packaging, but their negative impact on the environment, society, economy, and health has prompted the search for alternatives. Biodegradable packaging materials made from natural biopolymers are being explored, but their low mechanical and barrier properties hinder their commercial use. Cold plasma technology can enhance the performance of biopolymers by increasing surface roughness and surface energy and forming hydrophilic active groups on their surface. This project aimed to develop a bilayer zein chitosan film using a plasma-assisted layer-by-layer (PALBL) assembly method.

Method: A 12% w/v zein solution was prepared by dissolving zein in 95% ethanol through constant mixing for 30 minutes and heating to 40°C. The solution was then poured into Petri dishes and dried in a 40°C oven overnight. A 2% chitosan solution was made by mixing chitosan in 1% acetic acid solution by stirring at room temperature for 2 hours. The zein films were treated with cold oxygen plasma for 0, 2, 4, and 8 minutes; then, a chitosan layer was applied on top of the zein layer to create bilayer film samples. In total, six samples were prepared: Z, Z_0/C, Z_2/C, Z_4/C, Z_8/C, and C.

Results: The oxygen plasma treatment of the zein layer enhanced surface roughness and reduced the water contact angle. The FT-IR analysis of the zein demonstrated that the hydrophilic oxygen functional group, deposited on the surface by the oxygen plasma treatment, contributed to the increase in the water contact angle. Results from the tensile test revealed that the bilayer structure remarkably increased the tensile strength and elongation at break. Furthermore, the bilayer films demonstrated a significant reduction in oxygen and water vapor permeability. Also, the thermal analysis showed that chitosan/zein bilayer films had higher thermal stability than the individual layers, with a higher onset and degradation temperature. The bilayer structure also increased the glass transition temperature, indicating improved polymerization and intermolecular interactions.

Conclusion: The combination of chitosan and zein with the surface modification achieved by cold plasma treatment has the potential to improve the barrier properties and extend the shelf life of food products.

P2.1.057

Effects on the volatile composition of Tenebrio mollitor feeded with by-products from the agri-food sector

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Aim:

Nowadays, seeking for food alternatives to reduce animal production and, consequently, GHG emissions, is a trending research topic. However, the organoleptic characteristics of these substitutes is usually little addressed. *Tenebrio mollitor* was approved in 2021 for human consumption by the European Commission. The aim of this study was to evaluate the influence of the use of by-products from the olive and fungus agrifood sector, as substrates for growing insects, on *T. mollitor* volatile profile.

Method:

The usual diet employed to feed the *T. mollitor* was supplemented with leaflet of olive trees and depleted substrate of growth of *Pleorotus ostreatus,* using as control wheat bran. The *T. mollitor* larvae were grown for 3 months until a 10% of the individuals pupated, in that point the assay was stopped. The larvae were dried in an oven at 42 °C for 72 hours. After that, crushed of larvae were obtained and subsequently freezed. Samples analysed were the crushed of *T. mollitor* larvae feed with the three substrates and also the substrates themselves. Solid phase microextraction (SPME) and gas chromatography coupled to mass spectrometry was employed to analyse the volatile composition.

Results:

Results showed that the crushed larvae had a wide variety of volatile compounds such as acids, terpenes, pyridines, pyrazines, hydrocarbons, among others. It was observed that the *T. mollitor* larvae feed with leaflet accounted a higher amount for most of the volatile compounds than the ones feed with the other substrate. Regarding the relation between the volatile composition of substrates and their products, 74 compounds were detected in both. Among them, there was a direct correlation between the values of feeding substrate and the crushed larvae grown on them for 12 compounds such as 3-ethyl pyridine, myristicin or ethyl 6-heptanoate, and inverse for 7 compounds such as p-cymene, α-terpinolene or heptanoic acid.

Conclusion:

Supplementation of *T. mollitor* feeding with different substrates provided crushed larvae with different volatile profile, specially in the case of leaflet from olive sector, giving to the final product characteristic organoleptic properties. This could be a way to make a profit and a second use of this by-product.

P2.1.058

Could Consumers Environmental Perceptions Transform Food Systems?

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In this paper we investigate the extent to which consumer perceptions could contribute to the transformation of food systems and pave the way towards decarbonization. We use two distinct data sources for the analysis. First, the Eurobarometer survey, and second, a range of self-collected consumers initiatives related to the European food supply chain. Eurobarometer respondents are divided into three categories according to their core priority choice when buying food. The options represent perception sets, driving food choices according to economic, health and environmental-related priorities. Using this classification, we construct a "traffic-light" variable. Predominance of consumer selecting cost motives are coded red, yellow refer to health priorities and green to environmental and sustainability reasons when buying food. Considering that food consumption is a process influenced by personal and socioeconomic characteristics, variables related to education and income level, country of residence, and environmental perceptions are used to assess factor responsiveness across the trafficlight food choices, those come also from the Eurobarometer. With these data at hand, we estimate a discrete choice model that will serve to analyze the relative importance of each socioeconomic and personal characteristic in relation to collective actions such as consumer initiatives.

P2.1.059

Texture modification of fermented spreads based on sunflower press cake and sweet whey

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Aim:
Sunflower press cake (SPC) and sweet whey are food processing by-products which should be valorized to prevent food losses. The fermentation of mixtures of these by-products leads to microbially stable products with complex flavor and added value. Many studies point out that, besides taste, physical properties such as spreadability and mouthfeel play an important role for consumer acceptance of the resulting spreads.

Method:
In this study, SPC without hulls and reconstituted sweet whey where co-fermented with a combination of lactic acid bacteria and yeasts. The fermentation medium was prepared in a concentration of 22.5 – 30 g SPC/100 g and was autoclaved at 121°C before inoculation, which led to granulation due to the denaturation of proteins. To overcome this drawback, two approaches were conducted to reduce the grainy texture and to improve mouthfeel. The first one was a pre-treatment of the medium with proteases before autoclaving to prevent the formation of agglomerates. The second approach was the use of high pressure homogenization as a post-treatment after fermentation. The effects of the treatments on fermentation, microbial count, stability as well as textural and rheological properties of the fermented spreads were then analyzed.

Results:
High pressure homogenization at 65 MPa reduced the amount of agglomerates, leading to a smoother and shinier appearance of the samples. In addition, apparent viscosity of the fermented spread was reduced from 1600 ± 200 Pa.s to 500 ± 100 Pa.s at a shear rate of 1/s for the spread containing 22.5 g SPC/100 g. At the same time, stability of the spreads decreased, because more free liquid was available to build a serum phase, compared to the untreated samples, in which liquid was entrapped in the protein agglomerates. Treatments with Alcalase® (Novozymes A/S), an endoprotease, and Flavourzyme® (Novozymes A/S), a blend of endo- and exopeptidases showed promising results in reducing viscosity and the amount of agglomerates in the fermented spreads.

Conclusion:
This means that, by fermenting SPC and whey, valuable products can be produced from two by-products of food processing especially when enzymatic treatment or high pressure homogenization are applied to improve texture and appearance of the fermented spreads.

P2.1.060

Comparison of two different enzyme cocktails to obtain bioactive hydrolysates from porcine blood.

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[1]Iata-csic

Aim:
Enzymatic hydrolysis is an important treatment when trying to revalue porcine blood to obtain bioactive peptides. However, the choice of enzymes for hydrolysis determines the size and the composition of the generated peptides and, consequently, their bioactivity. This study aimed to revalue meat industry by-products such as porcine blood by optimizing enzymatic hydrolysis to obtain hydrolysates rich in peptides with antioxidant and DPP-IV inhibitory peptides.

Method:
Porcine blood was treated with ultrasonics and later hydrolysed using two different enzymatic cocktails to obtain two types of hydrolysates rich in bioactive peptides. One of the cocktails was composed of two enzymes which were an endopeptidase and an exopeptidase. The second enzymatic cocktail contained same enzymes but including a third additional enzyme with simultaneous endo- and exopeptidase activity. The degree of hydrolysis, antioxidant activity and DPP-IV inhibitory activity were determined.

Results:
The results showed different degrees of hydrolysis, obtaining a significantly higher value in the hydrolysate prepared with the cocktail of three enzymes. Both hydrolysates showed antioxidant activity although the hydrolysate with the three enzymes resulted with significantly higher activity values. However, higher DPP-IV inhibitory activity was obtained in the hydrolysate prepared with the cocktail of two enzymes which was less hydrolysed. The results suggest that the intensity of hydrolysis affects peptides by reducing its size and it is associated with DPP-IV inhibitory activity. Therefore, the choice of 2 or 3 enzymes for hydrolysis depends on the type of desired bioactivity.

Conclusion:
Enzymatic hydrolysis has resulted in an interesting and effective treatment to obtain bioactive peptides from porcine blood. However, the choice of enzymes is crucial as they determine the size and the composition of the generated peptides and, consequently, their bioactivity. So, the two assayed enzyme cocktails resulted in hydrolysates with antioxidant and DPP-IV inhibitory activity. The intense proteolysis obtained by using 3 enzymes was appropriate for obtaining high antioxidant activity while only 2 enzymes were most adequate for DPP-IV inhibitory activity. This represents a relevant issue when designing revalorisation strategies for meat industry by-products like blood.

P2.1.061

Bio-nanocomposites as biodegradable food packaging: A review of methods to assess the biodegradability

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Background and Aim:
The inevitable ubiquitous nature of plastics has made its sustainable alternatives as the need of the hour. In Nov 2022, the EU Commission proposed a more stringent revision of the regulations for the use of plastic in packaging to combat the ever-rising source of plastic waste. Over the past decade, food industry has explored greener alternatives to plastic and biodegradable plastics have garnered attention. Although biodegradable plastics have been promising, it is still incapable of completely replacing conventional plastics in food, owing to their inferior barrier and mechanical properties. Recent advancements in nanotechnology have shown that the application of nanoparticles as a filler in biodegradable plastic to form bio-nanocomposites has significantly enhanced its properties. However, there is still a large scope in understanding the influence of the nanoparticles on the biodegradability or compostability of the biodegradable plastics itself. Thence, the study explores the application of bio-nanocomposites in food packaging and identifies a suitable approach to assess and understand the biodegradability of bio-nanocomposites.
Method:
A comprehensive review of literature was conducted over published scientific articles from 2005 to 2022. The keywords used for the search includes ‘Biodegradability assessment methods’, ‘biodegradability’ and ‘compostability’ of ‘plastics’, ‘bio-nanocomposites’ and ‘bio-nanoparticles’

Results:
The review of the literature enabled to gain an understanding of the possible biodegradability mechanism of bio-nanocomposites. With the gained knowledge, a critical review of all the methods of assessment for the biodegradability showed that a single assessment method would not be sufficient to entirely evaluate the biodegradability of bio-nanocomposites. Aligning with the ISO requirements for a biodegradable packaging, the study recommends an approach with a combination of different assessment methods to evaluate the compostability of bio-nanocomposites.
Conclusion:
In conclusion, though the bio-nanocomposites are promising alternatives of synthetic plastics in food package, it is important to develop an assessment method to evaluate its ability to biodegrade for ensuring responsible production and consumption. The complex mechanism of biodegradation of bio-nanocomposites demands a well-designed approach with a combination of methods that can account for multiple influencing factors such as environmental conditions, microbes, etc.

P2.1.062

Antimicrobial effects of ultra-fine bubble water generated at different temperatures

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Aim: Reducing the microbial load in food ingredients is important for producing safe and long-shelf-life products. Chemicals such as peracetic acid and sodium hypochlorite have generally been used to wash raw materials. However, in recent years, there has been an increasing demand to reduce the use of such chemicals, because of the growing health consciousness of consumers, and to develop alternative washing methods. Ultrafine bubble (UFB) water is water containing air bubbles with particle sizes ≤ 1 µm. Though UFB water has been reported to have bactericidal effects, there are few reports verifying its effectiveness using actual food. In this study, UFB water generated at different temperatures was used to wash chicken meat to evaluate its antimicrobial effects.
Method: UFB water was generated by maintain 7 L of tap water at a pressure of 0.45 MPa for 40 min, at 2, 4, 8, and 12 °C, and at room temperature. Chicken samples (25 g) were placed in a swirl-type washing tank and washed with 7 L of the UFB water generated at the indicated temperatures for 10 min. Tap water adjusted to the above temperatures was used in control experiments. After washing, total bacterial viable counts (TVC) and the number of *Enterobacteriaceae* present in chicken meat were measured and compared with the number of bacteria in chicken meat before washing.
Results: There was a significant difference in the number of bacteria present in chicken samples before and after washing with UFB water generated at 2, 4, 8, and 12 °C ($p < 0.01$). Furthermore, chicken samples washed with normal tap water showed significantly different TVC (at 12 °C) and total number of *Enterobacteriaceae* (at 8 and 12 °C) than unwashed chicken samples ($p < 0.01$). In addition, no significant washing effect was observed in either bacterial group when the chicken samples were washed with UFB water at room temperature.
Conclusion: These results suggest that washing treatments with UFB water produced at a temperature range of 2–4 °C can significantly reduce bacterial TVC and the number of *Enterobacteriaceae* in chicken meat.

P2.1.063

Inactivation of murine norovirus in shell oysters by high hydrostatic pressure treatment

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Aim: Norovirus is a major causative agent of infectious gastroenteritis. The ingestion of raw oysters is one of the causes of food poisoning induced by norovirus. High hydrostatic pressure (HHP) treatment is a nonthermal food processing technology for the inactivation of microorganisms; it is used, for example, to sterilize jams and juices. HHP also has an inactivating effect on viruses; however, little is known about its inactivation effects on norovirus in shell oysters. In this study, murine norovirus (MNV-1), a norovirus surrogate, was inoculated into oysters, and the inactivation effect of HHP treatment on MNV-1 in shell oysters was verified.

Method: Oysters were preliminarily reared in a 100 L water tank for one week; then, some of these oysters were taken out from the tank and used to run a blank test. The remaining oysters were exposed to MNV-1 for 3 h by adding 2 L of 6.64 log PFU/mL virus solution to the aquarium. After exposure, an individual that was not subjected to high-pressure treatment was removed and used as the control test group. HHP treatment was performed at 275, 300, 325, and 350 MPa for 2 and 5 min. After high-pressure treatment, the oysters were shelled, and the MNV-1 titer was determined by plaque assays.

Results: MNV-1 was not detected in the blank, and the mean MNV-1 titer in the control was 3.02 log PFU/g. HHP treatments at 325 MPa for 5 min and at 350 MPa for 2 or 5 min reduced the MNV-1 titer below the detection limit. In contrast, 2 min HHP treatments at either 275, 300, or 325 MPa did not significantly decrease the MNV-1 titer; additionally, there was no significant difference in the MNV-1 titer among the oysters subjected to these pressures. However, when the treatment was performed for 5 min, the MNV-1 titer decreased stepwise as the pressure increased.

Conclusion: Oysters subjected to 300 and 325 MPa, showed significantly different MNV-1 titers when treated for 2 or 5 min, indicating that 5 min or longer HHP treatments were necessary to inactivate MNV-1 in shell oysters.

P2.1.064

Criteria for selecting optimal dates for food valorization as functional ingredient

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Aim:
The value chain of the Elche date palm is not efficient, generating large quantities of waste and by-products from post-harvest, industrial processing and distribution. The circular economy is presented as a way to reduce the environmental impact generated by the accumulation of waste and a solution for its transformation into products. The date palm fruit is a nutritious food and a source of bioactive compounds, that offers a wide range of technological and health benefits. A significant amount of non-commercial dates are generated and despite its potential, they has not been fully exploited. Due to the genetic diversity of this tree, there is a requirement to identify objective criteria for dates selection to be valorized as a natural and healthier food ingredient. This work aims to outline the key criteria for selecting dates as functional ingredients in food products.

Method:
The method followed for the selection, starting from 3000 date palms, consisted of choosing 90 female date palms, for which technical data sheets were prepared based on 44 descriptors of the International Plant Genetic Resources Institute (IPGRI). Finally, these parameters made possible to select 15 palms and characterise their dates (appearance, proximal composition, phytochemicals, physicochemical and technological properties and antioxidant activity).

Results:
The 44 international descriptors used for date palm selection were those that provided information on yield and bunch size, weight, date size, pulp/stone ratio...Furthermore, from the results obtained from the chemical, technological and functional characterisation of the dates, it is concluded that the selected fruits were rich in phytochemicals, such as phenols, sugars and dietary fibre. Therefore, dates could be processed without losing their functional properties, and could be considered as natural food ingredients versus synthetic ingredients. The identification of specific criteria would allow the selection of dates for application and assess their suitability in food products.

Conclusion:
By following these selection criteria, dates can be incorporated to enable a sustainable utilization as functional ingredients, enhancing the nutritional value, taste, and overall appeal of their products. Additionally, consumer satisfaction and health benefits can be maximized by utilizing high-quality dates that align with sustainable and ethical principles.

P2.1.065

Technological approaches for the development hop-based ingredients with enhanced quality performances

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Aim:

The rising consumer demand for sustainable, functional, and clean-labelled products is pushing food industries to replace synthetic additives with plant-based ingredients. In this context, hops (Humulus Lupulus L.) is a main ingredient in brewery, but their extracts are undervalued despite the presence and content of secondary metabolites (bitter acids, polyphenols, and essential oils) with recognized quality functionalities and bioactivity relevant for innovative food products. However, most of these compounds are highly sensitive to process- and storage-induced stresses.

In this study, different extraction and microencapsulation technologies were explored to develop hop-based ingredients characterized by different composition and responding to different technological, functional and sensory needs with the aim to widen their use for innovative food products.

Method:

Hops (cv. Cascade and Herkules) extracts were i) produced using ethanol (50 % v/v) and different extraction technologies (high hydrostatic pressure: HHP, high power ultrasounds: UPUS; low power ultrasounds: US; dynamic maceration: CONV), times (from 15 to 120 min) and temperatures (25, 60 °C), and ii) analyzed for bitter acid and polyphenol content (TPC assay; HPLC-DAD) and VOCs pattern (GC-MS). Hop extracts obtained by US (100-Watt, 50 kHz; T: 25 °C) for 30 min were mixed with (12 %) maltodextrin (MD) and Arabic gum (GA) and subjected to freeze-drying (FD) or spray-drying (SD). The microencapsulated hop powders were evaluated for moisture content, polyphenol yield, polyphenol encapsulation efficiency, and retention of bitter acids.

Results:

Extraction technologies and process parameters influenced the recovery of secondary metabolites from hops to a different extent. Overall, US and CONV 60 °C extracts showed high content of antioxidants and bitter compounds but different VOCS profiles. In particular, the former was richest of esters and monoterpenes with woody, balsamic, and fruity notes while CONV 60 °C of sesquiterpenes (*β*-caryophyllene, cis-*β*-farnesene) with woody, citrus and herbal notes. FD and SD microencapsulation, at equal extract formulation, led to the production of hop powders characterized by different polyphenol encapsulation efficiency and bitter acid retention and enhanced stability.

Conclusions:

By a strategic and optimal combination of extraction and encapsulation technologies, new hop-based ingredients matching end-user (industry, consumers) needs could be designed and developed.

P2.1.066

Effect of pre-treatments on some physicochemical properties and structures of pearl millet and cowpea

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The aim of this project was to investigate the effect of soaking, germination and fermentation on some physicochemical properties and structures of pearl millet and cowpea grains. With a major focus on starch, non-starch polysaccharides and phenolic compounds, as well as compare the effect of these treatments on milled flour by studying microstructure and pasting properties.

Starch content was determined using enzymatic essay and amylose content was measured using a colorimetric method based on iodine complex. Dietary fiber and its components were quantified by the Uppsala method and high performance liquid chromatography (HPLC) equipped with a diode array detector on a reversed-phase column were used to analyse phenolic compounds. Scanning electron microscopy (SEM) and a rapid visco analyser (RVA) were used to analyse the flours.

Overall, germination significantly decreased amylose and starch contents while fermentation significantly increased amylose and starch contents compared to soaked samples. Results obtained from germinated samples showed increased extractability of galactose sugar residue and total phenolic indicated different concentrations of phenolic compounds. Revealing a positive effect of germination

for improving the nutritional richness of the flours milled from treated grains. SEM and RVA studies revealed that the structure of pearl millet starch was completely changed by germination, numerous holes and broken starch granules were seen, which drastically reduced the final viscosity of the flour, while in cowpea, the structure was not much affected by germination but reduced the final viscosity. Germination and fermentation had a greater effect on pearl millet than cowpea in reducing viscosity. Soaking, germination and fermentation are simple techniques that can be used to improve the nutritional richness of flour. The study brings a good knowledge of the effect of traditional processing methods on the physicochemical properties and structures of pearl millet and cowpea to develop food products, and it is highly relevant for low and middle-income countries.

P2.1.067

A Novel Approach in Formulating Plant-Based Fish Using Fruit and Vegetable By-Products and Legume Proteins

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Aim: (heading must be in bold)
(Introduction text - align left, 10 point, Times New Roman, single line spacing)
Nowadays, consumers are increasingly interested in healthy and sustainable food products. Conventional animal-origin food production is one of the main causes of greenhouse gas emissions in the world. For this reason, the use of plant by-products as well as vegetables not suitable for sale can be a good circular economy strategy to produce fish analogues for the food industry. In this context, emerging techniques such as 3D food printing, freeze-drying and combination of different systems can achieve appearances similar to fish.

Method: (heading must be in bold)
(Methods text - align left, 10 point, Times New Roman, single line spacing)
For the present study, different vegetable food matrices unsuitable for market sale due to aesthetic conditions were used. Aubergines and zucchinis were used to make vinegar and pickled European anchovy analogues. For the production of vegan salmon, three different methodologies were studied: protein isolates in 3D printer, alginate formulations, and chickpea and corn starches. Raspberries, citrus fruits and apple peel were freeze-dried to be used as a food ingredient. The formulation was optimised for each product. Samples were stored at 4 ºC and shelf-life studies were carried out to study the sensory (hedonic and free choice profile), physicochemical (colour and texture) and microbiological quality. The products were compared with their animal analogues.

Results: (heading must be in bold)
(Result text must - align left, 10 point, Times New Roman, single line spacing)
Vinegar and pickled European anchovy analgoues were accepted with a good assessment until the last day of shelf life (21d). The 3D-printed products with chickpea protein isolate were found to be suitable for people with dysphagia due to their low value in the texture analysis. Alginate was not efficient for the formulation of the salmon analogues. Chickpea starch proved to be the most efficient formulation for making fish analogues, as in terms of colour, texture and sensory analysis it showed good consumer acceptance compared with their animal-origin analogues.

Conclusion: (heading must be in bold)
(Conclusion text must - align left, 10 point, Times New Roman, single line spacing)
The use of fruits and vegetables for the preparation of fish analogues will have a positive impact on the sustainable management of natural resources and the reduction of food waste In addition, the development of innovative and environmentally friendly products is expected to cater to consumers looking for healthy and convenient alternatives to conventional fish.

P2.1.068

Color retention effect of maltobionic acid on pickled eggplant

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Aim: Maintaining the purple appearance of processed eggplant products, such as pickled eggplant, is important. However, processed eggplant products have a short shelf life because anthocyanins in eggplant peels are unstable pigments and the pulp easily browns. In this study, we investigated the effect of maltobionic acid on suppressing the discoloration of pickled eggplant by soaking cut eggplant in maltobionic acid and calcium maltobionate, which have recently attracted attention as functional acidic oligosaccharides.

Method: Eggplants (*Solanum melongena*) grown in Japan were cut and soaked in 1% maltobionic acid and calcium maltobionate (1% and 5%) solution and then stored for 7 days. The color of the peels and pulp of eggplants before and after soaking and storage was measured using an L*a*b* colorimeter. The eggplants were subsequently separated into peels and pulp. Nasunin and chlorogenic acid, which promotes the oxidation of nasunin, were extracted from the peels and pulp with 0.35% hydrochloric acid 70% methanol, and then quantified using high-performance liquid chromatography.

Results: a* values of both the peels and pulp increased in the samples soaked in 1% maltobionic acid after storage for 7 days. The amount of nasunin in the peels decreased, and nasunin was detected in the pulp and in the soaking solution. The total amount of nasunin in the peels, pulp, and soaking solution was not significantly different from that in the non-soaked eggplant, and the nasunin levels were maintained even after soaking. In contrast, the color difference (ΔE) in the peels soaked in 5% calcium maltobionate was smaller than that of peels subjected to the other treatments. The average percentage of residual nasunin and chlorogenic acid in the peels soaked in 5% calcium maltobionate was the highest compared to all other treatments.

Conclusion: Eggplants soaked in 5% calcium maltobionate solution retained nasunin and chlorogenic acid in their peels, which was effective in maintaining the pigmentation of pickled eggplant.

P2.1.069

Use of flow-assisted magnetic resonance imaging for rheological characterization of a ‘protein enriched’ tomato juice

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Aim:
Viscosity of tomato juice in an important quality parameter during processing. When the juice is further mixed with different ingredients such as proteins, the low pH of the medium becomes a challenge and the juice quality could be affected adversely. Magnetic Resonance Imaging (MRI) is a perfect tool to design a viscometer by analyzing the images obtained during flow mode. In this study, a benchtop magnetic resonance imaging system was used to investigate the rheological changes of the tomato juice formulated with different proteins at different concentrations.

Methods:
Tomato juice was obtained following the removal of the pomace and the seeds. Hot break was applied to inactivate the enzymes. Pea protein isolate and rubisco proteins obtained from green leaves were used at 2 different concentrations (1 and 2%). Tomato peel was added to adjust the brix of the juice. The juice mix was first homogenized using a high shear homogenizer and later was homogenized using a high-pressure homogenizer at 1200bar for 2 passes. Homogenization was necessary to disperse the protein particles in the juice. Samples without protein were used as the control. A benchtop MR imaging system operating a ^{1}H frequency of 24.15 MHz was used in continuous flow mode. Different flow rates were tested. A pulsed gradient spin echo was used for imaging experiments. To compare the results, viscosity measurements were also performed in a conventional viscometer with a spindle head. One of the samples was also mixed with gastric juice during the flow to see how the flow behavior will be affected.

Results:
Tomato juice showed non-newtonian behavior for all protein concentrations. The presence of protein aggregates in the unhomogenized juice disrupted the flow behaviour. High correlation was observed between the conventional and MR viscometer results. Gastric juice effected the proteins and flow behavior significantly.

Conclusion:
It was shown that the benchtop flow MR system can be used to monitor the rheological changes in continuous mode for a tomato juice suspension.

P2.1.070

Potential food contamination pathways within the food processing facility: a review

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Aim: Food products in open food processing lines may become contaminated with various contaminants within the manufacturing process. Indeed, safe food processing is a complex procedure due to the variety of contaminants including chemical, physical, and biological contaminants that can circulate within the facility and endanger the safety of the food products. Implementing preventive food safety systems and programs such as HACCP, GMP, and hygienic design can effectively help minimize food hygiene-related risks and ensure food safety. To achieve a successful food safety plan, it is important to identify all food contamination pathways, operational risks, and related contaminants. This review is therefore aimed at broadening our understanding of food hygiene risks by reviewing published literature over the last 12 years to collect identified pathways of food contamination and provide an updated list of food contaminants and a brief description of operational risk factors for each pathway.

Method: A systematic literature review was conducted through Scopus, Google Scholar, and Science Direct on published peer-reviewed literature within the last 12 years, using specified search terms related to hygienic design, food processing, and potential food contaminants.

Results: The results from the literature review are classified into three defined categories of procedure, infrastructure, and material. In the sub-categories ten pathways have been identified as the main sources of food contaminants within the company, that should be monitored and managed properly. A holistic overview of known contaminants related to each pathway is provided as a comprehensive and reliable reference for food safety management systems to prevent hygienic risks in products, procedures, and environments.

Conclusion: This study provides information for food safety management plans, HACCP programs, and further studies on fast and precise hygiene monitoring methods to be able to detect food hazards at early stages of occurrence. This study can also be used as input when designing new food processing equipment, or to give input on new food processing factory layout. The review highlights the importance of regulations and laws that require companies to follow the rules for safe production as well as the law enforcement by the government on applying safety standards.

P2.1.071

Pulsed Electric Field Technology improves the traditional method for obtaining yeast extract

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Aim:

Yeast extract is the soluble fraction of yeast that remains after removing the cell envelopes. This extract rich in nutrients and bioactive components has different applications in the food, biotechnology, and pharmaceutical industries. Traditionally, yeast extract is obtained through the autolysis of yeast biomass at temperatures ranging from 45-50°C for 15-60 hours.

The objective of this investigation was to evaluate if the electroporation of the cytoplasmic membrane of yeast by Pulsed Electric Fields (PEF) improved the current process used for obtaining yeast extract.

Method:

A suspension of *S. cerevisae* 3D Viniferm was treated by PEF (15 kV/cm,180 µs, 101 kJ/kg) to electroporate more than the 90% of the population. The concentration of glutathione, polyphenols, proteins, amino acids, DNA and RNA in the supernatant of untreated biomass incubated at 55ºC (traditional process) and electroporated biomass incubated at 25, 35 and 55 ºC for 1, 6, 24 and 48 hours was compared.

Results:

While the extraction of glutathione from the untreated biomass was negligible at any extraction time, after 1 hour of incubation the extraction of this compound was maximum (8.1 mg/g dry weight) at any temperature assayed in the biomass treated by PEF. After incubation for 6 hours at 25 ºC the content of polyphenols, proteins and amino acids (6.3, 103.6 and 53.0 mg/g dry weight respectively) extracted from electroporated biomass was similar to those extracted from the untreated biomass after 24 h of incubation. Furthermore, after 24 hours of incubation at 35 ºC, the concentration of polyphenols and amino acids in the supernatant of PEF-treated duplicated those in the supernatant of untreated biomass. Nucleic acid extraction was very low, RNA was not detected in the supernatant containing PEF treated biomass and only the 25 % of the total DNA content was extracted after 48 h of incubation for both untreated and PEF treated biomasses.

Conclusion:

These results demonstrate the effectiveness of the electroporation of the cytoplasmatic membrane by PEF to reduce time and/or temperature during the yeast extract production process. Further studies are required to evaluate the nutritional and functional properties of yeast extracts obtained from biomass treated by PEF.

P2.1.072

Role of Process Simulation in Water-Energy Nexus (WEN) Assessment in Tomato Processing Facility

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Aim:
Tomato processing industry consumes substantial amount of water and electrical and thermal energy, which are linked to each other. To better understand the overall magnitude and distribution of water and energy use at tomato facility through the most relevant tomato processing steps, a water-energy nexus (WEN) assessment should be conducted in a way to systematically accounts for water usage and energy required to process water at each unit operation in industrial tomato processing. To this regard a WEN model have to be developed using a proper simulation tools that can be used to solve water mass balance for setting up the baselines of water and energy consumption through the different processing step.
In this work, which was carried out in the frame of the European project AccelWater (Project ID: 958266), a medium size Italian tomato processing facility was selected as a case study. WEN assessment was carried out and integrated into process simulation to calculate mass-energy balances, identify unknown streams, analyze the efficiency of complex loops, and individuate the water-energy consumptions in each processing step.
Methods:
A commercial process simulator software (SuperPro Designer®) was used to develop a flow diagram of a real scenario of a tomato processing plant in which peeled tomato and tomato puree are produced.
Results:
The washing stage emerged as the most water-demanding unit, followed by the cooling system. Peelers were found to be the most thermal energy demanding, primarily due to the specific product profile and equipment combination employed. Additionally, it was determined that pumps consumed the highest amount of electrical energy at the facility. The WEN assessment further revealed that approximately 60% of freshwater was recirculated for the washing phase; however, a notable waste of energy and thermal energy was observed in the overall process.
Conclusion:
It was demonstrated that WEN assessment integrated in a process simulation represented a powerful tool to individuate corrective action to reduce the use of water and energy resources in tomato processing. It can be considered a decision-making tool for identifying good practices and potential technologies to improve the sustainability of the tomato processing industry.

P2.1.073

Environmental Impact Assessment and Development Scenario for an Italian Tomato Processing Industry

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Aim: Recently, the food industry has been striving to achieve more sustainable production practices to minimize the negative impact on the environment. The agri-food sector, in particular, has been identified as one of the most significant contributors to environmental degradation and emissions. In Italy, the tomato processing industry is a vital sector within the agri-food industry and requires attention in terms of sustainability efforts. This study carried out in the frame of the European project AccelWater (Project ID: 958266), aims to apply LCA in an Italian tomato processing company to identify the hotspots and potential for improvements to mitigate the environmental load generated in the processing phase.

Method: To conduct the environmental impact assessment of tomato processing, the ReCiPe 2016 (V1.03) method was utilized at both midpoints and endpoints levels. The foreground data for the assessment were collected from a tomato processing facility located in southern Italy, while background data were sourced from the Ecoinvent database. Furthermore, the proposed action to decrease the environmental load by conservation measures within the production line with the aid of water-energy nexus simulation has been evaluated.

Results: The results show that the production of 1 kg of peeled tomatoes is responsible for 0.076 kg CO_2eq, while 1 kg of tomato puree generates 0.124 kg CO_2eq during the processing phase. In both processing lines, thermal units are identified as the primary contributor to adverse environmental effects and the primary opportunity for improvement. The study recommends conservation strategies that resulted in water savings of 12.5%, electricity savings of 10.5%, and methane savings of 10%, which consequently resulted in an 11% and 8% reduction in CO_2 emissions in peeled tomato and tomato puree production, respectively.

Conclusion: This study demonstrates the potential for reducing the environmental impact of the tomato processing industry in Italy through the implementation of conservation strategies. These findings provide valuable insights for companies in the tomato processing industry to adopt more sustainable processing practices which can significantly reduce the environmental impact, while also benefiting the company economically. However, the new solution needs to be more effective than the existing one and should be also evaluated from social and economic perspectives.

P2.1.074

Improvement of rapeseed protein quality with gentle processing approaches

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Aim:
Rapeseed is a promising plant protein source yet to be fully exploited. The protein has a balanced amino acid composition with a higher protein efficiency ratio than soybean. Nowadays, commercial rapeseed proteins are produced from press cake, a side stream of rapeseed oil production. The protein is traditionally extracted at high alkaline conditions to maximise the protein yield. Proteins extracted from the press cake have high variability, and the protein has low techno functionality due to heat and mechanical treatment. These harsh processes induced protein denaturation, promoted undesirable interactions with polyphenols, and activated endogenous protease. Most rapeseed protein extraction studies used pressed cake, and studies on undisturbed whole-kernel rapeseed protein extraction are scarce. Thus, this study aims to investigate the influence of the gentle extraction process of whole-kernel rapeseed to improve protein quality.
Method:
Three types of raw material are extracted with two different extraction processes resulting in spent grains and supernatants. The starting materials are whole-kernel seeds, i.e., non-defatted, 2x, and 4x hexane defatted. The produced supernatant was extracted at gentle alkaline (pH of 8.5). This study characterised the spent grain (structure and composition) and the protein extract.
Results:
The microstructure of the defatted seed showed disrupted protein bodies with a shrunken cell wall. The spent grains mainly consisted of water (65-77%), and remaining protein (5-7%) with little fat leftovers (0.2-3.5%). The spent grain of defatted material has lower water mobility (14-50% lower), while the supernatant of the defatted material has a lower protein yield (maximum 16% lower) than the seed. As expected, alkaline conditions gave a higher protein yield (6-12%). The protein secondary structure, denaturation temperature, and liquid chromatography profile provided further details about the protein modifications.
Conclusion:
In conclusion, solvent defatting changes the protein structure, reducing water solubility. This study will contribute to producing high-quality rapeseed protein from whole-kernel rapeseed.

P2.1.075

Cellulose-based film as an eco-friendly substitute for packaging broccoli florets

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Aim: Broccoli is highly esteemed for its nutritional properties, yet it is susceptible to swift spoilage. Modified atmosphere packaging (MAP) is an effective technology for prolonging the shelf life of broccoli. However, a major drawback of MAP is the extensive use of petrochemical-based films, which contribute significantly to the accumulation of domestic plastic waste. The aim of this work was to evaluate the viability of employing a biodegradable cellulose-based film as an alternative to polypropylene for packaging broccoli florets.
Method: Broccoli heads were cut into florets, washed, disinfected (NaClO), dried and packaged in macro-perforated polypropylene (Control), micro-perforated polypropylene (PP) and micro-perforated cellulose-based film (Cellulose). Samples were stored throughout 21 d at 4°C, and subsequently transferred to 15°C two days before sampling. In-package internal O_2 and CO_2 concentrations, mass loss (ML), color, firmness and sensory attributes (external appearance, odor and color) were evaluated during storage. ANOVA and Tukey's test were used at 5% of significance.
Results: No significant differences in CO_2 and O_2 evolution were found between PP and Cellulose packaging (10% CO_2 and 8% O_2 on average). Cellulose samples showed the highest ML (17.5%) compared to PP (1.2%) and C samples (9.5%). Broccolis packaged in cellulose presented less firmness (1.3 ± 0.6 N/mm) than those in PP (3.2 ± 0.9 N/mm). No differences in color ($L^* = 45 \pm 2$, $h_{ab} = 116 \pm 3$) and sensory attributes were found between PP and Cellulose samples. MAP preserved these quality parameters compared to Control broccoli florets ($L^* = 56 \pm 1$, $h_{ab} = 87 \pm 3$).
Conclusion: The sensory quality of the florets packed in cellulose film remained unaffected, despite showing higher mass and firmness loss compared to florets in PP. Therefore, cellulose film could be a packaging alternative for broccoli, reducing plastic waste. Additional research should be undertaken to explore solutions for mitigating product mass loss in this packaging material.

P2.1.076

Food Eco-design methodological guide and its application in a plant-based snack development

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Note to the congress secretary: This study includes the tasks of work package-2 carried out within the scope of the EU PRIMA Switching Mediterranean consumers to Mediterranean sustainable healthy dietary patterns (SWITCHtoHEALTHY) project, which has been carried out with the participation of 3 countries (Spain, Morocco and Türkiye).

Aim: The food industry has an important role to play in taking action on sustainability issues. This challenge is aligned with the increasing global awareness of environmental sustainability of consumers and the growing pressure for legislative action. Therefore, the next actions include the transformation of food and agricultural systems by ensuring sustainability practices. Within these actions, Eco-design is considered an effective and necessary tool to improve the sustainability of food production.
Aligned with the development of healthy and sustainable new food products, the current study will develop an Eco-design methodological guide to be applied by food manufacturers within the scope of the EU PRIMA SWITCHtoHEALTHY project. Specifically, a case study with Delafruit S.L.U., a healthy food manufacturer involved in the project, will be used to discuss Eco-design criteria applied in the new food product development process to optimize the design.
Method: The Eco-design strategies applied were based on the Lifecycle Design Strategies (LiDS) wheel tool, where the different strategies used are divided into the lifecycle stages of product. The case study is a healthy, sustainable, and nutritious plant-based snack product consistent with the Mediterranean Diet and aligned with consumers' preferences
Results: The outcome of this study revolves around a consequential multi-step Eco-design methodological guide. Firstly, definition of product typology, collection of information regarding manufacturing inputs/outputs and definition of technical specifications that should be met was done, by reviewing the Best Available Techniques (BAT), the legislation framework, the motivating factors, or environmental claims. The next step was the conceptualisation of specific Eco-design strategies based primarily on ingredient and packaging material selection. Finally, calibration of selected strategies via pilot scale and validation of corrective interventions were carried out before scaling-up the strategies to industrial level.
Conclusion: The Eco-design methodology aligns with current issues related to environmental responsibility that food companies have to respond to due to the increase in regulation and consumers' awareness about their food choices. The developed methodology guide will help food companies to develop new food products mitigating the environmental impact linked to the manufacturing processes of the food products.

P2.1.078

Microbiological and nutritional impact of cold plasma technology on whey protein powder processing

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Aim:
Milk derivatives are included in the formulation of innovative products target to personalized-nutrition, in functional and nutraceutical sectors, e.g. in the sport, infant or elderly products. Among them, whey protein, is one the most valuable protein-rich ingredients. The aim of the present study is the evaluation of surface microdischarge cold atmospheric pressure plasma (SMD-CAPP) treatments effectiveness to process whey protein (WP) in its final powder form (after pasteurization and spray-drying) ensuring the microbiological safety, protein value and digestibility of final delivered product.

Method:
A whey protein concentrate (WPC) (Hochdorf Swiss Nutrition Ltd., Switzerland) was used as a matrix, to be processed by SMD-CAPP. A CAPP home made equipment (developed by the Institute of Engineering systems in collaboration with Institute of Life Technologies, HES.SO Valais-Wallis) was used in the present study, applying total power values of 10, 12, 16, 20 and 30 W (7-10 kVpp) with treatment times in the range 0-5 min. Inoculated WP powder with *Enterobacter pulveris* (to a final concentration of 10^6 CFU/g) was disposed in thin layers on sterile glass slides (5 mg per cm^2) to be treated by plasma. Final bacterial counts in inoculated treated/untreated SMD-CAPP samples will be obtained and expressed as Log N (CFU/mL). An SDS-PAGE analysis was carried out to determine the impact of intensity SMD-CAPP treatment on protein fragmentation. Additionally, *in vitro* protein digestibility will be tested in control and SMD-CAPP treated samples.

Results:
A maximum inactivation level of 2.57±0.23 log_{10} cycles was achieved in *E. pulveris* reduction by SMD-CAPP under 14 W plasma power (plasma power density 93 mW/cm^2) applied during 10 min. A microbial load reduction close to 2 log_{10} cycles is effectively achieved with very low plasma energy required (67-93 mW/cm2), applying treatment times in the range 3-5 min. CAPP preserves protein stability/integritiy under effective treatments (10-14 W, 3-5 min). Just under the most intensive treatments by CAPP (30 W – 5 min), SDS-PAGE bands corresponding to 50-150 kDa (lactoferrin, BSA, Ig heavy chain) disappear. No significant differences have been observed in the value of digestibility between the different treatment powers applied (10, 12 and 14 W) on whey protein processing.

Conclusion: CAPP can be concluded as effective technology to ensure microbiological safety in WP powder, preserving nutritional value and digestibility of main whey proteins (α-lactoalbumin, β-lactoglobulin).

P2.1.079

Comparing equivalent thermal, ultrasound, pulsed electric field, and high-pressure processes for pasteurization of apple puree

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Aim:

This study aimed determine equivalent processing methodologies, namely ultrasound (US), pulsed electric field (PEF), and high pressure processing (HPP), for prolonging the shelf-life and guaranteeing the safety and quality of *Reineta Parda* apple puree. These methods were evaluated in comparison to thermal pasteurization (TP, 72 °C for 15 s).

Method:

Apple puree was inoculated with approximately 8.1 log CFU/g of *Escherichia coli* (used as the pathogenic target), followed by processing by US, PEF, HPP, and TP. Physicochemical properties such as colour, °brix (sugar content), water activity (aw), titratable acidity, and pH of the puree were evaluated before and immediately after processing. Additionally, the antioxidant activity (DPPH and ABTS) was assessed, along with a sensory evaluation. Indigenous microbial loads and inoculated *E. coli* were determined before and immediately after processing, and throughout the storage period of 30 days under refrigeration (5 ºC and 70% relative humidity).

Results:

The processing conditions were carefully chosen to achieve at least 5 log CFU/g reduction in *E. coli* loads. After an initial screening of the most suitable processing conditions, HPP at 400 MPa/1 min, US at 24 kHz/12 min, and PEF at 10 kV/cm resulted in reductions of *E. coli* counts of 6.6, 6.1, and 5.8 log CFU/g, respectively. These reductions meet the requirements set by the Food and Drug Administration (FDA) for achieving pasteurization status. Moreover, all treatments reduced the indigenous microbial loads below detection limits (1 log CFU/g). HPP and PEF increased the antioxidant activity compared to the remaining processing methodologies. Both untreated and treated samples exhibited changes in pH, °Brix, and color, which were clearly influenced by the specific processing conditions applied. The sensorial panel clearly identified differences according each processing methodology, especially in colour, taste and texture.

Conclusion:

In summary, these findings suggest that HPP and PEF are viable and sustainable alternatives to pasteurization for *Reineta Parda* apple puree, offering a minimally processed, value-added product with excellent sensory quality and improved antioxidant activity. These encouraging results warrant further research on HPP for the development of new products, and PEF for industrial implementation as an effective pasteurization methodology.

P2.1.080

Hyperbaric storage – a new food preservation methodology to avoid Clostridium perfringens endospores' development?

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Aim:
Hyperbaric storage (HS) is a new food preservation methodology stating storage pressure control, inasmuch temperature control as for the conventional refrigeration processes to inhibit microbial development. HS presents several advantages over the refrigeration process, especially when performed at uncontrolled room temperatures (RT), allowing to attain considerable energetic savings and lower carbon-footprints, as energy is only mobilized during the short compression/decompression phases of the pressure vessel, with no energy being required to neither control the storage temperature nor the storage pressure. This study aimed evaluating the potential of HS to inhibit the endospores' development of the pathogenic microorganism *Clostridium perfringens* and compare it with the conventional refrigeration.

Method:
C. perfringens spores were inoculated in brain-heart infusion (BHI) broth (at pH 4.50, 6.00 and 7.50, used as a model system for further validation), and coconut water (pH 5.30). HS conditions were set between 75-200MPa, up to 30 days (at uncontrolled RT), and control samples at atmospheric pressure at RT and under refrigeration (4ºC) were also evaluated. The endospores were enumerated in BHI-agar plates, incubated at 37ºC for 24h under anaerobic conditions. An aliquot of each sample was heat-treated at 70ºC for 10 min to infer the loss of thermal-resistant fraction, and then plated and incubated at the aforementioned conditions.

Results:
The results demonstrated the possibility to inhibit the germination of *C. perfringens* endospores in BHI-broth and coconut water by HS/RT, when compared to refrigeration, although, this process was pH-dependent (especially for BHI-broth). In addition, in coconut water, endospore inactivation up to 3-log units after 30 days under HS was observed, regardless of the storage pressure, despite the minor inactivation rates observed in BHI-broth (≈1-log unit). Minor variations on the thermal-resistant fraction were observed in BHI-broth and coconut water, which means that the endospores were not sensitized while under HS conditions.

Conclusion:
HS/RT was able to prevent *C. perfringens* endospores' development in a model system (BHI-broth), afterwards validated in highly perishable real food product (coconut water). Additionally, it was also possible to inactivate *C. perfringens* spores along storage, especially in coconut water. HS could be seen as a tool to inactivate bacterial spores, which is of extreme pertinence for food safety.

P2.1.081

Application of optical emission spectroscopy in food technology

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Aim:

According to the 2030 Agenda for Sustainable Development, SDG goal 12.3 is to reduce food waste by 50% at the retail and consumption stages, as well as food loss at the production stage by 2030. During the production and processing of foods, generated waste can be used using various green technologies. High-voltage electrical discharge (HVED) extraction is a new, efficient extraction technique. In HVED, created non-thermal plasmas (NTPs) are environmentally acceptable and sustainable due to operation at low temperatures without high energy consumption, shorter processing time and limited use of water and other solvents in extraction. NTP treatment shows a huge potential not only in the extraction of various bioactive components but also in many industrial and technological sectors. One of main objectives is to find optimal parameters and protocols and plasma diagnostics should accompany food treatment.

Method:

The experimental set-up consisted of a glass reactor (300-1000 mL) with a point-to-plate electrode configuration. A medical stainless steel needle was used as a HV electrode and stainless steel electrode was a ground electrode. Plasma was generated in liquid and gas phase through the capacitor charged with the pulsed HV power supply (IMPEL HVG60/1) to create electrical discharges up to maximal 50 kV. Frequency range was 0-300 Hz. Plasma diagnostics was done with Ocean FX extended range model (OCEAN-FX-XR1-ES) of optical emission spectrometer (OES). The emission of a certain volume in the plasma chamber was delivered by an optical fiber to the spectrometer.

Results:

NTPs of various samples were produced by HVED, while the operating parameters (frequency, duration of pulse and treatment time) were changed. Spectra of different plasmas obtained by OES were analyzed.

Conclusion:

OES is an ideal non-invasive measurement technique for plasma diagnostics in a plasma reaction environment, without contaminating the test conditions, which is extremely important in food, since the measurement is performed outside the process reactor. Since the OES from the plasma is often very strong, the efficiency of light collection and detection may not always be optimized. Due to its sensitivity and reliability OES has wide application in diagnostics of NTP used in food technology.

P2.1.082

Formulation of a new high-protein food product based on the valorization of oil industry waste

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Aim: Considering that the alternative protein market is constantly growing and that most of the existing protein products usually contain proteins from milk or soy, the application of new protein isolates has great potential. Milk proteins are widely accepted, but despite their good nutritional value, they do not satify all groups of consumers (vegans or consumers who do not use foods of animal origin for religious reasons). On the other hand, proteins from soy are considered as allergens and they are also very often of genetically modified origin, which makes them undesirable for cesrtain group of consumers. Hence, in this work, protein isolate obtained from the oil cake that remains after oil extraction from plum kernel was used for the formulation of a high-protein product intended to be consumed as a dessert.
Method: Pasteurized fruit nectar was enriched with protein, isolated from plum kernel, to produced fruit jelly. As a prerequisite for obtaining the product in the form of jelly, gelling ability of the protein isolate was tested. Least gelation concentration (LGC) as a function of pH value and ionic strength was determend. The resulting gels were characterized by their chemical composition (protein, fat and carbohydrate content) and sensory properties.
Results: Protein isolated from plum kernel oil cake formed gels at lower concentrations (4%) at neutral pH value (pH=7), but with increasing ionic strength, a higher concentration of protein is needed to form the gel. The greatest reduction in LGC value is achieved at pH=6, at ionic strength μ=0.6, from 10% to 4%. Sensory evaluations showed that this protein dessert has extremely suitable organoleptic properties, dominated by the taste of the product itself.
Conclusion: The most important innovative aspect of this product is the application of a completely new protein that is not yet commercially produced anywhere in the world. The production of protein isolate from the plum kernel achieves the utilization of waste from the food industry, and also obtains plant protein with extremely good nutritional, functional and biological properties. In this regard, plum protein isolate overcomes all previously listed shortcomings of the proteins most present on the market.

P2.1.083

A comparison between the extraction methods of plant-based oleosome-protein mixture: centrifugation versus filtration

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Aim:
Oleosomes are natural plant-based oil droplets, which are often extracted through the centrifugation method from oil-rich seeds. However, the most protein was lost during extraction process. An alternative extraction method is filtration via cheesecloth, known as a loose-woven gauze-like carded cotton cloth, that has the potential to filtrate both oleosome and protein from the insoluble components, namely fiber.
Method:
This study explored the potential of using cheesecloth as a filtrate to extract oleosome-protein mixtures from the rapeseeds that were pre-pressed by the colloid mill and twin-screw press. Different physio-chemical properties, e.g. ζ-potential, particle size, creaming index, and rheological properties of mixtures were characterized. The mixtures derived from the two methods were also adjusted to different pHs (3, 5, 7, and 9) of mixtures for the comparison of the storage stability. Besides, the thermal stability of the mixtures under heating at 95℃ for 15 min was explored upon storage.
Results:
Results showed that cheesecloth can achieve a higher oleosome recovery yield (around 6%) compared to centrifugation. Besides, a higher protein recovery yield(57.0 w/w%) was acquired compared to centrifugation of 50.2 w/w%. Further, cheesecloth also generates a more stable mixture compared to centrifugation regardless of the pH and the thermal treatment. Besides, no significant difference was found in viscosity between the mixtures separated by cheesecloth and centrifugation. Thus, the difference in the storage stability is most likely not shown in rheological behaviors but depends on other factors, such as composition, ζ-potential, and particle size of mixtures.
Conclusion:

This study indicated that cheesecloth filtration can be an alternative method to replace centrifugation for rapeseed oleosome separation in the food industry.

P2.1.084

Fermented table olives, an example of agro-food biodiversity loss in Portugal

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Aim: Climate change is a global emergency in the Mediterranean area affecting crop yields, quality of foods, and biodiversity. Many Portuguese table olives (TO) are facing extinction given the decline in consumption despite being a flagship of the Mediterranean Diet (MD). Olive fermentation is carried out by epiphytic microorganisms and TO quality and safety depend on the dynamics of the microbial populations whose balance can be disturbed by warming, plastisphere biofilms, and more. We discuss herein ways of addressing emerging food safety risks, quality changes, and potential food loss.
Method: Due to limitations and specificity of the subject and knowledge gaps, this critical analysis was based on a review of grey and indexed literature, as well as institutional national and international statistics, aiming at compiling relevant information on, i) existing TO *Olea europaea* cvs and the desirable microbial species in natural fermentations; ii) health benefits and drawbacks of TO in the context of MD and local development, and iii) a SWOT analysis as a contribution to the mitigation and climate adaptation strategies.
Results: Olive fermentation depends on lactic-acid bacteria and yeast originating from the fruit and surroundings. Fruit maturity and composition (phenols), depend on the frequency of rainfall, mean and extreme temperatures, radiation, minerals in soil, pollutants, and more. These factors also play a critical role in selecting the dominant fermentative microbial populations, which consequently affects the quality and safety of fermented TO. The collected data point to declining crop yields, changes in fruit composition, maturity at harvest, and quality and safety of TO. Challenges for the industry (SME, local producers) due to alterations in the natural fermentation at higher environmental temperatures will also be discussed.
Conclusion: Drifts of TO quality in microbial, nutritional, and sensorial properties may occur and should be anticipated. Adaptation strategies at the production level include reinforced/revised hygiene measures and the use of customized starters. At the consumption level, awareness should be raised about the nutritional value of TO and its linkage to the MD. Valuing agrobiodiversity will preserve it, and controlling the processing will ensure an adequate final product while protecting humans and the environment.

P2.1.085

Development of goat cream cheese using powdered milk

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Aim:
This study aimed at developing cream cheese using powdered goat's milk. In certain circumstances, such as limited cold chain maintenance or delayed transportation and, in certain geographical regions, the use of powdered milk to make cheese, a valuable source of nutrients, can be advantageous.

Method:
The cheese was processed using powdered goat's milk (146,63 g/L), salt (12 g/L), calcium chloride (0,5 g/L), and vegetable rennet (30 drops/L). To obtain cream cheese, three combinations of gums were tested (0,5%, w/w): A1(Locust bean gum (LBG) and carrageenan (1:1)); A2 (LBG and xanthan (1:1)) and A3 (LBG). The quality of cream cheese obtained was studied, for 6 days at 5 ºC, using physicochemical and microbial parameters: yield (%) of cheese, pH, a_W, humidity (%), fat (%), *Staphylococcus* coagulase-positive, *Escherichia coli*, microorganisms at 30 °C, molds and yeasts. The experiments were repeated three times.

Results:
The average yield of cheese produced with powdered milk was 65%. The a_W (0.967±0.004) did not show significant differences among the different cheeses, nor over the storage period. The pH (6,35±0,06) did not show significant variation amongst the processed cheeses, presenting a very slight increase over the storage period. Moisture was slightly lower in cheese A3 (14.4±1.5%) immediately after processing. However, in all cases, it dropped slightly during the storage period. The fat content was lower in cheese A3 (5.5±0.4%), compared to A1(6.7±0.4%) and A2 (6.9±0.2%). Staphylococci and *E. coli* were not detected in all cheeses during the studied period. Nevertheless, the microorganisms at 30 ºC were enumerated in all cream cheeses at levels of, approximately, log 2 cfu/g, increasing to log 3 cfu/g after 4 days and greater than log 5 cfu/g after 6 days. No molds were detected in any cheeses, but the yeast levels increased from 1 log cfu/g, after processing, to about 2 log cfu/g on the fourth day of storage.

Conclusion:
All cream cheeses obtained showed similar characteristics, resulting in a shelf-life not higher than 4 days. In the future, the organoleptic acceptance of these cheeses should be evaluated by a sensorial panel to select the best in terms of flavour and spreadability.

P2.1.086

Factors affecting acceptance of foods from animals fed with insect-based feed

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Aim:
Ireland has been facing major challenges in its progress on the United Nations' Sustainable Development Goal 12 of responsible consumption and production. Consuming foods from animals that have been fed with insect-based feed (IBF), could improve this progress. This study aims to provide insights into the acceptance of foods derived from animals fed IBF amongst consumers in Ireland.

Method:
An online survey designed to collect quantitative and qualitative data was developed using Qualtrics and distributed to consumers living in Ireland. Factors affecting the willingness of participants (N=233) to consume chicken, beef, pork, fish, lamb/mutton, eggs and dairy from animals fed with IBF were assessed. Quantitative data was analysed using non-parametric statistical tests via SPSS® while thematic analysis was used for qualitative data.

Results:
Most participants were willing to consume eggs (75.1%) followed by chicken (73%), dairy (70%), fish (64.4%), pork (62.7%), beef (62.7%) and lamb/mutton (56.7%) from animals fed with IBF. Females were less willing to consume beef ($U=5680$, $p=0.048$), pork ($U=5576$, $p=0.027$), fish ($U=5550$, $p=0.022$) and lamb/mutton ($U=5342$, $p=0.008$) than males as revealed from the Mann-Whitney U Test. Those aged 18-29 were most willing to consume chicken ($H(4)=10.555$, $p=0.032$), eggs ($H(4)=14.958$, $p=0.005$) and dairy ($H(4)=15.739$, $p=0.003$). Level of education had an effect only on willingness to consume fish ($H(4)=10.761$, $p=0.029$) where those more educated were more willing. Willingness was positively correlated ($p<0.05$) if the food is safe, cheaper or comparable to alternatives, if the information was on the food packaging, and if the insects are good for the environment and naturally part of an animal's diet. Qualitative findings revealed that most were concerned about the safety of feeding IBF to herbivores and the risk of contracting zoonotic diseases from such foods. The majority of the participants requested more information regarding the benefits/risks of these foods.

Conclusion:
Willingness to consume foods derived from animals fed IBF depends on the type of food and is affected by a combination of consumer-related and product-related factors. However, consumers do not have enough information concerning the benefits/risks of such foods. Hence, educating consumers in this regard while addressing zoonotic disease risks is recommended.

P2.1.087

Effect of mild heating on structural and rheological properties of calcium-pea protein aggregates

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Aim:
With the rising demand for plant-based protein, understanding the formation of pea protein aggregates induced by calcium is important for manufacturing of food products with appealing textural properties. Therefore, the objective of this study, is to understand the combined effect of calcium and temperature on the structural and rheology behaviour of calcium induced pea protein aggregates at moderate temperatures i.e. in the range 30 – 45°C.

Method:
The calcium – pea protein aggregates were prepared by addition of 20 mM to 10 % soluble pea protein suspension. The aggregates were then subjected to controlled temperature conditions at 30ºC, 35ºC, 40 ºC and 45 ºC. The aggregation behaviour of pea protein induced by calcium was studied with static light scattering (SLS) and the structural analysis was conducted using confocal laser scanning microscopy (CLSM) and fourier transform infrared spectroscopy (FTIR). Rheological properties were characterized by small amplitude oscillatory shear (SAOS) measurements to evaluate the viscoelastic properties of the dispersions of aggregates, as well as constant strain rate experiments to large amplitude to evaluate their yielding properties.

Results:
Our results show that the size of calcium-pea protein aggregates decreased upon heating (45 ºC), indicating a structural re-arrangement of large aggregates into smaller aggregates. This was reflected in the rheological properties where the storage modulus of gel formed by ca-protein aggregates increased with temperature from 20ºC to 30ºC, 35ºC, 40ºC or 45ºC. The descending order of the gel strength is as follows: 45ºC > 40ºC >35ºC > 30ºC. This indicates that the weak inter-aggregate bonds were broke during the mild temperature increase, leading to structural rearrangement and exposing more reactive groups. The increased bond density of inter-aggregate bonds leading to an increased connectivity between aggregates and resulting in the formation of stronger gel network.

Conclusion:
In conclusion, our study is the first to investigate the structural rearrangement of a network of weakly connected calcium-protein aggregates upon mild heating. These findings contribute to a better understanding of the dynamic nature of protein aggregates and provide information of the design and optimization of Ca-protein-based materials in various applications.

P2.1.088

Enrichment of protein from Finnish grass material for human consumption

Adjuct Professor Kaisu Riihinen[1], Saska Sormunen, Raija Lantto, Kaisu Honkapää
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Aim:
Grass is a promising source for food due to the high nutritional value and environmental sustainability. Red Clover (Trifolium pratense) is a commonly used grass crop for protein RuBisCo (ribulose-1,5-bisphosphate carboxylase/oxygenase) isolation, but there are no studies on the isolation of protein from the grass species Timothy (Phleum pratense). Therefore, the aim of this study was to optimize a two-step protein isolation protocol with heat coagulation and acid precipitation steps for enriching protein from both grass species.
Method:
The juice of the grass was screwpressed. The effect of an antioxidant, sodium sulphite Na2SO3, was studied by adding 25 mmol to inhibit polyphenol oxidation Heat coagulation was carried out at temperatures of 50 °C, 55 °C, and 60 °C to find the optimum temperature for coagulation of the green chlorophyl proteins. The precipitation of RuBisCo was conducted at a range of pH 5 to pH 2 to find optimum. Mass balance was assessed for the selected protocol.
Results:
The antioxidant was found to be effective inhibitor of the dark color formation in both grass species. The selected two-step protocol coagulated green chlorophyll proteins from grass juice as a first step while the RuBisCo protein was expected to remain in soluble form. The selected optimum temperature was 50 °C for both grass species. The second step was for isoelectric precipitation of the RuBisCo protein. The highest protein content was 45 g/100g DM at pH 4 in Red Clover precipitate and 56 g/100g DM in Timothy.
Based on the assessment of the selected protocol, it was found that protein was distributed in all fractions during fractionation. Only approximately 10% of total protein found in Timothy and Red Clover grass juice was recovered in the RuBisCo protein precipitate. The recovered Red Clover precipitate consisted of 41 g/100g DM of protein while the protein content was 51 g/100g DM in the Timothy precipitate.
Conclusion:
Overall, these findings suggest that further optimization of the protein fractionation protocol is necessary to maximize the recovery of RuBisCo protein fractions from Timothy and Red Clover.

P2.1.089

Computational comparison of ohmic and conventional heating: visualizing tailormade food preservation through multi-physics

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Aim:
According to the UN Sustainable Development Goals, global food security should be attainable by 2030. To achieve this goal, it is necessary to implement innovative thermal food processing techniques to assure a high throughput of safe food with reduced nutrient loss, which is precisely the advantage of Ohmic Heating (OH). However, the complexity of OH processing technology and the current lack of digital tools to characterize it, exposes a deficiency in engineering knowledge which restricts both scale-up abilities and predictions as to the preservation effect of OH.

Method:
Therefore, computational fluid dynamics (CFD) digital twins (DTs) of OH and UHT treatments, were developed on a semi-industrial scale. To increase the technical applicability of the DTs, the CFD models were fed with data of measured material properties of a carrot juice. Additionally, the thermal inactivation kinetics of *Geobacillus stearothermophilus* were determined and the CFD models were expanded to predict the inactivation rate of the treatments. Microbial inactivation rates from the physical systems were used to validate the data obtained from the digital model.

Results:
The DTs' data provided elaborated insights into fluid dynamics and the relevance of pipeline design. In fact, the presence of recirculation zones which occur after thermal treatment, coupled with the volumetric heating feature of OH, were beneficial in achieving the necessary holding time for thermal inactivation. The DTs were able to predict the inactivation rate of spores with a superlative accuracy of 1.10$\pm$0.83%, demonstrating that OH is as effective as UHT in terms of food preservation. Additionally, the CFD analysis determined that the heating time of the product is reduced by up to 82.34% through the application of OH, which would indicate a reduction of the thermal load on the product.

Conclusion:

OH, enables an enhanced application of the HTST (high temperature short time) concept for food preservation. Moreover, this study lays the groundwork for further digitalization of food processing that requires tailormade pipeline design to maximize the effects of fluid dynamics.

P2.1.090

The Proteomes that Feed the World

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Aim:

Plants constitute the nutritional basis of all life. As an alternative to animal-based protein crops can provide proteins that can sustainably nourishing an increasing population. Although the genomes of crops are increasingly elucidated, little is known about proteomes – all the proteins that execute and control nearly every aspect of life. To close this knowledge gap, we have assembled a large international group of partners and the international doctoral program “The Proteomes that Feed the World” which was both conceived and launched at TUM and is funded by the Elite Network of Bavaria. The aim of this project is to generate a proteome atlas of the 100 most important crops for human nutrition, which is of high value for academia; agricultural; food, and pharmaceutical industries.

Method:

For the Crop Proteome Atlas project, a robust and reproducible protocol for the processing and analysis of plant tissues by liquid chromatography tandem-mass-spectrometry (LC-MS/MS) was devised. This protocol constitutes a central component of the so-called Crop Proteome Engine. So far, the protocol has been tested on a variety of tissues such as leaves, roots, and seeds. The proteins get extracted from the powdered plant tissue and undergo a tryptic digest and a fractionation. The fractions were analyzed by microflow LC-MS/MS on an Orbitrap Eclipse tribrid mass spectrometer. Protein identification and quantification was performed by MaxQuant and Prosit rescoring. All data will be made available on Pride and ProteomicsDB.

Results:

To support a plant proteomics project of this scale, the international doctoral program brings together an interdisciplinary team of 16 PhD students and 12 principal investigators (PIs) with leading expertise in plant science, proteomics, and bioinformatics to form the Crop Proteome Engine, complemented by an international network of more than 30 excellent partners. To date, we can present the first comprehensive proteome of *Quinoa bicolor (20k+ proteins)* and for the fruit of *Solanum lycopersicum* (10k+ proteins). We are still looking for partners interested in joining the initiative by contributing plant material or bioinformatics capabilities.

Conclusion:

With the knowledge of the proteome of crops new goals can be achieved in plant breeding, novel food production.

P2.1.091

Effect of antioxidants on lipid preservation of Tenebrio molitor paste submitted to HHP

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Aim:

High Hydrostatic Pressure (HHP) is a well known novel technology for reducing microbial contamination in food without affecting its nutritional quality. However, lipid oxidation has been observed in fatty products subjected to pressure levels higher than 400 MPa. The aim of this study was to evaluate the effect of HHP on oxidation of insect paste and the ability of two commercial antioxidant mixtures for reducing such oxidation.

Method:

Insect paste generated by grinding *Tenebrio molitor* were alternatively mixed with two different commercial antioxidant blends (synthetic - propyl-gallate/BHA - and natural - rosemary based) from Kaesler Nutrition GmbH. A batch of paste without antioxidant was also prepared. Portions of each batch were vacuum packed and subjected to HHP treatment (600 MPa, 5 min). Untreated vacuum packed pastes were also generated. Free acidity, Peroxide value (PV) p-anisidine and TBARs were analysed in treated and untreated samples at time 0 and after 15 days of refrigerated (4°C) storage. pH, colour and fluorescence spectra were also monitored.

Results:

HHP led to a reduction in PV and TBARs, which were more evident in samples treated with synthetic antioxidants rather than in samples without antioxidants. No significant differences were detected on p-anisidine, while free acidity, was lower in HHP treated samples than in untreated ones. After 15 days, free acidity increased in all the samples (50-70%), TBARs were kept stable, peroxide increased in samples without antioxidant (50-100%) and with synthetic antioxidant (40-50%), while it decreased in samples with natural antioxidant. Reduction in p-anisidine values was regularly detected in all the samples, irrespective by the treatment and the presence of antioxidant.

Conclusion:

This study highlight that differently by other food, insects can be particularly resistant to HHP induced oxidation. However, lipid oxidation might occur during the storage. Natural antioxidant appeared to be more effective against late lipid oxidation, reducing the formation of peroxides, while synthetic antioxidant appeared to be more active during the HHP-treatment, stabilizing the peroxide and reducing the formation of secondary oxidation products. Therefore, HHP combined with natural antioxidants can be considered an interesting solution for ensuring oxidative stability of insect paste.

P2.1.092

Using High-pressure processing in comparison with thermal treatment to improve shelf-life of pumpkin pulp fruit

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Aim:

PulpIng Project is aimed to stimulate a value chain with innovative processes that goes throughout all developing stages of pumpkin fruit pulp formulation functionalised with a natural-based preservative extracted from pumpkin by-products. The overall process will be aligned with sustainability principles and non-thermal processes/technologies to improve pumpkin pulp fruit shelf life.

Method:

Pumpkin pulp fruit (100% pulp) was processed by high pressure (HP: 600 MPa / 4 min) and thermal process (TP: 90°C / 3 min) and stored at 5 and 20 °C. The shelf life up to 34 days was evaluated by microbiological analysis (investigation of mesophilic group, Enterobacteria and molds), pH, color, texture and oxidative stability via changes in β-Carotene, γ-Tocopherol, K1 vitamin, total phenolic content (TPC) and antioxidant potential (FRAP).

Results:

HP reduced up to 3.2 (mesophilic), 4.5 (Enterobacteria), and 7.9 (molds) $\log_{10}$CFU/g of contamination compared with control. The pH for HP samples remained stable during shelf life followed by TP and control, showing a reduction of 5%, 19% and 33%, respectively. The color change was noticeable for all samples stored at 20°C, and in general L* (lightness) reduced for all samples. For texture, HP showed an increase in firmness (N) in 54%, on the other hand TP has its firmness reduced by 8% and the control kept stable. Control samples stored at 5°C showed a better maintenance of oxidative stability, followed by HP and TP. K1 vitamin was not detected for all samples.

Conclusion:

In conclusion, HP samples stored at 5°C showed a better performance since less microbial growing, better color, oxidative stability retention and less pH reduction were observed. The next steps include the extraction of the natural-based preservative extracted from the pumpkin by-products and conbine with HP to extend its shelf life.

P2.1.093

Energy assessment of nonthermal processing of beetroot

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Aim: The aim is to evaluate the potential of using the by-product beetroot peel for maximum utilization of the raw material, as well to calculate how much energy is consumed for pretreatment with pulsed electric field (PEF), ultrasound-assisted extraction (UAE) and conventional extraction (CE) of betaine and dietary fiber from beetroot peel.

Method: After pretreatment with PEF, beetroots were peeled. From beetroot peel, dietary fibers and betaine were extracted by means of high power ultrasound (ultrasound assisted extraction – UAE) and conventional treatment. The quantity of betaine was determined with inhouse method (LC-MS/MS) in extract. The quantity of dietary fibers was determined with AOAC 991.43 method in extraction residue.

Results: The PEF pretreatment enables easier peeling, which results in a lower percentage of by-products (12%). Quantity of dietary fiber (44,1 g/100g) and betaine (22496,5 mg/L) is higher with UAE extraction, compared to conventional extraction in which we get 25.5 g/100g dietary fibers and 17952.8 mg/L betaine. The energy consumption for the PEF treatment was 0.0833 kW/h with the emission of 0.07 kg of CO_2. The energy consumption for the UAE treatment was 0.075, 0,15, 0,225 kW/h for 3, 6, 9 minutes, with emission of 0.0638, 0.1275 and 0,1913 kg of CO_2.The energy consumption for the conventional treatment was 1.94 kW/h for heating the water bath and 0.19, 0.39, 0,58 kW/h for 3, 6, 9 minutes, with emission of 1.649, 0.1615, 0.3315 and 0,493kg of CO_2.

Conclusion: From the calculations above, it can be concluded that PEF is an energetically justified pretreatment of beetroots. From the energy calculations and CO_2 emissions for the UAE and conventional extraction treatments, it can be concluded that the UAE treatment is an energetically more favorable treatment with lower CO_2 emissions.

P2.1.094

ANTIOXIDATIVE, ANTIBACTERIAL AND ANTIPROLIFERATIVE PROPERTIES OF HONEY FROM THE WESTERN BALKANS

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Aim:

The health benefits of honey derive from its antioxidant nature, antimicrobial and antiproliferative activity.With the aim to assess the antioxidant capacity, antibacterial and antiproliferative activity of different types of honey from the Western Balkans were examined.

Method:

Nineteen samples of different honey types (acacia, linden, heather, rapeseed, sun-flower, phacelia, basil, anise, sage, chestnut, hawthorn, lavender and meadow) were obtained from beekeepers who declared their botanical origin.

Physicochemical parameters (moisture, pH, electrical conductivity, free acidity, and hydroxymethylfurfural (HMF)) were analysed according to the methods of AOAC and the Harmonised Methods of the International Honey Commission.

Antioxidant potential of honey samples was assessed by determination of total phenolic content (TPC) and evaluation of scavenging activity towards diphenilpicrylhydrazyl radicals (DPPH$^{\cdot}$). Antibacterial activity was estimated *in vitro* using agar diffusion tests and measuring minimal inhibitory concentration (MIC). Antiproliferative activity was evaluated using the colorimetric sulforhodamine B (SRB) assay.

Results:

The highest phenolic content was found in basil honey (101 ± 2.72 mg GAE/100 g), while the lowest was registered in rapeseed honey (11.5 ± 0.70 mg GAE/100 g). DPPH scavenging activity varied among the samples being the highest for lavender honey (IC_{50} = 88.2 ± 2.11 mg/mL) and the lowest for rapeseed honey (IC_{50} = 646 ± 8.72 mg/mL).

Among investigated bacterial strains following resistant potencies were determined: *Escherichia coli* > *Escherichia coli* ATCC 8739 > *Enterococcus faecalis* > *Proteus mirabilis* > *Staphylococcus aureus* > *Staphylococcus epidermidis*. The linden honey from Fruška Gora and phacelia honey showed the strongest antibacterial activity.

The highest antiproliferative activity was obtained by linden honey (IC_{50}^{MCF7} = 7.46 ± 1.18 mg/mL and IC_{50}^{HeLa} =12.4 ± 2.00 mg/mL) and meadow honey (IC_{50}^{MCF7} = 12.0 ± 0.57 mg/mL, IC_{50}^{HeLa} = 16.9 ± 1.54 mg/mL and IC_{50}^{HT-29} = 23.7 ± 1.33 mg/mL) towards breast (MCF7), cervix (HeLa) and colon (HT-29) cancer cells.

Conclusion:

Investigated honey samples varied in antioxidative, antibacterial and antiproliferative properties due to botanical and geographical variations.

Acknowledgments:

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P2.1.095

Rapeseed press cake from Serbian rapeseed varieties as an alternative source of proteins

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Aim: The alternative plant-based protein market has been rapidly growing in recent years. Plant proteins, although highly demanded on the market, have certain disadvantages compared to animal proteins, particularly regarding their biological value. The remaining antinutritional factors could also negatively affect the protein quality. In this study, defatted press cake obtained from Serbian rapeseed variety was investigated. Amino acid profile and content of glucosinolates as the main antinutritional factors were determined in defatted rapeseed press cake to investigate the potential application of this industrial by-product in the production of high-quality food grade proteins.

Method: The crude protein content of the defatted rapeseed press cake was evaluated using the Kjeldahl procedure, using 6.25 as a nitrogen-to-protein conversion factor. The amino acid composition was determined by ion exchange chromatography using an automatic amino acid analyser. The separation of amino acids was recorded using cation

exchange chromatography, followed by the color reaction of ninhydrin and phytochemical detection. The glucosinolate content was determined by a spectrophotometric method based on the measurement of absorbance of Pd–glucosinolate complex at 425 nm.
Results: Based on the obtained results it can be concluded that the defatted rapeseed press cake analysed in this study has a low level of glucosinates and high protein content (34.25%). It can also be characterised as a valuable source of essential amino acids (37.81% of total amino acids), especially high in leucine (2.41%), lysine (1.81%), and valine (1.29%). Due to the high proportion of lysine, the analysed press cake would be a great source of proteins that are complementary to cereal proteins.
Conclusion: In addition to being rich in protein, the analysed rapeseed press cake has a well-balanced ratio of amino acids and a low level of glucosinolates which makes this by-product a good candidate for isolation of food-grade proteins.
Acknowledgments: This work was financially supported by the Ministry of Science, Technological Development and Innovations, Republic of Serbia (Contract No. 451-03-47/2023-01/200222), as well as by the Science Fund of the Republic of Serbia, Grant No 6673, PROTein from Rapeseed Oil Processing Waste: Application in Food and Wastewater Treatment – PROTOPOWER.

P2.1.096

Pasteurization of phycocyanin formulations by thermal and non-thermal technologies: comparison of inactivation and quality characteristics

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Aim:
Phycocyanin (PC) is a natural blue food colorant derived from microalgae, which has become an increasingly popular and sustainable alternative to chemical food additives. Due to its nature as a protein, various external influences lead to color losses, therefore limiting preservation of PC formulations by conventional treatments. Thus, the presented study is focusing on non-thermal decontamination of PC formulations at pH 3 and 7.

Method:
Inactivation of *Listeria innocua* and *Escherichia coli* by Pulsed Electric Fields (PEF; 32 kV/cm, up to 200 kJ/kg) and high pressure processing (HPP; 600 MPa, up to 10 min) was investigated and compared to short-time thermal pasteurization (up to 70 °C, 2 s). Color retention as well as reversibility of protein aggregation were evaluated.

Results:
Results showed sufficient inactivation levels for all treatments, which were facilitated at pH 3. In contrast to thermal effects, protein aggregation caused by low pH and short HPP exposure (≤ 2.5 min, 600 MPa) were shown to be reversible. For PEF treatment, the electric field itself did not seem to affect the proteins, however, especially at neutral pH the required high energy input levels and the associated temperature increase lead to irreversible protein aggregation.

Conclusion:
Altogether, process windows could be determined which allow for a sufficient microbial inactivation while simultaneously providing a best possible retention of PC color activity, therefore contributing to the industrial implementation of these methods.

P2.1.097

The interactions between transglutaminase-treated plant and dairy proteins in protein-rich beverages and gels

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Aim
Protein-rich foods are specialised to enhance daily nutrition intake in a small and convenient serving size. While the disadvantages of overused animal proteins have urged the industry toward sustainable food production, i.e. plant proteins, the choice of plant protein type and its concentration negatively influence food texture which challenges the industry with reduced market acceptability. This presentation introduces a protein-rich plant-dairy blend in which plant protein has more concentration and discusses the feasibility of using the enzymatic cross-linking technique to increase the milk and plant protein interaction that consequently can improve the food texture.
Method

Milk and oat protein concentrates and pea protein isolate powders were used to manufacture the plant and dairy mixture composed of a fixed amount of milk with 3.5% protein and varying amounts of the pea and oat proteins to form blended milk-pea of 11% and milk-oat of 9% total protein concentrations. After heating single and blended proteins at 85ºC for 20 min, different amount of microbial Transglutaminase enzyme was incubated with protein sample at 50ºC for 1 h. A molecular approach was adopted to measure the protein structural changes before and after transglutaminase activity.

Results

The gel electrophoresis results showed the non-reacted protein fractions to transglutaminase in single milk and pea faded from the cross-linked milk-pea protein profile. A significant decrease of ε-NH_2 detected by spectrophotometric assay confirmed milk-pea mixture synergistically reacted to the enzymatic cross-linking compared with the milk-oat mixture. The Fourier-transform mid-infrared spectroscopy revealed that proteins' side chains contributed to form cross-links between milk and pea proteins. The 10 U of the enzyme increased protein interaction between milk and plant protein compared with 5 U, while 20 U was an essential enzyme concentration to form a milk-pea gel.

Conclusion

The enzymatically cross-linked milk-pea presented a viscose and thick consistency due to the formation of resistant bonds between milk and pea proteins. This enables the food industry to manufacture functional beverages and gels with improved texture profiles from various protein sources. The effectiveness of enzymatic crosslinking depends on different factors. Thus, the industrial application of enzyme cross-linking requires optimising the effective factors while considering manufacturing costs.

P2.1.098

Bioactive extracts from oregano and maral root in increasing the shelf life of strawberries

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Aim: Across the food value chain, 33% of the food produced worldwide is wasted and this amounts to 1.3 billion tons of food globally per year, equalling 170 million tons of CO2 emissions. The latest estimates from Eurostat revealed that we are wasting around 127 kg per person per year in the EU, which is about 14% of the total food produced. Packaging technologies could reduce food waste by addressing some of the broader systemic causes of such as extending shelf life and maintaining food quality, providing appropriate portion sizes, or using date labelling effectively without discouraging the consumption of healthy foods. Active packaging has been defined as packaging that can be used to "extend shelf-life or improve safety or sensory properties while maintaining the quality of the food". To this regard, biologically active compounds formed in herbs hold promising potential as natural bioactives, as they enhance cross-linking of certain biopolymers, while their antioxidant, anti-microbial, anti-allergenic functions prolong shelf-life and improve health benefits of food products. The main objective of this work was to evaluate the effect of active packaging system based of bioactive compound extracted from oregano and maral root in increasing the shelf life of strawberries.

Method: The oregano (OR) extract and maral root (MR) extract were added to 2% w/v alginate solution. The effects of the extracts on the mechanical, barrier, antioxidant, and antimicrobial properties of the prepared films were assessed using up-to-date analytical methods. The prepared solution was used to coat strawberries and a short shelf-life study was conducted.

Result: The antioxidant properties of the alginate solution increased significantly with the addition of both OR and MR. No significant difference in the antioxidant properties of both solution was observed up to three weeks stored at 4oC. The mechanical and barrier properties of the alginate films increased with OR and MR addition meaning a possible cross-linking reaction between alginate and the extract. The coating experiment revealed that, the quality of the coated samples can maintain the food quality better as compared to the non-coated ones. However, the OR and MR coating solution served as a better coating solution as compared to only alginate coating.

Conclusion: This study has demonstrated the potential of oregano and maral root extract towards enhanced functionality of alginate films for active food packaging applications.

P2.1.099

Comparison of two discarded bread flours as an energy substrate for lactic acid bacteria

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Aim:

This work aims to investigate and compare the use of two discarded bread flours through a microbial fermentation process to develop a plant-based drink for human consumption and reduce food waste.

Method:

A commercial probiotic culture (CYDFX01) consisting of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* were chosen to carry out the fermentation. α-amylase and glucoamylase were used to hydrolyse the starch of the two bread flours, obtained from a Spanish and a Georgian white bread. Each bread flour was mixed with sterile water at 20% (w/v) and pasteurized at 72ºC for 5 min. Then, they were cooled until 37ºC. Both samples were inoculated at 10^7 CFU/g and incubated at 38 ± 2ºC for 24h. Each bacterium was counted in *S. thermophilus* isolation agar and MRS agar (MRSA) respectively at 0, 3, 6, 9 and 24 h in both beverages. Acidity and pH were analysed at the same times. After the fermentation, counts of aerobic mesophilic bacteria, lactic acid bacteria (LAB), *Enterobacteriacea*, sulphite reducing bacteria and molds and yeast were determined on PCA, MRSA, Mac Conkey, Bismuth sulphite agar and Sabouraud agar, respectively. The nutritional composition of the two breads was also evaluated.

Results:

Results show that the starter grew better in the beverage made with Georgian bread flour. The maximum rate growth for *L. delbrueckii* was three times higher (0.422 vs 0.129 log CFU/g) and that of *S. thermophilus* more than 2.5 times higher (0.355 vs 0.132 log CFU/g) than the Spanish´s bread flour rates. Moreover, the Georgian bread-flour beverage showed a higher percentage of lactic acid (0.299 g/100g of beverage) at 24h. Although, the Georgian bread-drink reached a lower pH (3.65), the Spanish bread-beverage showed a higher reduction of pH (1.3 units). Higher counts (approximately 8.5 Log CFU/mL) of LAB and aerobic bacteria were founded in both beverages. The nutritional variances between the two breads could be the reason for the differences in microbial growth, pH and acidity.

Conclusion:

Both discarded breads are great substrates for LAB and both beverages can be an interesting product for consumers thanks to their probiotic content and their contribution to the circular economy.

P2.1.100

Advancements in Preservation Technologies for Clean Label Products: The Case of Free-From Bakery Industry

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Aim: Clean-label food technologies are essential in satisfying consumers' expectations for transparency, natural ingredients, and healthier choices. This work focuses on reviewing recent advancements in preservation technologies, highlighting their significance in preserving product integrity, prolonging shelf life, and meeting the increasing consumer demand for natural and minimally processed food options. Furthermore, the study delves into the specific case of the free-from bakery industry, considering the challenges posed by gluten, dairy, additives, and allergens.

Method: An extensive literature review was carried out on the clean label applications of more classical food preservation methods, such as freezing, drying, fermentation, or use of organic salts, and more recent technologies, such as high-pressure, ultrasonication, cold plasma, electric fields, photohydroionization, or active packaging. A deeper exploitation was conducted on their application to the free-from bakery industry.

Results: The clean-label application of a comprehensive range of preservation technologies was analyzed in relation to various food sectors, including dairy, fruits and vegetables, meat & fish, juices & beverages, plant proteins, and bakery. The study identified the potential benefits and challenges associated with implementing these technologies. Specifically focusing on the bakery industry, the research examined the effects of food processes on proteins and starch.

Conclusion: This study underscores the significance of clean-label food technologies in meeting consumer expectations. The focus on the free-from bakery industry has shed light on the unique challenges of gluten, dairy, additives, and allergens while identifying potential avenues for future research. The findings emphasize the importance of implementing these preservation technologies across various food sectors, paving the way for enhanced product quality and consumer satisfaction.

P2.1.101

Solubilisation Techniques for Dietary Fibres in Okara (Soy Bean Residue)

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Aim: Soluble dietary fibres are beneficial to the gut microbiota and it is therefore desirable to increase their share in our meals. One approach to so is to transform insoluble fibres present in our food into soluble fibres. This study provides an overview of modification technologies used to transform insoluble dietary fibres in okara, a side stream from tofu and soy milk production, into soluble ones.
Method: A literature review was conducted to find relevant studies on the topic. Only articles reporting on the content of insoluble and soluble fibres before and after treatment were considered. The findings were grouped into four categories: biological, chemical, physical, and combined treatments. The impact of the treatments was displayed graphically.
Results: The present study revealed the wide variety of different treatment methods that had been investigated to modify okara fibres. Biological treatments with enzymatic digestion or fermentation resulted in the lowest increase in soluble fibres, with the original content increasing by around two and a half times on average. Reports on chemical treatments were scarcer but seemed to perform slightly better, increasing the content of soluble fibres by around five times. Physical treatment methods were diverse, and some were found to be extremely efficient. Overall, they increased the fibre content up to eight times. This was only exceeded by a combination of physical treatments, which boosted the soluble fibre content almost by factor ten.
Conclusion: In summary, a variety of processing strategies have been investigated to solubilise okara fibres so far. Combining different physical treatment methods, especially size reduction, was found to be the most suitable approach to maximise the solubilisation of okara fibres.

P2.1.102

Life Cycle Assessment of a Smart Packaging for the extension of shelf life of juices

Dr. Marina Stramarkou[1], Dr. Christos Boukouvalas[1], Prof. Magdalini Krokida[1], **Miss Konstantina Theodora Laina**[1]
[1]National Technical University Of Athens

Aim: The aim of the present study is the life cycle assessment (LCA) of a Tetra Pak smart packaging system equipped with a chemical sensor able to detect the modifications in the concentation of carbon dioxide, which represents an indicator of microbial spoilage in the contained food, and with a film of encapsulated antioxidant compounds, able to delay the spoilage of the food product, and specifically juices through their controlled release.
Method: Firstly, the environmental impact of the production of Tetra Pak smart packaging is assessed and compared to the production of a conventional Tetra Pak packaging. Afterwards, the study includes the stages of use and end-of-life of the two packaging systems and the food product contained in them with the aim of assessing the environmental benefits of smart packaging over conventional packaging. Based on the fact that smart packaging extends the shelf life of the contained food and, thus, reduces the food wastage compared to the conventional packaging, four use scenarios are adapted: conventional packaging generates 30% food waste, while smart packaging can generate 5% (optimistic scenario), 10 % (realistic scenario) and 20% (conservative scenario) food waste.
Results: The LCA of the production of smart packaging showed that its environmental footprint was 1.77 times higher than that of the conventional packaging in the most important impact category of climate change. However, when the stages of use and end-of-life of both the packaging systems and the food contained were also included in the study, the trend of environmental performance changed. Specifically, the environmental footprint of the smart packaging in climate change category was significantly lower than that of conventional packaging.
Conclusion: Smart packaging represents an innovative solution that combines the benefits of preserving the quality of the contained food while being environmentally sustainable by reducing the generation of food waste in the supply chain. This conclusion may influence not only the future trends of industry, which will turn to developing more smart packaging systems for various uses, but also the opinion and awareness of consumers, who will be informed of the positive effects throughout the shelf life of packaging sytems.

P2.1.103

Effects of caffeic acid on characteristics of gelatin based fibers produced by centrifugal spinning

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[1]Middle East Technical University Department of Food Engineering

Aim

Active food packages aim to improve or maintain the food quality and safety throughout the self-life of foods. Caffeic acid, (3,4-dihydroxy cinnamic acid), is the foremost phenolic compound present in the legumes, olive oil, coffee, fruits and wine. It is also known with its antimicrobial and antioxidant activity. Gelatin, sustainable, biodegradable, abundant, renewable polymer, is a promising external support matrix for caffeic acid. Therefore, the objective of the study is to develop gelatin based active fibers with caffeic acid by using centrifugal spinning which is an efficient method to produce microfibers.

Method

In this study, bovine gelatin was used as a polymer with 25% (w/v) concentration, by dissolving in 100% acetic acid. Then, 0, 2 and 3% (w/w) caffeic acid and 0.2 grams of Tween80 were added separately and stirred for 30 minutes. The volumetric flow rate and spindle speed were set as 10 mL/h and 1800 rpm, respectively for the centrifugal spinning. Viscosity of solution, fiber size distribution, total phenolic content and antioxidant activity of fibers were determined to examine the effect of caffeic acid concentration on to the centrifugal spin solution and fiber characteristics.

Results

Viscosity of solutions were 0.319, 0.296 and 0.245Pa.s, and diameter of fibers were 1789.45, 1877.24 and 2668.58 nm for 0, 2 and 3% caffeic acid concentrations, respectively. According to results, as caffeic acid concentration increased, total phenolic content and antioxidant activity of films increased. Total phenolic contents were 20.82 and 26.66 mg GAE/g while antioxidant activities were 73.4% and 85.2 for 2% and 3% caffeic acid concentrations, respectively.

Conclusion

As concentration of caffeic acid increased, diameter of fibers increased, whereas viscosity of solutions decreased. Addition of caffeic acid enhanced antioxidant activity and phenolic content. Increasing the caffeic acid concentration resulted in higher phenolic content and antioxidant activity. Therefore, caffeic acid added gelatin fibers might be a promising alternative in sustainable active packaging to preserve foods.

P2.1.104

Impact of galactolipids and phosphatidylcholine on the stability of commercial microalgal oil-in-water emulsions

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[1]Wageningen University & Research

Aim:

Microalgal oil is a sustainable source of omega-3-polyunsaturated fatty acids (ω-3 PUFA) compared to fish oil. Due to its high degree of unsaturation, it is very sensitive to lipid oxidation, especially when used in the form of emulsions.The presence of phospholipids and galactolipids in the microalgal oil could influence the oxidation of the oil, although their effect has not been fully elucidated yet. In this study, the impact of galactolipids and phosphatidylcholine on the physical stability and oxidative stability of microalgal oil-in-water emulsions emulsified by Tween 20 was investigated.

Method:

Phosphatidylcholine (PC), monogalactosyldiacyl glycerol (MGDG), and digalactosyldiacyl glycerol (DGDG) were added at a concentration below or above their critical micelle concentration (CMC) in commercial microalgal oil. Then, emulsions were prepared by a microfludizer using Tween 20 as emulsifier. The CMC in oil, the droplet size and zeta potential of the emulsion were determined with dynamic light scattering using a zetasizer; the instability index of the emulsion was measured by lumifuge; the amount of Tween 20 in the aqueous phase was measured by spectrophotometer at the wavelength of 620 nm. The oxidative stability was assessed by measuring oxygen consumption in the headspace and monitoring hydroperoxide and aldehyde formation by ^{1}H NMR spectroscopy.

Results:

The concentration of Tween 20 in the aqueous phase remained below its CMC in all emulsions and at all time points. All emulsions remained physically stable during the shelf-life with no change in droplet size over time. However, the zeta-potential of all emulsions decreased significantly during the shelf-life. Among all the polar lipid species tested, PC showed the most antioxidant effect when used at a concentration below its CMC.

Conclusion:

To conclude, polar lipids in microalgal oil could affect the physical stability and oxidative stability of commercial microalgal oil-in-water emulsion. Carefully controlling the amount of these polar lipids could help designing microalgal oil-in-water food emulsions with a higher oxidative stability.

P2.1.105

Developing a methodology for the validation of industrial heat inactivation for sustainable production of food

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Aim:
Different heat inactivation techniques are used in the food industry to inactivate pathogens. These heat inactivation techniques need to be validated to estimate their actual heat inactivation of pathogens in the specific food matrix during the process. This can be performed by using a non-pathogenic, surrogate strain that has the same heat resistance as the targeted pathogen. The non-pathogenic strain will be inserted in the industrial process and the inactivation will be determined after processing to provide information about the efficacy of the industrial process. This methodology will help to prevent recalls, leading to less food waste but can also lead to a reduction of the intensity of the process with less energy consumption. Therefore, it will help to obtain more sustainable production on an industrial scale. The aim of this study is to find a suitable surrogate strain for a food process: the baking of cookies.

Method:
The flour was inoculated with different micro-organisms: three vegetative food pathogens *Listeria monocytogenes*, *Salmonella* spp., *Escherichia coli* O157:H7, and two surrogates: *Enterococcus faecium* strains (996 and 76). The cookie dough was prepared, standardized cookies were made and the heat resistance of the four food pathogen cocktails was compared with that of the two candidate surrogate strains during a baking process for 1, 2, 3, 4, 5, 7.5, and 10 minutes at 205°C. The cookies and the dough were plated out on different media: selective, non-selective, and combination of both.

Results:
The inoculation of the flour was optimized and resulted in an inoculum of 7.4 ± 0.3 log CFU/g in the cookie dough. The plating medium was also optimized and the overlayer method was used consisting of a non-selective media and selective media. *E. faecium (*76) and the *L. monocytogenes* cocktail showed a similar heat inactivation curve. *E. coli* O157:H7 cocktail was less heat resistant and absent after 5 minutes of baking at 205°C. The *Salmonella spp.* followed a similar inactivation curve as the *E. faecium (*996).

Conclusion:
The selected *E. faecium* strain showed to be a good surrogate strain for the *Salmonella* spp. cocktail (most heat resistant) during the baking process.

P2.1.106

Influence of pest infestation on tea leaf composition during the growth and processing stages.

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Aim: Tea green leafhopper is one of the most important pests that affect tea yield and quality. However, it is well known that infested tea leaves can develop a mellow aroma and are used for producing oolong and other teas. Japanese green tea varieties are not suitable for black tea production, but if tea production can be optimized using leafhopper-infested tea leaves to develop high-quality Japanese black tea, this practice can effectively reduce the use of agricultural chemicals. In this study, we investigated the effects of leafhopper infestation on tea leaf composition during the growth and processing stages.

Method: In a tea plantation in Ikeda-cho, Gifu Prefecture, Japan, two pesticide-sprayed areas and two unsprayed areas were set up. Harvesting was conducted four times a year, and fresh leaves were sampled two weeks prior to harvest. Tea leaves harvested in June and August were processed into black tea. The tea leaf aroma was collected by the SPME method and analyzed by GC-FID and GC-MS. In addition, free amino acids were extracted from vacuum/freeze-dried and crushed tea leaves with pure water then quantified by UPLC.

Results: Geraniol content showed no significant change in the unsprayed area for the tea leaves in June on which leafhoppers were observed. In contrast, the aroma components linalool and linalool oxide III increased before harvest, and the observed changes were linked to leafhopper infestation. Phenylalanine content did not differ significantly for leafhopper infestation, but 2-phenylethyl alcohol, an aromatic benzenoid compound biosynthesized from phenylalanine, increased in the two weeks before harvest in the unsprayed area. In addition, linalool oxide III and 2-phenylethyl alcohol contents in the tea leaves after processing were higher in the unsprayed area than in the pesticide-sprayed area, while glutamic acid and theanine, which are responsible for umami flavor, were lower in the unsprayed area.

Conclusion: The aromas of linalool oxide III and 2-phenylethyl alcohol in the tea leaves fluctuated by degree of leafhopper infestation, indicating that leafhopper predation intensifies the floral aroma that is important for black tea quality.

P2.1.107

High-Pressure-assisted extraction of bioactive compounds from olive and tomato pomace

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High-Pressure-assisted extraction of bioactive compounds from olive and tomato pomace

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Aim:
High Pressure has been reported to assist the extraction of proteins, polysaccharides and bioactive compounds (BACs) from plant and animal tissues, algae, and food by-products. High-pressure-assisted-extraction (HPAE) includes mixing of the material with the solvent, subjection to high pressures (100-600 MPa), and recovery of the target compound. The extract can be further treated to obtain high purity compounds, as nutraceutical ingredients. This study aims to the investigation of HPAE as an alternative for the recovery of high value BACs from olive and tomato pomace,.

Method:
Raw olive and tomato pomace were initially air-dried. Different solvents (methanol, acetone, ethanol, hexane, ethyl acetate) at concentrations of 0-100% w/w and mass/solvent ratios from 1/5 to 1/30 were investigated. HPAE of the extraction mixture was studied in the pressure range of 200-600 MPa at ambient temperature for up to 20 min. The characterization of the extracts was performed using Folin-Ciocalteu and DPPH assay (total phenolics, antioxidant activity) and HPLC analysis (total carotenoids).

Results:
The maximum BACs recovery were achieved in the time required to reach each of the applied pressures and prolonged residence times did not significantly increased yields. An increase in applied pressure resulted in increased BACs recovery, exhibiting 56.6%, 81.4% and 125% increase for applied pressures of 200, 400, and 600 MPa, respectively. Among the tested mass/solvent ratios, the most efficient during HPAE were those below 1/10, when solvent concentrations of 40-60% w/w are used. Among solvents, ethyl acetate resulted in the highest BACs recovery from tomato pomace.

Conclusion:
Based on the results of this study HPAE could be considered as an alternative to conventional processing for the extraction of high value BACs, at short time processing, for eco-friendly valorization of agro-food by-products.

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P2.1.108

Extraction of Pumpkin Seed Protein by Using Different Methods

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Aim: Pumpkin seed is one of the most important agro-industrial wastes and is generally utilized for its oil content. However, it also contains a significant amount of protein with essential amino acids (~30%) thus it has a valuable potential to be used as an alternative plant-based protein source. Hence, obtaining a reasonable amount of extracted protein with a higher protein content is the aim of this study.

Method: Pumpkin seed flour was used as the raw material. Three different extraction techniques (*alkali, salt, and enzyme-assisted*) with 2 different pre-treatment methods (microwave-assisted (MA), and conventional heating (CH)) were used to obtain pumpkin seed protein (PSP) from its flour. In addition, untreated flour samples (UF) were also used for the different extraction methods. The analysis evaluated extraction yield, proximal analysis, protein solubility, and structural changes by Fourier-transform infrared (FTIR) spectroscopy.

Results: The results showed that among 3 different techniques, both the extraction yield and the protein content were the highest in the alkali-treated samples ($p<0.05$). In addition, MA treatment with the alkali method resulted in the highest extraction yield (~67%) and protein content (~78%) compared to CH and UF samples ($p<0.05$). Besides, the solubility of the PSP improved more in MA treated alkali samples with a shorter exposure time of microwave. FTIR spectroscopy analysis compiled well with the results obtained from the other analysis.

Conclusion: This study revealed that the selection of extraction methods had a huge impact on the yield and the properties of PSP, and the best results were obtained for the MA samples with the alkali treated method. This combination could be used as an alternative extraction methodology due to its milder conditions to obtain PSP to a greater extent.

P2.1.109

Rheological And Microstructural Parameters As Roasting Markers For Cocoa Beans Treatments

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Aim: Knowledge of how roasting process, in terms of different parameter combinations, can affect the characteristics of cocoa beans, is absolutely necessary for an appropriate chocolate production. Roasting can affect both physical and chemical characteristics of chocolate, in specific in terms of rheological, polyphenols and fatty acid compositions, as well as antioxidants and volatile profile. The aim of this study was the evalution of the rheological, microstructural and chemico-physical properties of cocoa beans subjected to different treatments, in order also to find a potential correlation beetwen these characteristics, to highlight if rheological and microstructural analysis can be employed as marker for different roasting treatments.

Method: In this study cocoa beans of different particle size were roasted by applying different combinations of temperatures (110-150 °C) and time (15-45 min.). Rheological behavior of samples were studied by means of empirical-imitative analysis. Additionally, microstructural, polyphenol and fatty acid profile, antioxidant capacity (DPPH and ABTS) and volatile analysis (by using gas-chromatography) were performed.

Results: Differences between samples were highlighted not only in relation to polyphenols content, antioxidant and volatile profile, which amount, intensity and peculiar patterns are s strictly related to the used temperature and roasting time, but also to structural ones. Higher time and roasting temperature affect both the matrix porosity in terms of pore size and their distribution, as well the compound distributions that affect their release in the matrix, contributing to confering different peculiar physocochemical characteristics. Moreover, all the modifications evidenced at microstructure level are strictly correlated with rheological ones, being a key factor to evaluate roasting cocoa beans characteristics.

Conclusion: Overall obtained results showed as roasting parameter can affect in strong way cocoa beans peculiar characteristic, in terms of rheological, microstructural, physicochemical and volatile profile. Moreover, a strictly correlation has been highlighting between rheological, microstructural and all the other analysed parameters, underlining the suitability and potentiality of rheological analysis to predict cocoa beans roasting parameters and characteristics.

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P2.1.110

Growth and survival of bacterial pathogens in plant nutrient solutions based on human waste

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Aim:
In future food production, recycling and reuse of nutrients is essential. In hydroponic plant cultivation, nutrient solutions based on organic waste has been suggested as sustainable, high quality, low-cost alternatives to chemical fertilizers. One such product is Aurin, wich is a commercial fertilizer based on human urine. From a food safety perspective, these nutrient solutions has to be free of micropollutants and to not support the growth of potential pathogens, to avoid their accumulation and spread in the food chain.
The aim of this study was to evaluate the food safety in supplemented nutrient solutions based on human waste by investigating the survival and possible growth of selected food-related, pathogenic bacteria in the solutions.
Method:
The investigation was designed as a in vitro challenge study. First, the growth and survival of selected food pathogens was monitored in Luria Broth (LB) adjusted to different pH (4-7), NaCl concentrations (0-1,7 M) and NH_4^+ concentrations (0-250 mM), to analyse how the bacterial strains responded to different stress conditions relevant to a hydroponic plant cultivation system. The growth was monitored by incubation in 96-well plates at 22 °C and OD_{600nm} measurements every 2nd hour for 48 hours. Further OD measurements were performed after 4 and 10 days to check for delayed growth.
Next, the growth and survival of the bacteria was monitored in Aurin, Aurin with different supplements, and a fully defined mineral nutrient solution for 28 days, with OD_{600nm} measurments every 24 hours. Where no growth was detected, the survival of the bacteria was tested by spread plating on suitable growth media.
Results:
All the bacterial strains grew well under the different stress conditions in LB medium, except for in pH 4. Some differences in perceived stress were observed between genera and species. However, when inoculated in the plant nutrient solution and Aurin, no growth was detected for any of the analysed strains after 4 days.
Conclusion:
The results so far indicates that the plant nutrient solutions alone does not support growth of the selected strains. Further result will be presented and discussed.

P2.1.111

Antioxidant properties of tomatoes-based foods from PRIMA project

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Antioxidant properties of tomatoes-based foods from PRIMA project
Aim:
The study aimed to formulate foods based on tomatoes, olive powder, and green leaves by recycling vegetable waste and implementing the use of proteins of vegetable origin as an alternative to animal ones, with a high environmental impact. In particular, sugar beet leaves (*Beta vulgaris* L.), containing an average of 22.8% of crude protein on dry matter, were used. The principal protein in all green leaves is the enzyme ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO), which has a highly desirable amino acid composition for human consumption and functional properties similar to those of soy and whey proteins. Based on this, we analyzed the protein-enriched tomato and olive powder food products, focusing on their antioxidant content and properties.

Method:
The antioxidant value of the protein-enriched tomato and olive products, obtained using different formulations and cooking methods, was estimated by analyzing the total content of polyphenols and flavonoids by Folin-Ciocalteu and aluminum chloride methods, respectively, and the antioxidant power through *in vitro* assays including DPPH, FRAP, and ORAC.

Results:
Several leather products based on a different percentage of olive powder and types of proteins were analyzed. The presence of RuBisCO, instead of pea proteins, positively affects the content of bioactive molecules and antioxidant activity (polyphenols: 5.31±0.07 mg GAE/g; flavonoids: 1.17±0.05 mg CE/g; EC_{50}: 0.98±0.14 mg/ml; ORAC: 67.65±6.34 µM TE/g; FRAP: 2143.25±76.72 µM Fe^{2+}). Moreover, analyses of bars with different percentages of olive powder and protein types, obtained by various processing mechanisms, highlighted a key role of RuBisCO and baking in formulating a tomato-based

food showing the highest antioxidant potential (polyphenols: 17.75±1.08 mg GAE/g; flavonoids: 10.24±1.92 mg CE/g; EC_{50}: 0.27±0.01 mg/ml; ORAC: 258.96±48.64 µM TE/g; FRAP: 7418.12±232.46 µM Fe^{2+}).

Conclusions:
Preliminary results show that tomato-based leathers and bars have good antioxidant power. The RuBisCO protein and the processing methods play a key role in determining the formulation of healthier products, while the level of olive powder had no significant influence on the antioxidant content.

P2.1.112

Combination of plasma activated water and biopolymer coating to extend pear fruit shelf life

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Aim:
The aim of the work was to evaluate the impact of combined non thermal technologies (plasma activated water, biopolymer coating) on the shelf life of pear fruits during storage at refrigeration condition.

Method:
Prelimary analysis has been done to evaluate the potential of plasma-activated water (PAW) at different temperatures to reduce the microbial load on fresh pear as well as to identify of relevant treatment indicators (stability and duration of usability of the PAW). The pears were treated with PAW at 20 °C, 30 °C and 40 °C for 1 to 5 minutes or tap water, stored up to 21 days at 8 °C and the microbiology was carried out (total aerobic mesophilic, *Enterobacteriaceae*, yeasts and molds) to evaluate the impact of the process. Then, pear fruits were washed by using PAW at the optimal condition and a caseinate based coating previously optimized (Miele et al., 2022) has been applied by dipping for 2 minute. Samples washed with tap water and without coating has beed used as control. All samples were stored for 33 days at 10°C and 70% RH, and at different storage times, microbial indicators (Pseudomonas spp. and yeast and moulds) and the texture has been measured.
Results:
The optimal condition for washing was PAW at 40°C for 2 minutes, since on this condition the highest level of inactivation was found in comparison with the control samples. The maximal reduction found was 3.25 log_{10}, 2.43 log_{10} and 2.83 log_{10} for mesophilic bacteria, *Enterobacteria* and molds, respectively. These reductions were stable over the storage period. During storage at 10°C, for samples washed with PAW and and then coated, Pseudomonas spp., yeast and moulds increased more respect to not coated samples. The coating could be as source of nutrient for the bacteria remained adherent on the peel. However, a reduction of texture loss of the pear of almost 30% was observed thanks to the combination of the technologies.
Conclusion:
In conclusion, the combination of PAW and caseinate based coating could be a right combination of technologies to preserve the safety of the pear and extend its shelf life.

P2.1.113

Investigating the gonads' quality of wild and formulate-fed sea urchins Echinus esculentus and Strongylocentrotus droebachiensis

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Aim: Urchins' gonads are a highly prized delicacy in many countries, presenting an ever-increasing demand in the global trade. Sea urchins' exploitation could contribute to the sustainable management of marine stocks by consuming them as an alternative seafood source. Simultaneously, controlling sea urchin populations is vital for sustainable marine ecosystem development, as they graze on kelp forests. As the biochemical and microbial quality varies between wild species, this study aimed to investigate how the formulated feed could probably eliminate the quality differences between species. Moreover, comparative differences in gonad quality were assessed before and after feeding.

Method: *Echinus esculentus* (EC) and *Strongylocentrotus droebachiensis* (SD) were captured from Mid-Norway and were fed for 10 weeks. Their biometrical, textural, and colorimetric parameters were measured. The proximate composition, psychrotrophic plate counts (PC), aerobic plate counts (PC) and H_2S-producing bacteria were determined. Also, their sensory attributes were evaluated.

Results: The gonad's weight significantly increased during feeding. The proximate composition did not significantly differ between wild and formulate-fed urchins. The PC and APC were significantly lower in EC than SD, while H_2S-producing bacteria were only detected in the wild SD. The microbial loads were reduced at the end of feeding. The gonads of wild and formulate-fed SD were more reddish and yellowish than EC; however, the feeding did not significantly affect the colorimetric parameters. Both sensory panel and texture profile analysis indicated significantly higher chewiness scores in EC than SD. Wild sea urchins were granular, sweeter, and less odorous than formulate-fed ones. Wild sea urchins were less bitter, melting, and salty than their formulate-fed counterparts. No difference in umami and aftertaste was found between wild and formulate-fed sea urchins. Both wild and formulate-fed EC had higher odour intensity, bitterness and a more intensive aftertaste than SD.

Conclusion: The results indicate a significant increase in gonad weight and an improved microbial quality after feeding. The inherent differences in the colour and texture between wild species could not be reduced during feeding. However, the sensory evaluation showed that the initial differences in the sensory attributes between species were reduced after rearing.

P2.1.114

Evaluation of environmental load of vacuum microwave dried kiwifruit production process

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Aim

Food loss, especially post-harvest losses of agricultural products, are an important problem for constructing a sustainable society. Drying is one of methods to reduce post-harvest losses. While drying can extend the shelf life of agricultural products, it consumes a large amount of energy. Vacuum microwave drying (VMD) has the potential to solve this problem. A previous study has reported that the energy consumption per 1kg water removed during the VMD and hot air drying (HAD) techniques was estimated to be 48.4 and 231.1 kWh/kg, respectively and 4.8 times smaller than that of HAD because of the extremely shorter drying times. Although energy consumption between VMD and HAD has been compared, only a few studies have focused on and compared the obtained date between HAD and VMD. Therefore, we applied the Life cycle assessment (LCA) in order to evaluate the environmental load of VMD process.

Method

Kiwifruits are used as a test material. HAD and VMD were applied to obtain dried kiwifruit samples. The system boundary enclosed six processes; cultivation, collection, wholesale market, processing, sales, and transportation. Functional unit was defined as 100g of dried kiwifruits. A life cycle inventory analysis was performed to clear its environmental load in the drying processes. The environmental load based on characterized and single score results were analyzed by using LIME2 method.

Results

Characterized results in many categories showed the highest contribution of environmental load in the dried kiwifruit production process. Single score results clearly showed that drying accounted for about 80% of the total environmental load of the dried kiwifruit production process.

Conclusion

The results suggest that VMD has a potential to reduce environmental load of dried kiwifruit production process.

P2.1.115

ULTRA-PROCESSING DEBATE: WHY FOOD HEALTHINESS CANNOT BE RELATED TO THE PROCESSING LEVEL

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Aim:
Consumers are demanding foods that are healthy and palatable, yet meet needs related to changing social lives in an increasingly complex relationship between work, diverse interests and activities, and time at home. In this context, the food industry has been able to look ahead with the offer of foods to give safe, palatable, nutritional foods, throughout different processing technologies, with longer serving characteristics and shelf-life. Furthermore, those foods were suitable to be eaten outside the home or at home with reduced preparation time.

Method:
Based on the prevalence of such types of processed foods, from a scientific side of food scientist mainly a community of epidemiologists and nutritionists, a new classification of foods, called NOVA, has been proposed based in principle on the level of processing. On the other hand, in the so-called "developed countries," where more industrial foods are consumed, there is an increase in obesity and other food-related problems, such as diabetes and cardiovascular disease, which has been related to the degree of processing, according to the authors of the NOVA classification.

Results:
Consumers have begun to view processed foods as less healthy and less natural than unprocessed foods. This led to a controversial understanding of the terms "ultra-processed foods" or "highly processed foods," giving rise to a debate among different fields of food science, in which technological aspects (including processing technologies, unit operations, and ingredients in the formulation) were considered not necessarily a reason to evaluate processed foods as unhealthy and unnatural. Indeed, several authors have begun to provide data to understand the relationship between the degree of processing and naturalness and wholesomeness, using well-recognized indices. The results showed that some highly processed products may have a good healthiness index (e.g., Nutri-Score) depending on their formulation, despite the degree of processing and/or the full list of ingredients. In conclusion, the simple NOVA classification seems to be unsuitable for correctly classifying foods according to wholesomeness and naturalness for good nutritional eating habits.

Conclusion:
Therefore, classifying foods according to the level of processing is not only wrong but also misleading and could be an obstacle for the food industry to move forward with innovations.

P2.1.116

Obtention of high protein flour from Tenebrio mollitor from by-products of the olive sector

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Aim:
Food production, mainly from animal origin, plays a very important role the increase of the GHG emission, therefore, the exploration of alternative protein sources is mandatory. The aim of this study was to use by-products from the agrifood sector, specifically olive and fungus sector, to use them as a substrates for growing insects, specifically *Tenebrio mollitor*, approved in 2021 for human consumption by the European Commission, obtaining a flour rich in proteins and other interesting nutrients.

Method:
The substrates employed to feed the *T. mollitor* were *alperujo* and depleted substrate of *Pleorotus ostreatus* growth (DSPO) using as control wheat bran. Different percentages of substrates were tested (20%, 40%, 60%, 80% and 100%) mixed with the control wheat bran. Tenebrios were grown for 3 months until a 10% of the individuals pupated, in that point the assay was stopped. Tenebrios were scalded to prevent enzymatic browning as much as possible and afterwards insects were dried in an oven at 42 °C during 72 hours. Afterward, flours were obtained and subsequently frozen. Analyses performed were the total content of protein (Kjeldahl method), protein characterization by PAGE-SDS electrophoresis, amino acids

profile by high performance liquid chromatography (HPLC) after derivatization. Also, complementary analyses were carried out such as minerals performed by plasm optic spectrometry and group B vitamins using HPLC.

Results:

The substrate that had the best-grown performance for *T. mollitor* larvae was % of *alperujo*. Despite the best substrate expected was wheat, probably, the consumption of an enriched media with other nutrients such as fatty acids, positively affected the larvae growth. However, with the increase of the percentage of *alperujo*, the growth was stopped, probably due to the accumulation of phenolic compounds which are toxic for the insect. The employment of feeding based on *alperujo* was more efficient than DSPO to produce rich in proteins and amino acids flour. The feeding significantly affected the content in proteins and amino acids.

Conclusion:

Supplementation of *T. mollitor* feeding with *alperujo* seems to be positive in the growing of the insects and looks promising as an alternative to reuse this by-product from the agri-food sector.

P2.1.117

Edible Oleogels: Preparation, Characterization and Evaluation

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Aim:

The present study focuses on the formulation of certain oleogels, as an innovative solution for diminishing the content of animal fats and improving nutritional value,by future incorporation as substitutes in meat products. Therefore, healthy fat-rich vegetable oils were selected for designing suitable oleogels that were further characterized through different methods, so that to identify the optimum formulafor intended subsequently purpose.

Method:

The oleogels were formulated with beeswax or ethyl cellulose. For a comprehensive understanding of oleogels’physico-chemical and sensory properties, specific methods were considered: the oil binding capacity, texture analysis,FTIR-spectroscopy, microscopy, peroxide index, and sensory analysis.

Results:

Oil binding capacity indicated the amount of oil that was retained by the gel matrix, quantifying the intensity of the interactions between the oil and the gelator. The higher the oil binding capacity was, the more efficient was the oleogel in immobilizing oil. Texture analysis assessed the physical properties of the oleogels, such as hardness, cohesiveness, adhesiveness, and chewiness, providing information about the structural and rheological properties of the gel network.

FTIR-Spectroscopy was used to characterise the oleogels, by studying the interactions that occurred between the components of the oleogels. The FTIR spectra of the pure components (oil and oleogelator) were compared with the spectra of the obtained oleogels. The results indicated the possible chemical changes that occurred during processing or storage of the oleogel. Microscopic analysis showed the distribution and arrangement of oil droplets or crystals within the gel matrix, providing insights into the gels’ physical properties and stability. The peroxide index proved the concentration of peroxides, which are indicative of oxidative degradation. A high peroxide level suggested poor oxidative stability of the formulated oleogels. Sensory analysis of the oleogels comparatively evaluated the appearance, texture, aroma, flavour, and overall acceptance.

Conclusion:

The processing parameters, together with the type and content of the oleogelator, have a major influence on the oleogels’ properties. Thus, the best-formulated oleogel will be used in meat products so that the benefits for human health, together with a good consumer acceptability to be fully attained.

P2.1.118

Effect of Cold Plasma on the survival of B. cereus in a rice matrix.

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Aim: Rice is one of the most widely consumed foods in the world, it is a raw material with low water activity which, once hydrated and cooked, is a frequent ingredient in ready-to-eat foods. Due to its high starch content, rice can be an ideal medium for the growth of *Bacillus cereus*, a gram-positive bacterium, present in soil and in a wide variety of foods. The problem with this bacterium is its ability to sporulate, so the usual rice cooking treatments do not completely inactivate its sporulated forms and if it is not stored at the right temperature after cooking, it could pose a health risk to the consumer. This is where Cold Plasma (CP) technology plays a key role, as it acts as a rice decontamination mechanism, significantly reducing the initial microbial load. Therefore, the aim of this research was to study the effect of cold plasma as a non-thermal decontamination technology on *B. cereus* in a rice matrix.

Method: A cold plasma (CP) equipment was used, working under vacuum conditions and using oxygen as the ionising gas. Different treatment times between 0 and 30 minutes and different powers were tested. The survival curves obtained were fitted to mathematical models.

Results: The results showing that as the treatment time increases, the inactivation of *B. cereus* increases, with significant logarithmic reductions being achieved with longer treatment times.

Conclusion: These results demonstrate that cold plasma technology is an interesting alternative for the control of *B. cereus* in dry food matrices such as rice.

P2.1.119

Improving Spray Drying Efficiency: Effect of Processing Parameters on Nozzle-Zone Agglomeration

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Aim: Spray drying is a widely used technique to transform liquid feeds into powders to extend the shelf life and reduce transport and storage consts. The functional properties of the powder, including reconstitution behavior, mechanical stability, and flowability, are affected by the particle size. A large fraction of small particles (<100 µm) can have a detrimental effect on the functional properties, makes powder handling difficult and can cause dust explosions. This may therefore lead to off-spec products that have to be reworked or discarded, impacting the economics and energy consumption of the process.

To prevent this, particles can form agglomerates. Agglomeration can be stimulated by recycling small particles into the nozzle zone. Steering this process effectively requires more knowledge about the influence of processing parameters and their interplay on the sticking probability. Therefore, this study aimed to investigate how spray drying processing factors affect the onset of nozzle zone agglomeration using a response surface methodology and to compare different techniques of quantifying this.

Method: A face-centered, central composite trial design was used for agglomeration trials using a pilot-scale spray dryer. Dry, small particles were added into the nozzle zone to simulate a single pass in an industrial multistage dryer. The amount of dosed powder, drying air flowrate and drying air temperature were varied. The volume increase was quantified using laser diffraction, and the fraction of agglomerated particles was determined using image analysis.

Results: The particle size enlargement and the formation of grape-like agglomerates were significantly increased by increasing the fines mass flow rate. In contrast, the increase in drying air temperature had a minor negative effect on size enlargement and did not affect morphology significantly. Increasing drying air mass flow rate negatively impacted particle size enlargement but had a positive effect on morphology. Furthermore, image analysis was determined to be the preferred method to quantify the onset of agglomeration.

Conclusion: These findings can help reduce rework and product losses and save energy. Therefore, understanding the impact of processing parameters and their interplay on sticking probability can lead to more energy efficient spray drying processes.

P2.1.120

Impact of stored treated domestic wastewater on the microbial quality of irrigated vegetables

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Aim
Due to climate change, more frequent and intensive summer droughts occur, hitting crop production and exacerbating the food crises. Facing the increasing water scarcity due to these dry conditions, the Flemish vegetable processing industry and their farmers want to explore alternative water sources to become more drought resilient. A potential alternative is treated domestic wastewater (TDW), as this is abundantly available. Currently, TDW fails to meet European legislation (2020/741/EC) regarding the reuse of wastewater for irrigation. Hence, this research aimed to study the effect of storage on the microbial quality of TDW, the microbial transmission to two vegetable crops irrigated with stored TDW, and the effect of a waiting period between irrigation and harvest on the microbial quality of the respective crops.

Method
Cauliflower and spinach crops were irrigated using stored TDW. Water samples were collected and analysed after 0, 1, 2, 4 and 7 days of storage, crop samples were harvested and analysed 1, 2, 4 and 7 days post-irrigation. Analysis of the samples consisted of the enumeration and/or detection of several microbial indicators, hygiene and pathogenic parameters.

Results
Storing TDW leads to approximately a 3-log reduction of *E. coli* bacteria after 7 days of storage. Even longer storage, up to 30 days, resulted in undetectable levels of *E. coli* and the absence of *Salmonella* spp. and *L. monocytogenes*. However, *B. cereus* levels remained constant during storage. Microbial transmission to the vegetable crops occurred but was limited for cauliflower, possibly due to the protection of its outer leaves. In both cases (spinach and cauliflower), the lowest microbial transmission was observed using TDW that was stored for at least 4 days, combined with a waiting period of at least 7 days between irrigation and harvest.

Conclusion
Storing TDW before using it as an alternative water source for irrigation of (outdoor) vegetables seems promising, provided that a minimum storage time of 4 days and a minimum waiting period of 7 days between irrigation and harvest is guaranteed. Nevertheless, caution must be taken when opting for TDW, as some pathogen levels are not sufficiently reduced during storage.

P2.1.121

Effect of concentration, temperature and z-potential on the rheological properties and consistency of peach puree

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Aim: Fruit purees and concentrated juices are widely consumed and the determinant factor of their quality is viscosity and consistency. In addition to quality, rheological properties also play a significant role in the design and operation of industrial equipment and so their study and improvement are of particular importance. Many research has been conducted about rheological behavior of different fruits and the effect of soluble solids and temperature. The main conclusions focus on the non-Newtonian behavior that can be adequately described by the Herschel-Bulkley model. On the other hand, Newtonian behavior was noticed in low-Brix juices. However, the scientific literature lacks information on the effect of processing and storage conditions on the rheological properties of fruit purees. Another major problem is the precipitation phenomena that occur in fruit purees during storage. Although these phenomena have no effect on the flavor of the puree, the fruit product can still be rejected by some customers since it greatly affects its consistency, appearance and mouthfeel.

Method: The objective of this work was the study of rheological behavior in peach puree as affected by soluble solids concentration and temperature during the storage time of product. The concentrations studied were ranging from 5°Brix to 30°Brix, while temperature from 10°C to 55°C. Furthermore, considering the fruit puree matrix as a colloidal dispersion, sedimentation rate, particle size and zeta potential were determined. Mechanical and ultrasonic homogenization and alginates addition were applied to peach puree samples in order to avoid agglomeration and sedimentation phenomena.

Results: Peach puree samples exhibited pseudoplastic behavior and were characterized by the power law model. The flow consistency coefficient and the apparent viscosity increased with an increase in concentration, whereas increase in temperature caused viscosity decrease. Moreover, there was no significant effect of temperature on flow behavior index, while the concentration effect was significant. Mechanical and ultrasonic homogenization decreased the particle size, while alginates led to zeta potential variations and satisfactory results in the matrix stability.

Conclusion: In summary, the formation of sediment can be delayed by changing the colloidal properties of peach puree.

P2.1.122

The impact of par-baking on the technological quality of wheat, whole wheat, and rye bread

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Aim

Par-baking has emerged as a prominent technique in the baking industry. The method consists of a two-step baking process with an intermediate storage phase. By facilitating on-demand production, prevention of overproduction, and extending product shelf life, par-baking contributes to responsible manufacturing practices and can be applied as a sustainable food production system. However, to optimize the process for industrial application, a better understanding of water absorption, starch gelatinization, and retrogradation mechanisms during production and storage is needed. Hence, this research investigates the effects of different par-baking degrees on the technological quality of par-baked and fully baked wheat, whole wheat, and rye bread.

Method

Wheat, whole wheat, and rye bread were selected for this study. Each bread type was subjected to a first baking step, in which they were baked for 50, 75 and 95% of the full bake time. After cooling, the breads were individually stored in sealed plastic bags at 12 °C for 4 days. Before the final bake, the breads were analyzed for volume, mass loss, color, moisture, and textural parameters. Subsequently, the breads underwent a final bake phase and were re-analyzed after cooling. After an additional two-day storage period (in plastic bags, at room temperature), further analyses were performed to assess the bread properties.

Results

Whole wheat and rye flour incorporation resulted respectively in a slightly and moderately higher moisture content during the production and storages. For each bread type, the 50% par-baked bread exhibited higher moisture content at every stage of the production and storage. This is contradicted, however, by no mass loss during the final storage phase. Hardness, as an indicator of bread staling, shows no difference between wheat and whole wheat bread. But rye bread, initially displaying an unfavorably higher hardness, was relatively softer when subjected to a 50% first bake phase.

Conclusion

The findings of this study demonstrate the potential of par-baking as an effective technique for enhancing the technological properties of different bread types. Further research can explore the underlying staling mechanisms and prove how the bread types differ between themselves.

P2.1.123

Optimization of fermentation conditions to develop Mediterranean vegetable beverages with probiotic and antioxidant potential

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Aim:

Rice, tiger nut and carob are typical Mediterranean products with valued nutritional properties for making new foods such as fermented beverages. They are rich in complex carbohydrates, without gluten or lactose and with a low allergenicity index. The development of fermented beverages from local crops can contribute to several Sustainable Development Goals (SDG) from United Nations, such as promoting health (SDG3), or sustainable production and responsible consumption (SDG12). The objective of this work was to determine the feasibility of the fermentative process of three vegetable beverages (rice, tiger nut and carob) by using different bacterial starters, sugar levels and temperature, as well as to evaluate the probiotic potential, total polyphenols, and antioxidant capacity throughout the fermentation process.

Method:

Four lactic acid bacteria (LAB) commercial starters (DANISCO VEGE 022, 033, 053, 061), three sugar levels and two temperatures (30ºC/37ºC) were used. The fermentative potential was evaluated by monitoring the pH and ºBrix. All samples were evaluated in a sensory test using a panel of 10 tasters. Once the best conditions were determined, samples were taken at different fermentation times (12, 24, 48, 72h) and the antioxidant capacity (TEAC and ORAC) and total polyphenols were determined.

Results:

The addition of sugar, as well as the microbial consortia, influenced the decrease in pH and viable counts, with low and intermediate levels of sugar, together with the 022 consortium, giving the best effects. In addition, the selected conditions also influenced the sensory tests, providing the carob the most complex aroma profiles. The temperature of 37ºC was the most effective to achieve a faster pH drop. Finally, the evaluation of total antioxidant capacity and polyphenols before and after fermentation allowed selecting the conditions with the highest antioxidant potential.

Conclusion:

It has been possible to develop three functional beverages fermented efficiently at 37 ºC, with different sensory notes, and promising probiotic and antioxidant potential.

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P2.1.124

Innovative ohmic heating concepts for tailored vegetable processing

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Aim:

Ohmic heating (OH) is an innovative volumetric heating technology that offers the potential to optimize conventional heating processes in terms of process efficacy and food quality maintenance. In addition, OH can reduce treatment times and energy consumption, contributing to conscious and sustainable energy management. However, various product and process parameters influence OH efficiency and homogeneity and thus the product quality. Therefore, this study investigated different approaches to optimize OH processes in order to develop tailored thermal processes for food raw materials with inhomogeneous tissue structure such as vegetables.

Method:

For this purpose, the effects of different pulse repetition frequencies (12 kHz and 300 kHz), specific energy inputs and electrical conductivities were studied to reduce process times and optimize cooking homogeneity. In addition, electrical pre-treatments were used for plant cell electroporation to minimize non-uniformities in the electrical conductivity of the plant tissue that affect the treatment homogeneity. The changes in local conductivity and tissue structure were evaluated before and after the pre-treatments and OH. The thermal processing was characterized by temperature kinetics using product-specific cooking values. The effects of pre-treatments and different process designs on the cooking behavior and quality of vegetables were evaluated by cell disintegration index, electrical conductivity, color and texture in different product parts. The OH treatments were compared with conventional cooking in water.

Results:

The results of the study showed distinct potential for the use of pre-treatments for a more rapid and homogeneous OH of vegetables and accelerated heating rates. The use of a higher pulse repetition frequency (300 kHz) increased the electrical conductivities (up to 3 mS/cm higher) in the vegetable tissue which resulted in improved heating uniformity compared to 12 kHz. The use of tailored process conditions showed reduced treatment times (up to 63 %) and enhanced product quality like improved color retention and texture uniformity of the cooked vegetables compared to conventional boiling.

Conclusion:

The study reveals the influence of electrical pretreatments and specific process parameters on plant product properties during and after OH to create targeted process designs for OH of specific raw materials with reduced energy requirements and treatment times.

P2.1.125

Exploring the potential of Supercritial Fluid Extraction for the recovery of valuable compounds from Spirulina

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Aim

Microalgae constitute a valuable source of nutrients, such as proteins, vitamins, minerals, or fatty acids, for instance, omega-3 or omega-6 . Moreover, they are rich in chlorophylls, carotenoids, and phenolic compounds. Consequently, they show a great potential to be implemented in the food and pharmaceutical sectors. Supercritical (SC) fluid CO_2 extraction (SFE or SC-CO_2) constitutes a sustainable, cost-effective technology that allows to obtain extracts with great selectivity, tailoring temperature, pressure, and flow rate parameters. With this regard, this work explores the potential of SFE for the recovery of bioactive compounds from *Spirulina*, mainly lipids and polyphenols, but also proteins, analyzing their content in the obtained liquid extract and the post-extraction residual solid, respectively. In addition, the results obtained by SFE were compared with a conventional Soxhlet extraction.

Method

The SC-CO_2 optimal conditions were optimized in terms of lipidic yield using a response surface method, with a Box–Behnken experimental design with three central points. The explored parameters were: extraction time (30–120 min), temperature (40–60 °C) and pressure (20-40 MPa). After that, the protein content was determined by Dumas method in the remaining solid fraction. In parallel, total phenolic content (TPC) and total antioxidant capacity (TAC) by means of Trolox equivalent antioxidant capacity (TEAC) assay were carried out for the liquid fraction, along with the total chlorophyll A and carotenoids content.

Results

SC-CO_2 extraction demonstrated to be more efficient compared to the conventional Soxhlet´when all the analyzed parameters were compared under the same conditions (ratio, time). Briefly, 86% of defatting was observed after SFE, whereas only 9% of lipids were recovered with the traditional method. Furthermore, the protein content enhanced in the SFE-treated solid (i.e., 74% *vs*. 68% (raw *Spirulina*) and 69% (Soxhlet)), whereas TAC and TPC, were considerably improved, revealing up to10 and 40-times higher antioxidant capacity, respectively. Finally, carotenoids and chlorophyll A content were also improved more than 5 and 20-times comparing SFE extraction with the conventional Soxhlet.

Conclusion

The intensified SFE technology constitutes a distinguished approach to sustainably extract valuable lipids and bioactive compounds from *Spirulina*, also highlighting the noticeable protein content in the SFE-treated solid to a further food applications.

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P2.1.126

Can nudging affect fragile populations' food choices? The cases of Italian and American university students

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Aim:

University students experience significant life transitions as they may have to leave their homes, be responsible for their own eating habits for the first time, or face financial constraints. Hence, they could be considered a fragile population. In order to gently guide them to make healthy and sustainable (HS) food choices, different types of interventions should be examined. This study aimed at understanding the effect of different nudges on the food choices of Italian and American university students.

Method:

The experimental design comprises a control and three treatment groups (HS logo, dish placement, and a combination of them). Online questionnaires were administered to university students in Italy (n = 1,168) and the US (n = 1,342). The effects of the nudging were tested on fragile and non-fragile groups. Factors affecting HS dish selection were determined.

Results:

Participants were divided into two groups: (1) the fragile group (students who did not have enough to get by) and (2) the non-fragile group. Results are similar for both Italy and the US. For the fragile group, the nudging did not have an effect on the students' food choices. While frequently going to the university canteen positively increased the number of selected HS dishes for the US fragile group only. For the non-fragile group, a combination of the HS logo and dish placement is the intervention that leads to a significantly increased selection of HS dishes. The higher percentage of plant-based consumption and being a graduate student increased the number of selected HS dishes. For Italian students, frequent going to the university canteen also increased the number of selected HS dishes, while living with parents negatively decreased them. For the US students, living on dormitory campuses positively increased the number of selected HS dishes.

Conclusion:

Results indicated that population traits, living conditions, and eating habits should be taken into consideration in order to establish a successful nudging technique. Promoting HS eating at the university canteen could improve student choices. Future research focusing on fragile students should be conducted to find suitable nudging strategies to encourage them to make HS food choices.

P2.1.127

Acid-induced gels from micellar casein and pea protein: Effects of protein ratios and preheating routes

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Aim:

Dairy proteins have been widely used as gelling agents in texturized foods such as yogurt and cheese. The partial replacement of dairy proteins with plant proteins in food products stands as an effective way to reduce environmental impacts associated with enormous animal protein consumption. Meanwhile, blending these hetero proteins may create synergistic effects, leading to superior functionality and complementary nutritional value. Protein gelation can be induced by adding acidifiers, e.g., gluconic-δ-lactone (GDL), which is known as acid-induced gelation. To date, acid-induced gels of single dairy or plant proteins have been widely studied, but only a few studies focus on their mixtures. Therefore, this study investigates the GDL-induced gels formed by commercial micellar casein isolate (MCI) and pea protein isolate (PPI) mixtures with different ratios and preheating routes.

Method:

MCI and PPI mixtures with different ratios were prepared by two preheating routes. Route Ⅰ: MCI and PPI dispersions (5% w/w) were first mixed at different ratios and then heated at 95 °C for 30 min. Route Ⅱ: MCI and PPI dispersions (5% w/w) were heated at 95 °C for 30 min separately, and then mixed at different ratios.

Results:

PPI showed better gelling ability than MCI. Compared to MCI gel, PPI gel showed a shorter gelling point, higher G′, and Tan δ, which could be related to different protein interactions and gel microstructures. For hybrid gels, the strength and elasticity were increased noticeably when more than 25% of MCI was replaced by PPI, but no synergistic effects were observed. When PPI became dominant in hybrid gels, preheating route Ⅰ led to lower gel strength compared to route Ⅱ. This might be because the steric hindrance effect of MCI increases the thermostability of native aggregates in commercial

PPI, and also the charge screening in the presence of exchangeable calcium cations arising from the micelles. These factors could hinder the formation of soluble aggregates that could arrange into gelled networks.

Conclusion:

Overall, our results demonstrated that the properties of acid-induced MCI gels can be tailored by incorporating different amounts of PPI and preheating two proteins at different routes.

P2.1.128

Use of infrared thermography to predict bovine mastitis during robotic milking for responsible milk production

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Aim:

The aim of this study was to investigate infrared thermography for the prediction of bovine mastitis in a robotic milking system.

Method:

The herd consisted of cows of the Holstein and Jersey breeds and their crossbreeds. Mastitis was confirmed by identifying the infectious etiology, in conjunction with somatic cell count (SCC). Milk fat content, udder surface temperature (Cold, Hot, Medium), milk electrical conductivity, zootechnical informations, score of dirt, body, and environmental temperatures were obtained. Data was subjected to binary logistic regression analyses using the glm function (family = "binomial") in R. Samples with SCC > 100,000 and microrganisms presence were classified as with mastitis (1), whereas samples with lower SCC and no microrganisms were classified as healthy (0). Breed, samplings, mammary gland, and score of dirt were binarized and included in the model along with numerical variables (conductivity, production, fat, parity, lactation stage, body and udder temperatures, and environmental indices. A stepwise procedure based on Akaike's An Information Criterion (AIC) was used to select significant ($p<0.05$) variables to the model. Accuracy, sensitivity, and specificity were calculated using the caret package, and the area under the response operating characteristics (ROC) curve (AUC) was calculated with pROC.

Results:

After removal of clinical mastitis samples and missing values, 418 observations from 86 animals were retained in the logistic regression analysis. Mastitic samples represented 13.16% of the total. The stepwise selection resulted in a model with coefficients of -8.6363 for intercept, 2.4523 for conductivity, 0.5138 for fat, 0.0074 for lactation stage, -0.1684 for Cold temperature, and -0.6947 for the anterior mammary gland. The model resulted in AIC of 257.93, log-likelihood of -122.9645, and AUC of 0.8256, and it was able to predict the occurrence of mastitis (values greater than the 0.11 cut-off) with 0.74 accuracy, 0.80 sensitivity, and 0.73 specificity.

Conclusion:

Infrared thermography was able to predict bovine mastitis in the cows, together with information related to milk, mammary quarter, and lactation stage. Automation processes can adopt this technique with the potential for large-scale adoption in sustainable production systems with voluntary milking.

Funding process:

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P2.1.129

Development of sustainable food production systems

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Aim:
The most significant grain crop produced globally is rice, which is followed in importance by wheat and maize. Rice is a good source of starch and carbohydrates. Due to its affordability and nutritional value, rice plays a significant role in human nutrition both in our nation and around the world. According to statistics for the 2021/2022 crop year, about 520 million metric tons of rice was consumed worldwide. Current industrial vision systems are far from satisfactory for the intelligent analysis of complex grain images. Our aim is to classify complex rice data by identifying broken and damaged grains.

Method:
The usual approach to characterising the quality of the output of a batch of milled rice is to take a 20g sample and analyse it by hand (including counting the number of broken grains). However, this size of sample is typically a very small sample size to characterise a commercial mill's output. We will use computer vision (CV) and machine learning (ML) based methods to automate the analysis of rice grain image features by applying image processing and neural network pattern recognition techniques for classification of damaged and undamaged grains. Our image processing pipeline will use various morphological features of rice grains in preprocessing methods such as filtering, thresholding, edge detection – before final classification using machine learning and will allow us to analyse much larger and more representative samples.

Results:
We achieved classificatiom of complex rice data by identifying broken and damaged grains. Our results shows good performance and is more efficient then conventional results.
Conclusion:
At the end, the conventional practice to calculate broken and damaged rice is very unsatisfactory and exhibits poor results. We attempted to solve this problem with the help of computer vision and machine learning techniques and our results shows good performance and can be efficiently applied to larger samples of rice grains.

P2.1.130

Supercritical CO2 drying of food

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Aim: Supercritical carbon dioxide has been investigated as an innovative technology for the simultaneous drying and microbial inactivation of the food.

Method: The process was investigate at laboratory scale at temperature ≤45°C, pressure ≤14 MPa, flow rate ≤30 Kg/h and drying time up to 12 hours. The drying kinetic was evaluated by the weight loss, moisture content and water activity. Standard plate count techniques were used to enumerate pathogenic microorganisms (e.g. *Salmonella enterica*., *Listeria monocytogenes*. and *E.coli* O157:H7). Sensorial properties were investigated through instrumental (e.g. color, texture) and panel test analysis. The process were applied on herbs, fruit&vegetables slices and meat.

Results: The drying kinetic depends on the process parameters used and a dry product can be achieved using a different combination of pressure, time, temperature and flow rate. The process is able to completely inactivate (≥6 Log CFU/g) pathogenic microorganisms inoculated on the samples. The inactivation capacity is product dependent and in case of coriander leaves and apple slice, for example, is achieved within the first 15 min. In case of meat the inactivation kinetic is slower and at least 45 min of treatment are needed for a complete decontamination. The nutritional quality of the product is higher while the sensorial characteristics are comparable to the ones achieved with conventional drying technologies.

Conclusion: Supercritical CO_2 drying is a promising innovative low temperature drying technology to maintain a high quality and increase the microbiological safety of the food.

P2.1.131

Coupling chemical and spectroscopic analyses for investigating the relationship between protein functional and physicochemical properties

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Aim:
Pea proteins are industrially produced, modified, and utilized as a promising source of proteins in food products. Changes of physicochemical properties caused by commercial processing could impact ingredient functionality and their interrelationship. However, the knowledge of these correlations among different properties of commercial proteins is still limited. We present a model of the relationship between functional and physicochemical properties to facilitate the prediction and modulation of the functional properties of commercial pea proteins.

Method:
Seven commercial pea protein powders, one concentrate (PPC) and six isolates (PPI1, PPI2, PPI3, PPI4, PPI5, PPI6), were obtained. Protein functionality (solubility, foam, and emulsion properties) and molecular characteristics (secondary and tertiary conformation, protein composition, zeta potential, surface tension and hydrophobicity, as well as particle size) of pea proteins were thoroughly evaluated. Pearson's correlation and chemometric approaches like regression models were employed to couple spectra data and chemical analyses.
Results:
The initial Pearson's correlation analysis showed that emulsion capacity (EC), foaming capacity and stability (FC, FS) were significantly related to surface hydrophobicity indicating that the amount of hydrophobic groups in the protein surface plays a key role in the formation of dispersed systems. Notably, a strong correlation between EC and FS also existed. Emulsion stability (ES) correlated with particle size and zeta potential. The analyses of spectroscopic data are currently in the progress and will be further added to the Pearson's correlation analysis and regression models.
Conclusion:
In conclusion, the functionality of commercial pea proteins was governed by a combination of different associated properties. Such a protein analytical toolbox containing the comprehensive information regarding the relationship between functional and physicochemical properties could be a useful tool to provide knowledge on functional properties as an alternative to traditional laboratorical analyses.

P2.1.132

Self-assembly of oat proteins in various colloidal states as function of the NaCl concentration

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Aim: Oats are increasingly considered as a source of protein in the production of liquid and semi-solid foods, thereby facilitating the replacement of dairy products. However, there is a clear lack of fundamental knowledge on the aqueous phase colloidal state and stability of native oat proteins at food system relevant conditions.
Method: The colloidal properties and stability of native (non-heat treated) oat proteins at varying NaCl concentrations (0 – 1000 mM) were investigated mainly via a combination of confocal laser scanning microscopy and static and dynamic light scattering measurements.
Results: A centrifugation step at high centrifugal force (50,000*g* – 4h) was carried out to remove partly aggregated material and thus to obtain a solution containing native, non-aggregated oat globulins only. To this solution (at varying protein concentrations), NaCl was added in concentrations between 10 – 1000 mM. At low NaCl concentrations (10 – 50 mM), oat proteins self-assembled into fractal aggregates (fractal dimension ~ 1.8), which increased in size considerably as function of storage time. At ≥50 mM NaCl, surprisingly, microphase separation of oat proteins occurred, as shown by the presence of large, smooth spherical structures in microscopy and light scattering analyses. The size of the obtained microphase droplets varied with protein and NaCl concentration, and they remained stable over the course of several days of storage. At >500 mM NaCl, these structures disappeared again. It was found that the microphase separated structures were formed as the result of a nucleation and growth-type process. Further research is needed into the molecular nature of the interactions driving the formation of these oat protein microphases.
Conclusion: For the first time, it was shown that native oat proteins occur in a wide range of morphologies, including solubilized oat globulins, microphase separated droplets and fractal aggregates, depending on the protein and NaCl concentrations of the system. The colloidal state and aqueous phase stability of oat proteins must be further investigated in a wide range of food system relevant conditions (pH, temperature, etc.). Moreover, no information is available today on how the occurrence of oat proteins in varying states would affect their functional behaviour in food systems.

P2.1.133

Exopolysaccharides from Porphyridium cruentum as a novel reinforcing agent for chitosan biofilms

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Aim:
This study evaluated and compared the potential use of microalgae exopolysaccharides as reinforcing agents in chitosan-based biofilms.

Method:
The exopolysaccharides (EPS) were previously obtained from microalgae exhausted culture medium and reinforced in chitosan-based biofilms at two different concentrations (1% and 2%) produced by the casting technique and using glycerol as a plasticizer. For comparison, chitosan films were used as a control. The characterization proceeded in terms of their optical and physical properties, besides mechanical, thermal, and microstructural properties through analysis of tensile strength, TGA, FTIR, and SEM, as well as their biodegradation capacity in soil.

Results:
The inclusion of EPS as a reinforcing agent showed very promising results. Films reinforced with EPS had higher thickness (1% 0.16 ± 0.02 mm; 2% 0.25 ± 0.02 mm), luminosity (1% 36.92 ± 1.54; 2% 41.08 ± 1.97) and opacity (1% 12.02 ± 0.25%; 2% 13.62 ± 1.20%) compared with the control (0.10 ± 0.01 mm, 34.76 ± 1.03, 8.84 ± 0.53%), whereas the moisture content (control 20.15 ± 0.02%; 1% 15.54 ± 0.01%; 2% 0.02%) and elongation at break (control 23.5 ± 2.15%; 1% 12.01 ± 2.15%; 2% 2.87 ± 0.31%) were lower. The incorporation of EPS made the films significantly less flexible, increasing tensile strength (control 3.81 ± 0.45; 1% 5.88 ± 1.44; 2% 7.88 ± 1.90 MPa) and Young's modulus (control 0.16 ± 0.02; 1% 0.53± 0.23; 2% 2.77 ± 0.72 MPa). Moreover, the reinforced films showed similar bands related to proteins, and polysaccharides, where 1% of EPS had a smoother and more regular surface than 2%. The TGA showed a less mass loss in the reinforced films with 2%, where the control had the largest mass loss (~59% at 340 °C). The films also presented a complete biodegradation capacity after 28 days.

Conclusion:
This study demonstrated the feasibility of utilizing microalgae byproducts from the industry as film reinforcement. EPS exhibits to be a potential reinforcing source increasing the possibilities as a raw material for the production of sustainable food films.

P2.1.134

Application of MIR spectroscopy to the analysis of meat-based and plant-based patties

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Aim:
The population increase brings concern about future protein demand. Therefore, alternative proteins and fats are becoming more relevant. Meat-based patties (M) and plant-based patties (P), replacing backfat with carrageenan emulsion (M-*hy* and P-*hy*) were prepared. Besides, high hydrostatic processing (HHP) and sous-vide (SV) conditions were applied. The objective of this study was to uso Fourier Transform Infrarred Spectroscopy as a technique for the analysis of effect HPP and SV in the M patties and P patties.
Method:
The pant-based ingredient was Legumbreta Fina, a commercially available extruded product made from mixes flours (soy, rice and bean) (Sanygran SL, Tudela, Spain) by rehydrating the extruded product. The meat (Biceps femoris) used for the preparation of the M from Ternera de Navarra IGP.
Mir spectra were obtained using a Bruker Platinum ATR Vertex 80 FTIR spectrometer with a KBr divider (10000-400 cm^{-1}) and Platinum ATR with a diamond crystal (2x2 cm). Scans were performed in the spectral range of 4000 to 400 cm^{-1} with a resolution of 4 cm^{-1}. 30 spectra were made for each sample (10 spectra per in triplicate). Data were analyzed according to the protein composition of the patties.

Results:
The information has been reduced to two principal components (92,58% of the variance). The principal component (PC1; 70,68% variance) spans the following wavelengths (nm): 3998,0-377,1; 2948,8-2190,9; 2173,5-2167,8; 2144,6-2142,6; 1434,9-1411,7; 1380,9-1307,6; 1290,2-1161,0 y 912,2-796,5. The second principal component (PC2; 21,90% of variance) covers the following wavelengths (nm): 1693,3-1674,0; 1596,9-1568,0; 1514,0-1469,6 y 752,2-709,7.
The PC2 factor makes a clear difference between M-*hy* patties from P-*hy*, having the opposite behavior.
Conclusion:
With the materials and methods used, it has been reached that the MIR technique is a good method to differentiate M patties and P patties and the effect HPP and SV in both products.

P2.1.135

Heating uniformity in batch microwave heating: effect of sample volume and applied rotation rate

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Heating uniformity in batch microwave heating: effect of sample volume and applied rotation rate
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Aim:
Microwave (MW) processing is considered to lead to a volumetric heating in processed samples, and 2450 and 915 MHz frequencies are used in home appliances and industrial applications, respectively. In both cases, however, temperature non-uniformity is observed due to the lower penetration depth. This is a rather significant issue specifically at 2450 MHz. Number of the samples also affect the temperature uniformity by changing the electromagnetic field, and rotational motion is the common physical mechanism applied to enable the samples to face a varying electromagnetic field. Therefore, the objective of this study was to determine the effect of sample numbers and applied rotation rates on temperature uniformity in MW processing.
Method:
For this purpose, an experimental set-up was designed to have 2, 3 and 5 samples while the rotation rates were at 3, 5 and 8 rpm. The MW system was a special design custom – manufactured system (IFTECH, Ankara) with 1 kW power operating at 2450 MHz. This system enabled a constant power application through the whole process like an inverter system. Distilled water samples were used as experimental material, and they were placed in Teflon cylindrical cups (≈55 mL). The cup holders were printed using a 3D printer, and temperature measurement of the samples were completed at the end of the MW processing using an infrared camera and thermocouples.
Results:
The increased number of the samples within the MW system resulted in a lower power absorption by the samples, and the lowest heating rate of the samples was obtained with 5 samples (where 1 sample was at the center surrounded by the other 4 samples at equal radial distance). While the center sample had the highest temperature increase, the surrounding samples had a similar temperature distribution with lower heating rates, and the applied rotation rates were effective in achieving an improved temperature uniformity.
Conclusion:
The results indicated that it was possible to obtain an improved temperature uniformity by varying the electromagnetic field distribution with increased number of samples. This result might be extended to modify the industrial scale systems for a more efficient processing.

P2.1.136

Influence of oils on plant-based meat analogues: Mechanical properties, product quality, and consumer acceptance

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Aim:
Plant-based meat analogues aim to replicate the fibrous, anisotropic structure of muscle meat for a meat-like texture. However, current products on the market often do not meet consumers' expectations regarding texture, juiciness, and mouthfeel. This study aims to examine the impact of rapeseed oil on the textural properties of meat analogues and to assess the influence of oil concentration and die temperature on consumer-relevant product properties.
Methods:

Pea protein and soy protein were used as model systems to study the effect of rapeseed oil on meat analogues using a Thermo Scientific lab-scale twin-screw extruder. The product structure was evaluated using electron microscopy and image analysis. Using a Thermo Fisher HAAKE rheometer, rheological, tribological, and texture analysis tests were performed to assess the influence of oil on mouthfeel, texture, and juiciness. The study evaluated different oil concentrations and die temperatures to understand their impact on the product's structural properties.

Results:

Results show that the addition of oil affected key mechanical and rheological properties, including gel strength, Young's modulus, and the length of the LVE region. Minimal changes can be observed in soy protein extrudates, while significant changes are observed in pea protein extrudates. This suggests that the influence of oil concentration on the textural properties of meat analogues depends on the protein source.

Conclusion:

It can be concluded that rapeseed oil droplets act as inactive fillers and can improve the juiciness perception of the extrudates. However, oil and fats can also disrupt the fiber formation and act as plasticizers, deteriorating the meat-like product features. The different effect of oil on the protein matrix can be explained by the encapsulation efficiency of the respective protein source. The study demonstrates the importance of using a combination of mechanical, rheological, and tribological tools to gain insights into the influence of formulation and process parameters, enabling the development of better plant-based meat analogues that meet consumer expectations.

P2.2.001

Texture engineering of alternative proteins via food 3D printing technology

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Abstract:

Alternative proteins from plant resources or fish processing side streams are lacking the typical fibrous structure and anisotropic texture found in whole cut animal-based food products. 3D food printing allows layer by layer production of food from a predesigned simple to complicated digital model. This provides flexibility in modifying food by changing the digital design and/or the used materials to customize and personalize foods based on individual wishes not only in shape but also in texture. Another important textural feather which uniquely exist in animal muscle-based products is anisotropic structure provided by muscle fibers which plays an important role in sensorial perception of this products.

We have explored the possibility of using the unique opportunity that digital design in 3D printing technology provides to engineer textural properties pea protein and proteins from fish processing side streams. The effect of infill level, printing pathways, assisting hydrocolloids and their combination on textural properties of meat/seafood analogues and possibility of creating a texture profile in different part of a 3D products will be presented.

Very promising results in developing anisotropic microstructure via proper printing pathway design and alignment of mesoscale fibers have been also achieved according to our Micro-CT and textural studies which will be also presented.

P2.2.002

Changes in nutritional composition of sea and land-based cultured algae and other sources of variation

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Aim: The aim of this study was to compare the nutritional composition of *Ulva* sp. algae grown in near-shore and land-based systems, and the composition of green and red algae grown in the same facilities.

Method: Samples of *Ulva* sp. of the same species were collected from sea and land-based facilities. Land-grown *Ulva ohnoi*, a green algae, was also sampled from the inland tank culture. In addition, two red algae were obtained from the same seawater cultivation facility: *Gracilaria gracilis* and *Gelidium* sp. The proximate composition (soluble and insoluble carbohydrates, proteins, moisture, ash and fat), fatty acid and amino acid profile, phenolic content, antioxidant capacity and mineral composition were analysed in the algae samples. The presence of antibiotics was also tested.

Results: Red seaweed showed a lower content of fat, antioxidant capacity, Na and Mg than red algae, but a higher carbohydrate content. When the cultivation methods were compared, *Ulva* sp. cultivated on land showed a higher composition of polyunsaturated fatty acids, with a particular increase in omega-3, than that cultivated in the sea. The content of phenolics, Mg, Na and K was also higher in the algae grown on land. In addition, the main heavy metals (As, Pb, Hg) and I were lower in the land-grown algae. Antibiotic presence tested negative in all samples.

Conclusion: The higher polyunsaturated fatty acid profile and omega-3 concentration of land-grown algae makes them a healthier product. In addition, the lower levels of heavy metals and iron improve their safety. In the case of red seaweed, the lower Na content makes them more suitable for people with heart and kidney disease, and the enhanced antioxidant capacity makes them suitable as a food and cosmetic ingredient.

P2.2.003

Optimization of Coaxial Spray-Drying for the Encapsulation of Tenebrio Molitor Protein Hydrolysate with DPP-IV-inhibitory Activity

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Aim:
Bioactive peptides derived from food proteins help to control blood glucose in diabetic patients by inhibiting dipeptidyl peptidase-IV (DPP-IV). *Tenebrio molitor* is a sustainable source of peptides exhibiting DPP-IV-inhibitory activity. However, the inclusion of bioactive peptides in oral delivery systems is limited by their degradation and loss of activity during manufacturing, storage, and digestion. Hence, encapsulation techniques, such as spray-drying, can be used to stabilize the peptides and improve their bioaccessibility. While monoaxial spray-drying is the most used technique for encapsulating thermosensitive compounds, coaxial spray-drying enables to simultaneously dry a core and a shell solution using a 3-fluids nozzle that leads to the formation of microcapsules with core-shell structures. Thus, the peptides encapsulated in the core might be better protected by the additional shell layer. Therefore, this study investigated the encapsulation of *Tenebrio molitor* protein hydrolysate exhibiting DPP-IV-inhibitory activity by coaxial spray-drying.

Method:
Tenebrio molitor protein hydrolysate exhibiting DPP-IV inhibitory activity was obtained by enzymatic hydrolysis. Coaxial spray-drying was carried out using Arabic gum as encapsulating agent and 190/90 °C as inlet and outlet air temperature. A Box-Behnken design was performed to optimize solid content in the core solution, Arabic gum content in the shell solution, and the core-shell ratio flow-rates. The capsules were characterized in terms of their particle size, morphology and structure by SEM and confocal microscopy. Encapsulation efficiency of the peptides was determined by XPS. DPP-IV-inhibitory activity of the encapsulated peptides was assessed in vitro.

Results:
results indicated a significant effect of the processing parameters studied in the yield of the coaxial spray-drying process. Interestingly, at optimum conditions, microcapsules with core-shell structure were obtained as confirmed by confocal images. The influence of the formulation of the core and shell solution (e.g. percentage of solids) as well as the ratio between core and shell flow-rate on the encapsulation efficiency of the encapsulates and the impact on their DPP-IV-inhibitory activity after drying will be discussed.

Conclusion:
This study provides new insights on encapsulation of DPP-IV-inhibitory peptides by coaxial spray-drying, leading to novel approaches for the stabilization of bioactives peptides that contribute to the production of functional foods.

P2.2.004

Antioxidant activity and phenolic compound content of Kombucha tea powders attained by two drying methods

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Aim:

Kombucha tea (KT) is a drink manufatured by fermentation by a symbiosis between acidophilic yeasts and acetic acid bacteria. This beverage has shown to be a rich source of biologically active substances which offers health benefits thanks to its antimicrobial, antioxidant, anti-inflammatory, anticarcinogenic, and anti-diabetic activit and thus, KT constitutes a sound alternative natural additive to the synthetic ones used in food formulations. Drying techniques such as spray-drying and freeze-drying have paved the way for manufacturing powdered natural additives resulting in good storage stability, convenient handling and reduced transportation weight in comparison to liquid extracts. The purpose of this study (supported by the Scientific and Technological Research Council of Turkey-TÜBİTAK-Project# 221O358) was to compare antioxidant activity and phenolic compound contents of KT powders, manufactured by spray-drying and freeze-drying, to be used as natural food additives.

Method:
KT culture purchased from a local market in Ankara, Turkey was fermented with black tea and sugar. The fermented KT was spray-dried with inlet air temperature of 160°C and 10% maltodextrin ratio. For freeze-drying, KT was frozen at -80℃ for 24 h, and then lyophilized in a Labconco FreeZone (Kansas City, MO, USA) lyophilizer at -54°C for 48 h, followed by grinding in a laboratory mill (Fakir, Germany). Antioxidant activity (%) was determined with the DPPH free radical scavenging assay. Individual phenolics were determined by HPLC, and total phenolic content (Gallic Acid Equivalents, GAE/kg) by the Folin–Ciocalteu method.

Results:
Spray-dried KT powders rendered lower total phenolic contents and antioxidant activity than the freeze-dryed ones. Total phenolic contents of spray-dried and freeze-dried KT powders were 14.3 mg GAE/kg and 38.5 mg GAE/kg, respectively. Correspondingly, freeze-dried KT powders possessed greater antioxidant activity (82.5%) than the spray-dried ones (69.6%). In the HPLC analyses of individual phenolic compounds, (-)epigallocatechin gallate, syringic acid, (+)epicatechin, (-)epicatechin, D-catechin and quercetin-3-ß-D-glucoside were observed in spray-dried KT powders wheares freeze-dried KT powders contained (-)epigallocatechin gallate, (-)catechin gallate, p-coumaric acid, rutin, syringic acid, ferulic acid, (+)epicatechin, (-)epicatechin, D-catechin, quercetin-3-ß-D-glucoside, sinapic acid, 4-deoxyphloridzin and diadzin. The lower number of phenolic compounds and thus, lower antioxidant activity in spray-dried powders is most likely due to elevated processing temperatures.

Conclusion:

It is shown that the drying process is critical to attain desirable powdered food additives, the two methods yielded different contents of phenolic compounds. Freeze-dried products exhibited greater antioxidant properties; however, considering shorter processing time, lower cost, better product uniformity and stability, an adequate natural food additive could be attained by spray drying. In other words, both methods are appropriate and the selection should be made based on well identified priorities.

P2.2.005

A ‘self-encapsulated’ sesame seed powder: Production and physical characterisation

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Aim: Sesame seed is considered as a high nutritious crop that contains significant amount of protein and oil. The main objective of this study is to produce a free-flowing sesame powder from sesame seed by using high pressure homogenizer (HPH) followed by freeze drying. During the production of the powder, oil is not removed and the protein in the sesame seed acts as a coating material to encapsulate the oil in the seed.
Method: In this study, 2 different sesame seeds were used. HPH was used at 2 different pressure values (600 and 1200 bar) and 2 passes to reduce the oil droplet sizes and to obtain a *self-encapsulated sesame powder*. Before using high pressure homogenizer, sesame seeds were mixed with water and passed through a colloidal mill. After passing through HPH, the suspension was dried with a freeze dryer and ground afterwards. Sesame directly lyophilized followed by grinding without any other processes was used as the control group. Surface oil content, flowability and TD-NMR experiments were performed (at a ^{1}H frequency of 20.34 MHz) to compare the homogenized and unhomogenized sesame powder samples. Also, microstructures of the powders were analyzed with scanning electron microscopy (SEM).
Result: Free flowing sesame powders were produced by using HPH. The results obtained from SEM analysis showed that microstructure of homogenized and unhomogenized sesame powders were different. Homogenized powders had smaller oil droplet as expected. T_2 relaxation times showed the presence of multiple proton populations which could have associated with the different oil states in the sample. Seed type also was shown to have an effect on the final properties of the powders.
Conclusion: A free flowing, encapsulated sesame seed powder with its own protein as the coating material was obtained. The powder can be used as a novel ingredient in different food formulations.

P2.2.006

Volatile flavor properties of fish skin during conventional frying, air frying and vacuum frying

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Aim:
Fried fish skin is a popular snack in Asia. Conventional deep-fat frying usually causes high oil content of the fried fish skin and leads to lipid oxidation, which reduces the product quality.
Method:
Alternative frying method such as air frying for 6 and 12 min under 180°C (AF6, AF12) and vacuum frying at 0.085 MPa for 8 and 24 min under 120°C (VF8, VF24) that were compared to conventional frying for 2 and 8 min under 180°C (CF2, CF8) for fried tilapia skin in this study.
Results:
hysical properties of fried skin were found that the moisture content, water activity, L* values and breaking force of all frying methods decreased, while the lipid oxidation and a*, b* values increased with the addition of frying time. VF offered the highest hardness of product compared to AF which had the lower breaking force. For the oil quality inside the product, AF and VF obtained reduced conjugated dienes formation and retarded oxidation compared to CF. The results of flavor compositions of fish skin measured by gas chromatography mass spectrometry (GC/MS) with solid phase microextraction (SPME) showed CF method obtained higher unpleasant oily odor (nonanal, 2,4-decadienal, etc.), while AF presented greater grilling flavor (2,5-dimethylpyrazine) and floral character (benzaldehyde and 1-dodecanol).
Conclusion:
Vacuum frying offered low-fat fried fish skin with the flavor note similar to conventional deep-fat frying product. Air frying was able to keep the original flavor and add special flavor especially roasted flavor note to the product. Vacuum and air frying were concluded both provided practical applications for the low-fat fried fish skin.

P2.2.007

Simultaneous HPLC-PDA determination of seven catechins in tea and wine by Salting-out Assisted Liquid-Liquid Extraction

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Aim:
Catechins, with their antioxidant, anticarcinogenic, antidiabetic, and neuroprotective properties, have become a topic of increasing interest for their potential to enhance the health benefits of various foods. Notably, green tea and wines are rich sources of these beneficial compounds. Traditional extraction methods involving methanol, ethanol, and water and measurement using a UV-visible spectrometer are time-consuming and ecologically unfriendly. These methods also yield inaccurate values due to their lack of specificity. To address these issues, this study focuses on developing a salting-out assisted liquid-liquid extraction (SALLE) procedure to simultaneously extract and preconcentrate seven catechins more efficiently and accurately.

Method:
Catechins were determined using a Thermo Scientific ACCELA HPLC system coupled to an Accela PDA detector at 280 nm. The presence of the catechins was confirmed using individual standards of(-)-gallocatechin, (+)-catechin, (-)-epigallocatechin-3-O-gallate, (-)-epicatechin, (-)-gallocatechin-3-O-gallate, (-)-epicatechin-3-O-gallate, and caffeine.
The simultaneous isolation and extraction of the seven catechins were carried out using a novel SALLE procedure. Those parameters affecting the method's effectiveness were assessed using a symmetrical screening design 3^4 in only 9 experiments.

Results:
The SALLE procedure could effectively extract the 7 catechins from green tea in a total analysis time of 20 min. Using a matrix-matched calibration, this method showed an excellent linear correlation (r2> 0.999) in the 30-200 ppm range. The recoveries of this method were between 80-120%, and the intraday and interday precision were below 15% RSD. The analysis of tea and wine samples, including green tea, allow us to accurately quantify the individual catechins and profile them in terms of this content.

Conclusion:
The salting-out effect in the SALLE procedure enhances the mass transfer from the aqueous sample to the organic solvent, which allows the significant reduction of the organic solvent needed compared with current methods. The enrichment factor of the method led to lower determination limits increasing the sensitivity of the method. Reducing the organic solvent, reagents, and total analysis time results in a more cost-effective approach than currently available in the literature.

P2.2.008

Optimization synthesis of Diamine Oxydase enzyme in legumes

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Aim:
Histamine is a biogenic amine, product of the decarboxylation of the amino acid L-histidine. In humans, histamine is involved in immune system responses and acts as a neurotransmitter in the central nervous system. In food, the overgrowth of bacteria with decarboxylase activity, can cause the degradation of L-histidine into histamine. The consumption of these foods produces an excessive accumulation of exogenous histamine in the body, which leads to adverse reactions such as migraines, headaches and asthma. Diamine Oxidase (DAO, EC.1.4.3.6) is the main enzyme in the metabolism of ingested histamine. DAO deficiency produces an imbalance in this regulation mechanism, which can produce histaminosis. Currently, to solve this intolerance, there is supplementation with DAO from pig kidney protein capsules. However, these supplements are only capable of reducing blood histamine levels by 12-14%. For this reason, it would be interesting to obtain new sources of DAO with high enzymatic activity. In this sense, plant-based products are presented as an interesting alternative. The objective of this work was to optimize the synthesis of the DAO enzyme in different legumes. Therefore, specific germination conditions were established.

Method:
For the present study, three different species of the Leguminosae plant family were considered: lentil (*Lens culinaris* Medik.), yellow pea (*Pisum sativum* L.) and white lupin (*Lupinus albus* L.). Legumes were germinated under specific conditions (darkness, 75%RH and 27ºC) during three, six and nine days. Furthermore, Pulsed Electric Fields were applied

before germination to enhance DAO activity. The PEF conditions applied were 10, 55 and 100 pulses at 3000, 6500 and 10000 voltages.

Results:
According to the enzyme activity analysis, all the samples exhibited a better DAO activity during six days of germination. The best results were shown in *Pisum sativum L*. for 3000 V of PEF conditions, whereas the utilization of 10000V PEF conditions stopped germination of the three legumes.

Conclusion:
The use of plant-based DAO sources could be a very good option for histamine intolerance people since it seems to be a more efficient source in comparison to pig kidney DAO. Besides, it is more respectful with animals, which is perfect for vegans.

P2.2.009

Oxidation treatment of Quercus robur leaves: Effect on infusion and kombucha composition

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Aim:
Kombucha has become increasingly popular in recent years due to its refreshing taste, health benefits, and versatility in beverage making. Traditionally, kombucha is made from sweetened infusions of black or green tea (*Camellia sinensis*), which are fermented with a Symbiotic Culture of Bacteria and Yeast known as SCOBY. However, there is a growing trend in developing kombucha analogues with new flavors to cater to a wider range of consumers. The difference between green tea and black tea lies in the processing of the leaves after harvest. While green tea undergoes minimal oxidation, the leaves of black tea are completely oxidized. This confers different flavor profiles and antioxidant properties in green tea compared to black tea. The oxidation of black tea leaves is an enzymatic process in which natural enzymes present in the tea leaves transform the chemical compounds present in the leaves. Fresh tea leaves are wilted and then rolled and broken to release the chemical compounds within the leaves. The aim of this study was to evaluate novel kombuchas made from infusions of *Quercus robur* leaves subjected to the same oxidation process as in black tea

Method:
Quercus robur leaves oxidation was carried out as following: leaves were steamed in an oven (30 ºC / 90% HR / 2 hours) and manually rolling and bruised. Consecutively, leaves were dried at 30 ºC for 48 hours. Total soluble solids (TSS), pH, total acidity (TA), instrumental colour (CIELab) and total phenolic compounds (TPCs) content were evaluated in sugared infusions made with *Quercus robur oxidazed* leaves *(*IQR-O) and regular *Quercus robur* leaves (IQR-C) as control. After SCOBY inoculation, both kombuchas (KQR-O and KQR-C) were evaluated at 1 and 7 fermentation days.

Results:
The oxidation treatment of *Quercus* leaves did not have a significant effect on the composition of the evaluated infusions and kombuchas. However, fermentation time had a statistically significant effect on all the parameters evaluated (except for the b* color coordinate).

Conclusion:
Unlike with *Camellia sinensis* leaves, the oxidation process of *Quercus robur* leaves did not significantly alter the composition of the infusions and kombuchas.

P2.2.010

Exploring strategies to enhance the interfacial properties of protein concentrates from Alphitobius diaperinus

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Aim:
Insects are being considered as a promising alternative to traditional animal proteins thanks to their high nutritional values and low environmental impact. Modification of insect proteins to improve and/or expand their techno-functional properties will broaden their use as food ingredients.
We investigated different approaches to enhance the ability of lesser mealworm (*A. diaperinus*) protein concentrate (LMPC) to maintain the physical and/ or oxidative stability of oil-in-water (O/W) emulsions, such as: *i)* partial enzymatic hydrolysis, *ii)* conjugation of LMPC with polyphenols, and *iii)* production of nanoparticles from LMPC to stabilize Pickering emulsions.
Method:
A screening of six different enzymes and a central composite experimental design using one enzyme (formea prime) were performed to determine the impact of several parameters (enzyme, temperature, pH, time and enzyme to substrate ratio) on the emulsifying properties of hydrolysates.
LMPC was conjugated with chlorogenic acid (CA) or tannic acid (TA) using an alkaline method. The structural characteristics and properties (antioxidant, interfacial, and emulsifying) of the LMPC-polyphenol conjugates and their ability to preserve the physical and oxidative stability of flaxseed O/W emulsions were studied.
Insect protein nanoparticles were produced after heat treatment of LMPC solutions with varying ionic strengths. Their ability to act as Pickering stabilizers in O/W emulsions was assessed by studying the creaming and physical stability under different conditions.
Results:
Partial hydrolysis of LMPC (degree of hydrolysis ranging from 0.8 to 10.1%), did not significant increase its emulsifying properties regardless of the enzyme and hydrolysis conditions used.
In terms of conjugation, TA possessed higher affinity than CA for LMPC. The antioxidant properties of the proteins were significantly improved by the conjugation without significant changes of the emulsifying activity. The use of conjugates significantly reduced TBARS formation while maintaining the physical stability of O/W emulsion.
The produced LMPC nanoparticles presented a suitable size and wettability to successfully stabilize O/W Pickering emulsions.
Conclusion:
Results obtained provide different strategies to obtain LMPC derived ingredients with improved properties as emulsifiers, broadening the potential of insect proteins as food ingredients.

P2.2.012

Membrane fractionation and pH shifting to enhance the techno-functional properties of edible insect protein concentrates

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Aim: As a sustainable alternative to the conventional protein sources, edible insect protein is getting attention over the past few years. Ultrafiltration and pH shifting techniques have been successfully applied to dairy and vegetal proteins to improve their properties. Hence, the present study is focused on the enhancement of insect protein stabilizing properties by ultrafiltration or pH-shifting to broaden their application as stabilizers for multiphase food systems.

Method: A 30 kDa ultrafiltration (UF) membrane was used to fractionate two edible insect protein concentrates, yellow mealworm (TMPC), *Tenebrio molitor*, and black soldier fly (BSFPC), *Hermetia illucens*, with two initial feeding concentrations (10 and 7.5 g/L). The permeate and retentate fractions were evaluated for techno-functional properties, such as emulsifying activity, foaming capacity, and foam stability. In addition, pH-hifting was used to modify the conformation of five edible insect proteins while subjecting the proteins to acidic (pH 1) and/or alkaline (pH 12) conditions for 4 h and adjusted back to neutral pH. All fractions were evaluated for techno-functional and physicochemical properties.
Results: Ultrafiltration in dead-end mode was successfully applied to fractionate TMPC and BSFPC with a commercial cellulose acetate membrane. The emulsifying activity of all the yellow mealworm fractions were in par with the control but it was significantly lower for the permeate fractions of black soldier fly. Foaming properties were maintained for both fractions of BSFPC and the ones from 7.5 g/L TMPC. Regarding pH-shifting, foaming capacity of cricket (Acheta domesticus) and lesser mealworm (Alphitobius diaperinus) protein concentrates were improved through pH shifting.

Conclusion: Ultrafiltration is a feasible technology for fractionation of edible insect proteins. Even though the emulsifying activity and the foaming properties of the fractions obtained by UF were not enhanced, the values are of interest for industrial applications to replace dairy proteins, showing that membrane separation has also potential for insect protein fractionation. Similarly, pH shifting also could be used as a potential tool to obtain insect protein fractions with improved techno-functional properties.

P2.2.014

Co-delivery of bioactive compounds in double emulsions with inner interface stabilized with surface-functionalized silica nanoparticles

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Aim: To evaluate the bioaccessibility of chlorogenic acid (CA) and curcumin (Cur) co-encapsulated in Pickering water-in-oil-in-water ($W_1/O/W_2$) double emulsions (DEs) with the inner interface stabilized with surface-functionalized silica nanoparticles (SNPs) with tocopherol succinate (TS) or myristic acid (C14).

Method: SNPs were synthesized according to the Stöber method, surface modified with 3-aminopropyl triethoxysilane (APTES) (Karnati *et al.*, 2019) and functionalized with TS (SNPs-TS) or C14 (SNPs-C14) (Tudose *et al.*, 2017). Each SNP (4%, w/w) was dispersed in linseed oil containing Cur (0.3% w/w), which was homogenized with the internal aqueous phase (W_1) containing CA (0.1% w/w) (20:80 W_1:O) with an ultrasonic processor (30 KHz, 100% amplitude, 1.5 min). Polyglycerol polyricinoleate (PGPR, 6% w/w) was used as control lipophilic emulsifier for comparative purposes. The W_1/O were homogenized with an external aqueous phase (W_2) containing sodium caseinate (0.5% w/w) and high-methoxy pectin (3% w/w) to obtain DEs, using a rotor-stator homogenizer (40:60 W_1:O:W_2, 6000 rpm, 4.64 min). Size and size distribution of oil droplets (laser diffraction) and the microstructure of DEs (confocal fluorescence microscope, CFM) were determined. DEs were subjected to *in vitro* gastrointestinal digestion (INFOGEST method; Brodkorb *et al*., 2019) and the bioaccessibility of the bioactive compounds was evaluated.

Results: All the DEs showed similar droplet sizes, with $D_{4,3}$ values in the range 24.7-27.7 µm, and a bimodal size distribution. The CFM images showed the typical structure of DEs, with small water droplets inside the oil globules that were dispersed in W_2. The release of CA from DEs with PGPR (DE-PGPR) after the gastric phase of digestion was 92.71±1.92%, while DEs with C14 (DE-C14) and TS (DE-TS) showed a release of 63.73±0.26% and 55.33±2.50%, respectively. This allowed to increase the bioaccessibility of CA from 35.38±0.41% (DE-PGPR) to 56.91±2.10% (DE-C14) and 57.39±5.34% (DE-ST). The release of Cur from all the DEs was lower than 2% after the gastric phase, and the bioaccessibility of Cur was between 80 and 90% for all the systems ($p > 0.05$).

Conclusion: SNPs functionalized with C14 or TS were suitable to obtain DEs with high bioaccessibility of encapsulated Cur and increased bioaccessibility of encapsulated CA compared with DE-PGPR.

P2.2.015

Liposomes with phytosterols as an innovative food components

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Introduction: Plant sterols, also known as phytosterols, are widely available on the market as functional food additives. Their biological properties are mainly related to lowering LDL cholesterol and preventing cardiovascular diseases. Phytosterols and their esters occur naturally in vegetable oils and fats, in which they make up to 90% of the unsaponifiable fraction (2-11 mg/g fat). Plant sterols are often added in large amounts (80 mg/g fat) as functional compounds to various food products. Such a high dose of these compounds is necessary due to their low absorption in the human gastrointestinal tract. The recommended intake of 2.5-3 g of phytosterols per day results in a 15-20% reduction in cholesterol levels. At the same time, these compounds are not stable and their degradation products, which have negative effects on human health, are formed during the oxidative-thermal treatment of food.

Aim: The objective of this work was to prepare a liposomes with phytosterols and analysis of their quality.

Material: Three methods of liposome preparation were used. One part was prepared using the traditional method with chloroform and methanol, while ethyl acetate was used for the other. The third sample contained liposomes of smaller size (up to 200 µm) prepared by the first method. For all samples, ultrasonic bath release was used.

Method: The quality of liposomes was analysed using the CellStream® flow cytometer (Luminex, USA) equipped with 4 lasers (405nm, 488nm, 561nm and 642nm), 17 fluorescence channels (acquisition in the form of a multi-channel CCD camera) and a laser scattered light detectors: forward scatter (FSC) and side scatter (SSC) with separate LED/laser lights: 450nm and 785nm, respectively. Each sample was analysed in triplicate. A post-acquisition analysis was conducted using the CellStream® Analysis 1.3.384 software (Luminex).

Results: The data obtained showed that the quality of liposomes obtained using ethyl acetate was very good and did not differ from liposomes obtained by the traditional method. The size of the liposomes did not affect their quality.

Conclusions: Phytosterols and their esters can be encapsulated into liposomes with high efficiency.

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P2.2.016

Conching dark chocolate – Insights into processing effects on aroma and texture

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Aim:
Conching is an essential step for the development of aroma and texture characteristics of chocolate and consequently its unique sensory experience. To date, the conching process is insufficiently understood, although it ranks among to the most energy and time consuming processes. In order to transform this experience-based process into an automated process in the sense of Industry 4.0, a detailed process understanding is indispensable. Combining aroma analytics and rheological characterization build the basis for simulating the conching process to enable a tailored process design.

Method:
Conching experiments were performed on a time-resolved basis at pilot scale involving variation of the process parameters (temperature, shear direction, presence of pre-charge). Aroma-relevant distribution processes during conching were evaluated by investigating plastic conched masses as well as their fat and particle phases. Therefore, six representative aroma-active volatiles (odorants) were quantified by stable isotope dilution analysis and gas chromatography-mass spectrometry. Rheological characteristics of plastic masses were determined using a closed cavity rheometer. PCA analysis allowed the discrimination of samples produced under varying parameters.

Results:
All conching parameters were found to influence the odorant concentrations significantly. Conching at increased temperature resulted in the lowest odorant concentrations, consequently to an increased odorant volatility. Conching with altered shear direction resulted in low odorant concentrations in the fat phase but the highest odorant concentrations in the particle phase. The presence of pre-charge affected the odorant concentration, while a high dependence on odorant polarity was observed. Consequently, odorant's physico-chemical properties and plastic mass composition seemed to impact odorant migration mechanisms during conching.
The complex viscosity of the plastic mass decreased and the free cocoa butter amount increased as a function of conching time, which displayed de-agglomeration effects. By means of conching with pre-charge, a lower complex viscosity was attained faster than without pre-charge.

Conclusion:
Our results facilitate approaching a deeper understanding of the influence of conching on the sensory quality of dark chocolate by providing an insight into the complexity of aroma migration and rheological changes during conching. This data is currently being used to provide model-based support for the conching process.

P2.2.017

Burger patties from oilseed press cake based extruded texturized protein

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Aim: Assessment of applicability of new meat analogue based on press cake TVP
Oilseed press cakes (PCs), the protein- and fibre-rich side stream of oil production, can be used as resource-efficient and nutritionally beneficial ingredient in extruded texturized vegetable protein (TVP) formulations. However, the resulting intermediate product still differs notably from common meat products, which is why the application of the TVP in a burger patty type product was examined to create a consumer-pleasing meat alternative with improved nutritional profile and sustainability.

Method: Extrusion, cooking, and characterization of TVP based burger patties
Fifteen different PC flours (almond, coconut, flaxseed, pumpkin seed, rapeseed, and sunflower seed) were mixed with pea protein isolate (PPI) at two different concentrations (45% to 100% PC) and extruded in a co-rotating twin screw extruder with a short 2.5 mm hole die. The resulting texturized vegetable protein (TVP) was dried and density, expansion and rehydrated texture properties were measured by gravimetry, diameter and texture profile analysis, respectively. The TVP was rehydrated, minced in a meat grinder, mixed with coconut oil, salt and different gelling agents and patties were formed in a mould. The patties were fried in a pan and shrinkage, cooking loss, colour and texture were measured by diameter, gravimetry, image processing and texture profile analysis respectively.
Results: Higher press cake levels in TVP increase similarity with meat texture
The different PC types and concentrations used influence the textural properties of the fried burger patties as the cohesiveness of the TVP is decreased with increasing PC concentration and depends on the PC type. While the TVP burgers' cooking losses and shrinkages are lower than those of beef and chicken patties, the chewiness is also 50% lower. However, for several PC types, the textural parameters are closer to real meat than those of commercial reference products.
Conclusion: Press cake based TVP can replace other plant proteins in vegan burger patties
Texturized vegetable protein based on different oilseed PCs is suitable as main constituent of vegan burger patties. The PC burger patties resemble the meat references' texture properties more than commercial products, although further recipe optimization is necessary.

P2.2.018

Are consumers ready to eat foodstuff with by-products? Case study on mayonnaise with apple pomace

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Aim:
Reformulation of food emulsions is a rising trend, due to vegan considerations and health-related replacements of animal ingredients. Reformulation strategies are usually based on adding hydrocolloids, starches, vegetal proteins and more recently by-products. Aquafaba-based mayonnaise is one example combining eggs replacement with the addition of by-products. However, the obtained texture is often too fluid, especially if the challenge of an oil content reduction is added to the egg replacement one. This study aimed to better understand the consumers' perception of a fat reduced and by-product fortified mayonnaise.

Method:
Mayonnaises were formulated with apple pomace (up to 17.5% w/w) with a drastically reduced fat content from 80 to 22% w/w. 3 mayonnaises were compared: 1 with by-product, 1 standard from the French market and the same standard mayonnaise colored in brown (*i.e.* to obtain the same color as the mayonnaise with by-product). They were blindly assessed by 52 naive consumers according to their preferences. They were also asked to give free comments about each product. The texture of mayonnaises was finally instrumentally characterized using a Texture Analyzer.

Results:
The incorporation of apple pomace allowed to compensate the firmness decrease that happened when the oil content in mayonnaises formulated at lab scale went from 80 to 22%. This mouthfeel evaluation was carried out by 6 experts. Instrumentally, the texture of the apple pomace mayonnaise was indeed firm, as the maximal resistance force appeared 4 times higher than the commercial one chosen as reference. Consumers clearly favored the commercial reference with a 7.4/10 grade, while the oil reduced + fortified one only scored 4.3/10. However, the brown color is one main barrier since the commercial product artificially colored in brown scored 6.6/10. The free comments reflected this color issue, as well as taste that was described with tasteless (10 times), bitterness (8 times) and acidity (7 times).

Conclusion:
This study highlights that the lower appreciation with by-product addition lies with taste and color rather than texture. For the future, those potential obstacles should be addressed in order to unlock consumers acceptance in the formulation of foodstuffs based on by-products.

P2.2.019

How does acidity and high pressure impact on Salmonella inactivation in apple and banana purees?

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Aim: High pressure processing (HPP) is an emerging non-thermal technology used to inactivate microorganisms, while preserving sensorial and nutritional properties. In a previous study, a meta-analysis of the microbial inactivation in fruit and vegetables juices and purees treated by HPP was performed, obtaining conservative predictive models according to the pH of the product. The aim of this study was to quantitatively characterize the effect of HPP, with or without previous acid exposure, on the inactivation of *Salmonella* spp. in apple and banana purees.
Method: Apple (pH 3.6) and banana (pH 4.2) purees were independently inoculated with *S. enterica* GN001 (Enteritidis) and *S. enterica* CIP106188 (Typhymurium) strains at 6-7 log cfu/g. Different HPP treatments (pressure range 300-600 MPa and holding times up to 10 min) were applied directly or after acid exposure (24 h at 4 °C after inoculation). The effect of sampling immediately after HPP or after 24 h was also evaluated. Model fitting was performed using GinaFit Tool and secondary modelling following Bigelow-type model. The one-step global fitting procedure was applied to estimate the model parameters.
Results: HPP-inactivation was product (acidity) and strain dependent. Higher inactivation was observed in apple puree and CIP106188 was slightly less resistant than GN001. After 2 min at 400 MPa, CIP106188 was reduced by 4.2 and 1.5 log in apple and banana puree, respectively; while GN001 showed 3.1 (apple) and 0.3 (banana) log reductions. In both purees, acid exposure effect was additive showing more inactivation than samples pressurised immediately after inoculation. Sampling 24 h after HPP had an important impact on the observed inactivation, showing less survivors than immediately after HPP. A log-linear inactivation trend was preceded by a shoulder shape in banana puree between 300-600 MPa, while in apple puree no shoulder was observed.
Conclusion: The developed mathematical models can be used by infant food producers as a decision support tool to define HPP process criteria for puree meeting *Salmonella* spp. food safety standards, accounting for the impact of exposure of *Salmonella* to fruit puree acidity before and after HPP.

P2.2.020

Quality deterioration and oxidative stability of virgin olive oil by cold atmospheric plasma treatment

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Aim:
Cold atmospheric plasma (CAP) is an emerging food process technology, widely known for its microbial decontamination of food products, mainly due to the interaction with reactive oxygen and nitrogen species (RONS) generated in the gas phase during processing. CAP treatment may lead to oxidation of lipids (including the fat content of foods), which may have an adverse impact on the shelf-life of food products. Prior to scale-up, it is imperative to comprehend the interactions between CAP and food lipids, as well as the critical parameters that govern lipid oxidation.
The aim of this study was to investigate the effect of CAP on food lipid oxidation in a model system, such as virgin olive oil. A kinetic approach was applied to understand how the CAP process conditions' intensity may affect the lipid oxidation.
Method:
Direct CAP treatments were carried out by a pin-jet CAP device using plain air as gas phase. Various voltages ranging from 28 to 32 kV were applied, while the duration varied from 1 to 10 min for 4 mL olive oil. The acidity, the peroxide value (PV), K_{232} and K_{270} indices, total phenol content, antioxidant activity, tocopherols' and chlorophylls' content of samples were measured. Fatty acids profile was also determined for all samples. The characterization of the samples was also performed through the use of FTIR and 1^H NMR.
Results:
Longer treatments in combination with higher applied voltages significantly affected the quality of virgin olive oil and enhanced the oxidative reactions. The PV of plasma-treated oils was 8-fold the PV of untreated sample. The concentration of antioxidant compounds decreased significantly due to the produced RONS that led to their oxidation. The main identified oxidation products were aldehydes (hexanal and pentenal), carboxylic acids, and hydroperoxides. A decrease of polyunsaturated fatty acids concentration for CAP-treated oils was observed, compared to the untreated one.
Conclusions:
The results obtained were considered as important information for a thorough scientific understanding how CAP affects the food lipids. Further research should be made to investigate the effects of CAP on lipids extracted from real food systems.

P2.2.021

The effect of microalgae incorporation on quality of yoghurt-type products – A shelf-life study

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Aim: A shelf-life study was conducted in order to evaluate the effect of the incorporation of whole Spirulina biomass or Spirulina protein extract on the quality and sensory parameters, as well as on the endogenous microflora of novel yoghurt-type products.

Method: High pressure processing was used to extract the protein content of Spirulina (61.4 g/100 g dm). Typical (from ovine milk-2.5% fat content) set yoghurts (Control), yoghurt-desserts containing 1%w/w Spirulina (SY_t) and yoghurt-desserts with 0.8%w/w Spirulina protein extract (SEY_t) were produced and stored in high precision incubators at 1, 4 and 10^{o}C. At specific times within a 2-month period, microbiological and quality analysis was performed.

Results: The proteins in Control, SY_t and SEY_t products were estimated as 10.64±0.11, 11.79±0.09 and 11.16±0.13 g (in dm) per cup. During storage, while the initial load of thermophilic lactobacilli (Control:8.20±0.21, SY_t:8.48±0.25, SEY_t:8.22±0.18) and mesophilic cocci (Control:7.93±0.14, SY_t:7.94±0.19, SEY_t:7.90±0.13) was gradually decreased for the control, the SY_t and SEY_t products retained significantly higher loads (approximately 36% higher compared to control). The carbohydrates were decreased (the storage temperature significantly affected their decrease rate), probably due to bacterial metabolic activity. This also led to lactic acid production, and consequently to pH-value decrease. For the control yoghurts, the color changed to yellow (increased b-values), mainly at higher storage temperatures. For SY_t and SEY_t products, the color parameters a and b were increased expressing a green- and blue-color decrease, respectively. This was also reflected by a decrease in chlorophyll and C-phycocyanin content. Control yoghurts showed the highest values in hardness, consistency, cohesiveness, and viscosity followed by SEY_t products, while SY_t showed the lowest values (creamy texture). The shelf-life of Control yoghurts, SY_t and SEY_t products was determined as 30, 35 and 50 days, respectively, considering the 6.0 logCFU/g as the limit for LAB load.

Conclusion: Spirulina incorporation or its protein extract may lead to yoghurt-type products of healthier profile, while simultaneously of increased shelf-life.

P2.2.022

Creating novel food products using beneficial forgotten and underutilized crops

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Creating novel food products using beneficial forgotten and underutilized crops

Aim:

Since the 1900s, more than 75% of plant genetic diversity has been lost. This has led to further dependence on a few staple crops which poses a threat to food security, leading to unbalanceddiets and ultimately malnutrition of the most vulnerable population groups dependent on traditional crops for their food.

Extreme monoculture diminished genetic differences between cultivars.

Poor nutrition is the leading cause of diet related disease and death worldwide. As a result of this homogenisation, thousands of cultivated and wild food crops are no longer used despite their-high nutritional value. However, a regular consumption of biodiversite foods is associated with a lower risk of various diseases, indicating the benefits of their increased consumption.

Method:

In the frame of BioValue project (GA 101000499) and following EFSA's guidelines for the development of novel foods, products containing forgotten and underutilised food species (Buckwheat, Dandelion or Sowthistle, Red lentils, Graspeas, Eggplants (Tsakoniki,Santorini), Tomato (Rousiko) and Armenian cucumber) were created. The novel foods are evaluated using Diet Assess & Plan (DAP), an advanced platform for standardised food consumption data collection, comprehensive dietary intake assessment and nutrition planning. Prototypes of the new foods were prepared in the experimental kitchen. Each recipe was blind tasted, rated and ranked according to its organoleptic quality. The taste ratings were made by independent professional taste experts as well as lay representatives.

Results:

Ten novel food products are developed, including biscuits, crackers, cakes and ready to eat meals such as pasta, salad, burgers and cakes. The new products incorporate forgotten foods as new sources of vitamins and/or minerals, include nutritionally beneficial combinations of ingredients and are using modified preparation methods that minimise nutrient losses and retain nutritional quality of foods.

Conclusion:

Innovative recipes, based on forgotten ingredients are developed to improve nutrition and promote health
and biodiversity in different local contexts across Europe. The new foods are evaluated by consumers to assess and improve their taste and appeal. Recipes for novel food products are created and modified to bring biodiversity to the plate in a way that is desirable to consumers and contribute to the sustainable healthy diet and food system transformation.

P2.2.023

BIOACTIVE PROPERTIES OF BLACK TEA PROCESSING WASTE EXTRACTS PRODUCED BY ULTRASOUND ASSISTED ENZYME EXTRACTION

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Türkiye is one of the biggest tea processing countries in the world and it produces up to 10% of the world's tea (275,000 tons were processed in 2021). In black tea production process, the structural integrity of leaves is broken, the tea phenolics are oxidized and characteristic black tea color, aroma, and taste is formed. During and at the end of the production process, huge amount of dry brown-colored fibrous materials including stems, stalks and dust particles are obtained as by-product which are also treated as soil fertilizer, animal feed, or fuel material. These black tea waste products (BTWP) account about 80% carbohydrates and 12% proteins with considerable amount of minerals. Moreover, the characteristic tea phenolics such as catechins and theaflavins are also exist in BTWP since those are absorbed on the carbohydrate structures. For these reasons, BTWP has the potential to be a good phenolic, alternative plant protein and prebiotic source for food industry. The main challenge of extracting bioactive components from BTWP is very rigid structural integrity cellulosic components, structural proteins (not storage proteins), and complexed phenolic compounds. However, usage of many organic solvents in the extraction of bioactive components from BTWP, the problems such as evaporation of organic solvent from food extract, recovery of organic solvents, toxicity and being hazardous for environment limits or bans the usage these chemicals in food industry. For these reasons the alternative being developed. The ultrasound and enzymatic treatments are the green extraction methods which find themselves in application in any different food processes. In this study, the extraction conditions of phenolics and proteins were optimized by using factorial desing (X1:amplitute, X2:Time, X3:Enzyme concentration) for Cellulysin, Pectinase and Viscozyme enzymes. All the enzymes increased protein solubility, and phenolic content and amplitute value and time are the main effectors on the extraction process. The obtained extracts were characterized for their radical scavenging of ABTS cation, Hydroxyl ion, DPPH and metal chelating. Moreover, the enzyme inhibition activities for α-amylase, α-glucosidase, ACE, and lipase were determined along with their amino acid and phenolic characterization. This study was supported by TUBİTAK #5220097.

P2.2.024

Computer tool to label, annotate and classify pollens grains in honey images

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Aim:
Pollen analysis is the standard method to classify honeys according to their botanical origin, such as citrus, rosemary or eucalyptus. This visual task is currently carried out by laboratory specialists who count and classify pollen grains in light microscope images. Some approaches have been reported in the literature to automate this slow procedure. But, in every case, a suitable pollen data set was needed. Therefore, a computer tool, named ***HoneyApp***, has been developed to label and annotate pollen grains in this type of images. It also represents a context in which to use some of the convolutional neural network (CNN) classifiers developed in this framework

Method:
HoneyApp application has been developed with Java technologies. This application shows several views: The first is the "Analysis-View" where the user looks at each honey image and can select multiple pollen/particle samples. Then, the label that corresponds to the type of pollen being observed is selected and noted. The second window is the "Pollen-View", where a mosaic is displayed with the images of all the labelled pollens. It is also possible to select only those of a specific pollen type. This global view helps the user to detect labelling errors and thus correct them immediately. A third view is the "Classifiers-View", where the overall results for a specific classifier are displayed. A final view is the "Honey-View", which summarizes the statistics/frequency of flagged pollens and assigns the possible monoflorality of a honey.

Results:
Around 70 honey samples have been used to make the pollen dataset and more than 38,000 pollen images have been extracted, annotated and stored. For every honey sample, an XML file is created with all the labels, annotations, and image path information from the target pollens. This dataset has also been used to train various classifiers and the most appropriated have been incorporated into the application.

Conclusion:
HoneyApp application constitutes by itself a very useful tool to support the technical specialist in the routine of the honey pollen analysis. Furthermore, it is being essential as a starting point to automate this task in the context of the monofloral honey cataloguing.

P2.2.026

Optimization of anthocyanin extraction conditions from purple sweet potato peel to obtain a natural additive

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Aim:
The use of green extraction technologies to obtain natural additives, bioactive compounds, and nutrients is currently increasing. Purple sweet potato (*Ipomea batata*) is an underutilized tuber characterized by its high content of anthocyanins. The present work aimed, firstly, to optimize the ultrasonic extraction of anthocyanins from purple sweet potato peel (PSPP). Secondly, to obtain a natural colorant and antioxidant for the food industry through an encapsulation technique.

Method:
Ultrasonicator UP400St (probe S24d22D; 180 W; 24 Hz; 50 ºC) was used for the extraction. Box-Behnken design coupled with response surface methodology was used for the experimental design and optimization. Time (2-6 minutes), solvent-to-solid ratio (1:10-1:30), and water: ethanol relation (45-85%) were selected as independent variables. Antioxidant methods (DPPH, ABTS, and FRAP), total monomeric anthocyanins, and color (CIELAB) were measured in the fifteen extracts obtained. Spray-dryer B-290 (145 ºC; 10 mL/min) was employed to encapsulate PSPP extract using maltodextrin as encapsulating agent.

Results:

The anthocyanin content ranged between 27.83-227.87 mg/100 g. Regarding antioxidant activity, the values varied between 4.91-18.52 mg Trolox eq./g, 6.54-16.52 mg ascorbic acid eq./g, 13.21-57.36 mg Trolox eq./g and 50.25-207.00 µmol Fe^{+2}/g for DPPH, ABTS, ORAC and FRAP, respectively. Therefore, the extraction conditions affected the antioxidant capacity of the PSPP extract. The extraction time was the most determinant variable to reach the highest anthocyanin content and antioxidant activity ($p<0.05$), followed by solvent-to-solid ratio, which only showed significant differences for ABTS ($p<0.05$). The optimal extraction conditions were: 6 minutes, 1:30 solvent-to-solid ratio, and 60% EtOH. The predictive model showed a strong predictive power for DPPH and ABTS values, with a relative standard difference between real and predicted values of less than 10%. The encapsulation process had a 78% yield. The encapsulated extract showed a similar antioxidant activity to the extract (13.31 mg Trolox/g, 20.89 mg ascorbic acid/g and 243.55 µmol Fe^{+2}/g for DPPH, ABTS, and FRAP, respectively).

Conclusion:

PSPP can be used to obtain anthocyanin-rich extracts, being the extraction time the variable that had the greatest effect in the ultrasonic extraction. The encapsulated extract could be used as a natural antioxidant and colorant in the food industry. However, more research is needed to test its effectiveness.

P2.2.027

Development of an ingredient rich in bioactive compounds from white wine pomace

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Aim:

Winemaking is one of the most important agro-industrial activities in Spain, and as a result, the productive system generates large amounts of by-products. The main by-product of winemaking is the wine pomace, a solid by-product that contains mainly seeds, skins, stems and remains of grape pulp. These by-products represent waste disposal, or they are used for wine alcohol production, serve as fertilizer or as animal feed. Nevertheless, wine pomace still contains interesting compounds such as dietary fiber and polyphenols, so it can be reutilized by the food industry. For this reason, the aim of this study was to obtain an ingredient rich in polyphenols (bioactive compounds) by inactivating the microbial and enzymatic load, that could improve the preservation of meat products.

Method:

White wine pomace (cv *Cayetana*) was provided by a local wine manufacturer company. The product initially was thermally blanched (TB, 103ºC/1 min) to reduce enzyme activity, minced and vacuum packaged. Then, it was treated by hydrostatic high pressure (HHP) (600MPa) to stabilize the product at the microbiological level. Total phenolic compounds content, polyphenoloxidase (PPO) enzyme activity and total mesophilic aerobic, moulds and yeasts and total coliform counts were evaluated. Finally, the treated pomace was characterized (proximate composition and individual phenolic compounds content).

Results:

PPO activity was significantly reduced after thermal blanching (TB), with a 99% decrease from initial, and thus, low levels of activity remained after HHP (1.3%). In addition, phenolic compounds levels were significantly increased after TB and were not modified by HHP treatment. Microbiological counts were significantly reduced after TB and HHP treatments. Thus the combination of TB and HHP allowed the development of a stable ingredient with low microbial counts and enzyme activity. The valorised pomace had high levels of phenolic compounds (like flavanols and flavonols) and fiber content.

Conclusion:

The thermal blanching process helps maintaining the stability of phenolic compounds during HHP treatment by inactivating the PPO enzyme. Therefore, the TB of the pomace and HHP would allow obtaining a microbiologically and enzymatically stable product that could be utilized as an ingredient for the preservation of meat products.

P2.2.028

Valorization of clementine pomace from fruit at two ripening stages to be used as emulsifier

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Aim:
Clementine pomace (CP) can be used to obtain novel food ingredients while also contributing to reducing food waste. CP is a rich source of biomolecules, such as polysaccharides (pectins) and proteins, which have good emulsifying and stabilizing properties. However, the fruit composition changes according to the ripening stage: as the fruit ripens, there are molecular changes that can affect the biomolecules' techno-functional properties. This study aimed to assess the stage of ripening of clementine on CP's potential to be used as a natural emulsifying and stabilizing ingredient for food formulation.

Method:
CP from fruits at two different ripening stages was hot air dried to be used as an emulsifier. Oil-in-water emulsions using 1%, 2.5%, and 5% of CP and 10/90, 25/75, 50/50, and 75/25 oil/solution ratios were prepared. The emulsifying capacity was determined by centrifuging the emulsions and measuring the emulsion layer volume with respect to the total volume. The microstructure of the emulsions was studied by light field microscopy.

Results:
The effects of the ripening stage, amount of CP, and oil/solution ratio factors and the interaction among the three factors were statistically significant on the emulsifying capacity. Also, the interaction between the % of CP and the oil/solution ratio was significant. The increase in the % of CP in the emulsions at low oil/solution ratios caused an increase in the emulsifying capacity. By contrast, increasing the % of CP when using high oil/solution ratios led to a decrease in the emulsifying capacity. The microscopic images of the emulsions showed that smaller fat globules with more homogenous size corresponded with the highest emulsifying capacities.

Conclusion:
Preparing emulsions using clementine pomace is a promising option to valorize this by-product. Clementine pomace shows emulsifying and stabilizing properties in oil-in-water emulsions at low oil content (10/90 and 25/75); these properties are favoured by increasing the amount of clementine pomace used in the aqueous phase of the emulsion.

P2.2.029

Effect of starch concentration from different origins on the pasting parameters of their gels

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Aim:
This work aimed to determine the effect of the starch concentration of the gels on the pasting parameters obtained by Rapid Visco Analyzer (RVA).

Method:
Wheat, normal and waxy maize, normal and waxy rice, potato, and tapioca starches were tested in a Perten RVA 4500 (PerkinElmer Inc., Waltham, MA, U.S.A.), following the STD1 test (AACC 76–21.02 method). Concentrations were: 6.4, 7.8, 9.2, 10.6, and 11.9 g starch/100 g gel.
Amylose/Amylopectin Determination Kit (K-AMYL 06/18) [Megazyme (Wicklow, Ireland)] was used, applying the procedure of Gibson et al. (1997).

Results:
Potato starch gels showed the highest peak viscosities but little dependence of this on concentration. Non-waxy cereals had the highest peak viscosity increase with concentration.
The highest final viscosity at 11.9 g/100g gels corresponded with higher amylose content.
The non-waxy cereal samples showed an important drop in pasting temperature at increasing gel concentration. Lower amylose content starches and tuber starches samples registered variations of ~ 1 °C between the lowest and highest gel concentration.

Conclusion:
Changes in the concentration of the starch gels had different effects on the samples. Viscosities and pasting temperature values variations were most marked in wheat starch gels, followed by normal maize. Amylose concentration exerted a preponderant effect on cereals, while it had a negligible effect on tapioca and potato starch gels.

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P2.2.030

The effect of legume and oilseed composition on their gastronomical potential in the professional kitchen

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Aim: Differences in the source, isolation method and processing result in variations in the composition of plant protein isolates. The composition of legume and oilseed protein isolates can vary in the legumin:vicilin (L:V) ratio. In isolates from different pea cultivars for example, the L:V ratio is known to vary from 66:33 to 10:90 (w/w). Researchers have suggested that these proteins have different techno-functional properties. However, these properties have mainly been studied in model systems and in a laboratory environment. Can the suggested differences in techno-functional properties of these plant proteins be used to develop and improve plant based products and dishes in professional restaurants? In this study, we aim to link the composition of different cultivars of legumes and oilseeds to their gastronomical potential.

Method: We are working in close collaboration with seed companies, gardeners, other research facilities and restaurant chefs. Legumes and oilseeds from different sources and cultivars are grown, harvested and processed into flours. Using mild extraction, a fraction rich in protein is extracted from the flours. The flours and protein-rich extracts are studied on their emulsion and foaming properties. Examples include their ability to form and stabilize mayonnaise, cappuccino-foam, meringue and ice-cream. These techno-functional properties are compared to the sample's gross and protein composition. In addition, the sensory properties will be analysed.

Results: Researchers have studied the potential of flours (e.g. Sridharan et al., 2020), mildly and extensively purified plant protein fractions as functional ingredients (e.g. Chen et al., 2019; Kimura et al., 2008). These studies have all been preformed on in a laboratory environment. In addition, plant proteins are more and more used as functional ingredients in food industry.

Conclusion: Researchers have studied the potential of flours, and different plant protein fractions as functional ingredients. However, these studies did not focus on the gastronomical potential, meaning their ability to function as ingredients in the professional kitchen and the sensory properties of the resulting final product or dish. Therefore, in this research study we are linking seed cultivar, to gross and protein composition, and gastronomical potential.

P2.2.031

Microparticles of Buriti oleosome produced by spray drying with different wall materials

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Aim

Buriti has in its composition lipids structured as oil bodies (OB), subcellular organelles found as naturally stable oil droplets. These droplets can be used in food, cosmetic and pharmaceutical industries as a natural and healthy ingredient/additive. Methods such as spray drying are widely used to produce microparticles, and compounds delivery systems with more resistance to degradation. Thus, this work aimed to produce buriti OB microparticles coated with maltodextrin (M) and two types of Arabic gums (G and GF) through the spray drying method.

Method

Buriti OB were extracted by a non-polluting aqueous extraction method. This extract was homogenized with the wall materials (M, G and GF, or a mixture of them) (20% total solids and 10% oil load) and dried on a spray dryer at 180ºC. The powders were analyzed as for water activity, moisture content, apparent density, total carotenoids, and color.

Results

The M formulation showed promising results with low moisture content and water activity (2.65 ± 0.25b and 0.29 ± 0.08a) and better features compared to G and GF due to maltodextrin solubility and wall-forming capacity. Nevertheless, GF also showed promising results for producing powders with good physicochemical stability. All formulations presented similar apparent densities. The highest carotenoid content was found in M, showing that maltodextrin can improve carotenoid retention in buriti OB microparticles. Concerning the color parameters, the higher values for b* parameter corroborates the improved carotenoid retention in buriti OB microparticles coated with maltodextrin.

Conclusion

This study showed that oil bodies can be used as dried agent with coating materials to produce microparticles with interesting compounds to be used in food, cosmetics and pharmaceutical formulations.

P2.2.032

Development of a mathematical model for the drying process of Spanish cured ham

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Aim

Build a 3D multi-physical finite element-based model that would estimate proteolysis, water activity and salt and water content distributions during the stage drying Spanish-cured ham process. This tool will be part of a digital twin of the meat industry.

Method

The 3D model built using Comsol® Multiphysics software demonstrated very good prediction of in-ham salt and water content distributions, water activity distribution, proteolysis index, and ham weight loss.

Results

The accuracy of the model was evaluated by comparing all the predicted values at the end of the salting and post-salting stages with experimental values measured over the same period of time in samples extracted from "Jamón De Teruel" DOP.

Conclusion

A valuable tool has been developed to help Spanish Ham Industry to optimize the process of drying cured ham.

P2.2.033

Herbal brews in a tailor-made powdered form - formulation design, processing adjustment and physico-chemical characterization

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Recently, a herbal market as a small-scale agriculture alternative has become of high interest to consumers, especially due to the promising potential of herbs for preventing lifestyle-related diseases. Numerous bioactive properties of these botanicals are in favour of developing new forms of pharmaceuticals, nutraceuticals, and functional foods.

Aim: The study aimed to design the powdering procedure (from bioactives extraction to powders obtainment) for *Alchemilla vulgaris* L., *Mentha piperita* L., *Urtica dioica* L. and their mixes by spray- and freeze-drying with the addition of commonly used and functional carriers. Products were studied for their physico-chemical properties including antioxidant and antiglycation potential.

Method: The initial stage focused on extraction conditions adjustment including temperature, time (0–120 min) and herb:water ratio. The spray and freeze-drying were applied for powders preparation with i.a., maltodextrin and inulin (5%; w/w), while no carrier was added to controls. Products were characterized in terms of selected physical properties (moisture content, water activity, colour, etc.), total phenolics content (TPC; Folin assay), antioxidant capacity (TEAC ABTS assay) and antiglycation potential performed in three different model systems (BSA-glucose, BSA-MGO, MGO-L-arginine).

Results: The most efficient extraction procedure for brews preparation was attained when 90 °C water brewing for 1 h was applied for 2 g of herbs per 100 g of distilled water. Although carrier addition resulted in lower content of bioactives compared to controls, its application increased drying yield. When considering the antioxidant capacity and TPC values, compared to maltodextrin, inulin was indicated as a promising encapsulant for all tested products. The analyzed powders exhibited antiglycation potential.

Conclusion: The present study provided a preliminary overview of herbal powders production, which may be readily incorporated into a wide range of foodstuffs, globally. However, further research is needed to determine the optimal conditions for extracting and spray drying these herbs to maximize their health benefits in fortified foods and the safety and activity of various doses of herbal powders. Additionally, it is important to ensure that these herbal powders do not negatively impact the final product's taste or flavor.

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P2.2.034

Phenolic compounds in red grape pomace: effect of hydrostatic high pressure and temperature of storage.

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Aim:

In the winemaking process, around the 25% of the weight of the grapes is transformed into co-products/wastes. Grape pomace is the main by-product of the enological industry and consist mainly of skin, pulp, stalk residuals, and seeds. It is rich in polyphenols, which have important bioactivity. Pomace is a seasonal by-product and its stability during storage is not known. The effect of relatively recent technologies, like hydrostatic high pressure, on pomace has been scarcely studied, and this technology would allow an integral use of the by-product. Thus, the aim of this study is the valorization of grape pomace and to know the effect of processing and storage conditions of grape pomace to preserve its phenolic compounds content.

Method:

Red grape pomace (*Tempranillo* variety) was collected and characterized (proximate composition). The product was minced, vacuum packaged and treated by hydrostatic high pressure (600MPa) (Hiperbaric Wave 6000/55). Then packages were stored for 9 months at room temperature (20ºC) and at refrigeration (4ºC). Total phenolic compounds content and polyphenoloxidase (PPO) enzyme activity were evaluated.

Results:

Red grape pomace has high fibre and phenolic compounds content. Phenolic compounds were slightly reduced after HHP, but they were importantly reduced during long-term storage. After 9 months around the 90-95% of the initial levels of phenolic compounds were not preserved at room temperature, while at refrigeration the 46% (Control) and 56% (HHP) of the initial levels were preserved. The PPO activity was not reduced after HHP, and it could remain active in the pomace during storage, so that it could reduce the phenolic compounds levels of the stored pomace.

Conclusion:

The preservation of phenolic compounds is essential for the valorization of grape pomace. These compounds were better preserved at refrigeration than at room temperature. In addition, it is also necessary to reduce the activity of PPO to maintain the levels of phenolic compounds. The application of a thermal blanching before HHP processing could be a solution to reduce the activity of the enzyme and maintain the initial levels of phenolic compounds in the pomace.

P2.2.035

NON-INVASIVE CHARACTERIZATION OF THIN-LAYER JELLIES IN SILICONE MOLDS USING AIR-COUPLED ULTRASOUND

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Aim:

Novel technologies for food quality monitoring at real-time and non-destructive and non-invasive way are highly demanded by the food industry. In this context, the recent development of ultrasonic transducers able to carry out contactless measurements opens a potential application of this technology in food processing. Thus, the aim of this study was to evaluate the feasibility of the air-coupled ultrasound technique for the characterization of thin-layer jellies in silicone molds at different gelatin concentrations.

Method:
Jelly samples were prepared at different gelatin (225 Bloom) concentrations (1, 2, 4, 6, 8, and 10 % w/v) at 60 ºC in silicone molds (90 mm diameter and 12 mm heigh). After gelation at 4ºC for 24 h, the samples were measured by air-coupled ultrasound technique (300 kHz) and ultrasonic velocity and attenuation were computed. The samples were located in a mobile 2D platform to perform automatically 30 measurements for each sample. Afterwards, physicochemical properties such as textural parameters (hardness, gumminess and springiness) density, colour, and moisture content were determined in triplicate.
Results:
Velocity of propagation of the ultrasound waves, as well as attenuation, was significantly ($p<0.05$) affected by the gelatin concentration. This fact was linked to the changes of the mechanical properties of the jellies, which were evidenced by the increase in hardness and gumminess of the gels as the gelatin content was higher, as well as the decrease in springiness. In addition, satisfactory relationships were found between the wave velocity and attenuation with the jelly density.
Conclusion:
The feasibility of air-coupled ultrasound for characterising physicochemical properties of thin-layer jelly samples in silicone molds has been demonstrated in this study. The studied ultrasonic parameters showed a direct relationship with the mechanical and compositional properties, which would contribute to its monitoring at industry. Therefore, this study represents a potential application of air-coupled ultrasound as a non-destructive and non-invasive technique for the quality inspection of jelly packaged products.

P2.2.036

Valorization of red pepper by-products by the application of hydrostatic high pressure

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Aim:
Red peppers are one of the most important crops in the north of Extremadura region to produce paprika. Pepper by-products are the ones that do not have the right caliber and thus do not conform to the necessary marketing characteristics. They are rich in antioxidants compounds such as polyphenols and carotenes. Hydrostatic high pressure (HHP) is a non-thermal technology which allows the preservation of food products. This technology reduces microbiological counts while maintaining levels of bioactive compounds. For the preservation of fresh meat products, generally, synthetic additives are used which should be replaced by natural ones. The main objective of this study was the evaluation a hydrostatic high pressure for the valorization of red pepper by-products and their introduction as an ingredient for meat products preservation.
Method:
Red pepper (Franchi cultivar) by-products were provided by a local company. They were ground as a purée and then it was vacuum packaged. Afterwards, a HHP treatment was applied in Hiperbaric equipment (600 MPa/5 min). The physicochemical composition of the purée was analyzed: pH, fiber, protein and moisture content. The effect after HHP was analyzed on microbiology (mesophiles, psychrophiles, coliforms, moulds and yeasts) and phenolic compounds content (Folin-Ciocalteu method). Pork burgers (100 g) were manufactured with different levels of red pepper ingredient (0.5%, 1%, 3%, 5%, 7% y 10%). Burgers were cooked and a sensory analysis was carried out to know the acceptability of the valorised red pepper ingredient added to the burgers.
Results:
The low pH of the red pepper allows an effective preservation of the treated product by HHP. The microbial load was reduced with HHP treatment, in mesophilic and psychrophilic counts were reduced by 5 log cfu/g; moulds and yeasts were reduced by 3 log cfu/g. Total phenolic compounds were very high (1,098.3 mg (100 g)-1) although significant differences were observed after processing HHP. In general panelists accepted high levels of addition of the red pepper ingredient.
Conclusion:
The red pepper ingredient has high moisture content and phenolic compounds values are high. The application of HHP (600 MPa/5min) reduce the microbial loads and thus allowed the utilization of the by-products for fresh meat products preservation. The ingredient obtained was well accepted at sensory level.

P2.2.037

Nutritional and functional properties of by-products from natural pistachios: comparison between different oil extraction systems.

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Aim:

The high fat content of pistachios makes them a raw material with a high potential for oil extraction, which is of great interest for the recovery of consignments of this nut in the lower commercial category. This study aims to respond to the technological demand for the integral use of natural pistachios of inferior calibre, or of low quality for their commercialization, carrying out a comparative study of two different oil extraction systems: screw press and hydraulic press. The use of two pre-treatment conditions set according to the temperature of the raw material was also studied.

Method:

Pistachios of low commercial quality were dehulled and cut with a grinder. They were then conditioned for 30 minutes at two temperatures: 25ºC and 60°C. Oil extraction was carried out using a screw press (SP) and a hydraulic press (HP). The cake was obtained as a by-product from both pressing processes and the extraction yield was determined as a function of the oil extracted. The cake was then ground in a mill to obtain a flour with a particle size of less than 500 microns. The flour obtained from the extraction process (partially defatted flour) was subjected to physico-chemical, nutritional and functional characterization.

Results:

The oil extraction yield was higher when SP was used (37±1% compared to 23.1% for HP). The proximate analysis, mineral content, and colour of the flours showed variations related to the type of press used for extraction and the preheating temperature, due to the different oil yields obtained. The level of protein, fibre and ash was significantly higher in the flour obtained by SP. Similarly, Ca, P, and Mg were more abundant in the flours obtained by SP from samples conditioned at 25ºC. Finally, their functional properties varied significantly depending on the extraction system and pre-treatment temperature.

Conclusion:

The results obtained in this study could be useful for the further use of the by-product obtained from oil extraction as an ingredient in the food industry. This will require adaptation of the processing system and operating conditions to the techno-functional requirements associated with the production of different products.

P2.2.038

Flavonols-phycocyanin covalent conjugation for increased thermal stability of phycocyanin

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Aim:
Phycocyanin is a natural blue pigment extracted from the microalgae *Spirulina*. The pigment is a conjugated complex of a protein with a non-protein dye, well known for its antioxidant and health-promoting properties. Despite its sustainable origin and health-promoting potential, broad utilization of phycocyanin is hindered by instability during pasteurization due to protein denaturation resulting in color deterioration. Covalent cross-linking was suggested as one of the approaches to increase pigment stability. However, this method often uses unwanted crosslinking agents unsuitable for food processing. Flavanols are nontoxic polyphenolic plant secondary metabolites possessing high antioxidant properties. In this study, covalent Flavonol-phycocyanin conjugation was studied to enhance stability during pasteurization with a potential added benefit of increasing health-promoting potential due to the covalent conjugation of flavanols.

Method:
Flavonols-phycocyanin conjugates were prepared using an alkaline reaction, color deterioration kinetics was quantified *in situ* using a spectrophotometer connected to Peltier, to study the conjugation sites free amino groups were detected by the OPA method, and the free sulfhydryl groups were detected with Ellman's reagent. The conjugates antioxidant properties were determined using FRAP method.

Results:
Phycocyanin was conjugated with rutin and quercetin; after conjugation, the free sulfhydryl groups decreased by 93% and 43% for quercetin and rutin conjugates, respectively. The free amino groups of the conjugates decreased significantly compared to the control. The color resistance of rutin and quercetin conjugates increased by 33% compared to the control. In addition, the color deterioration rate during heat treatment decreased by 24% and 34% for quercetin and rutin conjugates, respectively. The antioxidant properties of the conjugates increased significantly compared to the control.

Conclusion:
Quinones (formed from polyphenols) react with protein nucleophilic amino residues containing sulphydryl and amino groups during alkaline conjugation. The higher color resistance of the conjugates after heat treatment and the high antioxidant properties of the conjugates suggests that phycocyanin conjugation with flavanols is a potential strategy to produce more stable blue color pigments based on phycocyanin.

P2.2.039

Characterization of a protein concentrate from Kabuli chickpeas (Cicer arietinum L.)

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Aim: The increase in the demand for proteins from non-animal sources have boosted the search for plant proteins. The proteins functionalities represent an important area of research, because those properties have an impact on the quality and texture of the final food products. In this study we evaluated the functional and thermal characteristics of a protein concentrate from chickpeas (Kabuli, variety Orion).

Method: The protein concentrate was obtained by alkaline extraction (pH 9,5), followed by isoelectric precipitation (pH 4,5) and freeze-drying. Functionalities as solubility, water and oil absorption capacities (WHC, OHC), least gelation concentration (LGC), foaming capacity/stability and thermal property (DSC) were evaluated.

Results: The protein content in the concentrate was 61,23%. The minimum solubility was observed at pH 4-5, and the maximum solubility at pH 2 and 6-10. The WHC was determined to be 1,35 ± 0,02 g/g and the OHC 4,20 ± 0,11 g/g. A foam capacity of 118,67% obtained and the foam stability was 84,36% after 60 minutes. LGC formed a strong gel after 2 hours at a concentration of 20% w/v. A peak denaturation temperature (Td) of 88.7°C and a heat of transition (ΔH) of 33.7°C for the protein concentrate was obtained by differential scanning calorimetry (DSC).

Conclusion: The results obtained in this study are comparable to others regarding solubility, LGC, but they differ in WHC, OHC, foam capacity, and thermal denaturation. Future studies could evaluate how these characteristics may impact the gelation performance of the proteins, when used for food applications.

P2.2.040

Obtaining lupin protein isolates: maximizing protein recovery and anti-nutritional factor removal

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Aim

Lupine is a legume with a high protein content and minimal requirements that can contribute to sustainability through the production of protein isolates (LPI). However, its anti-nutritional factors (ANF) may pose health and technological concerns. The aim of this study was to evaluate the effect of microwave treatment (temperature and time), the solvent-sample ratio, and the percentage of ethanol on the production of LPI, maximizing protein recovery and LPI protein content, while minimizing its ANF content, using response surface methodology.

Method

A central composite design was used to determine the effect of the different variables. Three replicates were carried out for each treatment. The protein and ANF content of LPI, including alkaloids, saponins, total phenolic content (TPC), and phytic acid, were analysed. Response surface methodology was used to predict the optimum conditions.

Results

Results showed that microwave treatment did not increase the protein recovery and LPI protein content compared to the control, consisting of an alkali-based extraction. Likewise, the ANF content was unaffected by microwave treatments. However, the ethanol percentage and solvent-sample ratio influenced protein recovery and LPI protein and ANF contents. The optimal extraction conditions were set at a solvent-sample ratio of 22 and an ethanol percentage of 10% resulting in a protein recovery of 58% and a LPI protein content of 89%. The content in alkaloids, saponins, phytic acid and TPC in the LPI was 0.23, 4.92, 25.99, and 0.72 mg of each ANF /g LPI, respectively.

Conclusion

Under the studied conditions of time and temperature, microwave treatments did not represent a significant advantage over the alkali conventional method for obtaining LPI. However, protein recovery and LPI protein and ANF contents were improved by modulating the solvent-sample ratio and adding ethanol in the extraction solvent.

P2.2.041

From dairy to plant-based: exploring hybrid options for sustainable yogurt formulations

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Aim:

Plant-based diets have become increasingly popular in recent years, and the demand for plant-based products is rising. One area where this trend is particularly visible is in the dairy industry, where consumers are seeking alternatives to traditional dairy products. This has led to the development of plant-based dairy products, such as yogurt, which can offer similar taste, texture, and nutritional properties to their dairy counterparts.

Method:

In this study, we explore hybrid options for sustainable yogurt formulations, transitioning from traditional dairy to plant-based ingredients. By combining plant-based proteins, such as legumes (white beans) and oats, with dairy-based ingredients, we aim to achieve a more sustainable and nutritious product. We employed a rational food design approach to formulate and optimise a yogurt recipe with reduced animal protein content, using less refined and more sustainable sources of protein and micronutrients. We used a desirability-based mixture design to model and statistically optimise the formulation. Our study involved formulating nine yogurts with different ratios of milk, beans and oats, ranging from 100% animal protein to 100% plant-based protein. We evaluated the physicochemical, rheological and sensory properties of the yogurts using instrumental methods and a consumer perception study.

Results:

Our results showed that the yogurts with higher bean and oat content had stronger gel-like structures. Additionally, the plant-based yogurts exhibited higher syneresis than their animal-based counterparts, due to differences in protein composition. However, by optimising the ratios of plant-based ingredients, we achieved an acceptable level of syneresis while maintaining desirable texture and consumer acceptance.

Conclusion:

This study highlights the potential for hybrid options in sustainable food production, combining the best of both worlds to create a more environmentally and socially responsible food system. The use of legumes and oats in yogurt formulation offers a promising alternative to animal proteins and can contribute to the development of more sustainable and healthy food options.

P2.2.042

Mechanical properties and protein digestibility of texture-modified pork meats using fruit-derived enzymes

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Aim:

Pork meat is a good source of high-quality protein, being a valuable food for all people. However, its consumption can be difficult for persons with chewing difficulties like the elderly. In this regard, the development of texture-modified products is an interesting strategy, which can be achieved by the use of proteolytic enzymes. The aim of the study was to evaluate the mechanical properties and protein digestibility of texture-modified meats obtained by using the fruit-derived enzymes papain and bromelain.

Method:

Meat samples were prepared from fresh pork loin pieces (*Longissimus dorsi* muscle) and cut into medallions (1.5 cm thick and 5 cm in diameter). Meat samples were immersed in solutions of the commercial enzymes bromelain and papain, each of them prepared to reach 6000 U/g. Samples were incubated at 50 ºC for 24 h in an oven to be softened by the action of proteases, and finally heated at 95º C for 3 min for enzyme inactivation. Control samples were subjected to the same conditions but immersed in distilled water. Mechanical properties of the meat samples, by a texture profile analysis (TPA), and the protein digestibility before and during an *in vitro* gastrointestinal digestion were evaluated.

Results:

The TPA test showed a significant decrease in hardness in the enzyme-treated meats compared to the control samples. Regarding elasticity, cohesiveness, and chewiness, no significant differences ($p > 0.05$) were observed between both enzyme treated samples, which also showed low adhesiveness.. Digestibility assays showed that bromelain-treated samples presented the highest content of soluble proteins after simulated gastrointestinal digestion, whereas the extend of proteolysis was higher in the papain-treated samples.

Conclusion:

The application of fruit-derived enzymes on pork meat would affect its integrity and fibre structure resulting in reduced hardness and therefore, mastication effort, while papain-treated samples would present better protein digestibility. This information can help to develop foods that best suit the needs of certain population groups such as the elderly.

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P2.2.043

Effects of microbial fermentation and non-thermal treatments on functionality of clementine residues

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Aim:

Nowadays the management of wastes and by-products of food processing has become a major challenge. In this context, a strategy can be based on fermentations with safe microorganisms to provide desirable properties such as flavour, aroma, antioxidant, antimicrobial. Also, emerging non thermal technologies, eg as pulsed electric field (PEF), can be adopted to optimize fermentation by increase bioavailability of the residues' components.

Method:

Clementine by-products were treated with PEF before being inoculated with different strains of yeasts and lactic acid bacteria (LAB) (3-4 and 5-6 and log CFU/g, respectively). Microbial growth, prebiotic activity, total phenolics content (TPC), antioxidant activity (DPPH and ABTS^{+}), and volatile compounds (SPME /GC-MS) were monitored over 6 days.

Results:

All the tested LAB strains were able to grow and adapt to the adverse conditions of the matrices within 3 days. On the other hand, yeasts presented a strain-dependent behavior. In fact, some of them were not detected already after 24 hours, while others showed good performances with mean cell load increases of 2-3 log CFU/g. Moreover, most of the LAB increased the TPC values during fermentation, while ABTS values remained constant or decreased. Similar behavior was observed for most of the yeasts, except for a strain of *Yarrowia lipolytica* characterised by increases both in TPC and antioxidant activity. Concerning volatile profile, most of the strains initially accumulated several alcohols and terpenes associated with floral, citrus, and mint aromas, while at the end of fermentation presented a shift to molecules recognized as antimicrobials.

Conclusion:

Most of the strains used clementine by-product for their growth with an increase in TPC. Additionally, interesting flavor compounds were produced during fermentation, and PEF was shown to promote fermentation probably due to a higher bioavailability of by-products' components. Such outcomes are interesting in the view of exploiting the properties of the fermented clementines as a functional ingredient or flavoring agent for the production e.g. of fruit or plant-based beverages and also to enhance food shelf life and safety.

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P2.2.044

Lethal effectiveness evaluation of different plasma types (gas composition) on E. coli

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Aim:
Cold Atmospheric Plasma (CAP) is a complex technology, which decontamination effectiveness is influenced by many variables. Some of the most important variables affecting this technology are voltage, frecuency and gas composition. The aim of this study was charactericed the influence of the plasma generation intensity (by testing different conbinations of voltge and frequency) and the gas composition on the lethal effectiveness of the plasma activated atmosphere generated in the prototype designed by CNTA.

Method: This work was developed using a CAP gnerator prototype, designed and built in CNTA. The protype uses a dielectric barrier discharge electrode with a cooper Hv electrode and stainless steel square mesh with a PTFE dielectric layer of 1,5 mm thinner. Trials were performed using atmospheric gas, 100% N_2 and 100% CO_2. Peak voltage was varied between 5 and 20 Kv and frequency from 100 and 1000 Hz. Tratments were applied in hermetic boxoes of 6L capacity injecting plasma at a flow rate of 5 L/min during 2 minutes; achieving a final mix atmosphere of 50% air and 50% activated plasma atmospher. Boxes contained 6 TSA plates surface inoculated with *E. coli* O157:H7 (DSMZ19206) at different concentrations. After injection, mix atmosphere were maintained 10 minutes inside the boxes before open and remove inoculated plates for its incubation under appropriate conditions.

Results: The inactivation levels achieved ranging from 1.2 to 3.2 log cycles when using atmosphere air, from 0 to 1.4 log cycles when using 100% of CO_2 and <0.2 log cycles when using 100% N_2. Results also shows that higher intensities on plasma generation produces higher levels of inactivation of *E. coli* O157:H7 when using atmosphere gas. In case of CO_2 the inactivation level increased with plasma intensity until certain limit above which higher plasma intensities did not suppose higher inactivation.

Conclusion: In the conditions tested higher CAP intensities produce higher inactivation of *E. coli* O157:H7. In all cases atmospheric air was the mos effective gas for inactivating the target microorganism followed by 100% CO_2; while no significant inactivation was detected when 100% N_2 was used for plasma generation.

P2.2.045

Impact of apple pomace on the quality attributes of wheat blends and dough

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Aim:
Apple pomace, which is the by-product of apple juice and cider production, has long been considered a waste product in the food industry. However, recent research has shown that apple pomace contains a significant amount of dietary fiber, antioxidants, and other beneficial compounds that can be used in the production of various food products, including bread. The use of apple pomace to produce bread can be a sustainable and cost-effective solution for managing food waste in the apple industry while creating a new value-added product that can benefit both the food industry and consumers. The aim of the work was to evaluate the effect of different share of apple pomace (0/100, 5/95, 10/90, 15/85 and 20/80 ratios) on the pchysicochemical properties of blends and dough prepared from wheat bread flour (type 750) and semolina.

Method:
The qualitative (total protein, quantity and quality of wet gluten, falling number, sedimentation index) and amylographic features of wheat bread flour and semolina as well as those with apple pomace were determined. In addition, the rheological properties of the dough were investigated (farinograph, Mixolab).

Results:
Semolina blends were characterized by a higher falling number, maximum viscosity of flour gruels, lower water absorption, longer dough development time, shorter dough stability and higher retrogradation than blends made of wheat bread flour. Along with the increasing share of apple pomace, a decrease in the total protein content, yield and spreadability of wet gluten, falling number, increase in the maximum viscosity of paste, water absorption, extension of dough development time and stability, reduction in dough softening and retrogradation in blends were noted.

Conclusion:
Semolina and its blends were characterized by a lower activity of amylolytic enzymes and higher retrogradation than wheat bread flour and its blends, from which it can be concluded that from wheat flour type 750 we will obtain product with a

more moist crumb, which will stay fresh for longer. Enrichment of wheat flour blends with apple pomace up to 20% improved the rheological properties of doughs despite lowering the quality of gluten proteins.

P2.2.046

Foaming by plant protein colloids: a novel and easy-to-produce ingredient

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Aim:
Plant proteins play a crucial role as functional ingredients in our foods. One such functionality is stabilising foams. A challenge here is the lower foam formation or stabilisation of many plant proteins compared to dairy/egg proteins, without extensively altering the plant proteins. Therefore, we introduced a novel and simple method to create plant-based protein colloids, which we studied for their foam-stabilising properties.

Method:
Mung bean was used as a protein source to create the colloids, which are produced by inducing liquid-liquid phase separation. When decreasing the pH towards the iso-electric points, plant proteins can phase separate, giving protein-rich droplets in solution. These droplets are heated to induce gelation, giving mung bean protein colloids with sizes around 150 nm. These particles were studied for their interface and foam-stabilising properties, which were compared to whey protein.

Results:
The protein colloids (1% wt protein) had a foaming capacity of 320%, and a very high foam stability (half-life time) of nearly 400 min. Whey protein at a similar concentration has a comparable foam capacity, but only a foam stability of about 300 min. We discovered that the mung bean protein colloids had two major fractions: 1) a fraction with colloids and 2) a fraction with non-aggregated proteins. The non-aggregated proteins were responsible for the air bubble formation and stabilisation, while the larger colloids were stuck in the lamellae between the air bubbles. As a result, the colloids formed a blockage, which primarily reduced drainage, thus increasing foam stability.

Conclusion:
A simple method can be used to create plant protein colloids (the method is also validated for pea proteins). These colloids are excellent foam stabilisers, as we create two fractions that are working together in air bubbles and foam stabilisation. Such a method could provide a new type of high-end plant-based ingredient.

P2.2.047

Maté extracts encapsulation for chlorogenic acids recuperation and preservation

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Aim: *Ilex paraguariensis* is a South American tree known as yerba mate or maté. Its leaves and thin stalks have many bioactive compounds, especially chlorogenic acid isomers (about 10%, w/w) and caffeine, theobromine, rutin, and saponins. When in solution, these compounds have low heat, light, and oxygen stability. The aim was to produce maté chlorogenic acid-rich extracts from harvest branches epiderm and encapsulate them with the prolamin zein.

Method: The epiderm from harvested thick branches (residue) was manually removed, dried, grounded and extracted using a central composite rotational design (CCRD) experimental DOE (sample weight (g), time (min), and temperature (°C)). After that, The richest chlorogenic acid extract was encapsulated by the same DOE using zein anti-solvent coagulation (zein (g), stirring speed (rpm), and dropping rate (mL h^{-1}), followed by freeze-drying. The chlorogenic acid of all extracts was determined by LC-MS, as well as particle size ((DLS), morphology (SEM), encapsulation efficiency, FTIR, and thermal stability by thermogravimetric analysis (TG) from the encapsulated were examined.

Results: The sum of chlorogenic acid isomers, caffeoylquinic (CQA) (3-CQA, 4-CQA, 5-CQA), dicaffeoylquinic acids (DQA) (3,4-DQA, 3,5-DQA, 4,5-DQA), from maté residues was about 10.2% (w/w). The maté- extracts: zein dry precipitates results in small and irregular particles from the dry powder with non-defined morphology. The encapsulation efficiency ranged from 64% to 93% (weight total chlorogenic acid/zein weight). The best encapsulation was using 1.36 g of zein, 4 rpm of stirring and 18.14 mL h^{-1} of dropping. The FTIR corroborates with the encapsulation results, indicating the absence of some maté extracts bands after the anti-solvent coagulation. TG's mass loss (%) showed thermal stability of maté- extracts: zein systems, compared to maté-extracts. This behaviour indicates that this prolamin can help improve the heating stability of maté chlorogenic acids.

Conclusion: Maté chlorogenic acid-rich extracts were successfully optimised from harvest branches epiderm and encapsulated using zein. The high encapsulation efficiency improved the chlorogenic acids' thermal stability, an excellent alternative to delivering these compounds in foods and drugs that need thermal processing. Also, a non-commercial harvest residue can be considered a promising chlorogenic acid source, addressing the circular economy of maté-chain processing.

P2.2.048

Applying the Nelder-Mead simplex method for optimizing nutritional vaues of wheat bread: a case study

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Aim:

The challenges of the FOSC call are addressed within this contribution. This will be done by creating new and enhancing old agricultural technologies and a redesigned network of the existing African agri-food value chain to increase resilience, sustainability and circularity within the CHIAM project. The deployment of the networked chia-mushroom-pig biogas value chain contributes to the diversification and resilience of African food systems to the impacts of climate change. The goal of the contribution is to develop nutritionally valuable foods by fortifying staple foods used locally in Kenya with chia seeds and oyster mushrooms and to optimize their production processes.

Method:

The Nelder-Mead simplex method is a fast and easy to apply optimization method. It is often used is to optimize parameters by maximizing or minimizing an objective or quality function. The simplex method is an alternative to the response surface method. However, the optimization is carried out in an iterative approach. It often needs fewer experiments, because it directly climbs up the "optimization hill" to the optimal value. The Nelder-Mead simplex method can be performed within arbitrary dimensions, but the parameters must not depend on each other. It is also possible to combine this method with another optimization method, depending on the needs of the operator. A standard wheat bread recipe is used as basis for the optimization. The wheat flour is then substituted by milled chia seeds and dried oyster mushrooms. Both ingredients are beneficial regarding their nutritional values. The wheat flour mixtures are evaluated using standard methods in cereal science, e.g. determination of the water absorption using the Farinograph and the rapid pasting method using the Rapid Visco Analyser. Rheometer tests are performed as well.

Results:

Results showed that substituting ground chia seeds and oyster mushrooms for wheat flour in bread influences the gelatinization properties of starch. According to calculations based on the nutritional values of the ingredients, an increase in protein, fat and fibre content, as well as caloric values in breads can be observed.

Conclusion:

A more nutritionally valuable product fortified with chia and oyster mushroom is possible to be designed by applying the Nelder-Mead simplex method.

P2.2.049

Targeted micro- and nanoencapsulation of S-layer producing Levilactobacillus brevis for enhanced protection during gut delivery

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Aim:
The aim of this study was to enhance the delivery, and thus probiotic potential ability of S-layer producing *Levilactobacillus brevis* strains isolated from human milk, to survive under stressful conditions by using micro- and nanoencapsulation techniques.

Method:
Four *L. brevis* MB1, MB2, MB13 and MB20 strains, together with fructooligosaccharides (FOS) or galactooligosaccharides (GOS), were microencapsulated using alginate. Also, another approach included nanocencapsulation of *L. brevis* strains by layer-by-layer (LbL) assembly method to form 3 layers of two differently charged polyelectrolytes sodium poly(styrene sulfonate) (PSS) and poly(diallyldimethylammonium chloride) (PDDA). Surface charge was investigated by zeta-potential measurments in order to confirm the formation of layers within the nanocapsule. In order to evaluate possibility of higher cell viability, micro- and nanoencapsulated bacterial cells of *L. brevis* MB1, MB2, MB13 and MB20 cells were exposed to freeze-drying and simulated *in vitro* gastrointestinal tract (GIT) conditions.

Results:
Nanoencapsulation steps show changes between negative and positive charges for each assembly, thereby indicating successful formation of nanocapsules. According to the results, the viability of S-layer producing *L. brevis* strains in simulated GIT conditions and during freeze-drying after micro/nanoencapsulation, was generally significantly increased compared to viability of free cells. Regarding the survival in simulated GIT conditions, alginate microencapsulation of MB2, MB13 and MB20 cells combined with GOS, has been shown to be the optimal approach, as a significant increase in cell counts compared to free cells was determined. As for freeze-drying, microencapsulation using alginate as well as nanoencapsulation significantly improved survival rate for all *L. brevis* strains with addition of GOS, compared to free cells.

Conclusion:
LAB strains' ability to survive under stressful conditions is a prerequisite, among others, for their potential characterisation as a probiotic. Furthermore, S-layer has been shown to play an important role in the survival of producer strains in such conditions. However, new methods for improving the survival rate have been investigated, among which are micro- and nanoencapsulation. The capacity of micro- and nanoencapsulated *L. brevis* strains to withstand stressful conditions may improve their delivery and, besides achieving improved cell viability, can also contribute to the functional aspects of *L. brevis* strains within the probiotic concept.

P2.2.050

Antibacterial Potential of Bioactive Compounds from Albanian Myrtle (Myrtus communis) Leaves

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Aim:

This paper aims to present the potential of the bioactive compounds extracted from Myrtle (*Myrtus communis*) leaves in different alimentary or pharmaceutical applications based on their antibacterial properties.

Method:

Myrtle leaves were collected in Seman forest, Fier; Albania, in December 2022. The dried leaves were extracted by ultra-sonication for 15 min at 25°C, using two different extraction solvents, such as a mixture of *n*-hexane and acetone (3:1 w/w), and ethanol 70% (w/w). The antibacterial activity was investigated in duplicate tests, using Agar Well Diffusion Method on some pathogen strains such as *Bacillus spp.*, *Escherichia coli* ATCC 25922, and *Staphylococcus aureus* ATCC 25923. Ciprofloxacin and Chloramphenicol (1mg/mL) were used as positive controls. The carotenoid and polyphenolic profile of the extracts were analyzed by means of chromatographic methods, using Agilent 1200 HPLC system equipped with an autosampler, degasser, quaternary pump system, multi-wavelength detector, and column thermostat.

Results:

The extract obtained from *n*-hexane and acetone showed better results compared to the extraction with ethanol 70%. *S. aureus* was the most sensitive of the three bacterial strains with an inhibition zone of 30.0±0 mm from the *n*-hexane and acetone extract and 27.0±0 mm from the ethanolic extract. Negative results were observed for *Bacillus spp.*, and *E. coli*, which were not influenced by the ethanolic extract presence. The most abundant compounds separated and identified on the HPLC chromatogram were α-carotene (275.86±3.60 µg/g extract), β-cryptoxanthin (270.77±14.89 µg/g extract), and zeaxanthin (63.72±10.57 µg/g extract). The ethanolic extract was rich in phenolic acids such as protocatechuic acid (1997.44±27.49 µg/g extract) and gallic acid (169.05±66.20 µg/g extract).

Conclusion:

n-hexane and acetone extract showed the most prominent antibacterial properties on the selected pathogenic strains. However, its application in the food sector is limited due to solvent toxicity. The sensibility of *S. aureus* from the myrtle leaves extracts may lead to an opportunity to be implemented as a functional ingredient in food industry sectors in which this pathogen represents a health concern and as an ingredient in pharmaceutical or nutraceutical plant-based products.

P2.2.051

Modulation of apoptotic gene expression by a plant sterol-enriched rye bread digesta in Caco-2 cells

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Aim: Plant sterols (PS) may exert antiproliferative effect in the colon due to their low absorption. This work has as aim to evaluate the transcriptional changes in some apoptosis-related genes produced by an *in vitro* digested and fermented PS-enriched wholemeal rye bread (1.8g PS/portion) compared to a non-enriched one.

Method: The dynamic multi-compartmental continuous digestion system simgi® (CIAL-CSIC) was used to digest both breads during 120h. Subsequently, samples (stabilization blank (SB), fermentation liquid without PS (FL0), wash blank (WB), and fermentation liquid with PS (FLPS)) underwent centrifugation and the supernatants obtained were diluted with DMEM (1/5, v/v). After filtering (0.45µm, PTFE) to preserve cell viability, the samples were used to treat Caco-2 cells during 3 and 6 h. Quantitative PCR was used to assess changes in the expression of *BAX/BCL2*, *CASP3*, *CASP8*, *CASP9*, *CDKN1A*, *TP53*, *CCND1*, and *CCNE1* genes.

Results: After 6h of treatment, compared to their blanks, an increase of gene expression of *CASP3* (by 77% in FL0) and *TP53* (by 37 and 166 % in FL0 and FLPS) was observed, while the expression of *CCND1* was decreased (by 75 and 49% in FL0 and FLPS). No changes regarding apoptosis were observed for other genes, probably due to the excessive damage produced by the treatment. Only an increase of expression of *CASP8* (by 8 and 40% in FL0 and FLPS) was observed after 3h of treatment, compared to their blanks. Again, it was observed a gene repression in *CCND1* (by 55% in both FL). In this occasion, no changes in the effector caspase (*CASP3*) and *TP53* were observed, probably due to the lower treatment duration. Nevertheless, these results confirm an extrinsic pathway of apoptosis (*CASP8*) caused by both breads colonically fermented, but slightly higher in FLPS.

Conclusion: The presence of PS in a wholemeal rye bread can improve its antiproliferative effect through an overexpression of pro-apoptotic and a repression of cell cycle regulator genes.

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P2.2.052

Release properties of anthocyanins-loaded alginate microbeads under gastrointestinal conditions

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Aim:
The present study aimed to test different sizes of alginate hydrogel microbeads containing anthocyanins and evaluate their release properties in gastrointestinal environments.

Method:
Simulated gastric fluid (SGF) was obtained using 3.2 g Pepsin, 2 g NaCl, and 7 mL HCL (36% v/v) in distilled water. 6 M HCl was used to maintain the pH at 1.2. The simulated intestinal phase (SIF) was prepared with 6.8 g monopotassium phosphate and 1.25 g pancreatin in distilled water. 77 mL of 0.2 M sodium chloride was then added, and the pH was adjusted to 7.4 by 5M sodium hydroxide before making up to 1L. Anthocyanins-loaded alginate microbeads (F_1 and F_2), with particle sizes of 1294 and 1869 µm respectively, were dispersed in gastric and intestinal phases at 37°C for 2 hours on a shaker. Samples were taken at different intervals and analyzed by HPLC to determine cyanidin-3-glucoside concentration. Experimental data were fitted by the Korsmeyer-Peppas model using MATLAB (Version 9.12.0.1927505, R2020a).

Results:
A significant difference ($p<0.05$) was observed between the release percentage of two different alginate microbeads containing anthocyanins under gastric conditions. The smaller microbead (F_1) released less cyanidin-3-glucoside than F_2 (56 versus 68.5 %, respectively) in SGF within first 20 minutes, and after 240 min, these values increased to around 68.6% and 78.05%. The release of cyanidin-3-glucoside was rapid in SIF compared to SGF ($p< 0.05$). In both F_1 and F_2, the structure of alginate was found to be disrupted after exposure to SIF for 80 and 120 minutes, respectively. The release behavior was adequately described by the Korsmeyer-Peppas model with a high correlation coefficient (R^2) ranging from 0.9932 to 0.9984. K value, representing the release rate found to be the lowest for F_1 in SGF, and the highest for the same sample in the SIF environments. The release exponent (n) varied from 0.031 to 0.062, suggesting that the mass transport follows a Fickian diffusion.

Conclusion:
The release mechanism of cyanidin-3-glucoside was mainly dominated by Fickian diffusion, and it is dependent on particle size, the ability of the compound to diffuse through a biopolymer network, and pore size as well as the release medium.

P2.2.053

Exploring statistical tools to evaluate the effect of 3D printing on rheological properties of gels

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Aim: The study of rheological properties in food 3D printing provides essential information on the material's behavior during the stages of the process, and they are closely linked to the printability of the material and its stability. The main objective of this research is to analyze the rheological properties (G', G'', tan δ, and η*) of gelatine gels with different concentrations of apricot pulp (30%, 50%, and 70%). These properties will be evaluated both before and after 3D printing, using two different statistical methods.

Method: An oscillatory test was performed on the gels before and after 3D printing in a frequency range of 0.1 to 10 Hz. The data obtained were subjected to analysis of variance (ANOVA), with a confidence level of 95% ($p < 0.05$), and functional data analysis (FDA).

Results: ANOVA revealed significant differences ($p < 0.05$) in all rheological parameters before and after 3D printing. After printing, increased G', G'', and η* values were observed as the pulp content increased, indicating higher strength and elasticity in the samples. On the other hand, functional principal component analysis (fPCA) contributed to characterizing the behavior of G', G'', and η curves before and after printing. Analysis of the rheological curves evidenced clustering of the samples after printing due to predominantly elastic behavior (>G', >G'', and >η*) throughout CP1. In contrast to the ANOVA, fPCA through CP2 provided information on which Hz ranges (0 to 4.5 Hz and 4.5 to 10 Hz) were critical for differences between samples in the behavior of G', G'', and η.

Conclusion: These results indicate a change in the behavior of the gels after 3D printing, becoming more elastic, which influences the stability of the printed figures. Furthermore, the fPCA method was shown to be a valuable tool for analyzing a larger amount of data and reducing dimensions; addition provided more detailed information about the samples that presented greater differences to the rest, as well as the rheological values at different frequencies, compared to ANOVA, being a viable option for the statistical analysis of rheological data in this context.

P2.2.054

Development of an antifungal active packaging to prolong the shelf life of cape gooseberry fruits

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Aim

This study presents the design of an active packaging system that release natural antifungal compounds to preserve the physicochemical characteristics of cape gooseberry (*Physalis peruviana* L.) under storage conditions**.**

Method

The active element with antifungal potential was designed by selecting active compounds based on the literature review of previously reported results for the inhibition of gray mold (*Botrytis cinerea*). The selected compounds were encapsulated using β - cyclodextrin as a layer material in three different ratios of layer material and concentration of active compounds. The encapsulated compounds were added to a sheet of polylactic acid produced by the casting technique. The release of active elements was evaluated through weight loss, color change, compound release tests, and scanning electron microscopy. The effect of the active element was evaluated for visual and physicochemical characteristics of cape gooseberry fruits packaged and stored in refrigeration including color, texture, titratable acidity, and fungal damage index.

Results

The literature review indicated that cinnamaldehyde and carvacrol were effective in inhibiting fungal growth in fruits and could be volatilized in the headspace of the package. During storage, variations in the color of the fruits were observed, which is consistent with findings reported by other authors. However, fruits that were packed in the packaging system with the highest concentration of antifungal compound exhibited lower damage associated with gray mold. The combined use of these antifungal compounds in the active elements incorporated in the package demonstrated a synergistic effect in preserving fresh fruits and reducing the rate of deterioration associated with microorganisms. The active elements added with these compounds and their mixtures mitigate the fungal damage associated with the deterioration of the fruit by *Botrytis cinerea*. The formulation that allowed for maintaining the fruit's characteristics for at least 32 days was identified.

Conclusion

The use of active molecules such as cinnamaldehyde and carvacrol in the active packaging system preserved the visual and physicochemical characteristics of cape gooseberry fruits, thereby prolong the shelf life and improving their commercialization.

P2.2.055

Digital sensor options NH3ControlFarm

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Aim: This work presents the possibility of obtaining direct analytical information from NH_3ControlFarm sensors from a digital reading with portable devices thanks to two applications developed by the MINTOTA research group.

Method: These Apps allow the quantification of ammonia levels recorded with the NH_3ControlFarm using a methodology based on the colorimetric change of these sensors in the presence of the analyte. On the one hand, the SpectraFree App works with the RGB, R (red), G (green), B (blue) colour intensity values, and allows the concentration of the analyte to be

obtained directly by simply capturing an image with a smartphone. On the other hand, the GoSpectro App, which allows the recording of light and spectra, developed for Android and iOS licensed by Alphanov, directly quantifies the concentration recorded by the sensor using a fiber optic miniaturised spectrophotometer attached to a smartphone.
Results: The results obtained from the use of these two Apps for the estimation of ammonia with the NH_3ControlFarm have been satisfactory, achieving a direct response of the analyte concentration in a simple measurement way.
Conclusion: In both Apps, data can be easily saved and sent via a wireless network connection. In summary, these two smartphone Apps, which have been developed by the MINTOTA group, store and transfer these measurements allowing a fast, cost-effective and environmentally friendly estimation of ammonia levels with the NH_3ControlFarm sensor with the use of portable devices such as smartphones for in-situ analysis.

P2.2.056

Comparison of Changes in Antioxidant properties of Sea algae according to Different extraction technologies

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Aim: The aim of this study was to investigate changes in antioxidant properties of sea algae according to different extraction techniques which were ethanol extraction (conventional extraction), microwave assisted extraction (MAE, green extraction), and combined microwave and ultrasound assisted extraction (MAE+UAE, combined green extraction).

Method: 5 types of sea algae were used for the sample: green (Maesaengi), brown (Gompi, Daehwang, and Mojaban), and red algae (Laver). Mixing 20 g and 10 g of each sea algae and 300 mL and 150 mL of ethanol for the ethanol extraction and MAE under the optimum expraction condition obtained from previous studies, respectively. MAE+UAE was extracted under the optimum UAE condition after MAE extraction with the optimum MAE condition for each sea algae obtained in the previous study. After the extraction, the each extract was filtered and concentrated at 40℃ using the rotary evaporator. Then, DPPH radical scavenging activity and total phenolic content of the each extract were conducted to compared the antioxidant properties of sea algae according to the different extraction tehcnologies.

Results: DPPH (%) and TPC (mg/g) of ethanol extraction of Maesaengi, Gompi, Daehwang, Mojaban, and Laver were 28.56%, 10.33%, 66.43%, 13.78%, and 22.63% and 40.48 mg/g, 20.45 mg/g, 221.14 mg/g, 25.10 mg/g, and 26.37 mg/g, respectively. DPPH (%) and TPC (mg/g) of MAE of Maesaengi, Gompi, Daehwang, Mojaban, and Laver were 36.45%, 20.78%, 91.01%, 58.46%, and 19.25% and 55.98 mg/g, 18.76 mg/g, 227.46 mg/g, 61.95 mg/g, and 31.80 mg/g, respectively. In MAE+UAE, DPPH (%) and TPC (mg/g) of Maesaengi, Gompi, Daehwang, Mojaban, and Laver were 40.39%, 15.10%, 82.84%, 27.90%, and 18.61% and 71.61 mg/g, 19.97 mg/g, 258.00 mg/g, 70.50 mg/g, and 59.26 mg/g, respectively.

Conclusion: Antioxidant activities of most sea algae extract obtained from MAE+UAE were superior to these of the conventional extraction. Based on the result, MAE+UAE for sea algae would be the most useful extraction technology to improve antioxidant properties of sea algae.

P2.2.057

Towards Autonomous Bioprocess Control: Exploring Absorption Spectra as Observable Bioprocess States for Better State-Responsive Control

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Aim:
Rapid and reliable determination of the process state is a crucial requirement for any type of process control. However, the distinct state of a bioprocess is not observable in its entirety, as it contains the composition and metabolic state of all microorganisms involved. We want to demonstrate the use of online absorption spectroscopy to approximate the process state of *A. platensis* cultures. The cyanobacterium is a source of high-value products such as the blue pigment phycocyanine.

Method:
We sampled cultures of *A. platensis* throughout the cultivation time and in various stress scenarios to obtain a broad variety of spectra representing different process states. The spectra were measured using a warm white LED light source (400-750 nm), a transmission dip probe, and a fiber-coupled process spectrometer. The measurement setup can be used either as an online or as an offline tool for process monitoring.
The resulting spectra were processed and evaluated for their ability to serve as observable approximators for the process state. Independent Component Analysis (ICA) was applied to identify and isolate relevant components of the spectral data that contribute to a meaningful state space.

Results:
Our measurements and analysis show that online absorption spectroscopy is suitable for rapid process state estimation. The process states can be visualized and interpreted in terms of their similarity to each other and – when applied in the context of online monitoring – provide insight into the progress of the bioprocess in question.

Conclusion:
Although developed exclusively with *A. platensis*, the authors are confident that the proposed state-space approximation method is not limited to a specific organism. The method is suitable for monitoring various bioprocesses, provided that suitable training data is collected and that the absorption properties change in the observed wavelength range.
Online Absorption Spectroscopy is a method that allows rapid observation of the state of a bioprocess. This is an essential requirement for the application of advanced process control methods (such as reinforcement learning based control strategies), and it enables the autonomous adjustment of process variables in response to changes in the observed process state.

P2.2.058

Valorization of Wheat Bran

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Background and objective: The growing population worldwide and an increasing trend of veganism have instilled the need to replace animal protein with plant-based alternatives. By-products of the agricultural industries are a good source of nutrition and are often used as cattle feed or regarded as waste. Upgrading the feedstock from feed to food is a good strategy to increase the amount of plant-based protein for human consumption. Wheat bran, as an example of such a waste stream, accounts for 23-27% of the by-products produced from the wheat milling process and is a rich source of protein (14-16%). The bioaccessibility of the protein can be increased by subjecting the bran to refinery strategies such as mechanical, thermal, and enzymatic treatment or in combinations. The current study focuses on the extraction of proteins from wheat bran and analyzing its functional properties such as emulsification, foaming, solubility, water & fat-holding capacity.

Method and Findings: The bran proteins were sequentially extracted based on their solubility in in different solvents, resulting in three fractions: albumin, globulin, and glutelin with a total extraction yield of 20%. Among the fractions, glutelin exhibited a higher emulsion activity and stability index in comparison with egg yolk. Additionally, combined fractions of albumin and glutelin resulted in a higher emulsion stability index. At pH 5, the foaming capacity of glutelin was comparable with the egg white, while the foaming stability marginally differed. Further, the fat-holding capacity of albumin was significantly greater than egg yolk and egg white. In contrast, all three fractions accounted for a notably lower water holding capacity.

Conclusion: The protein fractions, albumin and glutelin have good functional properties in food application. Further, validating the nutritional profiles and anti-oxidant potential will increase their use in the food industry specifically in bakery and condiment products. Further studies need to be performed to increase the protein extraction yield.

P2.2.059

PHYSICO-CHEMICAL, TECHNOLOGICAL AND MICROBIOLOGICAL CHARACTERISATION OF YOGURTS ENRICHED WITH DATE PASTE (CONFITERA cv).

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Aim: The aim of this work was to analyse the effect of the addition of date paste from date coproducts (Confitera cv.) on some physico-chemical, technological and microbiological properties of yogurts.

Method: Date paste (DP) was obtained from coproducts of date fruits (Confitera cv.) at the routab ripening stage. Yogurts were prepared from UHT commercial whole cow's milk. Five formulations of yogurts were made: 0%, 2%, 4%, 6%, 8% of DP. The corresponding DP was previously mixed with the milk and heated to 43ºC, then, the yogurt starter culture (YO-MIX 495LYO) was added. Yogurts were placed in 150 mL polyethylene flask and the fermentation process was conducted at 42±2ºC, until pH 4.6 was reached. Then, samples were stored at 5±1ºC for 24 h. Physicochemical parameters (pH, color CIELab*, acidity and texture), syneresis (after 7 days of refrigerated storage) and microbiological counts (Lactic Acid bacteria: *Lactobacillus spp* & *Streptococcus spp*) were assessed in triplicate.

Results: The addition of DP did not impaired the coagulation process of yogurts reaching the final pH in 5 ½ h, except for yogurts with 8% DP that reached this pH one hour earlier, which could be related to the high sugar content in the DP. Textural properties (firmness, consistency, cohesiveness and viscosity index) were not influenced by DP addition ($p>0.05$). Neither the control nor the yogurt with DP added showed syneresis during storage (7 days). *Streptococcus spp* growth was not affected by the addition of DP ($1.4x10^9$ CFU/mL) while the growth of *Lactobacillus spp* was improved ($1.1\text{-}1.3x10^9$ CFU/mL in DP added yogurts *vs* $8.6x10^8$ CFU/mL in control). The addition of DP resulted in darker yogurts (from 4% DP), with lower whiteness index (from 6% DP) and hue than control.

Conclusion: The use of date coproducts for the enrichment of yogurts is technologically feasible without adversely affecting the coagulation process. The addition of date paste in yogurts enables to obtain products with physicochemical/technological properties and viable microorganisms counts similar to those of regular yogurts (depending on the concentration of date paste added).

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P2.2.060

Fine-tuning of Solid-state fermentation with Pleurotus Ostreatus in Fava beans: nutritional and antioxidant changes

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Aim: The objective of this study was to set up the Solid-State Fermentation with *P. ostreatus* in fava beans at lab scale in order to evaluate the induced changes in terms of nutritional value and antioxidant properties.

Method: Solid-state fermentation was carried out by placing 50 g of partially disrupted fava beans in a plastic recipient. Soaking time and particle size were previously studied to establish the best conditions for fungus growth. The substrates were inoculated into the plastic recipient by adding different amounts of fungus broth and incubated at 25°C for 10 days. The biomass increase was assessed during 10 days. Afterward, changes in the nutritional value (protein, fat, ashes, and carbohydrates) together with antioxidant properties (DPPH and total phenolic content) were determined.

Results: Soaking time was crucial for the level of P. ostreatus growth. Comparative analysis of the soaking duration effect on the final moisture content of fava beans sample was done (8, 16, and 24 h) before inoculation. Based on the obtained results, the 16 h soaking with final moisture of 66 % was selected. The breaking process was also studied to obtain a proper size for the most effective fungus growth. After 10 days of fermentation, the biomass content increased significantly compared with the initial sample. The fermentation process affects the fava beans' protein content compared with the control. Differences attributed to the fermentation process in the antioxidant and phenolic content are being studied and discussed.

Conclusion: The optimal parameters for fermenting fava beans with *P. ostreatus* were: soaking the beans for 16 h at 25 ºC, followed by sterilization for 20 min at 121 ºC. Subsequently, cooling to room temperature and inoculating with a fungus broth to substrate ratio of 1:10 and left for 10 days of incubation at 25°C. From the experimental data, it is shown that the use of P. ostreatus affects the nutritional value and antioxidant properties of fava beans.

P2.2.061

Online monitoring of the coffees roasting process and quantification of antioxidant activity using spectroscopy

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Abstract

Aim: Roasting is a significant step in coffee processing where green coffee beans undergo marked chemical, physical, structural, and sensorial transformations due to multiple chemical reactions. This work proposes the use of spectroscopy (near-infrared and fluorescence spectroscopy) and chemometrics for the online monitoring of the coffees roasting process and quantification of antioxidant activity (DPPH and ABTS).

Method: The coffee samples were roasted at 240 °C for different times that is; 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, and 29 minutes. Four chemometric approaches were applied to the NIR spectra: principal component analysis (PCA), multi-linear regression (MLR), k-nearest neighbor regression (KNNR), and partial least squares regression (PLSR).

Results: PCA analysis plots showed a clear separation of the samples, indicating possible differences in the chemical composition among them resulting from the roasting process. The MLR models for DPPH and ABTS assays yielded R^2 values above 0.9, indicative of good predictive ability in practical applications. For the fluorescence spectroscopy, the intensities of the peak observed at excitation/emission of 370 nm/450 nm increased as the time of roasting increased. Overall, the obtained results were satisfactory and promising.

Conclusion: Therefore, the methodologies developed may offer valuable analytical tools for the prediction of antioxidant activity in roasted coffee samples as well as monitoring of the coffees roasting process.

P2.2.062

Impoving Bioaccessibility of Polyphenolic Compounds in Goldenberry-Purple Passion Fruit Blend through Electrospray-assisted Ionic Gelation

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Polyphenolic compounds are substances found in fruits that can prevent oxidation and help prevent non-communicable diseases. However, for these compounds to be effective in the human body, they must be bioaccessible. One of the most promising methods to achieve bioaccessibility is encapsulation through ionic gelation. Despite its numerous advantages, the technique's main drawback is the large particle size achieved under normal operating conditions. **Aim:** Optimize the electrospray-assisted ionic gelation process to achieve smaller particle sizes and improve the bioaccessibility of polyphenolics from a goldenberry and purple passion fruit blend. **Methods:** A central composite design and response surface methodology were used for process optimization; the effects of the flow rate (11.08-27.2mL/min), needle height with respect to the gelling solution (15-25cm), and voltage (10-25kV) on the particle size (PZ)(μm), sphericity (ES), aspect ratio (AR), and process yield (PY)(%) were evaluated. I*n vitro* gastrointestinal digestion was performed to assess the bioaccessibility of the blend's free and encapsulated polyphenolics. **Results:** The ANOVA revealed that flow and needle height had a statistically significant effect on PZ and needle height and voltage on PY (*p-value*<0.05). The response surface indicated that increasing needle height reduced PZ, and decreasing flow increased PY; all three factors had a statistically significant effect on ES, for AR only flow and height had a significant effect, (*p-value*<0.05). The combination of factors that minimize PZ and maximize PY, ES, and AR (desirability=0.87) is flow rate of 4.33mL/min, needle height of 11.59cm, and voltage of 12.56kV. The the bioaccessibility of phenolic compounds from goldenberry and purple passion fruit blend was 3.95±0.88%, while its encapsulated form showed a bioaccessibility of 48.82±5.22%. **Conclusion:** The factors evaluated in the experimental design have a statistically significant effect on the response variables, the electrospray-assisted ionic gelation process could be optimized to achieve a PZ of 929.51 ± 374.48 μm., the results revealed that the bioaccessibility of polyphenolics was significantly improved by encapsulation, with a 12-fold increase observed in the capsules compared to the free form. and suggest that the electrospray-assisted ionic gelation could be a promising technique for enhancing the bioaccessibility of polyphenolic compounds in various food applications.

P2.2.063

Self-assembled green tea polyphenol palmitate in oil as potential multifunctional food additive

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Aim: Green tea polyphenols are widely known for their numerous health-promoting activities, including antimicrobial, anti-viral, anti-fungal, anti-inflammatory, anti-carcinogenic properties. Covalent liphophilisation with fatty acids has been recently explored as novel strategy to enhance their stability in physiological environment and bioavailability. These molecules have been recognized by the FDA as GRAS for the use as novel antioxidant under its intended conditions of use. However, despite extensive research on its biological properties, there is little information regarding their structure, organization, and properties in oil phase. Therefore, this study aims to explore the molecular organization of green tea polyphenol palmitate (PP) in oil including its self-assembly which directly affect the oil properties.
Method: PP at various concentration was dissolved in liquid oil while the structural organization on molecular level was analysed by transmission electrom microscopy and small-angle X-ray and the crytical micelle concentration (CMC) was determined using viscosity analysis. Additional perspective was gained by analysing the effect of PP organization on the oil properties using rheology and thermal analysis.
Results: Structural analysis revealed the formation of micelle structures with diameter of 2-5 nm, which upon concentration increase form elongated structures that can be referred to planar layered structure or interconnected micelle structure. Viscosity measurements determined CMC of 23.6 wt.% PP that can be related to a second CMC of sphere-to-rod transition. Frequency sweep test suggested the formation of larger PP aggregate network with increasing PP concentration. Additionaly, temperature depended rheology test confirm the solidification and melting of a network as a result of cooling and heating, respectively. The solidification transition temperature shifted to a higher value as PP fraction increased. Combination of PP in oil gel system showed significant increase in hardness and increase of ~20 ◦C in the sol-gel transition temperature upon addition of 1wt.% PP to ethyl-cellulose (EC) oleogels, suggesting possible PP-EC interactions.
Conclusions: The results of this study suggest that PP self-assmble into nano-micelles changing the physicochemical properties of the oil and affecting the gelation and final properties of EC oleogels. The results imply on PP potential use not only as antioxidant but also as multifunctional food additive.

P2.2.064

UV-A Laser Irradiation for Reduction of Campylobacter jejuni on Chicken Meat.

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Aim: Food contamination is a major global burden with *Campylobacter spp.* being the most common cause of human foodborne bacterial diseases in the EU. Although decontamination through ultraviolet light (UV) has long been in use for applications such as drinking water, air flows and surfaces with benefits such as the absence of chemicals, it has not been an established method for the decontamination of meat products. Commonly UV-C is used for decontamination appliances but its efficency is strongly reduced on meat surfaces. In this study, the aim was to evaluate the effectiveness of UV-A treatment for reducing *Campylobacter spp*. on chicken breast fillets.
Method: Chicken breast fillets were spray inoculated with *Campylobacter jejuni* (*C. jejuni*) PT 14 (10^8 CFU per sample) on the upper side and then irradiated by placing them underneath a scanner (Elephant, Novanta Europe GmbH, Wackersdorf, Germany) which directs the laser beam (343 nm; Laser TruMicro 8320; TRUMPF SE + Co. KG, Ditzingen, Germany) over the sample with an irradiation time of 286 s per piece with varied input beam power ranging from 6 W to 100 W. Followed by an incubation time for 48 hours at 42°C after recovering C. jejuni by washing the samples with 30 ml Maximum Recovery Diluent (MRD) and a ten-fold dilution series.
Results: Meat samples were subjected to a radiant exposure of 2.9 J/cm², 10.7 J/cm², 26.2 J/cm² und 43.3 J/cm². A log reduction as high as 2.5 log CFU/piece could be achieved with the highest radiant exposure, but with slight visible marks of denaturation on the meat surface, whereas a radiant exposure of 26.3 J/cm² could achieve a reduction of 2.1 log CFU/piece without any visible traces on the meat surface.
Conclusion: UV-A laser irradiation shows a significant germicidal effect both in vitro and on chicken breast fillets. Being a contactless, non-thermal process, UV-A laser irradiation could be an interesting option for meat decontamination.

P2.2.065

Microbiological challenges for plant-based foods and tool development to assess these hazards

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Aim:
Globally, the market for plant-based dairy and meat alternatives is growing. There is a growing awareness that microbiological challenges for plant-based products can be different from those of animal protein-based counterparts. Hazard identification and risk assessment tools specific for plant based products will aid in identifying potential microbiological risks. This contribution will discuss the microbiological challenges and tools in development at Wageningen UR to aid in design of safe and stable plant-based foods.

Method:
A hazard identification tool was developed to create a hazard profile for plant-based formulations. Information about the type of hazard and expected levels in the product ingredients was retrieved from an in-house developed ingredient-hazard database. Insights on microbial contaminants of plant-based ingredients and their heat inactivation rates were collected from metadata analysis in scientific literature. This data together with processing and storage conditions and microbial growth models were used to identify the most likely hazards for different recipes. This was done by using the FSO/PO (Food Safety Objective/Performance Objective) approach defined by ICMSF. Sensitivity analysis was performed to identify the most critical factors in assessing the risk.

Results:
This contribution will discuss an approach used by Wageningen UR for plant-based burgers as a case study. Heat treatment typical for plant-based burgers will inactivate vegetative pathogens, hence microbial spores are most important contaminats to control. However, after heat treatment*, Listeria monocytogenes* is an important re-contaminant to consider. Predictive models can be used to estimate in advance the risk of outgrowth of *L. monocytogenes.* It is important that these models are validated in a relevant product matrix. Many of the open-source models used, such as Food Safety and Spoilage Predictor (FSSP) and Combase, have not been validated for plant-based products. This contribution will also discuss the activities on validation of model predictions for plant based products in progress.

Conclusion:
New plant-based alternatives for meat products pose novel challenges for product quality and shelf life. Tool to asses microbiological hazards can aid in the development of safe and stable plant-based products already early in product development and shorten time from idea to market.

P2.2.068

Strategies to reduce sodium levels in canned fish products

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Aim: Excessive sodium (Na) intake has been linked to raised blood pressure and also with other health disabilities. Thus, the partial replacement of sodium chloride (NaCl) by other salts (such as potassium chloride, KCl) has been suggested as good strategy (in terms of functional and microbiological properties) to reduce Na in processed foods. However, the use of higher levels of KCl is mainly limited by its bitter taste. Since there is a growing demand towards "ready-to-eat" processed fish products, recognised as being potential contributors to consumers` high Na intake, this study aimed to (i) assess the effect of NaCl partial molar replacement on physicochemical and sensory properties of canned Atlantic horse mackerel (*Trachurus trachurus*) (an abundant species in Atlantic Ocean) prepared with olive oil and stored in different conditions and (ii) evaluate its stability and sterility after approximately one month of storage. **Method:** To this end, fish were headed, gutted, washed, drained, steamed for 5 minutes, cooled and filleted. Cans were prepared with cooked fillets (65%), refined olive oil and 5 ml of light brine (salts: 14%). Three formulations of brine were prepared: 100% NaCl (control; 35 cans), 50% NaCl+50% KCl (35 cans), and 50% NaCl+50% encapsulated KCl (35 cans). Cans were hermetically sealed and properly sterilised by heat treatment (70 min/115-116 °C). After cooling, half of the cans was mantained at room temperature (≈20

°C) and the other was aged at 40 ºC. Afterwards, stability and sterility of cans were tested. The levels of moisture, ash, free fat, protein, total carbohydrates, energy value, salt, sodium, potassium and histamine were determined in the raw material (fish) and canned products (after the storage period). The nutritional contribution of canned fish in terms of Na and K was evaluated, considering an usual portion and the dietary reference values recommended by European Food Safety Authority. Instrumental colour and texture, pH and sensory attributes (e.g., typical flavour, salty flavour, bitterness, firmness, succulence, oiliness, colour) were assessed in the canned products. **Results and Conclusion:** Evaluation of the analytical data is being finalized, but it can be anticipated that the proposed strategies appear to be very promising for reducing Na contents.

P2.2.070

Appetite control based in the food originated aromas

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Aim:

Change of health and demographical structure of societies leads to establish an appetite as one of the crucial factors affecting humans well-being. Unfortunately, the numbers of overweight or obese individuals are constantly growing and had reached in 2016 approximately 1.9 billion (38% of worldwide population) and 650 million (13% of worldwide population), respectively. In contrary, the number of elderly people (≥60 yo) in 2020 had reached 1.4 billion. Both this groups demonstrate considerable amounts of appetite disorders cases. Therefore, a study was designed to deeper explore the possible relations between the perception of food smell that enhances appetite or reduces appetite and the actual volatile constituents of the food. The focus of the survey was divided into two groups exhibiting appetite dysfunctions - (i) overweight or obese individuals and (ii) elderly people (≥60 years), and the collected survey results were used to indicate particular food products and meals subjected to their volatile profile investigation by chromatographical techniques.

Method:

On the of survey, carried out among elderly people and overweight and obese individuals, followed by chemical analyses (HS-SPME Arrow – GC/MS), we have identify the broad group of food originated volatiles with possible application in appetite control. The identified volatiles were used to design the formulations with potential to be used for appetite regulation, what was evaluated by the sensory panel. A group o six formulations, both for stimulation and reduction of appetite was chosen for further investigations with the presence of consumers. Also, the long term stability of chosen formulations, during shelf storage was evaluated.

Results:

On the basis of survey two groups of food products aromas were identified with appetite reducing or appetite stimulation potential. Nontheless, within particular groups, food products were diversivied and no clear pattern was observed. In the next step, the indicated food products were subjected to volatiles chemical analysis by HS-SPME-GC-MS technique. It resulted with volatile profiles consistent for products with appetite reducing potential and those with appetite stimulating potential. The main compounds for appetite reduction were: isoamyl acetate, α-terpineol, linalool, β-pinene, camphor, carvone, 2-acetylfuran and linear aldehydes or alcohols, whilke the main compounds for appetite stimulation were: organic acids (C6, C8 and C9), linear aldehydes (C7, C7, C10, C12), limonene, furfural, alpha-pinene, benzaldehyde, and 6-methyl-5-hepten-2-one.

Conclusion:

Despite the various survey answers within the food products aromas grops (one for appetite stimulation and one for appetite reduction) on chemical level the particular groups were constisten. Based on that knowledge, it will be possible to try use the particular volatiles for natural and gentle appetite regulation without a delivery of xenobiotics to humans organisms.

P2.2.071

Effects of sunflower seed flour in pasta on glycemic responses, blood pressure and subjective satiety

<u>Dr Aimilia Papakonstantinou</u>[1], Mrs Foteini Lympaki[1], Mrs Christina Birlia[1], Dr Varvara Andreou[2], Dr Sofia Chanioti[2], Dr Marianna Giannoglou[2], Dr George Katsaros[2]
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Aim: This study aimed to determine the glycemic index (GI) of four varieties of sunflower seed flour pasta (SFP) differing in protein and fiber content, compared to regular semolina pasta. Their effects on glycemic variability (GV), 24h mean glucose levels and target ranges using real-time continuous glucose monitoring (rtCGM) was also assessed.

Methods: In a randomized controlled, crossover design, 16 healthy participants (23±1y; fourteen women; BMI 22±1kg/m^2), were randomly assigned to receive 4 SFP meals (Fusilli16; Penne16; Tagliatelle16; Tagliatelle5), Tagliatelle-control, all containing 50g available carbohydrates, and 50g glucose as a reference drink. GI, GV, 24h mean glucose levels, and target ranges were measured.

Results: Fusilli16 and Tagliatelle5 provided low GI values (55 on glucose scale) and Tagliatelle-control, Penne16, Tagliatelle16 provided medium GI values (65, 64, and 63, respectively, on glucose scale). All five pasta types provided lower peak glucose values compared to glucose. No differences were observed between pasta types for fasting glucose. All SFP were pleasurable and increased satiety.

Conclusion: All SFP, regardless of soluble fiber and/or protein content, attenuated postprandial glycemic response, which may offer advantages to glycemic control.

P2.2.072

Effect of Saururus chinensis (Lour.) Baill extract on anti-inflammatory and anti-atopic dermatitis

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Aim:

The aim of this study is to investigate the anti-inflammatory and anti-atopic dermatitis effects of *Saururus chinensis* (Lour.) Baill extract.

Method:

Saururus chinensis (Lour.) Baill extract (SE) extract was prepared by sonication with 70% ethanol and analyzed for oxygen radical antioxidant capacity (ORAC assay), MTT assay, production of NO LPS treated Raw 264.7 cells, atopic dermatitis 3D skin model (HaCaT treated with TNF-α/IFN-γ), western blot(p38 MAPK, NF-κB pathway), and RT-PCR.

Results:

SE showed an oxygen radical antioxidant capacity (ORAC) of 3753325.6 mM TE/100g d.w.b. When Raw 264.7 cells were treated at 1mg/mL, cell viability was 91.3%, and NO production was 31.7μM in the control group, but decreased to 3.87μM. In HaCaT cells, SE reduced p38 MAPK and NF-κB pathway activity and the pro-inflammatory cytokines interleukin-8 (IL-8) and interleukin-6 (IL-6) and induced the expression of the Th2 chemokines TARC after treatment with TNF-α/IFN-γ.

Conclusion:
SE inhibits the production of pro-inflammatory cytokines and may be an effective anti-inflammatory agent for the treatment of atopic dermatitis.

P2.2.073

Breaking Bread: How Plantago Seeds and Husk Power up Gluten-Free Dough

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Aim:
The aim of this study was to investigate the effect of different *Plantago* products, including *Plantago psyllium* seeds and *Plantago ovata* seeds and husk, on the rheological profile of gluten-free dough and bread, as well as on bread quality and shelf-life.

Method:
Different *Plantago* products were added to the dough at a share of 3%, 6%, and 9%.The rheological parameters of the dough were evaluated using Mixolab protocols and uniaxial deformation test. Bread quality and textural profile analysis after cooling and storage were determined.

Results:
The addition of *Plantago psyllium* seeds weakened the dough, while all additives contributed to a reduction in starch retrogradation, bread hardness, and water loss during baking. Moreover, they improved the doughs' resistance to extension, dough energy, and bread yield. The positive influence of the *Plantago* products on bread quality was strongest when *Plantago ovata* husk was used. However, the consumer acceptance of the tested breads was low, with breads containing the seeds of both *Plantago psyllium* and ovata being rated better than those with husk.

Conclusion:
Plantago psyllium and *ovata* products have the potential to improve the quality and shelf-life of gluten-free bread, with *Plantago ovata* husk showing the strongest positive influence. However, consumer acceptance of the bread was low, indicating a need for further optimization to improve sensory properties. This study provides useful information for the development of functional gluten-free bread products that could benefit from the use of *Plantago* products as an ingredient.

P2.2.074

Production of gluten-free functional cake enriched with broccoli by-products

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Aim: The aim of this study was to use a by-product of the broccoli food industry for the production of a gluten-free functional bakery food (cake) as a source of dietary fibre, covering the deficiencies in fibre of commercial gluten-free foods especially for patients coeliacs. For this purpose, we have carried out a treatment with lignocellulosic enzymes to the by-product with which we intended to favor the conversion of insoluble dietary fiber into soluble dietary fiber, providing greater nutritional benefits to the consumer of gluten-free products.

Method: The broccoli by-product was subjected to three types of enzyme treatments: celluclast, vyscozyme and pectinex. Of these, only one type of enzyme (Viscozyme) was used to make two gluten-free cakes with different concentrations of broccoli extract according to fibre source and rich in fibre, comparing them with two cakes under the same conditions with the extract without treatment and with a control cake without extract. Each of the cakes was analysed for proximate composition, physico-chemical analysis and sensory analysis.
Results: The enzyme selected to carry out the treatment was Novozymes Viscozyme L, because it is the one that presents the greatest increase in the percentage of soluble dietary fiber with respect to total fiber compared to the others enzymes,

converting 0.28% present in the untreated by-product to 20.42%. A complete nutritional analysis was carried out on all the biscuits, differentiating between soluble and insoluble fiber, thus verifying the effect of the treated by-product. As expected, a much higher percentage of soluble dietary fiber was achieved in the fiber-rich sponge cake with enzymatically treated extract, reaching 15.93%, a high value compared to 4.40% in the control sponge cake. Finally, a sensory analysis was also carried out in which, although acceptability was not high, 60% of tasters stated that they would buy the product instead of its less healthy version.
Conclusion: Therefore, the incorporation of the food industry by-product broccoli (enzymatically treated) in the production of functional gluten-free biscuits rich in fibre is a novel and effective strategy in the nutritional improvement of gluten-free bakery products. gluten-free bakery products.

P2.2.075

Dynamic migration characteristics of K+ and Na+ during soy protein fractionation process

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Aim:
Currently, plant-based protein foods have been revealed to contain all the required nutrients to replace animal-based products. However, particular attention should be paid to the micronutrients of plant-based protein foods as these are mostly not emphasized by the manufacturers unless they are explicitly reduced or fortified.
Soybean is generally known as a high-potassium (K) low-sodium (Na) food with approximately 1500 mg K and 10 mg Na per 100 g before soy fractionation. While after the fractionation process, only 88 mg/100 g K was left in the soy protein isolate (SPI), and the Na content reached to about 1000 mg/100 g. High Na consumption and insufficient K intake contribute to high blood pressure and increase the risk of stroke and heart disease. Thus, the objective of this study was to understand the dynamic migration of K^+ and Na^+ during soy protein fractionation process, aiming to produce SPI with reduced Na content and simultaneously enriched K content.

Method:
Full-fat soy flour (FFSF) was used as the starting material, and SPI was obtained via traditionally wet fractionation process. Different combinations of NaOH and KOH solutions were applied on the protein solubilisation step and protein neutralization step to produce SPI with varied Na and K contents. Besides, the soy protein fractions were collected after each single step, analyzed and compared with their compositions and functionalities.

Results:
During the traditional wet fractionation of soy protein, the initial K+ in the FFSF lost mainly on the protein solubilisation step, while the Na+ enrichment of SPI happened on the protein neutralization step, resulting from the application of NaOH. The use of KOH during the fractionation process can improve the protein content of SPI and their thermal stability of 11S protein; whereas the protein extraction efficiency of SPI and protein solubility were dropped.

Conclusion:
The application of KOH as the alternative of NaOH on the protein neutralization step could produce the low-Na high-K SPI without significantly influencing its yield and functionalities. The developed methodology is potentially relevant to the applications of other plant materials, such as pea, fababean, and mung bean.

P2.2.076

Improving fish oil microcapsules characteristics by using combinations of caseinate and transglutaminase as wall material.

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Aim:
Omega-3 polyunsaturated fatty acids (ω -3 PUFA), mainly eicosapentaenoic and docosahexaenoic acids (EPA and DHA, respectively) have numerous health benefits, but the consumption of their main sources (fish and derivatives) is not enough to achieve recommended intakes. Because of this, adding these sources of EPA and DHA (fish oil) to food products is commonly performed. The addition of fish oil, both direct and in the form of an emulsion, poses important problems, both in terms of oxidation and the detection of unpleasant odors and flavors. For this reason, the microencapsulation of w-3

PUFA-rich fish oil is presented as an alternative to these problems. The main objective of this work was to evaluate the use of caseinate (Cas) and the enzyme transglutaminase (TGase), as wall materials for the microencapsulation of fish oil.

Method:

Cas and Cas+TGase fish oil emulsion were first prepared applying high-pressure homogenization. Then, the emulsions were spray-dried to obtain Cas and Cas+TGase microcapsules. Emulsions were analysed by means of creaming index, pH, viscosity, density and optic microscopy. Yield, moisture, water activity, instrumental color, density, solubility, efficiency, lipid oxidation, fatty acid profile, size and morphology were determined in the microcapsules.

Results:

The results obtained have shown that the use of both Cas and Cas+TGase as wall materials for the elaboration of fish oil microcapsules allows obtaining adequate quality characteristics both in the emulsions and in the microcapsules, improving, in comparison with prior studies, yield, microencapsulation efficiency, amount of EPA and DHA, oxidative stability, density and solubility in microcapsules. On top of that, the addition of TGase manages to improve the efficiency of microencapsulation, with values around 90%, as well as the tapping density, a parameter related to the packaging, transport and marketing of microcapsules.

Conclusion:

The production of fish oil microcapsules by spray-drying, using high pressure as a homogenization technique and a combination of Cas and TGase as wall materials, could be proposed as a strategy to obtain ω-3 fatty acid vehicles to enrich foods.

P2.2.077

Assessing quinoa leaves (Chenopodium quinoa) as a source of proteins with potential functional properties

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Aim:

The ongoing transition towards a more plant-based diet drives the need for developing new protein sources for a more sustainable healthy diet. In this context, RuBisCO is proposed as a promising protein with good nutritional value and functional properties. RuBisCO is an enzyme involved in the photosynthesis, common in different green leaves, and it is regarded as the most abundant protein on Earth [1]. The aim of this work was to assess four different species of quinoa leaves (two grown in Ireland and two in Chile) as a source of RuBisCO, and to characterize the nutritional value and functional properties of the protein extracts obtained from them.

Method:

Quinoa leaves were harvested, dried and milled until further use. For the extraction of the soluble proteins, the preserved quinoa leaves were suspended in water, and subsequently centrifuged to remove insoluble cells and debris. The soluble proteins were precipitated at pH 4 (close to the isoelectric point of RuBisCo) and freeze-dried to obain a protein concentrate powder. The protein extracts obtained from the different quinoa leaves were characterized in terms of proximal analysis, detailed protein composition, and nutritional value.

Results:

The protein extracts presented protein contents between 52.2 ± 0.3 and 63.3 ± 2.0 % w/w (on dry basis) and extraction yields between 1.0 ± 0.2 and 3.5 ± 0.6 % w/w (g protein extract/ 100 g of quinoa leaf powder). RuBisCO was identified by Matrix-assisted laser desorption/ionization-time of flight (MALDI-TOF). The amino acid profile covered the recommedations for all essential amino acids from the FAO [2]. The protein extracts presented unique solubility profiles largely affected by the isoelectric point of RuBisCO and showed promising functional properties for food application.

Conclusion:

The significant differences between the extracts from different quinoa species were observed in the micronutrient fraction which affected the solubility and functional properties. Quinoa leaves showed potential as a source of proteins with promising functional properties for food applications. Further research should focus on understanding the impact of growing and harvesting conditions on the extraction yield and protein characteristics.

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P2.2.079

Novel foods produced by precision fermentation – What matters for the safety assessment by EFSA?

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Novel foods produced by precision fermentation – What matters for the safety assessment by EFSA?

Aim:
Recent advances in biotechnology and fermentation technology have enabled the tailoring of food ingredients via precision fermentation (PF). In absence of a legal definition, PF refers to the use of engineered microbial cell factories in the production of food ingredients. In the European Union, food ingredients derived from PF require premarket authorisation under different regulatory frameworks (e.g., novel foods) involving EFSA's (European Food Safety Authority) scientific advise on their safety.
Method:
Published EFSA scientific outputs and ongoing applications were retrieved from the Open EFSA portal in order to identify NF produced by PF and scientific criteria for their risk assessment. Furthermore, this work will ouline the main outcomes of the 27th EFSA's Scientific Colloquium in relation to emerging safety and methodological aspects associated to PF and their impact on EFSA's risk assessment.
Results:
Authorised NF produced by PF include, e.g., human-identical milk oligosaccharides (HiMOs) such as 2'-fucosyllactose, 6'-sialyllactose or lacto-N-tetraose. Up to now, 15 scientific opinions on the safety of PF-derived HiMOs as NF have been adopted by EFSA. Key scientific requirements for the safety assessment of such products include: i) chemical/structural equivalence to native counterparts; ii) characterisation of the production strain (taxonomic identification; genetic modification; antimicrobial resistance; toxigenicity and pathogenicity), including the absence of viable cells and DNA in the NF; (iii) comparison of the anticipated intake of the NF under the intended conditions of use with the natural dietary intake; (iv) tiered ADME/toxicity testing approach. Additional considerations for the RA of PF-derived proteins as NF include protein quality, allergenicity and characterisation of potential residual proteins from the production strain. Moreover, the 27th EFSA's Scientific Colloquium outlined knowledge/methodology gaps and development needs for the safety assessment of food ingredients derived from PF.
Conclusion:
This work is expected to raise awareness on key scientific requirements for the risk assessment of NF produced via PF. Moreover, it is essential that EFSA's risk assessment methodologies and expertise keep abreast of the latest scientific developments, to better address fast-paced food innovation and consumer trends.

P2.2.081

Development of powder ingredient with prebiotic and antioxidant capacity from spray drying of Auricularia auricula-judae

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Mushrooms are foods appreciated since ancient times for their sensory attributes, nutritional, and medicinal properties. Interest in edible mushrooms has grown steadily, and they have been recognized as functional foods. The mushroom

Auricularia auricula-judae is a ligninolytic fungus containing biologically active compounds that report health benefits such as exopolysaccharides, polyphenols, ergosterol, flavonoids, and terpenoids. **Aim:** This research aimed to obtain a functional ingredient from the submerged culture of Auricularia auricula-judae, optimizing the spray drying process and incorporation of macromolecules that increase its functional potential. **Method:** Once the mycelial biomass of the fungus was obtained under optimal growth conditions in a bioreactor, a face-centered composite central factorial response surface design was applied to evaluate the effect of inlet temperature (150 -200°C), feed pump flow (15 -35%) and drying agent concentration (0 – 7% w/v) of the drying process on process performance. Finally, a proximal profile was performed, and the antioxidant capacity of the bioingredient and its prebiotic capacity were evaluated. **Results:** The factors found that maximize the drying performance and minimize the use of the drying agent were inlet temperature at 150 °C, feed pump flow at 15 %, and drying agent concentration at 2.57% w / v, reporting a yield of 72.41%. The characterization of the powder obtained under optimal drying conditions was 5.24%, 1.06%, 6.69%, 0.08%, 89.93%, and 375.2 Kcal/100 g sample for the parameters of moisture, ash, protein, total fat, total carbohydrates, and total calories, respectively. Regarding the antioxidant capacity, 1.02 ± 0.05, 8.64 ± 0.21, 0.71 ± 0.02, and 28.91 ± 0.13 µmol equivalent trolox/g samples were reported by the ABT, FARP, DPPH, and ORAC methods. **Conclusion:** In addition, the results demonstrated a prebiotic capacity on the part of the bio-ingredient, favoring the growth of probiotics and not that of pathogens. The results allow us to conclude that the spray drying method is optimal for obtaining powders from Auricularia auricula-judae without losing its antioxidant and prebiotic capacity.

P2.2.082

Effect of Plant Proteins on the Lipid Digestibility and Beta-Carotene Bioaccessibility of Oleogels

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Aim:
Oleogels are novel lipid structures that represent an alternative to animal fats and are also capable of encapsulating lipophilic bioactive compounds. Nevertheless, the influence of their incorporation into food matrices on their digestibility and the bioaccessibility of bioactive compounds remains unclear. This study investigates the impact of incorporating plant proteins on lipid digestibility of beta-carotene (βC)-enriched oleogels and the subsequent βC bioaccessibility.

Method:
βC-enriched corn oil (0.1% *w/w*) was used to formulate an oleogel using glyceryl stearate (GS) at 20% (*w/w*). The oleogel was prepared with and without a co-oleogelator, being lecithin (LEC) at 2.5% (*w/w*). Subsequently, the oleogels in the presence or absence of pea, wheat, or soy proteins (2.5% *w/w*) were subjected to a static *in vitro* digestion model. During the small intestinal phase, oleogel lipid digestibility was monitored with NaOH volume and subsequent free fatty acid (FFA) release with a pH-stat apparatus. Additionally, βC bioaccessibility was determined spectrophotometrically.

Results:
The presence of proteins, particularly pea and soy protein, significantly reduced oleogels lipid digestibility. Total FFA release at the end of the intestinal phase decreased in GS-oleogel from 80% to 44% (soy), 60% (wheat), and 38% (pea), and in GS-LEC-oleogel from 66% to 34% (soy), 45% (wheat), and 35% (pea). Wheat protein exhibited a lower oleogel lipid digestibility reduction, possibly due to their lower lipid-binding capacity. Additionally, proteins decreased βC bioaccessibility in GS-oleogels, with no significant differences among protein origins likely due to reduced lipid digestibility, which lowered the availability of released FFAs, leading to impaired or reduced mixed micelles. However, while LEC-containing oleogels exhibited lower βC bioaccessibility than GS-oleogels, proteins enhanced their βC bioaccessibility. This could be attributed to the specific interactions between proteins hydrolysates and LEC, potentially promoting the formation of mixed micelles being capable of accommodating and enhancing the βC bioaccessibility.

Conclusion:
The results of this study will shed light on the efficacy of utilization of oleogels with desired functionalities as fat replacers in foods containing plant proteins, to optimize nutrient absorption and utilization, leading to practical implications for the development of functional food products such as meat analogue with enhanced health benefits.

P2.2.083

Development of intelligent and predictive sensors for rapid wine quality monitoring

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[1]IATA

Aim:

The wine industry has undergone a significant revolution in recent years but still faces new challenges to improve the sector's competitiveness in different aspects. Among others, monitoring wine quality along the entire elaboration process - from the cultivation of the vine to the final product – is a complex task as some parameters are difficult to monitor or do not provide sufficient information on the quality of the product. In this aspect, the SENSWINE project proposes the development of intelligent and predictive sensors for the rapid monitoring of fermentative by-products (e.g. organic acids, aromas, ethanol) influencing wine quality during grape must fermentation, combining low-cost hardware sensors with predictive models of yeast metabolism.

Method:

In this work, we performed a set of laboratory-scale fermentations mimicking white wine elaboration with six strains of the genus Saccharomyces. We used a synthetic grape must incorporating thiols precursors, and a nitrogen addition (in organic or inorganic form) was performed at 1/3 of the fermentation time, as in the oenological industry. Across fermentations, cell population and extracellular metabolites such as sugars, organic acids, amino acids, major (e.g. fusel alcohols, ethyl esters and acetate esters) and complex (e.g. thiols) aroma compounds were analysed at seven sample points via distinct chromatographic techniques to evaluate the impact of the nitrogen addition on yeast metabolism and the global quality of wines. All these controlled variables are currently used to formulate a first approximation of predictive models at the laboratory scale, which will then be validated at the pilot plant scale before the sensor can be designed and integrated.

Results:

In general, the use of inorganic nitrogen supplementation reduced the fermentation time and differentially influenced the aromatic profile of wines compared to organic supplementation. Also, no significant differences were observed in the alcoholic content of wines between conditions and strains. Besides, all the fermentation data - over 10,000 measurements - are currently being used to develop the preliminary model.

Conclusion:

Inorganic nitrogen has a favourable influence on fermentation. To date, the first approximation of the model is still under development.

P2.2.084

Development of bioactive components using cocoa husk and their application in fortified smoothies

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The cocoa husk is the main waste produced during chocolate processing. Considering this industry's social and economic impact, in addition to the large amount of CBS produced, it has been selected as the main waste to be valorized in this work. The extracts obtained will be a natural alternative to some ingredients used in various food applications.

Aim: This work's main objective is to elaborate on new food products based on the revaluation of cocoa husk. This residue will be used to obtain high-added value compounds that will be used as new ingredients in reformulating functional foods rich in protein, fibre and antioxidants.

Method and Results: Microwave-based technology has been used to obtain the extracts from the cocoa husk, and the formulated products have been evaluated based on their antioxidant activity, stability, pH, protein content and shelf life. Using this technology to obtain extracts rich in bioactive compounds benefits the agri-food industry. It promotes a circular economy and generates a tremendous socioeconomic impact since a new ingredient with important nutritional characteristics is obtained from agri-food waste.

Conclusions: The results have shown that the new products obtained after revalorization have demonstrated their potential use in the elaboration of new 100% natural beverages since their antioxidant capacity and protein content are improved after adding 1% extract.

P2.2.085

Mathematical modelling of sensory texture attributes of bread formulations affected by inclusion of oat flour

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Aim: The present work evaluated the possibility of predicting the sensorial properties of 16 bread samples assessed by eight trained panellists using instrumental measurements

Method: Mechanically dry fractionated oat flour fractions (F), i.e., whole oat flour (F1), F2:<224µm, F3:250-280µm, F4:280-500µm, and F5:500-600µm were blended with white wheat flour at 10, 30, and 50% substitution levels for bread making. The blended flours, doughs, and bread samples were assessed for their structural characteristics. Results from the Mixolab, Rapid Visco Analyser, bread loaf volume characteristics, Texture Profile Analysis, and 2D crumb imaging were used for estimating the sensorial description produced by Quantitative Descriptive Analysis (QDA) QDA-based tests describing these different bread formulations. Partial Least Squares regression (PLSR) has been used for predicting and relating different instrumental results with a bread sample's sensory attributes that describe different relevant sensations of the oat bread texture profile.

Results: Regression results using different algorithms indicated that crumb texture attributes such as graininess, sickness, and denseness were better predicted compared with other attributes, and the correlation coefficient values for the test set were 0.64, 0.69, and 0.80, respectively. Feature reduction showed that some features were more influential on the performance of regression models than others, and such features include Dv90, peak viscosity, breakdown, final viscosity, setback, slice area, number of cells, and crumb hardness. These predictors could be used to predict the sensory attributes of different bread formulations.

Conclusion: This work provides the required knowledge in the research area of correlating sensory attributes with instrumental attributes; additionally, this research highlights the importance of calculating the relative weight of the components used in the formulation of food products and its impact on the sensory characteristics of the food product. Furthermore, it affirms that no single instrumental measure is capable of measuring different texture attributes with adequate precision.

P2.2.086

Upscaling of enzymatic hydrolysis of porcine haemoglobin from laboratory to pilot plant

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Aim:

With an increasing global demand for protein, there is a need for sustainable protein sources. Haemoglobin, or the red blood cell (RBC) fraction of blood, contains up to 35% protein and is such a potential source. In recent years, protein extraction from blood by enzymatic hydrolysis has been identified as an efficient method, recovering most of the protein while removing the unwanted haem iron. Numerous studies have been made on the enzymatic hydrolysis of RBC, however, the experiment scale is still limited to a small amount of RBC in the laboratory. The main objective of this project is to scale up and optimise the enzymatic hydrolysis of porcine haemoglobin from the laboratory method (<1 litre) to a pilot scale method (>500 litres) while securing microbial safety during processing and in the final product.

Method:

Stainless steel tanks with agitation and heating/cooling jackets along with pumps, hoses, plate heat exchanger and separation systems were used in the pilot plant upscaled process. All equipment was of food grade and sanitary quality. Porcine RBC fraction collected sanitarily from a slaughterhouse, cleaning processes and the hydrolysis process was tested for microbiological growth in laboratory. The hydrolysis was carried out using Alcalase 4.0 from Novozymes A/S, Denmark. Protein recovery, degree of hydrolysis, degree of decolouration, dry matter, size distribution and amino acid profile of the hydrolysates were measured and analysed. Process time, temperature, pH, and enzyme dosage were monitored throughout the process.

Results:

The current results showed that the hydrolysis process can be transferred from laboratory scale to pilot plant scale, using equipment that is comparable to the equipment used in the industry. Temperature and pH were easily controlled, including cooling and heating time during the process. First visual inspections of the hydrolysate showed a decolourized and clear product, indicating a successful hydrolysis. Chemical analyses of the hydrolysate are undertaken, and the results will be examined to further evaluate the upscaled process.

Conclusion:

A method for hydrolysis of RBC in an industrial scale has been successfully optimised. The results indicate that the RBC fraction from porcine haemoglobin can efficiently be hydrolysed in industrial scale.

P2.2.087

Examination of wheat starch and gluten as tools to tailor-modify the quality/nutrition of deep-fried foods

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Aim:

Deep-fat frying is a well-known cooking process across the world and deep-fried food products still remain a popular food category among consumers (Source: *Wall Street Journal*). Of the wide range of deep-fried food products produced, wheat flour-based foods constitute a large portion of this product category. Despite significant research into lowering the oil content of deep-fried foods while maintaining their desirable textural and organoleptic properties, it is still not well understood what contribution the main constituents of wheat flour– starch and gluten– have to the water loss and oil uptake dynamics of deep-fried wheat-based food matrices and how their physicochemical changes influence the microstructure formed during the frying process.

Methods:

The physical and chemical changes as a result of deep-frying were studied in both wheat starch-water and wheat gluten-water model systems in addition to doughs consisting of starch and gluten [containing 9, 12.5, and 16% gluten (dm)]. Utilizing both standard and novel, temperature-controlled time domain proton nuclear magnetic resonance (TD ^{1}H NMR) methods, the physical state of starch and gluten with respect to their mobility and interaction with water and/or oil was monitored after frying for various time intervals (0-180 s) and during frying (*in situ*), respectively. Size-exclusion high-performance liquid chromatography (SE-HPLC) was used to determine the changes to the gluten network due to the cross-linking of proteins. The microstructural changes related to product expansion and oil uptake/distribution were assessed by X-ray micro-computed tomography.

Results:

Model systems of starch-water and gluten-water showed structural expansion to be mainly dictated by the transitioning of polymers from the rubbery into glassy state as moisture content declined sufficiently. When sufficient product material had transitioned to the glassy state, the sample maintained its expanded structure due to frying-induced water evaporation. The gluten component was determined to influence expansion to a greater extent than the starch component. Changes in gluten network were mainly attributed to the altered non-covalent linkages between gluten polymers and the formation of cross-links between amino acid residues at higher temperatures.

Conclusion:

Starch and gluten constituents, and their respective ratio, have important consequences on microstructure development and mass transfer dynamics during deep-frying.

P2.2.088

Best practise in artisan food production – structuring the new product development process

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Abstract

Aim: New product development (NPD) is crucial for food companies to stay competitive. To increase the chance of success, careful planning of the process is essential, which is why various NPD process models have been developed. However, the literature on NPD models specifically tailored to the needs of food companies is limited, and to the authors knowledge there is no model that addresses the unique requirements of artisan food production. The purpose of this paper is to analyse the NPD process in general, on the level of food production and specialities in food craft to develop an NPD model for artisan food production.

Method: Based on literature review different structures to describe the NPD process in general, focused on food production and artisan food production are presented and compared. Two case studies gain a deeper understanding of the development process and identify specific requirements in food craft enterprises. Using this insight, a NPD model is developed specifically tailored to the needs of food craft enterprises.

Result: NPD process models in general are presented differently, but they share a common structure. Food craft enterprises have some peculiarities compared to industry. They have limited resources, but are characterized by customer proximity,

highly qualified employees and, depending on the size of the company, short communication channels and high flexibility. The specifics of these enterprises are considered in the development of an NPD process model presented in the study at hand.

Conclusion: Based on the literature review and the findings from two case studies, an NPD model for artisan food production has been developed that takes into account its special characteristics. Nevertheless, an NPD process model should always be considered dynamic and adapted to specific requirements of each enterprise individually. The model can serve as a framework for NPD in artisan food production and as a foundation for the development of other NPD process models for food craft enterprises. Further studies are required to validate the model in practice.

P2.2.089

EFSA's nutritional assessment of novel protein sources in the context of the novel food regulation

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Aim:
The use of novel proteins from new or underutilised sources has gained growing interest in recent years in order to meet the food demand from a growing world population, while calling for more sustainable and healthier food systems. In the European Union (EU), such products may require pre-market authorisation, involving EFSA's safety assessment, under different regulatory frameworks, such as the Novel Foods (NF) regulation. As part of its NF assessment, EFSA also assesses whether the consumption of the NF is not nutritionally disadvantageous for consumers compared to products already present in the European market.
The aim of this work is to provide an overview of key scientific requirements for the nutritional assessment of novel protein sources as NF, with a focus on protein quality.

Method:
Published EFSA scientific outputs and ongoing applications involving novel proteins as NF were retrieved from the EFSA online library portal.

Results:
NFs consisting of novel proteins can be derived from different sources, e.g., animals (e.g., insects, by-products), plants (e.g., pulses, water lentils), microorganisms, fungi or algae. Different technologies (e.g., fermentation, enzymatic hydrolysis) with potential impact on nutritional aspects could also be applied in their production. These NFs are proposed to be used as whole foods, food ingredients or food supplements on the EU market.
The nutritional assessment of novel protein sources may include their nutritional characterisation and the determination of the protein content and quality. The use of appropriate nitrogen-to-protein conversion factors, the completeness of the indispensable amino acid profile, or the method used to measure protein digestibility are key aspects for the assessment. Although the Digestible Indispensable Amino Acid Score (DIAAS) is often used to determine protein quality, other approaches, e.g. Protein Digestibility-Corrected Amino Acid Score (PDCAAS), have also been followed in varying NF categories differing in protein contents or proposed uses.

Conclusion:
A comprehensive nutritional assessment including a harmonised approach for protein quality is crucial to ensure that the consumption of these novel proteins on the EU market is not nutritionally disadvantageous for consumers.

P2.2.092

INCREASING FOOD SAFETY LEVEL OF GROUND BEEF BY 405 NM LED LIGHT TECHNOLOGY IN REFRIGERATORS

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Aim:
This study aims to investigate the potential of 405nm LED light technology in household refrigerators to extend the storage time of ground beef and improve food safety by reducing the growth of microorganisms, specifically *Escherichia coli*.

Method:
Ground beef samples were placed in a specific compartment of a household refrigerator designed to accommodate a 405nm LED. The samples were exposed to varying intensities of 405nm LED light, depending on their position from the LED. The total dose of light exposure was controlled and varied by adjusting the intensity and duration of exposure and proper control was implemented to ensure consistent temperature and humidity within the compartment throughout the experiments. Reduction in total aerobic bacteria and inhibition of *Escherichia coli* in ground beef was performed to evaluate the effectiveness of the technology.

Results: (heading must be in bold)
The use of 405nm LED light technology in household refrigerators was found to be effective in reducing the number of total aerobic bacteria and *E. coli* in ground meat.

Conclusion:
In conclusion, this study investigates the potential of 405nm LED light technology as a novel approach for enhancing the preservation of ground beef in household refrigerators. The expected findings offer promising implications for reducing food waste and enhancing food preservation, and may inform the development of new technologies in the field. This study builds upon existing research on the potential effectiveness of LED light technology for food preservation, with a specific focus on ground beef, which is a commonly consumed meat product. It can be concluded that LED light technology offer a promising solution for improving food safety in household refrigerators.
This study was supported by ARÇELİK and TÜBİTAK (522O015).

P2.2.093

Pumpkin leaves: from field crop side streams to novel nanocarrier structures encapsulating vitamin E

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Aim:
This research aimed to valorize pumpkin leaves from field crop side streams for the production of a bioactive protein-rich extract and evaluate the potential of its use in the development of nanocarrier structures for nutrient encapsulation employing vitamin E as a model nutrient.

Method:
Pumpkin leaves were subjected to pressing and subsequent acidic treatment to produce a bioactive protein-rich extract. The produced extract was assembled with zein and alginate employing a pH shift/electrostatic deposition-based technique followed by freeze-drying to develop nanocarrier structures for vitamin E encapsulation. The resulting structures were scrutinized regarding morphological, physicochemical, and functional properties, analyzing the effects of vitamin E encapsulation on these properties.

Results:
Assemblies of pumpkin leaf extract with zein and alginate were successfully produced and employed as nanocarrier structures to encapsulate vitamin E. Both assemblies, plain one and encapsulating vitamin E, showed the morphology of uniform nanoparticles with a mean diameter of 274 and 235 nm, respectively. The presence of vitamin E within the nanocarrier structures was confirmed by Fourier Transform infrared spectroscopy (FT-IR). Of note, plain nanoparticles, without encapsulated vitamin E, showed antioxidant activity, i.e., free radicals scavenging ability, suggesting the bioactivity of the pumpkin leaves extract. The encapsulation of vitamin E within the developed nanocarrier triggered a more potent ability of the resulting particles to scavenge free radicals. The results of water activity measurements suggested the stability of the developed particles with and without encapsulated vitamin E in terms of potential long storage periods.

Conclusion:
The here-presented results highlighted the promising potential of valorizing pumpkin leaves from field crop side streams as sources of compounds for the development of novel, bioactive nanostructures encapsulating nutrients as ingredients for functional food products. Adding value to field crop side streams and their upgrading from underutilization to use as constituents for functional food products is of interest to support the circular economy and sustainable development.

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P2.2.094

Conilon coffee consumption improves cognition and reduces oxidative stress in elderly with Alzheimer's disease

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Aim:
The aim was to evaluate the effects of conilon coffee consumption in elderly with AD.

Method:
Conilon coffee “Conquista_ES8152” was harvested with 80% cherry beans, roasted (AGTRON 55), ground, stored under vacuum, and delivered to patients. A sample was sent to laboratory for caffeine and chlorogenic acids (CGAs) analysis. The study was carried out with 9 participants (ethics committee nº4.978.050), during 90 days, by consumption at least 2 cups of 200 mL of coffee (7%; strainer) per day (400 mL/day). Cognitive assessment was done before (T0) and after 90 days (T90) as follows: Mini-Mental State Examination (MMSE); Immediate memory test; visual-spatial and abstraction abilities (Cookie Theft Picture-CTP); Similarity Test; executive and language functions, using the Boston Naming Test and Verbal Fluency Test; attentive function, using Trail Making Test; and visuoconstructive abilities. The advanced oxidation protein products (AOPP), thiobarbituric acid reactive species (TBARS), and biochemical blood analyzes were also analyzed T0 and T90. The analyzes of the compounds 3-CQA, 4-CQA, 5-CQA, 3,4-diCQA, 3,5-diCQA and 4,5-diCQA, and caffeine, were performed on coffee, also prepared at 7%, diluted and injected into a UHPLC, C18 column (100 x 2.1mm, 1.8µm) at 35°C. Mobile phase: 1% acetic acid and methanol (75/25), flow rate of 0.2 mL/min, in isocratic mode. Detection: 325nm for CGAs, and 270nm for caffeine.

Results:
The main CGA found in coffee was 3-CQA, with 78.1±0.25 mg/100mL of coffee. During the treatment, the participants consumed on average, considering 400mL/day, a total of 550mg of CGAs and 537±2.8mg of caffeine. Consumption did not significantly alter any biochemical parameter, such as liver transaminases, urea, creatinine, C-reactive protein, cortisol, ferritin, HbA1c, fasting glucose, insulin, total cholesterol and fractions. On the other hand, there was a significant reduction ($p<0.05$) of 37% in AOPP and 60% in TBARS, indicating a reduction in oxidative stress. There was a significant improvement ($p<0.05$) in the participants' cognition in the MMSE, similarity, CTP and clock drawing tests, between T0 and T90.

Conclusion:
For the first time, this study indicates that consumption of CGA-rich conilon coffee for 90 days is able to reduce oxidative stress and improve cognitive function in humans.

P2.2.096

Molecular properties of commercial and less processed plant proteins and their fractions

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Aim:
The replacement of animal proteins with plant proteins from sustainable sources presents one of the biggest challenges in the food industry today. In many foods, for instance yoghurt-type products, protein gelation determines the texture. The gelation of proteins is a stepwise process of unfolding, aggregation and network formation. The ability of proteins to gel depends greatly on the degree of denaturation. Many commercial plant proteins are often obtained through harsh extraction leading to denaturation. So far, it is not completely understood how the commercial production affects the molecular properties of the protein fractions. Therefore, this study aimed to determine the degree of denaturation of isolated protein fractions of commercial plant proteins and ground soybeans and peas as less processed standards.
Method:
Prior to isolation, the composition and the molecular weight distribution of the samples were determined. Subsequently, the protein fractions were isolated by a mild treatment, including alkaline extraction, isoelectric precipitation, dialysis and lyophilization. The isolates were characterized in terms of the molecular weight distribution, surface hydrophobicity, zeta potential and solubility to evaluate the degree of denaturation.
Results:
Both commercial soy and pea samples contained high molecular weight fractions that were not present in the less processed soy and pea standards. Although the protein content was much higher in the commercial samples, the isolation of protein fractions yielded much lower quantities, resulting in a minor isolation efficiency. Molecular properties of protein fractions in terms of the molecular weight distribution, surface hydrophobicity, zeta potential and solubility differed strongly between commercial products and less processed standards, indicating differences in the degree of denaturation among the samples.
Conclusion:
The analysis of the isolated protein fractions revealed differing molecular properties of commercial samples and less processed standards. These differences most likely result in differences in their functionality. Therefore, further studies on the functional properties such as protein gelation are necessary to understand the potential of less processed proteins. Moreover, the selective combination of different proteins or their fractions could be used to tailor the functional properties of plant-based protein gels.

P2.2.097

Shelf life extension of valorized fish powders via active packaging based on natural antioxidants

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Aim:
The increasing growth of aquaculture and fish processing result in high quantities of side-streams, being a source of valuable bioactive compounds. Marine biomass exhibits significant lipid oxidation due to the high content of unsaturated fats. The incorporation of natural antioxidants can act as barrier to extended lipid oxidation. Food packaging act protectively against food quality degradation, and within the context of plastic products reduction, the interest in biopolymers, e.g. polylactic acid (PLA), has gained significant scientific attention. This study focuses on the lipid oxidation prevention and shelf-life extension of a fish-based product via the incorporation of rosemary natural antioxidants, either as co-ingredient or encapsulated in PLA-based packaging films.

Method:
Salmon (*Salmo salar*) filleting residues were used for the preparation of lyophilized fish powders, with and without the addition of rosemary antioxidants (150 mg/kg fatty acids). Half of the samples were packed in conventional PLA and the rest in active PLA packaging films with encapsulated rosemary essential oils (10% or 20% w/w), previously produced in the lab. The efficiency of antioxidants on powders was determined through the evolution of primary and secondary lipid oxidation (peroxide value, p-Anisidine, K_{232}, K_{270}) at 20°C and water activity range of a_w=0.22-0.53.

Results:

The addition of antioxidants resulted in prevention of primary and secondary lipid oxidation in both case studies. Regarding active packaging, the highest antioxidant concentration resulted in the lowest peroxide and anisidine values ($k_{without}$=0.19 d^{-1}, $k_{20\%}$=0.07 d^{-1} at a_w=0.22), while the addition of 10% rosemary decreased up to 15% the primary oxidation rates constants. The direct addition of antioxidant into powders resulted in an increase in the estimated shelf-life up to 4-fold.

Conclusion:
This study showed the potential of the use of rosemary antioxidants in PLA-based active films or directly into dehydrated salmon powders. New product development from marine biomasses constitutes an alternative method for their valorization and may contribute to a sustainable utilization of fish processing side-streams.

Acknowledgment
Co-funded by the European Regional Development Fund Horizon 2020 Call: ERA-NET Cofund on Blue Bioeconomy, and Greek Operational Program "Competitiveness, Entrepreneurship and Innovation 2014-2020" - project: "SuMaFood – Sustainable preservation of marine biomasses for an enhanced food value chain" (MIS5161217).

P2.2.098

Plant protein gels: preparation, characterisation, and development of hybrid meat patties

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Aim: A fast-growing market of plant-based foods and subsequent increase in demand for meat alternatives is driving food scientists and entrepreneurs to develop new technologies. Plant-based foods have gained substantial popularity among consumers due to their minimal environmental impact and health-promoting factors. The present study attempted two-step freeze structuring of faba and pea protein gels to create an anisotropic fibrous network.

Method: Faba protein concentrate/pea protein isolate gels were prepared with the addition of sodium alginate, lecithin, red food colour, water, and sunflower oil. These protein gels were characterised for pre and post-heat treatment (60ºC, 30 min), and the gels were analysed for rheological properties, zeta potential and hydrodynamic particle size. Pea-based (PBMA) and faba-based meat alternatives (FBMA) were processed to form different composite variations of vegan-based (VB1, VB2 and VB3) and hybrid (HY1, HY2, HY3, HY4, HY5 and HY6) meat patties and were compared with the conventional beef patties.

Results: The zeta potential (ζ) of faba and pea protein gels was significantly ($p<0.05$) decreased on heat treatment from -3.25 and -2.35 mV to -7.5 and -4.5 mV, respectively. Whereas the hydrodynamic particle size (µm) of both the protein gels remained statistically unchanged upon heat treatment. Comparing PBMA and FBMA, the protein content was statistically high in PBMA (18.26%), while the fat was significantly ($p<0.05$) high in FBMA (5.90%). As expected, the beef patties had the highest protein content of 28.70% followed by the HY1 (PBMA 16.67%: FBMA 16.67%: beef 66.66%) (24.63%), whereas among the vegan patties VB1 (PBMA 100%) had the highest protein content (19.40%). Overall, the colour values for cooked beef patties and HY1 were in a similar range, however, the redness to greenness index was much higher in the cooked HY1 than in the cooked beef patties.

Conclusion: This study shows that hybrid-meat patties containing a significant portion of plant-based meat could be a substitute for conventional beef patties. Freeze structuring proved to be a technology that could be used to develop meat-like layered fibrous structures using faba protein concentrates and pea protein isolates.

P2.2.099

Near-infrared optical gas sensor for intelligent food packaging

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Aim:
This project focuses on the design and fabrication of an intelligent packaging system based on a gas-phase optical sensor. The optical sensor emits near-infrared light that is able to penetrate through visibly opaque materials, including plastics, paper, and cardboard. The sensor will provide real-time monitoring of the quality of packaged food products using a specialized, near-infrared camera.

Method:
The near-infrared signal from the optical sensor is based on the fluorescence emissions of carbon nanotubes (CNTs). The CNTs are wrapped with single-stranded DNA that is able to spontaneously assemble onto the nanotubes following sonication. This wrapping not only solubilizes the CNTs in aqueous solutions but also controls the optical responsivity of the CNTs towards different gases. The resulting solutions are then incorporated into an agar hydrogel. We subsequently investigate the response of the sensor in the presence of ammonia, a gas associated with food spoilage. Finally, we investigate the selectivity of the sensor in the presence of other gases.
Results:

Our results show that the fluorescence intensity of the $AT_{(15)}$-wrapped CNTs increases upon exposure to ammonia. Interestingly, we observe distinct responses from different CNT chiralities. We also observe a concentration-dependent and selective response of the $AT_{(15)}$-wrapped CNT sensors to the target gas, with no significant response to the other gases used in this study.

Conclusion:

Here, we developed an optical sensor based on the fluorescence of CNTs for intelligent food packaging applications. The sensor can be used to monitor food quality in real-time, notifying the user on onset of food spoilage. This sensor thus offers both consumers and manufacturers a quick and accessible means of ensuring food quality and safety.

P2.2.100

Valorisation of surplus peas into protein powder with healthy minor components using different fractionation methods

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Aim:
Wrinkled peas are very popular in the frozen and canning industry as they are sweeter than regular peas. They are usually overplanted and the surplus is left on the field to mature and dry. Generally the surplus goes to feed, but it is also an interesting raw material to produce protein-rich powders from. These powders can be used as a supplement in food products for elderly who struggle to have a sufficiently high protein intake. Besides keeping the protein, also healthy minor components in the product would increase the overall health benefits. Therefore, the protein recovery was studied by using two fractionation processes and the role of processing on the minor components was investigated.

Method:
The wrinkled peas were toasted to reduce off-flavours and consequently milled into flour. Air classification was used as to separate the flour into a protein-rich and starch-rich fraction. For the wet fractionation process, pea flour was dissolved in water and the pH was adjusted to 8 followed by 5 to separate the starch and protein content, respectively. Both fractions were spray-dried into powder. The pea flour and the different fractions were analysed on macronutrients, minerals and vitamins composition.

Results:
The pea flour contains 29.3% starch, 8.9% sugar and 30.6% protein (dry basis). Air classification recovered 28% protein in the fine fraction at 35% purity, the purity was much lower than for smooth pea varieties where purities up to 60% can be obtained. The low purity is explained by the relatively low starch content of wrinkled peas, which hampers separation. Wet extraction recovered 35% of the protein at 69% purity.
The minor components increased in the air classified protein-fraction compared to the pea flour. After wet fractionation, only calcium and zinc were higher. As part of the minor components are washed out during the process.

Conclusion:
With air classification, more minor components are retained in the protein-fraction compared to wet fractionation. However, in this case using surplus wrinkled peas, the wet fractionation was preferred to increase the protein content in food applications as the protein content of the air classified wrinkled peas was too low.

P2.2.101

Effect of the US treatment in the physical properties of wheat flour

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Aim:
This works aims to physically modify wheat flour by using low frequency ultrasounds (US) and to determine the influence of time (60 and 90 seconds) and power (105, 210 and 315 W) on the physical properties of the modified flours. Functional, thermal and pasting properties of the treated flours were compared to the native flour (control) and the freeze-dried native flour.

Method:
The starting material was purchased from Harivasa (Navarra, Spain). Thirteen essays were carried out according to the design of experiments defined with the two studied factors (time and power). The wheat flour was mixed with buffer acetate (pH 4.0) at 30.77% (w/v) and transferred into a jacketed beaker before US treatment (Labsonic U.B. Braun). Tap water was recirculated through the beaker to avoid heating and gelatinization of the flour. Each sample was treated with the different conditions of continuous US and all of them were freeze-dried and milled prior to the analysis. A viscosimeter (Haake RV1) was used to determine pasting properties. The thermal properties were carried out with differential scanning calorimetry (TGA/DSC3+, Mettler Toledo). Finally, water holding capacity (WHC), water binding capacity (WBC), water absorption index (WAI), water solubility index (WSI) and emulsion activity (EA) and emulsion stability (ES) were also analysed.

Results:
The results provided values in the following ranges 11.21-65.86%, 10.89-62.80% and 4.64-10.82 g/100g for EA, ES and WSI respectively, in which significant differences were found between control and the other samples. WBC and WHC reached the highest values at low power regardless of exposure time. US slightly affected the peak and the final viscosity of the pasting curve of the treated samples by comparison with control. US treatment delayed gelatinizacion temperature (DSC) in those samples at the following conditions: 60 sec and 105W and 90 sec and 315W.

Conclusion:
Results show that the freeze-drying treatment had a high impact on the functional properties rather than the US treatment, specially in EA. US treatment seems to slightly modify the wheat flour physical propieries. Notwithstanding, more tests at longer times or applying pulses and more analyses on the treated flours are necessary.

P2.2.102

Combat rations: effects of processing parameters on quality of different freeze-dried carbohydrates

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Aim:
The extreme demands placed on soldiers by psychological, physical, environmental and temporal stressors make field nutrition and food convenience essential. Freeze-drying is a drying unit operation widely used in the food industry and is an efficient process to increase shelf-life, convenience, and maintain the organoleptic properties of combat food products. One of the main parameters to verify the quality of dried products is the rehydration capacity, i.e. the ability to regain the initial amount of water present before the dehydration process. Ensuring rapid rehydration to preserve food properties is an important factor in developing and optimizing combat rations foods. Furthermore, rehydration is a complex process that is related to the structural changes that occur during drying. Therefore, the present study was set up to investigate the effects of boiling, freeze-drying and the subsequent rehydration process on the quality characteristics of different carbohydrate sources. Moreover, the study aimed to obtain data for process optimization to obtain combat rations and other foods with desirable technological properties.

Method:
Four carbohydrate sources were processed and analyzed: rice, potato and pasta (regular and whole grain). The effects of boiling time (1 to 18 minutes), freeze-drying, rehydration time, and temperature (at 20, 50, and 90 °C) on yield, moisture content, and texture profile were investigated. After the boiling and rehydration processes, the texture profile was analyzed on a Texture Analyzer TA-XT2 (SMS Ltd., Surrey, England) and expressed as hardness, springiness, cohesiveness and chewiness.

Results:

The boiling time significantly influenced ($p < 0.05$) the yield of all carbohydrate samples ($p < 0.05$). The potato needed more time freeze-drying to reduce water content by 90 % compared to other samples. The texture parameters (hardness, springiness, cohesiveness and chewiness) were significantly different among the freeze-dried and rehydrated samples compared to boiled samples.

Conclusion:
According to the results obtained, the combinations of boiling times, freeze-drying and rehydration of carbohydrate samples impact the yield and quality properties of the final product.

P2.2.103

The detection of rotten defect markers in hazelnuts of different origins: an untargeted UHPLC-HRMS approach.

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Aim
The rotten defect is one of the main defects on hazelnuts, even very small quantities can have very negative sensorial consequences. The development of an instrumental method extremely sensitive to the defect would support a more correct and precise classification of the batches during the visual quality control. In our study an untargeted approach based on UHPLC-HRMS was employed for the selection of molecular markers capable of recognizing and discriminating the intensity of the "rotten" defect in experimental samples (3 different origins) containing different percentages of defect (up to 1%).
Method
The raw hazelnut samples were selected from 3 different geographical origins: Piedmont (Italy), Akcakoca (Turkey) and Ordu (Turkey). The samples, during visual inspection, were divided in *control* (healthy hazelnuts) and in 4 specific classes of *rotten*: *strong, weak, with cimiciato* and *with mold*. For each sample, hydroethanolic solutions were prepared at different concentrations of rotten (100%, 10%, 1%, 0%) and the mass spectra were acquired using an Orbitrap Q-Exactive Focus. Statistical tools of differential and multivariate analysis were used to select the best performing markers. Furthermore, the putative annotation of the structures of markers was performed.
Results:
The multivariate analysis showed that the main discriminating effect among the samples was given by the presence of the rotten defect (at different percentages), regardless of the origin and the specific class of rotten.
A list of 11 markers able to be significantly discriminated in all 3 origins and for each defect level, even between 1% and 0% (Control), was selected. For each compound the putative annotation of the structures was performed and molecular classes compatible with the secondary metabolites produced by plants (after the response to biotic stress) or fungi, such as alkaloids, cyclic penta-peptides and guanidines, were annotated.

Conclusion:
This study represents the first specific instrumental method to identify molecular markers of the rotten defect in hazelnut, able to respond regardless of the specific class and origin. The tracking of these molecular markers can represent an improvement and a valid alternative to the qualitative assessment of hazelnuts, currently dependent on visual inspection.

P2.2.104

Plant and animal protein mix systems as wall material for microencapsulation of Mānuka essential oil

Dr Kandi Sridhar[1], Dr Saïd Bouhallab[1], Dr Thomas Croguennec[1], Dr Denis Renard[2], Dr Valérie Lechevalier[1]
[1]INRAe, Institut Agro Rennes Angers, [2]INRAe UR 1268 Biopolymères Interactions Assemblages

Aim: Plant proteins are becoming a valuable source of nutrition in the modern diet due to their high protein content and low-cost. Among plant sources, legumes are rich in protein and are a staple food in many cultures around the world. However, legume proteins may lack certain essential amino acids. Thus, both can be part of developing protein mix systems that can be used to protect and deliver bioactive ingredients (e.g., essential oils). Therefore, the study was designed to evaluate the plant (pea protein (PP) and lupine protein (LP)) and animal protein (whey protein, WP) mix system as a wall material for microencapsulation of mānuka essential oil. Moreover, physicochemical properties and *in vitro* release profile of encapsulated mānuka essential oil were studied
Method: Plant-animal based protein systems were used as a wall material in encapsulation of mānuka essential oil using freeze-drying. Microcapsules characteristics, such as moisture content, water activity, encapsulation efficiency, and

antioxidant activity were determined using different characterization techniques. The oxidative stability over 90 days and *in vitro* release kinetics of microcapsules were studied using TBARS and mathematical modelling, respectively.
Results:.Mānuka essential oil microcapsules exhibited low moisture content (5.27-7.14 %) and low water activity (0.33-0.37) with a solubility of 53.66-68.10 %. Change in wall material ratio significantly affected the color of microcapsules, while microcapsules prepared with 1:1 core/wall ratio demonstrated a high encapsulation efficiency (90.39 % and 89.42 %) for protein mix systems (PP+WP and LP+WP). Microcapsules further showed low values for lipid oxidation with a high oxidative stability and antioxidant activity (62.13-86.96 %). The zero order and Korsmeyer–Peppas models clearly explained the release mechanism of encapsulated oil, which was dependent on the type and concentration of the protein mix used.
Conclusion: The findings demonstrated that the protein mix systems successfully encapsulated the mānuka essential oil with controlled release and high oxidative stability, indicating the suitability of the protein mix systems as a carrier in encapsulation and application potential in development of encapsulated functional foods.

P2.2.105

Dried red grape pomace with lactic acid bacteria as value added powders

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Aim:
The aim of this study was to compare the effect of two drying methods (convective and infrared) at different temperatures (40°C, 45°C and 50°C) on the Băbească Neagră pomace (containing skins and seeds) inoculated with lactic acid bacteria (LAB) on cells viability, phytochemical profile and color.
Method:
The red grape pomace purée samples were analysed before and after drying and during storage for cell viability. Fick's second law was used to calculate the effective moisture diffusivity (Deff) at each temperature, whereas the Arrhenius relation was used to estimate the activation energy (Ea). An advanced phytochemical profile was performed by ultra-high performace liquid chromatography, using a Thermo Scientific equipment that was coupled with a Thermo Scientific Dionex Ultimate 3000 Series RS pump, Thermo Scientific Dionex Ultimate 3000 Series TCC-3000 RS column compartments and a Thermo Fisher Scientific Ultimate 3000 Series WPS-3000RS autosampler.
Results:
For the drying methods used in this study, the activation energies values were 29.366 kJ/mol and 19.391 kJ/mol for covective and infrared drying, respectively, suggesting a higher temperature dependence for the classic drying method. The phytochemical profile of the samples were analysed, highliting the highest levels of bioactive in the powders dried with infrared technique at 45°C. In both samples, the main anthocyanin found was cyanidin-3-*O*-monoglucoside with a concentration of 9.80±1.22 µg/mL extract for the convective dried powder and 9.62±0.98 µg/mL extract for the infrared dried powder. The flavonols profile revealed a higher concentration in the convective powder (270.96 µg/mL extract) when compared to infrared powder (256.37 µg/mL extract), the major compound being rutin, with a concentration of 26.31±0.65 µg/mL extract and 26.35±0.42 µg/mL extract, respectively. The lactic acid bacteria viable cells content decreased with 2 log during drying, allowing to obtain powders with a minimum 7.0 log CFU/g dry weight after 14 days of storage at 4°C.
Conclusion:
The obtained results highlited the potential to use both powders as potential food additive, due to the bioactive, viable cells and color to obtain value-added, functional foods.

P2.2.106

Investigating mayonnaise oxidation kinetics through isothermal calorimetry and oximetry analysis

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Aim:
This study aimed to investigate the impact of various vegetable oils on the rate of autoxidation in mayonnaise samples using oximetry and isothermal calorimetry at 60°C.
Method:
The rate of free radical formation (R_i) in the mayonnaise samples was controlled by the addition of a free radical initiator (AIBN). A typical workflow was used to transform the isothermal calorimetric heat flow to oxygen concentration, which was then used to determine the onset time (t, antioxidant capacity), rate of inhibited period (R_{inh}), and rate of uninhibited

period (R_{uni}). The oxidizability of mayonnaise was determined based on R_{uni}. Additionally, antioxidant efficiency (A.E.) was calculated using t and R_{inh}.

Results:

Both the methods provided similar onset times (t, antioxidant capacity), R_{inh} and R_{uni}, exhibiting a strong correlation (R^2 = 0.99). The mayonnaise samples prepared with extra virgin olive oil demonstrated the highest resistance to peroxidation, as evidenced by their highest t and lowest R_{inh} values. The order of resistance against peroxidation was found to be: extra virgin olive > corn > grapeseed > sunflower > apple seed oil. Whereas, sunflower oil exhibited the maximum A.E. among all the tested oils.

Conclusion:

Isothermal calorimetry provided a convenient and efficient method for simultaneously measuring multiple samples, with minimal experimental effort. The results indicated that the type of vegetable oil used significantly influenced the rate of autoxidation in mayonnaise samples. Extra virgin olive oil exhibited the highest antioxidant capacity, while sunflower oil showed the highest antioxidant efficiency. These findings contribute to our understanding of the oxidative stability of mayonnaise and have implications for the selection of vegetable oils in food formulations.

P2.2.107

Phycocyanin enrichment of minimally processed organic apples

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Aim:

Spirulina platensis, also known as spirulina or Arthrospira, is a blue-green filamentous prokaryotic cyanobacterium with a protein content of 55–70%, which includes a wide range of essential amino acids, vitamins, minerals, essential fatty acids and pigments such as phycocyanin. The aim of this study is to evaluate vacuum impregnation (VI) of organic apples with phycocyanin to obtain a nutrient-enriched product.

Method:

A solution containing phycocyanin extracted from the microalgae Arthrospira platensis was used. VI process was optimized varying levels of pressure and holding time to maximise the impregnation level and the concentration of phycocyanin in the tissue. The obtained enriched apples were stored under refrigerated conditions and their shelf-life was monitored for 10 days, during which the microbiological quality and various quality-related and nutritional analytical determinations were carried out.

Results:

The optimized VI conditions (200 mbars, 20 min) resulted in an impregnation yield of around 25%, in agreement with the level of porosity of the apple variety selected (Golden Delicious). Due to the natural color of the bioactive compounds, impregnated samples showed a significant difference in the colorimetric parameters compared to the control one. However, no significant changes were observed during storage. The shelf life of the products was limited by the microbial growth and resulted in 7 days, for both impregnated and control samples.

Conclusion:

VI with phycocyanin allowed to obtain a nutritionally enriched organic product, with shelf life comparable to the control one. Phycocyanin, being a blue pigment, gives the final product an unconventional blue-green colour. Therefore, an in-depth sensory analysis might be of interest to assess the overall quality of this product

Acknowledgements

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P2.2.108

Influence of cultivation system and processing on chemical and bioactive composition of black garlic powder

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Aim: Garlic is a plant widespread across the world and used in international cuisine due to its unique taste as well as in traditional medicine to treat a wide range of disorders.
The popularity of black garlic is increasing in Europe and around the world as an ingredient in high-end cuisine and the food industry, but also, due to its high antioxidant capacity, black garlic has been incorporated in the cosmetic industry, in shampoos, facial creams, body soap and skin protectors.
In this work we want to examine and evaluate: i) the chemical and bioactive composition of black garlic cultivated in organic and conventional agriculture (Voghiera garlic PDO, with a specially production disciplinary); ii) the composition of black garlic powder obtained with different thermal processing.
In both case we focused our attention on sulfur and antioxidant compounds and related activity, important for garlic aroma, health benefit properties and for prolonging the shelf-life of the product.
Method: We analyzed the proximate composition, sulfur compounds by GC-MS, total phenol content, flavonoids using spectrophotometric detections and antioxidant activity with different methods, spectrophotometrically and with photochemiluminescence.
Results: The heat treatment under controlled conditions of high temperature and high relative humidity for long periods of time produced important changes in garlic cloves mainly affecting sulfur compounds, phenols and antioxidant composition.
Black garlic presented important changes in organosulfur compounds and an increased amount of phenols and antioxidant activity also 10 times higher than raw garlic. The conventional cultivation of Voghiera Black garlic PDO showed higher antioxidant compounds than organic products.
The black garlic powder obtained with different thermal processing maintained chemical characteristics, antioxidant pattern and capacity of the starting product, ensuring a high content of bioactive compounds even after several heat treatments.
Conclusion: The food processing industry nowadays must meet the high demands of consumers looking for food and food supplements with high health-promoting values, therefore the research on bioactive compounds affected by cultivation methods and processing is important for industries to guarantee the consumer always high quality products.

P2.2.109

Fat crystals as Pickering particles to stabilize W/O emulsions

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Aim:
Pickering stabilization has gained significant research attention in the food industry, because of the ultrastability it provides to an emulsion system. However, finding food-grade particles to replace the classic surfactant, whilst providing good stability has been challenging. The aim of this study was to use solely fat crystals to create particle-stabilized W/O emulsions with increased volume fractions and measure their storage stability over time.

Method:
Water-in-oil (W/O) emulsions were stabilized by using cocoa butter crystals (CB) dispersed in high oleic sunflower oil (HOSFO). The capability of the CB crystals (10-20 wt% CB) to form W/O emulsions (30-60 vol% water) was characterized using cross-polarized light microscopy, cryogenic scanning electron microscopy, and confocal light microscopy. The characterization of the crystallization process and fat crystal polymorphism in cocoa butter was evaluated by SAXS. In addition, the storage stability and rheological properties of the emulsions were examined.

Results:
Results showed that CB crystals were able to stabilize W/O emulsion. The size of the droplets remained constant (0.35 µm) for a period of one month without any phase separation. Microstructural analyses of W/O emulsions at multiple length scales revealed that platelet-like CB crystals not only surrounded the droplet surface but also the CB fat crystals formed a network in the bulk phase further contributing to stabilization. The increment in the water content increased the emulsion viscosity of 40, 50, and 60% of water (%v/v), and all the emulsions show shear-thinning behavior, further demonstrating droplet aggregation. However, after one month all the emulsions behave similarly, with no change in viscosity, which might be associated with the growth crystals and crystal-crystal aggregation in the bulk phase contributing to locking the water droplets during storage, with rheological properties being largely governed by the CB crystals rather that the water droplet content.

Conclusion:
New findings from this study show that CB crystals can be used to stabilize the water-oil interface with an increased volume fraction of water in a W/O emulsion without any surfactant. Such stable clean-label Pickering systems offer promise for designing healthy low-fat confectionery products where biocompatibility is a key necessity.

P2.2.110

Supercritical carbon dioxide influence on anthocyanins stability and bioaccessibility in ready-to-eat and processed fruits

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Aim: The aim of the study was to assess how the type of food matrix and supercritical carbon dioxide treatment (SCCD) affect the stability and bioaccessibility of blackcurrant anthocyanins in the *in vitro* gastrointestinal digestion model.

Method: Blackcurrants crushed in the mortar (F), puree (P), raw juice (J), juice thermally treated at 45°C/10min (T45), juice pasteurized at 85°C/10 min (T85) and juice SCCD-treated in 10, 30 and 60 MPa/10 min/45°C (SCCD10; SCCD30; SCCD60), were digested in four-step *in vitro* gastrointestinal digestion model. Samples before and after each step of digestion were collected and anthocyanin content by HPLC as well as antioxidant activity (AA) with ABTS+• and DPPH• radicals were analyzed. Additionally, a model digestion of the main blackcurrant anthocyanin monomer (df-3-*O*-rut) was performed and analyzed by LC-MS/MS to detect anthocyanin metabolites.

Results: The highest content of total anthocyanins was noted in SCCD samples, however, during digestion in subseqent steps of the gastrointestinal tract, stability of anthocyanins was significantly higher in J samples compared to other matrix. The SCCD at 10 MPa increased the bioaccessibility of delphinidin monomers, but did not affect the total anthocyanins. The bioaccessibility of J was the highest (4%) from all samples. In contrast, bioacessibility of anthocyanins in M and P samples were 2 and 1%, respectively. Shredding the fruits causes anthocyanins degradation probably due to enzyme activity and intensification of oxidation processes. The AA with ABTS+• was significantly higher after digestion in SCCD-treated juices at 30 and 60 MPa than T45, T85, M and P samples and did not differ significantly from J. In the DPPH• assay, a significantly higher AA was observed in the M and P than in the other samples, by 34% and 45%, respectively. The analysis of the df-3-*O*-rut standard after digestion confirmed that the main metabolite of this compound is protocatechuic acid, strong antioxidant responsible for increasing AA.

Conclusion: Blackcurrant juice is a good source of anthocyanins with bioaccessibility and antioxidant potential higher than less processed fruits. SCCD treatment can significantly improve the stability and bioaccessibility of selected anthocyanin monomers. However, the obtained results should be confirmed by *in vivo* studies.

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P2.2.111

Enhancing Protein and Fiber Content in Plant-Based Yogurt Alternatives: A Promising Gurt Model

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Aim:

Commercial plant-based alternatives to yogurt are typically low in fiber and protein. To address this challenge, our study aimed to investigate the influence of oat and faba bean ingredients in the production of "gurt", a plant based dairy alternative, which would be source of fiber (>3%) and protein (>4%). Our objectives were to study the impact of different processing parameters on fiber and protein degradation and the resulting viscosity of the gurt.

Method:

The developed gurt process involved ingredient mixing, enzymatic treatment, heat treatment, fermentation, and storage. Various enzymes (amylase, amyloglucosidase, beta-glucanase) were tested with different incubation regimes. Fermentation was conducted at 40°C with a commercial starter culture until a pH of 4.5 was reached. Viscosity was measured using an Anton Paar rheometer at each

process step. Fiber degradation was assessed by measuring total fiber content, beta-glucan amount, and its molecular weight, as well as mono- and disaccharide contents. The oligosaccharide profile of the samples was also analyzed. The amount of free amino acids was determined by HPLC and changes in proteins were monitored by SDS-page. Final fermentation was followed by measuring pH, TTA, and growth of microbes.

Results:

Following optimised enzymatic treatment, all gurts exhibited low viscosity (approximately 0.4-0.6 Pa·s). The utilization of beta-glucanase proved essential in controlling the viscosity of gurts with high amount of oat ingredients. Enzymatic treatment resulted in the formation of starch originated oligosaccharides ranging from DP3 to DP7, with a higher proportion of DP3 oligosaccharides. The amount of beta-glucan did not undergo intensive reduction during processing. After a fermentation period of 7-8 hours, all gurts had a pH of approximately 4.5 and moderate acidity, presenting a mild and sensorially appealing flavor and texture.

Conclusion:

Our findings demonstrated the feasibility of producing a nutritionally improved plant-based dairy alternative without intensive fiber degradation.

P2.2.112

Effect of powders from fermented vs unfermented brown seaweed on wheat dough and bread

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Aim:

Macroalgae are rich in nutrients, in particular iodine. Moreover, they have been proposed as sodium replacers. This study evaluated the addition of macroalgae as partial sodium replacers in sodium-reduced bread, a staple food in Norway and other countries and a major contributor to sodium intake. We compared fermented to unfermented *Saccharina latissima* and *Alaria esculenta* powders in their effect on dough and bread properties.

Method:

The flour used consisted of refined and wholewheat flour in a 1:2 ratio. Macroalge were included into recipes based on their intrinsic sodium content. The corresponding formulations included 0.89 – 3.3% macroalgae/100 g flour. Control breads without algae but the same sodium amount, and a full-salt control were prepared. Dough was assessed via the Farinograph, Extensograph, for stickiness, pH and its protein profile. Breads were analyzed for color, texture, morphology, and crumb structure. Moreover, a descriptive sensory analysis by a trained panel was conducted.

Results:

Macroalgae levels significantly affected dough rheology. Farinograph water absorption increased with higher inclusion levels, while Farinograph dough development and stability times, as well as Extensograph parameters decreased. As for bread properties, textural parameters were not significantly different among samples, but specific volumes decreased as algae amounts increased. The results were in line with decreased ratios of polymeric to monomeric proteins as the algae amount increased. Panelists perceived sodium-reduced bread with unfermented macroalgae as significantly more salty than sodium-reduced control breads without algae, and not statistically different in saltiness to full-sodium controls. Color and flavor attributes were impacted by the algae type. Compared to bread with fermented *A. esculenta*, bread with fermented *S. latissima* received significantly lower scores for certain undesirable sensory characteristics such as algae odor and rancid flavor.

Conclusion:

Water absorption, viscoelastic properties and specific volumes were significantly impacted by algae incorporation in a dose-dependent manner. Our study showed the potential of using macroalgae as a NaCl replacer in sodium-reduced bread, but contents need to be optimized to avoid texture and volume changes. Bread with fermented *S. latissima* was characterized by a more favorable sensory profile than bread with other algae samples.

P2.2.113

High pressure impregnation of organic apples with oat beta-glucans

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[1]University of Bologna, [2]Wroclaw University of Economics

Aim: (heading must be in bold)
(Introduction text - align left, 10 point, Times New Roman, single line spacing)
The aim of research was to verify the possibility to develop the minimally processed organic apple slices by high pressure impregnation with extracted from oat β-glucan as value-added hydrocolloid. Beta-glucan has many health-promoting properties including reduction of insulin sensitivity of glucose intolerance, attenuation of peak blood glucose response and lowering of cholesterol in the blood. High-pressure impregnation (HPI) is a newly developing impregnation technique based on application of a high hydrostatic pressure to porous fruit and vegetables immersed into a solution with the desired composition.

Method: (heading must be in bold)
(Methods text - align left, 10 point, Times New Roman, single line spacing)

Organic Apples (Malus domestica, cv 'Golden Delicious') were impregnated for 20 min at 100 MPa with the solution containing beta-glucan. Two fractions of beta-glucan from oats of opposite molecular weights (fraction I - low molecular weight < 100 000 D and fraction II - high MW > 1 500 000 D) were investigated. The impregnated apples were evaluated for the physico-chemical parameters, sensory parameters, metabolic response (by TAM -Air Isothermal Calorimeter) and β-glucan content immediately after the process and during the refrigerated storage.

Results: (heading must be in bold)
(Result text must - align left, 10 point, Times New Roman, single line spacing)
Two fractions of beta-glucan investigated showed a different rheological property. The high-pressure impregnation gave the high rate of impregnation of beta-glucan in the apple tissue, higher if compared to simple dipping or vacuum impregnation. The physico-chemical characteristics showed only a slight change in HPI apples. Metabolic heat production of the minimally processed apples showed a decrease due to the HPI. Good stability of the beta-glucan amount during the refrigerated storage was observed.

Conclusion: (heading must be in bold)
(Conclusion text must - align left, 10 point, Times New Roman, single line spacing)
High pressure impregnation allowed to obtain a novel functional product with potentially high nutritional value.
The authors acknowledge the financial support for this research provided by transnational funding bodies, partners of the H2020 ERA-NETs SUSFOOD2 and CORE Organic Cofunds, under the Joint SUSFOOD2/CORE Organic Call 2019 (MILDSUSFRUIT).

P2.2.114

Therapeutic molecule release from natural lipid droplets

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Aim: Natural plant lipid droplets (oleosomes) are organelles in the eukaryotic cells, and they can be leveraged to carry and protect lipophilic therapeutics as an alternative to current carriers for food or medical applications. The inherent of oleosomes allows us to efficiently load lipophilic molecules into them, however, whether therapeutics are released from oleosomes to target sites is unknown. Therefore, the purpose of this study is to gain knowledge about the molecule transfer from oleosomes to cell bilayer.
Method: In our quest to understand the therapeutic release from oleosomes to cell bilayer, we chose curcumin and Nile red as model therapeutics and we used giant unilamellar vesicles (GUVs) to mimic cell bilayer. We investigated the transfer of molecules from oleosomes to GUVs by spectroscopy and confocal microscopy.
Results: We found that almost 75% of loaded curcumin molecules follow a burst release trend and substantially release from oleosomes to artificial bilayer in 3 secs. Meanwhile, Nile red molecules which are more hydrophobic than curcumin did not prefer transferring to the artificial bilayer. These trends were observed at both room temperature and 37 °C,

therefore it was concluded that temperature did not influence the oleosome stability and consequently, had no influence on molecule release.
Conclusion: Thus, our results suggest that oleosomes show promise for a natural alternative to current lipid-based therapeutic delivery systems with high encapsulation efficiency along with maintained structural stability at human body temperature.

P2.2.115

Effect of spray and freeze drying on antioxidant activity of distilled levander and oregano waste

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Aim: "Greek oregano" (Origanum vulgare spp.) and levander (Angustifolia lavandula) are worldwide recognized for their numerous applications in the food industry and beyond. Steam or water distillation is the main process for extracting their essential oils, which however generates a significant amount of waste. The aim of this research is the valorization of the solid waste from hydrodistillation of these two aromatic plants.
Method: Therefore, the objectives of this work were (i) to optimize the process of ultrasound extraction, ii) to evaluate the effect of spray and freeze drying on the extract's physicochemical properties and (iii) to characterize the obtained powder for its antioxidant capacity. A central composite design of experiments was used to optimize the sample/solvent ratio, ethanol/water ratio and extraction time in regard to total phenolic content. The extract was analyzed for its antioxidant potential by determining the %DPPH inhibition, FRAP and total phenolic content. The effect of spray and freeze drying on these properties of the extract was determined. The moisture sorption isotherm of the resulting powder was calculated. Finally, the resulting powder was tested for its antioxidant activity in a hemoglobin mediated lipid oxidation system, where oxidative stability was followed by TBARS and oxymyoglobin content.
Results: The optimum yield achieved was 0.01g and 6g of gallic acid equivalents/100g of dried waste for levander and oregano respectively. The moisture sorption isotherm data were adequately fitted to the GAB model. Also, it was found that both spray and freeze drying did not significantly affect the antioxidant properties of the extract, even though the resulting powders had a distinctly different morphology (determined by SEM). Powders from both drying methods equally retarded lipid oxidation and were comparable to the synthetic antioxidant BHT.
Conclusion: In summary, "Greek oregano" and levander powders have enhanced antioxidant properties and retarded lipid oxidation.

P2.2.116

Hydrogel development for production of meat-analogue structure via bioprinting method

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Aim:
In recent years, daily protein demands of people have increased and therefore it is crucial that alternative protein products are developed. The flavor and taste of meat are very preferable for most of consumers, so products derived from alternative protein, such as plants, have been developed. These products imitate the organoleptic and functional properties of meat, the so-called meat analogues. These meat analogues are of high interest in food industry and a variety of methods has been studied for their production. One novel and promising method is mycelium biopronting, in which mycelium cells are incorporated into appropriate hydrogels and these mixtures are used as a bioink formulating specific structures, resembling in meat products, using a bioprinter. The primary aim of this research is the study of the characteristics of developed hydrogels and their potential to be used as cell carriers for meat analogue production.
Method:
Sodium alginate was used to form hydrogels by adding $CaCl_2$ as a crosslinking agent. The parameters including concentration of sodium alginate, concentration of $CaCl_2$ and the ratio of these two, were studied. The developed hydrogels were characterized by their viscosity, their potential to penetrate the bioprinter's nozzle (18G) and to form continuous structures and, finally, their stability through time in cool environment. The bioprinted structures were formed into a supporting agar bath.
Results:
According to the results of this research, alginate hydrogels can be effectively developed using $CaCl_2$ as a crosslinking agent and these structures can remain stable for a time period up to 25 days.
Conclusion:

The method, regarding the development of the alginate hydrogels, appears to be efficient and these structures can be used as cell carriers for meat analogue production.

P2.2.117

Optimizing Protein Extraction from Ulva Lactuca Seaweed : A Sustainable Solution for alternative Non-Animal Proteins

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Objetive:

Given the recent interest in exploring alternative non-animal protein sources, seeweeds have emerged as a potential sustainable food source. Seeweeds exhibit are rich in proteins and dietary fibres, which are of great interest in the food industry, however, their intricate cell wall structure hinders the extraction of proteins, resulting in low yields. The aim of this work was to optimize the protein extraction from the green seaweed *Ulva Lactuca*. The effect of the seaweed physical state (frozen vs. dry) was evaluated. Furthermore, an ultrasound (US) pre-treatment was also applied to disrupt the cell walls and facilitate protein extraction.

Methods:

The crude seaweed samples were characterized in terms of gross composition (protein content, lipids, ashes, mineral content and carbohydrates). Protein-rich extracts were obtained from the frozen and freeze-dried seaweeds, evaluating the application of a US pre-treatment of 1, 5 and 30 min. After that, a pH shifting process, including an alkaline extraction (6-12) followed by a precipitation step at acid pH (1-5) was carried out. The obtained extracts were characterized in terms of composition and antioxidant capacity.

Results:

The results evidenced the potential of the US pre-treatment to disrupt the cell walls and facilitate protein release, as the extraction yields increased up to 2-fold, achieving a maximum protein extraction yield of 47%. In the subsequent pH shifting process, the optimal solubilization pH was 12, causing a significant swelling of the cell walls, as evidenced by optical and confocal microscopy. In the precipitation stage, the pH had a significant impact on the yield and protein purity, with pH 3 yielding the highest protein extraction. Interestingly, freeze-drying of the seaweeds led to a collapse in their cell wall structure, hindering significantly the protein extraction process and producing much lower yields.

Conclusion:

The application of a short ultrasound pre-treatment led to a higher protein yield for *U. lactuca*, being a promising technique, since it allows the production of novel protein-rich ingredients without excessive energy expenditure, which will have a great potential for their use in the food industry.

P2.2.118

Discard broccoli processing by different dehydration techniques: evaluation of aminoacid content antioxidant and anti-inflammatory potential

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Aim: In the agri-food industry, there are losses of raw materials at post-harvest and production levels, mainly due to inadequate agricultural practices, insufficient transportation and storage facilities. Therefore, the valuation of these products is highly relevant in terms of sustainability and the environment. The objective of this study was to determine the retention of bio-compounds, antioxidant capacity and anti-inflammatory potential of discard broccoli processed by different dehydration techniques. Broccoli florets fresh and dehydrated by vacuum (VD), convective (CD), infrared (IRD), low temperature vacuum (LTVD) and freeze-drying (FD), were used to carry out conventional methanolic extractions.
Method: The extracts were evaluated according to their total phenolic content (TPC), flavonoids (TFC) and glucosinolates (TGC) by spectrophotometric assays. On the other hand, the antioxidant capacity was determined by DPPH and ORAC assays. The anti-inflammatory effect of broccoli extracts was determined against inflammation induced by arachidonic acid (AA) in mouse ear edema. The amino acid profile was determined in dehydrated samples by HPLC.
Results: The values of TPC, TFC and TGC decreased in comparison with the fresh product. However, the freeze-drying process obtained a better retention of these components with values of TPC=2.24±0.28 1 mg GAE/g dry matter (d.m), TFC=7.13±0.71 mg QE/g d.m and TGC=39.75±4.2 µmol TE/g d.m. The ORAC assay showed an antioxidant activity concentration being higher in CD and IRD with values 148.83±6.81 and IRD = 134.78±11.09 mg QE/g d.m, respectively. All the extracts exhibited anti-inflammatory potential, being more evident in the samples treated by LTVD and CD. In the amino acid profile, the presence of arginine and glutamic acid stands out, which are concentrated when treated with LTVD and CD.
Conclusion: The treatment of discard broccoli with drying techniques allows the product to be considered as a functional ingredient with various beneficial properties for health.

P2.2.119

Animal cell culture-derived foods: exploring their risk assessment within the EU novel food regulatory framework

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Aim: Our agri-food system is constantly evolving, being shaped by factors such as animal and human health considerations, environmental sustainability, and societal demands. Striving to align with initiatives like the European Green Deal and the Sustainable Development Goals, academia and industry explore new food sources. An emerging area being investigated is animal cell culture-derived foods, manufactured by employing cell culture and tissue engineering techniques. These innovative food products fall under the category of Novel Foods in the European Union, as defined by Regulation (EU) 2015/2283, provided they do not contain genetically modified cells. Before these products can be authorized for the European Union (EU) market, their safety must be assessed by the European Food Safety Authority (EFSA).
Method: By considering the scientific requirements in the EFSA Guidance on the preparation and submission of an application for authorization of a novel food, as well as the outcomes of the 27th EFSA Scientific Colloquium on "Cell culture-derived foods and food ingredients", insights into the risk assessment of animal cell culture-derived foods are discussed.
Results: A comprehensive compositional characterization, alongside a detailed description of the production process, are the foundation for the risk assessment of these foods and can be used to identify chemical and biological hazards that may be present in the final product. Such hazards may arise from various elements of the production process, e.g., the cells used, the growth media, and the scaffolds. Moreover, a thorough assessment of the nutrient profile of these new products, combined with an exposure assessment, can showcase whether cell culture-derived foods could be nutritionally disadvantageous compared to currently consumed foodstuffs that they may replace. The extent of compositional characterization, possible uncertainties, and remaining data gaps will determine further whether and which toxicological studies may be needed to conduct the risk assessment.
Conclusion: This work highlights the comprehensive and multifaceted EFSA risk assessment methodology that ensures the safe potential inclusion of animal cell culture-derived foods in the evolving EU food chain. By undertaking this rigorous approach, EFSA supports ongoing food innovation efforts in this field, contributing to the continuous development of the European food sector.

P2.2.120

In vitro evaluation of red wine procyanidins in microbiota intestinal and the cholesterol metabolism

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Aim: This study aimed to evaluate the effect of red wine procyanidins and their metabolites on biomarkers related to cholesterol metabolism, using a system integrated by an *in vitro* model of colonic fermentation and a cell model.

Method: To study the effect of the red wine procyanidins on cholesterol metabolism a complex *in vitro* system was used. The system reproduces the gastrointestinal and colonic metabolism of these polyphenol and the effect on specific biomarkers of hepatic metabolism on a hepatic cellular model.The interaction of the intestinal microbiota was studied using an *in vitro* digester of colonic fermentation. The digester was inoculated with fecal microbiota of adults and after the stabilization,100 ml of wine with high procyanidins content was added daily for 14 days. Intestinal microbiota modulation was studied by microbiological the analysis of the main microbial groups using selective media and direct methods of plate culture. Moreover, the metabolic activity of the intestinal microbiota was evaluated through the analysis in the colonic digested samplesof short-chain fatty acids production (butyric, propionic and acetic acid) by Gas Chromatography with FID detectorFinally, the HepG-2 liver cell line has been used to study theeffectof the colonic digested . in the gene expression of biomarkers of cholesterol metabolism such as the gene HMG-CoA(that encoded the enzymeinvolved in the cholesterol biosynthesis) and LDL receptors, biomarkers were analyzed by rt-PCR were

Results: The daily incorporation of red wine with high procyanidin content, in a model of colonic fermentation *in vitro*, caused an increase in lactic acid bacteria and in the content of short-chain fatty acids (acetic acid, butyric acid and propionic acid). Regarding the evaluation of the effect of colonic digests on the human hepatic line, after the treatment the gene expression of HMG-CoA was downregulated and the gene expression of LDLr was upregulated.

Conclusion: *In vitro* evaluation of the effect of procyanidins present in red wine shows that these polyphenols were biotransformed by the microbiota, the biotransformation modulated the intestinal microbiota positively and contributed to beneficial changes in biomarkers of the cholesterol metabolism.

P2.2.121

EFFECT OF PULSED ELECTRIC FIELD ON SHELF LIFE AND BIOACTIVE COMPOUNDS OF MAQUI CRYOCONCENTRATE

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Maqui (*Aristotelia chilensis*) berry native to Chile has intense dark purple color and considered richest sources of anthocyanins and antioxidant compounds, proven beneficial effects health. It is a perishable fruit, so it must be processed quickly to preserve the bioactive compounds; however, few processes are efficient, as the components are susceptible to changes in temperature, pH, water content, and sugar concentration.

The **aim** of this research was to evaluate the pulsed electric field (PEF) treatment on bioactive compounds and shelf life of maqui cryoconcentrated extract.

For this, the following **method** was developed: the fruits were pulped and subjected to "clean" (aqueous) extraction to obtain the extract. The extract was treated by PEF and the best process combination was analyzed (10, 15, 20 and 25 kV, 10 µs pulse width and 40 and 70 Hz frequency). The content of bioactive compounds ((polyphenols (PT), anthocyanins (AT) and antioxidant capacity (AOX)) and count of aerobic mesophilic microorganisms (AMM) and molds and yeasts (M and L) were evaluated. Subsequently, the best PEF treatment was cryoconcentrated (the extract was frozen at -30°C and centrifuged at 4000 rpm for 10 min). In parallel, an "untreated" (S/T) cryoconcentrate was obtained and compared with PEF. S/T and PEF cryoconcentrates were stored at 4 and 20°C for 50 days, and the content of soluble solids (SS), bioactive compounds (PT, AT and AOX) and the count of AMM and M and L were analyzed.

The **results** showed that PEF at 10 kV/cm reduces microorganisms (AMM, M and L) and maintains PT, AT and AOX of the extract. After cryoconcentration by simultaneous centrifugation-filtration process, the SS (°Brix) content increases 3.4 times, the PT 3.5 times, AT 3.2 times and AOX 4.6 times content of the extract and increases shelf life by 15 days at 4°C.

In **conclusion**, the treatment with PEF in conjunction with cryoconcentration allows obtaining a maqui extract concentrate with a high content of bioactive compounds and a long shelf life, achieving the diversification of products from highly perishable berries and rich in antioxidant compounds that improve health.

P2.2.122

Exploring the bioactive potential of Deep eutectic solvents extracts: An In vitro study

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Aim:
Oxidative stress and inflammation, in the presence of chronic diseases, have been identified as crucial factors. Vitamin A, a vital group of fat-soluble compounds plays a pivotal role in immune function. Carotenoids, face challenges during extraction from plants, often employing hazardous organic solvents. However, the solution lies in the adoption of green solvents, offering a promising alternative to address these issues sustainably. Deep eutectic solvents (DES) are aligned with the principles of green extraction and have demonstrated promising results for extracting bioactive compounds. The aim of the present study is to formulate DES extracts with bioactive potential for the valorization of orange by-products.
Method:
Orange peel (Navel cultivar) and 3 DES (Menthol: Mirystic acid, Lauric acid: Octanoic Acid, Octanoic Acid: Proline) and Acetone as control. Extractions were performed using a solid/liquid ratio of 1:5, for 30 min in magnetic stirring at 45°C. The obtained extracts were characterized by total carotenoid content (TC) determined spectrophotometrically at 450nm. The cytotoxic and antiproliferative activity were assessed *in vitro* using HT29 and Caco-2 cell lines. The cell viability was assessed using a CellTiter 96® AQueous One Solution Cell Proliferation Assay containing an MTS. The anti-inflammatory potential was evaluated by the intracellular ROS production using DCFH-DA.
Results:
The results showed that the higher extraction yield of carotenoids was obtained using Octanoic Acid: Proline (16 µg/ml). The *in vitro* evaluation suggests that the concentrations needed by Octanoic Acid: Proline to inhibit 50 % of cancer cells is 26 µl/mL and for Caco-2 cells was 45 µl/ml. Meaning that at the concentrations that this extract exercises their antiproliferative not cause cell death in normal cells, exhibiting a selectivity action for cancer cells. The anti-inflammatory test showed that Octanoic acid: Proline extract seems to play a role in diminishing intracellular ROS production to more than half, indicating a possible contribution as anti-inflammatory.
Conclusion:
It was possible to create green extracts using DES and orange peels, with high-value bioactive properties such as anticancer and anti-inflammatory. These findings can be of great interest for the food and pharmaceutical industries for the formulation of new nutraceutical and more sustainable systems.

P2.2.122

Scaling-up of the food drying from the laboratory to the industrial scale

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Aim: The aim of the study was to compare the apples drying on the laboratory scale to the industrial scale production in a mobile drying unit.
Method: The samples were subjected to convective drying with and without pulsed electric field (PEF) treatment applied before drying. The drying was conducted in small-scale mobile design by CEDRUS company, while in the laboratory scale drying was conducted at Warsaw University of Life Sciences - SGGW. Parameters of PEF treatment (5.8 kJ/kg) and drying temperature (85 °C) were chosen on the basis of the optimization studies. The apples properties as total polyphenol content, antioxidant activity, color, rehydration rate and hygroscopic properties were evaluated.
Results: The drying time of the apple samples on an industrial scale was longer around 21% in comparison to the laboratory scale. However, the mass of the dried apples was incomparably larger than on a laboratory scale. Dried apples on an industrial scale were characterized by similar or lower amounts of total polyphenol content and antioxidant activity in comparison to samples dried on a laboratory scale. However, the application of PEF treatment resulted in a reduction of the bioactive compounds in both types of dried apples. Moreover, samples dried in a mobile dryer were a little bit darker in comparison to samples dried in the laboratory, which was related to the longer time of preparing the material for drying. Additionally, the rehydration properties were slightly higher while hygroscopicity was lower for apples dried in a laboratory dryer. Furthermore, the PEF treatment reduced the rehydration rate and did not differ the hygroscopic properties, when compared to the apples subjected only to drying.

Conclusion: Scaling up food drying processes involves transitioning from laboratory or pilot-scale operations to larger industrial-scale production. Process optimization lets to help with planning the drying process across a larger scale, however, some differences between the quality of the dried material on a laboratory scale and industrial scale are noticed.
Acknowledgment: This study was supported by the project financed from the European Union's Horizon 2020 research and innovation on programme under grant agreement No 817683.

P2.2.123

Hydrothermal extraction of fibers from hazelnut shells: effect of temperature, physical pre-treatments and lignin-degrading enzymes

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Aim:

Hemicellulose extraction from lignocellulosic biomasses and its valorization represent a significant research topic in the last decade. The conventional treatments to extract hemicellulose involve strong conditions, i.e., high temperature, pressures, strong acids/basis. This implies the formation of degradation compounds and the necessity to apply multiple purification steps. The aim of this research was to recover hemicellulose and other fiber fractions from hazelnut shells under mild conditions, by fostering lignocellulose matrix breakdown, through physical and biotechnological pre-treatments.

Method:

Ground hazelnut shells (<500 µm) were subjected to hydrothermal treatment at different temperatures (125, 150, 175 and 200°C for 1h). Innovative approaches, involving physical (mechanochemical milling or pulsed electric field) and biotechnological pretreatments (lignin-degrading enzymes) of the matrix were then applied. The physically pretreated samples, together with samples of the raw material, were subjected to enzymatic treatment, employing Laccase from *Aspergillus sp.* (40°C, 6h, pH 7.5). Control samples were also prepared to test the effect of physical pretreatment alone. All the samples were then subjected to hydrothermal treatment in the mildest conditions (125°C). Monosaccharides composition and total sugars yields of the extracts were determined by GC-MS and ^{1}H NMR, respectively.

Results:

The conventional hydrothermal treatment allowed to extract different fiber fractions, with variable extraction yields, as a function of the temperatures. Hemicellulose was not extractable at 125°C, while pectin was detected. At 150, 175 and 200°C hemicellulose was extracted. Extraction yields increased with the temperature until 175°C. Physical pretreatments resulted to be ineffective in facilitating hemicellulose and other fibers extraction, while the employment of the enzyme increased the extraction yields of 37±3 % (hydrothermal treatment at 125°C). The monosaccharides composition of the extracts showed galacturonic acid as the main sugar, indicating the prevalence of pectin.

Conclusion:

The enzymatic approach resulted to be effective in increasing pectin extraction, even if it was not efficient in extracting hemicellulose at low temperature. The physical pretreatments applied were not effective, thus, only the enzymatic pretreatment (lignin degrading enzyme) deserves to be considered for further implementation tests/applications.

P2.2.124

NUTRITIONAL PROPERTIES AND OXIDATION STABILITY OF OILS OBTAINED FROM SEVERAL EDIBLE INSECTS

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Aim: The aim of this work was to analyse the fatty acids profile and the oxidative stability of oils extracted from flours obtained from several insects including mealworms (*Tenebrio molitor)*, house crickets (*Acheta domesticus*), red palm weevil (*Rhynchophorus ferrugineus*), and superworms (*Zophoba morio*).

Method: To obtain the oils, the corresponding flours (freeze dried insects and milled) were mixed with hexane in 1:5 ratio (w/v) and left in an ultrasound bath without temperature control during 1 h. Then, the samples were centrifuged and the supernatants were collected in flasks and evaporated in rotary evaporator to removal the hexane**.** The four oils obtained were *A. dosmesticus* oil (ADO), *T. molitor* oil (TMO) *Z. morio* oil (ZMO) and *R. ferrugineus* oil (RFO). To determine the fatty acid profile the oils were derivatized into fatty acids methyl esters (FAMEs) and analysed by gas chromatography. The oxidation stability was measured with the Rancimat test.

Results: In reference to fatty acid profile, the principal fatty acids detected in ADO oil were linoleic acid (0.34 g/g oil) followed by oleic acid (0.25 g/g oil) and palmitic acid (0.36 g/g oil) whereas in TMO the main fatty acids found were oleic acid (0.41 g/g oil) and linoleic acid (0.28 g/g oil); palmitic and stearic fatty acids were also detected but in lower amount. In ZMO, again oleic acid (0.36 g/g oil) was the principal fatty acid followed by palmitic acid (0.29 g/g oil). Finally, in RFO oleic and palmitic acids were the main fatty acids found with values of 0.51 and 0.37 g/g oil, respectively. As regards to oxidation stability, RFO showed the highest stability value with an induction time of 20.15 h. ADO and ZMO showed similar values with induction times of 6.60 and 6.31 h. Finally, TMO showed the lowest stability with an induction time of 2.54 h.

Conclusion: Overall, the results obtained highlight the potential of oils from edible insects as food ingredients owing to their nutritional characteristics. Furthermore, it is plausible that these components can be a feasible and sustainable option for replacing some of the currently available fatty ingredients in the development of functional food.

P2.2.125

Textural and rheological properties of texture modified salmon products for dysphagia patients.

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Aim

To develop nutritive, texture modified salmon products suited for people with severe dysphagia within IDDSI level 4. Comparison of how two different texture modifiers (agar and corn starch) work with varied amount of oil and water as well as refrigerated and frozen storage to fulfil the lack of storage sable products suitable for dysphagia patients.

Method

Salmon (Salmo salar) portioned and frozen (-30 oC) prior production was thawed, heat treated at 90 oC,10 minutes (core temperature). Following heat treatment, the fish was blended (Thermomixer, VorWerk, France) with addition of oil (0, 1 and 3%), water and inclusion of texture modifiers (agar and corn starch). After blending, one part of the mixture was packed in PA/PE casing (Betan, Viscofan, Czech Republic), heat treated (core temperature 90 °C, 10 minutes) and stored cold (4 °C). The other part was filled in silicone moulds and frozen (-30 °C). All samples were preheated at 95 oC for 20 mins (core temperature 65-70 °C) prior to analysis. Frozen samples were thawed before preheating. Samples were analysed for hardness (Texture Analyzer, Stable Micro Systems Ltd, UK) and rheology (Rheometer, TA Instruments, US). As control a commercial dysphagia adapted salmon product was used.

Results

The corn starch products had low hardness values (0,8-0,6 N), higher both yield stress, storage modulus, viscosity measured at different shear rates and a tan δ value under 0.6. The agar products showed low yield stress and lower viscosity levels. There was significant difference between frozen and refrigerated samples for both corn starch and agar modifiers, but frozen corn starch samples showed more significant differences in all measured parameters. For oil content, no significant difference was observed between oil content for agar samples, but it was significant for 0 and 3% for corn starch samples.

Conclusion

Salmon products suitable for dysphagia patients were developed, categorised as pureed (IDDSI level 4). Oil content influence was dependent on the texture modifier used. Freezing influenced measured properties in all samples providing more insight into challenges of storage of food made for dysphagia patients.

P2.2.126

Vegan alternative to cheese: Melting properties of plant-based proteins

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Aim:
Recently, vegan alternatives to cheese become more popular and plenty of products are already available on the market. Nevertheless, there is still a need to improve such products and knowledge about plant-based raw materials is limited. Usually, cheese alternatives do not contain any or only little amount of protein. Thus, from nutritional point of view they do not represent an alternative to traditional cheese. From tofu production it is known that plant-proteins are able to form firm gels. Now the question arises: Is it possible to create a plant-protein matrix that shows a firm texture and also the typical melting behaviour of dairy cheese.

Method:
Heat-induced protein gels were prepared with pea protein and zein, the prolamin from corn. Afterwards, the thermoreversible characteristic of the gels was investigated with several methods. Here, oscillatory measurements with the rheometer and the "Schreiber-Test", at which the samples were heated in an oven at 232 °C, were conducted. Besides 100 % pea protein and 100 % zein gels also hybrids of pea and zein were analyzed.

Results:
Pea protein gels did not show any thermoreversible behaviour, whereas for zein melting was obsereved around 30 °C to 40 °C. Due to preparation of zein-pea protein hybrids melting was improved compared to pure zein gels and thermoreversible behaviour close to dairy cheese could be noted.

Conclusion:
For pea protein further research must be conducted to investigate how protein-protein interactions can be modulated to create a thermoreversible network. For zein protein melting behaviour close to traditional cheese could be created by preparation of zein-pea protein hybrids. For these hybrids further research should be addressed to optimize the general texture and aroma profile of the gels.

P2.2.127

Potential of protein hydrolysates as sugar replacers in non-fat and full fat ice cream

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Aim:
Ice cream is a popular dairy product, and usually contains a lot of sugar. Due to the negative health effects of sugar, the development of low-sugar ice creams is desired. In this study, we investigated the potential of protein hydrolysates as a sugar replacer, by investigating different properties of ice cream. Protein hydrolysates from different sources were used in both non-fat and full-fat systems.

Methods:
To investigate the effect of protein hydrolysates on the ability to control the freezing point and accompanying ice content, we determined the ice curve as a function of temperature for different systems by using differential scanning calorimetry(DSC). To confirm the positive effect of these hydrolysates in more complex ice cream systems, we also investigated ice cream recipes containing fat. By using a rheometer and texture analyzer, we test the physical properties of protein hydrolysates ice cream. A microscope with a temperature chamber was used to observe the ice crystals in both non- or full-fat ice cream.

Results:
We examined the influence of these hydrolysates on the development of viscosity, both in the premix and in the serum phase after freezing. Our results revealed that protein hydrolysates were able to control the ice content and increased viscosity and that the specific contribution was dependent on the compositions of the hydrolysates in terms of size distribution. Furthermore, we observed that protein hydrolysates positively influenced overrun, which has a large effect on different texture attributes, such as hardness. The addition of fat resulted in smaller ice crystals compared to the samples containing no fat, and a more homogenous size distribution compared to reference samples containing sucrose. The melting behavior of the protein hydrolysate samples was similar to that of sucrose samples, showing that the protein hydrolysate has the potential to replace sugar.

Conclusion:

Overall, our study highlights the potential of protein hydrolysates as a functional ingredient in ice cream formulations, with the ability to modulate ice content, viscosity, overrun, and accompanying melting and textural properties.

P2.2.128

Protein and Mineral in vitro digestibility of Edible Filamentous Fungi R.oligosporus

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Aim:
Edible filamentous fungi, as a source of mycoprotein, is an emerging sustainable protein source. A notable benefit of filamentous fungi is that it does not contain phytic acid. Moreover, certain fungi species, such as *Rhizopus oligosporus,* is known to produce phytase. Due to its capability of hydrolyzing phytic acid, the filamentous fungi is hypothesized to have a high mineral accessibility, even when cultivated in phytic acid-rich media such as oat. This study compared protein digestibility and mineral accessibility of *R. oligosporus* cultivated in phytic acid-rich oat media versus glucose media.

Method:
The fungi *R. oligosporus* was cultivated using submerged fermentation in oat flour and glucose media. The INFOGEST 2.0 static *in vitro* digestion protocol was employed to simulate gastrointestinal digestion of the fungal biomass, with oat flour used as the control. The *in vitro* protein digestibility was measured as the protein degree of hydrolysis (DH%) using the OPA reagent, while mineral accessibility (Ca, Fe, and Zn) was quantified as soluble minerals of the digests using MP-AES.

Results:
The fungi protein content was higher (39% dw) in glucose media compared to oat media (21% dw), however, fungi cultivated in glucose provided a lower DH (34%) upon *in vitro* digestion compared to fungi cultivated in oat (58%).
The fungi's mineral content varied with the media, particularly calcium. The phytic acid content of the fungi remained low (<0.1g/100g) in both oat and glucose media. However, fungi cultivated in glucose media presented Ca, Zn, and Fe accessibility at 51%, 9.3%, and 38%, while the fungi cultivated in oat media only provided an accessibility of -40.2%, -4.1%, and 14%, pointing at other antinutrients of the oat-derived fungi, beyond phytic acid.

Conclusion:
There are significant differences in content, digestibility and accessibility of protein as well as minerals between *R.oligosporus* cultivated in oat and glucose media. The fungi cultivated in oat media had a low phytic acid content, however, it exhibited antinutritional effects regarding minerals accessibility. Opposite, fungi proteins derived from oat were more accessible.

P2.2.129

Integrated product development enabled by digital measurements and process control of fibrous meat substitutes

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Integrated product development enabled by digital measurements and process control of fibrous meat substitutes

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Aim:
Meat analogues made from plant proteins are a promising solution for substituting meat. However, there are still huge gaps in textural properties that need to be closed to achieve a similar sensory experience. Instrumental analyses often fail to fully describe the sensations that humans experience when eating meat or meat analogues. For example, textural properties (i.e. tenderness, hardness) measured using a texture analyzer fall short in describing the mouthfeel. On the other hand, sensory analysis on its own is often too subjective and time-consuming to draw conclusions for technical product development. Therefore, an efficient and effective product development requires a holistic, integrated analytical approach that helps to characterize materials on several length scales (molecular, micro, meso, macro) and directional dependencies (lengthwise, crosswise).

Method:
For this purpose, meat and meat analogues are characterized and properties are correlated. On a molecular level, chemical composition as water, protein, fat and ash content is determined. At the microscale, SEM (scanning electron microscopy) is performed. At the mesoscale, Warner Bratzler and optical microscopy are chosen. At the macroscale, TPA (Texture Profile

Analysis), WHC (Water Holding Capacity), and sensory analysis by an expert panel are used to describe the samples. For the mechanical analysis, the samples were cut lengthwise and crosswise to the fiber's direction.

Results:

Several correlations were demonstrated. For example, the sensory attribute of "firmness to bite" correlates to the mechanical characteristic of hardness at 90% compression (obtained via TPA). Furthermore, a correlation was identified between the sensory attribute of juiciness and the water-holding capacity (WHC). Additionally, meat analogues display anisotropy on a macroscale, also reflected in directional dependency of mechanical analysis results. By contrast, meat appears isotropic on a macroscale, and therefore no directional dependencies were found. By adjusting the macroscale anisotropy of meat analogues, texture can be influenced to mimic a meaty mouthfeel.

Conclusion:

These results contribute to a better understanding of factors that influence the textural properties of meat analogues mimicking meat characteristics. These results will pave the way for creating a digital shadow that can be used to adjust the sensory and physiochemical properties of meat analogues.

P2.2.130

Cultured meat platform developed through the structuring of edible microcarrier-derived microtissues with oleogel-based fat substitute

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Aim:

Cultured meat aims to mimic the texture, nutrition, and appearance of animal-derived meat through tissue engineering and food technology. In the current research, we develop methodologies for scalable cell expansion based on edible microcarriers and introduce cell-to-meat processing approaches with the incorporation of oleogel-based fat substitutes to establish a novel technological platform for cultured meat.

Method:

Edible microcarriers composed of food-grade polymers were successfully developed to support cells' attachment and growth. Additionally, the method for cell expansion on the edible microcarriers in a scalable and commercially-viable manner was optimized, thus addressing different culture parameters and their effects on cellular growth and phenotypes. Served as the building blocks of cultured meat products, the cellularized edible microcarriers (microtissues) were directly incorporated into the final products or processed through additional steps such as aggregation and homogenization. Further restructuring of the cellular mass into stable, cohesive constructs was achieved using oleogel-based fat substitutes with enzymatic and physical approaches. We finally analyzed the textural, nutritional attributes, and color of the produced cultured meat prototypes and compared them to the animal-derived meat.

Results:

By optimizing scalable methodologies to produce edible microcarrier-derived microtissues, we verified the feasibility of their commercial-scale production. As for the fat substitute, we developed an oleogel system incorporated with protein, which presented a comparable appearance, color, and hardness to beef fat with better nutritional values. Its combination with the cellularized microtissues enabled the engineering of two cultured meat prototypes. The layered cultured meat prototype was produced based on microtissue aggregates that supported better stiffness and nutritional values, while the burger-like cultured meat prototype utilized homogenized microtissues to imitate the marbling appearance of animal-derived meat.

Conclusion:

The current research establishes a cultured meat platform based on cellularized microtissues and oleogel-based fat substitutes that are processed using different approaches to demonstrate two cultured meat prototypes, mimicking the appearance, texture, and nutritional values of animal-derived meat. Altogether, we have established a robust technological groundwork for the applicability and scalable production of cultured meat products.

P2.2.132

Basidiomycetes bioprocess to produce natural meat and dairy flavors from non-animal source

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Aim

We aim to develop natural meat and dairy flavors from plant-based sources using basidiomycete biotechnology to provide consumers with the same sensory experience and pleasure of consumption as animal-based products.

Methods

Basidiomycetes submerged cultivation and Sensomics are key tool-boxes to achieve our goal. 20 Edible Basidiomycetes act as starter culture to form the desired meaty and cheesy flavors using spices, herbs, plant proteins, and oils. Sensomics including instrumental analysis, sensory assessment, and statistical analysis, is utilized to uncover the fundamental molecular basis of flavor formation during fermentation.

Results

An innovative, scalable, and efficient basidiomycetes-mediated bioprocess has been developed, which allows sustainable production of natural flavors including meat (palatable meaty, savory, fatty, fried beef patty-like, liver sausage-like flavors) and pleasant cheesy flavors from pure *Allium* genus (garlic, onion and leek) and the combinations of diverse legume-proteins and coconut-oil, respectively. Under the dedicated control of mycelium condition, substrate concentration and light control, the developed new fermentation system with whole cells of edible basidiomycetes achieved a fast, robust, and cost-efficient bioprocess for clean-labeled natural vegan meat flavor generation (WO 2022/053599A1). Among the pleasant flavor mixtures, a series of sulfurous compounds and carbonyl compounds (bis(2-methyl-3-furyl) disulfide, (*E*,*E*)-2,4-decadienal, (*E*,*Z*)-2,4-decadienal etc.) proposed synthesized by leading basidiomycetes (*Polyporus umbellatus*, *Laetiporus sulphurous*) played an important role in the overall meaty aromas, whereas typical cheesy odor note was mainly attributed to biogenetic short-chain fatty acids (3-methylbutanoic acid, butanoic acid, 2-methylpropanoic acid) by *Aegrocybe aegerita,* as revealed by Sensomics. Through feeding tests, L-cysteine, thiamine and leucine were identified as the precursors for the formation of bis(2-methyl-3-furyl) disulfide and 3-methylbutanoic acid. Towards industrial production and food application of the created meat and cheese flavors, upscaling of the developed bioprocess (6 L) together with the aroma stability under heating and oxygen are addressed.

Conclusion

Our findings address knowledge and technology gaps in creating sustainable natural meat and cheese flavors from non-animal sources for future foods. Furthermore, knowhow in the developed biological process with basidiomycetes above is expected to be transferable to formation other innovative vegan natural flavors (cooked seafood flavor etc.), accelerating the development of foods that match consumer preferences.

P2.2.133

Thermally Induced Degradation of Beneficial Glucosinolate Progoitrin: Characterization of Flavor Products and Proposed Degradation Pathways

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Aim:

As important bioactive components and flavor precursors, glucosinolates are ubiquitous in the plant family of *Brassicaceae*. Glucosinolate degradation products are the major volatile flavor compounds of rapeseed (*Brassica napus* L.) oil, accounting for up to 80% of the total volatiles. However, up to now, little attention has been paid to the volatile flavor products of the nonenzymatic thermal degradation of glucosinolates which widely occurs in *Brassicaceae* plants during thermal processing. This paper aims at conducting a systematic study of the thermal degradation behavior of progoitrin (the main glucosinolate of rapeseed) under various conditions and proposing the possible generation pathways of the major volatile products to provide data and theoretical basis for the modulation of volatile glucosinolate degradation compounds of hot-pressed rapeseed oil to obtain oils with the desired flavors.

Method:

The thermal degradation behavior and flavor products of progoitrin in different matrices (phosphate buffer at a pH value of 5.0, 7.0, or 9.0, sea sand, and rapeseed powder) at different temperatures (150-200ºC) and times (0-60 min) were studied using high-performance liquid chromatography (HPLC) and headspace solid-phase microextraction-gas chromatography-time of flight-mass spectrometry (HS-SPME-GC-TOF-MS).

Results:
The degradation rate of progoitrin decreased in the following order: pH 9.0 > sea sand > rapeseed powder > pH 7.0 > pH 5.0. Further, a higher degradation was observed with increasing temperature and time. Under the applied conditions in this study, a total of 16 nitrogen-containing and sulfur-containing compounds were found, 14 of which were first identified in the thermal degradation substances of glucosinolates. 2,4-Pentadienenitrile was the major nitrile and thiophenes were the major sulfur-containing volatile compounds formed. Possible formation pathways of main sulfur-containing and nitrogen-containing volatiles were proposed.

Conclusion:
Glucosinolate progoitrin was more labile toward heat treatment under basic conditions compared to neutral and slightly acidic conditions. It was deduced that the bimolecular nucleophilic substitution reaction (S_N2) occurred during thermal degradation under basic conditions, which could explain the reason behind the rapid thermal degradation. Results could provide data and theoretical basis for the flavor control of glucosinolate-containing raw material (e.g., rapeseed and broccoli) under thermal treatment at elevated temperatures (>150 °C).

P2.2.134

Potential of Flour Fractions to improve Predictions of Baking Quality using Near-Infrared and Raman Spectroscopy

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Aim
One of the most important quality parameters of wheat flour is the bread-making quality. To date, it is still necessary to perform labor-intensive baking tests. Various attempts have been made to establish correlations and chemometric models to predict the baking quality from rheological or spectroscopic data, but they still lack in accuracy. For example, it is well known that the protein content is not well correlated to the baking volume. The aim of the study was to test if the predictions of baking quality from spectroscopic data can be improved by preparing and analysing gluten and starch fractions as well as dough from wheat flour instead of flour on its own.

Method
Doughs of fifteen wheat flour samples were prepared in a 50 g farinograph using the optimum water absorption and dough development time. The doughs were washed out according to ICC No. 155 to obtain gluten and a starch slurry, which was subsequently centrifuged. Doughs, glutens and centrifuged starch were freeze-dried for 24 h and finely milled. Near-Infrared (NIR) and Raman spectra of flour, gluten, starch and dough samples were recorded. Two large scale and one mini-baking test were performed. Partial least squares (PLSR) and principal component regression (PCR) were used to build models to predict the specific bread volume. Various preprocessing routines (e.g. Savitzky-Golay smoothing and differentiation, iterative polynomial baseline fitting (IPBF), high-pass filtering, Standard Normal Variate transformation (SNV), min-max normalization) as well as a combination of spectra of the different sample types were tested for their predictive ability.

Results
For both spectroscopic techniques and all baking tests, the predictions were improved by using gluten, starch, dough or a combination of different sample types compared to using flour spectra only. For flour spectra, the best coefficients of determination for cross-validation R^2_{CV} ranged from 0.40-0.70 for NIR and 0.15-0.50 for Raman spectroscopy. Using the other sample types or a combination thereof, R^2_{CV} of 0.72-0.92 for NIR and 0.65-0.81 for Raman spectroscopy were achieved.

Conclusion
The results demonstrate that different sample types prepared from flour have the potential to improve the predictions of baking quality using different spectroscopic methods.

P2.2.135

Food contaminants alter inflammatory mediators in neuronal cells

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Aim: The aim of this research was to elucidate the mechanisms of action by which GTX and OTA alone and combined exert their toxicity over non-differentiated SH-SY5Y and to observe which effect do they have over the immunological cell's action mechamisns.
Method: firstly, the cytotoxic effect of GTX, OTA and [GTX + OTA] treatments by the MTT ([3-4,5-dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide) assay during 24, 48 and 72h exposure time was assessed. Subsequently the isobologram method was applied to elucidate if the mixtures of these mycotoxins produced synergism, antagonism or additive effect. Lastly immunological mediators were measured by the determination of the production of IL-6 and TNF-α by ELISA.
Results: IC_{50} values were obtained in SH-SY5Y cells when treated with GTX 48 h and 72 h IC_{50} values were reached at, 1.24 and 1.35 µM respectively. IC_{50} values were obtained in OTA's treatment at all exposure times, 24 h, 48 h and 72 h, at 8.25, 5.49 and 4.5 µM respectively. Synergetic effects were obtained by [GTX + OTA] treatment after 24 and 48h exposure whereas after 72h an additive effect was observed. IL-6 and TNF-α production was increased when exposing SH-SY5Y cells at all mycotoxin's treatments being this increase, more pronounced for [GTX + OTA] after 48h exposure.
Conclusion: the synergism observed between GTX and OTA leaded to a higher cytotoxicity which can be explained with the rise in the production of IL-6 and TNF- α inflammatory mediators playing an important role in these mycotoxins' mechanisms of toxicity.
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P2.2.136

Valorisation of dietary fibre in oleogel preparation: textural attributes and storage stability

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Aim:
The aim of this research was to investigate the effect of fibre addition on structural and oxidative stability of rice bran wax oleogels. The latter, has great potential to be able to replace solid fat with gels containing unsaturated or poly-unsaturated edible while fibre contain structuring material and bioactive components (e.g. antioxidants or vitamins) that allow to improve the overall health benefits of the oleogels.
Method:
Rice bran wax (4.5% wt/wt) oleogels were prepared with inclusion of different dietary fibres as potential structuring agents. The effect of oil type (sunflower, SFO or extra virgin olive oil, EVO), fibre type (bamboo, citrus or aronia) and concentration (0.5% and 1%) were evaluated based on structural properties (texture) and oil binding capacity (OBC) of final gels. Moreover, storage tests under accelerated conditions (illuminated systems at 4°C and 35°C for 10 days) were carried out to assess thermal oxidative stability of systems using peroxide values (PV) as indicator.
Results:
In terms of texture attributes, no differences were detected compared to EVO or SFO controls. Nonetheless, EVO gels, without fibre addition, exhibited the highest oil retention. Oil/wax systems showed dissimilar texture attributes in presence of different fibres. Generally, 1% fibre addition led to an increase in gel strength network in presence of citrus and aronia fibre for EVO, and citrus and bamboo fibre for SFO. However, fibre inclusion dramatically affected oil binding capacity especially EVO systems for which oil loss ranged between 16.8 to 41.4% compared to the 86.78% of the reference gel. Regarding the stability, fibre showed a protective activity against oxidation especially in SFO samples. After production, fibre added gels showed PV almost one half time less than control. Finally, citrus and bamboo fibre, that displayed highest affinity in gel fortification, better performed in maintaining the lowest PV level along accelerated storage in both conditions.
Conclusion:

Dietary fiber addition showed an interesting protective action against oil oxidation, mantaing also the lower PV level. However, further investigation is needed to study the rheological and thermal behaviour as well as the microstructure of systems to better elucidate the role of fibre in 3D-network interaction.

P2.2.137

Molecular insights on the effect of onion polyphenols on peanut-derived immunogenic peptides bioaccessibility and bioavailability

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Aim:
The increase of non-communicable disseases, the exponential rise in the prevalence of dietary intolerances and food allergies, the different nutritional requirements according to age and the need to align all of this aspects with the organoleptic attributes and risks of food, conclude in a trend to develop research directions to design complex in vivo, in vitro and mechanistic models aimed at understanding the interaction between dietary components and the hosts and ultimately the impact on food quality and human health. Under this scenario, the work presented herein is focused on unravelling the molecular interaction between onion polyphenols and peanut proteins and the effect in peanut-derived immunologic proteins bioaccesibility, bioavailability and immune response in vitro.
Method:
Onion polyphenols were extracted, fractioned and further characterized by LC-MS/MS. Likewise, peanut proteins were extracted and characterized following a bottom up proteomics approach. The ability of onion polyphenols to modulate the immunogenic peptides bioaccesibility was studied after mimicking the in vitro digestion and following up the peptides formed by nano-LC-MS/MS and the intact proteins by SDS-PAGE. The bioaccesible fraction was further submitted to a transepithelial transport assay in a caco-2 cell model to characterize the peptides bioavailability.

Results:
Onion polyphenols showed a marked effect on peanut proteins digestibility and immunogenic peptides bioaccesibility. Indeed, the basic subunit of the peanut allergens Arah3 and Arah2 were rapidly hydrolysed in oral and gastric phase since the onion polyphenol improve the digestibility. Onion polyphenols clearly affected the release of immunogenic peptides after mimicking the human digestion process. When the assay was performed with the isolated protein fractions a strong inhibition in the release of immunogenic peptides was highlighting the influence of glycosylation grade and the hydroxyl-methyl substitution at 3`position. Furthermore, an overall transport inhibition by polyphenols was generally observed, which denote a clear influence of onion polyphenols on immunogenic peptides bioavailability in vitro.

Conclusion:
Results presented herein contribute to the current knowledge on the effects of polyphenols on immunogenic proteins bioaccessibility or bioavailability, while suggesting new guidelines in the selection of ingredients considering the food components interaction as a step forward towards the design of healthier foods.

P2.2.138

TEMPERATURE IMPACT ON TEXTURAL PROPERTIES OF COMMERCIAL DYSPHAGIA- ORIENTED PRODUCTS

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TEMPERATURE IMPACT ON TEXTURAL PROPERTIES OF COMMERCIAL DYSPHAGIA- ORIENTED PRODUCTS

AUTHORS:
Arantza García, Lorea Azcona, Francisco C. Ibáñez, María José Beriain, Adrián Claver, José Antonio García, María Teresa Murillo-Arbizu

Aim:
Oropharyngeal dysphagia (OFD) is the inability to safely move liquid or semisolid/solid food from the oral cavity to the esophagus. One strategy for the management of OFD include adapted feeding by texturizing solid foods. Nowadays, there are few studies that characterize the textural properties of commercial tailored foods for OFD people. Thus, the objective of this study was to establish the effect of temperature on the rheological and tribological characteristics of 6 commercial products oriented to people with swallowing difficulties.

Method:
The samples apparent viscosity was measured by a rotational viscometer fitted with a type R spindles (Haake, Karlsruhe, Germany). Samples were placed in 100 mL cylindrical glass beakers and the tests were carried out at a constant speed of 50 s^{-1}, for 120 s (Pa*s). Friction coefficient was assessed using a Pin-on-disk tribometer (MicroTest; Madrid, Spain). A steel ball and a PDMS membrane were used as contact surfaces (dimensionless results). All measurements were performed in triplicate at 20 ºC and 40 ºC.

Results:
At 20º C, viscosity values ranged from 3 to 65 Pa*s between samples. Two main clusters were obtained: one with viscosities data under <10 Pa*s, and a second group that reported viscosity values up until 5-folds higher. Results varied from 2.08-9.78 Pa*s at 40ºC. These findings reveal the temperature impact on this parameter mainly in the second cluster of samples. Except for two samples, where the friction coefficients values obtained were half at 40ºC compared to 20ºC, minor variations in the tribometry score were shown when assay temperature is considered. Values ranged from 0.06 to 0.16.

Conclusion:
The temperature condition of measurement influenced the viscosity and the tribological behaviours of commercial products. This study underlines the crucial importance of standardizing the test temperature while designing and developing new foods for OFD customers.

P2.2.139

Block cryoconcentration assisted by centrifugation applied to manzanilla (Chamomilla suaveolens) and matico (Buddleja globosa) infusions

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Block cryoconcentration (BCC) is an environmentally friendly technology that occurs at sub-zero temperatures, which requires lower energy costs and higher separation efficiency than other concentration techniques such as evaporation or membrane technology. Whereby, different liquid foods have been treated by BCC, and in addition, external forces have been coupled to increase the separation efficiency and nutritional properties in the final concentrate. However, there are few studies on centrifugation-assisted BCC applied to herbal plant extracts. Therefore, the aim of this work was to study the effects of BCC at three centrifugal freezing-thawing steps applied to extracts of manzanilla and matico leaves in terms of physicochemical properties, total bioactive compounds (TBC), and antioxidant activity (AA). Then, axial freezing at -20 °C was applied to obtain a cryoconcentrate from extracts leaves (10 g/1 L at 80 °C for 30 min) using centrifugation (1600 RCF/15 min/20 °C) for the separation of ice and cryoconcentrated fractions. This procedure was performed in three cycles, and in each cycle the concentrated fraction was used as initial solution for the next cycle of BCC process. Thereby, after three stages, the concentration (%w/w) of matico (initial sample 2.4% (w/w)) and manzanilla (initial sample 1.6% (w/w)) showed a significant increase, with a final value close to 19.7% (w/w) and 18.1% (w/w), respectively. Moreover, TBC and AA values presented an increase of 2.1, 2.0, 1.8 and 3.1 times, and 1.9, 1.5, 1.1 and 2.5 times compared to the initial values, with 745 and 623 mg gallic acid equivalents/100 g d.m., 256 and 201 mg catechin equivalents/100 g d.m., and 102 and 88 mg cyanidin 3-glucoside equivalents/100 g d.m., 1546 and 1027, and 2130 and 1341 µmol trolox equivalents/100 g d.m., for total polyphenol, flavonoid, and anthocyanin contents, DPPH and FRAP assays, for manzanilla and matico, respectively. For efficiency, percentage of concentrate, and solute yield, the values were close to 86%, 81%, and 0.9 (kg/kg), respectively. Therefore, the aqueous herbal plant extracts obtained by BCC are liquid solutions very interesting in quality properties, and in turn, the impact of this study is based on the concentration through a non-thermal and innovative technology.

P2.2.140

PhInd: a database on polyphenol contents in agri-food waste and by-products

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Aim:

This work aims to describe the database that collects and displays the data on the content of polyphenols in agri-food waste and by-products – PhInd.

Method:

The PhInd database was developed throughout five steps: literature search, data compilation, data aggregation, data exportation to the MySQL database and final data evaluation. PhInd was developed on the basis of data collected from peer-reviewed publications from 2015 until present. Key words used for data compilation were: by-product AND polyphenol OR phenolic OR anthocyanin OR flavan-3-ol OR flavanol OR flavonol OR valorization. The selection of the data was made on the availability of quantitative information on polyphenols as determined by HPLC. The PhInd database is publicly available at http://phind.uns.ac.rs/.

Results:

The database is organized into five sections: 1) type of agri-food waste and by-products and its botanical origin, 2) source of agri-food waste and by-products (e.g. branch of industry, industrial process and scale of process) 3) pre-treatment applied to assist the extraction (drying, deffating, hydrolysis, application of assistive technologies) 4) extraction solvents and technique used and 5) individual polyphenol compounds content. A total of 6454 composition data extracted from 701 scientific publications are included. Majority of the entries originates from fruit and wine processing (39.51 and 18.26%, respectively), followed by agricultural waste (11.55%), herb (6.42%) and nut processing (5.85%), while other types of industry processing is represented by less than 5% of entries.

Conclusion:

PhInd is the first comprehensive database on polyphenol content in agri-food waste and by-product, and it can serve as a valuable tool for researchers, industry and consumers. Researchers can utilize the database to access the data on polyphenol content, extraction methods, to discover trends, identify correlations, and monitor the research gaps. Industry can utilize database for product development, optimizing processes, and exploring opportunities for value-added utilization and ideally creation of new value chains. PhInd can help consumers to make informed choices, but also as educational resource which promotes awareness about the benefits of consuming polyphenol-rich foods and reducing food waste in the households.

P2.3.01

Difference in the temperature rise rate of common carp fillets packaged in three ways

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Aim:

Common carp (*Cyprinus carpio*) is a freshwater fish, the consumption of which is, especially in the countries of Central Europe, associated with gastronomic traditions, which creates a demand for carp meat. Thanks to the gradual development of freshwater aquaculture in Europe, common carp farming is becoming sustainable. The nutritional value of carp meat makes it an important food for human health. However, fish meat is generally susceptible to rapid spoilage during storage and transport. If the cold chain is disrupted, the food safety can be significantly affected. This work aims to determine the time during which the core of common carp fillets will temper to the elevated temperature of the surrounding environment, depending on the different ways of packing carp fillets.

Methods:

Fresh common carp fillets were packaged in three different ways: simple, vacuum and protective atmosphere packaging. The packaged fillets were first chilled and then placed into a thermostat tempered to an elevated temperature (temperatures of 8,11,14,17,20 and 25°C were tested) for 4 hours. The temperature in the core of the fillet was monitored using a needle temperature probe; the temperature in the thermostat was recorded as well.

Results:

Statistically significant ($p<0.01$) differences were found in the rate of increase in the fillet core temperature depending on the type of packaging. Vacuum-packed fillets, where the packaging film tightly surrounds the fillet, reached ambient temperature in 2-3 hours, while fillets packed in plain packaging or in a protective atmosphere in 3-4 hours. Apparently, the mixture of gases present inside the package acts as a thermal insulator and slows down the heat transfer to the fillet. The speed of reaching the ambient temperature also depended on the temperature itself. At higher tested temperatures (17,20,25°C), the time needed for tempering the fillet to the ambient temperature was longer than at lower temperatures (8,11,14°C).

Conclusion:

The method of fillet packaging significantly influences the time needed for the core to reach the ambient temperature. Vacuum-packaged fillets reached the ambient temperature significantly faster than those packaged in simple packaging or a protective atmosphere.

This work was financially supported by NAZV project No. QK21020245.

P2.3.02

Evaluating the impact of mepanipyrim and tetraconazole commercial fungicides on wine quality throught microfermentation assays

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Aim:

The residues of phytosanitary products in grape must, even at trace levels, could interfere with the fermentative activity of the yeast and, consequently, alter the course of the fermentation process and the biosynthesis of aromatic compounds. These changes could be attributed to the activity of the antifungal substances and the adjuvants present in the commercial formulations.

Method:

Synthetic musts were spiked, separately and jointly, with the target fungicides (tetraconazole and mepanipyrim) and their adjuvants (sodium docusate and sodium dodecyl sulphate-SDS, respectively). Microfermentations were carried out in triplicate after inoculation with the yeast *S. cerevisiae* EC1118™. In addition, control microfermentations (without fungicides) were done for comparative purposes. Throughout the fermentation process, liquid samples were taken to monitor the fermentation course and the aromatic composition of the fermented must.

Results:

The sugar consumption rate increased in the presence of sodium docusate and the mixture of tetraconazole and sodium docusate. On the contrary, this parameter decreased in those must spiked, separately, with mepanipyrim or SDS. SDS also increased the ethanol production rate and tetraconazole the biomass to ethanol yield. With respect to the aromatic profile, major changes were observed for tetraconazole that increased the floral and fruit nuances of the fermented must.

Conclusion:

The observed effects were fungicide dependent. In general, the addition of sodium docusate has an antagonist effect over tetraconazole while SDS has a synergic effect with mepanipyrim.

P2.3.03

Assessing new Bifidobacterium-based probiotics from the maternal-infant environment to improve colonic microbiota in cystic fibrosis

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AIM: Altered gut microbiota in children with Cystic Fibrosis (CF), as a consequence of the intestinal disease and the continuous use of antibiotics, is characterised by a decreased abundance of beneficial genera such as *Bifidobacterium*. Our objective is to screen the functional capabilities of different *Bifidobacterium* isolates from the maternal-infant environment in order to develop specific and targeted probiotic supplements for the CF population.

METHOD: From IATA microbial collection, Five *Bifidobacterium* strains (*B. animalis subsp. lactis* IATA01*, B. pseudocatenulatum* IATA35*, B. longum subsp. suillum* IATA02*, B. bifidum* IATA13*,* and *B. longum subsp. infantis* IATA05) isolated from maternal-infant faecal samples were characterized and assessed *in vitro* to determine some important probiotic abilities. Gastrointestinal digestion survival, carbohydrate (CH) metabolism, adhesion to mucin and anti-inflammatory properties were studied. In addition, a static *in vitro* colonic fermentation was carried out using inoculums of 4 pediatric patients with CF to assess the colonic microbiota modulation by targeted qPCR and microbial metabolisms by the production of short-chain fatty acids (SCFAs) analysed by GC-MS in each individual microbiota.

RESULTS: Strain-specific characteristics were detected in the different assessed functional capabilities. Three strains (*B. animalis subsp. lactis* IATA01*, B. pseudocatenulatum* IATA35 and *B. longum subsp. infantis* IATA05) were able to survive after simulated gastrointestinal digestion, from which *B. animalis* IATA01 showed a low CH growth profile, and in contrast the highest performance in adhering to mucin. All the strains were able to increase the levels of *Bifidobacterium* genus during simulated colonic fermentation (with the CF infant feces), while higher inter- and intra- individual variability was observed in reducing potential pathogenic groups (as *Enterobacteriaceae* members) and increasing beneficial bacteria (*Akkermansia* and *Faecalibacteriu*m), depending on both the inoculum and the strain. In most of the inoculums, the production of total SCFAs increased.

CONCLUSION: In conclusion, this study evidenced specific effects of different *Bifidobacterium* strains, even from the same species, and points to a *B. animalis subsp. lactis* IATA01 strain as candidate for future specific probiotic supplements for to improve colonic microbiota in children with CF.

P2.3.04

Shelf-life study of chicken hamburguers by culture-dependent and -independent techniques

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Aim:

Meat is considered a vital component of the daily diet due to its high nutritional value. Unfortunately, its high nutritional content, high water activity (≥ 0.85) and moderate pH (≥ 4.6), make meat a highly perishable food-commodity susceptible to microbial growth. The determination of the microbiota responsible of meat expiration is convinient in order to take measures to prevent microbial replication. Although culture-dependent techniques have been extensively used to determine food-related microbiota, culture-independent techniques, such as metagenomics, are increasingly being used because they provide faster and more complete information. Therefore, the aim of this study was to determine the shelf-life limiting microbiota of chicken hamburgers storaged under cooling and low-oxygen conditions by culturing techniques and metagenomics.

Method:

Chicken hamburgers from seven different batches were sampled on two different production days. Culturing techniques along with metagenomic analysis were carried out to determine the composition of the microbiota at two different times, on production day and after the expiration day.

Results:

Culturing techniques enabled the quantification of different microbial groups present in chicken hambugers' samples. Pseudomonas was the predominant microbial group on production day, what makes sense as they are one of the main spoilage microorganisims in meat. However, after the expiration day, pseudomonas counts had decreased and lactic acid bacteria counts had increased, which could be due to the low-oxygen levels.
Metagenomics enabled the determination of the relative abundance of the different microbial groups at each taxonomic level, from kingdom to species. In this case, *Pseudomonas* spp. was also the main genus on production day, followed by *Brochothrix* spp. and *Shewanella* spp.. On the contrary, *Lactobacillus* spp. and *Leuconostoc* spp.were the main genera after the expiration day.
Conclusion:
Both techniques concluded that lactic acid bacteria were the shelf-life limiting microbiota in chicken hambugers storaged under cooling and low-oxygen conditions. However, metagenomic analysis provided more information, highlighting that *Lactobacillus* spp. and *Leuconostoc* spp. were the responsible genera. In addition, metagenomics demonstrated the presence of different genera that were not take into account in culturing techniques, which could be very useful to identify potential sources of contamination.

P2.3.05

Microbiome analysis of the Mytilus galloprovincialis from Northern Greece, based on Next Generation Sequencing methodologies.

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Aim:
Mediterranean mussels (*Mytilus galloprovincialis*) (Lamarck, 1819), due to their nutritional mechanisms which involve filtering huge amounts of water, are affected by seawater pollution and can host microbial diversity of environmental origin as well as pathogenic bacteria, which must be constantly monitored. A Next Generation Sequencing marker gene (16SrDNA) approach was applied for the characterization of the *M. galloprovincialis* microbiota, collected from mussel farms in the region of Thermaikos gulf, Northern Aegean Sea, Greece.
Method:
The collection of samples was carried out during December 2021 – February 2022, July 2022, August 2022, in specific farm zones (Chalastra, Makrigialos). Totally fifteen samples were collected from a 3-8 meters depth, and within four hours they were transferred to the Veterinary Center of Thessaloniki. Then, their shell was opened with a sterile knife; the content was placed in stomacher bags and homogenized for 2 minutes, using the Stomacher device. A microbiological test was also performed using the Most Probable Number (MPN) method for the enumeration of *Escherichia coli* (according to ISO 16649-3: 2005) and the presence of *Salmonella sp*. (isolation method using RVS broth and XLD agar). DNA isolation with the DNeasy PowerFood Microbial Kit and amplification of whole 16SrRNA gene (1500 bp) was conducted with locus specific primers (27F & 1492R). Libraries were constructed according to the 16S barcoding kit and raw data were base called with algorithms implemented in GUPPY software. Clean sequences were subjected to EPI2ME Fastq 16S cloud-based bioinformatics workflow for taxonomic classification.
Results:
The microbiological analysis revealed a low presence of *E. coli*, <230 MPN/100 g and confirmed the absence of *Salmonella sp*. The most prevalent taxa at the genus level were *Mycoplasma* (12.2%), *Anaplasma* (5.8%) and *Ruegeria* (5.2%). Significant differences in the abundance of the most dominant genera were found in all levels of comparison (seasons, regions and zones within each region), highlighting the dynamic character of microorganisms.
Conclusion:
Abundance differences between the two regions in winter and summer may have occurred as a result of microenvironmental fluctuations, such as temperature and nutrient supply availability. Temperature displays a key role in the microbial community of *M. galloprovincialis*.

P2.3.06

Modulation of wine profile in a global warming scenario by different malolactic fermentation strategies.

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Aim:
Incoming global warming imposing strategies to adapt wine profile at an unknown scenario. Malolactic fermentation (MLF), the biological deacidification of wines, must become a conscious choice to optimize the content in organic acids and the sensory profile of the wine. The authors present different works to understand how modulate the oenological activity of strains of *Oenococcus oeni.*

Method:
Simultaneous fermentation is an alternative strategy for managing MLF, which involves the inoculation of lactic bacteria into the grape must, instead into the wine at the end of alcoholic fermentation as traditionally practiced in winemaking. This approach has been tested in southern red wines with a high ethanol potential, withe aromatic wines, and sparkling-base wines. Furthermore, on a population of strains of *O. oeni* was verified the effect of the correction of grape must/wine acidity by different organic acids, in terms of MLF kinetics, cell viability and diacetyl production.

Results:
In the last years the focus of the selection of bacterial strains for malolactic fermentation was re-oriented from the mere ability to accomplish malic acid degradation, to the adaptability at different winemaking protocols. In this sense, simultaneous inoculum of bacteria and yeast in grape must seems to achieve different goals. In southern, high ethanol and low acidity wines bacteria results more active respect to tests performed by traditional post-alcoholic inoculum, accomplishing MLF without spoilage effects, such as volatile acidity increase. In the case of tests performed in winemaking if aromatic or sparkling base wines the simultaneous inoculum results in a higher varietal character. Tartaric, malic, and citric acid were tested to correct the low acidity of grape must/wine before MLF. Malic acid over the 2.5 g/L affected evolution of MLF, while citric acid stimulates bacterial activity and diacetyl production. The addition of tartaric acid results counterproductive at the higher value. Bacterial activity in grape must is more efficient than in wine in terms of rate and completeness of MLF.

Conclusion:
The acidic profile of wine is one of the key aspects in a global warming scenario, for longevity and organoleptic quality. This work offers useful information to modulate the activity of lactic acid bacteria.

P2.3.07

Inactivation of Bacillus Coagulans by pulsed electric fields under different pH: comparison with thermal treatment

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Aim:
Bacillus coagulans is a spore-forming bacterium with optimal survival conditions at temperatures ranging from 30°C to 55°C and pH ranging from 4.5 to 7.0. Additionally, *Bacillus coagulans* has been shown to have a high heat tolerance, which allows it to survive and remain viable during pasteurization of foods. It can contribute to the development of undesirable flavors in canned vegetables and fruit products. Thus, its inactivation is a key safety target for the relevant industry. The application of pulsed electric fields (PEF) has already been recommended as a new non-thermal pasteurization method of fruit juices with lower heat load compared to the conventional thermal processes, while minimally affecting the quality of final products.
The aim of this study was to evaluate the effect of PEF treatment on the inactivation kinetics of *Bacillus coagulans* vegetative cells in different pH buffer solutions.

Method:
Bacillus coagulans (10^7 CFU/mL) were suspended in buffer solutions with different pH values ranging from 4.0 to 7.0. Thermal inactivation of *Bacillus coagulans* was also conducted at temperatures 60-90°C for 1 to 30 min, under all studied buffer solutions. The samples were also subjected to different PEF (11, 15 and 20 kV/cm up to 0.12 s, 20 Hz, 15 μs pulse width) process conditions at its most resistant pH condition. Mathematical description was also conducted using appropriate empirical mathematical equations. D values were estimated for thermal and PEF treated samples.

Results:

The results from thermal treatment showed that *B. coagulans* vegative cells were heat resistant and the optimal pH for their survival ranged from 5.0 to 6.0, with inactivation rates 4-fold the ones obtained for pH values 4.5 or 6.5. PEF treatment also inactivated *B. coagulans* cells. More intense PEF conditions resulted in increased inactivation rates. At 20 kV/cm, a full inactivation of *B. coagulans* was observed, even at its optimal survival pH values.

Conclusions:

The results obtained show that PEF processing at selected conditions could be applied for the inactivation of *B. coagulans* vegative cells independently of the pH of the environment (fruit-vegetable), allowing for promising scale-up.

P2.3.08

Digestibility and fermentability of supramolecular protein architectures: A case study of proteinaceous amyloid-like fibrils

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Aim: Processing can strcutrue proteins into diverse arcitechtures and assemblies, for example amyloid-like protein fibrils may form during spray or freeze drying. However, the link between amyloids and human pathogeneses raises concern over their formation in foods. Therefore, this study fabricated various protein fibrils, tested their fucntionality as delivery vehicles and their potential digestive fate.

Method: Processing conditions (pH=2, 37-80°C) were applied to alpha-lactalbumin (ALA), β-lactoglobulin (BLG) or ovalbumin (OVA) to fabricate amyloids fibrils (AF) that were characterized by DLS and TEM as well as Thioflavin T assay. In turn, AF samples were tested for encapsulation of capcaicin (CAP) in terms of loading and efficiency as well as digestibility using semi-dynamic *in vitro* digestion coupled to LC-MS/MS proteomic analyses. Persistent fractions were tested for colonic fermentability using *in vitro* anaerobic fermentations of freshly collected human feces (n=5) and studied by 16S sequencing and QIIME2. Microbial metabolic pathways were predicted in silco using PICRUSt2 and significant up/down-regulation of pathways were tested using ANCOM-BC on pathways abundance tables.

Results: This work shows amyloid structures attenuate the digestive proteolysis of ALA, BLG and OVA in the upper gastro-intestine and levels of bioaccessible peptides while effectively entrapping and controlling the release of 200 µM CAP. Colonic fermentations demonstarte fibrilization helps maintain microbiota diversity and protect butyrate producing Roseburia and Clostridium genera, as alpha-diversity scores were significantly lower ($p<0.003$) for OVA (121±29, n=13) in comparison to OVA-AF (161±27, n=17). Interestingly, beta-diversity ANCOM-BC analysis shows specific symbionts of the gut are significantly reduced in relative abundance in the presence of OVA (e.g., Roseburia). In silico analyses further highlight fibrils diverted microbiota metabolic trajectories towards those observed in fermentation of prebiotic fructo-oligosaccharides (FOS, used as a positive control.

Conclusion: Processed foods are increasingly confronted by the need to elucidate their impact on consumer health and wellness. This study indicates protein fibrils can be used as delivery vehicles, help maintain microbiota diversity in the colon and protect butyrate producing Roseburia and clostridium genera from adverse effects. Yet, human trials are required to fully affirm or refute safety and efficacy of amyloids in foods.

P2.3.09

Influence on the profile of volatile aroma compounds by fermentation of different protein sources

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Aim:

For many people, the pursuit of a healthy and sustainable diet has become the focus of attention. Since the high consumption of meat in particular is seen as problematic from the point of view of a sustainable and healthy diet, vegetarianism is becoming increasingly popular as an alternative form of nutrition. Many plant-based alternatives, for example, made from soy or rye milk, are already commercially available. These often have a strong taste in the corresponding raw material. Fermentation is a method of food preservation that has been known for thousands of years. As a transformative bioprocess, fermentation by microbial cultures or their enzymes can be used to extend the shelf life of raw plant and animal products. As one of the most commonly used cultures in food fermentation, it also influences foods' characteristic sensory and/or nutritional properties. Lactic acid bacteria are most commonly used in the production of dairy products, sourdough, or shelf-stable sausage. Fermentation with lactic acid bacteria is used to improve the flavor profile and sensory properties. In this way, new sensory-appealing products can be created on a plant basis. This study investigated the influence of lactic acid bacteria on the volatile flavor profile of rye drinks and soy drinks compared to lactic acid bacteria. The influence of the matrix on the formation of volatile aroma compounds during the fermentation of lactic acid bacteria will be investigated. To date, the flavor profile of rye drinks, in particular fermentation with lactic acid bacteria, has hardly been researched.

Method:
In this study, the fermentation of rye and soy drink with lactic acid bacteria is investigated in comparison to cow milk. Volatile aroma compound profiles were studied using headspace GS-MS analysis. The vials are subsequently analyzed using a headspace GC-MS (Shimadzu) and evaluated in the NIST database.

Results:
Initial results have shown that fermentation of the substrates with the lactic acid bacteria resulted in different volatile flavor profiles. In the fermented milk, 16 volatile aroma components were detected, whereas, in the fermented substitute, only 14 components were detected. It is noticeable that in the milk product mainly alcohols, aldehydes, and acids are measured, ketones could only be detected in small amounts. In the substitute products, on the other hand, mainly ketones and acids are analyzed, and aldehydes and ethanol are present only in small quantities.

Conclusion:
Fermentation of products with lactic acid bacteria opens up new possibilities for the preservation and refinement of products. In addition, high-quality protein sources are created for vegetarians or lactose-intolerant people.

P2.3.10

Effect of InVitro Gastrointestinal Digestion and Colonic Fermentation on the Stability of Polyphenols in Pistachio

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Aim:
The aim of this study was to evaluate the stability and bioaccessibility of polyphenolic compounds from different varieties of pistachio during in vitro gastrointestinal digestion and faecal fermentation by UHPLC-HRMS analysis.

Method:
Samples of six pistachios varieties were peeled, ground and store at -80ºC until analysis. An in vitro gastrointestinal digestion procedureand a colonic fermentation was carried out Aliquots were taken during the process at different times.. The identification and quantification of polyphenols in the extracted pistachio samples was carried out using a UHPLC-HRMS system.

Results:
The total polyphenol content decreased significantly during the oral (recoveries of 27 to 50%) and gastric phase (recoveries of 10 to 18%), without significant changes after the intestinal phase (recoveries of 5 to 9%). After in vitro digestion, the hydroxybenzoic acids and the flavan-3-ols were the main compounds found in pistachio, with respective total polyphenol contents of 73 to 78% and 6 to 11%, although both groups showed the most significant decreases during in vitro digestion.. The colonic fermentation affected the total phenolic content of the six varieties studied, with a recovery range of 11 to 25% after 24 h of fecal incubation. After 24h of fermentacion, a total of 12 catabolites could be identified and quantified by UHPLC-HRMS. The main compounds were the 3-(3´-hydroxyphenyl)propanoic, 3-(4´-hydroxyphenyl)propanoic, 3-(3´,4´-dihydroxyphenyl)propanoic, 3-hydroxyphenylacetic acids and 3,4-dihydroxyphenyl-G-valerolactone. Based on these data, a catabolic pathway for colonic microbial degradation of phenolic compounds is proposed.

Conclusion:
During the in vitro digestion process, a significant decrease in total polyphenol content occurred on all pistachio varieties. After complete digestion, Kerman and Larnaka varieties showed the highest bioaccessibility, followed by Golden Hills and Sirora, been Aegina the variety with the lowest bioaccessibility. The faecal fermentation process transformed the phenolic compound profile of pistachio into its degradation catabolites. After 24h of incubation, the main groups of polyphenols were hydroxybenzoic acids for the Aegina, Kerman and Larnaka varieties, and flavones for the Golden Hills, Kastel and Sirora varieties. The mayor catabolites identified at the end of the fermentation process are potentially responsible for the health properties attributed to pistachio consumption.

P2.3.11

Effects of selected thermal treatments on the bioactive and textural properties in bell peppers

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Aim:

The main objective of the work was to assess the impact of selected thermal processing techniques on the textural profile and bioactive properties of bell pepper fruits at various stages of fruit harvest maturity.

Method:

Separate fruits of green, yellow and red bell peppers were boiled in hot water (for 10 minutes) and microwaved (for 2 minutes and 30 seconds). The textureometric parameters of the bell pepper fruit were assessed using a texturometer and the double compression test. The total antioxidant potential, the content of polyphenolic compounds and reducing sugars after cooking and microwave processing were also determined.

Results:

The process of cooking and microwave processing contributed to an increase in the content of polyphenolic compounds in green bell peppers and, at the same time, to a decrease in yellow and red bell peppers. In turn, the cooking process increased the total antioxidant potential in green and yellow bell peppers and decreased the antioxidant potential in red bell peppers. The processes of cooking and microwave processing significantly reduced the hardness of green bell pepper, while not causing significant differences in the hardness of yellow bell pepper. After applying the described methods of heat treatment, no significant differences in cohesiveness and springiness were found for green bell peppers.

Conclusion:

The finding indicates that microwave cooking is more beneficial for red bell peppers. In contrast, cooking in hot water is more beneficial for green and yellow bell peppers. Thus, it should be suggested that the cooking process of red bell pepper should take place with the smallest possible amount of water and short cooking time to avoid large losses of bioactive compounds during processing.

P2.3.12

Fast differentiation of monofloral honeys by Fourier-transform infrared spectroscopy.

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Aim:

Visual sorting of pollen grains for monofloral classification of honey by human specialists is a difficult and time-consuming task. The objective of this study is to develop new, efficient, and user-friendly tools for classifying honeys based on their botanical origin. This will be achieved through the utilization of non-destructive and low-sample treatment techniques, specifically infrared spectroscopy.

Method:

The proposed methodology is based on the direct analysis of a small amount of honey using attenuated total reflection with Fourier transform infrared spectroscopy (ATR-FTIR). Subsequently, the obtained infrared spectra are analysed, and the most significant bands or regions are selected and integrated to calculate their areas. This information is then normalized using the quotient technique. This transforms the data matrix from original variables (areas) to predictor variables (area's quotients) which is logged into the chemometric software to perform linear discriminant analysis (LDA) for the classification of the honeys. The data matrix was divided into a training matrix and an evaluation matrix with the remaining samples. The conditions of the chemometric analysis were meticulously fine-tuned to achieve optimal separation between the botanical origin groups.

Results:

The aforementioned methodology was applied to 615 honeys previously classified as monofloral (citrus, rosemary, erica, eucalyptus, lavender, and thyme) by optical microscope when they met the minimum requirement percentage of pollen of a specific botanical species. This is a common practice in the commercial honey transactions. Following the execution of the optimized linear discriminant analysis, all six groups corresponding to the different botanical origins were accurately classified. This demonstrated that ATR-FTIR followed by LDA of the spectral data, presents a high potential to discriminate types of honey.

Conclusion:

This study developed an efficient methodology using infrared spectroscopy to classify honeys based on their botanical origin. The method involved direct and non-destructive analysis of honey samples, selection of important spectral bands and integration of their areas. After the adequate chemometric treatment of the data, all samples were successfully classified according to their botanical origin. The methodology provides a fast and reliable tool to attribute a honey to a certain monoflorality, with potential applications in quality control and traceability.

P2.3.13

Characterisation of Bambinella pear and application of post-harvesting treatments to prolong shelf-life

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Aim: The volumes of fruit locally grown in Malta are quite low due to the unique climatic conditions and the type of soil. Historically, Malta had always relied on imported fruits and vegetables to satisfy local needs, being vulnerable to food shortages due to seasonality patterns and facing issues related to food sustainability. *Pyrus communis* var. *bambinella* is a variety of a small summer pear, native to the Maltese islands, which is solely grown and sold between July and September every year and is highly susceptible to post-harvest diseases. The aim of the study was to characterize for the very first time the quality parameters of this unique variety and investigate the potential of selected post-harvesting methods to enhance prolonged availability to the local market.

Method: The quality indicators assessed in the current study as a way to define the optimal harvesting time for the pear included the weight, the flesh firmness, the soluble solid content, the starch degradation and the titratable acidity. The post-harvesting treatments employed included cold storage at 1-2°C, controlled atmosphere packaging (water vapor permeability), disinfection with chlorine solution of 100ppm for 10 min, disinfection with pyrimethanil at 400mg/L for 2 min and application of Na-alginate coatings.

Results: The results indicated that the most effective and low-cost post-harvesting treatment was the cold storage where an extension of the shelf-life was possible for a total of two months. The rest of the post-harvesting treatments showed similar outcomes in terms of shelf-life, with the exception of the coatings, where the crops were infected with fungal contaminants earlier than two months.

Conclusion: In conclusion, the findings of the study are of a particular importance for the local farmers and market, and could assist on determining the ideal harvesting time for the pear based on its quality characteristics, minimizing any food losses encountered early at the farms. Furthermore, this study also suggests a method for preservation so that the pear is available on the market for extended periods of time.

P2.3.15

In Vitro Fermentation of Wholemeal Rye Bread Modulates Intestinal Microbiota and Short-Chain Fatty Acid Production

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Aim: Intestinal fermentation of dietary fiber leads to an increase in short-chain fatty acids (SCFA), predomintantly acetate, butyrate and propionate[1,2]. A high-fiber diet is able to selectively promote the growth of *Bifidobacterium*, a specific acetate- and butyrate-producing bacteria[2]. In this study, the aim is to evaluate the influence of an *in vitro* colonic fermentation of wholemeal rye bread on the intestinal microbiota composition, and thus the production of SCFA and ammonium ion.

Method: *In vitro* fermentation assay was performed using the dynamic multi-compartmental digestion system simgi® (CIAL-CSIC) with 80 g of bread. Samples of fermentation liquids from the ascending, transverse, and descending colon compartments (AC, TC, and DC, respectively) at 0 and 72h were collected. Ammonium ion determination was carried out using the Spectroquant Ammonium Test Kit. Selective and differential culture media were used to microbial analysis and SCFA were determined by GC-FID.

Results: At 0h, ammonium ion concentration of 20.8, 16.5 and 10.5 mg/L in AC; TC and DC, respectively, were observed and decreased to values below 2 mg/L. In all colon compartments, an increase (72 *vs.* 0h) of *Enterococcus* spp. (2.3–3.0-fold), *Staphylococcus* spp. (2.1–2.3-fold), *Lactobacillus* spp. (1.5–2.1-fold) and *Bifidobacterium* spp. (1.2–1.3-fold) was observed. In AC and TC, an increase in acetate (4.2- and 2.4-fold) and butyrate (1.6-fold) was detected at 72 *vs*. 0h. In DC, acetate decreased 1.7-fold and butyrate increased 24.3-fold. Propionate decreased in all comparments at 72 *vs.* 0h by 30.5-, 9.9- and 2.3-fold.

Conclusion: This study confirmed the microbiota intestinal modulation by wholemeal rye bread consumption using an *in vitro* fermentation model. The expected growth of *Bifidobacterium* was observed, which consequently led to the production of SCFA, since it is a specific acetate- and butyrate-producing bacteria.

References: [1]Eriksen et al., 2020; [2]Gong et al., 2020.

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P2.3.16

Monitoring enteric viruses and somatic coliphages in raw and regenerated wastewater.

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Aim:

The current water scarcity linked to an adverse climatic situation entails the need to reuse available water resources, in particular regenerated water after urban wastewater treatment for agricultural, recreational and industrial purposes. The presence of emerging microbiological contaminants by water transmission contributes to the prevalence of infectious diseases after consumption of fresh produce, therefore Regulation (EU) 2020/741 establishes minimum quality requirements for regenerated water intended to be used for irrigation which promote public health and environmental protection. The aim of the study was to monitor the presence of human enteric viruses in the influents and effluents of a wastewater treatment plant located in the Valencian Community. In addition, viral infectivity was assessed by viability PCR along with quantification of somatic coliphages.

Method:

Analyses were performed on concentrated water samples by flocculation with aluminum hydroxide and the presence of human enteric viruses and crAssphage was determined by RT-qPCR and qPCR, respectively. Somatic coliphage counts were carried out as an indicator of human enteric viruses. Potential infectious viruses were detected using PMAxx-RT-qPCR, after validation in wastewater samples.

Results:

The results show significant reductions in influent compared to effluent levels for the viruses analysed, however, some of the effluent samples did not comply with the current European legislation reduction (6 Log_{10}). Titers of coliphages ranged from $2.80x10^5$ to $6.85x10^7$ in influent, and from not detected to $3.25x10^5$ in effluent waters, where only 40% of the analysed waters achieves the regulated reduction for total coliphages. The optimized viability assay (PMAxx-RT-qPCR) detected norovirus GI, norovirus GII and rotavirus potentially infectious in effluent samples.

Conclusion:

Enteric viruses show resistance to water depuration treatments, being detected in infectious forms in effluents, posing a risk to consumers.

P2.3.17

Gelatinisation type and gallic acid co-gelatinization modulates starch hydrolysis, rheology, and microstructure during simulated GI digestion

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Aim:

The mechanism by which nutritionally relevant sodium alginate oligosaccharides (SAOs) are degraded in the human gut microbiota (HGM) is poorly understood. Here we explore how the HGM organisms *Bacteroides cellulosilyticus*, *Bacteroides thetaiotaomicron*, and certain bifidobacterial strains such as *Bifidobacterium breve UCC2003* and *Bifidobacterium longum subspecies infantis* metabolise SAOs obtained through physically-mediated approaches.

Method:

Two commercial sodium alginate references with varying M/G ratios and molecular weight (M_w) were processed non-thermally in solution by high hydrostatic pressure (HHP) and pulsed electric fields (PEF) in the absence or presence of H_2O_2 to obtain SAOs. Depolymerisation products were then thoroughly characterised by rheology, GPC, XRD, FTIR and ^{1}H-NMR to confirm the flow behaviour of the processed solutions, M_w, crystallinity patterns, and M/G ratio, respectively. For the microbiological experiments, *Bacteroides* strains were routinely cultured in brain heart infusion (BHI) media supplemented with 1% haematin, whilst bifidobacterial strains were routinely cultured in either de Man Rogosa and Sharpe medium supplemented with 0.05% cysteine-HCl or reinforced clostridial medium. All strains were incubated under anaerobic conditions in a modular atmosphere controlled at 37°C, and growth supported by SAOs was monitored by OD_{600nm}. Cross-feeding assays, metabolite analysis and proteomics were further conducted to elucidate the metabolic pathways that allow the different strains to degrade SAOs.

Results:

Thorough saccharide characterisation demonstrated the ability of HHP and PEF in the absence or presence of H_2O_2 technologies to change the flow behaviour index, reduce the M_w and alter the crystalline structure of both polysaccharides. To date, this work has readily demonstrated that both commercial alginate references and their respective depolymerised products support the growth of *Bacteroides cellulosilyticus* and *Bacteroides thetaiotaomicron*. Accordingly, the metabolic pathways that allowed both strains to degrade SAOs have been elucidated. Further work is currently being undertaken to elucidate the potential of SAOs to support the growth of bifidobacterial strains *Bifidobacterium breve UCC2003* and *Bifidobacterium longum subspecies infantis*.

Conclusion:

From a prebiotic perspective, it seems that SAOs represent a very species and strain-specific carbohydrate (though we of course, do not know if other gut commensal may grow on it), but it may be a very effective and highly specific synbiotic if used in combination with a probiotic that has the ability to metabolise these SAOs fractions. Further studies will be required to investigate if other *Bifidobacterium* spp. or other gut commensals are able to metabolise these oligosaccharides and how this may impact other gut community members and, consequently and importantly, host health.

P2.3.18

Diversity of the microbial community and its correlation with VOCs of defective Iberian dry-cured shoulders

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Aim:

The aim of this work was to determine the internal and external microbiota of defective Iberian pig shoulders and to determine the characteristic compounds of the volatile profile of this spoiled Iberian dry cured meat products.

Method:

For the study, next-generation sequencing was applied to monitor the microbial communities of spoiled dry-cured shoulders. Microbial diversity was studied by sequencing the amplified V3-V4 region of the 16S rRNA gene using primers and PCR conditions described by Klindworth et al. (2013). Sample multiplexing, library purification and sequencing were carried out as described in the "16S Metagenomic Sequencing Library. Preparation Guide" by Illumina. Besides, the determination of volatile organic compounds was carried out by chromatography-mass spectrometry (GC-MS).

Results:

The results showed that the internal and external microbial communities were different. The main genus found in the outside of shoulders were *Pseudomonas*, *Psychrobacter* and *Pseudoalteromonas.* However, in the inner *Cutibacterium* and *Lawsonella* were main genus found. The volatile profile of spoiled Iberian dry cured shoulders showed that these products are characterized by presenting high values of different alcohols and high content in aldehydes.

Conclusion:

The results obtained indicate that the massive sequencing is a viable method for the characterization and identification of defects of this type of meat products.

P2.3.19

Bioconversion of soybean residue using Pleurotus ostreatus mycelium through solid-state fermentation

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Aim:

Soybean residue (okara) is a by-product from the tofu and soymilk industries accounting for 14 million tonnes of okara generation per year in the world and is mostly discarded despite its nutritional value. Moreover, mycelium which can decay and decompose organic materials may be able to accomplish a value addition to okara. Thus, this study aimed to conduct solid-state fermentation of okara using *Pleurotus ostreatus* mycelium and identify the potential of fermented okara to manufacture alternative food products.

Method:

An inner tissue of *Pleurotus ostreatus* (oyster) mushroom was inoculated on sterilized potato dextrose agar and incubated until the complete growth. After inoculating one piece of mycelium culture in each petri dish either packed with oven-dried and sterilized okara or a control medium containing sawdust, incubation was done to reach full colonization. Mycelium growth during the solid-state fermentation was evaluated by considering mycelium radial extension in two perpendicular directions. Unfermented and fermented okara were subjected to elemental analysis, amino acids (umami and sweet taste) analysis, and taste characterisation by electronic tongue measurement.

Results:

For both mediums, solid-state fermentation of okara by mycelium was completed within approximately two weeks of incubation. The growth rate was higher in the control during the first week of fermentation while similar growth rates (0.67-1.33±0.47 mm/day) were achieved in both mediums near the end of the fermentation. However, the mycelium density appeared to be higher in the okara medium. After the fermentation, in okara, the C content decreased by 4.9% while the N content raised by 1.6% leading to a decline of the C/N ratio from 10.73 to 7.21. The contents of both sweet and umami taste amino acids were increased with the fermentation of okara. Moreover, umami taste, saltiness, and richness were enhanced in okara by fermentation while sourness and bitterness were reduced.

Conclusion:

Solid-state fermentation of okara using *Pleurotus ostreatus* mycelium was conducted successfully while exhibiting its potential for food product development. Mycelium fermentation caused the improvement of umami taste characteristics and a decrease of the C content indicating the breakdown and decay of organic matter in okara.

P2.3.20

Autochthonous species as enrichment and starter culture for maize starch fermentation: the case of ogi

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Aim:
Traditionally fermented food may show variations in functional properties due to uncontrolled processing conditions and inconsistent contributions of the microbial species present in the mixed community of fermenting microbes. For constant and reproducible results, the control of fermentation using a starter culture is often promoted, which implies a sterile matrix for the added microorganisms to effectively grow and drive the turnover of substrates into the appropriate metabolites. Thermal treatments can provide this sterile condition but not every substrate can be heat treated without undesirable side effects, for example, maize starch for making *ogi*, a popular traditionally fermented product in West Africa. To bypass this constraint, lactic acid bacteria (LAB) and yeast were used as kick-off inoculum to dominate and direct the fermentation.

Method:
Maize starch was produced and fermented in plastic containers with lids at 30°C. Salted peptone water containing 7 log CFU/ml LAB and 6 log CFU/ml yeast isolates previously selected from traditionally fermented *ogi* samples, were added to the fermenting cultures at 1% (v/v). Single cultures (9) and 47 cocultures fermentations were evaluated together with negative (no inoculum) and positive (inoculated with traditional *ogi*) controls at 0, 7 and 24 h for counts, pH, sugars, organic acids and volatile organic compounds.

Results:
LAB counts in coculture samples were slightly higher than negative controls at every time point. LAB increased significantly within 7 h of fermentation but only slightly between 7 and 24 h. Yeast counts were 2 to 3-fold higher than negative controls after 24 h. Certain added yeast species did not contribute to significant growth of LAB, whereas others induced a decrease. All fermentations reached a pH value of around 4 after 24 h. Additions to the fermenting cultures of different combinations of strains generated almost similar aroma profiles to the positive controls.

Conclusion:
Our study shows that the addition of kick-off autochthonous cultures in maize starch fermentation may lead to products sharing similar characteristics with traditionally fermented starch. Follow-up research will evaluate this similitude through sensory and consumers tests. The functional properties and microbial stability of samples obtained from kick-off cultures will also be investigated.

P2.3.21

Hyperbaric storage – a new food preservation methodology for Byssochlamys nivea ascospores' development control?

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Aim: This study aimed evaluating the effectiveness of hyperbaric storage (HS) at room temperature (RT), a new food preservation methodology based on storage pressure control (inasmuch temperature control as in refrigeration) to control the germination and development of *Byssochlamys nivea* ascospores in commercial apple juice. Additionally, the impact of previous commercial-like pasteurization conditions, using thermal pasteurization (TP) and high-pressure processing (HPP) was assessed, to simulate a commercial apple juice contaminated with ascospores.

Method: Samples of commercial apple juice (pH=3.70) were inoculated with *B. nivea* ascospores (5.17 log CFU/mL) and subjected to different processing conditions, including TP (70°C-80°C, 30 sec), and nonthermal HPP (600 MPa, 3 min, RT). The processed samples, along with unprocessed ones, were then placed under HS conditions (25-150 MPa, 30 days, uncontrolled RT, 20-25°C). Control samples were also stored at atmospheric pressure under refrigeration. Microbiological analyses were performed in potato dextrose agar, with an aliquot of each sample being heat-treated treated at 70°C for 10 min to inactivate vegetative forms (to determine the thermal resistant fraction).

Results: The feasibility of HS/RT in controlling *B. nivea* ascospores development was found to be dependent on the previous processing methodology. Unprocessed and samples processed at 70°C/30 sec showed similar evolution under HS conditions, with neither ascospore germination nor inactivation being observed. Contrarily, samples processed at 80°C/30 sec and 600 MPa for 3 min exhibited both ascospore inhibition (25-50 MPa) and inactivation (75-150 MPa) of more than 3.0 log units. Conventional refrigeration only inhibited ascospore development, which could pose a food safety threat due to possible germination and mycotoxin production after 30 days of storage.

Conclusion: HS with a previous 600 MPa/3 min treatment resulted in the subsequent inactivation of *B. nivea* ascospores by more than 3.0 log units along storage. TP and HPP alone were unable to achieve ascospore inactivation, as expected. This nonthermal process (HPP+HS) delivers enhanced food safety by preventing ascospore germination and hyphae formation (and, indirectly, mycotoxin production), while also providing the advantage of energy savings and minimal impact on the quality of food products due to the storage being conducted at uncontrolled room temperature.

P2.3.22

HPTS Turn Down the Heat: The Influence on Food Safety & Food Quality

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HPTS Turn Down the Heat: The Influence on Food Safety & Food Quality

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Aim:
High pressure in combination with high temperatures is an innovative and emerging technology to efficiently sterilize low acid food products over a long shelf-life. In this regard it is crucial to inactivate in particular spore former and endospores. Compared to commercial sterilization techniques, with long dwell times and subsequent extensive heat impact, the additional pressure application enables faster heating and cooling rates and instantaneous heating throughout the whole product. Therefore, a less harsh impact on nutritional and sensorial qualities is generally attributed to the so-called High Pressure Thermal Sterilization (HPTS), ideally resulting in a better overall quality of the food product. To this day HPTS is lacking implementation in the food industry.
Method:
To test and to gain deeper insights on the influence of HPTS on spore inactivation and quality attributes in different foods, suitable process windows for the products were established based on a 10^{12} CFU/ml inactivation of *Bacillus amyloliquefaciens* via 600 MPa, 105-121°C and 1-10 min. The optimal treatment conditions were than validated via storage trials. Once the process conditions proved to be suitable for the product, the samples were processed with the optimal conditions and analysed via HPLC, GC-MS to determine the amount of vitamin C, carotenoids or food processing contaminats. Further color and texture measurements were also conducted. The thermal sterilized products were used as reference.
Results:
HPTS showed promising results in the mitigation of potential toxic processing contaminants (~90-95 %) and retention of quality attributes e.g. carotenoids: HPTS 7 % loss and thermal benchmark process 31 %; color for HPTS delta E around 6 and benchmark process delta E 10; texture HPTS was closer to the “untreated” reference sample as the thermal benchmark
Conclusion:
Findings indicate that HPTS besides effectively inactivating spores, it can also beneficially improve selected quality-related attributes, e.g. reduced formation of food processing contaminants like furan. Consequently, a higher quality product for consumer is attributed. Fine-tuning of the process parameters pressure, temperature and time is therefore mandatory to reach both goals, microbial stability and high quality. Further, the implementation of HPTS via a smart engenneering approach will soon be possible.

P2.3.23

Aroma-active compounds of four variants of Mabisi, a traditionally fermented Zambian dairy product.

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Aim:
Aroma is among the key sensory characteristics of food that influence consumer perception. Variations in the volatile aroma profiles coupled with the presence of some compounds above a certain threshold in different products characterize the key odorants that are perceived by human olfactory senses. In this study, we investigated the key odorants, otherwise known as aroma-active compounds of a widely consumed fermented dairy product from Zambia called mabisi. Mabisi is produced at a small-scale level in a spontaneous way and production is sufficient only for home consumption or supply to the local communities. However, if produced at a larger scale to reach a wider market, mabisi could offer economic benefits, reduce the spoilage of milk, and improve the nutritional and food security of many households. Since mabisi is produced under uncontrolled fermentation, the knowledge from our study could facilitate the control and improvement of product quality and consistency for the purpose of production upscaling.
Method:
Four variants of mabisi were used in this study. The volatile composition of the four mabisi variants was investigated by using the HS-SPME/GC-MS and PTR-QiTOF-Ms techniques. The aroma-active compounds were identified by the use of a GC-O-MS and the findings were validated through the calculations of the Odour Activity Values (OAV).
Results:
During the PTR-QiTOF-MS run, 390 m/z peaks were measured, of which 216 peaks differentiated the mabisi variants significantly, while 55 peaks were tentatively identified. Most of the identified volatiles were previously reported in mabisi and other dairy products. For the GC-MS analysis, 35 volatile compounds were detected, mainly consisting of ketones, aldehydes, alcohols, esters, and carboxylic acids. Twelve of these volatile compounds were detected by human olfaction during GC-O-MS analysis with the most prominent being the ketones and esters giving a buttery and fruity aromas respectively.
Conclusion:
A diversity of volatile compounds were identified in the four variants of mabisi investigated in our study. The mabisi variants differed in the identified volatile compounds, the peak areas/ concentrations, and the aroma-active compounds.

P2.3.24

Antifungal activity of lipopeptide biosurfactants and its interactive effect with food ingredients

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Aim:
Fungal spoilage of food products contributes to food waste and can also produce harmful mycotoxins. While the food industry uses chemical preservatives to extend shelf-life, there is a growing demand for natural, less toxic and sustainable ingredients. This study aims to investigate the antifungal activity of different lipopeptide biosurfactants against food spoilage strains, by determining the minimum inhibitory concentrations (MICs), and their interaction with food ingredients.
Method:
Antifungal susceptibility tests with 6 different lipopeptides (A-F) were performed using microdilution assays in 96-well plates, with yeast extract sucrose (YES) medium. Lipopeptides A and B were single compounds, while C to F were a mix of A and B of different purities. These were screened in a concentration range of 0.5-64 µg/mL against *Aspergillus niger* D-02906, *Penicillium paneum* CBS 302.97, *Penicillium roqueforti* CBS 174.87, *Rhizopus stolonifer* CBS 819.97, *Eurotium rubrum* D-061178, *Hyphopichia burtonii* C-00349 and *Saccharomyces cerevisiae* NCYC 77. Calcium propionate was included as a chemical preservative control. The interactive effect of the antifungal activity of compound B with different food ingredients (NaCl, sunflower oil and starch) was investigated by adding these ingredients to YES media at different concentrations and screening for changes in the MIC.
Results:
The MIC values determined for the fungal strains tested ranged from ≤0.5-8 µg/mL for compound B and within 1-16 µg/mL for compounds C, D and E. Sunflower oil and starch exhibited negative effects on the antifungal activity of lipopeptide B, in concentrations as low as 0.3% (v/v) and 1.25% (w/v) respectively, increasing the MIC against *A. niger* and *P. paneum* by 2-8 fold. Conversely, NaCl did not affect the MIC of this compound in concentrations up to 0.7% (w/v).

Conclusion:
Lipopeptide biosurfactants containing compound B presented much stronger antifungal activity against the target strains than calcium propionate, at much lower concentrations. These findings suggest that lipopeptide biosurfactants could potentially be used as natural preservatives in food products. Additionally, understanding the interaction of antifungal activity with different food ingredients can aid in assessing the feasibility of applying these compounds to specific products.

P2.3.25

Inactivation kinetics of Lactobacillus plantarum MIUG BL21 by different treatments to produce paraprobiotics

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Aim:
This study aimed to evaluate the effects of thermal, ohmic heating, high pressure and ultrasound treatments on probiotic *Lactobacillus plantarum* MIUG BL 21 inactivation in order to develop paraprobiotics.

Method:
The stock culture of *Lactobacillus plantarum* MIUG BL21 from the Microorganisms Collection of the Dunarea de Jos University of Galati (MIUG) preserved by freezing, in 40% solution of glycerol (w/v), at temperature of -80ºC was used in this study. The inactivation studies involved the use of thermal treatment (from 60°C to 100°C, for 0 - 60 min), ohmic heating (at electric field magnitudes varying from 4 to 55 V/cm for a holding time between 2 and 25 min), high pressures treatments (for 5-30 min at 300 MPa, 3-18 min at 400 MPa and 2-12 min at 500 MPa, at constant temperature of 8℃) and ultrasounds (for a holding time of 15 minutes at pulse amplitude of 20 -100%).

Results:
For each treatment used, the results were expressed as the logarithmic reduction of the number of culturable cells after selected treatments, in relation with the initial number of bacterial cells. For the thermal treatment, the decrease of the survival rate ranged from 3.90 log N/N_0 after 60 min of treatment at 60°C to 8.18 log N/N_0 after 10 min at 90°C. For the ohmic treatment, a decrease in survival rate of 2.07 log N/N_0 was found for a voltage gradient of 20 V/cm, after 15 min of treatment. For high pressure treatments, the results showed that by varying the pressure at a constant time, of 10 min, an increase in the inactivation degree from 1.18 log N/N_0 at 100 MPa to 6.62 log N/N_0 at 600 MPa is obtained. The ultrasound treatment results showed a maximum reduction in viable cells of 3.6 log N/N_0 after ultrasound treatment for 10 min at 100% amplitude. The experimental inactivation data were fitted to Weibull model and Peleg model, allowing to estimate the *b* and *n* parameters.

Conclusion:
The results indicated different behavior for inactivation patterns, with thermal treatment allowing the highest decrease in survival rate, whereas complete inactivation was achieved by successive combination of ohmic, high pressure and ultrasound treatments with heating. The data were fitted with different kinetic models, such as Weibull and Peleg, allowing to estimate the inactivation parameters.

P2.3.26

Fruit juice enriched with probiotic cultures and biofunctional compounds: short-term effects on human glycemic responses

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Aim: Consumers demand microbiologically safe fresh or processed fruit/ vegetable juices that could also offer functional properties beyond the classical nutritional factors. In that sense, fruit juices can be fortified with probiotics and/or functional bioactive compounds such as vitamin D, ω-3 fatty acids etc. This study aimed to study the survival of free and encapsulated probiotic cultures in fruit juice and then to determine in a clinical study the effects of the fortified drink on the human glycemic and salivary insulin responses and subjective appetite.

Method: Two commercial probiotic strains i.e., *Lacticaseibacillus casei* Shirota and *Lacticaseibacillus rhamnosus* GG were used to inoculate orange juice (pH 3.8) at 8 log CFU/ml, as free or encapsulated cells in a whey protein isolate/ gum arabic (WPI-GA) coacervate. Vitamin D3 was added to the juices too. Then, they were cold stored for up to 7 days and microbiological, pH and sensory analyses were performed. These fortified juices were used in a randomized controlled, doubleblind, crossover, clinical trial. Clinically and metabolically healthy men and women participated with a body mass index (BMI) 18-25 kg/m^2 and age 18-55 years old**.**

Results: Free and encapsulated probiotic strains remained at their initial population level (8 log CFU/mL) during storage of fruit juice, whereas pH showed a small decline (3.56). The sensory analysis revealed that the juice with the free probiotic cells was unacceptable by the sensory panel after 4 days of storage due to the intense sour taste. In contrast, the juice containing the encapsulated cells was acceptable until the end of storage without the loss of fresh juice character. The clinical study showed that all fruit juice types provided lower peak glucose values, lower mean glycemic and insulinemic responses, were more pleasurable and affected satiety scores compared to glucose.

Conclusion: Functional fruit juice can be produced with encapsulated probiotics, vitamin D3 and ω-3, which may offer advantages to improved appetite scores, glycemic and body weight control.

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P2.3.27

Use of whole genome sequencing to identify Listeria monocytogenes persistence in the produce industry

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Aim: *Listeria monocytogenes* in the produce industry remain a problem. Elaborate sampling programs combined with the use of whole genome sequencing may shed light on the *Listeria monocytogenes* persistence and confirms possible transmission routes and high-risk areas.

Method: *Listeria monocytogenes* isolates were collected in and around a freezing tunnel of a produce processing company from February 2021 to December 2021. The whole genome of a selection of isolates was determined to establish persistence and possible transmission routes. This included isolates of the conveyor belt before and after C&D (n=19), and during production (n=8), isolates of the floors near the entrance of the freezing tunnel (n=11), inside the freezing tunnel (n=4) and near the exit of the freezing tunnel (n= 10) and isolates resulting from the shoes (n=12). Another eight isolates were included resulting from the technical maintenance. To see if long-term persistence is present isolates of 2020 (n=8) and 2022 (n=4) obtained by the company itself of similar areas and the end-product were added. The isolates were sequenced using Illumina High throughput sequencing.

Results: The whole genome of 82 *Listeria monocytogenes* isolates was determined and *Listeria monocytogenes* persistence was proven as the strains present on the conveyor belt after C&D (in and out the freezing tunnel) of several samplings in 2021 were genetically identical. The persistent clone was also found in 2020 and 2022 (including on the end-product), indicating persistence of at least three years and the freezing tunnel being a risk factor for post-contamination. Transmission and recontamination of the production area after C&D throughout the company were found to be at least partially attributed to contaminated shoes. One of the trolley carts used for technical maintenance proved to harbour the persistent strain as well, making this a second transmission vehicle for *Listeria monocytogenes* contamination of the production environment.

Conclusion: The identification of a persistent *Listeria monocytogenes* strain indicates the need to review the existing hygiene protocols as these do not suffice to eliminate the pathogen, especially on food contact surfaces such as the conveyor belt and transmission vehicles such as shoes.

P2.3.29

Screening of food thickener-producing strains for dairy mimetics

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Aim: The growing consumer demand for foods that do not contain artificial additives and are "clean label" can be addressed by fermentation through the use of lactic acid bacteria (LAB) capable of synthesizing different ingredients, such as exopolysaccharides (EPS). The use of EPS in food production can have many advantages, as they can impart desirable rheological changes in the food matrix such as increased viscosity, reduced syneresis and improved texture, as well as having emulsifying, thickening and stabilizing properties. There is great variability in LAB-based EPS in terms of quantity, monomer composition, molecular weight, charge and structure, resulting in a number of physicochemical and rheological changes, properties that can be harnessed for various applications in the food industry. The objective of this work is to select LAB capable of producing high molecular weight EPS that act as texturizing agents in plant-based mimetic products.
Method: 16 LAB strains previously isolated by CNTA were estudied, belonging to 3 different species of the genus *Leuconostoc*: *L. citreum, L. mesenteroides* and *L. pseudomesenteroides*. First, a study of the production capacity of EPS in Petri dish was carried out, in order to verify the presence or not of "ropy" morphology (mucous appearance of the colonies as a result of the production of EPS). Subsequently, fermentations were performed in synthetic broth supplemented with sucrose where it was studied as response variables among others the viscosity of the fermented product and the type of EPS produced, in order to select those LAB with greater capacity to produce high molecular weight EPS and provide a greater viscosity, attribute related to texture and the ability of EPS to be used as thickeners.
Results: Out of the total studied, 4 strains presented viscosity values higher than the rest, being *L. citreum* CNTA 860 the one that generated the greater amount of high molecular weight EPS, which resulted in a higher viscosity of the fermented broth.
Conclusion: These results suggest that the strain *L. citreum* CNTA 860 may be a good candidate for the production of EPS that act as texturizers in plant-based yoghurt-like products and desserts.

P2.3.30

Screening of Lactic Acid Bacteria to produce Diacetyl from agri-industrial waste

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Aim: Diacetyl is a high value product used in the food industry since it confers a buttery flavour to diary products such as cheese and yoghurt. Despite being produced industrially by dehydrogenation of 2,3-butanediol, an increased demand for natural aromas makes fermentation an interesting alternative. This compound is formed by the non-enzymatic oxidative decarboxylation of the alpha acetolactate produced by lactic acid bacteria (LAB). Depending on the amount of diacetyl, it could impact not just on the aroma but on the taste as well. However, the flux of alpha acetolactate is directed mainly to the production of acetoin and 2,3-butanediol. Thus, the ability of LABs to produce diacetyl is strain dependent. Therefore, the development of methods to identify the best Diacetyl producing strains is a crucial step. In addition, sustainability of the process could be enhanced by employing agri-food wastes as substrates to produce value-added products such as Diacetyl. The aim of this work is to stablish the methods to select suitable LABs strains as starters to produce Diacetyl from agri-food wastes by fermentation.
Method: Different LABs strains including the *Lactoccocus*, *Leuconoctoc* and *Lactobacillus* genus were screened. PCR tests were performed to detect genetic markers related to the production of diacetyl from citrate. Plus, Kempler and McKay (KMK) and Voges-Proskauer (VP) biochemical tests were performed to detect citrate consuming and acetoin producing strains, respectively. Based on the previous analyses, fermentations were carried out in synthetic media using the selected strains to quantify diacetyl production. Finally, the ability of the best strains to produce Diacetyl from different carbon sources found in agri-food wastes was tested.
Results: Diacetyl producing *L. lactis* strains from citrate were identified by PCR. Among the teste strains, only those belonging to only the *Lactobacillus* positive in the KMK test were able to consume citrate and increase diacetyl production but at low concentrations. All the VP positive strains were able to produce diacetyl from sugar and a LAB strain able to consume sucrose was identified.
Conclusion: Combined PCR and biochemical tests proved to be a useful approach to identify diacetyl producing LAB strains that can be suitable starters to ferment agri-food wastes.

P2.3.31

Effects of osmotic and HPP stress on expression of virulence factors among enterococci from food

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Aim: The aim of the study was to determine the frequency of virulence factors such as gelatinase, hemolysin, the ability to biofilm formation and slime production and virulence-related genes among enterococcal strains isolated from food of animal origin. Moreover, changes in the expression of selected virulence-related genes in response to osmotic and high pressure stress were checked

Method: Strains belonging to the strain collection of the Department of Industrial and Food Microbiology were isolated from food of animal origin. Seventy eight enterococcal strains were tested to 17 virulence-related genes and presence of virulence. Then isolates, those showing discrepancy between phenotype and virulence genotype and simultaneously carrying four selected resistance genes: *gel*E, *asa*1, *esp* and *cyl*L were selected. These strains were exposed to osmotic and high pressure stresses and then the relative expression level of virulence-related genes was checked using Real-Time PCR method

Results: None of the strains showed a strong ability to form biofilm, 38.5% (n = 30) had the slime production ability, 41% (n = 32) had gelatinase activity, γ -type hemolysis was observed in 55% of isolates, and α-type hemolysis in 45%. All of the isolates carried 1 - 13 virulence-related genes. The most common genes were *gel*E (85.9%), *spr*E (78.2%) and *asa*1 (75.6%). There were also observed changes in the expression of the *gel*E, *esp*, *asa*1 and *cyl*L genes in response to various NaCl concentration and high pressure processing. Expression of all the genes increased in 4% of NaCl. However, at the concentration of 7%, expression of *gel*E, *esp* and *cyl*L genes increased more than in 4% but the expression of *asa*1 gene decreased. Phenotypic analysis showed that a significant increase in gene expression revealed a phenotypic feature - gelatinase activity, slime production, biofilm formation or change of the type of hemolysis from α to β. The analysis of gene expression in response to stress caused by high pressure showed that under the pressure of 400 MPa, the expression of the *gel*E and *asa*1 genes decreased, but this decrease was not significant, therefore it can be assumed that no change in expression is observed, while the expression of the *esp* and *cyl*L genes increased. In response to a pressure of 500 MPa, the expression of all four genes increased, but only expression of *esp* and *cyl*L increased significantly. However, phenotypic analysis showed no revealing of phenotypic features.

Conclusion: Results obtained in this study indicate that enterococci isolated from food may act as reservoirs of virulence genes. The presence of virulence factors among enterococci, especially the ability to biofilm formation is important for food safety and the protection of public health. The results presented in our work demonstrate that stress that can occur during food preservation and food processing can induce the changes in the virulence-related genes expression

P2.3.32

THE EFFECTS OF TEMPERATURE DISRUPTION DURING TRANSPORT ON THE MICROBIOLOGICAL QUALITY OF FRESH GROUND BEEF

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Aim:

Ground beef is appreciated worldwide because of its convenience. Unfortunately, its shelf life is limited because the large surface area facilitates spoilage. Thus, ground beef easily subjects to microbial spoilage processes and presents a food safety risk. During transport and storage, ground beef must be kept at a temperature below 2 °C (Regulation (EC) No 853/2004). The presented study evaluates the effect of elevated transport temperatures on the outcome of microbiological analyses of chilled ground beef in simple packaging as well as in vacuum and modified atmosphere packaging.

Method:

Chilled ground beef was packaged in normal atmosphere (hereinafter referred to as simple packaging), modified atmosphere (MAP) and vacuum packaging for the purposes of hte experiment. Model experiments simulated temperature increases during transport of the samples to temperatures of 2, 5, 8, 11, 14, 17, 20, and 25 °C, with exposure times of 1, 2, 3, 3.5, and 4 h. Microbiological analyses were performed immediately after the exposure to elevated temperature (0 h), 3 h, and 24 h after the return to the adequate storage temperature. The following microbiological parameters were determined for each analytical sample: the counts of total microorganisms (ISO EN 4833-1/2013), psychrotrophic microorganisms (ISO 17410/2020), and of *Escherichia coli* (ISO 16649-2/2003). In addition, the presence of *Salmonella* spp. was also evaluated (ISO EN 6579-1/2020).

Results:

The study statistically evaluated the effect of three factors namely (1) higher temperature, (2) the duration of cold chain disruption, and (3) the examination time after the disruption on the numbers and abundances of microorganisms in samples of all three packaging types. The results will be used to develop mathematical models describing the effects of temperature and the duration of exposure to elevated temperature on the microbial profile of ground beef. These models can serve for establishing the maximum acceptable cold chain disruption duration.

Conclusion:

The presented study helps standardize the methodology of collection and transport of chilled food samples for microbiological testing and to reduce the number of samples not accepted for processing by laboratories due to improper transport. From the perspective of the supervisory authorities, a significant benefit resulting from this study lies in providing information crucial for the defence against potential challenges of the results of analyses performed on samples taken during routine inspections.

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KN1.1

Towards predictive control of extrusion processing of plant-based food systems

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Aim:

High Moisture Extrusion Cooking (HMEC) is one of the core process technologies for production of plant-based meat alternatives. With reduced environmental impact, HMEC allows creating meat-like textures from plant proteins being seen as a potential sustainable solution for the future of food. Making sustainability impact involves to a good extent large-scale food manufacturing systems. At the current stage of development, HMEC is empirically handled and highly expert-dependent, limiting the progress towards reaching large production volumes. The developed approach aims to reduce the empiricism and transform HMEC into a more reliable and autonomous process for production of plant protein-based meat alternatives, enhancing its performance and the industrial upscaling capability.

Method:

A new sensing and process control method is proposed for HMEC by developing and connecting a hierarchical model-based predictive strategy with in-line sensor systems for (i) temperature and pressure profiles along the process, (ii) viscosity and elasticity of protein melt, and (iii) texture-mechanical characteristics of extrudate after the cooling die. Built on top of the existing HMEC architecture, the hierarchical predictive algorithm covers from process to product feature control and can be extended to integrate other technologies, such as Artificial Intelligence-based techniques, for a fully optimized and customized production.

Results:

Implementation of the approach was carried out effectively on a pilot-scale extruder, and its practical feasibility was demonstrated. The extrusion results showed improved operational stability and reproducibility, while ensuring the meat-like fibrous structure formation and desired textural characteristics.

Conclusion:

Technological advancements that drive the HMEC plant-based meat production to a new performance level are introduced. The solution for advanced HMEC process control facilitates a faster adaptation to larger-scale production lines, representing a first step towards an overarching concept that connects food processing, in-line measuring, predictive algorithms, and flexible automation for tailored product characteristics. Significant progress has been made in the first development steps through the proof of concept and implementation of functional prototypes on a pilot-scale extruder.

KN2.1

Relevance of novel bioactive peptides obtained from meat and fish co-products

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Aim:

Large amount of waste is generated every day in the meat and fish industry and its disposal represents a major economical and environmental concern worldwide. Innovative solutions are needed to create high added-value with the least environmental impact for an effective and sustainable management of meat and fish co-products. The aim of this lecture is to present recent valorisation strategies which are based on the enzymatic hydrolysis of such co-products to search for key active molecules with relevant nutritional properties like bioactive peptides that can exert some important physiological effects with promising applications in the food and pharmaceutical industries.

Method:

Proteins are extensively hydrolysed firstly by endo-peptidases followed by the successive action of exo-peptidases that generate numerous peptides with different sequences and lengths, some of them with relevant bioactivity. In fact, peptides with sequences containing between 2 and 20 amino acids are those searched in protein hydrolysates from meat and fish co-products.for antioxidant, anti-inflammatory, hypoglucemic and angiotensin I-converting enzyme (ACE) inhibitory activity. Furthermore, gastrointestinal digestion contributes to an additional intense proteolysis that releases a large amount of peptides, some of them with bioactivity of interest for human health.

Results:

This lecture is presenting an overview of the latest developments and trends in the production of bioactive peptides generated from meat and fish co-products, focusing on the recent advances on enzymatic mechanisms for the release of bioactive peptides from proteins, strategies followed for boactive peptides isolation, partial purification, and identification through advanced proteomic tools, as well as assessment of bioactivity and specific applications. Examples of profiles of peptides isolated from different types of meat and fish co-products and with identified bioactive sequences will be shown.

Conclusion:

The obtention of bioactive peptides through protein hydrolysis, increases the profitability and facilitates the management of meat and fish co-products, and therefore contributes to more sustainable meat and fish production.

KN3.1

Next-Generation Food Microbiome Research: Approaches for characterizing microbial communities in foods and the food chain

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Aim:

Microorganisms exist along the food chain and impact the quality and safety of foods in both positive and negative ways. Identifying and understanding the behaviour of these microbial communities enable the implementation of preventative or corrective measures in public health and food industry settings. Our aim has been to use a combination of next-generation microbiome-based approaches to better characterise microbial communities of relevance to foods and the food chain.

Method:

Current culture-dependent microbial analyses are time-consuming and target only specific subsets of microbes. However, the greater use of culture-independent metagenomic approaches has the potential to facilitate a thorough characterization of the microbial communities along the food chain. These approaches can be complemented by culture-based approaches to validate results and also facilitate the harnessing of the microbes identified, such new starters for next generation fermented foods.

Results:

The methods referred to have shown potential in contributing to outbreak investigation, ensuring food authenticity, assessing the spread of antimicrobial resistance, tracking microbial dynamics during fermentation and processing, and uncovering the factors along the food chain that impact food quality and safety. During the seminar, I will provide an overview of our recent research in these areas, while providing specific examples relating to specific foods and relevant food chain-related environments.

Conclusion:

In the coming years, these approaches are likely to be applied even more extensively and have the potential to bring about disruptive change within the field of food microbiology.

KN4.1

Influence of extraction process on microalgae protein fractionation and functionality for food applications

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Aim:

Microalgae are a highly nutritious source of proteins with an excellent amino acid profile that could resiliently be produced independent of arable land and weather conditions. Given their excellent nutritional value, microalgae protein concentrates, and isolates could become building blocks for several alternative food products. This research studied pulsed electric field (PEF) combined incubation as novel cell disruption method versus high-pressure homogenization (HPH) and their impact on crossflow microfiltration performance and protein techno-functional characteristics.

Method:

Heterotrophic *Auxenochlorella protothecoides* were treated by HPH (100 MPa, 4 passes) or PEF (25 $kV\cdot cm^{-1}$, 15 µs, n=12, 1'558 $kJ\cdot kg^{-1}$ dry matter, 24 h incubation). Cell permeability and integrity were assessed using flow cytometry, and the particle size was monitored using a laser diffraction analyzer. The cells and cell debris separation performance was studied using a bench-scale crossflow filtration system loaded with 3x0.1µm parallel polyester membranes with a total surface-area of 78 cm^2. The protein in each fraction was analyzed by total nitrogen, UV-spectroscopy, and SDS-page. The protein extracts' capacity to stabilize interfaces was assessed by bubble pressure tensiometry.

Results:

The microalgae disruption method influenced the downstream separation. Flow cytometry showed that HPH disrupted 97% of the cells, with only 3% remaining in the intact microalgae gate. Bigger inhomogeneous aggregates were detected in the HPH samples ranging from 1-200 µm prompting fouling at the membrane surface and impairing membrane flux. PEF-treated cells maintained their cellular structure (5-6 µm diameter with 90% permeable cells after incubation), producing lower fouling and higher fluxes (PEF: 20 $L\cdot m^{-2}\cdot h^{-1}$ vs. HPH: 10 $L\cdot m^{-2}\cdot h^{-1}$). The protein fractions extracted with HPH contained higher molecular weight proteins compared to PEF. HPH-released proteins decreased the surface tension more than the PEF extracted (2-5 $N\cdot m^{-1}$). This suggested higher surface activity of bigger proteins in HPH treated samples that unfold at and better stabilize the air-water interface than peptides do.

Conclusion:

Microfiltration of PEF treated microalgae suspensions combined with incubation resulted in higher fluxes improving membrane performance and reducing required membrane area for protein recovery. Nevertheless, HPH released bigger, more functional proteins despite lower flux. These results foster the optimization of protein extraction processes from microalgae for different applications.

KN5.1

Role of Food Industry 4.0 technologies in enhancing sustainability in agriculture and the food industry

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Abstract: To face great challenges in agriculture and the food industry, Food Industry 4.0 is being researched by academics and industry to promote sustainability in its three dimensions; environmental, social, and economic.
Food Industry 4.0 the in Environmental Pillar: With growing concerns over environmental degradation and accelerated climate change, addressing these challenges has become a global imperative. Industry 4.0 has a big potential to accelerate automation and digitalization, which contributes to enhancing sustainability in the food supply chain and fostering circular economy in food systems. For example, the holistic approach adopted by Industry 4.0 can benefit the environment by facilitating waste reduction through meticulous monitoring and product tracking using Industry 4.0 technologies such as artificial intelligence, big data, 3D printing, smart sensors, the Internet of Things, and other advanced technologies. Consequently, these Industry 4.0 technologies help decrease energy consumption, mitigate environmental pollution, and reduce the environmental footprint.
Food Industry 4.0 in the Social Pillar: According to recent research, several Industry 4.0 technologies (e.g., artificial intelligence, blockchain, smart sensors, etc.) could enhance traceability and transparency in the food supply chain. These crucial features can consequently help prevent fraud and increase food safety. For example, growing evidence shows that blockchain and other digital traceability tools could improve food product traceability, offering an increased ability to effectively monitor and track the flow of various food products throughout the supply chain, from their origin with the producer to their ultimate consumption by consumers (i.e., from farm to fork). Such positive outcomes can enable radical transformation to secure food systems, thus significantly impacting the social pillar of sustainable development.
Food Industry 4.0 in the Economic Pillar: Industry 4.0 will enhance economic sustainability by optimizing production and maintenance rates, improving the food chain performances, and enabling the correct and most effective exploitation of the available food resources. As more adoption of Industry 4.0 technologies can decrease energy and production costs, and reduce maintenance costs while increasing efficiency and competitiveness, Food Industry 4.0 is expected to foster economic growth in several agriculture and food industry sectors.
Keywords: Fourth industrial revolution, sustainable development goals, automation, digitalization

KN6.1

Intensified processing of almond- and wine-derived leftovers with pulsed electric fields and supercritical CO2

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Aim
This work focuses on an innovative, multistep protocol based on pulsed electric fields (PEF) and supercritical CO_2 (SC- CO_2) to recover biologically active compounds from wasted natural resources, as almond hull (AH) or exhausted grape marc (EGM).

Method
PEF and SC-CO_2 were applied for the extraction of the targeted compounds. Total antioxidant capacity (TAC) and polyphenols content (TPC) were determined by TEAC, ORAC, and TPC assays. Triple-TOF-LC-MS-MS allowed to detect the main polyphenols present in the liquid extracts. Nuclear Magnetic Resonance (NMR) analysis served to identify other compounds selectively extracted by these techniques. The post-extraction remaining solid after processing was evaluated by Scanning Electron Microscopy (SEM), Thermogravimetric Analysis (TGA) and Fourier-Transformed Infrared (FT-IR).

Results
For EGM, the efficiency in terms of TAC was increased to up to 68% after PEF processing with respect to conventional extraction. Nonetheless, the subsequent application of SC-CO_2 (PEF+SC-CO_2) boosted this value to up to 87%. For AH, this TAC was also enhanced (up to 77% compared to traditional soaking), detecting a TPC value 20% higher after PEF+SC-CO_2 as well. The Triple-TOF-LC-MS-MS analysis showed that mainly glycosylated structures were recovered after PEF (for instance, quercetin 3-*O*-(6-acetylglucoside) from EGM, or kaempferol 3,7-*O*-diglucoside from AH), and non-glycosilated´ were the predominant in SC-CO_2 crudes, as kaempferol, luteolin, or scutellarein. NMR analysis showed the selective recovery of carbohydrates (PEF) and lipids (SC-CO_2), in parallel to the polyphenols extraction. When evaluating the post-remaining solid fraction by SEM, PEF treatment induces the formation of pores in the surface, whereas SC-CO_2 extraction led to a high fibre compaction. Finally, by TGA and FT-IR, alternative ways of valorisation could be proposed, attending to the fibre composition.

Conclusion
A multistep processing of EGM and AH based on intensified technologies (PEF and SC-CO_2) was successfully developed for the extraction of bioactive compounds. For both matrices, the prompt SC-CO_2 application after PEF-assisted extraction (PEF+SC-CO_2) significantly boosted TAC and TPC. The analysis by Triple-TOF-LC-MS-MS concluded that different kind of polyphenols were extracted attending to the applied protocol. Additionally, both techniques resulted useful to selectively recover carbohydrates (PEF) and bioactive lipids (SC-CO_2) considering NMR analyses. Finally, the evaluation of the post-extraction solid showed alternative ways of valorisation with view to a zero-waste assessment, in line with the desirable concept of biorefinery.

KN7.1

Locally-sourced microbes in Latin America: from probiotics to the "Live Dietary Microbes" and "Postbiotics" concepts

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Considering together the collective findings from the research on the human microbiome, the randomized controlled trials conducted with probiotics, and the associative studies of fermented foods consumption and health, it can be considered that there is growing evidence of the beneficial effects of the regular consumption of safe live microbes, regardless if they can be classified as probiotics, or not. The raise of non-communicable chronic diseases has been linked, among other factors, to sterile diet patterns, devoid of microorganisms. The concept of probiotics has been well established in developed countries, however in Latin America it is still challenging going from "bench to bedside" with locally-sourced microbes applied as probiotics, though there are some examples. In parallel, the application of probiotics produced abroad is still challenging due to the fragmentation of the regulatory scenario among Latin American countries. In our laboratory, we isolated a group of lactobacilli and bifidobacteria from human milk and lactic acid bacteria from different forages and crops. These locally sourced strains have demonstrated *in vitro* and *in vivo* (animal studies) anti-inflammatory properties and the technological potential to be delivered as food supplements or to be used for the fermentation of plant-based beverages (quinoa, peanut), in order to deliver live dietary microbes. Some strains were also assessed for their capacity to be dehydrated using spray drying, a low cost alternative to freeze-drying. Microbes are not only able to deliver a health benefit when administered on their viable form, the emerging concept of postbiotics, defined by the International Scientific Association of Probiotics and Prebiotics as "*a preparation of inanimate microorganisms and/or their components that confers a health benefit on the hos*t", suggest that non-viable microbes can be also used to deliver certain health benefits. Interesting, they hold the potential to be delivered to remote regions, where the cold chain can-not be always guaranteed. Until being able to perform efficacy trials with these locally sourced strains, to consider them probiotics, they could be used to deliver live microbes through fermented foods, foods supplements and, in the meantime, explore their potential as postbiotics.

KN8.1

POTENTIAL OF SCATTERING TOOLS FOR VALORIZATION PURPOSES IN THE FOOD AREA

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POTENTIAL OF SCATTERING TOOLS FOR VALORIZATION PURPOSES IN THE FOOD AREA

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Global demand for food is expected to rise by at least 60% by 2050. At the same time, the food supply chain is under pressure due to limited resources, water scarcity, soil degradation, biodiversity loss and the impacts of climate change. Moreover, more than one third of the food produced in the world today is lost or wasted, thus, further complicating the situation. In addition, our food system has experienced huge transformation during the last century with changes in dietary preferences impacting on consumer health (e.g. increasing non-communicable diseases and obesity) and food availability. In view of this situation, a sustainable food system needs to be strengthened, from farm to fork, to increase food production sustainably while reducing waste in the food supply chain and limiting environmental impacts. Furthermore, food quality has to be the main focus with consumer preferences towards more natural products including health-promoting properties need to be satisfied.

In this sense, understanding structure-property relationships, i.e. the connection between food structure and the way a product behaves, is central for a rational product design. To measure and control food structure, to make predictions of behaviour and to deliberately engineer consistent or new products, characterisation techniques are essential. Moreover, in a circular economy context, understanding how the different components are structured within the biomass is essential to adequately design the valorisation strategies. Scattering methods are indispensable within the arsenal of characterization methods, having a number of advantages over other widely employed techniques. In this talk, an overview of the advantages of small angle scattering techniques together with a few examples showing the potential of these powerful tools to strengthen our future food system will be shown.

KN9.1

Ball milling: a green technology for the development of innovative starch-based structures with enhanced functionalities

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Ball milling: a green technology for the development of innovative starch-based structures with enhanced functionalities

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Increasing is the trend in developing tailor-made and personalized foods with enhanced health and bioactive delivery performances.
Starch is a cheap, plant-origin and widely available biomolecule used in a wide range of formulated foods. However, in the native state, starch has limited use in the food industry due to its poor functional and physico-chemical properties (e.g. low cold-water solubility, low viscosity). Different physical, chemical, and biotechnological methods have been applied to modify its molecular properties to improve, in turn, its technological functionalities.

Ball milling is an emerging and "green" technology, pioneered in the pharmaceutical sector and increasingly adopted in several areas, including food, mainly for size reduction. However, during the process, friction, collision, impingement, shear, or other mechanical actions could also lead to structure modification and changes of the molecular and physical properties of biomolecules, including, among others, the transition from crystalline to amorphous state or of carbohydrates. Ball-milling effects could depend on various intrinsic (e.g. size, conformation, state) and extrinsic (e.g. temperature) factors.

In this presentation, the effects of ball-milling on molecular and physical properties as well as technological functionality of starches, with main focus on the structuring abilities will be presented. The physical, microstructural and techno-functional properties (porosity, microstructure and mechanical properties) of gels and cryogels made by ball-milled starches of different origins will be presented.
The potentiality of using the innovative aerated structures as novel delivery systems or controlled release of bioactives (e. g. β-carotene) will be also discussed.

KN10.1

Green Separation and Innovative Approach for High Valued Utilization of Bioactive Compounds

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Aim:
Plant resources are rich in bioactive compounds such as polysaccharides and polyphenols. However, the utilization of these bioactive compounds needs multiple processes including extraction, purification, and further processing. Traditional processes always possess shortcomings like requiring high energy consumption, leading to subsequent pollution, resulting in inactivation of the compounds. Green separation and innovative approaches were carried out for high valued utilization of bioactive compounds.

Method:
To enhance extraction process, pulsed electric field (PEF) treatment and ultrasound assisted extraction (UAE) were applied for inulin extraction from chicory and polyphenol extraction from purple sweet potato (PSP), rescpetively. To increase the stability of anthocyanins extract of grape skin (AEGS), microencapsulation by emulsification/internal gelation followed by spray/freeze-drying techniques were applied. Complexation of maltodextrin-based inulin and green tea polyphenols were prepared with assistance of ultrasonication treatment.

Results:
With assistance of PEF treatment, inulin extraction temperature can be decreased to 50^{o}C, with comparable extraction yield under 80^{o}C without PEF treatment. The PSP extaction from UAE achieve more complete anthocyanin recovery. AEGS (in microencapsulation) retention remained 27 times of free AEGS after gastric digestion and intestinal digestion. The inulin-polyphenol complex showed better thermal stability.

Conclusion:
By appliying innovative technologies like PEF and ultrasonication, we can significantly intensify the mass transfer during extraction, increase the stability of bioactive compounds via formation of microencapsulation and complexation, leading to green and high valued utilization processes.

KN11.1

The first 1000 days of life: the influence of diet and the microbiome

Koren O

During gestation the female body undergoes hormonal, metabolic, and immunological changes such as an increase in body fat early in pregnancy followed by reduced insulin sensitivity later in gestation. Pregnancy progression is also associated with dramatic alterations in the composition of the gut and vaginal microbiotas. The vaginal microbiota of pregnant women is characterized with a decrease in bacterial diversity which is also seen in the gut microbiota as pregnancy progresses. In the gut, the lower diversity is accompanied by an increase in "between sample" diversity and an increase in the relative abundance of Proteobacteria and opportunistic pathogens. Germfree mice inoculated with gut microbiota from pregnant women presented metabolic changes mirroring those of the pregnant women.
We are now at the point of trying to understand whether these changes in community structure are a cause or consequence of some of the characteristics of pregnancy. It will be interesting to determine whether pregnancy associated microbiota alterations are required for a healthy pregnancy and whether pregnancy complications such as gestational diabetes are associated with dysbiosis?

KN12.1

Effect of Pulsed Electric fields and High Pressure on the acceleration of table olives de-bittering

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Aim:

"Spanish-style" is a widely known debittering procedure for green table olives, that involves the use of sodium hydroxide solution for minimizing the bitterness of fresh olives caused oleuropein, the dominant phenolic compound. Olives are immersed in alkali solutions (NaOH; 1.0-4.0%) for several hours (8-16 h) and then follow successively washing steps with tap water. Although this debittering technique is considered effective, it requires long processing times and generates wastewaters that their disposal causes several environmental concerns. Novel technologies could be used as pretreatments to accelerate lye de-bittering decreasing the required long time or eliminating the NaOH concentration.
The aim of this study was to evaluate the effect of High pressure (HP) and pulsed electric fields (PEF) as pretreatments on NaOH penetration rate, required lye treatment time and quality of final debittered table olives.

Method:

PEF- and HP-assisted debittering processes were performed at 3.5 kV/cm with 500 pulses (a pulse width of 15 ms and frequency equal to 20 Hz) and at 250 MPa for 5 min, respectively. After both pretreatments, lye debittering procedure with 1.0, 1.5 and 2.0% NaOH followed, for up to 24 h. During lye treatments, the NaOH penetration into olive flesh was monitored. Oleuropein content and total phenolic compounds of PEF, HP and conventionally de-bittered samples were determined. Color and texture of olives were also evaluated.

Results:

Both pretreatments resulted in enhanced NaOH penetration rates into olive flesh compared to conventional debittering procedure. PEF and HP pretreatments of 1.5% NaOH concentration had similar NaOH penetration rate to control of 2.0% NaOH concentration, leading to less NaOH consumption. The debittering time was estimated equal to 7.2, 5.2 and 5.3 h for conventional, HP and PEF debittering techniques, respectively, with 2% NaOH solution. In general, PEF- and HP-assisted debittering did not affect the quality of final de-bittered olives.

Conclusions:

The results confirmed that PEF and HP pretreatments were efficient in minimizing the lye de-bittering time of green table olives, while simultaneously limiting the use of alkali solutions that is a major issue for the relevant industry

KN13.1

Innovative Starch Modification Techniques in Response to Evolving Food Megatrends

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Aim

There is growing attention towards novel modified starches that are compatible with the global food megatrend of clean and green processing. Dry heat treatment (DHT) of starch and hydrocolloid mixtures is gaining acknowledgement since hydrocolloids can enhance the efficiency of DHT. However, the DHT of a starch–protein mixture has been less investigated. The main goal of this study was to develop a novel type of dual-modified starch using natural and green processing technologies to enhance the functional properties of starch.

Method

High amylose and waxy corn starches (HACS and WCS, respectively) were coated with sodium caseinate (SC), gelatin, and whey protein isolate (WPI) (starch:protein weight ratio of 97:3) by the dry and wet mixing method followed by DHT (120 °C for 4 h). The water interactions, viscosity, thermal properties and electron microscopic properties of the samples were studied.

Results

This novel modification resulted in desirable physiochemical changes such as increased peak viscosity, reduced enthalpy and gelatinization temperatures, and decreased gel firmness, gumminess, and cohesiveness, which could not be obtained by only mixing starch and the selected proteins. The addition of the proteins formed a thin coating on the starch granules, forming clusters that compacted in size during heat treatment, without affecting the crystallinity of the granules. The variations observed were influenced by the type of protein used, the ratio of amylose–amylopectin of the native starch, and the mixing method (dry or wet mixing). It was found that the wet preparation method was more successful than the dry mixing method in enhancing the functional properties of the treated starches through the addition of low concentrations of the proteins. Amongst the proteins, whey protein isolate was the most effective and gelatin was the least effective protein on the functional properties of starch before and after dry heat treatment.

Conclusion

The positive outcomes of this study are encouraging since a small concentration of protein can boost the starch viscosity without using chemicals. With the further exploration of different protein–starch interactions, the results of this study can find widespread applications in the food and pharmaceutical industries.

KN15.1

Sustainable food systems lead to healthy life

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Sustainable Food Systems Lead To Healthy Life

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Sustainable food systems are a means to meet global demand for food, mitigate food insecurity and promote the health and well-being of the world population. United States Department of Agriculture (USDA) plays a major role in the sustainable food systems goal and the mission is to provide leadership on food, agriculture, natural resources, rural development, nutrition, and related issues and the best available science, and effective management. In addition, a major focus of the human nutrition program of the USDA is to provide scientific evidence on how diet quality and dietary components are critical in the prevention of chronic disease development. As part of the USDA, our team studies how diet and dietary bioactives interact with the host and the mechanisms behind the positive health outcomes are being investigated. Specifically, we investigate the role of several pre and postnatal factors on child health. Obesity's impact on the maternal immune system and its association with microbiota and milk composition will be discussed. Furthermore, milk bioactives role on the gastrointestinal tract, microbiota and immune function will be presented.

KN16.1

Crop yield forecasting using remote sensing: from low to high spatial resolution

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Aim

NASA Harvest is the NASA's Food Security and Agriculture program. Its main objective is enhancing the use of Earth Observation (EO) data in decision making related to food security and agriculture. Within this context, one of the main priorities is providing valuable information on crop conditions and accurate and timely crop yield forecasts. This work presents the Agriculture Remotely-sensed Yield Algorithm (ARYA), a new EO-based empirical winter wheat yield forecasting model and how it can be applied to enhance precision agriculture.

Method

ARYA is based on the evolution of the Difference Vegetation Index (DVI) from the Moderate Resolution Imaging Spectroradiometer (MODIS) at 1 km resolution, the Growing Degree Days (GDD) from reanalysis MERRA2 data, and the accumulated daily difference of the Land Surface Temperature (LST) from MODIS. The model is calibrated at subnational level using historical yield statistics from 2001 to 2019. The model was applied to forecast the national and subnational winter wheat yield in the United States, Ukraine, Russia, France, Germany, Argentina and Australia (over 70% of global wheat exports) from 2001 to 2019. Besides, field level wheat yield data collected over Castilla y Leon from 2017 to nowadays is leveraged to build crop yield models based on Sentinel-2 satellite data.

Results

The results show that ARYA provides yield estimations with 5-15 % error at national and 7-20 % error at subnational level starting from 2 to 2.5 months prior to harvest. Preliminary results at field level show better performance metrics when using linear combination of different spectral bands compared to using solely the DVI.

Conclusion

EO data is a global, objective, timely and cost-effective tool that can contribute to increased food security, greater sustainability, and greater resilience in the agriculture sector.

KN17.1

Consumer related challenges in responsible food systems

Sandell M

Consumer related challenges in responsible food systems

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Food has many roles within our daily practices. We must eat to stay alive, to support our personal well-being and health, while considering our planet, alongside enjoying life. Consumers are important actors and agents not only in a food system but also in its' systemic change. Consumers are causing a lot of challenges, driven by their food choices, and eating behavior. From a global perspective too much food is wasted in many countries, while in parallel, there is a growing need for more food to feed everyone. Sustainable food system considers ecological, environmental, cultural, and social aspects. Recently published Nordic nutritional recommendations propose for the first time that food should be good for our health but also for the environment. However, it is not enough that food is sustainable and responsibly produced if people are not willing to use it. Plant based food materials have a lot of potential in sustainable food solutions. However, they often include sensory challenges such as flavor. Interestingly the taste perceived by consumers has significant variations. It is very important to understand the impact of ingredients, processing, cooking, and recipe on the multisensory experiences of the food or meal. Sensory based food education is a tool to promote sustainable and healthy eating via a focus on motivation through food related joy. This talk highlights the role of consumers, multisensory experience of plant-based food, and the potential of food education activities in a complex food system.

KN18.1

Edible Insects: Silent Contributors to the Future of Sustainable Food

Altintas Z

Edible Insects: Silent Contributors to the Future of Sustainable Food

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Aim: This study aimed to develop sustainable food and packaging materials by extracting functional lipids and proteins from lesser mealworm larvae flours. Our approach included innovating extraction of insect oil, oleogel development for low-fat spreads, insect protein isolate (IPI) production, vitamin B_{12} (VB_{12}) nanoencapsulation, yogurt fat substitutes, alternative protein in gluten-free bread, and edible film packaging (EFP).

Method: IPI was produced through a multi-step process, including lipid extraction via ultrasound-assisted alcoholic extraction (UAAE), chitin hydrolysis, salt washing, and freeze-drying. Physicochemical properties, antioxidant minor compounds, fatty acid composition, and lipid quality indices were analyzed. The superior oil blended with oleogelators of candelilla wax and beeswax (9:1 ratio) upon a heating-cooling process was applied to produce low-fat spreads in a laboratory-scale conch. After determining the optimal crosslinker (microbial transglutaminase (MTGase) or glucono-δ-lactone), MTGase-crosslinked IPI gel-stabilized W/O/W nanoemulsions were lyophilized to nanoencapsulate VB_{12}. A dual approach using MTGase (0.1-0.5%) crosslinking and high-intensity ultrasonication (HIU, 15-90 min) was employed to develop efficient IPI-based gel powders for preparing gluten-free bread rich in VB_{12} and EFP formulations. Non-fat yogurt formulation by incorporating MTGase-crosslinked IPI and *Lactobacillus acidophilus* La-5® was also optimized.

Results: A highly efficient UAAE (88.08%) extracted linoleic acid-rich insect oil at 22.5 v/w ethanol/isopropanol-to-insect powders and 70°C for 22.64 min. The candelilla wax-oleogels outperformed beeswax ones in hardness, viscoelasticity, oil binding capacity, and melting point. Low-fat spreads with 40% candelilla wax-based oleogels (0.5% pectin, 0.4% locust bean gum) minimized oiling out, providing excellent sensory attributes. MTGase than glucono-δ-lactone formed more stable IPI (~92.5% purity) gels, while MTGase-IPI, maltodextrin, and Arabic gum (2:1:1) yielded the best VB_{12} nanoparticles. Gel prepared with 60 min HIU and MTGase with superior thermo-mechanical stability displayed the most controlled VB_{12} release during simulated gastrointestinal digestion. Incorporating this gel and pea protein isolate improved gluten-free bread's physicochemical properties, with a notable retention rate of VB_{12} (65.3%). MTGase-crosslinked IPI showed a great fat replacer for manufacturing probiotic yogurts with enhanced protein digestibility, functionality, and overall quality. MTGase-crosslinked IPI-based EFP was suitable for maintaining the quality of strawberries in cold-storage.

Conclusion: Insect oil and MTGase-crosslinked IPI are promising bio-ingredients for food and pharmaceuticals.

KN19.1

The impact of fecal microbiome on diet-related colorectal cancer risk: contrasting red meat-based and pesco-vegetarian diets in rodent model.

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The impact of fecal microbiome on diet-related colorectal cancer risk: contrasting red meat-based and pesco-vegetarian diets in rodent model.

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Colorectal cancer (CRC) ranks as the third leading cause of cancer-related deaths globally. The geographical distribution of its incidence highlights the significant role played by environmental factors and dietary habits in its development. This study centers on investigating the role of the intestinal microbiome profile and its associated metabolites in CRC risk, with the aim of determining whether reduced consumption of red/processed meat can lead to a decrease in potentially toxic and/or carcinogenic metabolites.
In two animal models of colon carcinogenesis (chemically induced by azoxymethane and genetically driven by mutations in the Apc gene - Pirc rats), we compared a high-risk meat-based diet (MBD) with a low-risk pesco-vegetarian diet (PVD). An additional group followed an MBD diet supplemented with tocopherol (MBD-T), which could potentially mitigate the risk associated with red/processed meat consumption.
Across all animal models, we observed a diverse microbial community among the three diets, with certain bacterial genera showing a strong inverse correlation with both tumors and neoplastic lesions. Through fecal microbiota transplantation from Pirc rats to germ-free recipient rats with azoxymethane-induced carcinogenesis, we demonstrated that the fecal microbiome with specific metabolomic profiles was capable of transmitting cancer risk. Rats receiving MBD fecal transplants exhibited a significantly higher number of preneoplastic lesions associated with specific microbial and metabolomic profiles.
Our findings illustrate how diet can directly modulate the composition of the intestinal microbiome and, in turn, influence the risk of colorectal cancer in various animal models of carcinogenesis.

Keywords: intestinal microbiome; Metabolomics; Diet; Pesco-vegetarian diet; Colorectal cancer.

KN20.1

Development of functional brownies enriched with antioxidant extracts and dietary fibre adapted to tcoeliac patients

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Development of functional brownies enriched with antioxidant extracts and dietary fibre adapted to coeliac patients.

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Aim: The aim of this study was to formulate gluten-free muffins by improving the nutritional value of muffins on the market, using 4 different antioxidant extracts and enriching them with fibre.

Method: Five cocoa brownies were made with four different extracts: *Moringa oleifera*, organic hydroxytyrosol (HTX), non-encapsulated spirulina, encapsulated spirulina, enriched with dietary fibre using psyllium and quinoa flour and a control muffin without any extract. Nutritional composition, minerals, antioxidant capacity (FRAP, DPPH and ABTS) and total phenolic compounds (Folin), colour, pH and sensory analysis were studied to assess the organoleptic quality of the different samples compared to a commercial muffin.

Results: The results showed that the incorporation of psyllium and the incorporation of quinoa flour increased the percentage of total dietary fibre. In addition, the brownies enriched with the extracts had significantly improved antioxidant properties compared to the control and the commercial brownies. The promising role of HTX stands out, which, despite being the extract with the lowest concentration (550ppm), showed the best results in the antioxidant capacity and total phenolic compounds tests (603.24 mg galic/g). Furthermore, in the sensory analysis, it was one of the best rated samples

Conclusion: Therefore, taking into account the nutritional, physicochemical and organoleptic characteristics, HTX is the ideal compound for the production of fortified brownies for people with coeliac disease.

KN23.1

Bacteria, food, humans- a commitment for life

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Bacteria, food, humans- a commitment for life

Mankind and microbes share a long common history and rely on each other for existence. For example, the use of bacteria for food-processing in terms of preservation via fermentation can be dated back to the early Mesolithic. Still today, fermented foods play an important role in human nutrition in food cultures on every continent. With the help of microbes, a plethora of different types of fermented food and beverages with nutritive and culinary advantages are provided for human consumption. However, the most important aspect of food fermentation is the increase of shelf-life as well as the inhibition of spoilage and pathogenic bacteria. The issue of food safety for human consumption is very old, but still topical. The molecular biological methods available today, e.g. the -omics methods, that allow the description and characterization of the composition of the microbiota of different habitats including food open up new insights into the microbial world. Another aspect of the common history of mankind and microbes is the action of microbes in the metabolization of food in the human intestinal tract. This research area is also strongly associated with the -omics era which allows the culture-independent description of the composition of the human intestinal microbiota. Moreover, the possibility to cultivate strictly anaerobe bacteria from the human gut as well as the anaerobic in vitro fermentations of human fecal cultures lead to a better understanding of the interaction of human nutrition, microbes and human health. The microbiota of the human gut metabolizes a variety of nutrients derived from human nutrition and provides metabolites for the human host, e.g. short chain fatty acids, which have a high impact on human health.

O1.2

Oxidative Stability of β-Lactoglobulin-stabilized Emulsions affected by Phenolic Acid Derivatives

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Aim:
Proteins such as the whey protein β-lactoglobulin (β-Lg), are commonly used to stabilize oil-water emulsions. The additional use of phenolic compounds (PP), which can interact with the proteins at the interfacial film, affect the oxidative stability of the emulsified oil, as PP can split off protons and electrons, saturate radicals, and thus, have an antioxidant effect. However, by scavenging electrons, transition metals present in the system can also be reduced to pro-oxidant compounds. It is not known to which extent PP have an antioxidant or a pro-oxidant effect on emulsified oils, while interacting non-covalently (pH 6) or covalently (pH 9) with the interfacial protein film. The aim of this study was to characterize the impact of phenolic acid derivatives (PAD) on the antioxidant activity of an interfacial β-Lg film as a function of their chemical-structural properties and pH value.

Method:
Electron spin resonance spectroscopy analyses were performed to determine the ability of the β-Lg-PAD interfacial film to saturate hydrophilic radicals from the aqueous phase and hydrophobic radicals from the oil phase. The complexation of transition metals by the β-Lg-PAD interfacial film was investigated, which reduced the pro-oxidant effect of transition metals. Lipid oxidation products were analyzed in a model linseed oil emulsion over storage time to characterize the antioxidant efficacy of the β-Lg-PAD interfacial film.

Results:
The results showed that all PAD used at pH 6 scavenge hydrophilic radicals and PAD with a more hydrophobic molecular character scavenge hydrophobic radicals as well as reduce transition metals. As expected, transition metals are complexed only to a small extent, leading to increased lipid oxidation by non-complexed transition metals. At pH 9, there is strong complexation from the PADs and transition metals. The complexed transition metals at pH 9 can no longer be reduced by PADs, rendering them non-pro-oxidative. As a result, lipid oxidation in the emulsion is no longer promoted.

Conclusion:
For the first time, PAD interacting covalently and non-covalently with a interfacial protein film were investigated regarding their impact on the steps of lipid oxidation in emulsions and bear the potential to be applied more specifically in food products.

O1.3

Does the presence of other amines influence the degradation of histamine by plant-based DAO enzyme?

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Aim:

The presence of histamine in food may lead to the onset of symptoms of histamine intolerance in susceptible individuals due to a reduced activity of diamine oxidase (DAO), which is the key enzyme for histamine degradation at intestinal level. Nowadays, a novel food consisting of exogenous DAO enzyme from porcine kidney is used for the dietary management of this food intolerance. More recently, plant-based DAO enzyme is being studied in order to widen the use of this enzymatic supplement to vegetarian/vegan population.

Some studies have suggested that the copresence of other diamines, could compete for deamination by DAO enzyme, and thus enhance the adverse effects of histamine. However, the available experimental data about this topic are scarce, and have not been hither to studied with plant-based DAO enzyme.

Therefore, the aim of this study was to assess whether the presence of different amines hinders the degradation rate of histamine by plant-origin DAO enzyme.

Method:

The DAO catabolic activity of lyophilised pea (*Pisum sativum* L.) sprouts was tested *in vitro* on three amino substrates (histamine, putrescine and cadaverine, each at 5 mg/L), as well as on different substrate mixtures consisting of histamine (5 mg/L) combined with different concentrations of putrescine and/or cadaverine (1:0.25, 1:1, 1:2,5, 1:5 and 1:10).

Results:

The highest rate of degradation by DAO enzyme was observed for cadaverine (187.1 $\pm$ 10.9 mU), followed by putrescine (106.5 $\pm$ 2.9 mU) and histamine (4.128 $\pm$ 0,1 mU). Putrescine and cadaverine significantly delayed histamine degradation, specially when these diamines were present at equal or higher amounts than that of histamine. When the concentration of putrescine or cadaverine was 2.5-fold higher than that of histamine, the degradation of histamine was reduced by 45% and 55%, respectively, compared to histamine alone. The percentage of inhibition of histamine degradation by DAO enzyme was even greater when putrescine and/or cadaverine were added at higher concentrations (5- and 10-fold higher), reaching reductions of about 90%.

Conclusion:

These findings demonstrate that the capability of plant-origin DAO enzyme to degrade histamine is influenced by the presence of putrescine and/or cadaverine. This information may be relevant in the dietary management of histamine intolerance.

O1.4

Quality of fish balls from organic meagre side streams formulated with of fish protein hydrolysate

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Aim:

Demand in the global market is shifting toward higher value-added processed seafood with convenience and ease of preparation, and consumers are opting for products with high nutritional value that also satisfy sensory/hedonic attributes. Moreover, the sustainability of food systems has attracted the attention of the scientific community, which has focused its efforts on the reduction, management and use of food waste and by-products. Fish processing by-products are a source of different compounds with high commercial value, including collagen, gelatin, proteins, peptides, oil, lipids, chitin, vitamins, minerals, enzymes, pigments, and flavorings, which can be used as raw material as well as functional ingredients for the production of value-added products. The aim of this study was created a high valued add product based on meagre side streams with addition of Fish Protein Hydrolysate (FPH) from fish by-product.

Method:

Fish balls were prepared from meagre (Argyrosomus regius) flesh obtained by mechanical separation of the side streams obtained after the filleting operation. FPH was added to fish balls at the concentrations of 0.5%, 1% and 1.5% in order to develop a product with high nutritional value and desired sensory properties. For this purpose, physicochemical and sensory tests were performed to investigate the quality of the final product.

Results:

The results showed that the addition of FPH did not significantly affect the physicochemical parameters such as pH, water and content, color, t-bars and texture. On the other side, flavor of the fish balls was significantly affected, with sweetness increasing with increasing FHP concentration. However, samples added with 1.5% FPH resulted as the best group for sensory analysis results.

Conclusion:

Overall, the present study showed that the addition of FPH from fish by-products can be a strategy for the production of high nutritional value products from meagre side streams without changing the quality of the final product.

Acknowledgements

This research was conducted under the NewTechAqua project supported by the European Union's Horizon 2020 Programme (grant agreement No 862658). The project aims to expand and diversify European aquaculture production by developing and validating technologically advanced, resilient, and sustainable applications for finfish, molluscs, and microalgae.

O1.5

Cold plasma treatment to obtain safe minimally processed oysters (CRASSOSTREA GIGAS)

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Aim:
The aim of the research was to develop a minimally processed oysters treated post-harvest with cold atmospheric gas plasma (CAP.) The effects of the different conditions and storage effect were checked by evaluating the reduction of the natural spoilage microbiota and retention of nutritional and quality features of the treated products.

Method:
Pacific oysters (*Crassostrea gigas*) were harvested from France and transported to the laboratory under refrigeration within 24 hours. The live oysters were cleaned and shucked and the meat left on one side of the valve used for experiments. Two CAP prototype were used with ozone and NO_x reactive species with treatment times of 20 and 45 minutes.
After plasma treatment, oysters were packed in high-density polyethylene (HDPE) boxes with high barrier film under two MAP conditions (20% CO_2 + 80% N_2 or 80% CO_2 + 20% O_2) and stored at 4 °C and stored for 7 days. Control and treated samples were analysed for quality parameters (pH, dry matter, oxidation, texture, colour and sensory proprieties) and natural microbiota (e.g., *Pseudomonas* spp., aerobic mesophilic and psychrotrophic bacteria).

Results:
The quality parameters such as pH, dry matter and texture of the CAP treated oysters showed no significant changes in most cases, while 45 minutes treated oysters showed a darker colour, which affected the visual quality. Despite this effect, the CAP treated oysters were well appreciated by sensory evaluation. Nutritional quality showed increased lipid oxidation in CAP treated samples. Nevertheless, the innovative CAP -treated oysters had lipid oxidation levels below the expected limit for seafood. From a microbiological point of view the chosen CAP processing conditions in combination with MAPs allowed the produce safe product.

Conclusion:
The results of the study demonstrated promising effects of cold gas plasma treatment on some of the microbiological and physicochemical parameters investigated, with some synergistic effects observed with the use of MAPs.

Acknowledgements

This research was conducted under the NewTechAqua project supported by the European Union’s Horizon 2020 Programme (grant agreement No 862658). The project aims to expand and diversify European aquaculture production by developing and validating technologically advanced, resilient, and sustainable applications for finfish, molluscs, and microalgae.

O1.6

Influence of high-intensity ultrasound on technofunctional properties of dietary fiber and on bioaccessibility of protein

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Aim:
High-intensity ultrasound as a green and innovative technology is known to have great potential in transforming by-products of the food industry into valuable ingredients. Plant fibers often accumulate as waste products during several manufacturing processes, such as juice production or pectin extraction. They exhibit an excellent source of dietary fiber and micronutrients, but often show poor functionalities. Pea protein, as a growing protein source for plant-based meat analogs, is also marked by poor functionalities. Affecting technofunctional properties of both, plant fiber and pea protein, sonication might also have an impact on bioaccessibility of protein. Therefore, this study aimed not only at investigating the effects of high-intensity ultrasound on plant fiber and pea protein, but also on in-vitro protein digestibility.

Method:
Initially, 1 % of different commercial plant fibers were mixed with 10 % of pea protein using high-intensity ultrasound (amplitude 116 µm, t = 150 s, energy density = 225 kJ, $\bar{P}$ = 325 W). The in-vitro protein digestibility was conducted simulating stomach- and intestinal phase, using the appropriate enzymes. The enzymatic degradation was followed measuring the content of free amino acid groups during 120 minutes. Complementary investigations were particle size- and microstructure analysis, measuring rheological properties and water-binding-capacity.

Results:
Due to cavitational effects, changes in particle size for dietary fiber and pea protein were observed, causing increased solubility for pea protein and enhanced viscosity for all solutions containing pea protein and for solutions containing only apple and citrus fiber. The microstructure analysis revealed thin and nearly transparent layers for apple and citrus fiber after ultrasound treatment, possibly contributing to enhanced water-binding-capacity and viscosity. In general, viscosity is assumed to be an influencing factor regarding bioaccessibility of nutrients. However, in this study, no differences in digestibility neither for pure protein solution nor for fiber enriched pea protein solutions were found.

Conclusion:
High-intensity ultrasound demonstrated to be an effective technology in modifying technofunctional properties of dietary fiber and pea protein. Despite increased viscosity, a sufficient nutrient uptake might not be affected, as no negative impacts on protein digestibility were observed as an effect of fiber enrichment or ultrasound application.

O1.7

Bioactive compound concentration in Amaranthus hybridus leaves at different harvest times

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Aim:
The aim of this work was to determine the optimal harvest time for *Amaranthus hybridus* leaves in terms of their bioactive compounds and antioxidant capacity by quantifying total phenols, flavonoids, and antioxidant activity at different harvest times.
Method:
A. hybridus seeds obtained from INIFAP were planted in November 2021 in Querétaro, México. The plantation was set up in an open area, consisting of 8 rows, each 20 m long. Leaves were randomly harvested at 40, 50, and 60 days after planting. Bioactive compounds were extracted in methanol (80%). Total phenolic content was determined using the Folin-Ciocalteu assay, while total flavonoid content was estimated using the colorimetric method. Finally, antioxidant activity was evaluated using the DPPH assay.
Results:
A. hybridus leaves contain significant amounts of phenolics (18.782 - 20.316 mg GAE/g DW), flavonoids (13.89 -18.29 mg CE/g DW), and antioxidants activity (55.60 to 56.45 µmol AA/g DW), which are comparable to values reported in other studies. Leaves harvested at 40 and 50 days after planting showed the highest concentration of total phenolics (20.316 ± 0.342 mg GAE/g DW), and antioxidant activity (56.458 ± 0.497 µmol AA/g DW). Interestingly, the highest concentration of total flavonoids was quantified in leaves harvested at 40 days (18.290 ± 0.915), which was 33% and 47% higher compared to leaves harvested at 50 and 60 days, respectively. This supports previous studies reporting that the concentration of certain bioactive compounds such as phenolics and flavonoids decrease in leaves prior and during the flowering stage (flowering started around day 63).
Conclusion:
This study confirms that the optimal harvest time for *A. hybridus* leaves, in terms of bioactive compound concentration, is 40 days after planting. Results also suggest that delaying harvest beyond 40 days may result in a significant decrease in flavonoid content. Given the known health-promoting properties of the phenolics and flavonoids in *A. hybridus*, these findings have important implications for the optimal utilization of this plant as a source of bioactive compounds.

O2.3

Biopeptides derived from red macroalgae protein and their potential as heart health-promoting functional food ingredients

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Aim: Currently, red seaweed has been demonstrated as an important economic biomass with high contents and quality of protein and essential amino acids, potentially making it an attractive and promising alternative protein source for global food sustainability. Angiotensin-converting enzyme (ACE) has a significant role in the regulation of blood pressure and ACE inhibition with inhibitory peptides is considered as a major target to prevent hypertension. Until now, very few studies on ACE inhibitory peptides from red macroalgae have been conducted. Thus, we investigated the generation, isolation and characterization of ACE inhibitory peptides from *Gracilaria gracilis* proteins by enzymatic hydrolysis for use as a potential functional food ingredients.

Method: Firstly, the red seaweed proteins were extracted using different cell disruption strategies (chemical, physical and enzymatic treatments) applied individually or in combination. The protein content of the raw material and the resulting extracts were determined and amino acid profiling was carried out using an amino acid analyzer. Secondly, *G. gracilis* proteins were hydrolyzed using various food grade proteases to generate bioactive peptides, and their ACE inhibitory activities were assessed. The *G. gracilis* protein hydrolysates (GGPHs) were further fractionated and purified by membrane ultrafiltration and reverse-phase high performance liquid chromatography. Fractions and peptides were analysed by mass spectrometry. Furthermore, antihypertensive effects of peptides in spontaneously hypertensive rats (SHRs) were tested.

Results: Among the different methods of extraction investigated, it was found that the protein extraction efficiency was significantly increased by the use of cocktail based to proteases and polysaccharide-degrading enzymes compared to when enzyme was used alone. In terms of protein hydrolysis, the alcalase-digested hydrolysates exhibited the highest ACE inhibitory activity. Moreover, the degree of hydrolysis and anti-ACE potential of GGPHs can vary depending on the proteases used. After fractionation and purification by ultrafiltration, the <1 kDa fraction was the most active as inhibitor of the *in vitro* activities of ACE. Some of the peptides identified revealed strong blood pressure reductions in SHRs.

Conclusion: The biopeptides derived from protein hydrolysates of *G. gracilis* would be a heart health-promoting functional ingredients for nutraceuticals acting against hypertension and its related diseases.

O2.4

Vegetable-fruit mousses enriched with soluble dextrin fibre from potato starch for overweight and obese children

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Aim: The study with acronym PreSTFibre4kids is aimed at examining vegetable and fruit mousses enriched with soluble dextrin fibre (SDexF) from potato starch with prebiotic properties, in terms of the prevention of overweight and obesity in children and the reduction of metabolic disorders secondary to obesity.

Method: The project includes: development of recipes of vegetable & fruit mousses enriched with SDexF; preparation of demonstration batches; evaluation of their taste acceptability and tolerance; evaluation of effect of consuming them on selected clinical, metabolic and immunological parameters in children with overweight and obesity; analysis of changes in microbiome and metabolome in children undergoing clinical procedure with them; evaluation of stability and prebiotic activity of SDexF after pasteurization and storage of demonstration batches.

Results: Based on analysis, incl. assessment of the composition and nutritional value, as well as safety assessment, National Institute of Public Health issued a positive recommendation recognizing SDexF as food ingredient. Industrial partner developed recipes of 6 flavours of mousses with and without addition of SDexF. Based on sensory analyses incl. acceptance and preference surveys 3 flavours (apple-carrot-quince, apple-peach-parsnip, apple-cherry-carrot) were selected for clinical trials. 100 overweight or obese children aged 6-10 years (mean 8.5 years) and mean BMI = 23.3 kg / m^2 were included in the study. The analyses showed that there is no difference between the study group and the control group in terms of the impact on selected clinical parameters of overweight and obese children. However, beneficial changes in the composition of the intestinal microbiota, an increase in the concentration of SCFA in the stool, were found. It was shown that at least 60% of overweight and obese children showed an increase in the concentration of SCFA in the faeces and a decrease in the activity of faecal enzymes. Microbiome and metabolome profiles of children undergoing a clinical study were obtained. The prebiotic properties of SDexF after the pasteurization process of demonstration batches preserved.

Conclusion: It was shown that vegetable and fruit mousses enriched with SDexF showed the effect of reducing overweight and obesity in children and limiting the occurrence of metabolic disorders secondary to obesity.

O2.5

Creation of food structures by means of powder based additive manufacturing technique

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Aim:

The food industry employs a wide set of processes to manufacture (semi-)solid food products. These processes essentially entail blending, mixing, shearing, shaping and optionally heating processes to convert ingredients into structured foods with certain properties like texture, shape and flavour. The required ingredient functionalities and process conditions are thightly specified to control product quality and texture. In sharp contrast with conventional processes, an innovative additive manufacturing technique was developed combining powder based printing, liquid binding and selective laser sintering. This process allows to create food products without any mixing, shearing and shaping steps, as it instead accurately deposits liquid ingredients on powders to yield a product based on a digital volumetric design. The aim of this project was to study the capability of powder based printing to create food products with tailored properties and composition.

Method:

A model formulation for pet food with varying combinations of starch, protein, fibre and minerals was used to create printed pet food samples using a dedicated powder based printing machine. Water droplets were spatially deposited with a Lee valve to locally hydrate the powder before applying IR laser scanning of the hydrated sections. A range of physical characterization techniques was used to characterize the powders and define their requirements. XRT was used to quantify product microstructure and to relate this to textural properties as measured by TA.

Results:

Powder flowability index gouverned formation of even and compact powder layers and could be controlled by the formulation composition. Droplet size and surface tension of the liquid were critical to ensure wetting of the powder. Both variations in protein source in the formulations and amount of deposited liquid affected the micro and macrostructural morphology of the food products. These variations controlled the fracture properties of the pet food products produced.

Conclusion:

We show that it is possible to engineer food textural properties by spatially depositing liquid droplets on food powders and subsequently lasering these sections. Hence, food structures are created in the absence of shearing and shaping processes. This innovative powder based printing technique provides new avenues to flexibly create personalized, on-demand food products.

O2.6

Agri-Food Waste as Nutritional Goldmines: Subcritical Water Extraction Technology - Evidence from Two Case Studies.

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Aim:
According to the Food and Agriculture Organization (FAO), approximately one-third of global food production is lost or wasted throughout different stages of the food supply chain, reaching 50% in the case of fruit and vegetables products. This issue can be addressed through the adoption of the Circular Economy, achieving a "zero waste" approach, harnessing these residual materials as valuable resources to create new products rather than simply disposing of them. In line with these objectives, we explored the potential of subcritical water extraction (SWE) as environmentally sustainable technique to recover bioactive compounds from food waste, specifically blueberry pomace (BP) and pomegranate peels (PP).

Method:
The optimization protocol for BP involved two sequential extraction in acidified water at 80°C and 150°C for 20 min each. Instead for PP, after a single extraction at 100°C for 10 min, a downstream process was defined. The PP liquid extract was concentrated using nanofiltration membrane, and the permeate was used as the solvent for a new extraction. The processes were optimized by analyzing the overall yields on dry weight (DW), the phenolic (TPC) flavonoids (TFC) and anthocyanin (TAC) content, togheter their activity in terms of antioxidant and Cu-chelating features.

Results:
The first extraction on BP gave a 34.4% DW yield with a TPC and TAC of 86.44 mgGAE/gExtr and 21.96 mg/gExtr, respectively. The second extraction yielded 21.9% DW, with a TPC of 211.73 mgGAE/gExtr. The dry PP yielded 67.2% DW with a TPC of 262.15 mgGAE/gExtr. The nanofiltration membrane concentrated the six-fold extract, increasing the polyphenolic content accordingly. The permeate water was then recycled for a new extraction of dry PP, without affecting the product quality.

Conclusion:
The optimized extraction on BP led to the recovery of two bioactives extracts from one waste. The protocol applied on PP resulted in a product with increased selectivity towards polyphenols and an efficient water reuse strategy. These findings demonstrate process intensification potential of SWE, enhancing the recovery of a large array of bioactive compounds from food waste, while simultaneously improving resource efficiency through the implementation of sequential extractions and water recovery strategies.

O2.7

Recovery of bioactive compounds from fish processing side-streams enhanced by Pulsed Electric Fields

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Aim:

Fish processing industries are currently producing among the highest proportionally amounts of side-streams, rich in exploitable bioactive compounds, such as polyunsaturated fatty acids (PUFA) and proteins. Indicatively in the filleting lines about 50% of the input biomass is sold as primary final product. The valorization of fish discards by extracted ingredients could contribute in the circular economy. Several pretreatment processes have been proposed for enhancing the efficiency of recovery.

The objective was the application of pulsed electric fields (PEF) for the valorization of seabass by-products, through the lipid extraction followed by protein extraction.

Method:

Seabass filleting side-streams were freeze dried. Fatty acids (FA) recovery was carried out using polar (ethanol) and non-polar solvent (hexane). The effect of temperature (20-50°C), time (0-30 min) and solvent to solid ratio (l/s, 10:1-50:1) was investigated and total yield, FA composition and oxidation were evaluated. The defatted residues were subjected to protein extraction in acidic (pH=1-5) or alkaline conditions (pH=9-13), time (0-240 min), l/s (10:1-50:1) and temperature (20-50°C). Evaluation was based on recovery, purity of extract and protein size. PEF treatment (1.5 kV/cm, 20 Hz, up to 1000 pulses) was applied to the solvent-solid extraction system either before or after lipid extraction and the extracts were evaluated based on the aforementioned parameters.

Results:

Ethanol achieved exhaustive lipid recovery from the side-streams (36.6 g_{oil}/100 $g_{dry.material}$) at 35°C, l/s=50/1 and 10min of extraction, with the highest concentration of PUFA and oxidation levels lower than the FAO limits for edible fish oils. The maximum protein recovery was achieved at pH=13, l/s=50/1 and 50°C, after 2 h of extraction. PEF didn't affect the yield and quality of lipid extracts, but enhanced proteins recovery (up to 25% at 500 pulses), especially protein fractions of lower sizes (<35 kDa), and reduced the extraction time.

Conclusion:

This study showed the potential of non-thermal technologies and environmentally friendly solvents for the recovery of high quality proteins and fatty acids, respectively, which contribute to a more sustainable utilization of fish processing side-streams.

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O3.2

Fermenting for Health: How Probiotic Fermentation Boosts Wheat and Rye Fiber Benefits

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Aim:
This study aimed to investigate the changes in the content of complex carbohydrates in sourdoughs inoculated with potentially probiotic microorganisms and to determine the polysaccharide composition of the resulting bread, with a focus on wheat flour and rye flour sourdoughs.

Method:
Sourdoughs were inoculated with four different microorganisms, including *Saccharomyces boulardii*, *Lactiplantibacillus plantarum*, *Lacticaseibacillus rhamnosus*, and *Bacillus coagulans*, while spontaneous fermentation was used as a control. Samples of the sourdoughs were taken after 24 and 48 hours of fermentation as well as the resulting breads, and the content of individual dietary fiber components, including arabinoxylans, fructans, and β-glucans, was analyzed.

Results:
In the wheat flour sourdoughs, the use of sourdough fermentation led to a reduction in starch content and an increase in arabinoxylans solubility in the resulting bread. The bread produced from sourdough inoculated with potential probiotic microorganisms had higher β-glucan content than both the control bread and the bread produced from spontaneous fermentation. Sourdough inoculated with *S. boulardii* resulted in the highest reduction of fructan content in the bread and the highest content of soluble dietary fiber. In the rye flour sourdoughs, the treatments applied contributed to an increased total content of arabinoxylans in the breads, and the inoculation of sourdoughs with potential probiotic strains improved their solubility in water. The use of *S. boulardii* strain allowed for the greatest reduction of fructans in rye bread.

Conclusion:
This study demonstrated that sourdough fermentation, in combination with inoculation with potential probiotic microorganisms, can lead to significant changes in the content of complex carbohydrates in wheat flour and rye flour sourdoughs. The resulting breads had increased nutritional value and improved solubility of dietary fiber components. These findings suggest that sourdough bread can be a promising source of dietary fiber, and that the use of probiotic microorganisms may further enhance its health benefits.

O3.3

Fermentation of plant-based matrices for the development of dairy and cheese-like flavours

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Aim: Screening of bacterial cultures in different plant matrices to reduce unpleasant sensory attributes of plant proteins and/or develop dairy and cheese-like flavours through fermentation.

Method: Three commercial cultures were screened (two thermophilic and one mesophilic starter culture) in ten different plant-based matrices. The matrices with 7% plant protein were chosen as a base where the protein source was either yellow pea, fava bean and/or chickpea and a combination of thereof either with or without oat concentrate. Fermentation curves were obtained with the iCINAC system in a 20h long fermentation. In parallel microcalorimetry was used for monitoring the metabolic activity of chosen cultures in different plant sources. Sensory analysis was performed on all the samples at the 16h fermentation point. Additionally, HPLC, GC-MS and UPLC analyses were done for profiling organic acids, sugars, volatile compounds, and amino acids.

Results: Data collection and analysis are ongoing and will be completed by September 2023.

Conclusion: Based on the results, a potential combination of microbes and plant proteins for the development of dairy analogues like plant-based cheese alternatives is presented.

O3.4

Lactic Acid Bacteria Fermentation of Lentil Protein Emulsion and Its Potential for Plant-Based Yoghurt Alternatives

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Aim:
In our previous research, lentil protein isolate was shown to be an excellent base material for plant-based yoghurt alternatives (YA) due to its gelling behaviour upon acidification by lactic acid bacteria (LAB) fermentation, high protein content and low carbon footprint. As this approach is novel, little is known about how different lactic acid bacteria behave in a lentil protein matrix. Our study aimed to gain a deeper understanding of the fermentation behaviour of LAB on a lentil substrate and the techno-functional and sensory properties of the resulting YA prototypes.

Method:
A lentil protein emulsion was fermented with either *Leuconostoc citreum* TR116, *Leuconostoc pseudomesenteroides* MP070, *Lacticaseibacillus paracasei* FST6.1, or a commercial *Streptococcus thermophilus* yoghurt culture as a control. Microbial growth, acidification and rheological structure formation were monitored during fermentation. Several core metabolites of the LAB, the metabolism of sugars and FODMAPs, and the production of organic acids and antifungal phenolic compounds were analysed. Textural, rheological and tribological methods, and confocal laser scanning microscopy studied the structure of the YA. A preliminary sensory analysis of the YA was also performed.

Results:
Lentil protein isolate proved to be a suitable substrate for all tested strains, as shown by high growth rates and typical acidification. The YA showed a gel-like texture typical for non-stirred yoghurts, high water holding capacity and whiteness index, and good robustness against shear stress. The tested strains produced significantly higher levels of antifungal phenolic compounds than the control and are therefore promising candidates as adjunct cultures for shelf-life extension. *L. citreum* TR116 and *L. pseudomesenteroides* MP070 convert fructose to mannitol and could be used for sugar-reduced fermented dairy applications. Fermentation with *Lc. paracasei* FST6.1 resulted in a YA with a typical sensorial profile and overall acceptability not significantly different from the control.

Conclusion:
Lentil protein isolate is a favourable substrate for LAB, and the tested strains produced YA with distinct techno-functional and sensory properties. Further research could explore the potential of lentil protein as base material for other fermented dairy alternatives relying on protein gelation, and the strains' properties in combination with different LAB to maximise their functionalities.

O3.5

Effect of lactic acid bacteria fermentation on the technological properties of sorghum composite bread

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Aim:
Sorghum is a climate-resilient crop with a high presence of bioactive components. However, sorghum proteins are highly hydrophobic and poorly digestible. Moreover, sorghum starch is trapped in the protein matrix and has poor technological performances. Fermentation is a sustainable technology that can improve the nutritional and technological properties of grains. This study aimed to evaluate the effect of LAB fermentation on the properties of sorghum-composite bread.

Method:
Lactobacillus delbruekii subsp. *bulgaricus* 1932, *Lacticaseibacillus casei* 4339 and *Leuconostoc* spp. 4454, previously selected according to their proteolytic, aromatic and EPS-producing activities, were used for the sourdough fermentation of sorghum flour (25°C, 15h). The pH, TTA and microbial counts of the sourdoughs were analysed. Moreover, the colour, antioxidant activity, viscosity, thermal properties, and ^{1}H NMR molecular mobility of the sourdoughs were evaluated. To evaluate the effect of fermentation on sorghum-composite bread, wheat breads with 25% sorghum sourdough and a control bread (unfermented) were analysed. The specific volume, a_w, moisture content, antioxidant activity, texture and colour parameters were evaluated in all bread samples.

Results:
All LAB strains showed excellent growth capacity on sorghum, reaching values of up to 10^9 CFU g^{-1}, and pH between 4.2 and 4.5. After fermentation, the samples showed a pH-induced colour change, probably affecting the phenolic compounds, showing increased values of a*, b* and L* in both sourdoughs and breads. The antioxidant activity also increased after fermentation. Furthermore, fermentation improved the gelatinisation capacity of the sourdoughs and increased their viscosity, probably due to the production of EPS. However, the specific volume of breads was not affected by LAB fermentation, but the texture parameters improved after fermentation, showing increased cohesiveness. In addition, the moisture content (%) of bread crumb was higher in breads with fermented sourdough, probably due to the presence of water-binding molecules (EPS) that prevent water loss during baking.

Conclusion:
Sourdough fermentation of sorghum flour proved to be a good technique to improve the technological properties of sorghum sourdough bread. Future studies should be conducted to evaluate the consumer acceptability of sorghum sourdough bread and the effect of sourdough on the staling sorghum-composite bread.

O3.6

The effect of pre-processing, starter culture, and temperature on fermentation of seaweed

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Aim:
Fermentation can provide new properties to food in terms of flavour, odour, and texture. Fermentation also has a conservation function and can prolong the shelf life of a food product. This is highly relevant in the seaweed industry, as the short season limits the availability. Fermentation of seaweed could ensure an even distribution and availability throughout the whole year. Compared to drying as conservation method, fermentation demands less energy and maintains more of the nutritional value and antioxidant activity of the raw material. Yet there are few studies focusing on different fermentation approaches. Hence the aim of this study was to explore how the factors pre-processing, starter culture and temperature affects fermentation of seaweed.

Method:
Sugar kelp (*Saccharina latissima*) was fermented using 8 different combinations of approaches, varying the factors pre-processing (blanching), starter culture (two different *Lactobacillus plantarum* cultures), and temperature (room temperature or 37 °C). pH levels were monitored regularly to determine when the seaweed was considered as fermented. The fermented samples were analysed for microbiology and sensory characteristics (odour, colour, texture, flavour).

Results:
Boiling prior to fermentation avoided the occurrence of mould and yeast in the seaweed samples, in addition to preserving more of its bright green colour. Fermented samples hade a more pleasant texture than unfermented, especially those who had been blanched. The fermented samples were described as acidic and umami in terms of odour and flavour, however one of the starter cultures gave a more pleasant odour in the sensory analysis. Increased temperatures accelerated the fermentation time, fermenting seaweed in 28.5-91 hours at 37 °C and 3-10 days at room temperature, depending on the starter culture.

Conclusion:
Pre-processing, starter cultures and temperatures influence the fermentation process of seaweed in several ways. Fermentation of blanched seaweed at 37 °C using *Lactobacillus plantarum* as starter culture can provide a shelf stable product of suitable sensory characteristics. Product development implementing fermented seaweed into food products is recommended to fit fermented seaweed to the European market.

O3.7

Quantification of the number of viable but non-culturable Campylobacter jejuni using dielectrophoresis with micro-fluidic device

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Aim: (heading must be in bold)
One of the causes of foodborne illness by *Campylobacter jejuni* may related to existence of viable but non-culturable (VBNC) cells due to morphological change from spiral to coccoid. Although the VBNC state cells can be quantified by some techniques, *C. jejuni* cells in VBNC state are difficult to isolate and collect as they are without chemical modification. The aim of this study was to investigate the possibility to apply a novel technique using dielectrophoresis (DEP) with micro-fluidic device to quantify VBNC state *C. jejuni* cells without chemical labelling.

Method: (heading must be in bold)
Pre-grown *C. jejuni* cells (10^8 CFU/mL) in Bolton broth were stored in phosphate buffer in a micro-aerobic condition at 4 and 37°C to investigate the occurrence of VBNC cells during storage. The culturable bacterial cells were enumerated by mCCDA culture media, and VBNC cells were quantified by the DEP procedure using the apparatus (ELESTA PixeeMo, AFI Corp., Japan) with 3000 to 7000 kHz frequencies to clarify the dielectric nature of C. jejuni cells. Furthermore, EMA-qPCR method was used as a standard procedure for detection of VBNC cells.

Results: (heading must be in bold)
Although culturable *C. jejuni* cells were rapidly decreased and not detected ($< 10^2$ CFU/mL) after 24 h at 37°C storage, the live cell numbers detected by the DEP and EMA-qPCR methods showed different behaviors. The changes in the live cell numbers enumerated by the DEP method with 5000 kHz illustrated moderate decrease by 4 log cells/mL in four days storage, which is similar to the results of the EMA-qPCR method. While the number of culturable *C. jejuni* cells gradually decreased for eight weeks, the live cell numbers did not change throughout the storage period.

Conclusion: (heading must be in bold)
The combined technique of DEP with micro-fluid device suggests that the possibility of detection and quantification of the number of VBNC *C. jejuni* without chemical labelling.

O4.2

Comparing electrostatic separation of soy and lupin: effect of de-oiling by solvent extraction

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Aim: Electrostatic separation is a sustainable dry separation technique based on tribo-electric charging of different tissue components, such as protein bodies and fibres, to obtain refined food ingredients from fine milled legume flours, which has been successfully applied to several oil seeds. However, the separation of soy is less efficient than the separation of lupin, which could be due to a difference in material properties like oil content, or the electrostatic separator design used. Therefore, the aim of this research was to determine the mechanism behind the ineffective separation of soy and if it could be altered by de-oiling.

Method: For this, several scenarios were compared, which used soy and lupin de-oiled with different solvents (none, acetone, ethanol, and hexane). Next to that, two electrostatic separation setups were used with a venturi principle to enhance the driving force for particle dispersion, which is critical to achieve good separation of fine powders.

Results: Electrostatic separation of lupin resulted in a higher true protein content (58.5 %DM (dry matter) (N x 5.7)) than electrostatic separation of soy (protein purity 45.0 %DM (N x 5.7). De-oiling soy with hexane and milling improved the purity of the soy protein enriched fractions (purity 59.6%DM (N x 5.7) towards more similar levels as lupin protein enriched fractions. The protein purity of lupin increased to the highest extend by using polar solvents (acetone and ethanol).

Conclusion: The separation of soy was ineffective because the soy protein bodies were still embedded in the cellular structure after milling, which translated into a larger particle size and lower small particle dispersibility. De-oiling soy flour with hexane and an additional milling step resulted in liberated protein bodies, which is the key towards effective separation of soy to obtain protein purities closer to the purity of pure protein bodies.

O4.3

Citrus fibres for the formulation of cold-filled gel emulsions: a sustainable multiphase system

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Aim:

Citrus is one of the most widely grown fruit crops in the world, with over 145 million tons produced in 2019. Since it is a main source of pectin, there is a great number of citrus by-products from the industry that can be valorised by recovering fibres to be used as natural food additives. Pickering emulsions are stabilized by solid particles, and citrus fibres can act as a sterical barrier against coalescence and increase the stability of emulsions by gelling the water phase, thanks to their high viscosity and gelation ability. This work aimed to test citrus fibres (CF) as emulsifier in the development of a sustainable multiphase system to be used as a fat substitute in low-fat products and/or as a carrier for bioactive compounds, thus increasing the nutritional value of the final product.

Method:

A Central Composite Design (CCD) was used to investigate the effect of 3 factors (type of emulsifier, emulsifier amount, and oil amount) on the characteristics of emulsions stabilized by CF or lecithin (used as reference). CF ranged from 8 to 16% (on the water phase), while lecithin ranged from 0.5 to 2.5% (on the oil phase), and corn oil ranged from 15 to 60% in both cases. All the runs were characterized for particle size distribution, apparent viscosity, and stability at 4°C until 14 days; images at the optical microscope were also acquired. The Response Surface Methodology (RSM) based on the desirability function was applied to obtain the optimized formulations.

Results:

Apparent viscosity increased when increasing the concentration of oil and CF; the particle size analysis showed an increase in droplet dimensions with the increase of oil volume phase and the decrease of emulsifier percentage. CF gave higher stability to the water phase until 14 days, while creaming stability resulted better with lecithin. The optimized formulations resulted in 8% CF with 40.66% corn oil, and 2.5% lecithin with 58.49% corn oil.

Conclusion:

CF gave promising results in terms of higher apparent viscosity and stability, with the advantage to use a lower oil percentage than in the optimized formulation with lecithin.

O4.4

Is it safe to cut off mold from bread?

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Aim:Determining the food safety of moldy bread

Meeting the food demands for a growing population has become among mankind's major concerns. One strategy to maintain the food supply is to reduce the amount of waste generated. Bread is among the major staple foods worldwide and due to its high content of nutritional components and sometimes high moisture, it is strongly prone to the formation of mold. We determined the mold growth and the respective produced fungal metabolites in sliced bread.

Method: DNA barcoding, multispectral imaging, and LC-MS/MS

A package of sliced wholemeal spelt bread was opened and finally overstored to facilitate mold growth. The fungal species were identified by DNA barcoding. Nine primer combinations were used, which aligned at the sequences for beta tubulin, calmodulin, mitochondria, and three ribosomal DNA sequences (internal transcribed spacer rDNA (ITS), large subunit (LSU) and small subunit (SSU)). Multispectral imaging was used for macroscopic identification of moldy regions on the bread slices. For multi-mycotoxin determination, an LC-MS/MS method was established to identify and quantify all mold metabolites within one run.

Results: *Chaetomium globosum, Penicillium chrysogenum and Scopulariopsis brevicaulis* were identified on a bread slice

In overstored sliced bread, we identified three mold species on the first slide of the stack (*Chaetomium globosum, Penicillium chrysogenum* and *Scopulariopsis brevicaulis*) by DNA barcoding. Targeted metabolite profiling confirmed the presence of the mycotoxin producers *Chaetomium globosum* and *Penicillium chrysogenum* in the bread sample. In contrast, the second slice was less infected, which was revealed by the lower amounts of mold metabolites and by nCDA analysis after multispectral imaging. The third slice was already free of mycotoxin originated from the contaminations. Data for further bread types will be presented as well.

Conclusion: Food waste can probably be reduced if statistics proofs the safety of bread

If health-threatening substances are found only in the first layers of sliced bread, the recommendations for the disposal of moldy bread should possibly be reconsidered. Further research in this regard should be intensified, as we did in this project. A larger dataset with appropriate statistical analysis and further data might help to convince customers that edible food should not be disposed of, and this might help to meet the increasing demand for food.

O4.5

Thermophysical Insights for High-Moisture Extrusion Texturization of Plant-Based Proteins: Towards Sustainable Production of Meat Analogues

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Aim:

The current trend towards a sustainable production of meat analogs has prompted scientific research to understand and evaluate protein texturization during high-moisture extrusion (HME). To achieve desired meat-like textures, it is important to study the influence of thermophysical properties of plant-based proteins and their high-moisture meat analogs (HMMA), as thermodynamic approaches can provide valuable information on the state and potential behavior of food systems. Therefore, this study aimed to gain insights into HME texturization of plant-based proteins and their HMMA by investigating their thermophysical properties to predict and achieve defined meat-like textures. The research employs calorimetric analyses, sensory evaluations, and numerical simulations to determine texturization conditions and visualize physical-chemical changes in the HME process.

Method:

In HME experiments, HMMA were produced on a bench-scale, co-rotating twin screw extruder, and evaluated via sensory and texture analyses. Thermophysical properties of HMMA and their plant-based proteins were determined based on calorimetric analyses using DSC measurements. Sensory, texture and calorimetric data were compared and a texturization factor was implemented to predict texturization conditions for different plant-based proteins. Numerical simulations were performed using the commercial software ANSYS CFX.

Results:

The results showed that calorimetric methods can be used to predict the texturability and process conditions of various plant-based proteins by applying a self-derived texturization factor. Further, this approach can predict the by us defined extrusion melting hurdle (EMH). EMH represents the minimum necessary temperature needed for protein texturization. Furthermore, using this texturization factor enables efficient screening of plant-based proteins for HME and streamlining the production of “tailor-made” HMMA. In addition, the implementationn of the thermophysical data in numerical simulations provided very accurate data on structure formation during HME, which is not accessible or very difficult to obtain in the closed black-box-like extrusion system.

Conclusion:

The knowledge generated in this study using thermophysical analyses, modeling, and numerical can help to minimize resources, innovate and rationalize product development, and improve ingredient flexibility by eliminating the need for trial-and-error HME experimentation. The findings of this study could support the sustainable production and development of plant-based meat analogs with specific textures through HME.

O4.6

Effects of different extraction on properties and future applications of cocoa pod husk pectin

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Aim

The aim of this study was to evaluate how different extractant solutions, assisted by ultrasound, affect the extraction of pectin from cocoa pod husk.

Method

Pectin was extracted from cocoa pod husk powder following a Central Composite Design (CCD) where explanatory variables were: temperature (50-70 °C), time (45-90 min), and ratio (30 – 50 ml/g) for alkaline (pH= 12) and acidic (pH=1.5) solutions. Enzyme load of 15-60 U/g, (pH= 4.5 and 37 °C) was studied instead of temperature for enzymatic extraction. The optimum points were obtained according to the pectin extraction yield for each type of solution. The extracted pectin was chemically characterized by analytical determinations of caffeine content, theobromine content, antioxidant capacity, degree of esterification, degree of methoxylation, viscosity, and infrared spectra between 4000 - 650 cm^{-1}; commercial pectin (apple and citrus) were used as control.

Results

The optimum extraction yields were 7.1, 21.9 and 7.3 % for acid, alkaline, and enzymatic extraction, respectively. The alkaline environment may promote pectin release by solubilizing polymeric materials, particularly hemicellulose, and pectin bound to the cellulose coating in cocoa pod powder, thus, increasing the extraction yield. Moreover, the alkaline extraction underwent demethoxylation of the extracted pectin according to FTIR characterization, where these samples presented a lower methoxyl ratio and high availability of -COO- groups (observed at 1608 cm^{-1}). This characteristic may indicate that this type of pectin can form more stable gels. The extracted pectin showed concentrations below (10 ppm), the quantification limit for theobromine and caffeine. Significant differences ($p>0.05$) between treatments were observed for the degree of esterification and methoxylation; these findings were confirmed via chemometric analysis of the pectin infrared spectra, where differences in chemical composition between commercial pectin and extracted pectin were observed.

Conclusion

Extraction solutions impact the chemical composition of pectins. The alkaline solution generated a higher yield and possible applications for pectin crosslinking in neutral environments. The enzymatic extraction method may present a viable alternative to acidic extraction.

O4.7

Effect of 3D printing conditions on the development of protein foods

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Aim:

This work aimed to evaluate the influence of 3D printing parameters on the printability of rice protein.

Method:

Printing a cylinder 3 cm in diameter and 1 cm in height using a protein mixture of rice (30%) and water (70%) with 0.5% xanthan gum was evaluated in an extrusion printer with an XYZ system. A ½ fractional factorial design was used with three factors: nozzle diameter (Ø) [1.2 – 2.2 mm], layer height (Lh) [1.0 – 2.0 mm], and printing speed (Ps) [20 – 50 mm/s]. Each combination of factor levels was performed in triplicate for 12 runs plus three central points. Time (min), total weight (g), change in diameter (%), change in height (%), change in volume (%), mass flow rate (mg/s), and appreciation (qualitative variable) were obtained as response variables. The linear effects of the factors were evaluated by analysis of variance. Additionally, a principal component analysis was performed to visualize the similarity between the observations and the relationship between the variables.

Results:

The Lh and Ps factors significantly affected ($p<0.05$) the sample weight, diameter, and volume variation. Meanwhile, mass flow and total printing time were significantly affected ($p<0.05$) by all three factors. It was found that a Ps of 20 mm/s and an Lh of 1 mm with a Ø of 2.2 mm increased the printing time. While with Lh of 2 mm and a Ps of 50 mm/s, a higher mass flow rate (116 to 126 mg/s) was obtained using the same Ø. Samples obtained with a nozzle diameter of 1.2 mm (independent of velocity or layer height) showed similar behaviors associated with a higher variation in diameter and volume. Finally, samples at the center points (Ps=35 mm/s, Ø =1.7 mm, and Lh =1.5 mm) were strongly associated with the appreciation variable that evaluated the desired print quality.

Conclusion:

It is concluded that high Ps and Lh increased the mass flow rate, deteriorating the quality of the printing surface, while low Ø increased the diameter and volume variation. These results indicate the importance of carefully selecting parameters to achieve optimal 3D printing of food with the desired quality.

O5.2

Plasma Functionalized Bio-Polymers Based Coating with In-package Plasma Treatment for a Sustainable Poultry Processing Chain

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Abstract

The poultry-processing chain faces continuous challenges in controlling pathogenic bacteria which are considered a major burden to the health and environment sectors. Bio-polymers have wide applications and roles across the food industry because of their diverse functionalities. Cold plasma (CP) is a novel process technology with promising emerging applications in the food sector, which to date have focused on controlling micro-organisms and extending the quality of various fresh products.

Aim:

The main goal of the present study is to develop and characterise the safe implementation of cold plasma technology in poultry post-slaughter process environments to enhance the microbial safety of fresh poultry meat using plasma functionalized bio-polymers in combination with natural compounds and in-package plasma treatments.

Method:

Chitosan and sodium alginate (SA) were functionalised with a dielectric barrier discharge plasma system for 0-30 min to develop edible coatings. Three essential oils were sequentially and individually incorporated; lemongrass, oregano, and thyme, at increasing concentrations (0.1-0.4 %). The fresh chicken meat (skin on/off) was coated in the bio-polymers using the dipping technique and subjected to final in-package plasma treatment (0-5 min) in a modified atmosphere package. Samples were removed for analysis at regular intervals for microbiological analysis: psychrophilic, Enterobacteriaceae and total aerobic bacteria counts as well as physicochemical analysis over a storage period of 7 days at 4 °C.

Results:

A decrease in the viscosity and improved solubility for plasma-functionalised chitosan were observed, making it suitable for the coating application. An increase in both the oil holding capacity and roughness of functionalised SA was observed. CP functionalisation of chitosan improved the antimicrobial potential. Lemongrass displayed better antimicrobial efficacy than the control, oregano or thyme EO's. The combined approaches and the sequence of their application in this study led to a significant reduction in microbial growth of up to 2.36 log CFU/g reduction. No negative impact on the quality of the chicken meat was observed.

Conclusion:

Cold plasma can be applied in different forms at individual or sequential process stages to rapidly control bacteria present in suspension or attached to the surface of poultry meat.

O5.3

Sustainable technology development at Cosun: Chicory Inulin Process 2.0

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Cosun is a Dutch farmers cooperative with more than 100 years history in processing vegetable crops (sugar beet, chicory root, potatoes) into food, feed, energy and non-food markets. Sustainability drivers, need for total product valorization and focus on new, healthy, products give a strong need for new technologies and production methods. There is a transition to a new approach of process development starting from 'green by design' and milder and sustainable technologies. This is found in new process concepts to produce new (functional) proteins but also in process innovations for existing processes. New technologies make processes more sustainable, open doors to biorefining but also create new products. One case will be highlighted in more detail.

Inulin from chicory is commercially produced for almost 30 years where the center of production lies in de Belgian/Dutch region. As with most capex-intensive processes changes to the process are often a matter of evolution rather then revolution. Consequently, the resulting inulin products are also mere variants on what is already present on the marketplace. Fortunately, the need for a drastic change can be induced by market demand. In our case, the strong demand for more sustainable and mildly produced products enabled us to implement a more radical approach to the production of inulin from chicory. Instead of improving the existing situation, we went to the drawing board to design an inulin factory with the knowledge of today. This is not straightforward since chicory contains very bitter tasting components. Thus, a new process should be able to purify inulin in such a way that desired plant components are conserved, but that the bitter taste is removed. In order to tackle this problem, a mild process based on sequential membrane steps was designed. The proof of concept was shown in our demo-facilities where the whole process was operated continuously and repeatably at a scalable size. The resulting product was certified as organic underlining the revolutionary approach. Moreover, the process showed less capex and opex intensive than the traditional processes, while also carbon emission and gas consumption were reduced. Currently, parts of this new inulin process are introduced parallel to our current process in order to reduce costs in this process as well. Due to this introduction, our process also becomes more flexible for producing inulin types that are processed more sustainably. Moreover, the mild process enables to bring inulin variants to the market that still contain healthy plant components while still tasting great.

O5.4

NOVEL BLOCK CRYOCONCENTRATION METHOD APPLIED TO POMEGRANATE JUICE

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Aim:
There are several methods of concentration by freezing: suspension, progressive and block. In general, there is a consensus that the future of cryoconcentration will lie in these latter systems. The objective of this work is to propose a new method CABC-VABC, in which the centrifugation-assisted block system (CABC) and vacuum (VABC) are combined in successive stages.

Method:
For this research, pomegranate juice of the Wonderful variety was used. A factorial design was carried out with 18 treatments and 7 response variables: concentration index (IC), solute yield (SY, %), efficiency (Eff, %), soluble solids (SS, ◦Brix), total phenolic compounds (TPC, mg GAE/L), total phenolic compound concentration index (TPCCI) and total phenolic compound concentration efficiency (TPCC Eff, %). The operating conditions evaluated were for CABC: centrifugation speed of 40 RCF (600 rpm), 750 RCF (2600 rpm) and 2360 RCF (4600 rpm), times of 10 min, 35 min and 60 min, and for CABC-VABC: same as for CABC and 20 kPa (absolute pressure) was held constant for 10 min. Pomegranate juice was frozen at -20°C for 48 hours prior to treatments.

Results:
With the CABC method without application of VABC, the best treatment was 750 RCF for 60 min, CI: 3.5, SY: 44.3%, Eff: 82.1%, SS: 49.8 ºBrix, TPC: 4825.9 mg GAE/L, an TPCCI: 4.4% and TPCC Eff: 80.9%. These results are better than those reported by other authors for the same product in several stages. It should be noted that with the CABC-VABC method the response variables improve. In this new method, the best treatment turned out to be 2360 RCF for 10 min, with 20 kPa for 10 min, obtaining: IC 3.8, SY 66.7%, Eff 90.2%, SS 54.3 °Brix, TPC 5412.7 mg GAE/L, TPCCI 4.9 and TPC Eff 89.0%. In addition, the time is shortened to 10 min, although a higher spin speed is required.

Conclusion:
With the combination of centrifugation and vacuum (CABC-VABC) it is possible to improve the response variables with respect to cryoconcentration by centrifugation, highlighting the high concentration rates of soluble solids and total phenolic compounds in the concentrated liquid phase.

O5.5

How does PEF impact membrane integrity and the volatile profile of broccoli stalks?

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How does PEF impact membrane integrity and the volatile profile of broccoli stalks?

Aim: Pulsed electric fields (PEF) treatments have gained attention in the food industry in the recent decades as it can serve as a non-thermal processing technique and can be implemented in several (food) applications. At lower field strengths, PEF might impart the (plant) intracellular structure by membrane permeabilization, and consequently, influence biochemical reactions and the concomitant volatile profile. This study aims to investigate the effect of different PEF conditions during a PEF treatment at low electrical field strengths on these characteristics. The study was performed on broccoli stalks, which is characterized by a rich flavor profile.

Method: PEF treatments at low field strengths with varying electric field strength and varying total specific energy input were performed on broccoli stalks. On the one hand, tissue integrity was measured in a quantitative way by (tissue and medium) conductivity measurements. On the other hand, volatile profiles were analyzed via HS-SPME-GC-MS. Finally, analytical outcomes of different PEF-treated stalks and control stalks were compared and interpreted.

Results: This work showed that PEF at low field strengths could induce substantial membrane permeabilization of broccoli stalks for which the degree depends on the applied processing conditions. A significant effect of implementing different total specific energy inputs between 2.19 and 41.10 kJ/kg at a fixed low electrical field strength on the resulting cell membrane disintegration and volatile profiles of incubated broccoli stalks was observed. Contrarily, varying the electrical field strength above 1.01 kV/cm at 2.50 and 8.00 kJ/kg did result in comparable volatile profiles of incubated broccoli stalks. Therefore, it could be implied that the total specific energy input has a more outspoken effect on cell membrane disintegration in comparison to the effect of electrical field strength under the conditions tested. As broccoli belongs to the *Brassicaceae*, these results can be extended to other vegetables from this plant family. Moreover, this output might be relevant in the context of steering biochemical reactions by PEF to create an intended volatile profile of vegetables (in the context of acceptance and/or preference).

O5.6

Exploring the Potential of Solar Cooking: Impact of Parabolic and Box Models on Broccoli Quality

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Aim:
The aim of this study was to explore the potential of solar cooking as a sustainable and economical method for food processing, particularly in developing countries. The focus was on investigating the impact of solar cooking on the processing and nutritional quality of food, with a specific emphasis on solar cookers' performance.

Method:
Broccoli (*Brassica oleracea* L. ssp. *italica*) was selected as the primary vegetable for this study due to its recognized nutritional value and abundance of bioactive compounds such as antioxidants, phenolics, and vitamins. Two types of solar cookers, namely parabolic and box cookers, were compared to traditional cooking methods. The physico-chemical properties of the initial and final products were evaluated, including total antioxidant activity, phenolic compounds, carotenoids, chlorophylls, water activity, color, texture, and volatile compounds. The changes in these parameters were also analyzed under isothermal conditions using five temperatures ranging from 70°C to 95°C.

Results:
The study concluded that there were no significant differences in the quality of broccoli cooked using either traditional or parabolic solar cooking methods. The kinetics observed under isothermal conditions effectively predicted the quality of solar-cooked broccoli, suggesting the potential use of these models to enhance the utilization and acceptance of environmentally friendly food processing technologies.

Conclusion:
This key study revealed that parabolic solar cookers can serve as an alternative to traditional cooking methods without compromising the nutritional properties of broccoli. However, the box-type solar cookers resulted in more significant losses. It is important to note that this study represents an initial exploration, and further research is required to assess the impact of solar cooking on the quality of various food products, considering different cooker models and climatic conditions.

O5.7

Food insecurity in Italy: stakeholders' opinions on the current situation and future development

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Aim:
In Italy, an increasing number of people are at risk of food insecurity. Food banks and other organizations are working hard to address them, but the issue persists. Stakeholder engagement should be used to identify solutions that might result in social sustainability. This study is part of an ongoing project to define a model that could mitigate food insecurity. In this stage, understanding the roles and opinions of stakeholders could help to understand the situation and find a possible way to deal with food insecurity.
This study aims to: (1) identify stakeholders involved in food distribution for those experiencing food insecurity; and (2) identify models that could improve the distribution of healthy and sustainable food to them. Research areas are Parma, Milan, Piacenza, Como, and Bari to define and compare different existential models emerging in the different contexts.
Method:
In-depth interviews will be conducted with relevant stakeholders in the chain of food distribution for people with food insecurity (i.e., policy makers, food providers or donors, distributors, and beneficiaries) in the research areas. The main questions are: (1) what are the current situation and future developments of food insecurity?; (2) what is the model of food distribution and actors involved in it?; (3) what are the key opportunities and challenges?; and (4) what intervention can deliver the preferred future for Italy? Thematical analysis will be applied to identify emerging and important themes from the interviews.
Results:
The expected results will provide insight into the issues that emerged from the interviews. Current distribution models in different contexts will be identified. The main concerns and future developments, together with opportunities, challenges, and possible interventions, will be highlighted. The findings will be applied in the following phase of the study to identify and evaluate improved distribution models in living labs.
Conclusion:
The proposed study is relevant to food insecurity policies and offers insights into different models from various contexts. The policy implications will be provided.

O6.2

Bigels formulated with carrageenan and walnut oil/beeswax oleogels for 3D printing applications

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Aim:

There is a clear trend to replace certain fats due to negative health concerns. Bigels that are composed of two gelled phases (oleogels and hydrogels) have emerged as promising semi-solid structured systems to substitute animal or hard fat in several formulations. 3D printing offers appealing opportunities to develop novel customized food products. Optimization of relevant properties in 3D food printing is essential to create new 3D printed products with improved quality and efficacy of the printing process. In this study, bigels were manufactured with oleogel containing walnut oil (WO) and carrageenan based hydrogel for 3D printing applications. Organogelator amount, oleogel/hydrogel ratio and printing speed were optimized to develop a functional WO-based bigel formulation.

Method:

Bigels were manufactured by mixing an oleogel containing WO and beeswax (organogelator), and a carrageenan based hydrogel. A smart Fused Deposition Modelling type 3D food printer (ArtıBoyut, Turkey) was used to obtain elliptic cylinder shaped bigels with fill density=100%, nozzle height=1.0 mm, and nozzle diameter=1.8 mm. Box-Behnken design of Response Surface Methodology (RSM) was used to determine optimum levels of organogelator (10, 15 and 20%), oleogel/hydrogel ratio (50/50, 70/30, and 90/10) and printing speed (15, 20 and 25 mm/s) based on oil binding stability (%) and dimensional stability (diameter and height, mm) of the 3D printed bigels.

Results:

The results from RSM indicated that the optimum conditions to obtain the best matched 3D printed elliptic cylinder shaped bigels with targeted dimensions (35 mm for diameter and 10 mm for height), and maximum oil binding stability were: organogelator concentration=20%, oleogel/hydrogel ratio=71.7/28.3, and printing speed=16 mm/s. The accuracy of the optimization procedure was tested by performing a confirmatory experiment. Diameter, height and oil binding stability for the printed bigel were 35.5 mm, 10.0 mm, and 99.6%, respectively under the optimized conditions.

Conclusion:

The results of this study indicate that 3D printed bigels manufactured with WO could be used to attain functional low-fat food products of high quality in terms of composition and structural characteristics.

O6.3

Lubrication performance of dark chocolate across different length scales and stages of oral processing

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Aim:

Tribological studies of phase change foods (PCF) can be challenging. This is particularly due to a sequence of dynamic changes to PCF during oral processing, the interactions between the PCF and oral surfaces and the lack of materials and setups replicating the real human tongue and tribo-conditions in mouth.

Method:

For the first time, we used a bespoke in situ tribo-microscopy, 3D biomimetic tongue-like tribological surface and a single papillae-like probe to unveil the multiscale lubrication mechanisms of chocolates, a model PCF. The lubrication mechanisms were fundamentally explored at three main eating stages of solid, molten and saliva-mixed states under realistic orally-relevant tribo-contact conditions underpinned by theoretical lubrication theories. A highly-sophisticated tongue-mimic material replicating the surface texture, wettability and mechanical properties of a real human tongue was used for the full-tongue scale measurements.

Results:

A shift in lubrication mechanism from an effective solid fat-dominated lubrication to poor aqueous lubrication (saliva-dominant regime) was observed in the licking stage. The shift resulted in an increased coefficient of friction by three folds. At the papilla-scale, the governing mechanisms were bridging of cocoa fat in between confined solid cocoa particles and coalescence of emulsion droplets at the contact interface for the molten and saliva-mixed stages, respectively. At the full-tongue-scale, a speed-dependent hydrodynamic fluid film was formed at the contact interface indicating the distinctive differences when the papilla scale was assessed against the tongue scale. Mixing with saliva altered the shear-thinning behaviour of chocolates and influenced confinement of solid cocoa-particles at the contact interface which occurred in the molten state.

Conclusion:

New insights from this study inspire engineered design of healthy PCF and next generation of solid particle-containing colloids and bio-lubricants. Particularly, chocolates with less cocoa butter content can be developed in a layered design with minimum compromise on the textural perception of chocolates to deliver silky chocolates with health benefits.

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O6.4

Sustainable valorisation of legume by-products and marine residuals into novel consumer products-Pathway to market approval

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Aim: The global situation in protein supply and demand has created a ‘protein gap’ in Europe and compelled it to import 95% of its soya or cereals to meet the current protein demands. However, these current sources of proteins are becoming unsustainable from an economic as well as an environmental point of view. ALEHOOP demonstrates the application of biorefineries for the valorisation of macroalgal residual biomass and legume processing by-products to recover valuable biomolecules and their conversion into healthy, sustainable and novel high added-value ingredients for the food and animal feed sectors. For the approval of “novel” foods or ingredients into the European Market, legal requirements are enforced by regulatory agencies such as EFSA, which covers all aspects of novel foods, safety and risk assessments, labelling requirements, nutrition and health claims, among others.

Method: An overview of standards in the areas of biomass characterisation, safety and toxicology, biorefinery and product validation with regard to ALEHOOP activities was prepared. The monitoring of legal requirements was done by framing of the guidelines, rules and regulations relevant from the raw material acquisition, processing, production, and until the commercialisation of the extracts. The safety of the pea and lupin extracts was assessed through *in vitro* studies including microbiological safety (foodborne pathogens like *Coliform*, *Salmonella*, *E. coli*, *S. aureus*), detection of heavy metals (such as Cu, Cd, As, Pb & Hg) and genotoxicity (Ames mutagenesis test). The pea and lupin extracts were analysed for numerous pesticides to determine if they were present within the MRL limits set by the EU.

Results: The pea and lupin extracts were within the limits of safety and non-toxicity for the parameters tested for food additives.

Conclusion: The outcomes of the project will be successfully exploited through the facilitation of standardisation activities, compliance with relevant legislation and safety assessments. The application of existing standards within this project ensures that products will reach a better market application. The pea, lupin extracts and the novel ingredient from macroalage can be successfully added to formulate food products for consumers with different dietary requirements and value-added novel products, respectively.

O6.5

Scattering techniques to investigate the nanostructure of polysaccharide-based gels and their behaviour upon gastrointestinal digestion

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Aim:

Polysaccharides are the major components in foods such as fruits and vegetables and they are crucial for the food industry due to their capacity of providing different functionalities to foods (e.g. thickening, gelling, emulsifying, etc.). Furthermore, some polysaccharides, such as agars and carrageenans, are able to form different types of gel-like structures, such as hydrogels, emulsion gels and aerogels. These structures are extremely useful as ingredients to modify food functional properties (e.g. texture), develop novel foods with improved nutritional aspects (e.g. reduced animal fat content, increased satiating effect) or as templates to protect bioactive compounds. In this context, understanding the relationship between structure and functionality is essential to exploit the full potential of polysaccharides and design novel food products with improved nutritional and techno-functional properties.

Method:

To this end, small angle scattering techniques are an extremely powerful tool, since they allow investigating the structure of highly hydrated polysaccharides, as found in their raw sources or when forming gel-like structures, and even conduct *in situ* experiments simulating physiologically relevant conditions.

Results:

In this talk, some examples will be shown to demonstrate how SAXS and SANS, combined with complementary techniques such as microscopy, spectroscopy and rheology, can provide very useful information on the multi-scale structure of cellulose in plant cell walls, the gelation mechanism of sulphated polysaccharides and the nanostructure of novel polysaccharide-based gel-like materials. Furthermore, these techniques can be used to investigate the structural evolution of polysaccharide-based systems during the gastrointestinal digestion process and evaluate the type of structural features formed by the digestion products.

Conclusion:

Food nanostructure plays an essential role in the functional properties and digestion mechanism. Furthermore, the nanostructural assembly of the digestion products will be of high relevance to assess the nutritional impact and health benefits of novel food sources and ingredients.

O6.6

From gritty to soft: in-mouth texture modulation of fibers via microstructural engineering

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Aim:
The increasing world population and the global environmental crisis calls for a radical change in the diets of billions of people towards more environmental-friendly food. Numerous plant-based products have been developed to address this challenge. However, many of them lack an appealing texture which becomes even more important when using less refined ingredients. Being oral textural perception one of the main drivers in product liking, there is a urge to identify and design new strategies to improve the in-mouth perception of plant-based products.

Method:
We engineered three different microstructures to assess whether fluid gels can be used to modulate in-mouth perception of fiber dispersions ranging from a fiber concentration of 0 % to 6% w/w. The effect of the different designed microstructures on in-mouth perception was evaluated by a trained panel and the results were then analysed using univariate and multivariate analysis. In addition, we developed a method to evaluate the process efficiency to obtain the desired texture modulation and an in-vitro method to study the effect of oral processing on the designed microstructures using a rheometer.

Results:
The sensory study revealed that one of the engineered systems enabled to modulate the in-mouth perception of the fibers by a significant extent up to~2 % w/w of fibers . However, at higher fiber concentrations the in-mouth modulation progressively decreased until reaching ~0% at a fiber concentration of 6% w/w. The in-vitro oral processing method showed that during the sample assessment, the fluid gel particles might be subject to oral breakdown during consumption which could explain the continuous increase in the sensory stimuli investigated.

Conclusion:
In this study we proposed a new strategy to significantly reduce in-mouth perceptions caused by fibers using an easy-to-implement process and microstructural design. These results will help to engineer more appealing plant-based products that will facilitate the consumption of more eco-friendly food.

O6.7

Bioaccessibility of polyphenols from tigernut pulp and its functional properties

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Aim:
Tigernuts (*Cyperus esculentus L.*), also known as chufa, are small tubers with a sweet flavour. They are rich in fiber, antioxidants, and minerals. Tigernuts from the Valencia region of Spain have been recognized as a PDO product.. Tigernuts are used in Spain to make a popular beverage called "Horchata de chufa". The production of this beverage generates a considerable amount of solid by-product known as "tigernut pulp" (TNBP), which represents approximately 60% of the total weight. The aim of this study is to characterize the polyphenolic compounds present in TNBP and assess their bioaccessibility during an *in vitro* digestion, as well as investigate the potential inhibitory activity effects on digestive enzymes.

Method:
Laboratory-scale horchata was prepared and the resulting TNBP was subjected to *in vitro* digestion (INFOGEST) . The horchata and the bioaccessible fraction were characterized for the polyphenolic composition by HPLC-UV/VIS along with the total antioxidant capacity (TAC) by the ABTS assay. TAC of the TNBP and solid residue (pellet) resulting from the digestion weres assessed by QUENCHER.. Additionally, the potential inhibitory effect of the bioaccessible fraction on digestive ezymes' activity was evaluated.

Results:
Fourteen polyphenols were identified and quantified. Caffeic-hexoside, ferulic-hexoside and protocathecuic acid were the most abundant and showed a bioaccesibility of 122%, 78% and 56%, respectively,. An epicatechin derivative and cinnamic acid were found to be the most degraded at the end of the digestion. The bioaccessible fraction exhibited a TAC of 9.16±0,03 µmol eq Trolox/g DW, and demonstrated inhibitory effects on the activity of α-amylase (56%), α-glucosidase (88%), and lipase (60%). The TAC of the pellet (34.50±0.32 µmol eq Trolox/g DW) was higher than the TNBP before digestion (21.91±0.17 µmol eq Trolox/g DW).

Conclusion:
The results suggest that TNBP is a valuable source of bioaccessible polyphenols that exhibit significant TAC and inhibitory effects on digestive enzymes. Altogether data highlight the potential applications of TNBP as a functional food ingredient. Further research should be conducted to explore the benefits *in vivo.*

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O7.2

Next-generation prebiotics: Oligosaccharides-protein conjugates for selective targeting of proteins to probiotic bacteria in the colon

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Aim:

Consumption of prebiotics is a well-known approach to promote gut-probiotics, for improving human health. Current prebiotics are predominantly carbohydrates. However, great competition exists among gut-microbes for the scarce protein in the colon, as most consumed protein is absorbed in the small-intestine. Still, no protein-containing-prebiotics are commercially-available. Here, we developed and evaluated in-vivo the next-generation prebiotics: protein-containing-prebiotics, for selectively-targeted delivery of protein to colonic-probiotics, to boost their growth. This system is based on micellar-particles, composed of Maillard-glycoconjugates of 2'-Fucosyllactose (2'-FL, human-milk-oligosaccharide) shell, engulfing lactoferrin peptic-then-tryptic hydrolysate (LFH). This core-shell structure lowers protein-core digestibility, while the prebiotic-glycans are hypothesized to serve as molecular-recognition ligands for targeting probiotics. To the best of our knowledge, this is the first microparticle system in the realm of food science that is selectively delivered to target cells.

Method:

To study the efficacy of this novel prebiotic, we fed C57BL/6 mice either with 2'-FL-LFH Maillard-glycoconjugates, with unconjugated components as conventional prebiotic control, or with saline as blank. The metabolic activity and composition of gut-microbes were assessed, and plasma lipopolysaccharides (LPS) levels were quantified.

Results:

Consumption of 2'-FL-LFH significantly increased the colonic-concentration of short-chain-fatty-acids (SCFAs), compared to the unconjugated-components or to saline, by raising the levels of SCFAs-producing bacterial families (Ruminococcaceae, Lachnospiraceae, and Odoribacteraceae). Functional profile prediction of the microbiome also revealed a significant increase in pathways related to SCFAs production, mainly butyrate, in the 2'-FL-LFH group compared to the unconjugated components and the saline groups. Moreover, a significant health effect was observed, as the levels of plasma LPS, which indicate increased gut-permeability and inflammation, were significantly lower in the 2'-FL-LFH group compared to the unconjugated-components and the saline groups.

Conclusion:

We found that 2'-FL-LFH can serve as novel protein-containing-prebiotics, beneficially modulating gut microbial composition and its metabolic activity, thereby may contribute to host health more effectively than the carbohydrate-only prebiotics. By varying the oligosaccharide-part we may selectively-target different probiotics, and by varying the protein-part we provide different amino-acids essential to these bacteria. These possibilities would enable tailoring the product for certain desired health benefits or target consumer populations, for personalized nutrition, or for personalized medical intervention.

O7.3

Utilization of pulse-derived raffinose-family oligosaccharides in mixed fermentations to produce sour beer

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Aim:
Interest in specialty beers including sour beers, has increased in recent years. However, some sour beer styles take years to produce. Furthermore, the brewing industry is facing challenges due to climate change, such as increasing ingredient costs and shorter brewing seasons for some traditional beer styles, such as Lambic. The aim of this study was to investigate the potential of utilizing raffinose family oligosaccharides (RFO) derived from pulses as a carbon source in the controlled production of sour beer. This could lead to a more diverse portfolio in sour beer production while utilizing a food side-stream.

Method:
Eighteen brewing yeasts and lactic acid bacteria (LAB) were screened for growth in Yeast-Extract Peptone (YEP) and deMan-Rose-Sharpe (MRS) media supplemented with RFOs as carbon source. Furthermore, the influence of ethanol and isomerized α-acids on the growth of these strains was investigated in beer media. Microorganisms with observed growth potential were selected to produce sour beer with and without RFOs. Samples were characterized chemically and physically (pH, ethanol content, α-acids, organic acids, volatile compounds, titratable acidity). To determine whether the presence of RFOs resulted in differences discernible by consumers, a Tetrad test was performed that compared beers with and without RFOs.

Results:
Some brewing yeasts as well as some LAB were able to grow in media with RFOs as carbon source. LAB growth was limited by the amount of isomerized α-acids present. Especially noteworthy was the capability of *Brettanomyces claussenii* in combination with different LAB to create a beer that is comparable to commercial Belgian sour-beers in terms of acidity within 19 days. The majority of participants were able to differentiate between beers produced with and without RFOs in the Tetrad test, which aligns with differences in titratable acidity as well as lactic acid concentrations. In contrast, volatile compounds were only moderately impacted by RFOs.

Conclusion:
By combining common food microorganisms with RFOs it is possible to brew a sour beer within three weeks that is a potential alternative to products that otherwise take years to create and have a less controllable and more complicated brewing process.

O7.4

Spirulina Reimagined: Harnessing Fresh Microalgae and Fermentation for Nutritious and Tantalizing Gastronomic Creations

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Aim:
Spirulina, a sustainable and nutritionally-rich microalga, has low consumer acceptance due to its taste and appearance.[1] This study aims to promote fresh, artisanal, locally sourced spirulina and develop innovative, sustainable gastronomic products using fermentation and sweet elaborations, as these methods enhance sensory appeal and nutritional value while preserving the health benefits of spirulina's blue pigment, c-phycocyanin.[2]

Method:
We compared the thermal stability and antioxidant activity of fresh, dehydrated and insutrially produced spirulinas using UV-Vis spectroscopy and the ABTS method. We also analyzed sugar-added syrup spirulina samples. Fermented spirulina products, such as yogurt, tempeh, amazake, and rice wine, were developed using lactic acid bacteria, moulds, and yeasts, alongside ice cream and cheesecake.

Results:
UV-Vis spectroscopy showed that c-phycocyanin's thermal stability decreased above 60°C, but sugar addition increased its stability. Fresh, artisanal and locally sourced spirulina contained higher carotenoid levels compared to dehydrated and insdutrially produced spirulinas. Furthermore, antioxidant activity correlated with thermal stability up to 50°C. Spirulina-rich substrates containing 5 – 10% fresh spirulina, were suitable for microbial fermentation, yielding successful koji and its derivative fermented products, tempeh, and yogurt. Additionally, we developed high-value, consumer-accepted spirulina-infused cheesecakes and ice creams.

Conclusion:
Fresh, artisanal, locally sourced spirulina exhibited higher thermal stability, consumer acceptance, and bioactive compound concentrations compared to dehydrated and industrially produced spirulinas. Fermentation proved an effective method to incorporate spirulina in innovative culinary products, demonstrating the potential of fresh spirulina and fermentation in developing appealing, nutritious, and sustainable gastronomic offerings.

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2. Martelli, G., Folli, C., Visai, L., Daglia, M. & Ferrari, D. Thermal stability improvement of blue colorant C-Phycocyanin from Spirulina platensis for food industry applications. *Process Biochem.* **49**, 154–159 (2014).

O7.5

Lactofermentation to design functional foods from sweet potato

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Aim:
In several countries, lactofermented sweet potatoes are part of the traditional meal. However, a gap of knowledge was identified to increase sweet potato's value chain and to develop food products of good nutritional quality. To proceed to lactofermentation, the use of amylolytic strains can increase the digestibility of sweet potato starch, while that of bacteria producing exopolysaccharides can improve the rheological properties and organoleptic quality of food. Hence, the objective was to isolate LAB with targeted properties to ferment sweet potatoes and to design functional foods from them.

Method:
Sweet potatoes cultivars were obtained from Vatel BRC (Biological Resource Collection, France). LAB were isolated and identified from sweet potatoes. The isolates plus 16 other LAB strains were then characterized with micro-tests of sweet potato fermentation. Amylolytic activity was screened with *Bacillus subtilis* used at positive control.

Results:
More than 80% of LAB isolates were identified as *Leuconostoc mesenteroides*. The strains all formed colonies on sweet potato plates and acidified the medium, but with variable growth and acidification levels. After 7 days, fermented sweet potato purée odor varied from unpleasant to pleasant, depending on the isolate, with five isolates among 29 leaded to pleasant smell. EPS production on sucrose MRS was detected for 10 *L. mesenteroides* isolates and 14 strains from the collection belonging to *Leuconostoc* and *Weissella* species. On sweet potato medium, only 6 sweet potato isolates and 11 strains from the collection were able to produce EPS. Moreover, mucoid appearance of the colony depended on the strain. Finally, no amylolytic activity was detected for any of the 13 isolates and only one strain from the collection hydrolyzed starch.

Conclusion:
On the basis of their ability to lacto-ferment sweet potato purée (growth and acidification capacity), to produce EPS and to degrade starch, one *L. mesenteroides* sweet potato isolate and two collection strains of the species *Leuconostoc mesenteroides* and *Weissella cibaria* were selected. They will be used to ferment sweet potato roots from different cultivars, in combination with different cooking methods. The process applied to sweet potato is expected to impact their composition, nutrient bioavailability and glycemic index.

O7.6

Quality and nutritional properties of a symbiotic fermented and non-fermented peach and grape juice

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Aim:
Probiotics are live nonpathogenic microorganisms that provide health benefits. Fermented food products and, specially beverages, are suitable carriers to enhance probiotics potential. The aim of this experiment was to develop a peach and grape juice (PGJ) with a probiotic microorganism (*Lactobacillus casei*) and a prebiotic (inulin) and to evaluate the probiotic viability and nutritional properties of the fermented and non-fermented probiotic juice before and after digestion and during a refrigerated storage (5ºC) for 12 days.

Method:
A PGJ containing the prebiotic was inoculated with the probiotic strain (10^7 cfu/mL) and maintained at refrigeration conditions (PRO) or was fermented for 48 h at 37 ºC (FER) followed by storage at the same conditions for 12 days. An evaluation of the viability of the probiotic and its impact on the physicochemical, nutritional, and sensorial quality of the PGJ were conducted throughout the self-life. Survival of the probiotic and nutritional biaccesibility were also evaluated after a simulated digestion process

Results:
L. casei was found to survive throughout the storage (7.6 log/mL), to grow after fermentation up to 8.4 log/mL and to survive the digestion process. Lactic acid and vitamin B12 were produced during the fermentation. However, the addition of the probiotic, before and after fermentation, did not resulted in a significant improve of polyphenols, vitamin C content or antioxidant activity. A meticulous description of the juices were obtained after a sensory evaluation and more than 90 and 50% of testers accepted the probiotic and fermented juice, respectively. The digestion supposed an increment of total polyphenol content (64%) and antioxidant capacity (54%) and a decrease on ascorbic acid content (almost 40%) in fermented and non-fermented juices .

Conclusion:
Our study revealed that *L. casei* is a viable probiotic in a fruit beverage and is able to deliver a fermented functional fruit beverage, that would be specially addressed to vegetarian or vegan consummers due to its important content in vitamin B12.

O7.7

Characterizing sweet potato by-product extracts from innovative processing techniques and assessing their prebiotic potential

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Aim: Approximately one-third of the world's food production is lost throughout the entire food supply chain, prior to reaching consumers. This wastage not only has significant environmental consequences but also leads to substantial economic impacts. The revaluation of waste and byproducts and the development of sustainable processing technologies represent an attractive alternative to reduce their quantity, transforming them into new sources of bioactive compounds with nutritional and biotechnological interest.

The aim of this study is to obtain and characterize extracts from sweet potato skins applying pulsed electric fields (PEF) as a new processing technology and to evaluate their prebiotic and antimicrobial potential.

Method: Extracts of the skin of four sweet potato varieties have been used: white, white with purple skin, orange and purple. The extracts were obtained both with the use of conventional extraction techniques and PEF, optimizing the conditions for this matrix. Probiotic strains from the genus *Lactobacillus* were selected to assess the effect of the extracts on their growth kinetics for 24-48h and the production of short chain fatty acids (SCFA) compared to standard conditions. Similarly, its antimicrobial potential on pathogenic strains was also evaluated.

Results: Sweet potato skins are a source of bioactive compounds, obtaining a different profile of compounds depending on the extraction technique used. Greater growth of the probiotic bacterial strains studied is observed when supplementing the minimal MRS medium used with the different extracts obtained, compared to the standard medium. When adjusting the kinetics to the Gompertz mathematical model, an increase is observed both in the maximum growth and in the growth rate, this effect being more significant in those extracts obtained by PEF. On the other hand, in the case of the pathogenic strains, the antimicrobial effect of all the extracts on *S. aureus* is appreciated, since the growth is lower compared to the control.

Conclusion: These new extraction technologies allow a greater retention and use of bioactive compounds from waste and food by-products, as we can see in the case of sweet potatoes. That is why they should be considered as an alternative, since they can be effective tools in the development of new products with properties of interest.

O8.2

Fabrication and Lubrication Performance of Sustainable Pickering-like Water-In-Water Emulsions Using Plant Protein Microgels

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Aim:

Aqueous multiphasic systems have attracted a great deal of interest recently owing to the growing demands of environmental sustainability for the development of stable 'oil-free' emulsions, often complicated by their limited stability against droplet coarsening. Although particles may provide ultrastability to water-in-water (W/W) emulsions formed in phase-separating polymer systems, the need for lubrication in such oil-free W/W emulsions presents an important challenge for their use in diverse applications.

Method:

In this work, W/W Pickering emulsions were stabilized by sustainable plant protein (pea)-based microgels (PPM) using starch and xanthan gum as the biopolymers generating the W/W phase separating droplet structures. The lubricity of these systems was compared with that of parallel systems stabilised by animal (whey) protein microgels (WPM).

Results:

Unprecedented results reveal that PPM are more soft and adhesive than WPM and outperform the latter in boundary lubrication performance in striking contrast to the behaviour of the non-microgelled proteins. Furthermore, the PPM tend to stabilize a different, less spherical type of W/W droplet that may contribute to the lower friction observed in PPM-stabilized W/W emulsions.

Conclusion:

These novel insights pave the way forward for designing water-based sustainable bio-lubricants from plant proteins which should have applications in food, pharmaceutical, personal care and allied sectors. Further development should investigate the sensory response to such systems in order to validate whether the frictional data translates to the oral or skin regimes in terms of mouthfeel or skinfeel.

O8.3

Developing High-Protein, Clean-Label Plant-Based customizable ingredients for novel food product development.

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Aim:

To develop customizable clean-label protein ingredients for food products without artificial structuring ingredients.

Method:

The investigation focused on leguminous plant proteins, where they undergo a comparable phase transition, forming coacervates. Coacervates were formed by reducing the biopolymer's electrostatic repulsion, resulting in liquid-liquid phase separation. Coacervates were developed from unpurified material with minimal processing history, containing a wide range of impurities and different protein fractions. Optical tweezing was used to induce coalescence and study the dynamics of coacervation.

For ingredient development, these coacervates were first heat-treated for stabilization and subsequently dried using Spray drying (SD) to simulate industrial drying conditions. These SD powders were characterized and evaluated for their properties, such as morphology, viscosity, internal protein content, and protein leakage, using various methods such as light scattering, static image analysis, rheometric analysis, and more.

Result:

The coacervates were observed as a viscous spherical droplet that exists as an intermediate stage between soluble proteins and aggregates. Macroscopic and microscopic analyses show differences in the coacervation of different leguminous plant proteins. It was observed that protein aggregation confirms coacervate sticking to each other, indicating the overlap between aggregation and coacervation. The protein fractions, such as glycinin and legumin, demonstrated a preference for insolubilizing to a coacervate phase or maintaining solubility by staying in a continuous phase. The investigation showed that contrary to pure protein coacervates such as soy glycinin, the coacervates developed from unpurified material differ significantly and resist coalescence.

The SD pea protein powder was measured to be smaller than seven microns in size and sphericity greater than 0.9. Compared to conventional ingredients, showing a monomodal distribution. It is also seen that altering post-coacervate processing can fine-tune the ingredients for specific applications. The dispersibility stability rheological properties in different environments were assessed to evaluate the application of the ingredients. Significantly lower viscosities could be achieved using these ingredients.

Conclusion:

Coacervation is a generic phenomenon in leguminous proteins for a narrow pH range and concentrations. The SD powder made using this method can be fine-tuned for specific applications, exhibiting improved properties for developing low-viscosity, high-protein beverages, or processing aid.

O8.4

In vitro digestion of two protein-rich dairy products in the aging gastrointestinal tract

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Aim:
Insufficient protein intake can lead to a condition called sarcopenia, characterized by the loss of muscle mass, strength and function. To avoid this condition healthy older adults need to increase the amount of high-quality proteins in their diet, particularly foods rich in leucine, to promote muscle health. However, it is still unclear if changes in protein digestibility and absorption kinetics in old age may affect the anabolic effect of high-protein foods. The objective of this study was to investigate the digestion of two high-protein (10% w/w) dairy products *in vitro*: a fermented dairy product formulated with a ratio of whey proteins to caseins of 80 to 20% (WBD), and a Skyr containing mainly caseins.

Method:
The new static *in vitro* digestion model adapted to the general older adult population (≥65 y) proposed by the INFOGEST international consortium was implemented to investigate the digestion of these products, and compared to the standard version of the protocol. Kinetics of proteolysis were compared between both models for each product, in the gastric and intestinal phase of digestion. Protein hydrolysis was studied with the OPA method, SDS-PAGE, and LC-MS/MS, and amino acids were quantified by HPLC.

Results:
Protein hydrolysis by pepsin was slower with the older adult model than with the young adult model, and consequently, in spite of a longer gastric phase duration, the degree of proteolysis (DH) reached at the end of the gastric phase was lower. Two different scenarios were observed depending on the type of dairy product studied: -10 and -40% in DH for Skyr and WBD, respectively. In the intestinal phase, lower concentrations in free leucine were observed in older adult conditions (approx. -10%), but no significant differences in proteolysis were measured overall between models.

Conclusion:
The digestion conditions used influenced significantly the kinetics and extent of proteolysis in the gastric phase but not in the intestinal phase. A clinical study comparing the effect of WBD or Skyr on older adults' postprandial muscle synthesis is underway, which should improve our understanding of differences in digestion between whey protein and casein-based products.

O8.5

Understanding oleosome structure and their potential uses in foods with advanced properties

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Aim: Understanding oleosome structure and their potential uses in foods

Oleosomes, also known in biology as Lipid Droplets are lipid storage organelles, found in all seeds. They have a unique architecture consisting of a hydrophobic core of neutral lipids, which is enclosed by a phospholipid monolayer that is decorated by a specific set of proteins. The oleosome membrane is evolved to a metastable material, which is designed to withstand physical and chemical stresses but releases the neutral lipids upon specific stimuli. However, the structure-function relationship of the molecular components in the oleosome membrane is still not well understood and requires more attention to take complete advantage of their potential functions and uses in foods. We are investigating the molecular combinations at the oleosome membrane and their effect on the oleosome properties aiming to use them to create functional food emulsions with novel properties.

Method: Investigating the mechanical and physical properties of oleosomes in food systems

We extracted oleosomes from various seeds and investigating their stability, physical and mechanical properties using light scattering, high resolution confocal microscopy and 2D/3D rheology.

Results: Oleosomes are soft droplets which can be used for high internal phase emulsions without rupturing. Additionally, oleosomes can be loaded with therapeutics, and selectively release their oil core upon mastication or digestion.

Oleosomes can be extracted from various seeds and be used in food emulsions. Oleosomes are soft particles, a property that makes possible their use for high internal phase emulsions with an oil volume fraction higher than 90 wt%. Their soft nature is assigned to their elastic membrane with limited interactions between the interfacial molecules, as was proven by using dynamic molecular simulations and interfacial rheology. A result of the relatively weak interactions on their membrane is that lipophilic molecules can diffuse through it and adsorb in their core, as shown with confocal microscopy. Additionally, when the oleosomes are in contact with a hydrophobic surface, lipids are fuelled outside oleosomes leading to their deflation, as shown with fluorescent and atomic force microscopy.

Conclusion:

By understanding the properties of oleosomes, we can efficiently use them in emulsion-like foods with advanced functionalities. For example, we can fortify them with flavours and vitamins and create high-internal phase emulsions, which is physically stable that can be a healthy and sustainable mimic of animal fat for meat analogues.

O8.6

Upcycling mango peels into a functional ingredient by combining fermentation and enzymatic-assisted extractions

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Aim:

This study aims to evaluate the potential of different enzymes and probiotic strains (*Lactiplantibacillus plantarum* (LP) and *Bifidobacterium animalis* (BA)) to increase the solubilization of bioactive phenolic compounds (PC) in aqueous extracts from mango peels.

Method:

Mango peels were washed and processed into a slurry with the addition of water (1:4 (w/w)). The slurry was treated with two different commercially available enzymatic cocktails (i.e. Viscozyme® (VI) and Pectinex® XXL (PE)) at 50 °C for 2 h and was subsequently centrifuged to obtain the supernatant. The supernatant was then fermented by *Lactiplantibacillus plantarum* and *Bifidobacterium animalis* for 48 h at 37 °C to obtain the ultimate aqueous extracts.

Results:

On one hand, the enzymatic treatments had a positive effect on the concentration of galacturonic and glucuronic acids, resulting in an increase of 2,764% and 765% when using PE and 12,346% and 5,373% when using VI, respectively. The enzymatic treatment with PE also facilitated the solubilization of oligosaccharides, almost doubling their concentration. Nevertheless, none of the enzymes used increased significantly the dry matter content of the supernatant, nor they influenced the microbiological growth of the fermentation applied thereafter. On the other hand, the fermentation resulted in a greater recovery of total PC (178 and 116% for LP and BA, respectively) and increased the antioxidant activity of the ethanolic soluble material when compared to the control.

In addition, the use of a combinative treatment with enzymatic hydolisis and fermentation successfully increased the PC, antioxidant activity, galacturonic acid concentration and the relative concentration of oligosaccharides. The combination of treatments increased the production of gallic acid and mangiferin aglycones, and achieved a remarkable increase in antioxidant activity by 30% when compared to the control.

Conclusion:

This study shows the positive effect of combining enzymatic and fermentation processes for the upcycling of mango peels to a functional ingredient or beverage. The combination of VI and LP leads to a higher solubilization of gallic acid and mangiferin aglycones. This approach could be used for the isolation and purification of specific phenolics, which can be used as ingredients for the formulation of new products, thereby reducing mango peel waste and adding value to the food industry.

O8.7

Screening of bioactive peptides from winemaking industry by-products: protein hydrolysis optimization and antihypertensive effects

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Aim: Food-derived bioactive peptides are specific protein fragments normally containing short sequences between 3-20 amino acid units. They can be considered as components of functional foods which may exert regulatory activities in the human organism, irrespective of their nutritive functions and potential antioxidant activities. These peptides encrypted within the sequence of the parent proteins can be released by enzymatic hydrolysis. Due to the varying specificity of the enzymes, hydrolysis with different enzymes or combinations of them may produce diverse peptides originating from the same protein. Therefore, also the bioactivity of the hydrolysates may differ.

Method: In this work, the release of peptides from grape pomace (GP) and wine lees (WL) proteins by Alcalase (A), Flavourzyme (F) and Protease (P) and their combinations was investigated. Degree of hydrolysis (DH) was used to evaluate the efficiency of the enzymes during the optimization studies. Under optimum conditions, peptides were separated in two fractions (smaller and higher than 3 KDa) by ultrafiltration and their bioactivity was evaluated using an angiotensin I converting enzyme inhibitory (ACEi) activity assay. Subsequently, this fraction was purified by preparative chromatography and the qualitative peptide patterns of GP and WL protein hydrolysates of more active fractions were determined by UHPLC-MS/MS with an Orbitrap Fusion Lumos system.

Results: After optimization of digestion conditions, DH ranging between 13 and 46 % and between 25 and 86 % for GP and WL, respectively, were obtained. The combination of enzymes (A+P) allowed an increase in the DH in an average of 13 and 40 % for GP and WL. Besides the increased DH using the enzyme combinations, the ACE inhibitory activities were similar or lower than by applying the individual enzymes. In general, the fraction <3KDa was more active than the fraction >3 kDa and peptide solution that was not fractionated, with F and A yielding the highest activities for GP and WL, respectively. The 50 % inhibitory concentration values (IC50) were 52 µg/mL for F in GP and 21 µg/mL for A in WL.

Conclusion: GP and WL protein hydrolysates may be a source of bioactive peptides with potential to be used as a health promoting ingredient with ACE inhibitory activities.

O9.2

Case study for a quality-orientated production control system by utilzie digitalzied methods

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Aim: Delicatessen salads are composed of a wide range of ingredients, including vegetables, fruits, fish, meat, and dressings. The production process and raw material parameters play a crucial role in determining the quality of end products. Given this complexity, it is important to prioritize sustainable production control and sequencing that takes into account these factors and is focused on achieving the desired final product quality. The aim of the study was to improve the production management, scheduling, and product quality of a delicatessen manufacturing process through digitalization techniques. Utilizing a digital twin and artificial intelligence (AI) for production sequencing, the aim was to minimize environmental impact while maintaining high product standards.

Method: The case study was conducted in a delicatessen salad manufacturing factory located in Germany. The research examined the product quality and kinetic models of sensitive ingredients, such as sour herring, through various methods like texture profile analysis, sensory tests, and water drip tests. Quality measuring sensors and RFID-sensors were tested to monitor production times, locations, and quality throughout processing. Digital twin and artificial intelligence tools were used for simulation and optimized scheduling.

Results: First, the digital twin has been successfully established as a digital representation of machines and products, which are constantly being parameterized using real-time data from sensors. Second, the optimization of time and resources for each working and cleaning step has been successfully achieved through the implementation of a scheduling process. The AI has utilized simulation data from the digital twin, quality-based kinetics, and feedback from the production process to accomplish this task.

Finally, the optimized scheduling of production processes by using digitized methods, combined with quality-based sensoring, led to significant energy and material savings. Food waste during production was reduced by approximately 75%, while dwell times of raw or intermediate materials were decreased, resulting in improved end-product quality. Additionally, the optimized scheduling reduced cleaning activities by approximately 37%, leading to energy and cleaner savings.

Conclusion: Overall, this case study of delicatessen salads showed that the implementation of digitalization techniques and quality-based sensoring can greatly improve production scheduling and product quality while minimizing environmental impact.

O9.3

Influence of Process Conditions on Gas Hydrate Formation for the Cold-Concentration of Soluble Coffee

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Title:
Influence of Process Temperature and Pressure on Gas Hydrate Formation for the Cold-Concentration of Soluble Coffee

Aim:
CO_2 gas hydrates can be observed in aqueous systems at elevated pressure and temperatures above 273 K. They offer prospect to increased energy efficiency and concentration at low thermal load for liquid food extracts, such as fruit juice, sugar cane juice or coffee. The aim of the current contribution was to study the formation of CO_2 gas hydrates in a batch autoclave system for pure water and reconstituted soluble coffee, to define the process window for a maximum amount of hydrate formation.

Method:
CO_2 gas hydrates were formed in a batch autoclave system with pure water and reconstituted soluble coffee. Varying pressure and temperature settings were tested, and the obtained hydrate structures were examined in terms of gas content, total solids content and characteristic length.

Results:
Once stable hydrate conditions were reached after process initiation, instantaneous hydrate formation in both pure water and reconstituted coffee was highly reproducible, with a success rate of over 90 %. Both process temperature and pressure were shown to influence the gas hydrate formation. Higher and thus less favourable process temperatures for gas hydrate formation seemed to reduce overall process control and repeatability. The morphology of the formed gas hydrate was observed to be greatly dependent on the chosen process temperature, in addition to a lower gas content and higher total solids content of the obtained hydrate. Higher pressure seemed to favour hydrate formation and growth, also leading to a higher gas content. Overall, it could be observed that a change in temperature affects the properties of the obtained hydrate to a greater extent than a change in pressure.

Conclusion:
CO_2 gas hydrate formation can be triggered in pure water and reconstituted coffee solutions applying different process conditions. The chosen process conditions influence the morphologies of the formed hydrates, as well as their gas content and total solids content. The formation of large-scale continuous structures with simple morphologies offers prospect to efficient separation of the solid gas hydrate phase from the remaining liquid, even at ambient conditions. Ultimately, the liquid concentrate can be obtained with minimized coffee loss at low energy input.

O9.4

Deciphering the UV-LED technology as a potential decontamination strategy of poultry meat towards Campylobacter jejuni

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Aim:

Prevalence of *Campylobacter jejuni* in Europe demands novel technological interventions for the food industry. UV-LED has proven effective in reducing bacterial burden on meat surfaces, making it a potential solution for the poultry industry.This study aimed at investigating the ability of UV light to affect the bacterial culturability and susceptibility to antibiotics to explore the effectiveness of the UV-LED technology to inactivate *C. jejuni* on chicken meat.

Method:

Twenty-five *C. jejuni* strains, including clinical, primary production, and food isolates, and exhibiting diverse antimicrobial resistant patterns, were cultured on Columbia blood agar plates and incubated microaerobically at 42°C for 48 hours. Isolated colonies were then inoculated into brain heart infusion broth with 0.6% yeast extract. After another 48-hour incubation at 42°C under microaerophilic conditions, *Campylobacter* suspensions were applied to chicken dices (~10 g) at a concentration of 4-5 log CFU/g and allowed to dry for 20 minutes to facilitate cell attachment. UV-LED treatment at 280 nm was applied for 6 min, while untreated samples served as controls. *Campylobacter* concentrations were determined following ISO 10272-2:2017 using modified charcoal cefoperazone deoxycholate agar (mCCDA) with *Campylobacter* selective supplement and Campyfood agar, incubated microaerobically for 48 hours at 42°C. Colonies from both media from treated and control samples were analyzed by MALDI-TOF. Additionally, these colonies were sub-cultured using blood agar plates for antimicrobial susceptibility testing following EUCAST guidelines.

Results:

Campylobacter average reductions of 0.35 ± 0.35 and 0.41 ± 0.24 log CFU/g were obtained after UV-LED treatment in Campyfood and mCCDA, respectively. However, high variability in bacterial reductions was observed with a maximum reduction of 0.84 log CFU/g in Campyfood agar and 1.61 log CFU/g in mCCDA and a minimum reduction of 0 log CFU/g in both media. An altered MALDI-TOF profile was observed in all strains when comparing both media and in certain strains when UV treatment was applied. Antibiotic susceptibility profile was not modified after UV-LED exposure.

Conclusion:

Variability of the UV-LED decontamination effectiveness may be strain-dependant. In order to understand this phenomenon, MALDI-TOF profiles of treated and untreated bacteria are currently being investigated. UV-LED did not affect the antibiotic susceptibility profile of the 25 strains.

O9.5

Investigation of emulsifying and emulsion stabilization mechanisms of commercial pea protein powders

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Aim:

Pea proteins have attracted more interest of their utilization in the food industry because of low cost, hypoallergenicity, and comparable functionality. The emulsifying properties of laboratory-produced pea proteins have been studied extensively. However, there is a knowledge gap between industrial processed (commercial pea protein powder) and laboratory-scale protein powder. Therefore, to obtain an accurate assessment of commercial pea proteins for food applications, it is necessary to thoroughly investigate their emulsifying property and emulsion stabilization mechanisms.

Method:

Seven commercial pea protein powders: one concentrate (PPC) and six isolates (PPI1, PPI2, PPI3, PPI4, PPI5, and PPI6), were used to prepare fine emulsions. These emulsions were analyzed for droplet size, zeta potential, apparent viscosity, morphology, and stability and related to solubility, particle size, and interfacial tension of homogenized pea protein solution. Moreover, small-angle-X-ray-scattering (SAXS) was applied to evaluate the protein size and shape changes during emulsion storage.

Results:

Commercial pea protein-stabilized emulsions had different oil droplet sizes (in the range of 1.10–42.25 µm) with the order of PPI6 > PPI3 > PPC > PPI4 > PPI5 ≈ PPI2 ≈ PPI1. PPI1 formed a stable emulsion with small volume mean droplet diameter (D4,3 = 1.10 µm) and low instability index. This is attributed to PPI1's high solubility and, consequently, the fast adsorption rate of proteins at the interface. Both confocal laser scanning microscopy and flocculation index indicated significant bridging flocculation in PPI6 stabilized emulsion, which may be related to its large particles and high amount of non-soluble proteins. Interestingly, emulsions stabilized with PPI6 displayed better stability against centrifugal forces than PPI3, despite more flocculation being observed. The possible reason is that aggregated floccules induce increased viscosity, thereby preventing the movement of the droplets during the accelerated stability measurement.

Conclusion:

Emulsions stabilized by commercial pea protein powders created different emulsification and had different emulsion stabilization mechanisms. The emulsion properties were related to solubility, particle size, and interfacial tension of pea proteins after homogenization. Further, their correlation will be modelled to establish a protein analytical toolbox to help improve pea protein commercial production and expand their industrial availability.

O9.6

Formulation of high-value-oil-rich ingredients by citrus pectin and insoluble fiber

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Aim: The citrus industry is one of southern Italy's most widespread agri-food chains. Starting from citrus, it is possible to squeeze the juice, distill essential oils and finally extract the pectin. The final residue is the insoluble component of total dietary fiber. With this work, the interactions between pectins and insoluble fiber were studied with the goal of obtaining food products resistant to heat treatment, with a wide range of textures and the possibility of implementing lipophilic molecules in them. For this purpose, the manufacturing of emulsion-filled-hydrogels was selected as best potential system, using mango puree as dispersing phase to improve taste and nutritional value.

Method: First, emulsions at different concentrations of sunflower oil (20 - 25 - 30%) and insoluble fiber (3 - 4 - 5%) were prepared and analysed for the oil droplet's size (Fluorescence Microscopy) and phase separation after centrifugation (4000 g for 2 minutes) to find the more stable combination. Mango puree, oil, and insoluble fiber were mixed at 1200 rpm for 15 min with a mechanical mixer while heating up to 90°C. After 10 min of mixing, four low-methoxy pectins with different degrees of methylation and amidation were added at 1% w/w to create the emulsion-filled-hydrogel. The resulting samples were allowed to cool overnight at room temperature and then subjected to texture and confocal analysis to demonstrate the emulsion-filled-hydrogel formation and investigate consistency and microstructure.

Results: The insoluble citrus fiber showed the ability to stabilize the emulsion reaching a D5:3 droplet size of around 15 µm. The final selected formulation was with 1% pectin, 5% fiber, 20% oil, and 74% mango puree. Depending on the pectin type a variety of products with different structural characteristics were obtained.

Conclusion: Insoluble citrus fiber can stabilize an emulsion able to withstand the heat treatment necessary to prepare the hydrogel. The final products are oil- and fiber-rich without any added sugar. They can be considered as a texturally versatile way to implement foods with fat-soluble nutrients (e.g. PUFA, D and E vitamins). Further study should be made to investigate potential preserving effects for the oily phase.

O9.7

The metabolic response of red bell pepper tissue subjected to US and PEF combined treatment.

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Aim: The aim of the research was to evaluate the effect of non-thermal combined treatments: sonication (US) and pulsed electric field (PEF) on physiological changes in red bell pepper tissue. For the reason that vegetables are made up of biologically active tissues, evaluating the effect of different technologies on the tissue metabolic response and cell integrity and vitality are very important.

Method: The treatment was carried out with the use of ultrasound with an ultrasonic probe (400 W, 24 kHz) in time: 60, 180, and 300 sec, and the PEF treatment with the energy of 1, 5.5, 10 kJ/kg. The effect on metabolism was examined by assessing endogenous heat production by isothermal calorimetry (TAM), cell viability by fluorescence microscopy using fluorescein diacetate and cell membrane integrity by electrolytes leakage.

Results: The increase in thermal power is the result of an increase in the internal metabolic activity of tissues, provoked by PEF and US induced stress. A decrease in metabolic heat rate was observed with increasing intensity of PEF, power of ultrasound parameters, due to the possible consequences of loss in cell viability.

Conclusion: Both techniques can be used to intensify mass transfer. The combination of sonication and pulsed electric field was tested as a possible method for the increased shelf life of fresh-cut vegetables. The possibility of novel treatment and its effects on the quality of fresh produce may present an exciting opportunity for the fresh-cut sector and minimal processing. Establishing the parameters of PEF and US which could influence the metabolic response of new products is necessary to maintain the quality of final products during storage and post-processing. The project also uses analytical tools such as an isothermal calorimeter, impedance measurement and fluorescence microscopy to optimize PEF and US parameters.

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O10.2

The effect of ternary anthocyanin-iron ion-pectin interactions on spectral properties and stability

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Aim:
Food color is one of the essential sensorial characteristics. In recent years, consumer health awareness increased, and the trend toward healthier nutrition amplified the search for more natural food additives, such as natural colorants. Natural pigments such as anthocyanins are being explored to meet the demand for more natural food additives. However, they suffer from poor color stability during processing and/or storage compared to some synthetic counterparts; thus, new stabilization methods are being constantly explored. We aim to expand the knowledge regarding ternary pectin-metal ion-anthocyanin interactions, specifically the impact of anthocyanin structure on such interaction as a tool to stabilize anthocyanin color.

Method:
Iron-enriched pectin (PIr) was prepared by incubating apple pectin in an aqueous $FeCl_3$ solution to facilitate molecular "anchors" of iron on the pectin backbone. Pectin was characterized by ICP, and SEC-MALLS-RI. The effect of complexation (PIrA), and the effect of anthocyanin structure on coordination, color degradation kinetics, and binding affinity were studied using UV-Vis absorbance, color analysis, and Amicon Ultra Centrifugal Filters. The difference between blackcurrant anthocyanin extracts (multi-component) and their chemical standards (single-component) was studied as well.

Results:
At identical anthocyanin concentration, PIrA complexes resulted in blue color (b*=-40.53±0.10), compared to a light-pink aqueous solution (b*=-2.49±0.04). Highest bathochromic shifts, highest relative binding (7.8±1.2 % and 5.1±0.4 %, compared to 64.8±2.8 % and 36.4±1.5 %), and lowest equilibrium dissociation constants (K_d) were observed for anthocyanins composed of delphinidin aglycons compared to cyanidin, containing three and two hydroxyl groups on their B-ring, respectively. Furthermore, significantly higher color stability was observed for the PIrA system (K=-0.025±0.002[a] [1/day]), compared to the system where non-bound iron ions were added to pectin and anthocyanin (K=-0.041±0.002[b] [1/day]).

Conclusion:
The bathochromic shift confirms complexation between anthocyanins and pectin via iron ions in a structure-dependent manner. As a result of PIrA complexation, blue color is formed, confirmed by L*a*b and hue values. Furthermore, PIrA complexation prevents sedimentation and results in a slower color degradation rate as opposed to apple pectin with added anthocyanins and Fe^{3+} ions (where Fe^{3+}- anthocyanin complex formed without initially binding the iron to the pectin).

O10.3

Legume proteins and arabinoxylans as emulsifiers to deliver vitamin E and D at intestinal level

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Aim: We addressed the feasibility of using plant-based emulsifiers (i.e. legume proteins and arabinoxylans) to replace polysorbates, which are well-known emulsifiers displaying a detrimental effect on the gut. To this aim, we evaluated their emulsification potential and feasibility to encapsulate and deliver fat soluble vitamins.

Method: The emulsification potential of 4% Pea protein (PPI), 4% Lentil protein (LPI), 1% arabinoxylans (AXs), legume protein-arabinoxylan mixtures (4%PPI or 4% LPI+ either 0.15 or 0.9%AXs), and 2% Tween80 (control) was assessed by evaluating: i) surface tension and ζ—potential of emulsifiers and ii) droplet size, physical stability, *in vitro* vitamin bioaccessibility and uptake by Caco-2 cells of vitamin E and D from the different 10% oil-in-water emulsions.

Results: All emulsions presented small droplet sizes (d(4,3)<4 µm), both fresh and upon storage (21 days), with the exception of the 4%LPI + 0.9%AXs emulsion that showed bigger droplet sizes than the control stabilized with 2% Tween80 (d(4,3) of ~18.76 µm vs ~0.59µm, respectively). Emulsions stabilized with the combination of 4%PPI + either 0.15% or 0.9%AXs presented a vitamin D3 and E *in vitro* bioaccessibility that was not significantly different from that of emulsions stabilized with 2%Tween80 (vitamin D3 and E bioaccessibility was 43% and 28% for 4%PPI + 0.9%AXs and 49% and 47% for the control, respectively). The bioaccessibility of vitamins from emulsions stabilized with the individual emulsifiers was significantly lower than that from the control emulsion. Vitamin D and E cellular uptake from emulsions stabilized with plant-based emulsifiers was lower than that from the control except for vitamin E from 4%PPI+ either 0.15 or 0.9%AXs emulsion (vitamin D3 and E cellular uptake was 6 and 21% for 4%PPI + 0.9%AXs, and 22 or 40% for the control, respectively).

Conclusion: The combination of pea proteins and arabinoxylans as emulsifiers results in emulsions with small droplet sizes allowing a good fat-soluble vitamin *in vitro* bioaccessibility, but lower cellular uptake, compared to Tween80. This study thus constitutes an important contribution for the development of healthy and sustainable food products. The potential of the most promising emulsifiers should now be confirmed *in vivo*.

O10.4

Effect of defatting insect meals in wheat bread formulations

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Aim:

Despite lacking essential nutrients, bread is one of the most consumed foods worldwide. Thus, edible insects could be added to complement bread's nutritional profile. However, lipids present in *Acheta domesticus* (AD) and *Tenebrio molitor* (TM) may affect the bread's quality by interacting with gluten and starch. This study aims to evaluate the effect of AD and TM fat in breadmaking, and the physicochemical and textural characteristics of insect-supplemented loaves.

Method:

Full fat (FF), partially- (PD) and complete-defatted (DF) insect meals (TM and AD) were used to replace 10% (w/w) of wheat in bread formulations resulting in 6 different composite flours (FFAD, PDAD, DFAD, FFTM, PDTM, and DFTM) and a 100% wheat control flour. Thermomechanical properties of the dough were measured prior to baking. Breadmaking parameters were measured to calculate oven spring and specific density. Proximal characterization was performed on all loaves. A texture profile analysis was carried out during 5 days. Finally, protein digestibility and Protein Digestibility Corrected Amino Acid scores (PDCAAS) were determined.

Results:

Defatting insect meals increased water absorption of composite flours by 7 and 3% in TM and AD which seem to reduce the gelatinization of starch. TM fat increased the dough's stability time by 2.4 min, improving dough handling. Also, FFTM showed the highest volume among the experimental loaves (718-843 cm^3) yielding low density (0.19 g/cm^3) even though the gluten content was reduced by the substitution. The protein content of AD and TM bread ranged 18.3-19.7 % Dry mass (d.m). and 17.5-18.8 % d.m., respectively. Texture analysis revealed that FFTM had lower hardness value through time than the rest of the loaves. Defatting AD increased PDCAAS from 64.08 to 69.03 while TM values were also enhanced from 61.7 to 66.31. Experimental loaves enhanced protein content and quality from the control bread (14.7 % d.m; PDCAAS: 44.7).

Conclusion:

Overall, AD loaves did not show significant differences among treatments in most parameters. TM fat increased dough handling, improved breadmaking parameters and reduced starch retrogradation without compromising the nutritional quality. These findings indicate that insect endogenous fat contributes to dough development, making FF insect meals suitable for breadmaking.

O10.5

Physicochemical, textural and sensory properties of custard formulated with quinoa as a novel ingredient

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Aim: Currently around 42% of the global consumers are identified as flexitarians, i.e. they want to reduce the consumption of animal-based foods in favor of plant-based foods. In order yo meet this demand, the development of hybrid dairy foods (in which milk is partially replaced by plant-based ingredients) is one of the emerging trends that the dairy industry should address. The study aimed to asses the effect of quinoa (flour and drink) incorporation on the physicochemical, textural and sensory properties of custard suitable for a flexitarian diets.
Method: Custards were prepared using the following ingredients: commercial UHT whole fat cow milk, sucrose (6%), quinoa flour (10%), vanilla essence (3 ml) and rice-quinoa drink to obtain 5 types of custard formulations with different milk/rice-quinoa drink ratios (100/0; 75/25; 50/50; 25/75; 0/100). All the ingredients were mixed, heated to boiling and then the custards were stored at 4ºC for 48 h until further analysis. Physicochemical parameters (color, aw and pH) and syneresis of custards were measured in triplicate. Textural characterization (TPA) was carried out in triplicate. For the sensory analysis, consumer panelists scored the samples for aroma, flavor, color, texture and overall rating.
Results: Quinoa drink incorporation didn't influence the pH of the custards. Luminosity (L*) decreased from 66.41 to 57.27 by increasing the proportion of quinoa drink in the custard, becoming less luminous. Coordinate a* was lower as the proportion of quinoa drink in the custards increased while b* remained similar in all samples. Water activity varied from 0.86 to 0.98 being higher in the custards containing 25, 50 and 75% quinoa drink. Also, the incorporation of quinoa drink didn't impair the syneresis of the dairy dessert but resulted in a reduction in hardness (from 17.26 to 5.27 N) and compressibility (111.1 vs 5.71 N/mm) in samples formulated with 75% quinoa drink while adhesiveness increased (from -41.44 to -1.05 N/mm) compared to custards made with 100% milk. Sensory analysis revealed that the custards containing 25% quinoa drink were the best rated, obtaining the highest overall rating.
Conclusion: The results demonstrate that quinoa is a potential ingredient for the development of new hybrid dairy desserts with good sensory properties.

O10.6

Application of complexes from phycocyanin and pectin in a model beverage system

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Aim:

Coloring with the blue-appearing phycocyanin from *Arthrospira platensis* is expensive due to severe color losses during production and storage. Many studies looked at stabilizing phycocyanin via biopolymer complexation. Experimental results have not yet been applied to beverage systems containing more ions and sugars that could interfere with the primarily electrostatic complexation mechanism. The study aimed to validate laboratory experiments of complexing phycocyanin with pectin, a side-stream product, in a larger-scale model beverage system.

Method:

Pectin-phycocyanin complexes were prepared at 5 ratios (0.67-2.5) in double distilled water and stored unheated and heated (85 °C) at 25 °C. Color stability was evaluated by photometric measurements for 13 days. In addition, the size and the zeta potential were measured to evaluate structural changes and electrostatic stability of the solutions. The most promising complex in terms of both colloidal and color stability (pectin:phycocyanin 2:1) was prepared in a model beverage system and compared to a pure phycocyanin reference under light storage conditions over a 13-day storage period.

Results:

Heated pectin-phycocyanin complexes kept their colloidal stability after heating throughout the 13 days of storage at a mixing ratio of 2 and 2.5 in aqueous solutions. Increasing the pectin content increased the interactions between phycocyanin and pectin, resulting in a greater initial color shift. In the beverage system, the complexes were applied directly to the beverages, resulting in precipitation. Thus, the samples were evaluated shaken and unshaken. After heating, the color shift from an unheated phycocyanin-containing reference sample was $\Delta E_{00} = 3.47 \pm 0.05$ for the pure phycocyanin-containing beverages and $\Delta E_{00} = 4.66 \pm 0.05$ for the complex-containing beverages. During the 13-days of light storage, the color shift increased more rapidly for the pure phycocyanin-containing beverages. Hence, there is a transition point after roughly 9 days where color protection by complexation becomes valuable.

Conclusion:

Applying complexes of phycocyanin and pectin within model beverage systems demonstrated the ability to economically improve the use of phycocyanin as a coloring food. However, initial color shifts and the order of addition of the complexing agents must be considered to unlock the potential of its blue color in a wide range of products.

O10.7

Hazelnuts and walnuts spreads with probiotics: development, characterization, and storage stability.

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Aim: The aim of this work was the development of two different kinds of nuts spreads added with probiotics. Tree nuts are widely consumed for their taste and healthy properties, whereas probiotics are one of the most used functional ingredients for the production of innovative and nutraceutical confectionery products. For this purpose a strain of *Bifidobacterium animalis subsp. lactis* (BB-12®) was selected to be added to the spreads, due to its most documented beneficial effects.

Method: Walnuts and hazelnuts were selected as base-ingredients for nut butters preparation in order to maximize the sensorial and nutritional profile of final products, thanks to their typical bioactive compounds (vitamins, antioxidants) and macronutrient compositions (fibre, proteins, PUFAs). Freeze-dried BB-12® was added to the nut pastes in calculated amount to guarantee an initial viability of 10^{10} UFC/g for serving portion (15g). In addition, a mixture of oligo- and polysaccharides (maltodextrin and tragacanth gum) and sugar alcohols (maltitol) was expected to be used for preserving and/or enhancing chemical, physical, and microbial properties. Based on an estimated activation energy of about 90 kJ/mol for nut lipid oxidation, it was possible to simulate sample storage at 21 °C for more than one year in a shorter period: samples were stored at 40 °C for 40 days and characterized once a week for rheological properties, microbiological, and oxidative quality.

Results: Both nut spread formulations exhibited an excellent nutritional profile and resulted also stable to the oxidative stress. The probiotic strain kept a viability of 10^9 UFC/g through all the considered shelf life in both samples allowing to use the claim that the products "*promote the balance of intestinal flora*".

Conclusion: BB-12® probiotics showed a good adaptability and resistance to survive inside the walnuts and hazelnut spread formulations both during processing and storage: their viability was maintained, making possible to obtain a nutraceutical product. The addition of different ingredients that can contribute on creating an appealing product for new consumers, also approaching the industries, is being evaluated.

O11.2

From Monoculture to Mixed-Culture: Data-Driven Modelling of Beer Fermentation Dynamics

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In recent years, the craft beer movement has increased interest in mixed-culture fermentation, which offers unique flavour characteristics and brewing opportunities. However, the complexity of mixed-culture fermentation presents a challenge in achieving consistent results at scale. We propose an empirical, data-driven, approach to multi-variate system modelling and real-time predictive process control for mixed-culture fermented beer to address this.

Aim:

This study aims to develop a data-driven approach for modelling and predicting the fermentation dynamics of mixed-culture beers, aiming to improve consistency and offer decision support to brewers.

Method:

To develop the model, training and testing data were produced using a sensor array to monitor critical fermentation parameters of both pure monoculture and mixed-culture co-fermented beers. These experiments were conducted at pilot-scale to ensure relevance to real-world brewing processes. These empirical data were then used to train and test machine learning and artificial intelligence algorithms, enabling the creation of an effective system for monitoring and estimating key system parameters.

Results:

The data-driven models successfully simulated and predicted the fermentation behaviour for monoculture fermentations using ale and lager yeasts and co-fermentations using a mixed ale and lager yeast inoculum. The model's accuracy and performance were evaluated based on comparison with experimental data, demonstrating its effectiveness in capturing the complex dynamics of mixed-culture fermentation.

Conclusion:

This study presents a promising data-driven approach for modelling and predicting the fermentation dynamics of mixed-culture beers. By leveraging machine learning and artificial intelligence techniques, our model offers a cost-effective solution for enhancing batch-to-batch product consistency and providing decision support to brewers. The results show the potential of this approach in addressing the challenges of mixed-culture fermentation, paving the way for improved brewing processes and product quality.

Future work in this area includes the generation of larger training datasets based on real-world mixed-culture fermentations, particularly those involving yeast and lactic acid bacteria co-fermentations. Expanding the dataset will further refine the models and enhance its applicability to a broader range of brewing scenarios. With continued development and refinement, data-driven modelling of beer fermentation dynamics has the potential to revolutionise the craft brewing industry and contribute to the production of innovative and consistent mixed-culture beers.

O11.3

A web-based interface for bacterial growth and death prediction in predictive microbiology

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Aim:
In predictive microbiology, probabilistic approaches have been utilized to predict the growth and inactivation of individual bacteria. The probabilistic model has been used instead of the kinetic model to show the variation in population behavior. The probabilistic approaches help estimate the dose of consumption. However, the requirement for programming in software has impeded the widespread use of these probabilistic approaches. To address this challenge, we aimed to perform predictive analysis through a simple and user-friendly interface using Streamlit in this study.

Method:
Our method involves reproducing individual bacteria's growth and death processes by calculating the growth and death times from exponential distributions based on the initial number of bacteria, which follows a Poisson distribution. The input variables are time and logarithmic of a number of cells. The variables are fitted to Weibull or the three-phase model. In addition, a growth/no growth model was also developed.

Results:
The results indicated that the viable model could be easily fitted and predicted by inputting numerical values. The coding skill is not required to perform the probabilistic approach in this system. The system is available on smartphones, tablets, and computers.

Conclusion:
This program developed in this study can serve as a convenient tool for evaluating probabilistic safety in the future.

O11.4

Low-cost culture medium for biomass production of indigenous lactic acid bacteria by using bioreactor

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Aim: Use bioreactor for the selection of dairy by-products as a potential probiotic *Lacticaseibacillus paracasei* A11 growth media.

Currently, the de Man, Rogosa, and Sharpe (MRS) broth is widely used for the growth of lactic acid bacteria (LAB), however, the high cost of this medium and time-consuming biomass processing procedures limits its use under specific laboratory conditions. On the other hand, by-products of dairy industry, such as sweet and acid whey concentrates and their permeates may serve as an affordable LAB cultivation media, providing an alternative for the repurposing of liquid whey and liquid whey concentrates.

Method: Cultivation of the strain was carried out in whey protein concentrate (WPC), whey permeate (WP), acid whey protein concentrate (AWPC), and acid whey permeate (AWP). The physiological activity of the strain was assessed in the bioreactor (RTS-1C, Biosan) by real time optical density (OD) measurement; LAB plate count in flask cultures was performed in parallel to estimate the yield of strain biomass.

Results: The strain demonstrated similar doubling time (2 hr) and yielded similar amount of biomass in WPC as that obtained in MRS broth in 24 hours (8.46; 8.20 $\log_{10}$ cfu mL^{-1}). Longer doubling time of the strain was calculated in WP (17 hr) and AWPC (24 hr), and they needed 48 hours to reach similar biomass yield as in MRS broth (7.95; 8.30 $\log_{10}$ cfu mL^{-1}, respectively).

Conclusion: Employing WPC, AWPC, and WP for LAB biomass production thus utilising whey proteins, peptides, and naturally occurring sugars as an energy source for the strain growth instead of harvesting it from MRS broth proved to be a valid, natural, and potential cost-effective biomass growth method.

Acknowledgements: The Project The edible coating formulated with liquid acid whey protein and bioactive compounds, and biopackaging for safety and quality of probiotic cheese (Biocoat) benefits from a 974 thousand € grant from Iceland, Liechtenstein, and Norway through the EEA Grants. The aim of the project is to develop an edible coating formulated with liquid acid whey protein concentrate and bio active compounds, in combination with biodegradable packaging to ensure safety, extend the shelf life and enhance functionality of probiotic cheese. Project contract with the Research Council of Lithuania (LMTLT) No is S-BMT-21-10 (LT08-2-LMT-K-01-046)

O11.5

A Multi-Omic Approach to Food Spoilage and Nutritional Composition Within a Vegetable Food Matrix

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Aim: Foods are subject to physiochemical and microbiological biotransformation's during the food chain that influence shelf-life. At present, food deterioration is determined using microbial and organoleptic assessments that are both outdated and insensitive, while the nutritional composition of foods remain unassessed. The extent of vitamin deterioration, and its relationship with microbial growth, remains unknown and is of vital importance to health and food security. However, advances in -Omic technologies enable a more in-depth understanding of the spoilage mechanisms during the shelf-life period. The aim of the investigation was to provide a novel multi-omics derived, in-depth characterisation of a food commodities stability over the shelf-life period, to understand both vitamin composition and the relationship between food spoilage and vitamin status.

Method: Characterisation of spoilage was performed in a vegetable matrix using amplicon sequencing targeting 16S rRNA and metabolomic fingerprinting. Alongside, novel hydrophilic interaction chromatographic methods were used to analyse vitamin composition throughout storage and macronutrient composition, microbial growth and physiochemical changes were also analysed. The matrix was stored for 5-days under an established baseline condition and a series of conditions, including different temperatures, gas compositions and preparation methods.

Results: *Lactococcus*, *Leuconostoc* and *Yersinia* were the genera responsible for spoilage of the vegetable matrix under baseline conditions. However, bacterial dynamics were shown to be highly influenced by the storage condition. This was complemented with metabolomic fingerprinting, which highlighted metabolites associated with freshness (e.g., glutathione, adenosine 5'monophosphate, arginine), spoilage (e.g., hypoxanthine and biogenic amines) and identified metabolites not previously linked with spoilage. This further showed metabolic pathways including, purine, glutathione, arginine, and proline metabolism were involved in the spoilage process. In addition, a relationship between water-soluble vitamins and spoilage activity was captured; the content of riboflavin and thiamine reduced by 85.2% and 41% respectively, and nicotinamide was fully exhausted when growth of *Lactococcus*, *Leuconostoc* and *Yersinia* reached to 2.105×10^8 CFU/g. This observation was influenced by microbial load and bacterial communities present.

Conclusion: This comprehensive -Omic evaluation of food spoilage has provided novel findings regarding food spoilage dynamics that could inform future studies into food spoilage detection and shelf-life extension.

O11.6

AI-based surrogate models of digital twins for food and drink manufacturing systems.

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Aims and Objectives

Digital twins (DT) are virtual replicas of physical systems, products, or processes that enable simulation, optimization, and prediction of their behaviour. With the help of Artificial Intelligence (AI) solutions applied to Industry 4.0. The core aim of this project is to investigate novel machine-learning architectures for data-driven surrogate modelling in food and drink manufacturing systems. The main objectives needed to support this aim are:

1. Develop an Industry 4.0 exemplar system within NCEFE to acquire real-world data from food processing machinery.
2. Develop a Digital Twin model of this system based on both system process dynamics and the integration of acquired sensor data.
3. Create computationally lightweight machine learning-based surrogate models combining data from the Digital Twin model and real-world sensor data to use in design space exploration and advanced model predictive control.

Methodology

The methodology and framework to be used for this project can be broken down into the following main stages:

Identify a food and drink manufacturing exemplar process and create a test bench via instrumentation with Industry 4.0 sensors.

Develop a digital twin model capturing the process dynamics of the exemplar system (e.g., by integrating CFD/DEM/FEA modelling techniques - as appropriate - with real-world data).

Create lightweight computationally tractable ML/AI-based surrogate models from the complex digital twin models capable of being used in rapid design space exploration and advanced model predictive control strategies.

Validation and evaluation of ML/AI-based surrogate models built in (iii).

Results

The specific expected outcomes of this project are:

Deeper insight into the dynamic behaviour of the exemplar food and drink manufacturing process to allow efficient production designs.

A novel set of AI-based methods for creating data-driven surrogate models that are not only applicable to the food manufacturing industry but also to other manufacturing sectors.

Conclusion

The coupling of advanced machine learning-based surrogate models and digital twin technology for design space exploration, anomaly detection, and model predictive control is a highly novel area - with applications not only to the food and drink manufacturing industry but to other manufacturing sectors.

O11.7

Nitric oxide synthase bacteria as a key factor for "nitrite-free" fermented sausages

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Aim:
Despite nitrites have been used for years in meat processing, the debate about their use has been growing since indicated as critical factor for N-Nitroso compounds (NOCs) formation and associated to severe human diseases. Health concerns related to the consumption of cured meats are leading to alternative process to prepare healthier meat products without added nitrite, though preserving high sensory quality.

In this context, Nitric oxide synthase (NOS) bacteria have received attention for their potential role in generating NO, leading to nitrosylmyoglobin formation (NOMb) without nitrite addition. Objective of this work was to evaluate the effect of *Staphylococcus vitulinus* and *Staphylococcus xylosus*, selected for NOS and nitrate reductase (NR) activities, respectively, on red pigments and NOCs accumulation in "nitrite-free" fermented sausages. The contribution of ascorbate (A) and natural polyphenol mix (grape seed/green tea) (M) were evaluated, too.

Method:
Three nitrite-free sausage minces were inoculated with NOS and NR Staphylococcaceae ($3{,}5 \times 10^7$ CFU/g, Chr Hansen®) and formulated as S: with NOS and NR bacteria, SA: S + ascorbate, and SMA: SA + polyphenols, respectively. Negative control (C-0) (only salt added, without NOS nor NR) and nitrite control (C-NO2) were also prepared. CIEL*a*b* colorimetric indices, red pigments (HPLC), and apparent total NOCs contents were assessed on final samples. Color stability was evaluated by replicating the measures after 30 min air exposure.

Results:
All sausages showed red color development, although differing in red pigments pattern. In C-0 the main red pigment was Zinc Protoporphyrin IX (ZnPP), about 15 mg/kg; same level of ZnPP in S, SA, SMA, moreover the NOS activity enriched the pigment profile with NOMb (around 20 mg/kg). Color stability increased in both C-NO2 and SMA sausages ($P < 0.05$). Nitrite addition (C-NO2) resulted in NO-Mb pigment formation (about 70 mg/kg) and caused an accumulation of total NOCs of about 110 nmol NO/g); conversely, NOS bacterial activity limited total NOCs to about 20 nmol NO/g (the lowest level in SMA).

Conclusion:
NOS bacteria is a promising nitrite substitute for color formation in fermented sausages, preventing NOCs accumulation. Processing strategies for promoting the NO yield and replacing nitrite, deserve further research.

O12.2

Moderate pressure pasteurisation as a novel nonthermal pasteurisation technique– two case-studies in highly perishable foods

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Aim:

Recently, several studies showed the capacity of hyperbaric storage (HS) to inactivate microorganisms (75-100 MPa). These results led us to test a new nonthermal pasteurisation approach to exacerbate microbial inactivation, tentatively called moderate pressure pasteurisation (MPP). This way, foods would be pasteurised at room temperature (RT), while being stored. Therefore, to enhance microbial inactivation, MPP pressures (above 100 MPa) would be used during the pasteurisation/storage period, since after, the foods could be preserved at refrigeration (RF) or by HS/RT. Thus, MPP would occur at RT, what is an advanced feature for a pasteurisation process and additionally, if MPP was followed by HS preservation at RT, it would be a *quasi*-energetically costless process.

Method:

To test this novel pasteurisation process, MPP was carried out in two different food products (milk and a ready-to-eat (RTE) fish soup) at different pressure levels between 125-250 MPa, up to 24h, at RT (≈20°C), followed by storage at RF or HS/RT. The MPP effect was evaluated in endogenous and inoculated microorganisms.

Results:

Generally, for both case-studies, MPP caused a significant reduction of microbial counts, either endogenous (total aerobic mesophiles, lactic acid bacteria, *Pseudomonas* spp. and Enterobacteriaceae) or pathogenic microorganisms (*Listeria innocua, Salmonella enterica and Escherichia coli*). For the higher pressures applied (200 and 250 MPa) endogenous microorganisms reached the detection limit (<1.0 log CFU/mL) in milk and reduced at least 3.0 log CFU/g when applied in RTE fish soup. Regarding pathogenic microorganisms, reductions over 5.0 log CFU/ml were verified (MPP;24h) in milk, while for RTE fish soup, 4.0 and 6.9 log CFU/g reduction was obtained for *Salmonella enterica* (MPP;6h) and *Listeria innocua* (MPP;24h), respectively.

When reached the detection limit no microbial development occurred under RF after MPP (post-MPP), for at least 21 days. Post-MPP at 75 MPa/RT continued to promote microbial inactivation during storage increasing food safety.

Conclusion:

Overall, the results show that MPP is very promising as a new nonthermal food pasteurisation technique. Also, this work points for the possibility of pasteurising foods by MPP, at the same time foods are stored, followed by storage under HS conditions, being so a *quasi*-energetically costless methodology.

O12.3

Future farms – Barriers of sustainable business models for innovation: The case of Mossagården, Sweden.

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Aim:

The demand for organic farming is growing in the European Union (EU) and has been targeted as a key concept to contribute to the achievement of 25% organic farming of EU agricultural land by 2030 (IFOAM Organics Europe, 2022). Organic farming will contribute to counteract the negative externalities and find alternative solutions to intensification and monocultures that causing scarcity, degradation, desertification, and deforestation (Gjerris & Gaiani, 2013, p. 16). To enable the transition, new sustainable business model innovations (SBMI) in the organic farming sector need to be created that address the demand for research and development on SBMI in the agrifood sector (Tell et al., 2016). Setting the stage for organic farming will be accompanied by barriers to implement a SBMI in the organic farming sector sustainably in the EU. Thus, the paper focuses on overcoming these barriers on an entrepreneurial level and aims to conceptualize a framework on SBMI for sustainable enterprises.

Method:

It follows a qualitative approach by exploring the literature on barriers in the organic farming sector and analyses a case study of an organic farm in Skåne, Sweden, implementing the proposed framework on SBMI to exemplify the barriers to draw conclusions of how to facilitate future sustainable organic farming, while understanding limitations and implications for future research.

Results:

The barriers found in the literature, that hinder the transition towards organic farming, were categorized into external, internal barriers as well as divided by the sustainability dimensions, social, economic, and environmental. Most pressing barriers identified were policies and regulations, consumer behaviour, lack of knowledge, farm mentality, high capital costs along with volatile market situation, scalability, dependency on compensatory payments from the EU and weather conditions.

Conclusion:

To foster organic farming and support the farmers with the right tools and framework, the analysis gives evidence that similar barriers for the case study were identified in terms of social and environmental aspects. Nevertheless, more emphasizes needs to be put on economic barriers to make the transition feasible. Applying a SBMI framework will contribute to sustainably transform the food system but more support from policy and inter-organizational collaboration is needed.

O12.5

Particle modification to enhance the shelf-life of plant-based milk powders

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Aim:
This project aims to enhance the shelf-life of plant-based milk powders by reducing lipid oxidation and investigate storage-induced changes within those powders. Different impact factors such as particle structure, material diffusivity and emulsifier determine the storage stability of plant-based powders. Furthermore, storage can alter powder properties such as rehydration or caking. Within this work the drivers for lipid oxidation and property alterations in plant-based powders are investigated with a focus on the role of plant-derived ingredients.

Method:
Plant-based milk powders were produced by spray- or freeze-drying of emulsions containing pea protein isolate, maltodextrin, sunflower oil and beta carotene.
In order to monitor lipid oxidation, beta carotene dispersed in sunflower oil was used as a tracing molecule. Beta carotene was extracted from dissolved powder solutions using heptane and the concentration was determined by measuring absorbance at 450 nm in a uv-vis spectrophotometer.
Powders were further characterized before and after storage by means of free fat content, material density, confocal and electron scanning microscopy as well as Fourier Transform Infra-Red (FTIR) Spectroscopy.

Results:
Powders with differing protein contents as well as different maltodextrins were produced by spray- and freeze-drying and stored under standardized conditions. While protein content did not influence powder particle size and free fat content, it showed a significant influence on oil droplet size of the emulsion as well as on lipid oxidation during storage.
For investigated samples, further changes were observed in color, rehydration behaviour, free fat content and contact angle before and after storage. Using FTIR spectroscopy, storage-induced changes in the protein structure were observed and a linkage between structural alterations and changes in rehydration behaviour could be established.

Conclusion:
Building a link between lipid oxidation and other physicochemical changes during storage helps to deepen the understanding of milk-like systems made by novel plant ingredients. Generating this knowledge enables us to tailor recipes and particles for greater stability as well as functionality leading to stable and sustainable plant-based product solutions.

O12.6

Seasonal chemical characterization of Ostrea edulis as a potential source of bioactive molecules

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Aim: the conservation of the European flat oyster, namely *Ostrea edulis* (Linnaeus 1758), is a focus of ecological restoration efforts to profit from the ecosystem services of this biogenic reef-engineer species. Moreover, this oyster species is highly praised for its culinary and medicinal values. This oyster species, is at the core of many scientific projects and actions by governmental and non-governmental organizations in relation to the aquaculture, restocking, restoration or reintroduction in its former range.
Unfortunately, diseases and pests such as *Bonamia* and *Marteilia,* have dramatically reduced or indeed depleted the stocks and farms of *O. edulis* throughout European waters. This has had obvious consequences for the development of innovative production technologies when compared to other shellfish species of commercial interest, such as the Pacific oyster (*Magallana gigas*).
Our study on the chemical characterization of *Ostrea edulis*, aims to find bioactive molecules with antioxidant activity, heart protector and that improve age-related learning. Furthermore, this study, could also represent a good chance of cultivation of the *O. edulis*, especially in areas where the parasites *Bonamia* and *Marteilia* are not endemic.

Method: the characterization presented here consists on the evaluation of proximate composition, nutritional components and antioxidant capacity of *O. edulis* grown in Valli di Comacchio (Italy), sampling on three growth seasons: December, June and October.

Results: the results show the seasonal changes in the proximate and nutritional composition and antioxidant capacity. The amount of lipids, ashes, and carbohydrates showed differences in the three harvesting periods. The percentage of lipids in October samples was higher than other sampling periods; while oysters winter sampling presented a higher percentage of PUFA. In the December sampling, the total carotenoids and antioxidant activity were higher than June and October.

Conclusion: the limited knowledge on ecophysiological and environmental conditions and the difficulty in obtaining seeds for aquaculture, limits the development of successful breeding methods for this species. The our study, represent a opportunity for give greater knowledge and value for this species oyster, to increase its breeding and settlement in all those natural areas of which, in the past, it was the dominant species.

O12.7

PORTABLE TESTING SYSTEM FOR TOTAL ANTIOXIDANT ACTIVITY DETERMINATION IN FOOD SAMPLES

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Aim:

Total Antioxidant activity (TAC) is considered an important parameter to ensure quality and safety of agri-food products. Classical spectrophotometric methods for TAC analysis present some limitations including complex sample pretreatment, long procedures, expensive instrumentation and the interference of turbid/color samples.

The aim of this work is to evaluate the performance of a new portable electrochemical device (BRS) for TAC analysis in different types of agri-food samples. Electrochemistry is a powerful tool to study the redox state of agri-food samples, with features that include rapid response, high sensitivity, inherent miniaturization, low cost and low-power requirements. Moreover, electrochemical techniques can be used in turbid or colored samples.

Method:

TAC measurements were performed using the BRS device (Bioquochem SL). The device comprises a hand-held meter and disposable test strips. The meter is controlled by a smart mobile device.

BRS uses a voltammetric technique to measure TAC. The sample is electrochemically oxidized by applying a potential scan and TAC value is calculated from the voltammetric charge. TAC results for agri-food analysis are expressed in terms of BRS Value.

Results:

BRS device was able to measure TAC in a wide variety of agri-food samples (beverages, fruits, plat extracts,) with a very good precision (CV < 10%). Samples were analyzed in less than a minute using a small sample volume (50 µL). BRS device exhibits a wide linear range for the most used antioxidant standards which minimizes the need of sample dilution.

Conclusion:

BRS device is a suitable electrochemical system for the direct and fast determination of TAC in a wide variety of agri-food samples.

BRS analyses can be considered as a direct evaluation of the antioxidant activity of the sample in its native environment.

Similar to a glucometer, the BRS comprises a hand-held meter and disposable test strips controlled by a smartphone, making TAC analysts simple and fast for all professional profiles.

O13.2

Effect of PEF processing on the yield and quality of juice from industrial carrot cultivars

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Aim:

Extraction of carrot juice is commonly carried out with belt presses that rely on compressing trimmed carrot to extract the juice. However, carrots are notorious for their hard, ligneous texture, especially during late season harvesting. This complicates any comminution processes and leads to low juice extraction yields. To avoid these issues, thermal treatments such as blanching are employed which lead to juice quality deterioration and increased energy consumption. Pulsed Electric Fields rely on exposure of plant tissues to high intensity electric field in order to soften the tissue and increase extraction yields. This work explores the effect of PEF on the yield and quality parameters of carrot juice, as compared to thermal blanching.

Method:

Whole carrots were PEF treated (0.5-1.7 kV/cm, specific energy 0-5 kJ/kg) and blanched (60-90°C, 1-20 min, specific energy 120-250 kJ/kg), ground and juiced using a rotary press (5 L capacity). Juicing yield was determined for all treatments and quality parameters of the resulting juices were compared (pH, titratable acidity, CIELab color). For PEF treatments, the juice yield was correlated to the cell disintegration index, determined using electrical impedance measurements.

Results:

Juicing yield of carrots was highly correlated with the cell disintegration index Z. The maximum value of Z achieved was equal to 0.45, with a corresponding juice yield equal to 42%, compared to untreated carrots which exhibited a juice yield equal to 25%. This was achieved for a specific energy input equal to 1.7 kJ/kg. Similar yields were obtained for a 2 min treatment at 90°C, with an energy input equal to 247 kJ/kg. Even though similar yields were achieved in both PEF and thermal treatments, the specific energy input required for PEF treatment was equal to 0.7% of the corresponding value for a thermal blanching. Moreover, juice obtained from the blanched carrots exhibited significant color deterioration.

Conclusion:

PEF pretreatment provides substantial energy savings by rendering the juicing process of problematic crops such as carrots highly efficient and sustainable.

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O13.4

Physiochemical and microbial quality changes in Norwegian red sea cucumber (Parastichopus tremulus) during storage

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Aim:

Sea cucumbers (Parastichopus *tremulus*) are a food delicacy in Asia, still consumed fresh and dried. The aim of this study was to investigate the effect of storage on the proximate composition, the physicochemical and microbial quality of P. *tremulus*.

Methods:

Eighty sea cucumbers were slaughtered and stored individually on ice (0°C) or at 4 °C. Samples were first collected everyday from day 1 to 7. After day 7, the samples were collected every second day from day 7 to 17. The sample were analyzed for drip loss and quality changes. The physicochemical quality was assessed by analyses of texture and adenosine-5'-triphosphate (ATP)-degradation products. The microbial quality was assessed using culture-dependent and independent methods.

Results:

No significant differences were found in drip loss, protein content and texture between P*. tremulus* stored at 4°C and 0°C. The psychrotrophic aerobic plate counts and aerobic bacteria counts were significantly higher at 4°C compared to 0°C. No significant difference in H_2S-producing bacteria loads was found between treatments. The present study demonstrated that the microbial counts reached their maximum population density on day 7 (6.57 ± 0.10 log cfu/g and 7.38 ± 0.1 log cfu/g at 0°C and 4°C, respectively) and then no significant differences in the population density was observed until the end of the storage trial. The amount of the ATP-degradation products was higher in the 4°C than 0°C at the end of storage trial due to possibly higher microbial loads in this treatment.

The microbial communities of fresh samples consisted of genera classified to Flavobacteriaceae, Hyphomonadaceae and Rhodobacteraceae families. The storage temperature did not affect the microbial community succession as no significant fluctuations were found in the relative abundances of bacterial taxa in the middle and the end of storage time. The predominant genera were *Flavobacterium* spp. and *Psychrobacter* spp. in both treatments at the end of storage time.

Conclusion:

The sea cucumber is spoiled after the seventh day of storage and a proposed shelf life would be seven days stored at 4°C and 0°C. More studies are needed to conclude the shelf-life of sea cucumber.

O13.5

Design of a manothermosonication prototype for the pasteurisation of liquid whole egg

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Aim: Ultrasound (US) technology is gaining recognition as an emerging method to provide high-safety food products. However, high power and long processing times are required to achieve microbial target reductions, which may damage food products' composition, structure, or sensory properties. In this sense, research was made in the exploration of combining the US with other techniques, such as heating at mild temperatures (40-70°C) and elevated pressure (200-500 kPa), resulting in a technology called manothermosonication (MTS). Therefore, this work aimed to design and built an MTS application unit and evaluate its microbial decontamination potential for liquid egg pasteurisation.

Method: The MTS unit design consists of a double-jacket chamber with a US-probe system. Concerning the control of temperature and pressure, a water bath is used to circulate tempered water through the chamber, and a valve is incorporated to elevate the pressure inside the chamber, respectively. Different processing parameters, such as wave amplitude (33-132 µm) and pressure (100-300 kPa) were optimised for pasteurising liquid eggs. The microbial inactivation potential of MTS was evaluated using *Salmonella* Enteritidis DSM 17420 as a target microorganism in liquid whole egg pasteurisation.

Results: The MTS unit was built, and the processing parameters were optimised for the application of treatments in liquid whole egg, with 132 µm wave amplitude and 300 kPa pressure as the optimal processing conditions. Treatments were applied under dynamic temperature conditions for 6 min resulting in a final temperature of 57°C and achieving a 5.0 Log_{10} reduction of *S.* Enteritidis. Comparing these results with the traditional heat pasteurisation guidelines for the inactivation of *Salmonella* spp. in liquid egg products (60°C, 3.5 min), treatments of 19 min would be required under isothermal conditions at 57°C to achieve the same level of inactivation, meaning a reduction of about 68% of the processing time when applying MTS.

Conclusion: As an alternative to traditional thermal treatments, a MTS application unit was designed and built, and treatment conditions were optimised, requiring lower processing time and lower final temperature to achieve the same inactivation level of *S.* Enteritidis resulting in the production of safe liquid whole egg.

O13.6

Biotechnological approaches to improve the polyphenol extraction in orange by-products

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Aim: Orange peel is the main by-product from orange juice industry. It is a known source of bioactive compounds and is widely studied for its antioxidant, anti-inflammatory, anti-cancer, anti-rheumatic, anti-diabetic and cardioprotective activities. Nowadays, this wastage is causing an environmental problem, so the use of new technologies to take advantage of it is a novel field of research Thus, this research focuses on using submerged fermentation by lactic acid bacteria followed by ultrasound-assisted extraction as novel combination tool for improving the bioactive compounds extraction from orange peels.

Method: Orange peels were fermented by *Levilactobacillus brevis* CECT 5354, *Lactiplantibacillus plantarum* CECT 748T and *Lactiplantibacillus plantarum* CECT 9567 (formerly strain C4) during 24 and 48 hours. The fermented orange peels were extracted using a sonotrode at the optimized conditions 45/55 ethanol/water (v/v), 35 min, amplitude 90% (110 W), and pulse 100% established by a 27 experiments Box-Behnken design. The phenolic compounds were identified and quantified by HPLC-ESI-TOF-MS.

Results: They were appreciated reductions of about 7 and 18% in the phenolic content when fermenting at 48 h compared to 24 h in the cases of *La. plantarum* CECT 9567 and *La. plantarum* CECT 748T, respectively. It was achieved an increment up to 15% in the phenolic acids and in the total phenolic compounds with *La. plantarum* CECT 9567 compared to a non-fermented control. The higher increment in the total flavonoid content was obtained when fermenting with *Le. brevis* CECT 5354 (up to 10% compared to control), especially in the hesperidin, narirutin and total apigenin derivatives with contents of 960.16 ± 6.35, 621.47 ± 8.42 and 564.91 ± 10.20 µg/g d.w., respectively.

Conclusion: According to the results, submerged fermentation by lactic acid bacteria combined to ultrasound sonotrode extraction led to an interesting increase in the polyphenol content of orange peels, which could then be useful for food, nutraceutical or cosmetic purposes.

O13.7

The potential of alginate microbeads containing anthocyanins as novel pH-indicator in intelligent packaging: Ammonia sensitivity

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Aim:

This research aimed to explore the feasibility of alginate hydrogel microbeads containing anthocyanins from purple corn as a pH-indicator for monitoring the freshness of seafood products.

Method:

Hydrogel microbeads of different sizes containing anthocyanins were investigated for their ability to discriminate ammonia. To assess the color response, fabricated microbeads (F_1 and F_2, in turn with particle sizes of 1142 and 1912 µm, respectively) were placed on a permeable fabric and attached to the lid of a container, containing 25 mL of various ammonia concentrations (1, 3, 6, 12, 21, 30, 45, 60, 120, and 300 ppm). The exposure was followed for 24 h, and color values were recorded at the end of this period. The limit of detection (LOD) and limit of quantification (LOQ) were calculated based on the total color difference versus volatile concentration (ppm) in the linear range from the formulas below:

LOD= 3σ/S

LOQ= 10 σ/S

Where, σ and S represent the root-mean-square deviation of blank measurements and the slope of the fitted line of the calibration curve, respectively.

Results:

The color of hydrogel microbeads changed from pink to yellow as ammonia concentration increased from 0 to 300 ppm. A linear relationship between ΔE values and ammonia concentrations was observed between 0 and 12 ppm. Large microbeads (F_2) were found to be more sensitive than small microbeads (F_1) to ammonia. LOD values were reported to be 24.85 and 14.96 ppm, for F_1 and F_2, respectively. R^2 values higher than 0.94 indicated a high detection sensitivity and precision of the calibration curve. F_2 was more sensitive to lower ammonia concentrations, making it an ideal indicator in the early stages of spoilage or in products where a lower amount of ammonia is produced. However, F_1, can be applied in the later stages of the product shelf-life or in products with high ammonia levels.

Conclusion:

The present study demonstrated the potential of alginate microbeads loaded with anthocyanins from purple corn as a promising component of an intelligent packaging system. Both indicators successfully responded to ammonia gas and could therefore be used in various stages as an intelligent indicator of seafood spoilage to mitigate seafood waste.

O14.2

Functionalization of durum wheat pasta through the incorporation of novel protein-rich sources (Tenebrio molitor larvae)

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Aim:

Insects are effective alternatives to animal protein sources to face population growth and increasing demand for animal proteins by the consumers, who are interested in adopting affordable and eco-friendly diets. *T. molitor* larvae, compared to other edible insects, have well-balanced nutrient profiles fulfilling the demands for essential amino acids. However, despite their nutritional and environmental benefits, due to the emerging nature of this theme, their consumption is very limited.

The aim of this study is the functionalization of a staple food, durum wheat pasta, through the incorporation of T. *molitor* larvae flour, focusing on how the addition of these non-conventional ingredient and pasta production processing steps affect the technological, structural, sensory, and nutritional properties of the newly formulated food product.

Method:

A comprehensive characterization of the mixtures composed of *T. molitor* larvae flour (0 – 30%) and durum wheat semolina was conducted. Water and oil absorption, water solubility index, swelling index, colorimetric and pasting profiles, nutritional values, and bioactivity, in terms of polyphenols, antioxidant activity (FRAP, DPPH, ABTS assays), and reducing sugars, were determined. These analyses were also performed for dry and cooked pasta, in addition to the texture profile (stickiness and hardness), and cooking properties.

Results:

Regardless of the amount added, the novel ingredient incorporated in the pasta matrix demonstrated to positively contribute to its bioactivity (2-fold higher than the traditional pasta), which remained constant even after the production process. The different types of functional pasta produced, up to 10% of insect flour, showed consistency, residual moisture properties, water absorption capacity, cooking losses, and microstructure comparable to those of traditional pasta. Interestingly, the addition of 30% of larvae flour led to a reduction in cooking losses, viscosity and roughness of the pasta.

Conclusion:

The results obtained highlighted the potential use of the *T. molitor* larvae flour as novel source of bioactive compounds, allowing to formulate hypothesis for the implementation of such innovative ingredient to be used for the production of durum wheat pasta at the industrial scale and promote healthier diets without requiring consumers to radically change their eating habits.

O14.3

Developing contextualized computer vision techniques to improve controlling of complex food processes

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Aim:
Computer vision (CV) offers the ability to digitally interpret visual information to monitor food production, inspect product quality, and automate food manufacturing processes. To implement CV, it is essential to contextualize digital measurements with meaningful references by linking them to specific food physiochemical properties, processing conditions, and consumer feedback. Moreover, the CV-based measurements should also be connected to specific actions that can enable automatic processing parameter adjustments. This presentation demonstrates applications of designing contextualized CV tools to control 3D food printing, evaluate 3D food printing accuracy, and quantify fibrousness in plant-based meat analogues. The contextualized CV-based measurements can therefore offer adaptivity and flexibility required for smart food manufacturing.

Methods:
Various CV methods such as image skeletonization, image correlation, and optical flow were adopted to estimate extrusion speed during 3D food printing, measure dimensional accuracy of 3D-printed foods, and quantify fibrousness of plant-based meat analogues. Specifically, control strategies were designed to implement extrusion speed measurement to understand the efficacy of a CV-based calibration method. Human evaluations (n = 101) of 3D printing accuracy were collected to determine the level of error tolerance for an image-based 3D printing accuracy measurement tool. An expert survey panel (n = 26) was referenced to validate the effectiveness of CV-based fibrousness measurements of plant based meat analogues.

Results:
Real-time measurement of extrusion speed can improve the 3D printing accuracy by 8.7 - 10.6%. Also, human evaluations identified printing inaccuracies more as over-extrusions rather than under-extrusions in 3D-printed foods. A CV-guided parameter optimization was able to minimize the effect of over-extrusion by 85% and improve the overall 3D printing accuracy as validated by human evaluations. The CV-measured fibrousness was validated and found to be highly correlated to an expert panel (R = 0.88). A meaningful reference fiber score derived from chicken meat can be used as a quantitative visual benchmark for plant-based meat analogue formulations.

Conclusion:
Contextualization creates meaningful references and validations to CV-based measurements. Contextualized CV methods can therefore provide real-time feedback to adaptively control food processes based on raw material variations, processing condition limitations, and individual consumer needs.

O14.4

What's new on the menu? Trends in novel foods in the European Union

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Background:

In the last decade, an unprecedent number of new foods and food ingredients has become available to consumers in the European Union (EU). This trend has been primarily driven by (i) the rapid pace of research and innovation in food and neighbouring areas and (ii) the urging societal demand for healthier and more sustainable food systems. When not used for human consumption before 15 May 1997, such new foods/ingredients fall under the novel foods (NF) regulation and thus, require safety assessment by the European Food Safety Authority (EFSA) prior to market authorisation.

Aim:

The present work aims at providing insight on recent trends in food innovation from the privileged observatory of an EU agency, as well as outlining key scientific requirements for the safety assessment of NF.

Method:

Since the implementation of the new NF regulation (EU) 2015/2283 in 2018, EFSA has received about 250 requests from the European Commission (EC) to evaluate the safety of NF . Published EFSA outputs and ongoing applications were retrieved from the EFSA Open portal in order to identify recent trends in NF. Based on a scoping literature review, new food products and production technologies that may soon have an impact on the EU food system have also been flagged.

Results:

New foods/ingredients authorised as NF or currently subject to risk assessment by EFSA are typically derived from unused or underutilised sources in the EU (e.g., plant-based), albeit in certain cases they might be traditionally consumed in other areas of the world. Moreover, recent technological advances have paved the way to new or enhanced foods/ingredients. Interestingly, precision fermentation uses engineered microbial cell factories to produce food ingredients, e.g., human-identical milk oligosaccharides, while cell culture-derived foods promise to revolutionise the way animal- and plant-based foods are produced. Key scientific requirements for the risk assessment of NF typically include chemical/microbiological characterisation, description of the production process, nutritional, toxicological and allergenicity assessment, and anticipated intake assessment under the intended conditions of use.

Conclusion:

This work showcased new and upcoming trends in NF, and risk assessment criteria for the introduction of new foods/ingredients in the EU market.

O14.5

Economic and efficient sensors for the control of ammonia in livestock farms, NH3ControlFarm

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Aim: Implementing economic and efficient sensors for the control of ammonia in livestock farms, NH_3ControlFarm. Ammonia (NH_3), yet common in nature, in concentrated form can have strong negative impact in animal farms, in particular in the poultry industry with adverse effects on birds' health, growth rate, immune system and intestinal histomorphology. Additionally, the release of NH_3 in the environment is a cause of acid rain, acting as catalyst. The Council Directive 2007/43/EC states that the NH_3 concentration should not exceed 20 ppm-v over any eight-hour period or 35 ppm-v over any ten-minute period during the poultry production cycle. NH_3ControlFarm tool developed by MINTOTA can reduce the risk of danger to health in livestock farms by increasing the detection of contamination as soon as possible in poultry farms, avoiding the negative impact on birds from the control of the NH_3 concentration. The current in place solutions for NH_3 measurement are not cost-effective.

Method: Testing and demonstration of the NH_3ControlFarm through use cases covering real-life problems. Passive sensors with different compositions that allows ammonia determination, requiring zero energy cost and having no toxicity have been developed. A comprehensive evaluation of ammonia in atmospheres of poultry farms from in place distributed sensors is carried out (**PDC2021-121604-I00** and **AGROALNEXT 2022/019** projects). Digital measurements are evaluated.

Results: Conducted use cases at poultry farms. Outputs are the technical diagram of the selected farms and the sampling plan for establishing the NH_3 concentration in a scenario corresponding to habitual working conditions for chickens' growth periods (winter and summer) where NH_3 controlling is difficult. Indoor temperature must not exceed the outdoor temperature by more than 3º C when the latter is 30º C and relative humidity for 48 hours must not exceed 70% when the outside temperature is below 10ºC.

Conclusion: Besides resilience (passive, color responses at several T and % RH), other important advantage of the NH3ControlFarm is its capacity for giving information of the whole atmosphere of the poultry farm by distributing the suitable number of sensors in the entire farm. This design is not possible with the actual options in a sustainable form.

O14.6

The effect of unconventional polyphenols addition on quality and safety of fried snacks

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Aim:
The aim of the study was to determine the effect of unconventional polyphenols (from evening primrose, flax and pumpkin seeds) in the form of ethanolic extracts as well as in natural matrix of flour meal after oil cold-pressing on the quality and safety of fried snacks after processing and during 4-months of storage.
Method:
Polyphenolic composition of meals and obtained extracts was analysed by UPLC-MS. The snacks were obtained by extrusion followed by frying of pellets. In fresh and stored snacks hydrolytic and oxidative changes, as well as polyphenolic content and antioxidant capacity by ABTS were monitored. Additionally sensoric properties were evaluated.

Results:
The addition of polyphenolic extract from evening primrose affected the darkening of the color of pellets and fried potato snacks. The content of polyphenols decreased with increasing storage time. The best organoleptic properties during storage were characterized by snacks with the addition of flax seeds flour, while the worst ones with pumpkin seeds flour.

Conclusion:
It has been stated that more effective were polyphenols used in the form of extracts than in natural matrix. The quality and safety of snacks during storage was improved by addition of evening primrose followed by flax seeds polyphenols extracts, while pumpkin seed extract as well as meal induced oxidation reactions in stored products.

O15.2

How in vitro digestion conditions affect the antibiotic resistance of Salmonella enterica and Listeria monocytogenes

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Aim:

Nowadays, antibiotic resistance of pathogens is considered one of the main worldwide threats to public health. This research is the first to shed light on how the physicochemical conditions of the gastrointestinal tract (GIT) modulate the antibiotic resistance of foodborne pathogens.

Method:

The minimum inhibitory concentrations (MIC) of the antibiotics ciprofloxacin and tetracycline were investigated against *Salmonella enterica* and *Listeria monocytogenes*, respectively. The MIC of the antibiotics against the pathogens was determined under three different conditions: (i) in aerobic broth, (ii) in anoxic broth, and (iii) in an anoxic environment after the exposure of the pathogens to the hurdles of the human digestion, like the low gastric pH, and the presence of digestive enzymes and the potent antimicrobials, bile acids. For achieving the latter, a contaminated, food model system was exposed to the digestion process according to the INFOGEST standardised static *in vitro* digestion method.

Results:

In the case of *S. enterica*, the MIC of ciprofloxacin in aerobic broth was 0.05 mg/L, while in the anoxic broth the pathogen thrived, and the MIC was higher than 0.1 mg/L (highest tested concentration). When shifting to the simulated GIT environment, the MIC of ciprofloxacin against *S. enterica* dropped to 0.025 mg/L. Regarding *L. monocytogenes*, the MIC of tetracycline was 1 mg/L in both aerobic and anoxic broth. Contrary to the results for *S. enterica*, after the exposure of *L. monocytogenes* to the digestion process, the MIC of tetracycline was elevated to 8.0 mg/L.

Conclusion:

This work demonstrated that the physicochemical environment of the GIT has indeed an effect on the antibiotic resistance of foodborne pathogens, relying on an *in vitro* digestion method. For *S. enterica*, there was a significant increase of the antibiotic resistance when transitioning from aerobic to anoxic conditions, while it showed higher susceptibility due to the remaining physicochemical conditions of the simulated GIT. *L. monocytogenes* behaved similarly in the presence of tetracycline under aerobic and anoxic conditions, whilst it became significantly more resistant after the exposure to the harsh digestive environment. These facts are of high importance to be considered especially during the preclinical research of new drugs.

O15.3

Lipidic species in faeces: indicators of dietary lipid digestion- absorption in children with cystic fibrosis

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Aim: Children with Cystic Fibrosis (CF) with pancreatic insufficiency present with different extents of dietary lipids maldigestion (triglycerides (TG) not being hydrolysed) and malabsorption (TG are hydrolised into monoglycerides (MG) and fatty acids (FA), but these are not absorbed), which have been related to deteriorated nutritional status. Further, unabsorbed lipids have been suggested as possible determinants of altered colonic microbiota. The aim of this study was assessing for the first time the lipidome profile of faecal fat in children with CF, to deduce whether excreted fat was due to maldigestion (TG), malabsorption (MG, FA), or both. Secondarily, the study focused on exploring possible associations between lipidome profile and altred colonic microbiota and nutritional status.

Method: a cross-sectional observational study involving 44 children with CF and 12 healthy controls (HC). Anthropometric and clinical data was retrieved and 24-hour faecal samples were analysed for lipidomic profile (UHLC-HRMS); and microbiota composition (16S rRNA amplicon sequencing in Illumina platform). Unsupervised cluster analysis was applied to define different lipidome profiles and ordinal regression models were used to assess associations between lipidome profile and microbiota phylum and genus relative abundance and nutritional status indicators (z-scores of height and weight percentiles).

Results: four lipidome clusters (LC) were obtained: LC1) healthy subjects, good digestion and absorption: low TG and low MG and FA; LC2) good digestion and poor absorption: low TG and high MG and FA; LC3) Mild digestion and poor absorption: intermediate TG and high MG and FA; LC4) poor digestion and absorption: high TG and high MG and FA. The statistical analysis revealed that the phylum Bacteroidota and Verrucomicrobiota in faeces were decreasing through LC1 to LC4 ($p < 0.001$), Proteobacteria showing the inverse pattern ($p < 0.001$). In addition, the lipidome profile was significantly associated with nutritional status indicators, being higher in LC1 and decreasing in LC2 to LC4.

Conclusion: this study highlights the relevance of assessing lipidomics in faecal samples to determine how dietary lipids are digested and absorbed and its relevance on nutritional status and microbiota. This new evidence could be used as a basis to define targeted nutritional interventions towards reverting fat maldigestion or malabsorption.

O15.4

Lipids and carotenoid from oleaginous yeasts grown on lignocellulose as sustainable food ingredients

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Aim
In the recent years, demand for sustainable, natural, more nutritional, and healthier food products has been increased. One of such important categories of nutritional biomolecules is the lipo-compounds group, such as carotenoids and lipids. Oleaginous yeasts have been identified as a potential source for sustainable production of carotenoids and lipids. In this study, the main aim was to investigate the total lipids, carotenoids and fatty acids produced by Rhodotorula toruloides yeast, cultivated on lignocellulose hydrolysate, to valorize local resources and to reduce the carbon footprint of food production.

Method
In the initial part of the study, the lipids and carotenoids were extracted using the conventional methods like Folch method for lipid extraction and acetone-extraction method for carotenoids. The extracted lipid samples were methylated and the resulting fatty acid esters were analysed in the gas-chromatography system. The traditional carotenoid extraction method involved saponification which led to degradation of the highest antioxidant potential carotenes, torularhodin and torulene. As an alternative solution, a more advanced method of extraction for lipid and carotenoids was adopted, that is Supercritical carbon-dioxide extraction (SCE).

Results
From UHPLC analysis, it was observed that, in extracts from both conventional and SCE method, four major carotenoids were observed- β-carotene, γ-carotene, torularhodin, and torulene. In the conventional method samples, β-carotene was observed as the major carotenoid and torulene and torularhodin were degraded due to saponification. In SCE samples, torularhodin was identified as the major carotenoid. From GC analysis, in both conventional and SCE method samples, oleic acid was the major fatty acid followed by palmitic acid and linoleic acid.

Conclusion
This study demonstrated that Rhodotorula toruloides, cultivated in lignocellulose hydrolysate, produces lipids of the quality of vegetable oils. Thus, yeast oil can replace vegetable oils that are partially produced with a high carbon footprint. In parallel, yeast carotenoids can be produced from low-value raw material, which in part have a better antioxidant potential than common plant-derived carotenoids (torulene and torularhodin). Extraction using supercritical carbon-dioxide as green co-solvent in SC-CO2 extraction, is a potential process to achieve a higher recovery of polar carotenoids and lipids. However, developing new strategies in supercritical fluid extraction, using cost-effective green co-solvents to augment the production of carotenoids and lipids from natural sources for large scale industrial applications, is still in its infancy and requires further research

O15.5

Development of Freeze-drying Tolerant Lactic Acid Bacteria by Evolutionary Engineering

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Aim: To develope a freeze-drying resistance strain of *Leuconostoc mesenteroides* by Evolutionary Engineering
Kimchi is a Korean traditional vegetable product that is fermented by microorganisms in raw ingredients. Currently, commercial kimchi industry of Korea considered kimchi starter-culture such as LAB as an alternative for uniform taste and quality. In this study, we proposed the use of evolutionary engineering (EE) processing to obtain advanced *Leu*. *mesenteroides* with higher productivity of LAB powder.

Method: EE was applied on wild type to obtain an advanced freeze-drying (FD) resistant strain.
The wild-type of *Leu*. *mesenteroides* was conducted to 50 serial EE cycles consosting1 h of heat-osmotic stress to imitate dehydration, followed by 22 h of growth for each cycle. The gene expression changes of both wild and EE-type strains were analyzed by mRNA sequencing, and the fatty acid composition was measured by gas chromatography. The FD resistance was evaluated by assessing the viability after FD, and storage stability was measured until 8 weeks.

Results: The FD resistance of EE-type strain was enhanced by over 30% compared to the wild-type strain, and its gene related to membrane characteristics was overexpressed.
The gene expression of EE-type strain related stress resistance (PadR, ytrB, MarR, MFS, MerR, and cold-shock protein), cell membrane envelopment (PspC, tagD1,GtrA, and ThiS) , and functional redundancy for evolution (RNase H) were overexpressed. The saturated fatty acid of *Leu*. *mesenteroides* was decreased 1.4%, while the cyclopropane fatty acid was increased 5.1% after 50 EE cycles. The viability of the FD *Leu*. *mesenteroides* was improved 23.5% in the EE-type strain. The difference in viability was retained until 8 weeks of storage.

Conclusion: The EE processing enhanced FD resistance and storage stability of *Leu*. *mesenteroides* and inproved productivity of LAB powder.
The objective of this study was to enhance the FD resistance of *Leu*. *mesenteroides* for high productivity using EE processing. The EE processing affected the gene expression of the bacterial membrane, modified fatty acid composition, and resulted in improved FD resistance of *Leu*. *mesenteroides*. The EE processing is a useful non-GMO engineering approach for industrial applications.

O15.6

Heterotrophic single cell-protein production in Galdieria sulphuraria: protein content and bioaccessibility.

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Aim: This work aimed to explore the potential of the polyestremophilic microalgae *Galdieria sulfuraria* for single-cell protein production. To this end, four *G. sulphuraria*'s strains were cultivated heterotrophically and compared for their protein content and bioaccessibility.

Method: Four *G. sulfuraria* strains were selected: two strains known to maintain their blue-green colour during heterotrophic cultivation while the other two were known to lose pigmentation in heterotrophy. The four strains were cultivated in an inorganic medium at pH 1.8±0.3, containing 20 g/L glucose. The experiments were conducted in flasks using six biological replicates. Two flasks were harvested during the exponential phase , two immediately after glucose depletion, and the last two 24 (S24) and 48 (S48) hours after substrate depletion. We compared protein content and bioaccessibility (INFOGEST 2.0) during the different growth phases.

Results: The strains had an exponential growth rate between 0.90 and 1.65 day^{-1}. After substrate depletion, the growth was terminated and dry weight decreased 12-17% from E and S48 . Substrate depletion strongly affected protein content and bioaccessibility. In three strains protein content increased from 33% w/w during the exponential phase to 53% w/w in S24, while their bioaccessibility was halved, from 65% in exponential phase to 32% in S24. One strain instead showed signifincantly higher protein content, 50% w/w in exponential phase and 75% w/w in S24, while its bioaccessibility remain constant (65±3%) throughout the whole experiment.

Conclusion: Our results highlight the large variation in protein content and bioavailability among *G. sulphuraria* strains during different growth phases. Selecting the right strain and harvesting at the right time are keys for efficient single-cell protein production.

O15.7

Actinidia arguta leaves extract as nutraceutical ingredient: Validation through in vitro and in vivo assays

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Aim: *Actinidia arguta* leaves are a source of phenolic compounds with pro-healthy biological effects, such as antioxidant and anti-inflammatory activities [1]. This study aims to validate by *in vitro* and *in vivo* assays an *A. arguta* leaves extract as new nutraceutical ingredient.
Method: *A. arguta* leaves were extracted with ultrasound-assisted extraction, according to Silva *et al.* [2]. A 3D intestinal permeation was performed using a Caco-2 and HT29-MTX co-culture, accoupled to LC/DAD-ESI-MS analysis. For the *in vivo* assays, Wistar rats (n = 6/group) were orally treated during 7 days with water (Group I), *A. arguta* leaves extract (50 and 75 mg/kg bw/d, respectively, Group II and III) or vitamin C (Group IV). Afterwards, animals were sacrificed, livers and kidneys were removed, and the blood collected. The antioxidant enzyme activities levels, namely superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH-Px) and malondialdehyde (MDA), were determined.
Results: The principal phenolic compounds that permeated the intestinal co-culture model were coumaroyl quinic acid, rutin and chlorogenic acid. The results attested the *in vivo* upregulation of the antioxidant enzymes activities for animals treated with *A. arguta* leaves extract. The highest SOD activity in kidneys and livers was observed for Group III (183.36 and 175.26 units/g protein, respectively). Similarly, groups II and III achieved the best CAT results for livers (7840180 and 7526357 nmol/min/g protein, respectively), while Group II significantly increased the GSH-Px activity (kidneys = 205.35 units/g protein; livers = 133.60 units/g protein and serum = 64.57 units/mL protein). Regarding the MDA levels, groups III exhibited the lowest levels (44968 and 54566 nmol/g protein for livers and kidneys, respectively). Regarding lipid peroxidation, the rats treated with *A. arguta* leaves extracts suffered a downregulation when compared to the control groups.
Conclusion: The data obtained support that *A. arguta* leaves extract possessed a good *in vivo* antioxidant activity, ensuring its safety use as nutraceutical ingredient to improve human body antioxidant defenses.

References: [1] Silva, A. M.; *et al.*, IJMS, 23(22) (2022) 14130; [2] Silva, A. M.; *et al.*, Antioxidants, 11 (2022) 763.

O16.2

Valorisation of a wine co-product to improve the nutritional quality of peach and grape juice

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Aim:

The valorisation of agri-food co and by-products not only represents important economic and environmental benefits, but can also be a source of potentially profitable, functional and safe raw materials or ingredients. Previous studies by the research group have demonstrated the angiotensin-converting enzyme (ACE) inhibitory activity and antihypertensive activity of a wine co-product. The aim of this study was to valorise this wine co-products (WC-P), by incorporating them, in unpasteurized peach and grape juice stored under refrigeration (5°C).

Method:

Antimicrobial activity of five different WC-P concentrations (0, 0.5, 1, 1.5 and 2%) in peach and grape juice was assessed against *Listeria monocytogenes* and *Saccharomyces cerevisiae* artificially inoculated, followed by the evaluation and monitoring the impact of the addition of the wine co-product, in the two concentrations selected (1.5 and 2%) on the the physicochemical, nutritional, microbiological and sensorial parameters for 21 days in order to describe the global quality of the resulted juices.

Results:

WC-P were found to present a major inhibitory effect against Listeria monocytogenes (4 log reduction), although such activity was not observed against Saccharomyces cerevisiae (<1log) at a concentration of 2%. The addition of 2% of WC-P in the juice resulted in a significant increase of total soluble solids (10%), polyphenol (75%) and ascorbic acid (41%) content and antioxidant capacity (86%) and a slight improve of ACE activity. Ascorbic acid decreased in storage, while antioxidant capacity and total polyphenols remained stable, as well as total soluble solid, pH and titratable acidity. A significant correlation between Total Polyphenol Content and Total Antioxidant Capacity (FRAP=0.9878 and ABTS=0.9805) was observed. Total aerobic mesophilic bacteria and yeast counts increased during storage. Fifty-seven percent of tasters (n=26) rated positively the addition of WC-P to the juice.

Conclusion:

This co-product could be valuable to deliver a functional juice with a longer shelf life, which would contribute to its valorisation.

O16.3

Development of functional cookies enriched with chestnut shells extract screened by in-vitro and in-vivo assays

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Aim:

Over the last decades, food industry has invested plentiful resources to create sustainable functional foods and nutraceuticals. The demand for antioxidants obtained from natural sources, such as food by-products, has intensified, with industries searching for novel bioactive molecules in close alliance with the Sustainable Development Goals from Agenda 2030. Chestnut (*Castanea sativa*) shells (CS), an undervalued agro-residue, are exceptional sources of antioxidant compounds with pro-healthy effects. This study attempts, for the first time, to develop and characterize functional cookies enriched with a nutraceutical ingredient extracted from CS by Subcritical Water Extraction and previously studied by *in-vitro* and *in-vivo* assays using metabolomic techniques (LC-ESI-LTQ-Orbitrap-MS) to attest the outstanding role of phenolic compounds and their metabolites before its incorporation as functional ingredient.

Method:

The nutraceutical CS extract was incorporated into functional cookies after ensuring its bioactivity and safety using cell-based assays and animal models. The functional cookies were characterized regarding nutritional composition, phenolic profiling, antioxidant/antiradical properties, biological activities, and sensory evaluation. The impact of *in-vitro* gastrointestinal digestion on cookies' phenolic composition was also evaluated.

Results:

The results emphasized that the functional cookies were mainly composed of carbohydrates (53.92%) and fat (32.62%), while moderate contents of fiber (5.15%) and minerals (2.14%) were determined. Phenolic acids, flavonoids, and hydrolyzable tannins were the main polyphenolics present, attesting the high total phenolic and flavonoid contents. The antioxidant/antiradical properties were noteworthy, enlightening the scavenging potential against pro-oxidant reactive species. The sensory evaluation accomplished satisfactory outcomes, endorsing the acceptability of cookies. Using an *in-vitro* digestion model, higher phenolics concentrations were retained after intestinal digestion, achieving 94% of bioaccessibility and reinforcing the protective effect of cookie matrix with slow phenolics release. The phenolic profiling unveiled the identification of novel compounds during the cookies digestion and changes in their concentrations.

Conclusion:

These findings highlighted the sustainable employment of antioxidants-rich CS extract as active nutraceutical ingredient in functional cookies, proving its efficacy and safety for human use in the prevention/co-therapy of lifestyle-related diseases triggered by oxidative stress and proposing a novel approach to valorize this agro-industrial waste.

O16.4

Spent Coffee Ground as a healthier ingredient for functional Shortbread Cookies

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AIM: Shortbread cookies must be considered a "high glycemic index" and "high energy value" food. The aim of this work was to evaluate Spent Coffee Grounds (SCG) as a healthier wheat flour substitute in shortbread cookie formulation. The effects of different SCG mass fractions in dough fortification were assessed in terms of dough technological properties which include dough workability and stability, and cooking performance. Color, development indices, texture, sensory, and healthy properties of shortbread cookies were also determined to find the best dough formulation and cooking conditions.

METHOD:
Spent Coffee Grounds (SCG) were analyzed for their gross composition and healthy properties (polyphenols, tocopherols antioxidant, radical-scavenging capacity, and anti-proliferating tumoral cell capacity) according to literature methods. SCG was used from 0 to 20% of total mass fraction. Structure-dynamic-function relationships were investigated on mesoscopic-, microscopic-, and macroscopic levels, following a multiscale approach based on 1H-NMR proton relaxometry, modulated differential scanning calorimetry, and rheology.
Color and cookie development indices were evaluated by image analysis. Fracture and texture properties were determined by mechanical analysis under destructive conditions. Sensory profile and preference were analyzed through the RATA test and partial-least square multivariate analysis. Chlorogenic acids, caffeine, and tocopherols were determined in the final product.

RESULTS: Dough technological properties and cooking performance were linked to water molecular mobility and rheological properties and to the changes in the capacitive and thermokinetic events as a function of SCG mass fraction and of the main dough hydrocolloids.
The enrichment in SCG of shortbread dough improved its technological properties, with the 20% of total mass resulting in the best dough quality in terms of workability and stability as compared to the control dough. The cookies made with SCG had a lower spread ratio, more uniform color development, higher total phenolic content, and antioxidant activity, as compared to the control..

CONCLUSION: The use of SCG as a substitute for wheat flour in shortbread cookies can improve the technological quality of the dough and increase the healthy value of the final product

O16.5

A rheological and neuro-psychophysiological approach to assess acceptability and liking of cocoa creams

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Aim:
Sensory analysis is a scientific discipline, defined as the objective analysis of a food product, realized by using human sensory perceptions as measuring instruments. This discipline is an essential tool for food innovation and new product development thanks to the creation of an accurate and complete sensory profile and the study of consumers' sensory preferences. The basic principles of sensory evaluation are grounded in consumer physiology, psychology and psychophysics and although some studies have been conducted in the past on this subject, many correlations are still poorly understood. Understanding how a perception is processed and elaborated at the neural level is essential for comprehend sensory acceptability processes. In products such as cocoa creams fluidity and smoothness are priority parameters of evaluation, even before olfactory and taste characteristics, and the consumer acceptability is undoubtedly correlated to specific rheological characteristics, so much that their loss determines their non-acceptability and the end of their shelf-life.

Method:
In this study fundamental and empirical rheological characterizations of 20 commercial Italian and Switzerland cocoa creams were realized to highlight their peculiar structural parameter. In parallel sensory analysis (affective and flash profile tests) were performed to assess both the main descriptor and acceptability parameters. On the basis of the preliminary obtained results ten different cocoa cream were formulated by modulating and enhancing the principal sensory and rheological acceptability parameters. Subsequently a psychophysiological response of consumers to the different realized creams has been assessed explicitly by means of a visual-analogue scale as well as implicitly by recording psychophysiological marker of the participants' liking such as skin conductance response, heart rate variability, electromyographic signals and the electroencephalographic activity

Results:
Obtained results showing how different cream rheological properties can affect in strong way the preferences and acceptability of consumers, being strictly related to neurophysiologic stimuli. Moreover, from this study has been possible to highlight as different neurophysiologic perceptions can lead the consumer's purchasing choice.

Conclusion:
In conclusion it is possible to highlight as this research represent a very interesting starting point in order to realize tailored cocoa cream with enhanced rheological and sensory pleasantness parameters to satisfy consumer expectations.

O16.6

Oleogels and bigels as healthy fat replacers in laminated pastry products

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Aim:
Nutrition experts recommend increasing the uptake of mono- and polyunsaturated fatty acids, which are mainly found in liquid vegetable oils. However, in laminated pastry products, like puff pastry and croissants, the solid consistency of the fat is necessary for the homogeneous build-up of the alternating fat and dough layers during lamination, which are essential for the development of the characteristic honeycomb-like internal structure und the flaky texture after baking. Oleogelation has the potential to convert an unsaturated oil into a solid-like material by using suitable gelling agents. In Europe, use of regional rapeseed oil is particularly advantageous, since it improves nutritional value of the foods as well as sustainability by replacing palm oil. By emulsifying the oleogels with a hydrogel, bigels can be formed. Additionally, to the advantages of oleogels, bigels may reduce the caloric value of the pastry products by increasing the water content. To use the gels as laminating fats, they need to be able to withstand the high mechanical stresses during lamination in order to form very thin continuous layers. Furthermore, they must be able to withstand high processing temperatures during fermentation and baking without losing their functional properties.

Method:
Laminated pastry products were prepared from conventional laminating fats (controls) and from oleogels and bigels with varying ingredient ratios. Homogeneity and thickness of distinct dough and fat layers were measured as well as quality parameters of the baked products, like volume, pore structure and textural properties.

Results:
Laminated pastry products prepared with specifically adapted oleogels and bigels could successfully be prepared. They showed very similar properties to those made with traditional fats. Detailed results with respect to individual quality parameters of the laminated pastries will be presented and differences will be discussed.

Conclusion:
Oleogels and bigels can be used to replace saturated fats with nutritionally more valuable unsaturated fats in laminated pastries while also reducing calories and improving sustainability. However, due to high shear forces and a wide temperature range during the production of laminated pastry products, the use of oleogels or bigels as laminating fat is still challenging.

O16.7

New (bio)technological approaches for creation of modern personalized nutrition

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New (bio)technological approaches for creation of modern personalized nutrition

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Aim: The field of modern nutrition is complex and multifaceted, encompassing a wide range of disciplines and perspectives. Achieving personalized and healthy nutrition requires an understanding of not just the nutritional value of foods, but also their impact on the gut microbiome, gene expression, and other biological processes. This holistic approach to nutrition, which requires collaboration between experts in epidemiology, biochemistry, behavioral science, food science, healthcare professionals, and industry stakeholders, can be provided by organization such as The Global Harmonization Initiative (GHI). To develop next-generation functional foods, it is necessary to consider a variety of factors, including the origin of the ingredients, the presence of chemical or genetically modified additives, the ease of preparation, and the microbial content. Traditional ethnic dishes can serve as a valuable starting point for the development of functional foods, as they often meet many of these criteria.

To facilitate the adoption of functional foods, it is essential to establish databases and artificial intelligence tools that can help calculate personalized nutrition needs. One of the key challenges in developing functional foods is balancing their potential health benefits with practical considerations such as shelf life, transportation, and recipe variability. To address these challenges, researchers are exploring a range of (bio)technological approaches, including fermentation and microbial cultivation.

Method: The information system for personalized nutrition creation and prescriptions aimed to regulate the gut microbiota ratio, biodiversity, and functionality had been developed. The proposed IS operates as an algorithm for the selection of individually required contents from a large amount of data (databases, DBs).

Results: Recently, a new line of functional foods called EdiensTM has been developed that incorporates unique microbial starters and plant-based biological active compounds. These products have been carefully tested *in vitro, in vivo,* and *ex vivo* models to assess their impact on human health. Personalized diets based on EdiensTM products have also been shown to effectively regulate the gut microbiome in limited controlled diet studies.

Conclusion: In order to promote the implementation of newly developed functional foods relevant databases and AL for the calculation of personalized nutrition needs had been established and proposed.

O17.2

Flavor tuning of green tea infusion towards hedonic western flavors by fermentation with edible basidiomycetes

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Aim
In response to the increasing interest of western consumers in the nutritional value of green tea but their low acceptance of its green odor, basidiomycetes were employed as innovative starter cultures to tune flavor of green tea infusion.

Methods
A novel submerged one-step fermentation system using basidiomycetes as starter cultures for tuning of green tea flavor was established. Aroma profiles were elucidated by means of sensory evaluation and gas chromatography-mass spectrometry-olfactometry (GC-MS-O).

Results
This study revealed that a simple and short one-step fermentation with selected basidiomycetes well shifted the original green tea flavor towards interesting and hedonic flavors. Three edible basidiomycetes were chosen for further studies: *Flammulina velutipes* (chocolate-like and nutty flavor), *Mycetinis scorodonius* (chocolate-like and slightly malty flavor) as well as *Wolfiporia cocos* (jasmine-like, and citrus-like flavor).
Elucidation of key aroma compounds revealed methyl jasmonate, □-ionone, (*E,E*)-2,4 decadienal as well as 2-ethyl-3,5-dimethylpyrazine to be responsible for the overall chocolate-like aroma impression produced by *F. velutipes*. Elucidation of key aroma compounds after *M. scorodonius* fermentation revealed a different pattern of aroma compounds (dihydroactinidiolide, isovaleraldehyde, and coumarine) to be responsible for the flavor shift. Both findings revealed for the first time that basidiomycetes can synthesize alkylpyrazines, however the biosynthesis pathway including intermediates and enzymes is not clear so far. The third chosen combination of green tea with *W. cocos* exhibited an appealing floral, jasmine like and slightly citrus-like beverage with original green-tea bitterness and astringency attributed to methyl anthranilate, linalool, 2-phenylethanol, and geraniol. Elucidation of the catechin profile showed reductions in a range up to -50% compared to original catechin concentrations. Nevertheless, *in vitro* antioxidant capacity revealed still 80% of the original antioxidant capacity being present after fermentation.

Conclusion
Overall, the potential of the novel approach for tea beverages aromatization was successfully confirmed with three edible basidiomycetes. New tea-based beverages with pleasant flavors tailored for the European and Western market could be achieved. Besides, it also opens up a new approach to the creation of natural chocolate-like flavors that meet consumer demand for clean-label foods and industry interest in new processes for natural flavors.

O17.3

Exploring the potential of house crickets as food for the future

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Aim: House crickets can address the need of agri-food systems for resilience and sustainability, due to their low environmental impact and rich nutritional profile. The aim of this study was to apply food chain innovation to house crickets rearing and processing and to evaluate the product quality for further appications
Method: Insects were introduced to indoor farming with the aim to be co-cultivated with other organisms. The intensity of LEDs (50-150 µmol $m^{-2}s^{-1}$) and the exposure to narrowband UV-B irradiation at 285 nm were evaluated for their effect on their physiology and composition. Post-harvest, pulsed electric fields (PEF) treatment and electrohydrodynamic drying (EHDD) were tested for efficiency, energy requirements and the quality of the flour produced. The insect flour was further used as a basis for extraction of nutrients and innovative technologies including PEF (4.9-49.1 kJ/kg), high-pressure (200-500 MPa) and ultrasound (25-50% amplitude, 5-10 min) were tested for conversion of the cricket biomass to valuable ingredients by sequential fractionation. Further, green processes (deep eutectic solvents (DES), enzymatic treatment, fermentation and microwave treatment) were investigated for the recovery of chitin and production of chitosan from crickets.
Results: Narrowband UV-B exposure increased the crickets' survival rate and protein content by 20% and 15.83%, respectively. Post-harvest, application of EHDD reduced the energy requirement of the drying of crickets by 65%, while PEF improved the quality and increased the extraction yield of lipids (42%) and proteins (18%) of cricket flour. Regarding the conversion of crickets to valuable ingredients, high-pressure and ultrasound pretreatments did not affect the lipid extraction yield of the crickets; however, ultrasound treatment increased the phenolic yield. DES successfully separated proteins and chitin and led to the recovery of both at 90% and 77%, respectively. Further, an alternative processing pathway was established for chitin extraction using fermentation with *Lactococcus lactis* and digestion with bromelain, generating chitosan at a purity of 90%, with significant antioxidant activity, antimicrobial activity and dye reduction capacity.
Conclusion: House crickets showed very high potential for introduction in innovative farming and processing with emerging technologies and were confirmed as a valuable source of nutrients in the future food chains.

O17.4

How organic acids improve the dough rheology and the quality of wholemeal sourdough-type bread

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Aim :
The gluten network is crucial for the development of bread with a good loaf volume and crumb structure. During sourdough breadmaking, lactic acid bacteria and yeasts produce organic acids amongst other fermentation metabolites. Previous research showed that succinic acid production influences the gluten network and dough rheology of yeast-leavened bread to a large extent. Higher concentrations of lactic, acetic, and succinic acid are formed during sourdough breadmaking. However, the specific impact of each acid on the dough and bread quality remains unclear. Therefore, this study aims to unravel and compare the impact of each organic acid on the process parameters, the dough rheology, and the quality of wholemeal sourdough-type bread.

Method :
First, the impact of each acid on the gluten network was studied on a macroscopic and microscopic level. Concentrations which acidify the dough matrix to a pH of 4.5, 5.0, and 5.5 were used. The interaction between the organic acid, the acidification level, and the wholemeal dough matrix was researched by investigating the secondary protein structure and the extensional rheology. Second, the interplay between the organic acid and the breadmaking process parameters (mixing time and water absorption) in relation to the specific bread volume was studied using an optimal experimental design that integrates acidification as a nested factor in the model.

Results :
A unique and pH-dependent impact of each acid on the gluten network and the fundamental rheology parameters of the dough was observed. Data analysis and modelling showed a negative interaction between water absorption and mixing time on the one hand and acid addition on the other hand. The model predicted an increase in the maximal specific volume when succinic - (3.25 ml/g; pH= 4.5), lactic - (3.11 ml/g; pH= 4.5), or acetic acid (3.02 ml/g; pH= 5.5) is added, compared to a control wholemeal bread (2.74 ml/g).

Conclusion :
This study revealed that, apart from the acidification of the matrix, the fermentation metabolites specifically interact with the dough matrix. These results facilitate the development of high-quality wheat bread by designing the fermentation strategy.

O17.5

Pork liver and lung as potential sources of flavour-related substances

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Aim: Over the last decades, the increase in world population has generated a higher demand for quality proteins, increasing the production in meat industry but also the generation of thousands of tons of by-products with a negative economical and environmental impact. To manage this waste, the revalorisation of slaughterhouse co-products by giving them a new use as food ingredient is one of the best strategies to meet the demand for protein production while reducing environmental damage. On the other hand, taste is possibly the most influential factor in consumer´s purchasing decision and in meat products it is mainly influenced by the content in free amino acids and nucleotides. In this work, a comparative study was carried out between two of the largest porcine organs (liver and lung) as raw materials for obtaining flavour substances.

Method: The proximal composition of the organs was analysed, and then the content of free amino acids and nucleotides was determined by HPLC. From the results obtained, the Taste Activity Value (TAV) and the Equivalent Umami Content (EUC) were calculated.

Results: Liver showed the highest protein and free amino acids content, while lung was the organ with the highest nucleotides content. TAV results indicated that umami (Glu), sweet (Ala) and bittersweet (Val and Lys) amino acids were the main responsible for the taste of organs. Furthermore, a correlation was detected in the EUC between amino acids and nucleotides in umami taste, with liver standing out significantly over lung.

Conclusion: Liver has proved to be an excellent source of flavour-related substances, but although its content is generally higher than that of lung, the latter could also represent a notable source of these substances, therefore the use of both organs could result in a very interesting revalorisation for the food industry.

O17.7

Strategies for the valorization of date fruits from Alicante palm groves

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Aim: Alicante province (Spain) has the largest palm groves (Elche and Orihuela) in Europe (approx. 500000 palm trees). Their date production (approx.75000 tons) is undervalued and undervalorizated (only 2% of its production is used), mainly due to the lack of knowledge of fresh dates' nutritional and technological properties. The aim of this work was to make several strategies for the valorization of this production contributing to the sustainability of palm groves in Alicante.

Method: Dates from different ripening stages (Khalal, Routab, and Tamar) were harvested and processed (according to their specific characteristics) to obtain different stabilized value-added products. Grinding, soaking, and dehydration, technologies were applied. Operational conditions were optimized depending on the raw material and the final product. Chemical composition and physicochemical parameters were evaluated.

Results: Three value-added products were obtained: date paste, date juice, and date flour. The predominant fraction in date pastes was the moisture followed by total carbohydrates (sugars and dietary fiber) with small amounts of fats, ashes, and proteins. Moisture and dietary fiber content of date pastes decreased and sugar content increased ($p<0.05$) as the ripening stage progressed. L* decreased through ripening, showing the highest L* date paste from dates at the Tamar stage ($p<0.05$). The higher the ripening stage, the higher the total soluble solids (TSS) content in date juice. Date juices at Routab and Tamar stages showed the highest TSS values (18.3-19.5ºBrix). The main components in date flours were sugars (> 50%) and TDF (27.9-32.1%) following the same trend as date pastes were affected by the ripening state. Date flour lost lightness as the maturation stage increased.

Conclusion: The application of simple basic operations as tools for Alicante dates valorization has allowed the obtention of stable intermediate food products with high added value, such as pastes, juices, and flours, whose composition and physicochemical properties contribute to their high potential for use as ingredients in food product development.

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O18.2

Effect of structural characteristics of textured vegetable protein on functionality

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Meat analogues are crucial food products for facilitating the so-called 'protein transition'. Most of the protein used to produce meat analogues comes from textured vegetable protein (TVP), which is a porous and fibrous material prepared using extrusion. To improve the quality of meat analogues, especially in terms of juiciness, it is important to understand how the structural features of TVP (porosity, pore size, wall thickness, etc.) impact its functionality, particularly with relation to water binding and water release properties.

Aim:

The objective of this study was to investigate the effect of structural characteristics of TVP on its rehydration behaviour and link this behaviour to different physicochemical properties of meat analogues containing these TVPs.

Method:

Porosity, pore size, wall thickness and wall density of thirteen commercial TVPs were quantified using X-ray microtomography in combination with image analysis. The water absorption capacity, water holding capacity and water absorption kinetics of TVPs were examined. The TVPs were incorporated into meat analogues, of which the cooking loss, expressible liquid and textural and rheological properties were determined. A correlation analysis was performed to relate the structural characteristics of TVP to its rehydration behaviour and the different physicochemical properties of meat analogues.

Results:

Our results showed that water absorption by TVP can be described with a double exponential model. In the early stages of water absorption, thicker walls were found to promote the absorption of larger volumes of water. However, at longer time scales, the water absorption capacity and water holding capacity were found to be higher for TVPs with thinner walls and higher porosity. Our results suggest that water is absorbed by the walls of TVP, probably driven by capillary forces induced by nanopores within the walls of TVP.

Conclusion:

We found relations between various TVP characteristics and the rehydration behaviour of TVP and the cooking loss, expressible liquid, textural properties and rheological properties of TVP-based meat analogues. These relationships will be discussed in the presentation. Our results provide insights into the desired characteristics of TVP, which could be used in the design of extrusion processes.

O18.3

Oatmeal concentration's effect on nanoemulsion lipid digestibility and β-carotene bioaccessibility: in vitro semi-dynamic digestion study

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Aim:
The incorporation of nanoemulsions into meals can be an effective strategy for food fortification with lipophilic bioactive compounds. However, the impact of food (micro) structure on their digestion remains unclear. Hence, this study aimed to investigate the *in vitro* lipid digestibility of nanoemulsions after their incorporation into oatmeals with varying oat concentrations.

Method:
β-Carotene was solubilized in corn oil (0.5% w/w) to form an enriched O/W nanoemulsion (4% w/w) with Tween 80 0.4% (w/w). The nanoemulsion was mixed with oatmeals at different oat concentrations (10% and 20% w/w) at a 1:5 ratio. The nanoemulsion-oatmeal mixtures were subjected to an *in vitro* gastrointestinal digestion system through a semi-dynamic gastric model, monitoring gastric emptying (GE), followed by a static small intestinal model. Viscosity, free fatty acid (FFA) release, and β-carotene bioaccessibility were evaluated during the digestion.

Results:

An increase in oatmeal concentration from 10% to 20% and, hence, an increase in caloric content and viscosity resulted in a decrease in GE rate from 4.51 mL/min to 2.56 mL/min. Lipid digestibility, indicated by the percentage of FFA release, decreased with successive GE stages in nanoemulsion-oatmeal 10% (from 13.6±0.28% at GE1 to 3.3±0.03% at GE5). In nanoemulsion-oatmeal 20%, FFA release decreased from 8.5±0.75% at GE1 to 6.3±1.01% at GE2, and then increased until reaching the highest percentage of FFA release (8.9±0.28%) in GE4. Also, total FFA release declined from 47.9% to 34.2% with increasing oatmeal concentration (10% to 20%). This reduction in lipid digestibility can be attributed to oat-derived carbohydrates and proteins, which interact with the lipid fraction and inhibit pancreatic lipase. There was a negative correlation between total FFA release and viscosity, but a positive correlation between FFA release and viscosity for each GE. This trends also affected β-carotene bioaccessibility due to availability of FFAs for micelle formation.

Conclusion:

Higher oatmeal concentration in the mixed food matrix with nanoemulsion led to a reduction in gastric emptying rate, fat digestibility, and β-carotene bioaccessibility. This suggests that incorporating oatmeal at increased concentrations could potentially support controlled digestion and absorption, aiding in nutrient utilization and health benefits.

O18.4

Effect of ultrasound treatment on fish protein hydrolysate extracted from Atlantic mackerel (Scomber scombrus)

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Aim: Fish protein hydrolysates (FPH) obtained from fish rest raw material by enzymatic hydrolysis allows for smart valorization of seafood side streams. However, further treatments are normally needed to enhance bioactive and functional properties of obtained FPH.

At present, the commonly used methods to improve functional properties of FPH include chemical and enzymatic modification. Chemical treatments often cause environmental problems, while the difficulty of controlling degree of hydrolysis limits the wide application of enzyme modification method. In recent years, emerging technologies such as ultrasound treatment (US) have shown great potential in protein modification with high efficiency and safety, low energy consumption, and low nutritional destructiveness.

Method: The present study as a part of IMPRESSIVE-project aims at investigating the effect of different ultrasound treatments (20 kHz, power 300W, 450W, and 600 W) on physicochemical and functional properties of FPH from Atlantic mackerel (*Scomber scombrus*).

Results: The results shows an significant increase of protein solubilty in all US-treated samples compared to control (untreated sample). US-treatment significantly increased the degree of hydrolysis and free amino acid content of FPH samples treated with 450W and 600W compared to control samples. At the same time, it was found that the carbonyl content of FPH increased (significantly for 450W and 600W), while thiol groups decreased (significantly for 300W and 450W). The increase in total carbonyl content indicated that some US-treatments induced the oxidation of FPH. Amino acid composition of FPH has revealed that US-treatment significantly increased the proportion of essential amino acids in the sample treated with 600W, resulting in an increase of biological value of the product.

Conclusion: It may be concluded that ultrasound treatment of FPH contributes to a general improvement of functional properties of the product, with treatment at 600W giving the best result.

O18.5

Unlocking the potential of chicken rest raw material: optimization of hydrolysis using response surface modeling

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Aim:
The study is aiming to develop a predictive model describing the influence of the parameters of enzymatic protein hydrolysis (EPH) on the quality of the product. This model can be used to predict the optimal process conditions to maximize the yield of the fraction of interest.
In the previous work from our group, it has been found that hydrolysates produced from mechanically deboned chicken residues (MDCR) show promising antioxidant and antihypertensive activities, which can be enhanced by altering the process conditions. It has also been found that the bioactivity correlates with size-exclusion chromatography (SEC) and Fourier-transform infrared spectroscopy (FTIR) fingerprints of respective hydrolysates. Later work identified which SEC-fraction contains the bioactive peptides (ACE-1 inhibitors). In this study, we were working on optimization of the process to increase the yield of bioactive fraction.

Method:
MDCR was hydrolysed using Food Pro PNL protease preparation (best-performing protease from the previous work), while temperature, enzyme concentration and hydrolysis time were varied. Following the full factorial design, the combination of these three parameters yielded 108 different hydrolysates. Hydrolysates were characterized by SEC and FTIR. Response surface modeling was done using MiniTab software. Area of the bioactive fraction peak in SEC chromatogram was used as a response, while temperature, time and enzyme concentration were assessed as independent variables. The inhibition of ACE-1 enzyme by all produced hydrolysates was determined by fluorimetric assay. Antioxidant activity of hydrolysates was determined by ABTS decolorization assay.

Results:
Surface response modeling was used to estimate the optimal process parameters for maximizing the yield of desired SEC fraction. While properties of hydrolysate depended on all the parameters employed, enzyme concentration turned out to have the highest impact in this case. The bioactivity measurements showed correlation with the amount of fraction of interest. The processing of the FTIR data is ongoing. Additionally, hydrolysates will be characterized by ^{1}H NMR spectroscopy.

Conclusion:
EPH is a biotechnological tool which had been used to extract bioactive peptides from numerous food-sources. However, this process still requires significant optimization, which can be aided by careful design of experiments and applying methods such as response surface modeling.

O18.6

Modulating platelet function with bioactive rich herbs and spices- An acute randomised clinical trial

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Aim: There is an increased interest in the anti-platelet action of polyphenol-rich dietary herbs and spices and their potential to attenuate the effects of postprandial and other types of physiological stressors. We investigated the effects of the consumption of water extracts of nettle, dill, and mursal (Sideritis scardica) tea on platelet activation in an acute, randomized, double-blind, four-arm, parallel, controlled trial in subjects with metabolic syndrome.

Method: Eighty subjects with metabolic syndrome (NCEP ATP III) were randomly assigned to either one of three intervention groups or the control group (hot water) (n=20 per group). Water extracts were prepared by infusion of dry herbs with boiling water over 10 mins (2g in 200 ml). Parameters of platelet function were assessed before and 2h after the consumption. The effects on platelet activation were measured using the flow cytometry, based on the expression of P-selectin and GPIIbIIIa, at resting state and in response to suboptimal (0.5M) and optimal (20M) levels of ADP, as an ex vivo agonist. Wilcoxon signed-rank test (within group; $p < 0.05$) and Mann-Whitney U test (between groups; $p < 0.0167$.) were used for statistical analysis.

Results: The dill extract was the most effective in modulating platelet activity. The percentage of P-selectin positive platelets was lower after the consumption of dill extract in resting platelets and in platelets treated with optimal and suboptimal ADP action, and significantly lower compared to the control. The density of P-selectin receptors and GPIIbIIIa expression were significantly lower after the consumption of the dill extract but not significant when compared to the control. The effects of the nettle were observed on the P-selectin positive platelets after the action of 20M ADP, and were significantly lower, compared to the control, while the effect of mursal tea was only observed within the group (pre-post) and with suboptimal agonist action.

Conclusion: Bioactive-rich herbs and spices could be considered as effective modulators of platelet function with the potential to mitigate the effects of prandial and other stressors. Their effects on platelets should be investigated further as a mechanism towards healthier biodiverse dietary patterns within the framework of sustainable diets.

O18.7

Development of Biobased Phase Change Material Packaging for Fat Bloom Control in Dark Chocolate.

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Aim: To develop a biobased phase change material (PCM) packaging and evaluate its performance on the fat bloom control during chocolate storage.

Method: A thin PCM film was made by using fatty acids-lignin-zein capsules as fillers and PVA as matrix via film casting method. Thermal buffering performance of the PCM films was determined by using IR camera analysis. This film was designed as the secondary package for the application of chocolate storage. 10 cycles of temperature fluctuation between 20~32℃ were applied during the chocolate storage with/without PCM films. Surface whiteness, texture properties, and surface/interior morphologies of chocolate were analyzed to evaluate the performance of PCM films. Thermal and physiochemical properties of the PCM films were characterized before and after chocolate storage applications by using DSC, FTIR, SEM, to evluate the shelflife of PCM films.

Results: Fully biobased PCM capsules as the filler could be well dispersed in the PVA matrix with a high mass ratio of 60%. 30~40 J/g of the latent heat of fusion was reached in the PCM film. Through IR camera analysis, obvious thermal buffering effect was achieved with the PCM films, which was also enhanced by multiple layers. Compared to the non-PCM films, PCM films showed effective mitigation of fat bloom upon 10 thermal cyclings during the chocolate storage. However, the PCM films exceeding 4 layers showed reverse effect. The thermal and physiochemical properties of the PCM films were stable after applications, presenting a good quality and shelflife under temperature fluctuation.

Conclusion: In general, it is promising that the developed biobased PCM film as chocolate packaging could effectively control the formation of fat bloom under temperature fluctuations.

O19.2

Using biological networks to unravel microbiome-metabolome implications in non-responding celiac disease patients following gluten-free diet

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Aim: We use biological networks to investigate the microbiome-metabolome relationship within symptoms persistence in non-responsive Celiac Disease patients (NR-CeD) -a pathology characterised by the persistence of symptoms from CeD after one year on a gluten-free diet-.

Method: We include 39 deep phenotyped NR-CeD patients. Symptomatology data and GFD compliance were recorded through validated questionnaires, and three-day food registries were used to assess diet quality. Markers associated with mucosal integrity and inflammation were measured, summing up to 99 different variables. The gut microbiome and metabolome were analysed through metagenomics and untargeted metabolomics, respectively.

Results: Using machine learning techniques, we selected 43 clinical variables and applied a Gaussian mixture model with the Canberra distance for clustering. This analysis yielded two patient clusters: "Low-grade symptoms" (n=25), characterized by milder symptoms, lower inflammatory markers, and intestinal permeability, and "High-grade symptoms" (n=14), characterized by more severe symptoms, elevated inflammatory markers, and higher intestinal permeability. Both patient clusters adhered to the GFD appropriately and had a fair dietary index, with an average consumption of carbohydrates, fibre, and proteins. We utilized sparse inverse covariance estimation and model selection to construct co-occurrence networks for analyzing the microbial community structure. Cluster-specific differences were observed in the dominant keystone taxa, network properties, and microbial metabolic pathways. In the metabolomics analysis, we identified and classified 372 metabolites into four groups: host-specific metabolites, microbial metabolites, microbial-host cometabolites, and others. Metabolic pathway enrichment analysis of microbial and host-microbial cometabolites resulted in 4 and 29 matched metabolic pathways, respectively. Finally, we summarised and integrated differential metabolites from microbiota and cometabolism origins and their related bacteria within a network to obtain a whole picture of the microbiome-metabolome cross-talk associated with symptom persistence.

Conclusion: Biological network assessment allowed us to determine not only the microbial profile but also interactions among the microbiome and metabolome between NR-CeD patients undergoing GFD. Two clusters of patients with functional and taxonomic microbial differences were identified.

AI4FOOD (Y2020/TCS-6654) and AEI (IJC2019-042188) founded this study.

O19.3

Impact of V. inaequalis on the apple microbiota and on their aptitude at cider production.

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Aim:

Venturia inaequalis, the agent of apple scab, represents one of the major threats to apple production. Its appearance causes black spots on the skin, making apples not suitable for fresh consumption. In a perspective of circular economy and waste reduction the cider production using fruits affected by apple scab could be a promising strategy. In this work the effect of *V. inequalis* on the apple microbiota and on the cider production process were evaluated. The characterization of cider chemical profile highlighted the effect of pathogen, and of its associated microbiota, on the suitability of affected apples for cider industry.

Method:

Apple of cv. Golden and Gala affected by *V. inequalis* were sampled in warehouse of the Trento province, on of the main apple production district in Europe. The apple skin microbiota was compared to that of safe apples, stored in the same conditions, by Illumina next-generation sequencing approach. Ciders were produced following an ordinary productive process, starting both from safe and affected apples, and were characterized by different techniques. Enzymatic analysis was employed to determine basic chemical parameters; HPLC-MS and GC-MSMS were applied to describe the fixes and volatile profiles, respectively. Data were treated by different statistical approaches.

Results:

Illumina sequencing showed a relevant biodiversity in the apple skin microbiota. Different variables modulate its evolution: apple cv., geographical origin, incidence of disease. Some taxa resulted typical of affected apples, such as *Acetobacteraceae, Enterobacteriaceae* or *Didymellaceae*, but in general the infection of *V. inequalis* reduced the microbiota biodiversity. The alcoholic fermentation of apple juice made from affected samples was slower than that of safe apples. Malolactic fermentation occurred only in ciders made from safe fruits. Statistical treatment of compositive profiles of ciders discriminated between apple cv., but also between affected or safe samples, identifying some chemical markers.

Conclusion:

V. inequalis non only alters the morphology of apples, but also influences their microbiota and their aptitude at the industrial utilization. Obtained data will allow the exploitation of mitigation strategies to make apples affected by *V. inequalis* suitable for cider industry.

O19.4

Microbial Community of Italian Cheese Produced by Alpine or Valley Cow Milk

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Aim:
In Italian Alps there are dairy farms open only in summer season because located over 1300 m.a.s.l. Dairy cows are delivered fom valley farms to these alpine small farms, called *Malga*, during the summer season, to enjoy the alpine pasture. These farms have cultural, economic and environmental importance for the landscape protection. We investigated microbiota of commercial cheeses produced by using either milk from Malga or from indoor farms located at valley.

Method:
We anlysed four types of cow raw milk cheeses ripened 3-8 months and a grana-like cheese ripened 18 months. For each typology, six cheeses have been sampled: three using milk produced in Malga and three using milk produced in valley indoor farms for a total of 30 cheese samples. Collected cheeses have been investigated by classical microbial plate counts and Illumina NGS techniques.

Results:
The bacterial counts were not significantly different between Malga and valley cheeses. The grana-like cheeses showed significantly lower bacterial counts than raw milk cheeses which had a shorter ripening. Principle Component Anlysis revealed the cheeses were clustered by factory of production and not for type of milk used (alpine in Malga or valley).

By analysis via Illumina sequencing we observed the cheeses had highest abundance of *Lactobacillus* and *Streptococcus* taxa. According to results obtained by plate counts, cheese microbiota was more affected by cheese factory of production than milk source (alpine in Malga or valley). In some cheese samples, a significant higher abundance of *Bifidobacterium* taxa was found. The microbiota of Grana-like cheese was significantly different when compared to the other cheeses.

Conclusion:
The microbial community was affected by cheese technology of production and cheese factory more than source of milk (alpine in Malga or valley) most likely a result of longer maturation period and difference in manufacturing, such as cooking temperature, salting and storage conditions.

The discovery of some particular taxa (*Bifidobacterium*) only in some samples suggests the presence of microbial environmental niches present only in some alpine pastures (malga) or dairies. The cheese chemical analysis are in progress in order to associate a different pattern of compounds with the different microbiota.

O19.5

Metabolomics of Amasi; the impact of storage time, lactic acid bacteria, and health benefits

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Abstract

Aim:

Amasi, traditional fermented milk produced in Southern Africa, is associated with several health benefits, such as probiotic activities, immune system modulation, as well as antimicrobial, antitumor and antioxidant activity. These benefits are closely related to the produced metabolites during fermentation.

Method:

This study presented the metabolites profile of raw amasi cow milk (ACM) and raw amasi goat milk (AGM) using the versatile Liquid chromatography-mass spectrometry (LC-MS) and the smooth Gas chromatography-mass spectrometry (GC-MS) spectrophotometric methods for complete profiling of the metabolites. Samples were drawn from both raw cow and goat milk and the fermented milk at 0h, 7h, 48h, and 96h and the metabolites were categorized based on their pathways.

Results:

Data obtained were classified into compound groups such as acids, alcohols, cyclic compounds, esters, ketones, phytosterols, vitamins and many others, and their characteristics such as the retention time observed mass, molecular formula and mean peak areas were reported. The results showed a significant increase ($p \leq 0.05$) in the metabolites produced by ACM compared to AGM in terms of the mass observed, the same trend was noticed in the raw cow milk (RCM) compared to raw goat milk (RGM). The immune and drug pathways were significantly increased for both ACM and AGM and generally, RCM has more metabolites compared to RGM in terms of observed mass. Metabolite increase was noticed as the time of fermentation increased for both ACM and AGM.

Conclusion:

These data represent the collection of metabolites in ACM and AGM and may be useful for the identification and utilization of functional compounds, molecular docking, and invitro studies in foods-related drug discovery analysis.

Keywords: Metabolites, GCMS, LCMS, amasi, cow milk, goat milk

O19.6

Biological activity of Spirulina protein isolate based xero-carriers embedding living Lacticaseibacillus rhamnosus GG cells

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Aim:

Anhydrobiotics, i.e. structurally engineered xero-carriers conveying living cells are extensively used in the production of probiotic supplements. Milk proteins are considered as the golden standard for preserving the biological activity of probiotics. Due to dietary, socio-cultural and ecological constraints, the demand of plant-based protein sources including microalgal biomass, is growing. The present work aimed to understand the technofunctional and biological role of Spirulina (Arthrospira platensis) protein isolate (SPI) in lyophilizates embedding living Lacticaseibacillus rhamnosus GG (LGG) cells.

Method:

Different approaches in structuring the xero-carrier precursor i.e., solution or hydrogel prepared via direct or indirect acidification, were assessed. As a comparison, pea (PPI) and whey protein isolate (WPI) were used. Accelerated storage trials at different temperatures (T = 4, 20, 37 °C) and water activities (a_w = 0.11 and 0.54) were conducted for determining the LGG total viable counts (TVC). Finally, the biological activity of LGG as associated to the colloidal changes as well as the proteomic and peptidomic profile of the delivery systems were analysed under simulated in-vitro digestion conditions (INFOGEST 2.0).

Results:

According to our findings, both the protein type and pre-acidification step affected significantly the LGG TVC losses during lyophilization and storage. The non-fermented SPI and PPI-based lyophilizates exerted the lowest TVC losses. Expectedly, the cellular lethality was remarkably higher at 37°C and a_w=0.54. Throughout in vitro digestion, the cellular lethality was significantly higher in the simulating gastric phases (1.65 log CFU/g) compared to the intestinal exemplars (0.08 log CFU/g), despite the limited matrix disintegration and in-vitro digestibility (7-10 and 37-49%, for gastric and intestinal phases) of the former. Interestingly, the LGG cells embedded in the fermented lyophilizates exhibited an enhanced ability to counterbalance the harsh gastric pH conditions. The ability of LGG cell to adhere to the mucosa layer of the intestinal epithelium was not significantly influenced by the lyophilizate composition (3.6 – 5 log CFU/cm^2). Finally, secondary health benefit conferring effects due to the release of bioactive peptides were observed.

Conclusion:

In conclusion, Spirulina protein showed to be a promising replacement for milk proteins for the development of probiotic supplements.

O19.7

Impact of Plant Species, Soil Types, and Cereal Varieties on Fermented Munkoyo Beverage

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Aim:
Munkoyo is a popular non-alcoholic beverage in Zambia and some parts of the Democratic Republic of Congo, made by traditional fermentation of cooked grains using the roots of several wild plants as an inoculum. This beverage is an essential part of the local diet and culture and is consumed by people of all ages for its refreshing taste and nutritional benefits. Despite its popularity, the impact of Munkoyo roots on the functional and physicochemical properties and the microorganisms involved, as a function of plant species and soil types, remains inadequately investigated. Additionally, the influence of different cereals on these aspects has not been studied in detail. The objective of this study is to evaluate the impact of plant species, soil, and cereal types on the microbiological, functional, and physicochemical properties of the Munkoyo beverage.

Method:
The impact of plant species, soil types, and cereal varieties on the characteristics of the Munkoyo beverage was investigated. Munkoyo beverages were prepared using various cereal ingredients, plant species, and from different soil origins. The microbiological analysis included determining lactic acid bacteria (LAB) cell counts and conducting high-throughput sequencing of 16S rRNA gene amplicons to analyse the microbial composition and diversity. Functional properties were evaluated using high-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS). Physicochemical properties such as pH and titratable acidity were measured.

Results:
Preliminary results show significant differences in the microbiological, functional, and physicochemical properties of the Munkoyo beverage based on the plant species, soil types, and cereal varieties used. Further analysis of the results is ongoing.

Conclusion:
The findings of this study have implications for improving the nutritional quality and shelf life of the Munkoyo beverage. Understanding the influence of plant species, soil types, and cereal varieties on the characteristics of the beverage provides valuable insights for optimizing the fermentation process and enhancing its sensory and nutritional attributes

O20.3

Life Cycle Assessment for improved management of durum wheat supply: Italian pasta production scenario

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Aim:
Durum wheat pasta production plays an important role in the agri-food industry being one of the most present foods on the consumers' table worldwide. The durum wheat pasta production is proven to have significant environmental impacts throughout the stages of its life cycle. As the demand for it increases, the need for more sustainable practices increases accordingly. Italy, one of the top producers of durum wheat around the world, still imports high volumes of durum wheat. There is a lack of investigation concerning the environmental impact arising from the supply of durum wheat from different countries. This study aims at evaluating the environmental impact associated with durum wheat pasta production process, analysing different scenarios for durum wheat supply from around the world and using different transportation systems to serve as recommendations for decision making for durum wheat importers and pasta producers.

Method:
The Life cycle assessment was carried out according to the ReCiPe 2016 method at midpoints levels. The foreground data for the assessment were collected from a durum wheat pasta producer in Southern Italy while background data were sourced from the Ecoinvent database.

Results:
The results showed that the production of 1 kg of durum wheat pasta produced around 1.2 kg_{CO2eq} with the cultivation phase contributing to more than half of it. Intermodal transportation systems have reduced the total environmental impact importantly at the international level while on the local level, rail freight emerged as a more sustainable option for durum wheat supply with a minimum reduction level of 5 %. European durum wheat supplies showed lower environmental impact than farther countries. Incorporation of new technologies such as hybrid vehicles contributed to further reductions in the CO_2 arising from the transportation of supplies.

Conclusion:
This study allowed to identify the durum wheat supplying modes with the lowest environmental impact taking into account the different possible transportation systems. Integrating information on agricultural practices adopted in the different countries in the LCA allowed to define strategies and suggest actions to reduce the environmental footprint of durum wheat supply to Italian durum wheat importers and pasta manufacturers.

O20.4

Implications of Production Sites and Varieties on Pea Protein Extraction

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Aim:

The aim of this project is to investigate the impact of production sites, varieties, and year on the extraction yield and functional properties of pea protein in Italy, focusing on four different varieties of pea flours.

Methods:

A full analysis of physico-chemical characteristics was conducted,

The determination of these characteristics involved the utilization of established methods. The AOAC method was employed to measure moisture content. The AACC method was utilized to separate organic and mineral substances and determine the ash content through complete incineration. Acid hydrolysis with 4 M HCl and standard Soxhlet extraction with petroleum ether were used to assess total fat content. The Kjeldahl method was employed for determining crude protein content. The polarimetric method was utilized to evaluate total starch content, while the Megazyme enzymatic kit, based on AOAC and AACC methods, was employed to analyze total dietary fiber content.

Following the characterization, a protein extraction protocol was conducted using an alkaline extraction followed by acid precipitation approach. Pea flour was dispersed in a $Ca(OH)2$ solution (0.9 g/L) at a ratio of 1:10, with an adjusted pH 9 and stirred and heated until the temperature reached 50°C, and the suspension stirred for 30 minutes. Centrifugation at 5000 rpm for 15 minutes at 25°C was performed, and the supernatant was adjusted to pH 4.5 using citric acid to precipitate the proteins. The proteins were subsequently collected by centrifugation.

The extracted products Deposit, Gel, and whey are being analyzed for physico-chemical characteristics and functional properties (emulsifying, gelling properties, and viscosity.)

Results:

The results obtained from the analysis are reported as mean values ± standard deviations of at least three replicates. The ongoing characterization for the extraction products and mass balance will provide additional insights.

SITE/YEAR	VARIETY	TOTAL DRY MATTER (%)	DEV	ASH (%)	DEV	TOTAL PROTEIN on DM (%)	DEV	TOTAL FAT on DM (%)	DEV
FOGGIA 2021	BALL TRAP	90,06	0,06	3,29	0,03	22,83	1,88	2,02	0,16
	CARLING	89,78	0,01	3,56	0,04	23,25	1,34	1,75	0,09
	ESCRIME	89,90	0,03	3,20	0,16	23,01	2,27	1,5	0,11
	PADDLE	89,88	0,04	3,69	0,01	23,05	1,32	2,11	0,17
FOGGIA 2022	BALL TRAP	89,54	0,09	3,40	0,04	25,34	2,23	1,25	0,05
	CARLING	89,97	0,10	3,32	0,06	23,83	1,45	1,08	0,01
	ESCRIME	89,48	0,04	3,14	0,02	23,15	1,03	1,6	0,11
	PADDLE	89,63	0,03	3,42	0,02	25,45	0,97	1,58	0,02
RAVENNA 2022	BALL TRAP	91,57	0,24	3,52	0,06	19,05	2,03	2,78	0,15
	CARLING	91,46	0,09	3,35	0,01	20,61	1,35	2,44	0,4
	ESCRIME	91,08	0,04	3,23	0,04	19,61	2,43	1,74	0,34
	PADDLE	91,02	0,03	3,31	0,05	19,49	1,56	2	0,09
SCHIAVON 2022	BALL TRAP	90,38	0,09	3,22	0,07	21,82	1,84	2,75	0,16
	CARLING	90,33	0,12	3,26	0,00	22,23	2,57	2,57	0,1
	ESCRIME	90,97	0,10	3,22	0,02	20,83	0,83	2,35	0,15

SITE/YEAR	VARIETY	TOTAL STARCH (%on DM)	DEV	WHC (g/g)	DEV	OHC (g/g)	DEV	Tota Dietary Fiber (% on DM)	ST.DEV
FOGGIA 2021	BALL TRAP	42	0,5	1,30	0,08	1,13	0,13	17,73	0,52
	CARLING	42	0,5	1,32	0,05	1,34	0,13	18,59	0,69
	ESCRIME	41	0,5	2,14	0,11	0,96	0,10	15,23	1,49
	PADDLE	40	0,5	1,90	0,14	1,29	0,11	18,26	1,10
FOGGIA 2022	BALL TRAP	42	0,5	1,31	0,20	1,06	0,17	17,31	1,21
	CARLING	37	0,5	1,52	0,22	0,94	0,05	19,68	0,94
	ESCRIME	39	0,5	1,05	0,14	1,09	0,04	16,75	0,48
	PADDLE	41	0,5	2,05	0,21	1,08	0,09	17,01	0,64
RAVENNA 2022	BALL TRAP	47	0,5	1,83	0,17	2,41	0,11	19,55	0,68
	CARLING	42	0,5	1,76	0,17	2,66	0,16	21,43	0,21
	ESCRIME	44	0,5	1,72	0,05	1,41	0,16	18,80	0,16
	PADDLE	43	0,5	1,56	0,03	1,51	0,14	19,51	0,67
SCHIAVON 2022	BALL TRAP	39	0,5	1,64	0,24	0,99	0,05	20,40	0,26
	CARLING	40	0,5	1,89	0,08	1,15	0,04	20,86	0,66
	ESCRIME	35	0,5	1,76	0,11	1,18	0,09	19,16	0,05

SITE/YEAR	VARIETY	PDI (%)							
		H20	DEV	pH7	DEV	pH8	DEV	pH9	DEV
FOGGIA 2021	BALL TRAP	33,40	0,47	78,90	2,08	83,03	1,57	93,93	0,38
	CARLING	21,45	1,59	38,47	4,01	83,48	1,38	91,80	2,82
	ESCRIME	29,71	3,58	45,85	2,90	80,38	1,20	95,95	4,90
	PADDLE	35,00	3,80	75,75	1,55	86,52	4,77	99,30	3,12
FOGGIA 2022	BALL TRAP	34,84	2,43	38,69	2,36	78,35	3,55	95,95	10,40
	CARLING	26,07	1,08	37,71	1,87	84,02	2,52	97,38	3,85
	ESCRIME	37,71	0,14	47,12	4,16	87,71	0,80	98,07	1,44
	PADDLE	46,39	1,69	48,26	6,88	85,23	5,93	86,76	7,10
RAVENNA 2022	BALL TRAP	70,02	0,29	60,25	7,97	89,49	1,71	93,95	5,03
	CARLING	48,90	5,03	47,46	0,16	78,07	2,93	85,77	7,19
	ESCRIME	56,22	2,90	55,33	2,81	78,37	7,30	92,17	2,61
	PADDLE	54,74	3,41	58,62	1,44	90,45	5,60	97,87	4,25
SCHIAVON 2022	BALL TRAP	52,49	2,80	56,49	1,00	75,62	1,38	79,34	5,30
	CARLING	40,49	3,77	53,10	2,67	76,31	9,19	70,48	9,40
	ESCRIME	59,22	3,97	67,81	7,37	75,41	7,30	78,92	12,46

Conclusion:

This study highlights the importance of optimizing the sustainability of plant-based protein extraction. The influence of production sites and varieties on the environmental footprint of pea protein production is emphasized. While the full characterization for the extraction products and mass balance is still ongoing. These findings contribute to understanding the optimization of plant-based protein extraction and its potential for sustainability in food production.

O20.5

Turning plant-based side streams into local protein sources using mild processing technologies

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Wheat bran (WB) and oat fibers (OF) are by-products from milling of wheat grains and oat processing which currently goes to animal feed/biogas production. Red seaweed (*Palmaria palmata*) and brown seaweed (*Saccharina latissima*) are underutilized and highly nutritious aquatic resources that are abundant in proteins and valuable nutrients. These raw materials can be abundant local sources of high quality proteins for development of sustainable future foods. However, the proteins in WB and OF are tightly surrounded with fibres and antinutrients, and seaweed contains polysaccharide-rich cell walls which makes their protein extraction challenging.

Aim

This study has aimed to develop mild fractionation technologies for valorisation of protein-rich functional fractions (PRFF) from WB, OF, and seaweed with an acceptable yield, protein purity, and functional properties. The final goal is to texturize the PRFF to develop new generation of hybrid future foods with the aid of high moisture extrusion and 3D food printing.

Method

A milder version of the classic wet fractionation technology (WFT) in terms of solubilization pH and centrifugation force has been developed for protein extraction from WB and OF. Assistant technologies such as high-shear mechanical homogenization (HSMH), ultrasound (US), and enzymes have been combined with WFT to increase the protein recovery at milder solubilization pH values. The effect of milling technologies and particle size reduction strategies has also been investigated.

Results

An extraction pH of 11 was optimal for solubilization of WB and OF protein. Achieving efficient particle size reduction before the pH-shift process with the aid of HSMH and US resulted in a higher mass yield and protein recovery for WB. HSMH was found most effective in increasing protein extractability from OF. However, both the mass yield and protein recoveries were still low for the OF. Results from the effect of different extraction and milling technologies on the techno-functional and nutritional properties of the recovered proteins will also be presented.

Conclusion

A combination of HSMH and US as assistant technology during mild fractionation of WB was found promising for promoting protein extraction efficiency. Particle size plays a key role in the valorization of WB and OF to protein ingredients.

O20.6

Active, biodegradable films of PHBV with rice straw extracts for food packaging

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Aim:
Biodegradable active packaging materials represent an efficient alternative for food preservation purposes. Incorporation of antioxidant/antimicrobial extracts obtained from agricultural wastes into biodegradable polymers, such as PHBV, allows for the waste valorisation while provide the material with new functions to preserve foods. In this study, rice straw extracts obtained by subcritical water extraction were incorporated into PHBV films and their effect on the film properties as active packaging material was analysed.

Method:
Rice straw extracts were obtained by subcritical water extraction at 160 and 180 ºC for 30 min and then freeze dried and characterised as to their antioxidant and antibacterial (*Listeria innocua* and *Escherichia coli*) capacity. Films were obtained by melt blending of the polymer with 6 % wt. of each extract and subsequent compression moulding of the blend pellets. Films were characterised as to water vapour and oxygen barrier capacity, tensile properties, polymer crystallinity and antibacterial activity against the same bacteria.

Results:
Incorporation of extracts into PHBV films slightly reduced their water vapour barrier capacity, the resistance to fracture and the stretchability due to the polymer crystallinity decrease and the reduction of interchain forces in the matrix. However, extracts enhanced the oxygen barrier capacity of the films due to their oxygen scavenging effect while provided them with antioxidant capacity and significant antibacterial action, mainly against *E. coli*. Despite the extracts were more effective against *L. innocua* (lower MIC value) than against E. coli, the films seem to deliver to a greater extent in the culture medium the most effective compounds against the gram-negative bacteria. The active properties were more remarkable for the films containing the extract obtained at 180 ºC that exhibited higher antioxidant and antibacterial capacity.

Conclusion:
Antioxidant and antibacterial PHBV films could be obtained by incorporating active extracts, rich in phenolic compounds, produced by subcritical water extraction of an agricultural waste, such as rice straw. In this way biodegradable active materials for food packaging could be produced using sustainable processes, thus contributing to the waste valorisation and food preservation.

O20.7

Recovery of polyphenols from olive pomace and valorization of exhausted biomass after extraction treatment

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Aim:

In recent years, the problem of food waste has become more and more important, increasing the interest of researchers from all over the world. The amount of food waste has been estimated in 50-60% of all produced wastes. In the coming years, their numbers are expected to rise, leading to a multitude of issues, including economic and environmental concerns, as they are one of the impacting sources of greenhouse gas emissions. Therefore, it is necessary to apply a circular economy model with the aim of exploiting them as a primary source of high added value compounds using green extraction techniques. The main purpose of this work involves the valorization of wastes from olive oil production, particularly pomace (OP), in order to recover polyphenols through green extraction techniques and to characterize the exhausted biomass to be used for the production of biomethane through anaerobic digestion.

Method:

High Pressure and Temperature extractor (HPTE) and SOlid-Liquid multiVariable Extractor (SoLVE) were used to recover polyphenols from the OP. Extractions were performed using green solvents (water and ethanol) with a solid/liquid ratio of 1:10. Extraction with HPTE was carried out at 180 °C, while extraction with SoLVE was performed with different solvents and temperature conditions in order to set-up the patented system. The total quantity of polyphenols was characterised by the Folin-Ciocalteu's colorimetric assay. The solid residue after the extraction was characterized and compared with the OP.

Results:

The extraction of high added value compounds using non-conventional techniques has proven to be a rich source of polyphenols. In particular, HPTE extraction resulted more efficient for their recovery, obtaining a more concentrated extract, resulting in an exhausted biomass more suitable for the anaerobic digestion process.

Conclusions:

Olive pomace has been found to be a good substrate for the recovery of high-value compounds. Additionally, the extraction residue can be further valorized and used for the production of biomethane through anaerobic digestion. The results obtained will be used as a starting point for the development of a pilot extractor within the PNRR project 'Agritech'.

O21.1

Upcycling of Brewer Spent Grain, Extending the Circularity of a Brewery Byproduct to Human Diet

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Aim:

The purpose of this thesis is to address the research gap in the field of brewer spent grains' (BSG) contribution to value creation, specifically around sustainability in the market for plant-based beverages. As a result, it seeks to ascertain if BSG as a beverage may contribute to the growth of a more sustainable, circular, and efficient economy that would benefit not just the brewery industry but also the whole food and beverage (F&B) sector.

Method:

A qualitative single case study with Tetra Pak (TP) was conducted to accomplish this, supported by external experts. The empirical data was gathered through 13 semi-structured interviews that were performed both in-person and online. To analyze the empirical findings, the template approach by King (2004) was applied.

Results:

The findings show that two customer categories are influenced differently by the introduction of a BSG-based beverage and consequently have different value propositions. These two groups can be found in either developed or developing nations. Furthermore, the studies demonstrated that value creation differs in the short and long term. In industrialized countries, it was recognized that "balanced nutrition" would provide value in the short term, leading to "improved health" in the long run. In developing nations, the possibility of a low-cost and nutritionally helpful plant-based BSG beverage will result in a substantially larger improvement in society by making beverage consumption affordable to everybody and improving living conditions in general.

Conclusion:

Byproduct usage of a BSG-based beverage supports value creation and sustainability value by utilizing upcycling to optimize resource usage, reduce waste, encourage a circular economy, create new revenue streams, boost societal company acceptance, and encourage innovation within the processing companies. Businesses may primarily benefit financially, but by implementing upcycling processes into their revenue stream, they also contribute to a future that is more sustainable, profitable, and resource-efficient.

O21.2

Non-invasive detection of foreign bodies in burger meat patties by contactless ultrasound imaging

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Aim:
In the production of burger meat patties, there is a risk of contamination by foreign bodies such as plastic, glass, wood, metal fragments, and other waste from packaging materials, parts of processing machines and conveyor belts. Detecting these foreign bodies in-line during processing is a noticeable challenge for the meat industry. Therefore, there is an urgent need for non-invasive and cost-effective technologies for real-time monitoring of meat product quality and safety. Contactless ultrasound has emerged as a promising technology for in-line inspection of the entire production process, as it provides non-contact measurement, improves resolution, increases inspection speed and is cost-effective and versatile. Thus, this study aimed to assess the feasibility of contactless ultrasound imaging for the detection of foreign bodies in commercial meat patties.

Method:
Different types of foreign objects (10×10 mm-wood, paperboard, soft and hard plastic, and metal washers) were independently inserted into the burger patties to obtain out-of-control samples. Acoustic images of burger patties were acquired using an automated 2D system through which the surface of the product was scanned over an area of 80 × 80 mm and spatial resolution of 1 mm. This system was coupled with two contactless ultrasound sensors (0.25 MHz) that operated in through-transmission mode. Three energy-related ultrasound parameters (peak-to-peak distance, squared norm, and integral) were computed in the time domain.

Results:
In general terms, it was observed that the presence of the foreign body leads to the reduction of all energy-related parameters due to the increase in attenuation as a consequence of wave scattering and absorption. Furthermore, it was demonstrated that the detection capability depends on the type of foreign body, as significant differences were found between the different materials studied.

Conclusion:
Contactless ultrasound imaging has proven reliable in monitoring the presence of foreign bodies in burger meat patties. Industrial in-line implementation of this technology could largely contribute to real-time decision-making in the meat sector.

O21.3

Development of 3D printed patties prepared with mycoprotein and insects for sustainable and personalized nutrition

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Aim:
Mycoprotein is an alternative food-grade protein obtained from a fungus named *Fusarium venenatum*. Edible insects have been promoted as human food and animal feed due to their high feed conversion to protein regarding livestock. Innovative meat analogues have been formulated with mycoproteins and insects to study both proteins sources as sustainable ingredients. 3D Food Printing (3DFP) is a technological solution for food processing (design, preparation, and dosage) that has been pointed as a valuable tool for precise nutrition. The present study is focused on the development of mycoprotein and insect-based 3DF printed patties as a meat substitute for a personalized nutrition.

Method:
A patty formulation was designed to reach 14% w/w protein, mainly from fungus and insects, while being sensory appealing for consumers. Formulation contained mycoproteins and dehydrated insect powders, water, vegetable oil, plant-based texturizers, binding agents, stabilizers, and flavours. The insect species applied were *Tenebrio molitor*, *Acheta domesticus* and *Alphitobius diaperinus* due to their optimal balance between taste and texture. Round patties were produced by 3DFP process using a 3D printer device. Microbiological, physico-chemical and sensory characteristics were evaluated. The initial aerobic bacterial count and the presence of *Salmonella Typhimurium*, coliformii and *Listeria monocytogenes* was analysed. The thermal cooking effect in the count reduction or survival was also studied. The physico-chemical parameters evaluated were cooking loss, moisture and proximate analyses, texture analyses (TPA, Cutting Force) and colour analysis. Consumer tests were carried out for the sensory assessment of the 3DF printed patties using an intensity and acceptability 9-point scale for different sample attributes.

Results:
Microbiological analyses showed that cooked patties were safe for consumption. Texture analyses showed and appropriate hardness, springiness and cutting force values for an optimal mastication and mouthfeel. Sensory analyses showed that consumers had a high acceptability for the protein alternative-based patties, especially for its texture and flavour.

Conclusion:
The results of the study demonstrate that 3DF printed patties elaborated with mycoproteins and insect flour can be a source of alternative protein for personalized foods and diets and, therefore, a contribution to the transition of food systems in Europe towards a more sustainable food market.

O21.4

Cheese whey valorisation to develop compostable films for lipophilic foodstuffs

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Aim:

Seeking new approaches towards sustainable food production systems, this work aimed at finding other valorization alternatives of biowastes from cheese manufacturing processes to develop biodegradable biopolymeric films as replacements to currently used food packaging synthetic and non-compostable plastics.

Method:

The whey used in this study to obtain whey protein concentrate (WPC) was collected from the Urruela SC farm (Basque Country). The amino acid composition of both whey and WPC was assessed. Then, WPC films were prepared using compression moulding and physicochemical, optical, morphological and biodegradation (ISO 14855) assessments were carried out. In addition, the environmental impacts (ISO 14040) of the films were assessed considering the WPC extraction, film manufacturing and film composting stages.

Results:

The films were 144 µm-thick, transparent, pale-yellowish, and easy to handle. As for their inner structure, films had heterogeneous bulk due to WPC composition (presence of mainly proteins, and lesser amounts of carbohydrates and lipids). Regarding their solubility, films were partially soluble in 95 % v/v ethanol, a food simulant. As the degree of biodegradation was ≥ 70 % after 45 days, whey protein films were considered compostable films. Finally, in the WPC films' life cycle assessment, it was observed that the manufacturing stage contributed the most to the environmental load of the whole analysed stages due to the energy consumption of some manufacturing equipment.

Conclusion:

Compostable whey protein films, from the valorization of cheese whey, could be considered promising candidates for the replacement of fossil commodity polymers used for food packaging applications. Regarding the type of food to be packaged with these films, considering the partial solubility of films in ethanol, films could be used to package lipophilic foods such as cheese. This latter consideration could be a circular economy strategy since the whey protein used in this work was extracted from the whey obtained as a biowaste from cheese production.

O21.5

Development and characterisation of TPS/PBAT biodegradable food packaging containing food preservative

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Aim:

Novel biogradable food packaging material based on cassava thermoplastic starch (TPS) and polybutylene adipate terephthalate (PBAT) blends containing food preservatives via blown-film extrusion was successfully developed to improve functionality. However, several food preservatives contain functional properties to enhance appearance, taste, color and delay quality deterioration of the food products. However, the addition of food preservatives directly affects consumer perception, health and safety. This research aimed to develop and chatacterize the novel functional biodegradable food packaging from bioplastic TPS/PBAT incorporated food preservatives namely sodium tripolyphosphate, tetrasodium pyrophosphate and sodium nitrite.

Method:

1. Preparation of TPS/PBAT films containing food preservatives with different concentration (0, 1, 3 and 5%) using extrusion TPS/PBAT films.
2. Characterization of TPS/PBAT films were determined using nuclear magnetic resonance, fourier transform infrared spectroscopy, scanning electron microscope, mechanical and barrier properties.
3. Identification and evaluation of compounds using dissolution methodology by dichloromethane and ethanol for extraction. The extracts obtained were analysed by liquid or gas chromatrography
4. Safety of packaging was evaluated by the migrants on different food simulants using GC-MS and UPLC-QTOF.

Results:

The physico-chemical properties of the films were investigated. Adding food preservatives into TPS/PBAT films modified chemical structure which hydrogen atoms were modified via intermolecular forces hydrogen bonding. Chemical structure displayed interactions of a chemically modified polymeric matrix via crosslinked network and hydrolysis. The modification led to starch granule disruption and destroy the inter- and intra-molecular. TPS/PBAT films effectively provided high barrier film especially high oxygen barrier packaging, depending on polymer chemical structure, heterogeneity and microstructure of the matrices. Linear and cyclic oligomers from PBAT were detacted with the high intensity including adipic acid, terephthalic acid and butanediol. Migration experiments with 3 food simulants were also performed: ethanol 95%, ethanol 10% and acetic acid 3%. The results showed new compounds coming from the reaction with food simulants were present in migration solutions such as pentacosane and tetracosane in GC-MS.

Conclusion:

Novel biodegeadable food packaging effectively enhanced compatibility of the film and potentially replaced direct addition of food preservatives in meat products.

O21.6

Bioplastic material based on ethyl-cellulose

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Aim

The extensive usage of conventional plastics leads to resource depletion, massive waste accumulation and carbon dioxide emission into the atmosphere. The growing awareness of these deleterious effects has resulted in increased interest in developing new and sustainable bioplastics. The current research aims to exploit ethyl-cellulose (EC), a polymer derived from renewable sources, to formulate biodegradable bioplastic films using thermal processing and examine their performance.

Method

EC-based films were fabricated using hot-melt extrusion followed by compression molding. Films based on neat polymer at various molecular weights and with the addition of various plasticizers were prepared. The resulting films were examined for their thermal, mechanical, structural, barrier, and surface wetting properties, as well as their biodegradability.

Results

The extrusion process seems to reduce the biopolymer molecular weight and crystallinity as confirmed by gel permeation chromatography tests and thermal analysis. The thermal analysis also showed lower T_g and T_m values for all added plasticizers, confirming their activity. Additionally, all plasticizers led to thermoplastic mechanical behavior characterized by elastic and plastic deformation, as opposed to the solely elastic behavior of the neat EC films, confirming their mechanical plasticizing effect. The plasticized films exhibited significantly higher tensile strength and percent of elongation at break, resulting in stronger and more flexible films. Surprisingly, the water contact angle measurements revealed a hydrophilic nature characterized by a contact angle lower than 90º, which was supported by the water vapor permeation tests. EC-based films showed relatively high permeability to water vapor and high permeability to oxygen, signifying their suitability as packaging material for fresh produce. Microscopy imaging did not reveal any significant difference between EC films, suggesting that the plasticizers were miscible with EC and evenly distributed in the films. Furthermore, biodegradability tests confirmed that certain cellulases can decompose EC-based films.

Conclusion

This study demonstrates, for the first time, the feasibility of forming EC-based films with tunable properties using hot melt processing with different plasticizers that can be used in diverse applications. These findings strengthen the significance of EC as a sustainable bioplastic material and provide the first step towards the development of new bioplastics from bio-based sources.

O21.7

ENCAPSULATION OF BIOACTIVE COMPOUNDS BY HIGH THROUGHPUT ELECTROSPRAYING ASSISTED BY PRESSURIZED GAS

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Aim: A novel high-throughput room-temperature drying and encapsulation technology, termed as electrospraying assisted by pressurized gas (EAPG), has been recently developed by our research group, based on the atomization of a solution by a pneumatic injector using compressed air that nebulizes within a high electric field. The aim of this work was to demonstrate the capacity of this technique to provide high quality bioactive encapsulates at lab and industrial scale.

Method: Solutions of bioactive compounds of high industrial interest, such as omega-3 fatty acids, hydroxytyrosol and probiotics together with the encapsulating matrices were processed by EAPG at room temperature. The encapsulates were characterized in terms of morphology, encapsulation efficiency, bioactive properties, and stability.

Results: The encapsulated materials were collected as a free-flowing powder, with an average particle size bellow 5 microns and narrow particle size distribution. Encapsulation efficiencies higher than 95% were obtained for omega-3 fatty acids and hydroxytyrosol. The antioxidant properties of hydroxytyrosol were maintained after the EAPG process. Regarding probiotics, no loss of viability was detected after the encapsulating process. Additionally, the stability of these bioactives was increased thanks to the protection of the encapsulating material in comparison with the neat bioactive. Finally, the scale-up of the process was performed achieving the production volumes of several kilos per hour of free-flowing powder without affecting the characteristics of the encapsulates.

Conclusions: The results for the case studies described herein demonstrate the potential of the EAPG technology for the stabilization of challenging bioactive compounds at the production volumes of the commodity food applications.

O22.2

Optimization of Cutin Extraction from Tomato Processing Waste by High-Pressure Homogenization

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Aim: In the agri-food industry, tomato is the leading vegetable for processing. During tomato processing, a huge amount of tomato wastes (e.g. peels, seeds) is generated, which has a high potential for valorization. Tomato peels contains up to 20% of cutin which can be successfully used to produce biobased packaging materials. This study carried out in the frame of the European project AccelWater (Project ID: 958266), was aimed at optimising the recovery process of cutin from tomato peels by conventional method. Moreover, the use of high-pressure homogenization (HPH) was proposed and investigated to improve the extraction process.
Method: To define the optimum condition for conventional cutin extraction, response surface methodology (RSM) was applied to optimize three processing variables, namely time, temperature, and solvent concentration. The defined optimized conditions for conventional cutin extraction has been applied for HPH-treated samples (80 MPa, 25℃, 10 passes) to evaluate the effect of novel technology on the extraction procedure. FT-IR spectroscopy was used to analyze the chemical structure of cutin extracts through the identification of the functional characteristic groups of target substances.
Results: The results showed that the optimal condition for cutin extraction was 130℃ for 120 minutes, with NaOH 3%, resulting in 32.5% extraction yield, with NaOH concentration playing a major role in the extraction procedure. Under this optimized condition, the HPH-treated sample resulted in a 46.1% cutin extraction yield, suggesting that HPH technology can increase the cutin extractability by 37.6% compared to control (untreated) samples. Interestingly, the application of HPH treatment resulted in a decrease of usage of NaOH (by 66.6%) and HCl (by 70%) in the extraction process. Furthermore, FT-IR analysis revealed that cutin extract achieved upon both conventional and HPH-assisted extraction processes have the same chemical structure, thus indicating the chemical groups and cutin structure were not altered or destroyed by HPH treatment.
Conclusion: This study demonstrates that HPH technology can be promising to significantly increase the yield of cutin extraction from tomato waste while decreasing the solvent amount, resulting in a more sustainable cutin extraction process. These findings have important implications for developing sustainable and cost-effective methods for valorisation of tomato waste for cutin extraction.

O22.3

VALORIZATION OF BROWN SEAWEED'S INDUSTRIAL SOLID-RESIDUE AFTER ALGINATE EXTRACTION FOR THE PRODUCTION OF PROTEIN EXTRACTS

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Aim:

The growing interest in the so-called "blue bioeconomy" and the valorization of marine macroalgae has boosted research and industrial efforts to deepen the study of brown algae and to develop valorization strategies for the waste streams generated through processing for phycocolloid extraction.

Method:

The present study explored acid/alkali extraction with or without ultrasound (US) and enzyme-assisted methods to extract proteins from brown algae (*Saccharina latissima* and *Ascophyllum nodosum*) residues remaining after the alginate extraction process. The protein extraction efficiency, as well as the structural, functional, and nutritional properties of the recovered protein, were evaluated.

Results:

It was found that the combination of US with the enzymatic treatment led to an increase in the release of the protein fraction, able to recover more than 46% of the total protein present in the residues. Regarding functional properties, protein extracts from *S. latissima* residue showed better foaming capacity, water and oil retention capacity, and emulsifying capacity. In comparison, extracts obtained from *A. nodosum* residue had higher antioxidant capacity. Both the amino acid profile and the molecular weight distribution of the extracted protein depended on the extraction process.

Conclusion:

The protein extracted from brown algal residues could have potential future use in the food industry, either as animal feed or as vegan protein, following the European strategy of production and supply of alternative plant proteins.

O22.4

The credibility of dietary advice formulated by ChatGPT

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Introduction & Aim:

The role of artificial intelligence (AI) tools in food industry is becoming more and more visible. The introduction of ChatGPT (chatbot developed by OpenAI) has been met with enormous public interest – just in January 2023 over 100 million people used the tool. The everyday prompts often include food restrictions which apply to millions of people around the world. Therefore, the aim of the study was to assess the credibility of the nutritional recommendations in food allergies proposed by ChatGPT.

Method:

Single-prompt conversations with ChatGPT (January 9 Version) were conducted for a 30-year-old woman with specific food allergies. They included one of the food allergens and four restriction levels: A – food quantity, B – food quantity + another food allergy, C – food quantity + 2000 kcal, and D – food quantity + 1000 kcal. The total of 56 menus (14 allergens × four restriction levels) were evaluated by a qualified dietician.

Results:

The credibility of each menu obtained was verified in relation to the criteria of *i*) *safety* (= no allergen), *ii*) *accuracy* (= adequate food quantity and energy value), and *iii*) *attractiveness* (= variety of the menu). The (*safety*) results showed that ChatGPT had the potential to produce harmful diets (4 out of 56 menus included food allergen). More common (*accuracy*) errors applied to inaccuracies when specifying food quantities and energy values of food, meals, or diets. Finally, the AI tool produced monotonous diets (*attractiveness*) that might not be followed due to the lack of variety or overreliance on some products.

Conclusion:

In the study, elimination diets were used as an exemplary factor verifying the correctness of dietary advice formulated by the most popular AI tool – ChatGPT. Based on a preliminary analysis of 'robo-diets', it was showed that ChatGPT – while generally accurate – has the potential to produce unsafe (with food allergen) and unattractive (repetitive) diets. However, taking into account the pace of development of the tool, it can be expected that by November 2023 most of the above errors will no longer be made by this tool.

This example is particularly worrying as nut allergy is a severe food allergy where consumption of even a small amount of the allergen can lead to severe health consequences

Conclusion: (heading must be in bold)

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O22.5

Digestibility of hemp seed oleosomes loaded with cannabidiols

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Aim:
Oleosomes are natural lipid droplets widely present in seeds, which might be a new route as sustainable carriers to transport hydrophobic functional compounds, like cannabidiol (CBD). Cannabidiol has a high potential as a therapeutic for curing diseases, but its application is limited due to poor water solubility, low bioaccessibility, and low chemical instability. Digestibility is the key to the development and utilization of oleosomes as carriers. However, the physicochemical properties of oleosomes affecting digestibility are unknown. We encapsulated CBD into oleosomes extracted from hemp seeds and applied in *in vitro* gastrointestinal digestion model to investigate their digestibility.
Method:
Oleosomes were extracted and purified from hemp seeds. CBD was encapsulated in oleosomes and loaded oleosomes were compared with native oleosomes. The digestibility of oleosomes was also compared to free oil and emulsions stabilized by whey protein isolate (WPI) or/and phospholipids (PL). The digestibility of oleosomes and artificial droplets were assessed through *in vitro* gastrointestinal digestion model.
Results:
We investigated different membrane densities, membrane compositions and interfacial structures of oleosomes/emulsions that showed significant differences in lipid digestion. *In vitro* experiments showed the free fatty acids (FFAs) release of native oleosomes was enhanced to 8.98±2.34 % compared with free oil (2.54±0.41 %) while being lower compared to the same size of homogenized oleosomes (19.64±5.73 %) and artificial droplets (83.32±4.12 % of WPI, 95.12±9.68 % of PL, 88.57±3.96 % of WPI+PL). Furthermore, oleosomes exhibited better stability and prevention of CBD during digestion than homogenized oleosomes and artificial droplets. These data suggest that the faction of membrane on the surface of droplets has a great influence on the digestibility of oleosomes and artificial droplets.
Conclusion:
By investigating the effect of oleosome properties on digestibility, we suggest that oleosomes are stable in *in vitro* gastrointestinal digestion model due to their unique membrane compositions and structures. We hypothesize that hemp seed oleosomes might be potentially controlled- or delayed-release carriers to transport and release functional compounds to specific locations.

O22.6

Process Simulation approach for improving Water-Energy Nexus (WEN) in Tomato Processing Facility

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Aim:

Process simulation is a well-established, powerful tool that has been used by the chemical process and food industries for years to optimize current plant operations or to assist in the design of new plants. It is a useful tool to obtain material and energy balances, calculate capital and operating costs and evaluate the environmental impact. To test the feasibility of water-energy nexus (WEN) improvement to lower the environmental impact at food processing plant, it is necessary to utilize process simulation to examine the implementation of process-specific measures that would lower water-energy use at individual level of unit operation. In this research, which was carried out in the frame of the European project AccelWater (Project ID: 958266), a medium-sized Italian tomato processing facility was selected as a case study. A customizable model of the tomato processing was developed and simulated to evaluate the impact of conventional strategies and alternative technological solution at WEN points on the reduction of water, electrical and thermal energy consumption and wastewater generation.

Methods:

A commercial process simulator software (SuperPro Designer®) was used to develop a flow diagram of a real scenario of a tomato processing plant in which peeled tomato and tomato puree are produced. Then, simulation trials were conducted to analyze different scenario.

Results:

The results showed that the implementation of closed-loop recirculating systems in both the washing stage and cooling units can lead to substantial water savings. This improvement in water efficiency also contributes to a reduction in energy consumption at WEN points. Furthermore, recycling steam condensate from thermal units back to the boiler presents an opportunity to save a significant amount of water and methane. Finally, overall process performance and cost benefits of the applied different strategies were predicted.

Conclusion:

It was demonstrated that the process simulation tool enabled decision-makers to make informed choices and improve overall performance in a controlled and cost-effective manner. This approach can be considered effective and efficient permitting to analyze many processing scenarios before putting them into practice, with time, money, resources, and effort savings.

O22.7

Effect of ultrasound pre-treatment prior to enzymatic hydrolysis on quality parameters of herring hydrolysate

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Aim: The present study aimed at investigating the effect of US pre-treatment prior to enzymatic hydrolysis on functional and quality parameters of the recovered FPH.

High value products such as fish protein hydrolysate (FPH) and lipids rich in omega-3 fatty acids can be extracted from pelagic fish rest raw material by conventional enzymatic hydrolysis. To improve the traditionally used method of extraction, reduce costs, increase the yield, and enhance the quality parameters of the recovered ingredients, advanced non-thermal technologies can be used as pre-treatment prior enzymatic hydrolysis. Ultrasound (US) is one of the emerging non-thermal technologies that can be used to improve functional and quality parameters of the recovered FPH. It also requires low energy consumption with practically no effect on biological and nutritional values of the product. However, other potential effects from the use of US such as lipid-protein and protein oxidation have to be investigated.

Method: In total, four FPH from herring by-products were obtained, as follows: one control without application of ultrasound pre-treatment, and three pre-treated with US (20 khz, 600W, 900W, 1200W) prior to enzymatic hydrolysis performed at 50°C for 60 minutes with addition of 0.1% w/w Alcalase.

Results: (heading must be in bold)

The results showed that the use of US increased the proportion of emulsion during enzymatic hydrolysis, resulting in a significantly lower yield of proteins from the process. However, the results of the FPH quality showed that the use US (1200W) prior to enzymatic hydrolysis resulted in a significantly higher solubility and degree of hydrolysis of the FPH. At the same time, the use of US prior to enzymatic hydrolysis did not affect significantly the proportion of essential amino acids. The highest content of thiol groups was observed in the control FPH, although it was not significantly higher compared to the FPHs treated with UL. The content of carbonyl groups was higher in the FPHs treated with US, but the difference was not significant.

Conclusion: It can be concluded that use of US prior to enzymatic hydrolysis can increase the solubility of the proteins and degree of hydrolysis without affecting quality in terms of protein oxidation.

O23.2

Lactobacillus cultures prevent the proliferation of L. monocytogenes in ready to eat ham products

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Aim:
Ready-to-eat (RTE) ham product are designed so that consumers can eat these foods without further processessing. Manufacturing of bone-in-hams typically uses hurdle technologies to control microbiological spoilage. Lactic acid bacteria (LAB) have the potential to dominate the microbial population of foods, and their application as a protective culture prior to final packaging of RTE ham products is an additional tool to control food pathogens such as *L. monocytogenes*. The aim of this microbial challenge study was to assess the survival/growth of *L. monocytogenes* in cured ham products that have been treated with LAB culture.

Method:
A challenge study assessed the survival/growth of *L. monocytogenes* in cured ham products (quarter hams, centrecut hams and smoked hocks) that had been treated with either (i) Control 2-3% acetic acid and <1% citric acid) or (ii) LAB treatment - *Lactobacillus curvatus* (B-LC-48®). Prior to final packaging, all Control and LAB treatment samples were inoculated with a *L. monocytogenes* cocktail, vacuum packed and stored for 35 days at 4 °C.

Results:
Control samples displayed an initial reduction (~0.5-1 Log10 cfu/g) in the concentration of *L. monocytogenes* up to and including Day 14. From day 14 to 21, a significant increase in the concentration of *L. monocytogenes* was observed (3.33 Log10 cfu/g in quarter hams; 3.54 Log10 cfu/g in centrecut hams; 3.79 Log10 cfu/g in smoked hocks) and then maintained till day 35. The LAB quarter ham samples achieved a 0.64 Log10 cfu/g reduction in the level of *L. monocytogenes* till day 28. The LAB centrecut hams and smoked hocks achieved a ~1 Log10 cfu/g reduction in the level of *L. monocytogenes* over the 35 days.

Conclusion:
The results from this challenge study indicate that the LAB treatment was effective in controlling the growth of *L.monocytogenes* and achieved the acceptance criteria of <0.5 Log10 cfu/g increase of *L. monocytogenes*. These results demonstrate that use of LAB bioprotective cultures are an effective post-processing hurdle to prevent proliferation of food pathogens like *L. monocytogenes* in hams.

O23.3

Combined application of UV-A laser and bacteriophages to decontimanate Campylobacter on chicken meat

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Aim: Despite different approaches to reduce the *Campylobacter* spp. load of fresh chicken meat, the number of foodborne infections with *Campylobacter* spp. in the EU is still high and often chicken meat products are implicated. In this study, the efficacy of a UV-A laser surface decontamination in combination with the application of a *C. jejuni*-specific bacteriophage was investigated to achieve a sufficient inactivation of the target pathogen while not affecting the product quality.

Method: *Campylobacter jejuni* PT14 was inoculated at 10^8 CFUon the upper surface of fresh chicken breast fillets (approx. 50 cm^2), and subjected to UV-A laser (343 nm),treatment at radiant exposure 26.2 J/cm² (60 W, 286 s), and to a previous or subsequent bacteriophage treatment with 10^8 PFU of the *Campylobacter*-specific phage C11 (PTC, Bönen, Germany). Phage treatment was followed by incubation at 4 °C. In addition, organoleptic properties and chemico-pyhisical parameters (pH, peroxide value, protein stability/differential scanning calorimetry), scanning electron microscope, colour space) were analysed of UV-A laser-treated samples

Results: The combined treatment with UV-A laser and bacteriophages led to a significant reduction of *C. jejuni* counts on chicken meat. When bacteriophage treatment was followed by UV-A laser application, a total inactivation of 1.9 ± 0.1 log_{10} CFU was observed, while 2.3 ± 0.1 log_{10} CFU were inactivated when UV-A laser application was followed by bacteriophage treatment. Control samples without treatment and samples subjected to only one of the approaches were also stored refrigerated, revealing an additive inactivation effect of the combined treatment. Interestingly, refrigerated storage of *C. jejuni* on chicken meat prior irradiation had a protective effect against UV-A laser treatment. However, the killing effect mediated by phages was more pronounced when UV-A laser was applied after phage treatmentUV-A laser treatment at 26.2 J/cm^2 had no verifiable effects on chemical, physical or organoleptic properties butat 68.7 J/cm^2 significant colour change, denaturation of meat proteins and destruction of surface topography was observed.

Conclusion: Combined UV-A laser and bacteriophage treatment is a promising approach to reduce the load of *Campylobacter* spp. on chicken meat. It can contribute to eliminate the risk of foodborne infections by this pathogen.

O23.4

Ranking microbial hazards from ingestion of Ready-To-Eat fresh produce irrigated with treated wastewater

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Aim: The consumption of contaminated fresh horticultural produce, especially minimally processed leafy green vegetables and fruits, is increasingly recognised as a source of foodborne illnesses, posing a significant health safety risk to humans. Recycling wastewater is important for sustainability, and it can be used for irrigating crops, however, it may contain a suite of harmful pathogens. This Quantitative Microbial Risk Assessment (QMRA) aimed to assess and rank microbial hazards (infection or illness) arising from the human consumption of RTE fresh produce irrigated with treated wastewater considering the entire lifecycle (farm-to-fork) of packaged RTE fresh produce.

Method: A QMRA model was constructed to analyse human exposure to foodborne pathogens associated with consuming RTE fresh produce, followed by annual risk estimates, entailing a four-step risk assessment framework. A list of foodborne target pathogens that pose human health risks linked with the consumption of horticultural produce was identified and collated from the literature. The input parameters of this probabilistic model were the initial concentration of pathogens in irrigation water, pathogen inactivation due to chlorine treatment, cumulative decay, post-harvest chlorine treatment, cold storage at 4°C and estimation of the final concentration of pathogens attached to RTE crops. Literature-based dose-response models were adopted for hazard characterisation towards evaluating daily/annual risk estimates.

Results: The results showed a 'very high' annual risk associated with *Cryptosporidium parvum*, followed by *Giardia lamblia* and norovirus with 'high risk' and adenovirus with 'moderate risk'. Sensitivity analysis revealed that the consumption of RTE fresh produce is the most sensitive parameter of the QMRA model and is followed by cumulative decay constant, potential growth on shelves, the effect of cold storage and finally, postharvest chlorine treatment.

Conclusion: This ranking approach prioritised *Cryptosporidium parvum*, *Giardia lamblia*, norovirus and adenovirus (descending order) as pathogens of concern aligned to RTE fresh produce (irrigated with treated wastewater) consumption. This study highlights the role of chlorination, as recommended by the EU, as a remedial measure to provide greater food safety assurance levels. Chlorine treatment can also help reduce the annual risk probability at the pre-harvest (irrigation) and post-harvest (packaging) stages, resulting in low risk from the selected pathogens.

O23.5

Thermal Inactivation of Ohmic Pilot Plant: Non-pathogenic E. coli Surrogate and Vitamin C Reduction Evaluation

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Aim:
The aim of this study is to investigate the thermal inactivation kinetics and achieve a 5-log reduction of non-pathogenic Escherichia coli (E. coli ATCC 8739) surrogate based for strawberry nectar, using an Ohmic pilot plant with a capacity of 400 L/h at the CTCPA center in Avignon, France. Additionally, the study aims to evaluate the reduction of Ascorbic acid (AA) levels during the thermal process. The primary objective is to comply with the thermal reduction standards set by the U.S. Food and Drug Administration (FDA) for ensuring food safety.

Methods:
Non-pathogenic E. coli surrogate beads were prepared by mixing strain of ATCC 8739 with sodium alginate and forming spherical beads through gelation. An Ohmic pilot plant was used for the thermal treatment. The surrogate-alginate beads were added to a water solution that contains AA (25 mg/100 mL). The Ohmic pilot plant was operated at a specified temperature to achieve thermal inactivation of 5-log. The surrogate concentration, temperature, and time were monitored during the process.

Results:
The study revealed that the kinetics of thermal inactivation on the Ohmic pilot plant were similar to those observed in conventional thermal treatments at lab scale, achieving the desired reduction of the non-pathogenic E. coli surrogate. However, the Ohmic process demonstrated a shorter treatment time compared to traditional methods. Furthermore, the reduction in ascorbic acid levels during the Ohmic treatment showed a similar behavior to that observed in normal lab-scale assays, indicating that the Ohmic process did not significantly affect the degradation of AA nor microbial reduction. These findings suggest that Ohmic technology holds promise as an efficient and time-saving method for achieving microbial reduction in food processing while maintaining the quality of thermosensitive components such as Vitamin C.

Conclusions:
The kinetics of thermal inactivation on the Ohmic system were comparable to traditional methods, achieving a 5-log reduction in a shorter time. Moreover, the Ohmic process exhibited a similar behavior to conventional thermal treatments regarding Vitamin C reduction, preserving its quality. These findings highlight the potential of Ohmic technology as an efficient and time-saving method for microbial reduction in food processing while maintaining nutritional quality.

O23.6

Antimicrobial-resistant lactic acid bacteria in sheep flocks and in their raw milk used for cheese-making

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Aim:

For decades antibiotics have been overused, both in human medicine and in animal production, resulting in bacteria developing the ability to withstand the action of antimicrobials. Antimicrobial resistance (AMR) already causes 700,000 deaths per year worldwide and, consequently, addressing AMR is within the Sustainable Development Goals to ensure healthy lives. Food production chain is classified as a vehicle of dissemination of AMR and, therefore, this study focused on the production chain of raw ewe milk-derived Idiazabal cheese, preliminarly analyzing the prevalence of antimicrobial-resistant lactic acid bacteria (LAB) in sheep flocks and in their derived milk.

Method:

Ovine faeces and raw milk samples were obtained from four traditional Idiazabal cheese producers. LAB were isolated in MRS agar and were identified by Sanger sequencing, amplifiying the V1–V3 16S rRNA region and sequencing it in a SeqStudio platform. Taxonomic classification was performed against Nucleotide Basic Local Alignment Search Tool. The minimum inhibitory concentration was defined as the lowest concentration inhibiting isolates' growth, which was evaluated by broth microdilution for the most common antibiotics used in farms (amoxicillin: 0.0313-16 µg/mL, dihydrostreptomycin: 1-512 µg/mL; benzylpenicillin: 0.0313-32 µg/mL and polymyxin B: 2-1024 µg/mL). The AMR was interpreted according to the microbiological cut-off values proposed by the European Food Safety Authority and European Committee on Antimicrobial Susceptibility Testing.

Results:

The 80 isolates obtained corresponded to different species of the genera *Bacillus, Enterococcus, Lacticaseibacillus, Lactiplantibacillus, Levilactobacillus* and *Streptococcus*. In faeces, *Enterococcus hirae* (60.6%) predominated, followed by *Bacillus thuringiensis* (12.1%); while in raw milk *Enterococcus faecalis* (34.0%) and *Bacillus thuringiensis* (12.8%) were notable. Overall, at least the 50.0% of the isolates of most bacterial species, including the predominant ones, were resistant to 3 of the 4 antibiotics tested (multi-resistant). In faeces, the most susceptible species were *Enterococcus faecium* and *Lacticaseibacillus paracasei*, and *Enterococcus avium*, *Lacticaseibacillus paracasei* and *Lactobacillus* sp. in raw milk.

Conclusion:

A high prevalence of LAB resistant to those antibiotics frequently used in farms was observed. Although the raw milk is not directly consumed, the prevalence of antimicrobial-resistant LAB during cheese-making should be studied, to determine the potential food safety risk of cheese.

O23.7

Microorganisms in unpasteurized spontaneously fermented vegetables: a food safety perspective

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Aim:

Spontaneously fermented vegetables are increasingly set available in small-scale retail and (pop-up) catering shops**.** This (re)discovery of alternative and traditional food networks is driven by changing consumer preferences, e.g. towards plant-based and (perceived) healthy diets, together with increased environmental awareness. Microbiological food safety is generally of low concern for low-acid fermented vegetables. However, the exclusion of both starter cultures and the end-of-production pasteurization step respectively lower process reliability (acidification rate and final acidity) and omits the main food safety intervention step. This research explores consumer exposure to foodborne pathogens in unpasteurized, spontaneous fermented vegetables. Moreover, the potential of vegetables to support the growth and survival of foodborne pathogens during fermentation is assessed.

Method:

A market survey was carried out to identify unpasteurized, spontaneous fermented vegetable products. Selected products were sampled seasonally and analysed (day of purchase + end of shelf-life) for microbiological parameters (i) linked to the fermentation process (lactic acid bacteria), (ii) linked to process hygiene or reliability (*Enterobacteriaceae*, *E. coli*, *Listeria* spp.), and (iii) relevant foodborne pathogens (*Salmonella* spp., *Yersinia enterocolitica*, STEC and *Listeria monocytogenes*). Challenge tests were performed to assess the growth potential of selected foodborne pathogens during vegetable fermentation, considering different food handling scenarios.

Results:

It was found that a rapid pH drop to a level below 4.2 is one of the major safety determinants for spontaneously fermented vegetables. Most market samples complied with a pH level lower than 4.2. Persisting *Enterobacteriaceae* or *Listeria* spp. in some samples might indicate either a slow pH decrease with related favourable initial growth conditions or a too short fermentation time. Challenge tests strengthened the importance of the fermentation time for pathogens to be no longer detected.

Conclusion:

Combining the use of well-selected starter cultures with an end-of-production pasteurization step is generally advised to ensure the safety of fermented vegetables. However, traditional spontaneous fermentation fully relies on (i) the level and composition of the indigenous microbiota, being inherently high in variability, and (ii) the fermentation practices. Therefore, this research highlights the importance of proper food handling practices and process control to ensure food safety.

O24.1

Exploring the Effects of High Pressure Processing on the Quality of Craft Beer

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Aim:
This study evaluated the potential of High Pressure Processing (HPP) in beer production as an alternative preservation method to improve the quality and shelf-life of unpasteurized and unfiltered craft beer.

Method:
India Pale Ale (IPA) and Blonde Ale alcohol-free (AF) were processed at 600 MPa for 3 min at room temperature (RT; ~20 °C). Physicochemical parameters such as pH, color, bitterness, haze, and ethanol content were monitored over 90 days at 4 °C and RT, with or without HPP for both beers. Microbiological spoilage indicators including total mesophilic bacteria, yeasts and molds, and lactic acid bacteria were also analyzed. The IPA beer was subjected to a triangular and a preference test for sensory evaluation.

Results:
HPP caused minimal changes in the physical characteristics of both beers. Additionally, no significant differences in bitterness, color, haze, density, or extract were found between HPP and untreated samples. Storage temperature had a greater impact on beer's physicochemical quality than HPP. For example, bitterness decreased over time in beer stored at RT while it remained stable at 4 °C, regardless of processing. A similar trend was observed for color. HPP reduced the microbiological spoilage indicators to below the detection limit from an initial load of about 3 log CFU/mL. They stayed below this level for the 90-day storage period, irrespective of the storage temperature. As expected, the storage temperature significantly affected the microbiological evolution of beer when not treated by HPP. The sensory tests showed that HPP did not alter the sensory characteristics noticeably.

Conclusion:
HPP is a promising and effective method to preserve the original flavor of beer and extend its shelf-life by reducing microbial spoilage without negative effects on key product attributes that may compromise beer's quality. The results of this study provide valuable insights for industry professionals who want to use HPP to improve their beer production process. Future studies could explore the effects of HPP on different types of beer and compare them with conventional pasteurization methods.

O24.2

Elderly Digestion of Whey Protein

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Aim:
Malnutrition is widespread in healthcare settings especially in the elderly population, with around 1 in 4 adult patients in hospital, and more than 1 in 3 patients in care homes being at risk of malnutrition. Older adults have an increased risk of suffering from malnutrition which is associated with a reduced quality of life, poorer health and increased disease occurrences. Undernutrition has negative health effects associated with it such as sarcopenia, osteoporosis, increased frailty, and a general increase in morbidity and mortality. Prevalence of malnutrition and undernutrition in the elderly is commonly treated using high-quality proteins, food-fortification and/or oral nutritional supplements (ONS). These supplements can potentially attenuate issues with muscle protein turnover in older adults and contribute to resolving bone health issues such as osteoporosis and increased frailty, although changes to the digestive system with increasing age can affect the availability of nutrients, especially protein, in this cohort.

Method:
Using current *in-vitro* digestion protocols, adaptations to replicate elderly digestive conditions were made to digest whey proteins, focusing on the digestive matrix and specifically changes to pH and enzymatic quantity associated with increasing age. The effect on the digestibility of whey proteins were examined through characterisation of protein breakdown in terms of molecular weight distribution by size exclusion chromatography (SEC-HPLC), as well as Degree of Hydrolysis by OPA and peptide bioavailability was examined using ultrafiltration methods.

Results:
Results show that within a simulated *in-vitro* digestive system, changes to the gastric digestive matrix to replicate elderly conditions of a pH above pH 3, and reductions in enzymatic quantity below 2000U/mL, can dramatically alter the digestibility of whey proteins.

Conclusion:
These highlighted changes in gastric environment reflective of an aging cohort can lead to drastic changes in the gastric hydrolysis of whey proteins that need to be taken into consideration when formulating ONS for this cohort.

O24.3

Comparison of High-Pressure Homogenization and Pulsed Electric Fields for the extraction of compounds from yeast

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The beer industry generates large amounts of yeast biomass during fermentation. Proper management of this biomass is essential to reduce environmental impact and utilize it as a source of valuable bioactive compounds for various industries. Various techniques have been proposed for extracting these compounds from microbial cells.
The aim of this study was to compare a technique that causes the complete destruction of the cells (High-Pressure Homogenization (HPH)) with a technique that provokes an increment of the permeability of cytoplasmic membrane (Pulsed Electric Fields (PEF)) for the extraction of compounds of interest from yeast biomass.

Saccharomyces cerevisiae SafAle S-04 was treated by HPH treatment (2 passes at 1000 bar) that inactivated over 90% of the population and PEF treatment (15 kV/cm for 100 µs) that electroporated over 90% of the population. After treatment samples were incubated at 25 and 35 ºC and amino acids, glutathione proteins, total carbohydrates and antioxidant capacity were monitored over time.

Two hours after HPH treatment at 35°C, the maximum amounts of glutathione (10.52 mg/g dry extract) and proteins (322.43 mg/g dry extract) were extracted from yeast biomass. However, during incubation, the protein concentration in the extraction media decreased, while the concentrations of amino acids and total sugar increased. This effect was attributed to the hydrolysis of proteins and cell walls catalyzed by endogenous yeast enzymes.
Except for glutathione, which reached maximum extraction after two hours of incubation (6.47 mg/g dry extract), the extraction of other compounds from PEF-treated yeast biomass increased over time. Maximum protein (159.79 mg/g dry extract) and carbohydrate (45.27 mg/g dry extract) extraction occurred after 24 hours of incubation, regardless of incubation temperature. However, maximum amino acids extraction (169.49 mg/g dry extract) was observed after 48 hours of incubation at 35°C, indicating proteolysis within the yeast's cytoplasm during incubation.

The results demonstrate the effectiveness of HPH for the rapid and efficient release of all intracellular compounds of yeast biomass. The progressive release of intracellular compounds based on their molecular weight in PEF-treated yeast biomass could serve as a valuable tool for developing a cascade procedure to obtain a spectrum of high-value biomolecules.

O24.4

Valorization of spent coffee grounds towards the production of polyhydroxyalkanoates

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Aim:

Over the years, the use of traditional oil-based plastics has been gaining an increasing concern due to their potential environmental issues and the finite natural resources. Research is oriented towards eco-friendly bioplastics, such as polyhydroxyalkanoates (PHAs). They are bio-based, biodegradable, and biocompatible thermoplastic polyesters, synthetized and stored in bacterial cells in form of intracellular granules. When the process is fed with carbon sources derived from agri-food wastes to replace expensive commercial fermentation media, two main purposes can be achieved: the reduction of the overall production cost and the transformation of residues into valuable resources. Therefore, the main aim of this work was to produce PHAs using the lipidic fraction of spent coffee grounds (SCGs) as carbon source for a selected accumulating microorganism.

Method:

Cupriavidus necator DSM 545, purchased by the Leibniz Institute DSMZ (Braunschweig, Germany), was selected as PHAs accumulating microorganism. The fermentation was preliminarly conduced in a batch mode in shake flasks and different C/N ratios were investigated. The polymer accumulation ability of the bacterium was tested on both glucose, as a reference carbon source, and oil recovered from SCGs. Lipids were extracted from the residue through a Soxhlet extraction in n-hexane. Antioxidant and antimicrobial compounds, which can inhibit the microorganism growth, were firstly removed from SCGs through a high pressure and temperature extraction (HPTE), performed with a lab-scale stainless-steel stirred discontinuous reactor.

Results:

The pre-treatment step of SCGs to extract antioxidant and antimicrobial compounds demonstrated to be efficient, as proven by the antioxidant power of the extracts. Furthermore, thanks to probable modifications in its structure, the pre-treated SCG reached lipids extraction yields up to 12% (w/w), higher than the non-pre-trated one.
Cell dry weights (CDW) obtained during the accumulation test all presented similar trends: after an initial exponiential phase, the microorganism adjusted its growth in a stationary condition during which the polymer was accumulated inside. Results from FTIR on the extracted polymer showed the characteristic bands of scl-PHAs.

Conclusion:

SCGs were valorized by firstly extracting antioxidant compounds and then oil demonstrating their potentiality in being employed for the production of biomaterials, like polyhydroxyalkanoates.

O24.5

Advancing in the knowledge of colorless carotenoids: Preliminary study of bioavailability in humans

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Aim:
The intake of carotenoids and their plasma and tissue levels is associated with a lower risk of developing cardiometabolic diseases, several types of cancer, and other conditions. The objective of this study was to gain further insight into the bioavailability of the main tomato carotenoids (phytoene, phytofluene and lycopene) in humans by measuring their postprandial serum levels and feces content.

Method:
After a two-week washout period, eleven fasting volunteers consumed a carotenoid-free breakfast and 660 mL of tomato juice (day (D) 0). Blood samples were taken before and after breakfast (0, 2, 4, 6, 8, and 10h). Feces were collected for 6 days (D0-5). Carotenoids were extracted from serum and feces and analyzed by RRLC.

Results:
Postprandial serum lycopene concentration showed two maximum peaks, at 2h (150.27 nM) and 6h (171.06 nM) after breakfast. The second maximum may be due to the fact that the fatty acids ingested at lunch can facilitate the release into the circulation of the lycopene retained inside the enterocytes. Phytoene and phytofluene showed a maximum peak at 6h (48.75 nM) and at 4h (86.62 nM), respectively. Despite the much higher intake of lycopene (6.41 mg of phytoene, 6.07 mg of phytofluene, and 126.99 mg of lycopene), the bioavailability followed the order: phytofluene > phytoene >> lycopene. The highest amount of phytoene, phytofluene, and lycopene excreted in feces were found on D1, D1, and D2, respectively. The carotenoid concentration in feces was minimal on D5.

Conclusion:
The results of this study add further evidence to the higher bioavailability of colorless carotenoids relative to lycopene and, for the first time, data about their different fecal excretion are provided.

O24.6

Unlocking Kamut Wheat's Antioxidant Potential: Triple Detector Analysis of Bound and Free Phenolic Extracts

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Aim:
Kamut wheat is a type of ancient grain that has gained popularity in recent years due to its perceived health benefits. This study aimed to investigate the antioxidant activity of Kamut wheat (*Triticum turgidum* ssp. *turanicum*), by analyzing the bound and free phenolic extracts using a triple detector system. and phenolic compounds of bound and free extracts of Kamut wheat using an HPLC system with three detectors.

Method:
Free and bound phenolic extracts of Kamut wheat were obtained, and their antioxidant activity, total phenolic and flavonoid content were determined. A triple detector analysis approach was used, which included an HPLC system coupled with a diode array detector (DAD), a CoulArray detector (CAD), and a mass spectrometer (MS) detector. The use of this approach allowed the characterization of bound and free phenolic extracts of Kamut wheat and identified the most potent antioxidant compounds present in each.

Results:
The bound extract had significantly higher antioxidant activity, total phenolic and flavonoid content than the free extract. The total phenolic content of the bound extract was six times greater than that of the free extract, while the total flavonoid content of the bound extract was also six times greater than the free extract. The characterization of the extracts revealed that the free extract was mainly composed of tyrosine, phenylalanine, tryptophan, and apigenin 6-C-arabinoside-8-C-glucoside, while the bound extract was composed of hydroxycinnamic acids, ferulic acid, and its derivatives, which exhibited a stronger antioxidant capacity.

Conclusion:
Our findings indicate that Kamut wheat is a promising source of dietary antioxidants, and the use of an HPLC system with three detectors provides a more comprehensive understanding of the composition of antioxidant compounds in Kamut wheat. These results have important implications for the development of functional foods with health benefits.

O24.7

Processing, Digestion and Colonic Fermentation as Determinants of Fruit and Nut Bagasse Functional Effects

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Aim: The aim of this work was to study the effect of dehydration conditions and *in vitro* gastrointestinal digestion on antiradical capacity, total phenols content in almond bagasse, orange bagasse and discarded persimmon. Moreover, the effect on the fermentative microbial community, antiradical capacity and phenol content after colonic fermentation have been determined.

Method: Samples of almond bagasse, orange bagasse and discarded persimmon were subjected to hot air drying at 60, 70 ºC and freeze drying until water activities below 0.3 were obtained. Total antiradical capacities by DPPH, ABTS methods and total phenols were determined before and after the *in vitro* gastrointestinal digestion and after colonic fermentation of almond bagasse, orange bagasse and discarded persimmon. The growing microbiota composition after colonic fermentation was identified using high throughput sequencing.

Results: The results obtained showed that the effect of processing was different depending, mainly, on the composition of the raw material. In orange bagasse and discarded persimmon the antiradical activities and total phenolics were higher after dehydration treatments. On the contrary, in almond bagasse, air drying at 60 and 70 ºC and lyophilisation significantly reduced the antiradical capacity and total phenolics. Lyophilization of almond bagasse produced a powder with a higher total phenolic content than hot air drying. Hot air drying gave higher results than freeze drying in discarded persimmon, while hot air drying at 70 ºC and freeze drying gave the higher values in orange bagasse. Furthermore, in dehydrated samples, both *in vitro* digestion and colonic fermentation provided a phenolic content and antiradical capacity superior to those present in undigested products. In addition, beneficial bacterial species were identified after colonic fermentation.

Conclusion: Cleartly, the composition of the raw material influenced the effect of processing and gastrointestinal digestion on antiradical capacity and total phenols of the dried products. Understanding the role of other macronutrients in the bioaccessibility of polyphenols, in their degradation or biotransformation, is key to providing relevant and holistic information about the product as well as the detailed effect of dehydration treatments and digestion process.

PL1.1

Applying microbiome knowledge to the future of a healthier and more sustainable agri-food chain

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Scientific discoveries in the study of the microbiome of soils, edible plants, farm animals and humans allow us to start defining new strategies to use this scientific knowledge for the development of a healthier, safer and more sustainable agri-food chain. This presentation will show different examples of the use of these new technologies and their positive impact on the health and/or sustainability of the agri-food system.

PL1.2

Doing Good by Doing Food

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Food production is the biggest threat to the health of people and the planet.

Our food system is the most impactful sector for the health of people and the planet, and this system is broken. We are in urgent need of transforming this broken system, that is failing to meet the nutritional needs of a growing population within the planetary boundaries. How might we stimulate action in the areas of critical importance for humanity such as a better future of food? And what does that future look like?

A growing loss of biodiversity which affects soil and gut health. The deceasing variety of microbes in land is not only one of the biggest contributors of deforestation and subsequent generation of GHGe, but also contributes to a poorer and less nutrient-dense diet. The interlinkage of planet and human health pushes us to look at the problem from a holistic perspective thinking about a future of food that uses natural resources consciously while satisfying the hunger of a growing population.

How do we grow more (and better) food with less resources? Foodtech and collaboration: solutions throughout the whole value-chain of food

Entrepreneurs from around the world are developing solutions in the areas of New Proteins, Molecular Farming, Biodiversity, Waste, Packaging, Personalized Nutrition, etc. For these solutions to grow at scale, impact investors and large corporations will need to work closely to accelerate the speed of development of these technologies. A powerful and prepared workforce will also be required to forge this systematic, far-reaching, and global challenge. KM ZERO Food Innovation Hub is a growing community of food changemakers from companies, academia and institutions leading the transformation towards a healthier, more sustainable, resilient and fair food system.

PL1.3

Bioactive compounds from plants, algae and agrifood by-products against Alzheimer disease investigated by Foodomics

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A multi-analytical approach was applied to study the neuroprotective effect of different extracts enriched in bioactive compounds from plants, algae and agrifood by products. For this purpose, green extraction processes (e.g., based on compressed fluids such as pressurized liquid extraction (PLE) and supercritical fluids (SFE), making use of Generally Recognized As Safe (GRAS) solvents) were used. On the other hand, using a battery of in vitro bioactivity assays, the neuroprotective potential of the extracted bioactives has been evaluated through inhibition assays of the cholinesterase enzymes - acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) - as well as of the lipoxygenase enzyme (LOX), involved in cholinergic neurotransmission processes and neuroinflammation, respectively. In addition, the antioxidant capacity of the obtained extracts has been also studied by neutralization of free radicals (ABTS), and reactive oxygen and nitrogen species (ROS and RNS) scavenging assays. In parallel, the phytochemical composition of the evaluated extracts has been characterized making use of advanced analytical techniques such as gas chromatography and liquid chromatography coupled to high resolution tandem mass spectrometry (GC-Q-TOF MS/MS and LC-Q-TOF MS/MS).
The ability of the bioactive compounds to cross the blood-brain barrier (BBB) in order to exert their neuroprotective function in the brain was evaluated using two complementary methodologies. In a first approach, an in vitro permeability methodology using a parallel artificial membrane (PAMPA-BBB) was used to simulate the physicochemical properties of the BBB. Subsequently, a more advanced cellular model based on human brain microvascular endothelial cells (HBMEC-BBB), considered the anatomical and functional basis of the BBB, was used. The possible cytotoxic effect of the extracts was evaluated in four different human cell lines: HK-2 human kidney cells, THP-1 monocytes, HBMEC endothelial cells and SH-SY5Y neuroblastomas.
Finally, the extracts that showed the highest in vitro neuroprotective effect and the most favourable results in BBB permeability assays, were selected to test their neuroprotective effect in an *in vivo* model of Alzheimer's disease, using the CL4176 transgenic strain of the nematode Caenorhabditis elegans (C. elegans), which under thermal induction is able to express the Aβ42 peptide, causing paralysis in the nematode that can be quantified.
Using Foodomics, some mechanisms that explain the neuroprotective effect of the selected extracts on the CL4176 transgenic strain of C. elegans were elucidated. Namely, the use of lipidomics, transcriptomics and metabolomics, allowed the identification of some interesting metabolic pathways and cellular processes altered.

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PL2.1

Healthy and sustainable food through processing?

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Aim:
Looking at sustainability assessment of food products and at nutritional guidelines, it seems that the selection of the raw material and the ingredients as well as the eating habits are of much higher relevance for a healthy and sustainable diet compared to the impact of food processing. However, the prerequisite of food safety as well as attributes such as taste and convenience will be impossible to reach without the application of innovative food processing technologies. The talk aims on discussing processing concepts and strategies able to meet above mentioned requirements to a large extent.

Method:
The case of electrotechnologies in food processing will be used to exemplify developments towards a tailored and targeted food processing. Optimization of processing times, costs and energy requirements on one hand and quality attributes on the other hand will be pointed out. Application cases in the are of food preparation and cooking as well as food preservation will be shown to illustrate the potential that is provided by food processing in order to keep unwanted changes of raw material properties to a minimum and allow the generation of desired consumer attributes at the same time.

Results:
It can be shown that established thermal processes such as baking or pasteurisation and sterilisation can benefit from the application of electrotechnologies by the improvement of resource efficiency, treatment uniformity and product quality while maintaining food safety. In addition, electrotechnologies have shown the possibility to promote the introduction of new concepts for ingredient recovery while reducing side streams and waste.

Conclusion:
A profound analysis of existing processing concepts is required in order to derive successful application cases for innovative food processing technologies. The evaluation of benefits has to be based on a comprehensive process description including the quantification of nutrition and sustainability attributes. The transfer of results from lab and pilot scale investigations into industrial applications has to be considered at an early research stage in the technical as well as economical domain.

PL2.2

'Biotics' in foods: definitions and future perspectives

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'Biotics' in foods: definitions and future perspectives Seppo Salminen

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Gut microbiota influences health and impacts our metabolism in part by interacting with our dietary components and converting them into metabolic products. Microbiota-targeted dietary components include the `biotic` family, probiotics, prebiotics, synbiotics and postbiotics as well as fermented foods. The first gut microbiota modulating substances may have been fermented foods. Fermented foods and beverages have a long history of use, accompanying the transition from hunter-gatherer communities to sessile agricultural communities in the Neolithic revolution about 14,000 years ago. Fermented foods may theoretically encompass all these substances, as they supply us with microbes at various stages along the live-dead continuum, predigested nutrients, and bacterial metabolites, all of which may affect human gut microbiota.

Understanding fermentation processes has changed our perceptions of the components in and the nutritional value of fermented foods, leading to the idea of 'biotic' components in our foods with potential to modulate microbiota. Facilitating such processes may lead to the formulation of effective foods with 'biotic' components able to positively impact gut microbiota development from infants to the elderly. Biotic components are defined by the Nature journals: Biotic components are the living organisms present in an ecosystem, such as bacteria, fungi, plants and animals, and elements produced by them. (https://www.nature.com/subjects/biotic)

Given the mechanisms by which such microbiota-modulating foods may achieve their desired effects, the current regulatory framework needs definitions that help in understanding the challenges and rewards in determining how microbiota modulating components should be classified. Over the past 8 years, ISAPP (www.ISAPPscience.org) has advanced consensus definitions of probiotics, prebiotics synbiotics and postbiotics. Each definition requires existing evidence of health promoting effects. Consensus definitions are useful for these developing fields, so that scientists, clinical trialists, industry, regulators, and consumers have common ground for future activity in the area of biotics. A generally accepted definition for each member of the biotic family will hopefully help in creating regulatory clarity and promote innovation and the development of new microbiota modulating products. The definitions and their background have been published in Nature Reviews in Gastroenterology as open access publications (Table).

Table. ISAPP definitions for fermented food, probiotic, prebiotic, synbiotic and postbiotic.

Fermented Foods	Foods made through desired microbial growth and enzymatic conversions of food components	Hill C et al Nat. Rev. Gastroenterol. Hepatol. 11, 506–514 (2014)
Probiotic	Live microorganisms that, when administered in adequate amounts, confer a health benefit on the host	Gibson G et al Nat. Rev. Gastroenterol. Hepatol. 14, 491–502 (2017)
Prebiotic	A substrate that is selectively utilized by host microorganisms conferring a health benefit	Swanson K et al Nat. Rev. Gastroenterol. Hepatol 17, 687–701 (2020)
Synbiotic	A mixture comprising live microorganisms and substrate(s) selectively utilized by host microorganisms that confers a health benefit on the host	Marco M et al Nat. Rev. Gastroenterol. Hepatol 18, 196-208 (2021)
Postbiotic	Preparation of inanimate microorganisms and/or their components that confers a health benefit on the host	Salminen, S. et al. Nat Rev Gastroenterol Hepatol, 18, 649-667 (2021)

PL2.3

‘How ‘low’ – trophic – can we go?

Kousoulaki K

‘How ‘low’ – trophic – can we go?

The High-Level Panel for a Sustainable Ocean Economy 2019 report shows the potential of the oceans to solve climate change cutting more CO_2 than the emissions from all the world's coal power plants! But to make this happen we need to go ‘low’…Our seafood items should be harvested more and more lower in the trophic chain, we must eliminate waste, and redirect raw materials and biomass from animal feed, directly to human consumption. We must embrace and include circular economy on our dinner table. If we manage to do that now we can, not only secure access to high quality food for future generations, but also bring unthinkable benefits to ours!

PL3.1

Agricultural by-products and food residues to revalorize our world

Ibañez E[1], Sánchez-Martínez J[1], Mendiola J[1], Álvarez-Rivera G[1], Cifuentes A[1]
[1]CIAL-CSIC

At present, one of the great challenges facing humanity is the eradication of hunger, one of the top commitments on The Sustainable Development Goals (SDGs) [1]. New approaches on agricultural development for food security and nutrition are challenging our research since they will allow an easier access to safe and nutritious food for sustaining life and promoting good health.

In our laboratory, we are continuously trying to provide need answers towards sustainability through the application of Green Chemistry and Green Analytical Chemistry (GAC) principles in our everyday life [2]. This is the main focus of Green Foodomics [3], that integrates those principles in each of the -omics platforms during method development to determine food constituents and nutrients at the molecular level. Moreover, Green Foodomics also deal with food safety and quality assessment and with the bioprospecting of compounds with nutritional or functional value using, among others, green solvents and environmentally friendly extraction techniques, measured using different Green Metrics.

In the present work we evaluate the safety of agricultural by-products intended to be applied as potential sources of compounds with neuroprotective activity against Alzheimer Disease. A new methodology, based on the use of Natural Deep Eutectic Solvents (NADES), has been developed, tested and validated for twelve pesticides commonly employed in the citrus industry. The greenness of the procedure has been evaluated using AGREE calculator. Finally, the whole method has been applied for the safety assessment of seven citrus by-products produced in Spain, finding the presence of several of the evaluated compounds at concentrations higher than the established limits for similar products.

Moreover, new methodologies, based on the use of compressed fluids, were applied to improve the recovery of neuroprotective compounds (mainly terpenoids) from citrus by-products; comparison among conventional extraction procedures and pressurized liquid extraction has been carried out in terms of yields, in-vitro bioactivities and composition. Promising results were obtained with in-vivo models for citrus by-products extracts obtained with ethyl acetate under PLE conditions.

References

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[3] Ballesteros-Vivas D, et al., Current Opinion in Green and Sustainable Chemistry 2021, 31:100522.

PL3.2

Industrial technologies and protocols for selective green extraction of primary and secondary metabolites from plant material

Cravotto G

Topic 2. New food product development: from risk assessment to nutritional foods
Subtopic 2d. New techniques and technologies for tailored food design
Title:
Industrial technologies and protocols for selective green extraction of primary and secondary metabolites from plant material.
Author:
Giancarlo Cravotto
Department of Drug Science and Technology, University of Turin, Via P. Giuria 9, 10125 Turin (Italy)

Aim: To improve the production of high quality extracts from agri-food leftovers and residual biomass through a selective approach. The high demand for alternative proteins has encouraged the development of extraction processes using non-conventional energy sources. Highly-efficient green technologies are also expected for the extraction of other primary metabolites such as oils, carbohydrates, and soluble fibres. An even greater challenge is the isolation and fractionation of secondary metabolites and volatile compounds. The definition of crucial extraction parameters and conditions, at pilot scales, with a careful analysis and modeling of heat, mass transfer and the corresponding energy consumption, is of paramount value for scale-up engineering.
Method: The application of enabling technologies that lead to process intensification, energy and cost savings, and often greater selectivity. New semi-industrial and industrial reactors for solid/liquid extraction have been developed. The main non-thermal technologies available operating in continuous flow are power ultrasound (US), rotor/stator hydrodynamic cavitation (HC) and pulsed electric fields (PEF). Processes under heating/cooling and pressure/vacuum are also available (both batch and flow) exploiting ohmic and dielectric heating as well as a new technology for multiple-effect fractional condensation under vacuum.
Results: Relevant progress in the application of eco-friendly, non-conventional extraction processes at industrial scale. In addition to process intensification the new paradigms in plant extraction mainly refer to continuous flow processes, which are in contrast to classical batch methods. Another new paradigm in extraction refers to the so-called hyphenated extraction methods. A synergistic effect is observed when different energy sources are combined. Relevant examples are the combination of US (or HC) with PEF, atmospheric plasma, enzymatic treatment and supercritical fluid extraction (SC-CO_2). Impressive results in terms of yield and time savings have been obtained with subcritical water extraction (SWE).
Conclusion: Nowadays the technology readiness levels (TRLs) of the above technologies are much higher, namely ready to replace the traditional maceration and percolation.

PL3.3

Testing the effectivity and safety of phage cocktails for foods and food production.

Lavilla M[1], Ruiz-Santamaria E[1], Lasagabaster A[1]
[1]AZTI

Aim: Phages are becoming one of the most noteworthy alternatives to achieve the need of new antimicrobials for assuring food safety as well as animal and human health without affecting the environment (One-health approach). This work is intended to show how phages are validated for their best performance with both *in vitro* and *in vivo* trials, to acquire the best stientific information about their effectivity and safety for their potential applicability in real conditions.
Method: Phages were isolated and purified through standard microbiological methods (spot tests and double layer methods) against the target bacteria (in particular, *Vibrio*, *Listeria* and *Campylobacter* spp.). After genetic and technological characterization (host range, resistance to different environmental and food processing conditions, efficiency, doses…), the optimization of each application conditions, according to the expected purpose of each phage coctail, was accomplished by *in vitro* and *in vivo* trials (incl. animal model *Galleria mellonella*).
Results/Conclusion:: Conditions where phages can be applied must be checked for the best effectivity and safety: Thus, *in vitro* methods are mandatory to assist the technological characterization and selection of the most suitable phages depending on the intented purpose. Although phages are the most frequent microorganisms on hearth (and generally recognized as safe), additional animal models and *in vivo* trials (following environmental, animal welfare and ethical matters) are necessary, in order to confirm the safety and the effectivity of selected phages in previously selected "close-to-real" conditions.

Healthy Foods for all – the essential role of food processing

Ahrne L

Healthy Foods for all – the essential role of food processing
Chairs: Lilia Ahrné and Dolores ORiordan

As we increasingly aspire to a sustainable, healthy diet for all, the need for collaboration between Food and Nutritional Sciences has never been greater. Nutritionists and Food Scientist ultimately strive for the same end point, ensuring the provision and promoting the consumption of safe, sustainably sourced nutritious foods to enhance human health.

There are examples of excellent interdisciplinary research between Nutrition and Food Science, however in many cases dialogue and collaboration need to be improved. Inevitably this has led to both disciplines taking different perspectives on important issues relating to food quality. This is particularly evident in the case of the widely used term 'Ultraprocessed food' and food classification systems such as NOVA. These approaches deserve revision and going back to scientific foundations is required.

In this session we will explore:

- Why do we process food – in the past and today?
- How can food scientists and nutritionists work together to close the gap for development of healthy foods?

We will hear from leading scientists:

Vincenzo Fogliano: The link between food processing and food quality: can we go beyond the obvious ?
Christoph Hartmann: How processing enhances the nutritional value of food products
Elisabet Rytter: Dialogue between food scientists and nutritionists and the nutritional recommendations
Erich Windhab: On the differentiation of processing and formulation - impacts on consumer-relevant food classification

followed by a panel debate with the 4 speakers.

Special session 2

ENOUGH project: Technologies, tools and methods to achieve climate neutral food businesses

Sliwinski E

Special Session Description:

Food systems are globally responsible for 20 to almost 40 % of total greenhouse gas emissions. Over the whole food chain approximately 60% of food should be refrigerated at some point and it is estimated that approximately 70% of emissions from food are related to perishable foods. The main source of emissions is related to energy use within the food chain, but leakage of high GWP refrigerant is another relevant source.
This session will introduce ENOUGH, a Horizon2020 R&I project that started in October 2022. ENOUGH will address the challenges in the food sector related to greenhouse gas emissions. It will suggest many practical and efficient solutions to provide a sustainable cold chain for the food sector with decreased carbon emissions. Equally important, the project aims to increase awareness among policy makers, businesses, investors, entrepreneurs, institutions, stakeholders and citizens of selected innovative systemic solutions and their potential for uptake at EU scale.
The ENOUGH session will consist of 6 different presentations by highly esteemed scientists:

1. ENOUGH: Technologies, tools and methods to achieve climate neutral food businesses by Edward Sliwinski
2. Estimation of the UK 2019 Baseline Year's Energy Demand and Emissions of Cold Storage Using a Bottom-Up Model by Xinfang Wang
3. Technology demonstration to reach climate neutrality in European food industry by 2050 by Hanne Dalsvag
4. Energy savings of dynamic controlled atmosphere storage of pear fruit by Pieter Verboven
5. Vacuum-freezing technology implementation in domestic-scale freeze-dryer for an affordable long-term food storage by Michel Palacz
6. Policy Gaps and Feasible Policy Interventions in The European Food Value Chain by Inmaculada Martínez-Zarzos

Chair: Edward Sliwinski, PhD,

Affiliation: European Federation for Food Science and Technology, Wageningen, The Netherlands

Presenter 1: Edward Sliwinski, PhD,
Affiliation: European Federation for Food Science and Technology, Wageningen, The Netherlands

Co-authors:
Kristina Widell

Affiliations:
[2] SINTEF Ocean, Trondheim, Norway

1: Title: ENOUGH: Technologies, tools and methods to contribute to the EU Farm to Fork strategy to achieve climate neutral food businesses

Abstract:
Food systems are globally responsible for 20 to almost 40 % of total greenhouse gas emissions. Over the whole food chain approximately 60% of food should be refrigerated at some point and it is estimated that approximately 70% of emissions from food are related to perishable foods. The main source of emissions is related to energy use within the food chain, but leakage of high GWP refrigerant is another relevant source.
The main scope of the ENOUGH project is to support the EU farm to fork sustainable strategy by providing technical, financial, and political tools and solutions to reduce GHG emissions (by 2030) and achieve carbon neutrality (by 2050) in the food industry. This 4-year project, funded under topic HORIZON-CL6-2021-FARM2FORK-01-12, started in October 2021.

ENOUGH will provide technologies, tools and methods to contribute to the EU Farm to Fork strategy to achieve climate neutral food businesses. The project will address the challenges in the food sector related to greenhouse gas emissions. It will suggest many practical and efficient solutions to provide a sustainable cold chain for the food sector with decreased carbon emissions. Equally important, the project aims to increase awareness among policy makers, businesses, investors, entrepreneurs, institutions, stakeholders and citizens of selected innovative systemic solutions and their potential for uptake at EU scale.
What will ENOUGH do?

- Elaborate strategies to decarbonising the food chain that will help the European food industry to reduce emissions to reach their regulatory and strategic targets.
- Provide solutions to integrate and manage the food chain of the future through a system approach on how to use (and mitigate), make, store, move, manage, finance and regulate energy and carbon demands through the food chain
- Demonstrate new technologies and their performance to help decarbonisation of the food chain
- Propose innovative food chain systemic approaches and solutions to achieve the sector sustainability through technology, behavioural change, governance and financial opportunities.

Keywords:
GHG emissions, decarbonizing, climate neutral food businesses

Presenter 2: Xinfang Wang, PhD,
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Co-authors:
Hameed B. Mahood[1], Leyla Sayin[1], Xinfang Wang[1], Ahmed Alammar[1], Rasaq Lamidi[1], Asha Singh[1], and Toby Peters[1]

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Centre for Sustainable Cooling, School of Chemical Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

2: Title: Estimation of the UK 2019 Baseline Year's Energy Demand and Emissions of Cold Storage Using a Bottom-Up Model

Abstract:
Aim: The food cold chain is becoming essential for food security. It reduces food waste and sustains the food quality of consumer demand. Many foods are dropped after the production stage to centralised cold stores before being distributed to retail. These stores, however, are used only to maintain the food products' temperature; therefore, they could be chilled or frozen depending on the food requirement.
Method: This short paper uses a bottom-up approach to estimate the energy, cooling demands and emissions from the UK cold storage for the baseline year 2019. Pre-cooling of food commodities is considered a part of cold storage. Only refrigerated edible food is considered. Further, refrigerated food is categorised into chilled and frozen to capture the difference in energy requirements.
Results: We consider six categories for refrigerated food – meat, poultry, fish, milk, fruits, and vegetables- requiring different temperatures and ambient conditions. Both indirect (energy-based) emissions and direct (refrigerants fugitive) are included. Energy-based (i.e., indirect) emissions are calculated based on the energy consumption of the considered food products using a suitable electricity emissions factor of the baseline year (0.22 kgCO2e/kWh). On the other hand, direct (fugitive) emissions are estimated based on the information on refrigeration systems stock, annual charge, GWP used, percentage of leakage and equipment lifetime. Only emissions from fugitives during the equipment operational period and disposal are considered.
Conclusions: The results showed that the overall energy consumption and cooling demand were about 2.16 TWh and 3.44 TWh, respectively. On the other hand, the sector's total emissions (pre-cooling and cold storage) were about 1.17 MtCO2e. Of these, about 62.5% were indirect emissions, and the remaining (37.5%) were direct (fugitive) emissions.

Keywords:
Food cold chain; cold storage; energy demand; emissions.

Presenter 3: Hanna Dalsvag, MSc,
Affiliation: SINTEF Ocean, Trondheim, Norway

Co-authors:
Kristina Widell[1]

Affiliations:
[1] SINTEF Ocean, Trondheim, Norway

3: Title: Technology demonstration to reach climate neutrality in European food industry by 2050

Abstract:
Aim: The world is no longer making progress on reaching the UN sustainable development goals by 2030. One third of global anthropogenic GHG emissions come from food systems, making the food industry a key area to speed up the work on reaching the goals and reaching climate neutrality.
Method: The EU ENOUGH project is tackling these issues through developing and showcasing innovative and advanced technology demonstrators to achieve neutral carbon food businesses by mitigating climate change, reducing energy use, and increasing energy efficiency. The technologies represent different steps of the food value chain (processing, distribution, storage, and preparation of foods) and different key food product categories (meat, fish, dairy, fruit and vegetables, and other).
Results: We are now halfway through the project and several results have already been disseminated, which will be highlighted in this presentation. Examples are CO_2 heat pump for a dairy processing plant, high temperature heat pumps to reduce fossil fuel for steam production, natural refrigerants for multi-temperature refrigerated transport and building blocks for a digital twin of a large cold store complexes.
Conclusions: It is highly important that the results from these demonstrators are exploited and disseminated further, so that others also can implement them and thereby reduce their GHG emissions. The presentation will also highlight some key steps to this.

Keywords:
GHG emissions, Climate neutrality, energy use, food value chain

Presenter 4: Pieter Verboven, PhD,
Affiliation: KU Leuven, division MeBioS, Postharvest group, Leuven, Belgium.

Co-authors:
Bert Verlinden[2], Hoang Minh Phan[1], Sander Vanwayenbergh[1,3], Niels Bessemans[3], Bart Nicolai[1, 2]

Affiliations:
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[2] Flanders Centre of Postharvest Technology (VCBT), Leuven, Belgium
[3] Optiflux NV, Houthalen-Helchteren, Belgium

4: Title: Energy savings of dynamic controlled atmosphere storage of pear fruit

Abstract:
Aim: To assure a year-round supply, pome fruit (apple, pear) are stored at low temperature and in a controlled atmosphere (CA) with low oxygen and modified carbon dioxide gas concentrations to prevent ripening and decay. CA storage is an energy intensive process. Dynamic controlled atmosphere (DCA) is a recent CA technology that adapts the gas concentrations in the storage room in response to the measured respiratory metabolic rate of the fruit, that is a driver for postharvest ripening. This allows improved management of the storage avoiding food losses, better quality preservation of the fruit and energy savings in the operation of the refrigeration and gas control systems. DCA is a digital technology that combines sensors and models for fruit batch specific optimal control of the storage room. The aim of this work was to implement an industrial scale DCA system in comparison to conventional CA, and evaluate fruit quality and energy use.

Method: Commercial CA rooms were equipped with a dedicated gas, temperature and pressure measurement unit to accuretely monitor and register the changing conditions due to fruit respiration. Based on the measured quantities, a dynamic gas exchange model was used to compute the value of the respiration quotient of the

fruit, as measure for the respiration status of the fruit. In the DCA rooms the setpoint of the oxygen concentration in the room was consequently adapted based on previously developed and validated protocols. In the normal CA storage, the oxygen concentration was maintained at a predefined level. The rooms were loaded with pear fruit harvested at commercial picking date. Firmness and color after storage was also assessed to verify if high quality standards were reached by DCA. A storage room energy balance model was used to compute the total energy use reduction in the DCA rooms with respect to standard CA.

Results: Oxygen concentrations in DCA rooms could be reduced to as low as 1 %, while in standard CA conditions it was 3%. Firmness and green background color of the fruit were maintained very well in DCA after more than 100 days of storage, without a need of chemical control agents such as 1-methylcyclopropene. Energy savings of DCA compared to CA were computed to be 15%.

Conclusion: DCA was successfully implemented at industrial scale, demonstrating benefits for quality preservation and energy savings after long term storage of pear fruit. Together they contribute to reduce significantly the CO_2 emissions from fruit supply chains.

Keywords:
fruit quality, energy use, controlled atmosphere storage, modeling, optimal control, industry application

Presenter 5: Michel Palacz, PhD,
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Co-authors:
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5: Title: Presenter 5: Jakub Chrobak, MSc,
Affiliation: Faculty of Environmental Engineering and Energy / Department of Thermal Engineering ul. Konarskiego 22, room 219, 44-100 Gliwice, Poland.

Co-authors:
Jacek Smolka[1], Michal Palacz[1], Michal Stebel[1], Ignat Tolstorebrov[2]

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[2] Department of Energy and Process Engineering, Norwegian University of Science and Technology, Kolbjorn Hejes 1B, Trondheim, 7049, Norway.

5: Title: Improvement of domestic-scale freeze-dryer affordability by implementing vacuum-freezing technology, volumetric heating method and natural-based working fluid

Abstract:
Aim: Freeze-drying is the process that can guarantee high-quality dehydrated food products that can be stored without chilling for a long period of time. However, the processing is energy-intensive during the freezing and freeze-drying periods. For that reason, vacuum-freezing was proposed to be the pre-freezing method in a domestic-scale freeze-dryer in order to reduce the total processing time and improve energy efficiency. Moreover, the possibilities of using microwave-based volumetric heating during the lyophilisation stage assisted with the R290 refrigeration system were assessed. The expected result is a significant reduction in power input for the freeze-drying process and a reduction in carbon footprint for long-term food storage.
Method: A reference freeze-dryer for domestic use was modified to perform vacuum freezing before the freeze-drying period. Required modifications covered changes in the vacuum system and the introduction of a new control system. Experimental activities were focused on determining how vacuum freezing affects the quality of food products and what should be the most effective strategy for controlling pressure and vacuum level. A comprehensive investigation of the refrigeration system allowed to prove that R290 is a suitable natural-based fluid to be used in a new generation of domestic freeze-dryers.

Results: The expected results will allow for a significant reduction in the freeze-drying time and energy input for several reasons. First, the vacuum freezing itself allows for the rapid freezing of small foods. Second, during vacuum freezing, a part of water in food products is removed to reduce the temperature by the latent heat of freezing, so the freeze-drying will be shorter. Furthermore, vacuum freezing is expected to enhance the porosity of food product structure, which will emphasise ice sublimation during the freeze-drying period. The experimental results will be compared with a reference freeze-dryer operating with R452A refrigerant.
Conclusions: The study proves that the conventional freeze-drying process of foods can be improved in order to reduce the energy input and the overall carbon footprint of the process. Implementation of vacuum-freezing, using state-of-the-art refrigerants and changing the heating method are the most promising solutions to make freeze-dried foods be feasible in terms of long-term storage.

Keywords:
lyophilisation, food freezing, vacuum-freezing, storage

Presenter 6: Inmaculada Martínez-Zarzoso, PhD
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Co-authors:
Ianna R. Moreira-Dantas

Affiliations:
[2] Faculty of Economic Sciences, Georg-August-Universität Göttingen, Göttingen, Germany

6: Title: Policy Gaps and Feasible Policy Interventions in The European Food Value Chain

Abstract:
Aim: According to the current state of governmental policies, industries shall decarbonize their operations by 2050 (European Commission, 2019). The food sector is a central element of this transformation, given the relevance of food security and poverty alleviation (SDG1,2) and also given that greenhouse gases (GHGs) emitted along the stages of the food supply chain (FSC) have to be reduced (Garnett, 2011). With increasing food and energy demand, achieving the needed emission reduction from farm to fork (F2F) will require massive structural changes, while considering that some stakeholders in the FSC are key GHG emitters but very vulnerable to climate change (Myers et al., 2017). The European Commission (EC) announced in 2023 a number of policy measures, including subsidies, and financial support measures for investments in sustainable ventures and clean technology (European Commission, 2023a) that should serve as instruments to achieve the goals.
This paper evaluates the feasibility of the ongoing European policies, which aim at achieving a carbon-neutral economy in three decades and identifies potential gaps in the current policy and regulatory framework related to the FSC.
Method: The methodology consists on a comprehensive analysis of current policies and regulations that refer to the FSC to spot synergies and opportunities for policy design to promote sustainable FSC in Europe. The existing policies are linked to sustainable priorities in a way to spot synergies and gaps along the FSC.
Result: In total, 13 food-related political strategies were found and detailed according to FSC stage, scope (climate change mitigation or adaptation, and governance) and their contribution to the decarbonization target. The results highlight the FSC stage-specific policy gaps according to the political priorities proposed by the F2F. Although the European Green Deal (EGD) sets a new era for transformation with a roadmap for taking the required legal and legislative action to pace the way towards decarbonization, the FSC is a complex system encompassing activities that produce, add value and supply food products and services to final consumers and this will difficult the achievement of the goals.
Conclusions: Despite visible synergies with F2F priorities, current policies do not cover all aspirations proposed in the F2F blueprint, a fact that calls for concise planning and political interventions in all working areas.

Keywords:
Food value chain, decarbonization, policy gaps, European Green Deal.

Special session 4

Microbes4SustainableFoods – Designing future fermented foods

De Vries J

Microbes4SustainableFoods – Designing future fermented foods

Session from 10:30 – 12:30 on Tuesday November 7

Special Session Description:
Foods, made through desired microbial growth and enzymatic conversions of food components have been part of the human diet for millennia. Globally a very broad range of fermented foods exist, both animal and plant based. Fermentation processes have mainly been applied to conserve perishable foods. Potential health benefits of fermented foods have only been considered rather recently. Only very recently, promotion of controled fermentation processes in foods have drawn scientific attention, not only from a nutritional perspective but also from a sustainability perspective. In the Microbes4SustainableFoods sessions, five European projects with overlapping interests in food fermentation processes, In the Microbes4SustainableFoods sessions , five European projects, with overlapping interests in food fermentation processes, collaborated to present a varied program on the design of future fermented foods. In a general introduction presentation on food fermentations, the common state of the art of the different projects will be presented. Afterwards, the setup of HealthFerm, PIMENTO, DOMINO and WHEATBIOME will be discussed, followed by some results of the MASTER project, DOMINO and HealthFerm. Finally, a roundtable discussion with the coordinators of the different projects on a sustainable network in food fermentation technology, how to create synergy between the European projects on Microbes4Sustainable Foods and the critical steps into application of foods that are available to the consumer.

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Presenter 1: Yamina De Bondt

Laboratory of Food Chemistry and Biochemistry, KU Leuven, Leuven, Belgium

1: Food fermentations – state of the art

Yamina De Bondt[1], Stéphane Chaillou[2], Christophe Chassard[3], Paul D. Cotter[4], Susana Soares[5], Christophe Courtin[1]

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[4] Teagasc Food Research Centre, Moorepark, Ireland

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Abstract:

In 2020, the World Economic Forum highlighted that fermentation presents an opportunity to fundamentally change the way the world eats and improve global human and environmental health and the economy. However, much research is still needed to understand the impact of fermentation technology on human and environmental health and to design fermentation processes optimally. Fermentation in the food industry can refer to food fermentation, biomass fermentation or precision fermentation. In the context of the European projects HealthFerm, Domino, WHEATBIOME and MASTER, and the Cost Action Pimento, a general introduction to the topic of food fermentations is given in this presentation.

Fermented foods were defined in 2021 by ISAPP as "foods made through desired microbial growth and enzymatic conversions of food components" (Marco et al., 2021). Fermented foods have been a part of the human diet for millennia. A broad range of fermented foods exists, being produced from diverse food substrates, such as vegetables, grains, soybeans, milk, fish and meat. Fermented foods often contain live microorganisms, like yoghurt, cheese and kombucha. However, in several fermented foods, the microorganisms are no longer alive; for example, in bread, pasteurised fermented vegetables and soy sauce.

In this presentation, the microorganisms involved in food fermentations and the physicochemical transformations of raw materials, with a focus on plant-based raw materials, will be summarised. Furthermore, the different possible technofunctional and sensorial benefits of food fermentations will be discussed. Finally, an overview of the current knowledge on the effect of fermentation on health benefits and microbiome-enhancing effects will be given.

Keywords:

Food Fermentation, Microorganisms, Human Health, Microbial foods

Presenter 2: Christophe Courtin

Laboratory of Food Chemistry and Biochemistry, KU Leuven, Leuven, Belgium

2: HealthFerm: Innovative pulse and cereal-based diets for human health and sustainable diets

Christophe Courtin[1] and the HealthFerm consortium[2]

[1] Laboratory of Food Chemistry and Biochemistry, KU Leuven, Leuven, Belgium; [2]HealthFerm consortium: KU Leuven (Belgium), ETH Zurich (Switzerland), University of Helsinki (Finland), Umeå University (Sweden), European Research and Project Office GmbH (Germany), Vrije Universiteit Brussel (Belgium), Institute of Biology Bucharest (Romania), Free University of Bozen-Bolzano (Italy), University of Turku (Finland), Swedish University of Agricultural Sciences (Sweden), Chr. Hansen A/S (Denmark), VTT Technical Research Centre of Finland (Finland), Puratos (Belgium), Valio Ltd (Finland), Planted Foods AG (Switzerland), University of Eastern Finland (Finland), Vlaams Instituut voor Biotechnologie (Belgium), Chalmers University of Technology (Sweden), Institut Paul Bocuse (France), University of Copenhagen (Denmark), Bridge 2 Food (The Netherlands), HealthGrain Forum (Finland), International Association for Cereal Science and Technology (Austria)

Abstract:

Fermented foods are consumed in Europe and across the globe. Especially in the past decades, fermented foods have been hailed for their nutritional and perceived health benefits. Yet little is known about the impact of fermentation on human health or how fermentation can be leveraged to enhance the use of sustainable plant-based raw materials. The new EU research project HealthFerm, a collaboration of 23 partners from across Europe, will shed light on this forward-looking topic. The project is funded through the European Union's Horizon Europe Framework Programme for Research and Innovation and the Swiss government.

The HealthFerm project targets the societal and industrial transition from traditional to sustainable plant-based fermented foods by design for a healthy everyday diet. This will be achieved by disentangling the interaction between food fermentation microbiomes, grain-based foods and the human gut microbiome and health.

Drawing from a community science approach, HealthFerm will identify micro-organisms and metabolic pathways that may result in desired nutritional and health effects. Fermentation technology will be used to develop novel, healthy and nutritious liquid and (semi-)solid foods based on legumes (pea and faba bean) and cereals (wheat and oat). The impact of these foods on human health and the gut microbiome will be assessed in a number of intervention trials. Consumer acceptance of fermented foods, their technologies and their role in the transition towards a more sustainable healthy diet will be studied in different social contexts. Finally, extensive ecosystem building and training activities will contribute to HealthFerm's strong participatory approach.

Keywords:

Microbial Resources, Fermentation Technology, Human Health and Microbiome, Consumer behaviour, Horizon Europe

Presenter 3: Marta Laranjo

3. Promoting Innovation of Fermented Foods (PIMENTO) – Cost Action CA20128

<u>Marta Laranjo</u>[1], Vittorio Capozzi[2], Marie Champomier-Vergès[3], Zuzana Ciesarova[4], Antonio Del Casale[5], Juana Frias[6], Photis Papademas[7], Michail Syrpas[8], Smilja Todorovic[9], Guy Vergeres[10], Christophe Chassard[11]

[1] MED–Mediterranean Institute for Agriculture, Environment and Development & CHANGE–Global Change and Sustainability Institute, Institute for Advanced Studies and Research, Universidade de Évora, Evora, Portugal

[2] Institute of Sciences of Food Production, National Research Council (ISPA-CNR), Bari, Italy

[3] INRAE, AgroParisTech, Institut Micalis, Jouy en Josas, France

[4] National Agricultural and Food Centre, Food Research Institute in Bratislava, Bratislava, Slovakia

[5] MICROBION, Open Innovation Department, Verona, Italy

[6] Institute of Food Science, Technology and Nutrition (ICTAN, CSIC), Madrid, Spain

[7] Cyprus University of Technology, Limassol, Cyprus

[8] Kaunas University of Technlogy, Kaunas, Lituania

[9] Institute of Neurobiology, University of Belgrade, Belgrade, Serbia

[10] Agroscope, Zurich, Switzerland

[11] INRAE, Université Clermont Auvergne, VetAgro Sup, UMRF0545, Aurillac, France

Abstract:

Present in all European diets, fermented foods (FF) hold a strategic place due to the benefits they offer in terms of nutrition, sustainability, innovation, cultural heritage and consumer interest. The potential of FF for improving human health but also driving food innovation and local production in the next decades has become highly relevant. The PIMENTO project, a COST Action CA20128 (Promoting Innovation of ferMENTed fOods; https://fermentedfoods.eu/), which started in November 2021, is supported by COST (European Cooperation in Science and Technology; www.cost.eu). The challenge of PIMENTO is to federate the scientific community and other key stakeholders working on FF. The long-term goal of PIMENTO is to place Europe at the spearhead of innovation on microbial foods, promoting health, regional diversity, and local production at different scales, contributing to economic and societal development as well as food sovereignty in order to promote multi-moda l innova tion and respond to the expectations of European communities. The wide variety of stakeholders engaged will enable CA PIMENTO: i) to tightly connect and clarify scientific knowledge on health aspects of FF ii) to tackle technical, societal and legislative bottlenecks behind FF-based innovations iii) to contribute to the establishment of long-term scientific collaborations on FF iv) to disseminate widely defined scientific knowledge on FF v) to outline a strategic roadmap for future joint research. PIMENTO will contribute to the European Green Deal and the “Farm to Fork” strategy by enhancing research and innovation into fermentation-based solutions for food products and processes, improving nutritional, sensory and functional properties. This collaborative network of researchers that includes food scientists, innovators, entrepreneurs, microbiologists, biochemists, and nutritionists has a very broad geographical coverage with more than 480 partners of 59 countries. This regional and international diversities will play an important role through considering a differentiated panel of FF in diets.

In the frame of this EFFoST session, we want to contribute together with the other main EU projects in the field to promote and disseminate the knowledge on FF and further collectively build the future.

Keywords:

Fermented foods, food innovation, nutritional benefits, health, sustainable production, cultural heritage

Presenter 4: Stéphane Chaillou

Université Paris-Saclay, INRAE, MICALIS institute, Food Microbial Ecology research group. Domaine de Vilvert, 78352 Jouy-en-Josas. France

4: Horizon Europe DOMINO project: Harnessing the potential of fermented foods for healthy and sustainable food systems

Stéphane Chaillou[1] and the DOMINO consortium[2]

[1]Université Paris-Saclay, INRAE, MICALIS institute, Food Microbial Ecology research group. Domaine de Vilvert, 78352 Jouy-en-Josas. France; [2]DOMINO consorttium: INRAE (France), Teagasc (Ireland), University of Trento (Italy), University of Naples (Naples), University of Turin (Italy), CSIC (Spain), Stiching Vrij Universiteit Amsterdam (The Netherlands), Technical university of Munich (Germany), AIT Austrain institute of technology (Austria), European Food Information Council (Belgium), INRAe transfert (France), TFTAK (Estonia), Imperial College London (UK), IRD (France), Green spot technology (France), Les nouveaux affineurs (France), Herbel crest ltd (Ireland), Moorepark technology (Ireland), Fratelli Merano (Italy).

Abstract:

European consumers are expressing a clear demand for healthier and more sustainable food. Fermented foods (FFs) have the potential to meet these expectations but there is a need to demonstrate their health impacts scientifically, while developing innovative strategies to tackle both sustainability and nutritional health.

In this frame, DOMINO will investigate the health impacts of FF-based diet on a healthy population and a cohort suffering from metabolic syndrome to better focus on health biomarkers. A second objective of DOMINO is to provide tailor-made microbial solutions using an integrated 'omics' strategy and computational biology modelling to address the challenges associated with sustainable food production and healthy nutrition. In six food case studies, selected as representative of the wide diversity of plant-based FF prototypes, we will involve key stakeholders in a multi-actor approach through several living labs across Europe. These food prototypes will help to develop an open access database and new computational tools for profiling food microbiomes' metabolic interaction during food fermentation and their overlap with the healthy gut microbiome. Meanwhile the living labs will ensure DOMINO scientists to move towards a vision of the future of FFs in Europe while enhancing the trust of citizens in the food value chain through their involvement and genuine integration of their perspectives, paving the way for citizen-friendly innovation.

At last, a third objective of DOMINO is to provide a knowledge-based logical frame of analytical strategies, including several combination of *in-vitro* and *ex-vivo* models (distal colon digestion models, organoids, gut-on-chip etc…) for facilitating the health risk/benefit analysis of any fermented food and their tailor-made microbiota.

Keywords:

Fermented food, food innovation, health impact, risk-benefit analysis, gut microbiome, plant based, sustainability,

Presenter 5: Rosa Perez-Gregorio

Departament of Food and Analytical Chemistry. Nutrition and Bromatology Area. Faculty of Science. University of Vigo. Campus As Lagoas s/n 32004 Ourense, Spain

5: WHEATBIOME project: Unravelling the potential of the wheat microbiome for the development of healthier, more sustainable and resilient wheat-derived food & feed products

Rosa Perez-Gregorio[1] and the WHEATBIOME consortium[2]

[1] Departament of Food and Analytical Chemistry. Nutrition and Bromatology Area. Faculty of Science. University of Vigo. Campus As Lagoas s/n 32004 Ourense, Spain

[2] Universidade do Porto (Portugal), Universidad de Vigo (Spain), Universitat de Valencia (Spain), Instytut Biotechnologii Przemysłu Rolno-Spożywczego im. prof. Wacława Dąbrowskiego – Państwowy Instytut Badawczy (Poland), Contactica SL (Spain), Stichting Wageningen Research (Netherlands), Szkoła Główna Gospodarstwa Wiejskiego (Poland), Universidade Nova de Lisboa (Portugal), Editorial Agricola Espanola SA (Spain), UAB ART21 (Lithuania), Isanatur Spain SL (Spain), Állatorvostudományi Egyetem (Hungary)

Abstract:

The current food system faces many challenges, and a profound change is urgent to design resilient, inclusive, sustainable, and healthy foods. Furthermore, a raised awareness of the connection between healthy ecosystems and human well-being has been observed. In this regard, microbial communities present an unexploited potential able to work in a whole approach, from soil to plate.

Wheat is a central crop in Europe and soil and plant microbial communities are of particular interest in wheat crops since (1) they are crucial solutions for restoring soils and protecting the crops and wheat-derived products against abiotic and biotic stressors; (2) they play a key role in regulating plant metabolisms and, thus, the quality and properties of crops; and (3) they can be promising producers for a wide range of nutritional and healthy food and feed products. Nevertheless, the knowledge in these topics is scarce. Therefore, the WHEATBIOME project aims an holistic approach with a strong collaboration between different stakeholders to: i) understanding factors that affect wheat breeding and the role of microbiomes; ii) increasing the data on soil & plant microbiomes and their interactions with plants; iii) addressing the concerns & needs of the diverse food system actors towards sustainable food production systems; iv) applying this new knowledge through translational research to develop novel approaches for farming by providing a decision support system (DSS) and agricultural sustainable recommendations; v) generating and validating new food and feed products via microbial fermentation, that will be healthy, tasty, environmental-friendly, and affordable; vi) enlarging the knowledge on food/feed-host microbiome interactions; and (7) effectively communicating results more directly to the stakeholders of the food industry as well as to citizens by providing training, workshops, and active communication in social platforms.

In this session, an overview of the WHEATBIOME project and its working packages will be explained.

Keywords: soil & plant microbiome, fermented food, foodomics, taste, celiac disease, protein-bioactive interactions

Special session 5

Sustainable and Digital Transformation of the Spanish Agri-Food Sector for a Greener and Healthier Future

GASCON E

Sustainable and Digital Transformation of the Spanish Agri-Food Sector for a Greener and Healthier Future

Special Session Description:

"Planes complementarios" is a new instrument funded by the Recovery and Resilience Facility (RRF) – NextGenerationEU,.which aims to establish close collaborations with the regional governments (CCAA) in R&D&I actions that have common objectives. It involves creating synergies, aligning fund execution, and establishing common priorities. Agroalnext is oriented towards the transformation of the agri-food sector into a greener, more sustainable, healthier, and digital scenario, bridging the gap between scientific discoveries, technology development, and their implementation. In this special session several projects that are being implemented in the different CCAAs participating in this program will be presented. The session will close with a roundtable discussion and Q&A from the audience.

Chair: Inés Echeverría Goñi[1]

[1] Centro Nacional de Tecnología y Seguridad Alimentaria (CNTA), San Adrián, Navarra, Spain.

Presenter 1: Elena Gascón Villacampa

CNTA, San Adrián, Navarra, Spain.

1: Introduction

Abstract:

Introduction, Agenda and objectives of the session.

Keywords:

Agroalnext, NextgenerationEU, Agri-food sector, Sustainability

Presenter 2: (TBC) D.G: Desarrollo Rural, Innovación y Formación Agroalimentaria

Spanish Ministry of Agricultrue, Fisheries and Food

2: Challenges facing the agri-food sector in Spain

Abstract:

With revenue close to €140 bn and employing more than 440,000 people, the Spanish agri-food industry is the country's main manufacturing activity in which Spain is the fourth agri-food power in Europe and tenth in the world. Alongside the tradition, the industry is undergoing a disruptive and decisive transformation towards digitalisation and sustainability to face new challenges in the form of climate change and adapting to new consumer trends. The national R&D system must play a key role in the evolution and adaptation of the sector to this changing and challenging environment.

Keywords:

Agroalnext, Nextgeneration, Spanish agri-food sector, sustainability

Presenter 3: Inés Echeverría Goñi

CNTA, San Adrián, Navarra, Spain.

Co-Authors: David Alonso[1], Alberto Bernúes[2], Silvia García de la Torre[3], Raúl Moral[4], Francisco José Barba[5], Carmen González[6], M José Trinidad[6], Ana Robert[7], María del Carmen Oliván[8], Juan José Alarcón[9], Andrés Martínez[10]

1: Universitat Politècnica de València, Comunitat Valenciana, Spain

2: CITA, Zaragoza, Spain
3: CNTA, San Adrián, Navarra, Spain
4: Universidad Miguel Hernández, Comunitat Valenciana , Spain
5: Universidad de Valencia, Comunitat Valenciana, Spain
6: CICYTEX, Extremadura, Spain
7: Gobierno de La Rioja, Spain
8: SERIDA, Villaviciosa, Asturias, Spain
9: CEBAS-CSIC, Región de Murcia, Spain
10: IMIDA, Región de Murcia, Spain

3: Mapping of Spanish biomass resources in the framework of Agri-Food Sector

Abstract:
In this session, it is presented a methodology for quantification and mapping of biomass resources (waste or by-products), mainly, in the framework of Agri-Food sector. Quantification of biomass resources is performed using generation ratios and available statistical indicators (crop area, production, processed fruit, head of livestock…) about present agricultural crops, industries (mainly food industry), livestock, forests and other.
Geographic location of biomass resources was performed using GIS. This information is usually aggregated at province level and it is generated a datasheet with information (biomass types and quantities) per province, however, some information can be available per municipality or specific site. This datasheet allows the identification of main biomass resources and their potential combinations to improve feasibility of different valorization strategies. It is also generated specific thematic maps, per type of biomass to identify key provinces for each type of biomass resource.
The methodology was applied in Spain and evaluated biomass resources are: agricultural (herbaceous and woody crops), livestock production, vegetable processing industries (as wine, olive oil, canned products and other), slaughterhouses and meat industries, dairy industries and fish industry.

Keywords:
Agroalnext, biomass mapping, waste biomass, biomass resources

Presenter 4: Amparo López Rubio
IATA – CSIC, Comunitat Valenciana, Spain.
Co-Authors: Zaida Pérez-Bassart, Christine Bäuerl, Maria Jose Fabra, Antonio Martínez-Abad, Maria Carmen Collado
IATA – CSIC, Comunitat Valenciana, Spain

4: PANACEA: mushroom residues as an alternative source of advanced nutraceuticals

Abstract:
Aqueous fractions (FA) and purified aqueous fractions (FAp) from various Pleurotus species and from the stipes of *P. ostreatus* were obtained and their macromolecular composition, structure and physicochemical properties were characterised using a broad range of analytical techniques. The carbohydrates present in the aqueous extracts significantly differed in terms of monosaccharide composition, molecular weight (Mw), thermal stability and β-glucan content. Different cell culture models including epithelial NF-κB-pathway reporter cell lines and, also, THP-1 differentiated macrophages were used to evaluate the immunostimulatory activity of the different Pleurotus-derived extracts.
Very good yields were obtained for the aqueous fractions (FA) of the various Pleurotus species (ranging between ~ 27 and 42%). In contrast, a significant lower extraction yield was obtained from *P. ostreatus* residue (stipe) (~ 17%), probably ascribed to its more recalcitrant nature. The β-glucan content varied from less than 10% to more than 60% and significantly increased after purification, reaching values above 80% for some of the species. The thermal stability and molecular weight profile pointed out to rather different β-glucan structures, further confirmed through NMR and linkage analysis.
Interestingly, these structural differences also resulted in different functional activity of the extracts. Some of the functional activities studied are pro-inflamatory and inmunostumulatory and anti-inflamatory effects. This work thus sets the basis for obtaining new nutraceuticals derived from mushroom biomass.

Keywords:
Bioactive compounds, Functional activity, Pleourotus, Nutraceuticals, Aqueous extractions.

Presenter 5: Jesús J. García Parra
CICYTEX, Extremadura, Spain.

5: Innovative combination of technologies and techniques in food processing

Abstract:
Application of High-Hydrostatic Pressure (HPP) and High Pressure/High Temperature in protein models with improved microbiological quality and safety by eliminating spoilage or pathogenic microorganisms and prolonging the shelf life of foods while improving nutritional and sensory quality.

Keywords:
High-hydrostatic pressure, protein models, microbiological safety, innovative combination

Presenter 6: Mabel Gil
CEBAS (Centro de Edafología y Biología Aplicada del Segura,) Murcia, Spain.

6: Control of microbiological risks associated with sustainable production and processing systems

Abstract:
New and sustainable production systems of fresh produce include controlled environment agriculture (CEA) and to optimized processing facilities. However, implementation of novel technologies might lead to new or emerging risks. Listeria monocytogenes is ubiquitously prevalent in natural environments and widespread in produce-growing and processing facilities (e.g. soil, water and environmental surfaces). The interplay between product, equipment surfaces, water and employees represent a complicated web of interactions, allowing L. monocytogenes to spread beyond its initial introduction site to elsewhere within the facility. Therefore, concerns have raised about the potential microbiological risks associated with L. monocytogenes in novel and sustainable production and processing systems. This project focuses on the identification of risk factors in CEA systems and associated processing operations for leafy greens. Improved environmental monitoring programs (EMPs) for production and processing environments have been developed to determine the relevance of L. monocytogenes contamination in these sustainable systems. The results obtained so far provide interesting insights about the main pathogen sources, potential transfer routes from production to processing facilities, identification of hot spots of contamination and the efficacy of specific control measures. The approach implemented in this project which combines conventional and advanced molecular techniques, such as whole genome sequencing (WGS), represents an original approach for the genetic characterization of different L. monocytogenes strains. The analysis of the genetic sequences obtained from the pathogenic strains is also critical for the identification of specific virulence genes, antimicrobial resistance genes as well as other bacterial stress responses. The project outputs will help the food industry to understand the origin of transient and persistent contamination as well as the most efficient intervention strategies to eliminate them. The implementation of effective food safety strategies in production and processing facilities is critical to reduce risks to the consumer.

Keywords:
Food safety, foodborne pathogens, microbial contamination, fresh produce

Presenter 7: Mª Carmen Olivan
SERIDA, Villaviciosa, Asturias, Spain
Co-author: Silvia García de la Torre
CNTA, San Adrián, Spain

7: Transferring knowledge and Research results to the business sector

Abstract:
Agroalnext promotes the creation of "Transfer Hubs" which are collaborative environments to enhance the creation of synergies between scientists, technicians, companies and farmers, in order to ensure

the implementation of applied studies and a real transfer of innovation to the agri-food sector. Two Hubs have been created: Eatex Food Innovation Hub (Navarra) and SERIDA-Hub (Asturias).
Eatex Food Innovation Hub: The challenges of sustainability, efficiency and food safety require, more than ever, the application of innovative technological solutions that generate impact throughout the entire agri-food value chain. R&D centers can play a relevant role and their connection with agri-food companies is strategic to promote innovation. Eatex Food Innovation Hub was born with the aim of improving and accelerating the technological transfer of value solutions from R&D centers to the agri-food sector, including start-ups. For it, Eatex carries out activities to connect challenges and solutions, finances the development of innovations through its R&D project programs and supports the scaling and implementation of innovations with different services.
SERIDA-Hub: Research in the agri-food sector requires the availability of human and technical resources that allow applied studies to be carried out in real situations, that is, on farms where different experimental designs can be tested for implementation of sustainable, healthy and beneficial agricultural practices. This Hub offers a network of Demo-Farms, which are experimental farms (testbeds) covering different farm types (arable crops, woody crops, natural and improved grassland for livestock production and regenerative agriculture), in which to test innovative solutions for the agri-food sector. SERIDA-Hub also promotes the development of "Living labs" and “Light-houses” to promote demonstration and training activities.

Keywords:
SERIDA-Hub, Eatex Food Innovation Hub, technological transfer, innovation, soil health, carbon farming

Moderators: Carmen González[1], M José Trinidad[1]
1: CICITEX, Extremadura, Spain.

8: Roundtable table discussion

The last 15 minutes of the session will be devoted to a roundtable discussion.

Special session 6

'MASTER'ing Fermented Foods

De Vries J

Microbes4SustainableFoods – Designing future fermented foods_ Part 2

Presenter 6: Paul Cotter

Teagasc Food Research Centre, Moorepark, Ireland

6: Title of abstract 'MASTER'ing Fermented Foods

Abstract:

MASTER (Microbiome Applications for Sustainable food systems through Technologies and EnteRprise) is a European Union Horizon 2020 project that, among other things, focused on using next-generation sequencing technologies to investigate the microbiomes of food systems and to improve our food quality, security and sustainability. One of the outputs of MASTER has been the development of a curated Food Metagenomic database, which, in addition to containing data relating to 583 samples from public food datasets, contains data corresponding to 1950 new samples sequenced by the MASTER team. Analysis of this data, by assembly-based (through generating metagenome assembled genomes; over 10,000 high and medium quality MAGs) and non assembly-based has provided new insights into fermented food associated microorganisms including information regarding their prevalence, distribution and overlap with gut-associated taxa.

Keywords: fermented food, gut, microbiome, shotgun metagenomics, DNA sequencing, health, lactic acid bacteria, EU

Presenter 7: Abelardo Margolles

IPLA-CSIC. Paseo Río Linares s/n. 33300 Villaviciosa. Asturias, Spain

7: Design of microbial solutions for plant-based fermented food prototypes using synthetic ecology approaches (from the DOMINO project)

Abstract:

The deployment of new multi-disciplinary scientific strategies to improve the understanding of microbial interactions in food is one of the key steps in fostering innovation in the field of food fermentations.

Synthetic ecology approaches are part of these new multi-disciplinary scientific disciplines. They involve knowledge-driven strategies to design, construct and understand engineered artificial consortia (made from natural strains) and these approaches have not yet been harnessed to facilitate the production of medium complexity fermented foods (FF) for consumers. This discipline requires an integration of various scientific skills, including food production to genomics, high-throughput screening strategies and mathematical modelling.

The ambition of DOMINO is to implement synthetic ecology experimental strategies for designing microbial solutions for six plant-based food case studies covering a large panel of raw materials (vegetables, cereals, pulses, olives, fruits and biowaste such as apple pomace) and several food prototypes (kefir, cheese-like, flours etc…). In DOMINO, synthetic ecology approaches will includes 5 different steps: (1) to leverage microbial genomic resources from raw and fermented food materials of sustainable sources; (2) to design knowledge-driven microbial consortia and testing them as microbial solutions in food models; (3) to design factorial experiments for screening the consortia based on functional and metabolic profiles; (4) to construct metabolic ecological networks to understand food microbial interactions during fermentation; (5) to asses with ex-vivo models the nutritional/health benefits for all solutions produced at pilot scale.

A brief overview of these different steps and their expected results will be presented.

Keywords:

Fermented foods, Food model, Plant based, synthetic ecology approach, microbial genomics, metabolic profiling, nutrition and health benefits

Presenter 8: Kati, Katina

University of Helsinki, Finland

8: Processing induced changes in starch, fibre and protein in plant-based dairy alternative “gurt” (from the HealthFerm project)

Silvia Cera[1], Fabio Tuccillo[1], Prabin Koirala[1], Mika Immonen[1,2], Samy Boulos[3], Noora Mäkelä-Salmi[1], Laura Nyström[3], Riitta Partanen[2], Ndegwa H. Maina[1], Rossana Coda[1], Kati Katina[1]

[1] Department of Food and Nutrition Sciences, P.O. Box 66 (Agnes Sjöbergin katu 2), FI-00014 University of Helsinki, Helsinki, Finland

[2] Valio Ltd., R&D, P.O. Box 10, FI-00039 Helsinki, Finland

[3] Laboratory of Food Biochemistry, Department of Health Sciences and Technology, Institute of Food, Nutrition and Health, ETH Zurich, Zürich, Switzerland

Abstract:

Many plant-based yogurt alternatives currently on the market have a very low fiber and protein content. Oats are well-recognized for their health benefits, primarily due to ß-glucan (BG). The interest in faba bean as a source of plant protein and polyphenols has increased. Our study investigated using oat and faba bean ingredients to produce a fiber (>3%) and protein (>4%) rich "gurt", a plant-based dairy alternative with well-defined molecular status of fibre, starch, and protein. The gurt-making process involved mixing, enzymatic and heat treatments, and fermentation. We used amylase, amyloglucosidase, and ß-glucanase to ensure desirable viscosity and the release of sugars into the food matrix. Fermentation was done by using a commercial starter culture at 40°C to reach pH of 4.5. Development of acidity was studied by measuring the pH and the total titratable acidity (TTA) during processing. Anton Paar rheometer was utilized to measure viscosity. BG content was measured by Megazyme Kit; moreover, the total fiber (TF) content, oligosaccharides, and the BG molecular weight (Mw) were studied. Total protein content was determined, and the free amino acids were quantified by HPLC. Mono- and disaccharide content was determined by HPAEC-PAD. Microbial quality of the gurt was also analysed.

The TF and protein content were 4% and 5% (f.w), respectively. The processing did not extensively reduced BG content, and BG Mw decreased to 100 kDa while remaining in a polymeric state. Starch-originated oligosaccharides were detected after enzymatic treatment. The viscosity of gurts ranged from 0.4-0.7 Pa·s. In the BG containing gurt, ß-glucanase significantly prevented excessive viscosity increase. All gurts reached a pH of ca. 4.5 and mild TTA values of 6-7 mL after 8 h fermentation. Microbial strains moderately consumed sugars present in the gurt, and a slight growth was observed, whereas no unwanted microbes were detected.

Keywords:

Plant based, yogurt alternatives, food processing, food analysis

Roundtable discussion

Moderator: Jan de Vries[1]

[1] De Vries Nutrition Solutions, Gorssel, The Netherlands; Communication Manager Healthgrain Forum, Tietotie 2, 02044 Espoo, Finland

9: How to improve a sustainable science network for Food Fermentation Technology across Europe

Christophe Courtin, Christophe Chassard, Stéphane Chaillou, Susana Soares, Paul Cotter,

Abstract:

In this interactive discussion, the following issues will be discussied:

- How to achieve a sustainable network in Food Fermentation Technology
- Optimizing synergy between the EU projects
- Critical steps for fast application of new fermentation technologies in consumer products

Keywords:

Microbial Resources, Fermentation Technology, Human Health and Microbiome, Consumer behaviour, Horizon Europe, Science network, Cooperation, EU food technology projects, synergy, grains, pulses

Special session 7

FOX: Small-Scale, Big Impact - Innovative Approaches for Local Food Processing

Knol J

FOX: Small-Scale, Big Impact - Innovative Approaches for Local Food Processing

Special Session Description:
(align left, 11 point, Arial, single line spacing)
No more than 300 words.

Ariette Matser[1] and Jeroen Knol[2]
[1] Wageningen Food and Biobased Research, Wageningen University & Research, Wageningen, the Netherlands
[2] EFFoST, Wageningen, the Netherlands

Presenter 1: Ariette, Matser
Wageningen University & Research, Wageningen, the Netherlands

1: FOX: Food Processing in a BOX. Innovative mild technologies for short food supply chains

Ariette Matser[1], Kerstin Pasch[2]
[1]Wageningen University & Research, Wageningen, The Netherlands,
[2]DIL Deutsches Institut für Lebensmitteltechnik e.V., Quackenbruck, Germany

Abstract:
When thinking of food production, the image of big factories, often located outside the city, comes to mind. But imagine that a mobile container can do the same thing. FOX – Food Processing in a Box – is an EU-funded project that aims to develop exactly that; transforming large-scale technologies for the processing of fruits and vegetables, to small, flexible, and mobile container units.
FOX focuses on mild processing technologies, such as low-temperature drying and mild preservation techniques, to achieve the optimal physical and nutritional quality of fruit and vegetable products. Minimizing the use of resources and packaging material is key.
The innovative processing solutions are flexible, resource-efficient, and based on seasonality and demand. It considers the expectations of farmers and small food businesses, looks at the technical and economic feasibility, and takes into account the needs of the food chain and consumers. Consumers are actively involved in the development of new products and new business options for sustainable consumption.
FOX stimulates short food supply chains; transitioning from a more centralized industry to local production hubs. So-called food circles are the European regions in which FOX technologies will be demonstrated to be integrated into the entire food production chain. In these regions, which have significant fruit and vegetable productions (conventional and organic), the impact of the FOX approach on the environment, business, people, and their health will be assessed. That, together with the input from engaged consumers, will serve as vital input for the further development and upscaling of FOX.
This session will present the main results of FOX and conclude with a panel discussion on the potential impact of the FOX approach towards sustainability, business opportunities, and consumer engagement.

Keywords: Minimal processing, fruit and vegetables, mobile food unit, consumer, local food processing

Presenter 2: Kemal, Aganovic
DIL German Institute of Food Technologies e.V. Quakenbrück, Germany

2: Low oxygen juice extraction and mild preservation with PEF in a mobile container

Milena Zdravkovic[1], Kemal Aganovic[1,2]
[1]DIL German Institute of Food Technologies e.V. Quakenbrück, Germany
[2]Institute of Food Quality and Food Safety, University of Veterinary Medicine Hannover, Hannover, Germany

Abstract:

Decentralized mobile food processing systems are gaining increasing interest among different food sector stakeholders. It is believed that small-scale decentralized food production has the potential for a more resilient and flexible food supply chain. The combination of such production systems with innovative food processing technologies holds promising potential to increase the competitiveness of primary food producers as well as processors. Additionally, it can lead to better valorization of biomass, reduced waste, shorter supply chains, and a significantly reduced environmental footprint.
In this work, the decentralized mobile juice processing unit, equipped with innovative down-scaled technologies for low-oxygen extraction (vacuum spiral filter press) and mild preservation (Pulsed Electric Field (PEF)) is assessed. The FOX system is designed to be easily transported and operated at the farm level or as a regional hub while enabling improved processing and preservation of various types of fruits or vegetables into high-quality products (juices, smoothies, and purees). The study includes concept development and construction of the container mobile unit, proof of its operability and cleanability, as well as a demonstration in the field on several case studies. The results reveal the benefits and disadvantages of the system and highlight necessary improvements in terms of production practicality, cleanability, and maintenance, as well as in operation and transportation.
In terms of sustainability, the FOX unit was compared to a conventional stationary decentralized system of comparable capacity. The FOX system has more than 12% higher juice yield and requires a lower amount of specific energy for juice preservation. In a life cycle assessment, the FOX system demonstrated 20% lower environmental impact than the conventional system in comparative life cycle assessment, depending on the investigated scenarios (stationary position, regional hub placement, or weekly relocation). Moreover, the suitability of different electrode materials for the PEF treatment for mitigation of potential quality losses and risks potentially arising from metal release was studied. The study suggests that silicone doped with phosphorus and glassy carbon electrodes could be safe and viable alternatives to the typically used titanium electrodes.
This study demonstrates that PEF and spiral filter press are promising technologies to be exploited in decentralized mobile juice production systems, both from ecological and producer/processor perspectives.

Keywords: Juice, preservation, technologies, non-thermal, processing

Presenter 3: Malgorzata Nowacka
Warsaw University of Life Sciences, Institute of Food Sciences, Department of Food Engineering and Process Management, Warsaw, Poland

3: Low-temperature drying combining PEF pretreatment with mild drying in a mobile container

Malgorzata Nowacka, Aleksandra Matys
Warsaw University of Life Sciences, Institute of Food Sciences, Department of Food Engineering and Process Management, Warsaw, Poland

Abstract:
In recent years, there has been a growing trend in the popularity of dried products in recent years. The compound annual growth rate (CAGR) for this food category, ranging from 5.3% to 7.0%, highlights the increasing demand for dried fruits and vegetables. However, the drying process is one of the most energy-consuming technologies and necessitates minimizing environmental impact. One promising pre-treatment method used before drying is the pulsed electric field (PEF), which is based on the electroporation phenomenon. Choosing the proper parameters of pre-treatment as well as the drying method and its process parameters usually results in reduced drying time.
In this study, PEF pre-treatment was evaluated as the method used before the convective drying process, and the Response Surface Methodology was used for the optimization process with the PEF energy equal to 5.8 kJ/kg. Then the apple tissue was subjected to convective drying (CD, 85°C) on a laboratory scale and in a mobile container (small industrial scale). The samples were compared taking into account the physical and chemical properties of the dried apples obtained on a lab scale and in the mobile container.
Obtained results showed that there is generally not a significant difference between samples treated with PEF and those without PEF treatment. Physical parameters, such as color and water activity, showed similarities or slightly higher values without PEF. Total phenolic content and antioxidant activity were lower with PEF treatment. Hygroscopic properties were similar while rehydration properties were also lower for apples with PEF treatment. Moreover, mechanical and acoustic analysis showed similar or slightly lower hardness in PEF-treated samples.

Generally, PEF treatment can be used to modify the quality of dried products, particularly for hard materials. Moreover, employing process optimization helps in planning the production process, nevertheless, differences in the quality of the dried material may arise between laboratory-scale and industrial-scale operations.

Keywords: Pulsed electric field, convective drying, infrared-convective drying, mobile container, physical and chemical properties, laboratory scale, industrial scale

Acknowledgment:

This study was supported by the project financed from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 817683.

Presenter 4: Leonor Pascual

Ainia, Spain

4: Innovative quality analyses and sustainable packaging of fresh fruit and vegetables in a mobile container

Leonor Pascual and Mª Paz Villalba

Abstract:

Fresh-cut fruits and vegetables are minimally processed products characterized by their convenience for consumption. For such products, the packaging system plays a crucial role in extending shelf life and ensuring food safety during commercialization. However, developing an appropriate packaging system is complex and must be tailored specifically to the type of fresh product to minimize its respiration rate.

On the other hand, the concept of a sustainable packaging system is based on the equilibrium of three main pillars: environmental, social, and economic aspects. Environmental aspects involve ecodesign strategies, while social aspects encompass food safety, product shelf life, and packaging convenience. To accurately assess the sustainability of a food packaging system, both the food product and packaging must be considered as a whole, considering that the ultimate goal of packaging should be to prevent food waste.

This research focuses on the various ecodesign strategies employed for different packaging systems used for combinations of fruits and vegetables defined within the framework of the FOX – Food Processing in a Box project, which will be used within the developed mobile unit. Concerning the primary packaging system, the use of both flexible and rigid packaging has been considered, allowing for the implementation of distinct ecodesign strategies in each case. Furthermore, in relation to the secondary packaging system, efforts have been made to develop an alternative packaging material: a biocomposite based on PHBV incorporating granulated post-consumer cork, intended for reusable packaging for transporting refrigerated fruits and vegetables.

This study presents the functional and sensory characterization results of the packaging systems obtained in each case

Keywords: Fresh-cut processing, sustainable packaging, eco-design strategies, recyclability, biocomposite

Presenter 5: Martijntje Vollebregt

Presenter 6: Joanne Siccama

5: Upcycling plant side streams using mild processing: advise of the FOX *Processtimator* tool on the feasibility of an additional washing step for industrial carrot and ginger juice extraction

Joanne Siccama, Bert Dijkink and Martijntje Vollebregt

Wageningen Food & Biobased Research, Wageningen, The Netherlands

Abstract:

Food loss and waste (FLW) is an important aspect of food production and contributes significantly to the environmental impact of food. Next to prevention and reduction, valorization of unavoidable FLW aids in improving the resource efficiency of the food chain.

To support food processing experts in the demand for feasible valorisation options, the *Processtimator* tool is developed within FOX – FOod processing in a Box. The tool combines flow charting and knowledge databases, to explore different process routes for side stream fractionation and valorisation, while accounting for the impact on overall value, costs and greenhouse gas (GHG) emissions. Based on side stream characteristics, the tool advises on possible processing routes. Side streams are characterized by daily availability and yearly volume, and on composition, both on major

and valuable minor nutrients. After optimizing the operational window and equipment employment, the impact on mass balances and Opex/Capex is estimated.
In this study, the tool was used to evaluate an additional washing step in the industrial production of ginger and carrot juice to optimize production costs, waste streams and GHG emissions. The results showed that for carrots the additional step is not economically feasible and does not reduce the GHG emissions per kilogram of product. Whereas for ginger extraction, an additional washing step is economically feasible, and if the primary production is considered also the GHG emissions per kg of concentrated juice are lower. The different outcomes can be explained by the total use of the carrots. From carrots, both juice and fibres are suitable to be used as food ingredients, whereas for ginger only the juice is used. The washing step recovers more solids for the juice thereby reducing the fibre fraction.
This case demonstrates the benefits of using the *Processtimator* tool to evaluate process changes before starting expensive and time-consuming tests.

Keywords:
Process optimization, GHG emissions, juice extraction, waste stream reduction, side stream valorization

Presenter 7: Liesbet Vranken[1]
Presenter 8: Björn Moller[2]
Presenter 9: Klaus Grunert[3]
Presenter 10: Ariette Matser[4]

6: Impact of the FOX approaches: sustainability, business opportunities, consumer engagement

Liesbet Vranken[1], Björn Moller[2], Klaus Grunert[3], Ekaterina Salnikova[3], Ariette Matser[4]
[1]KU Leuven, Leuven, Belgium
[2] Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe, Germany,
[3]Aarhus University, MAPP Centre, Aarhus, Denmark,
[4]Wageningen University & Research, Wageningen, Netherlands

Panel discussion with panel members and the public

Abstract:
FOX – Food Processing in a Box – aims to transform large-scale technologies for the processing of fruits and vegetables, into small, flexible, and mobile container units and by doing this stimulating short food supply chains. In this part of the special session, an overview of the impact and opportunities of the FOX approach on sustainability, business opportunities and consumer engagement will be presented, followed by a panel discussion on the potential impact of the FOX approach.
The FOX approach intends to have a positive impact on sustainability goals by promoting local supply chain configurations and innovative approaches for valorising agricultural products and side streams. Life Cycle Analysis (LCA) was performed, to identify initial environmental considerations on the possible positioning of the FOX products in the market and to steer ongoing technological evolution and product design of the FOX solutions. Findings indicate that FOX products either outperform alternatives or at least have environmental scores that do not significantly differ from those of the substituted products, but do not systematically offer a more sustainable alternative compared to the substitute products that consumers might have access to.
Key to the adoption of FOX innovative solutions by farmers, cooperatives or small and medium-sized enterprises (SMEs) is the ability to generate profits for the technology adopters. In the FOX food circles, foresight workshops were organized were business models where discussed and economic opportunities were identified against different future scenarios. Findings indicate that solutions developed within the project have the potential for economic feasibility, contingent on ensuring a reasonable investment cost and the ability to market the final products at fair prices.
To address possibilities for consumer engagement with the novel approach of mobile food processing in small units employed within the FOX project, we have identified a multitude of factors that contribute to both intrinsic and extrinsic motivations driving consumer engagement with local food systems spanning six European regions. Consumer engagement with the local food system is influenced by a complex interplay of intrinsic motivations rooted in personal values and beliefs, as well as extrinsic motivations intertwined with practical elements of marketing strategies. Understanding these motivations is crucial for policymakers and food producers to tailor their efforts encouraging greater consumer engagement more effectively.

Keywords:
Sustainability, business model, economic feasibility, consumer engagement, food systems, intrinsic motives and beliefs, marketing strategies
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Special session 8
Filling knowledge gaps on alternative proteins to accelerate the dietary shift

Miron L

Special Session: Filling knowledge gaps on alternative proteins to accelerate the dietary shift

Special Session Description:
A transition from animal-based to alternative protein diets is crucial for reducing environmental impacts and improving human health. Food systems account for approximately 11.3% of total greenhouse gas (GHG) emissions in the European Union. Partially substituting animal-based proteins with alternatives can significantly decrease the dietary CO2-equivalent impact of the European diet. The significant impacts of the current food system on biodiversity, land use, and animal welfare can be mitigated by shifting from traditional animal-based sources to more sustainable protein sources.

Paul Vos[1] and Lucian Miron[2]
[1] Wageningen Food and Biobased Research, Wageningen University & Research, Wageningen, the Netherlands
[2] EFFoST, Wageningen, the Netherlands

Presenter 1: Paul, Vos
Wageningen Food and Biobased Research, Wageningen University & Research, Wageningen, the Netherlands

1: The GIANT LEAPS project - an integrated approach to filling knowledge gaps on alternative proteins to accelerate the shift toward healthy and sustainable diets

Paul Vos

Abstract:
Accelerating the transition from animal-based to alternative dietary proteins – the dietary shift – is key to reducing the footprint of our food system in terms of greenhouse gas emissions (GHG), energy, water, and land use, and other relevant environmental impacts, and for improving the health and well-being of people, animals, and the planet. The EU GIANT LEAPS project delivers the strategic innovations, methodologies, and open-access datasets to speed up this dietary shift, in line with the Farm-to-Fork strategy and contributing to the Green Deal target of reaching climate neutrality by 2050. This 4-year project is funded under topic HORIZON-CL6-2021-FARM2FORK-01-12 and started in September 2022.
Achieving the dietary shift in practice is inherently complex due to the diverse set of actors involved and further hindered by major knowledge gaps – scattered across the various alternative protein sources and the domains of *health* (safety, allergenicity, and digestibility), *environment* (GHGs and other environmental and climate impacts, biodiversity, circularity), and/or *barriers to adoption* (technological, sensory, and consumer acceptance). The project consortium consists of the key actors and spans all expertise to address relevant knowledge gaps and proactively engages to arrive at optimized future diets based on alternative proteins that are broadly accepted across stakeholder groups. In order to deliver required insights for short--, mid-, and long-term decision-making and impact, protein sources have been selected for either targeted or full assessment based on their current level of specification. The innovations and improved methodologies combined with accessible and comprehensive information generated for a wide collection of alternative proteins will enable policymakers to prioritize changes in the food system toward the dietary shift based on the desired impact. It will also enable value chain actors to make strategic scientific, business, and investment choices, and the general public to make more sustainable and healthy dietary choices.

Keywords:
Alternative proteins, dietary shifts, knowledge gaps, healthy choices, sustainable choices, climate neutrality

Presenter 2: Matilde, Milana
Wageningen Food Safety Research, Wageningen University & Research, Wageningen, the Netherlands

2: Towards the optimization of the dietary shift

Matilde Milana

Abstract:

Future diets are foreseen to include more protein alternatives to animal proteins. These alternatives may entail plant-based proteins, but also insects or algal proteins. WP7 of the GIANT LEAPS project is aimed at the optimization of the dietary shift of consumers eating more of these alternative proteins. The objective is to assess the impacts of the foreseen shifts using foods derived from alternative proteins (to replace animal protein) on human health and the environment and compare these with current diets. Eventually, the focus is to optimise the dietary shift to meet health and environmental requirements, also accounting for consumer acceptability and diet costs. Current dietary patterns were defined for four European regions (North, South, East, and West) based on nationally representative dietary surveys from the European Food Safety Authority (EFSA) Comprehensive Food Consumption Database. Also, current dietary patterns were linked with the Dutch Food Composition (NEVO) and European Environmental Sustainability (SHARP-ID) databases to estimate nutritional adequacy and associated environmental impacts. Results showed that in all four regions a) average protein intake exceeds protein requirements, b) meat consumption overtakes plant protein consumption and is responsible for the highest environmental burden. Current diets were then used to compose future diets incorporating the different consumption habits across EU regions. The impacts of dietary shift will be assessed for the dimensions of health (i.e. safety, allergenicity, nutritional adequacy, and quality) and environment (i.e. GHGs emissions, land use, and water use). To this end, indicators have been identified for use in the appropriate models. Data on the indicators will be collected and used in modeling approaches to estimate the impact of dietary shifts on these dimensions. Results ultimately will provide insights for optimising the foreseen dietary shifts to ensure healthy, safe, sustainable, and acceptable diets for the European population.

Keywords:
Alternative protein sources; Protein transition; Sustainable diets; Dietary shift optimization

Presenter 3: Michael, Siegrist
ETH Zurich, Zurich, Switzerland

3: Which alternative proteins could help to reduce meat consumption?

Michael Siegrist

Abstract:

Animal-based foods tend to have a high environmental impact. A reduction of meat in the diet has been proposed as a strategy to reduce the environmental impact associated with food production. It is widely assumed that alternative proteins, such as highly processed plant-based meat alternatives, cultured meat, or insects, could substantially reduce animal protein consumption, and that this may result in a more sustainable food system compared with the current one. I will outline some of the challenges and barriers to overcome before alternative proteins play an important role in people’s diets. Furthermore, I will present data from a Swiss survey (N=1014) that examined the acceptance of different protein sources for meat alternatives. Results suggest that plant-based proteins are more accepted compared with insects or cultured meat. Furthermore, meat alternatives with protein from potatoes, lentils or peas are more accepted compared with soy or rapeseed. The implications of our results for the development of novel meat substitutes will be discussed.

Keywords:
Meat substitutes, plant proteins, insects, cultured meat

Presenter 4: Hans, Verhagen
Food Safety & Nutrition Consultancy, Netherlands

4: Effective policy briefs and strategies for promoting alternative proteins in EU

Hans Verhagen

Abstract:

The major impacts of the current food system on biodiversity, land and water use, and animal welfare, could be mitigated by a shift from traditional animal-based towards more sustainable protein sources. The ambition of the GIANT-LEAPS project is to develop improved, fast, and animal-friendly methodologies for the health, safety, and environmental assessment of alternative proteins to arrive at future diets that are accepted by consumers and optimized for health and environmental impacts within the scope of the project.
Methods: The research will focus on nine alternative proteins that are not commonly applied in foods (lentils, fava beans, oats, quinoa, rapeseed, microalgae, single cell bacteria, insects, cultured meat) to fill knowledge gaps as well as on a selected set of novel alternative proteins for specific safety-related

aspects. This allows for identifying the highest potential alternatives for specific cultures and target groups in the different regions of Europe. All missing elements of an integrated framework to evaluate protein sources are developed to enable the shift towards a sustainable food system and healthy nutrition: (i) innovative prototypes that unlock the potential of sustainable protein sources in foods, products and diets, (ii) predictive in silico and in vitro methodologies for safety and health parameters, (iii) datasets and cloud platform for data integration, analysis and comparison, and (iv) models to estimate and optimize the environmental and health impacts of future diets and the shift towards alternative protein foods. Policy briefs are one set of deliverables.
Significance: Around 60-70% of total protein intake is derived from animal sources in European diets. The ambition of the GIANT-LEAPS consortium is to achieve 50% of total protein intake derived from alternative protein sources, representing a decrease in absolute animal protein intake of 20-30% under the assumption that increased alternative protein intake fully substitutes traditional animal protein intake.

Keywords:
Alternative proteins, policy briefs

Presenter 5: Clara, Talens
AZTI, Food Research, Basque Research and Technology Alliance (BRTA)

5: MINDFOODNESS: Mindful Food Design for healthier, sustainable ingredients and microstructures

Clara Talens[1], Saioa Alvarez[1], Amaia Garcia-Olea[1], Irene Fenga[2], Marcello Alinovi[2], Maria Paciulli[2]
[1]AZTI, Food Research, Basque Research and Technology Alliance (BRTA), Derio, Spain
[2]Department of Food and Drug, University of Parma, Italy

Abstract:
In the agri-food industry, there is a growing interest in exploring sustainable alternatives to animal-derived ingredients. Pea protein has been gaining attention as a plant-based alternative due to its nutritional profile and functional properties. However, the potential of pea pods as a functional ingredient to create food structures has been largely unexplored.
In this study, we aim to evaluate the techno-functional properties of pea pod extracts for the development of plant-based emulsions and foams. The pea pods were obtained as a by-product of local pea growers in the Basque region (Spain). The extracts were obtained using a water-based extraction process (at varying ratios of pea pods:water and pH). The pea pod extracts were characterised for their physicochemical properties, including pH and colour. The techno-functional properties of the aqueous phase were characterised in terms of foaming and emulsifying capacities and stabilities, and by the application of this new ingredient in the creation of new plant-based food structures such as edible foams and emulsions.
Preliminary results show that pea pod extracts possess good emulsifying and foaming capacities. The obtained foams and emulsions systems were also very stable and comparable to that of commercial plant-based emulsifiers and foaming agents. The incorporation of this new ingredient in more complex edible matrices allowed to obtain new plant-based versions of meringue and mayonnaise-like emulsions.
Overall, this study demonstrates the potential of pea pods as a source of functional ingredients for the development of sustainable plant-based food structures. The valorisation of pea pods not only offers a solution for waste reduction but also provides an opportunity to create value-added food structures. In conclusion, the results of this study highlight the importance of exploring underutilised food side streams for the development of sustainable and nutritionally sound plant-based products, hence, meeting the growing demand for healthy and environmentally responsible food choices.

Keywords:
plant-based; alternative proteins; pea pods; techno-functional properties; emulsions; foams

Presenter 6: Nesli, Sozer[1]
Presenter 7: Anni, Nisov[1]
Presenter 8: Juliane, Halm[2]
[1]VTT Technical Research Centre of Finland, Espoo, Finland
[2]University College Cork, Cork, Ireland

6: Exploring alternative proteins: Challenges and opportunities in processing

Nesli Sozer, Anni Nisov, Juliane Halm

Abstract:

The major impacts of the current food system on biodiversity, land and water use, and animal welfare, could be mitigated by a shift from traditional animal-based towards more sustainable protein sources. Alternative proteins, including plant-based, fungal, insect and microbial sources, have gained significant attention as sustainable alternatives to conventional animal-derived proteins. However, there are still major knowledge gaps relating to the protein transition.

Recently funded Horizon Europe project Giant Leaps strategically addresses these knowledge gaps from the perspectives of technology, health, safety, environment, and consumer barriers to adaptation of alternative diets. This presentation will particularly focus on the techno-functional and sensory challenges of a diverse group of alternative protein ingredients researched in the food processing work package of the Giant Leaps project. The presentation will include a comprehensive map of the techno-functional (e.g.emulsification, gelling, foaming, solubility) and sensory properties which reveals their applicability in the design of meat, dairy, and egg analogues. The talk will also give initial insights into functionalization strategies to overcome the technofunctional and sensory challenges.

In conclusion, alternative proteins hold immense potential for revolutionizing the food industry by providing sustainable and nutritious dairy and meat alternatives. A comprehensive understanding of their technofunctional and sensory properties is essential for product development and consumer acceptance. This research paves the way for the continued growth of the alternative protein market, addressing global food security and sustainability challenges.

Keywords:
Alternative proteins, plant proteins, single-cell proteins, microalgae, insects, dairy analogues, meat analogues.

7. Panel discussion: Current regulations and future outlook for promoting alternative proteins in EU.

Moderator: Paul Vos

Experts: Michael Siegrist, Nesli Sozer, Hans Verhagen and Clara Talens

Special session 9

From innovation to product development gaining consumer acceptability – building sustainability in food system

De Vries J

From innovation to product development gaining consumer acceptability – building sustainability in food system
Special Session Description:

HEALTHGRAIN -the best of the grain for consumer well-being . With this motto the Healthgrain Forum (HGF) promotes science based concepts fully unlocking the health promoting potential in the entire grain food production chain to obtain healthy, convenient and appealing foods.Grain based foods assist consumers in health maintenance worldwide, help reduce health care costs and provide added value for companies in the production chain.
Facing challenges of climate change human nutrition cannot be seen without taking into consideration sustainability aspects. Therefore the HGF session starts with presenting promising results in in the exploration of grass as an alternative, sustainable and perhaps soon also palatable protein source for human nutrition. Requirements for suitability as a protein unit will be discussed by Kaisu Riihinen (Research Team Leadar,VTT Technical Research Centre of Finland), as well as food safety aspects related to the Novel Food Regulation.
The session will span new results in the other important protein source of legumes and one of the main obstacles in consumer acceptance, namely taste challenge in one of the main alternative protein sources that is faba beans. Fabio Tucillo (PhD candidate, University of Helsinki) reports on the sensory profile of field bean ingredients and extrudates through generic descriptive analysis and characterization of lipid-degrading enzymatic activities, flavor precursors, and flavor-active compounds of the samples. Kerstin Burseg (Head of R&D and product development, GoodMills) reports on the benefits and challenges in the application of legume flours from an industry perspective.
The session will be rounded off with a presentation by Peter Shewry (Prof, Rothamsted Research) focusing on wheat the most common cereal and an important source for both protein and dietary fibre. What is healthy about wheat? Interesting results from the Well on Wheat project will be presented.

Jan de Vries[1], Silvia Folloni[2]
[1] De Vries Nutrition Solutions, Gorssel, The Netherlands; Communication Manager Healthgrain Forum, Tietotie 2, 02044 Espoo, Finland
[2] Open Fields, Chief Operating Officer, Strada Madonna Dell'Aiuto 7/A, 43126 San Pancrazio, PR, Italy

Presenter 1: Kaisu Riihinen
VTT Technical Research Centre of Finland, Espoo, Finland (maximum 1 affiliation per presenter, align left, 9 point Arial)

1: Cultivating sustainability: The green promise of grass proteins

Kaisu Riihinen

Abstract:
Grass is a promising source for food due to the high nutritional value and environmental sustainability. This talk will focus on a case example where Timothy (Phleum pratense) has been utilized for RuBisCo (ribulose-1,5-bisphosphate carboxylase/oxygenase) protein isolation. Currently Timothy is cultivated for ruminant feed in Finland. However, this grass species growing in Northern latitudes may enable a novel source of alternative protein and confirm food security in rural areas in the future.
Mild taste and off white color are expected characteristics for food ingredients targeted to be added in various food formulations. The two step isolation process developed for grass protein extraction consist of the coagulation step to remove green color, chlorophyll protein and grassy tasty from pressed grass juice. The obtained brown colored juice consist of water soluble RuBisCo protein which can be isolated simply by acid precipitation. The acid precipitate consists of 51 protein g/100g DM. Isolated protein is a beige-colored fluffy powder after lyophilization. The presentation describes the mass balance of the developed isolation protocol and the obtained purity of protein isolate for food

purposes. Isolation of RuBisCo protein from Timothy scaled up to reveal for the first-time purity and functional properties of this novel protein source. The presentation will also show results from an array of technofunctional properties such as solubility, foam forming and gelling properties to represent the applicability of RuBisCo protein in diverse applications.
Prior commercialization of novel protein sources requires confirmation of safety as food ingredient and authorization before launching to markets or even marketing for food use to consumers. This presentation will also give an overview of the requirements of chemical, microbiological, and toxicological data for confirming the safety of green protein in accordance Novel Food Regulation.

Keywords:
Grass proteins, alternative proteins, Pleum Pratense, technofunctional properties

Presenter 2: Fabio Tucillo
University of Helsinki, Helsinki, Finland

2: Sensory Profiling and Flavor Analysis of Faba Bean Ingredients and Extrudates

Fabio Tucillo

Abstract:
Faba bean has gained popularity for several environmental, nutritional, and technological reasons. Its seeds can be processed into protein concentrate, protein isolate, and flour, all of which can be used to produce meat alternatives. In this context, high moisture extrusion is an innovative technology that allows the formation of a fibrous structure from ingredients high in proteins. However, only a few studies have been carried out on this topic, and no information is available on what flavor changes occur during the extrusion of faba bean ingredients. In fact, the flavor of faba bean is one of the main obstacles to consumer liking and acceptance due to its beany and bitter qualities.
To address this current knowledge gap, the present work aimed at: (I) Defining the sensory profile of faba bean ingredients and extrudates by generic descriptive analysis with a trained panel in sensory laboratory conditions. (II) Characterizing the lipid-degrading enzymatic activities, flavor precursors, and flavor-active compounds of the samples. (III) Applying multivariate regression to analyze the interaction between the chemical and sensory data.
During three and four training sessions, panelists were able to generate the vocabulary, evaluate reference samples, and conduct a full sensory evaluation of ingredients and extrudates, respectively. Samples were evaluated three times in a randomized block design across assessors and sessions. A total of 13 and 20 attributes were defined and evaluated for the ingredients and extrudates, respectively.
The sensory properties of faba bean protein concentrate, isolate, and flour were clearly different. The highest bitterness was perceived in faba bean protein concentrate and in the extrudates made from it. Pea flavor and aroma were the strongest in faba bean protein concentrate, whereas faba bean protein isolate was characterized by cereal-like qualities. The different chemical characteristics of ingredients and extrudates were found to influence and differentiate their sensory profile.

Keywords:
Faba beans, protein concentrate, protein isolates, flavor, sensory

Presenter 3: Kerstin Burseg
GoodMills Innovation GmbH, Hamburg, Germany

3: Advantages and Challenges of Using Pulse Flours in Food Applications: A Focus on Sustainability, Protein Enrichment, and Nutritional Benefits

Kerstin Burseg

Abstract:
The burgeoning interest in sustainable and nutritious food alternatives has focused attention on pulse flours—specifically from fava beans, yellow peas, chickpeas, and red lentils—as ingredients in plant-based meat analogues, baked goods, and snacks. This abstract assesses the multifaceted advantages and inherent challenges of using pulse flours, with particular emphasis on sustainability, protein enrichment through air classification, techno-functional improvements via fermentation, and nutritional benefits, while also addressing issues related to antinutrients and off-flavours.

In terms of sustainability, pulse flours offer considerable environmental advantages. These crops require less water and generate fewer greenhouse gas emissions compared to conventional animal-based proteins. Additionally, they contribute to soil health through nitrogen fixation. The sustainable profile of these flours renders them an appealing choice for environmentally-conscious food formulations.

Air classification is a pivotal method for enhancing the protein content in pulse flours, enabling an increase of up to 60% protein content. This highly enriched protein fraction positions pulse flours as a potent plant-based protein alternative. Further, fermentation techniques can yield techno-functional benefits, such as improved texture, flavour, and shelf-life, in food applications.

Nutritionally, pulse flours are a noteworthy source of essential amino acids, contributing to a balanced protein profile. Their inherent protein content is competitive with that of animal proteins, ranging from 20-25%. Moreover, they are rich in resistant starch, which benefits gut health and presents a lower glycemic index, thereby making them suitable for diabetes-friendly formulations.

However, these flours are not without challenges. The presence of antinutrients like phytates and lectins can impede nutrient absorption, although these can be mitigated to some extent through certain processing techniques. A less frequently discussed but relevant issue is the potential for off-flavours, which may necessitate flavour-masking agents, adding complexity to food formulation.

In summary, pulse flours offer a promising, multifaceted ingredient for diverse food applications. They excel in sustainability metrics, can be enriched in protein, and offer substantial nutritional and techno-functional benefits. Yet, challenges like antinutrients and off-flavours require further research and technological innovation for more widespread consumer acceptance and application.

Keywords:
Legumes, legume flours, milling, protein concentrates, protein functionality

Presenter 4: Peter Shewry
Rothamsted Research, Hertfordshire, UK

4: Harvesting Sustainability: Exploring the Nexus of Whole Grains and Alternative Proteins for a Greener Future

Peter Shewry

Abstract:
Abstract will follow shortly

Keywords:
whole grains, wheat, health benefits, sustainability

Special session 10

Enabling transparency in food supply chains via implementation of digital technologes to boost health, sustainability, and safety of products, processed and diets.

Special Session Description:

Traceability determines how materials, packaging, products, processing aids, and so forth have moved through the supply chain. Often broken down into two aspects, *track* and *trace*, traceability systems underpin food safety, food quality, sustainability claims, and transactional mechanisms to prevent food fraud and food defense incidents.

Over the past two decades, our understanding of food traceability has grown dramatically. Just like any other emerging field of study or practice, however, it can be shaped and reshaped in different directions until the concept settles and matures. It also differs in how it is applied in practice. Traceability is developing and maturing, but much remains to be tackled. For instance, F2F traceability is frequently discussed and, in some supply chains, has been achieved through analog, paper-based systems.

While transitioning to digital traceability approaches has been proposed, there are challenges in collating and open sharing of all information in supply chains (supply chain visibility). Allergen management is one area where such systems have direct public health implications.

This session will introduce TITAN, a Horizon Europe R&I project and some of its industrial and research partners (INL, University de Santiago de Compostela, Wageningen University, Consentio, AZTI, Helsinki University, Warsaw University, Cardiff University). The new TITAN EU consortium comprising 28 partners form 15 countries started 1 September 2022 and will end by 31 August 2026.

The session will consist of 6 different presentations by highly esteemed representatives from both academia and industry:

1. TITAN Transparency solutions for transforming the food system by Edward Sliwinski, PhD, (8.30h – 8.50h)
2. Food safety and transparency through cutting edge DNA-based analysis methods by Marta Prado, PhD, (8.50h – 9.10h)
3. Transparency and redefining stakeholder roles in the digital age of agrifood supply chain networks by Douglas Robinson, PhD, (9.10h – 9.30h)
4. Using technology to track distribution route and measure the water and carbon impact within the food supply chain by Vincent Rosso, co-founder, (9.30h – 9.50h)
5. Knowledge, attitude, needs and barriers for the transition of European families towards healthy and sustainable diets. A cross cultural study in Spain, Finland, and Poland by Ana Baranda, PhD, (9.50h – 10.10h)
6. Envisioning transparency for more sustainable food systems: towards a basis for future policy by Ananya Mukherjee, PhD, (10.10h – 10.30h).

Chair: Edward Sliwinski, PhD,

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Presenter 1: Edward Sliwinski, PhD,

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1: Title: TITAN Transparency solutions for transforming the food system

Abstract:
A major transformation of the food system is required if Europe is to address the two major challenges of the 21st century, i.e., addressing societal and planetary health. The Farm to Fork Strategy is at the heart of the European Green Deal (EGD) objective to make food systems fair, healthy, and environmentally friendly. A key point of the EGD is that it provides the basis for the EU agri-food economy to thrive in a new business environment that embraces the new technologies, concepts and behaviours that are required to meet 2030 and 2050 goals.
Comprising 28 partners from 15 countries (10 MS and 5 associated countries), TITAN will provide an extensive platform for the development of a wide range of innovations that aid transparency and address key challenges identified in the EGD. The project comprises a mix of technology providers and research centres linked to agri-food actors and businesses through an interactive co-creation approach that was initiated prior to the submission process. Innovative solutions showcased in TITAN have already been sense-checked by stakeholders through answering a pre-proposal questionnaire that was conducted earlier in 2021. The TITAN innovations, all transparency related, address the following themes: enhancing transparency in agri-food businesses with a focus on SMEs; improving food choices by providing more transparent information to the consumer; using improved transparency to enhance food safety and authenticity of products; and providing improved information on the health and sustainability of food products. TITAN will showcase 15 innovations covering these themes with TRLs moving on average from TRL 5 to 7 within the lifetime of the project. The project has included the provision of an extensive tender for an open call (€1.2M) to provide financial support to third parties and supply more innovations on transparency related solutions.

Keywords:
#Food system, #Transparency, #Traceability, #Visibility, #Food safety, #Sustainability, #Health

Presenter 2: Marta Prado, PhD,
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[2] Department of Analytical Chemistry, Nutrition and Bromatology. University of Santiago de Compostela (USC), Spain

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TBd

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[3]AITalentum, Spain
[4]Open Food Chain, Netherlands
[5]FOCOS-FOOD, Germany

2: Title: Food Possibilities: Food safety and transparency through cutting edge DNA-based analysis methods

Abstract:

Aim: DNA based analytical methods have been applied for food analysis for some decades already, they allow a very specific identification of organisms, and they have been applied to food safety and authenticity. However, DNA analysis is still not extensively applied by food producers and other stakeholders since normally involves a fully equipped laboratory and highly trained staff. The rapid advances in micro and nanofabrication in combination with the synthesis and discovery of new materials have propelled the development of miniaturized devices. Such devices, which provide paramount advantages such as low consumption of sample, reagents and even energy, rapid response, and multiplexing possibilities are called to bridge this gap between the advance analysis and its use by the different stakeholders along the food value chain, and at the same time enable the connectivity and the use of data to better prevent food safety issues.
Methods: we will present a novel modular approach for the different steps of DNA analysis in two different use cases and the evaluation of the possibilities of combining these devices with blockchain to ensure both authenticity and traceability on the olive oil value chain, and with AI to prevent the presence of unintentional allergenic ingredients on the bakery value chain.
Results: Within the TITAN project we are developing and integrating DNA-based methods for the specific detection of autochthonous olive varieties on miniaturized devices and evaluating the different points of the olive oil value chain that can help to ensure the full traceability of this product with the objective of combining both technologies for an holistic control, and the same time a similar approach is being developed for the detection of the main allergenic ingredients that can contaminate the bakery value chain, and its combination with AI will enable to better control the safety of this products.

Keywords:

DNA analysis, microfluidics, blockchain, AI, traceability, authenticity,

Presenter 3: Douglas M. Robinson[1], PhD
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Co-authors:
Verena Otter[1]

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[1] Business Management & Organisation, Wageningen University & Research, Hollandseweg 1, Wageningen 6706 KN, The Netherlands

3: Title: Transparency and redefining stakeholder roles in the digital age of agrifood supply chain networks

Abstract:
Aim: Agri-food systems worldwide are coming under ever-increasing pressure to address contemporary challenges of the 21st century (Béné, 2020; Hellegers, 2022; Jaiswal & Agrawal, 2020; Meuwissen et al., 2019; Pingali, 2015). In the European Union, the Farm to Fork strategy is a key plank in the European Green Deal with the objectives of making agri-food systems fair, healthy and environmentally friendly (European Commission, 2022). The aim of this study is to show how increasing transparency demands in agrifood supply chain networks through measures such as the EU Farm to Fork Strategy are redefining both the organisation of the chains themselves, stakeholder roles, and the networks of actors within these chains.
Methods: We combine a netchain approach (Lazzarini et al., 2001) with stakeholder theory (Freeman, 1984). Primary data for mapping these netchains are collected via thirteen semi-structured interviews with primarily chief operating officers or chief executive officers of different technology providers in the agri-food sector. These interviews are analysed through a semi-structured content analysis.
Results: Initial results indicate that from a netchain perspective, related services are playing an increasingly prominent role for transparency. Particularly some digital providers are providing services beyond what was initially envisaged in netchains, where related services, such as advisory services and technical services, are considered to run in parallel but not be directly involved in these chains (Adetoyinbo & Otter, 2021; Althoff et al., 2005).
Conclusions: Based on our pilot interviews, we illustrate that the structure of agri-food netchains is changing with the increasing prominence of digital services, a trend that is only likely to increase driven by demands for transparency to aid sustainability transitions through policies such as the EU Farm to Fork strategy. Novel digital solutions which challenge the status quo may hold the best bets for generating real transformation for transparency in EU agrifood supply chains.

Keywords:
#transparency, #netchain approach, #stakeholder theory, #digitalisation

Presenter 4: Vincent Rosso, MSc,
Affiliation: Consentio, Madrid, Spain

4: Title: Using technology to track distribution route and measure the water and carbon impact within the food supply chain

Abstract:

Aim: This presentation delves into the transformative role of traceability within the food supply chain, showcasing how it can revolutionize transparency, safety, and sustainability. **Method:** Traceability systems enable precise monitoring and documentation of the journey of food products from farm to table. It elucidates how traceability empowers consumers with vital information about the origins, processing, and handling of food, thereby enhancing their ability to make informed choices. in addition to strengthen food safety measures, it highlights the environmental implications of traceability by promoting sustainability through reduced food waste and improved resource management.
Results: With practical examples and technological advancements, this abstract outlines how traceability in the food supply chain is poised to usher in a new era of transparency, safety, and sustainability, ultimately benefiting consumers, producers, and the environment alike.
Conclusions: It concludes by advocating for the widespread adoption of traceability systems to ensure a more resilient and accountable food supply chain.

Keywords:

#sustainability, #supply chain, #food, #traceability, #carbon impact, #water impact

Presenter 5: Ana B. Baranda, PhD
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5: Title: Knowledge, attitude, needs and barriers for the transition of European families towards healthy and sustainable diets. A cross cultural study in Spain, Finland, and Poland

Abstract:
Aim: Health concerns and sustainability are driving the urgency towards a food system that keeps people healthy, improves access to food and minimizes environmental impacts to feed future generations. Therefore, understanding, describing and measuring the barriers and facilitators that influence the dietary behaviour of consumers considering geographic, cultural, and socioeconomic differences is key to providing solutions that help this transition towards healthy and sustainable diets.
Method: Families with children represent a large and important consumer group within the European Union (65 million European households have children). Creating healthy eating habits during childhood is essential to encourage the practice of a healthier lifestyle in the future and to avoid chronic diseases in adulthood. Besides, the role of the family is important since children learn by imitation.
Results: Within the TITAN project, a tool is being developed to help families make better dietary choices in terms of health and sustainability. To adapt the tool to the real needs and barriers that influence dietary behaviour, different co-creation activities have been developed. Among these activities in August 2023 a cross-cultural study was carried out in 3 countries that differ in culture and socioeconomic characteristics (Spain, Poland, Finland). This study was carried out through a questionnaire, in which 240 families with children 6-12y per country participated. The questionnaire included more than 40 questions regarding knowledge of healthy and sustainable eating, compliance with dietary recommendations, consumption and eating habits and attitude, behaviour, and barriers to this type of diet. Participating families answered questions including not only their point of view but also that of their children.
Conclusions: This work shows the most important preliminary results, according to the country and socioeconomic level of participating families. These results will help not only to improve our tool but also to design future interventions that help transition of families through a more health and sustainable diet.

Keywords:
#children, #food behaviour, #healthy eating habits, #families with children, #nutrition knowledge, #digital tool, #co-creation tools

Presenter 6: Ananya Mukherjee, Ph.D.,
Affiliation: [1] School of Geography and Planning, Cardiff University, Cardiff, Wales, UK,

Co-authors:
Christopher Bear[1]

Affiliations:
[1] School of Geography and Planning, Cardiff University, Cardiff, Wales, UK,

6: Title: Envisioning transparency for more sustainable food systems: towards a basis for future policy

Abstract:
Aim: The notion of transparency has gained currency over the past three decades as a key requirement for safe and sustainable food systems. Along with the closely associated concept of 'traceability,' its use gained momentum following a series of food-related crises, such as BSE, foot and mouth disease, and the horse meat scandal. Transparency of food supply chains has subsequently formed a focus for international organisations, such as the United Nations, the International Standards Organisation, and the European Union, while national policy interventions (e.g. the UK Food Data Transparency Partnership) intend to promote greater transparency as a route to more sustainable food systems. This paper aims to examine how policy envisions transparency, and its role in contributing to the transformation of future food systems, in multiple ways.
Methods: The paper draws on a desk-based review of EU policy documents. From an initial search of around 200 documents relating to health, sustainability and safety in the food system, 56 made explicit reference to transparency, while 62 referred to traceability. These documents were analysed for the ways transparency is defined, the purposes for which it is employed, and the role envisioned for technologies in implementing transparency solutions.
Results: The research has identified considerable variability in the definition and use of ‘transparency’ in existing policy. Despite its popularity as a policy focus, its definition remains inconsistent at best, and often highly opaque; policies, laws and regulations frequently adopt the term but fail to define it.
Conclusions: While achieving transparency around food and associated policy- and decision-making remains a laudable objective, the failure of current policy to define the term means that it is open to considerable interpretation by actors within and beyond food systems. As a result, expectations around the nature and outcome of transparency solutions could be difficult to manage.

Keywords:
#transparency, #sustainability, #safety, #traceability, #food systems, #health

Special session 11

Shaping our Future Sustainable Food Systems

Knol J

SPECIAL SESSION:
FOODPATHS "MODUS OPERANDY" AT THE LIVING LABS.
FOOD FOR LIFE-SPAIN CASE OF STUDY

Wed 8thNovember :08:30 -10:30h.

08:30-08:45 Welcome EFFoST, INRAE.
08:45:09:00 An approach to the FOODPATHS PROJECT:THE MODUS OPERANDI OF FOODPATHSPROJECT. Hugo de Vries/Maurine Mames-INRAE.
09:00-09:15 The Food for Life -Spain Technology Platform case as a Living Lab. Eduardo Cotillas-FIAB.
09:15-09:30 The role of the Boardof Food for Life-Spainfrom a Technological Centre point of view. Belén Blanco-CARTIF.
09:30-09:45 The Advisory Group at Food for Life-Spain:How to fund projects.Carlos I. Franco-CDTI.
09:45-10:00 Managing the Working Groups of Food for Life-Spain: President ot the Food ServiceWG. Purificación García-UPV.
10:00-10:15 Research and Innovation proposals at Food for Life-Spain. Teresa Jiménez-IATA-CSIC (TBC).
10:15-10:30 How to deal with new proposals:An SME approachat a Living Lab. Miguel Angel Cubero-Ingredalia.
Conclusions.

Special Session Description:

■ The European Partnership for Sustainable Food Systems for People, Planet & Climate, to be launched in 2024, will not only coordinate, align, and leverage European and national R&I efforts to future-proof food systems through an integrated and transdisciplinary systems approach. Just as importantly it will provide the collaborative experience among practitioners and citizens, to support the transformation of local, national, European and global food systems. FOODPathS is a project funded by the European Commission that aims to offer a concrete pathway and necessary tools to support the establishment of the Partnership. ■ One such tool will undoubtedly be to ensure that all relevant stakeholders are represented in the Partnership, including the private sector. One other important tool is to ensure that all members of the Partnership function efficiently together and to their mutual benefit, converging to the common goal of sustainable food systems. ■ This session will address the specific question of how the Partnership for Sustainable Food Systems can be attractive and function effectively with diverse actors, with a focus on the industry or private sector including relevant companies of all sizes. This will be done through the Food for Life Spain Technology Platform case as a successful Living Lab story. Invited speakers from Food for Life Spain will give insight and engage in a discussion on how the modus operandi, or daily operations and functioning in the platform, successfully manage the challenge of actively maintaining and developing not only the activities of the network, but also of its members.

Special session 12

Shaping our Future Sustainable Food Systems

Knol J

Shaping our Future Sustainable Food Systems

Special Session Description:
The European “Partnership for Sustainable Food Systems”, together with the 10 FOOD2030 pathways of HorizonEurope will set the scene for future food science and technology topics in Europe. In this session, the crucial role of Food Science and Technology in changing the patterns of our, current, linear food chains, towards sustainable ones balancing between planetary and societal limits will be discussed. This will be done on the basis of a number of food system cases, presented by FOODPathS, FoSSNet and FOOD*force*. FOODPathS is a project funded by the European Commission that aims to offer a concrete pathway and necessary tools to support the establishment of the European Partnership for Sustainable Food Systems for People, Planet & Climate, to be launched in 2024 based on the experience gained during the project’s lifetime. FoSSNet is a project yet to start that will establish a permanent pan-European network for Food System Science and on the other hand to advance inter- and transdisciplinary Food System Science and education. FOOD*force* is a network of leading European research provider organisations active in the areas of food, nutrition and health that provides a proactive forum for discussions on delivery of best practice and societal impact and facilitates international aspects of knowledge exchange and innovation.

Dr. Hugo de Vries[1]
[1] INRAE, Paris, France

Presenter 1: Hugo de Vries[1]
[1] INRAE, Paris, France

The Partnership Sustainable Food Systems and Food2030 Pathways fuel the food science and technology agenda

Abstract:
Aim: The United Nations Sustainable Development Goals and the European Commissions’ (EC) Green Deal and Farm-to-Fork strategy fuel the development of the Partnership on Sustainable Food Systems (P-SFS). Together with the 10 FOOD2030 pathways of HorizonEurope, the P-SFS set the scene for future food science and technology topics in Europe.
Method: The Strategic Working Group Food Systems of the Standing Committee on Agricultural Research together with EC-DG RTD had created a taskforce to define the Strategic Research and Innovation Agenda (SRIA) of the P-SFS. The taskforce had organized expert working group sessions, interviews and open consultations. Thanks to all input, the SRIA has been published in January 2023. The translation of the SRIA in a first prototype P-SFS is currently carried out in the CSA FOODPathS project (in which EFFoST is partner), financed by the EC since June 2022 for 42 months.
Results: The SRIA has defined four scientific priority areas. Two of them are directly related to food science and technology (FST) themes, namely ‘change the way we process and supply food’ and ‘change the way (what) we eat’. The SRIA also proposes four transversal areas, all relevant for the EFFoST community, namely R&I funding, a SFS observatory, SFS living labs and knowledge sharing. FOODPathS has mapped first food system cases in these areas.
Conclusions: The SRIA proposes that future FST trajectories will target enlarged diversity (in resources and diets), circularity (including re-utilisation of main and co-products in food designing processes), fairness (food and nutritional security for all, everywhere), one health concepts, guaranteed safety, scalability (e.g. of technologies in different contexts) and robustness (of for examples processes facing shocks). The mobilization of digitalization – in widest sense – is strongly recommended, as well as the connections with socio-economic sciences. The latter are highlighted by first examples of food system cases reviewed in FOODPathS. The SRIA and FOODPathS underline the crucial role of FST in changing

the patterns of our, current, linear food chains, towards sustainable ones balancing between planetary and societal limits.

Keywords:

Presenter 2: Camila Massri[1]

1 European Food Information Council, Belgium

CLEVERFOOD project

Presenter 3: Camila Massri[1]

1 European Food Information Council, Belgium

FOSSNet project

Presenter 4: Anlaug A. Hansen

1 Nofima, Norway

High quality for more sustainable white fish products

Presenter 5: Laura Bardon

1Quadram Institute Bioscience, UK

Development of a sustainability data map for the UK dairy food chain

Presenter 6: Maria Manuela Estevez Pintado

1 Catholic University of Portugal

Value chain synergies in sustainability- A case study of livestock and sustainable leather

Presenter: Manuela Pintado: (10 min)

Manuela Pintado

Abstract:

As currently experienced, leather production is linked to some serious sustainability issues, not least as a by-product of the meat industry. The evaluation by Higg MSI (Higg Materials Sustainability Index) has led to a negative perception of leather and other natural fibres, resulting in some major world brands deciding against leather, which announced replacing leather with oil-based, synthetic materials. The high-quality shoes industry is using leather as main raw material to develop their products, and this is posing relevant problems due to the growing replacement by synthetic materials. However, this is contradictory since leather as the industry often presents it is an important model of circular economy, where hides from livestock are valorised instead of being thrown as waste to landfills. Rearing of livestock has severe environmental impacts such as deforestation, water and land overuse, and gas emissions. So, the entire supply chain of the meat industry contributes to an array of environmental issues affecting climate change and our water quality. However, if we produced livestock in a sustainable system, we could demonstrate the sustainable character of leather. So, we can work with the value chain from retailors to the corporate agriculture to implement the policies needed for a sustainable supply chain allowing traceability that may allow controlled sustainable leather.

During the presentation will be presented the ongoing case study of cooperation, between the retailor, engaging their livestock supply chain, producers, and slaughterers, to create a sustainable supply chain for meat and at same time engaging the leather producers and shoes industry to promote the required traceability to assure a solution for sustainable leather with a positive Higg MSI.

Presenter 7: Peter Holl, DIL Deutchs Institut fur Lebensmitteltechnik e.V, Germany

1 DIL Deutchs Institut fur Lebensmitteltechnik e.V, Germany

Innovative approaches for local food processing @ FOX

Panel discussion: Shaping our Future Sustainable Food Systems

Moderators: Jeroen Knol, *EFFoST, the Netherlands*, Peter Holl, *DIL Deutsches Institut fur Lebensmitteltechnik e.V, Germany*, Peter Jongebloed, *Wageningen University & Research, the Netherlands*

Special session 13
ECO READY project: Achieving ecological resilience for the European food system through consumer-driven policies (ECO-READY HE RIA)

Manikas I

Achieving ecological resilience for the European food system through consumer-driven policies

Special Session Description:

The objective of this special session is to present some preliminary findings of the ECO-READY RIA Horizon Europe project. The ECO-READY project will develop a real-time surveillance system, an Observatory offered as an e-platform and as a mobile application. This will function as the necessary singular source of information, provide real-time assessments for the food system, will be available to society, policymakers, the scientific community, and the agri-food industry, and integrated with a network of 10 Living Labs, covering all bioclimatic regions in Europe, forming the ECO-READY project knowledge infrastructure. ECO-READY will produce knowledge based resilience strategies, and develop tools that will be embedded on the Observatory, such as an early warning system and decision support tools using innovative Artificial Intelligence based on holistic prediction models and Life Cycle Assessment results. ECO-READY will ensure that European farmers and society's interests be reflected in future policymaking and monitoring, through early-stage active engagement incorporating bottom-up recommendations, facilitated by the increased usership of the digital tools developed, and resulting in increased awareness for climate-adaptive and mitigating agri-food products. Furthermore, the Observatory smart application will include tools that will empower the citizens to actively engage in policy making, and interact directly with the scientific community, farmers, and industry and policy makers, thus driving change in consumption habits.

Chair: Ioannis Manikas
Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences in Prague, Czechia
Presenter 1: Ioannis Manikas
Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences in Prague, Czechia

1: Title of abstract: Achieving ecological resilience for the European food system through consumer-driven policies; an introduction to the ECO-READY HE project*

Ioannis Manikas

Abstract: ECO-READY HE RIA project aspires to recognize, categorize, and dissect the drivers that affect food security across Europe. A holistic breakdown and assessment of direct/indirect factors across 10 Living Labs, through an open call for third party funding, located at strategic European regions will provide a base-to-top scheme framework and networking for decision making. Since each driver can generate oscillating imprints on the production line across regions and/or crop products, a clear demarcation of drivers and a 'per case' analysis will be conducted to quantify and model such stressors. ECO-READY will firstly identify these factors and manage them according to their cluster/input. Climate change and biological factors are anticipated to pose a profound effect at a global or regional scale since they can influence crop physiology, leading to yield collapse. Still, at several EU regions, shifts of average temperature can provide a unique opportunity for the introduction of novel culture zones and the opportunity for consumers to select alternative staple sources. Climate change can also influence the population of phytopathogens, and thus unpredicted dangers can arise from plant-pathogen interactions risking crop yields. ECO-READY will provide a real-time surveillance system (a digital Observatory, offered as an e-platform and as a smart phone application) developed and customized for such occasions. ECO- READY will assess the influence of policies and climate change on socio-economic constrains that greatly fluctuate across member states, and produce targeted resilience and mitigation policies, addressing regional needs, reflected by inputs of the 10 Living Labs.

Keywords:

Horizon Europe, climate change, biodiversity, food security

Presenter 2: Nam Vu and Michael Bourlakis
Cranfield School of Management, Cranfield University, United Kingdom

2: Title of abstract: Climate change and biodiversity drivers of food security: A systematic literature review *

Nam Vu, Michael Bourlakis

Abstract:

The food system holds a vital role in today's world, as it is responsible for feeding the world population and support billions of livelihoods. Despite already efforts in increasing food supply, millions of people still suffer from food insecurity. Furthermore, climate change and biodiversity are becoming increasingly important forces affecting food security. Recognizing the great interest on this topic, as well as the vast body of literature regarding the climate change – biodiversity – food security nexus, this work comprehensively reviews relevant studies to determine climate change and biodiversity induced drivers of food security. Employing a well-known method in the domains of management and medical studies – Systematic Literature Review (SLR), a collection of 300 papers was selected after a robust process of searching and screening. While coming from multiple disciplinaries (e.g., biology, ecology, agriculture, food system, etc), these 300 research papers address the complex and dynamic interaction between climate change/ biodiversity and food security. By analysing the contents of the selected studies, a set of 29 drivers were induced. When examining these drivers and their impacts on the food system, it is evidenced that climate change and biodiversity have extensive effects on almost every aspect of food production, ranging from agriculture (crops, cash crops, horticulture, etc), fisheries, livestock, aquaculture, mariculture, and so on. Subsequently, it was observed that all pillars of food security (availability, accessibility, utilization, and stability) are affected by the identified drivers. However, the majority of the impacts found in the literature are on the availability and accessibility facets of food security. Further, the mechanism by which each driver can affect food security was discovered from the literature review. Overall, this work contributes to the expansion of knowledge regarding the subject of climate change – biodiversity – food security, informing the scientific community as well as the public and policymakers.

Keywords:

Climate change, biodiversity, food security, systematic literature review

Presenter 3: Dettenhofer, Markus[1]; Smeets Kristkova, Zuzana[2]
[1]Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences in Prague, Czechia
[2]Wageningen Economic Research, Netherlands

3: Title of abstract: Projecting long-term ecological resilience of European food systems: Towards an integrated protocol for bridging scenarios with economic modelling*

Dettenhofer, Markus, and Smeets Kristkova, Zuzana

Abstract:

European food systems need to respond to multiple local and global challenges. In order to assess their ecological resilience from a dynamic perspective, it is crucial to develop forward-looking approaches that take into account plausible scenarios for the future and their impacts on food security, resilience to climate change and preservation of biodiversity. The complexity of today's food security challenges, given the ecological and climatic stresses, calls for a wholistic approach to transforming food production. Within the ECO-READY project, we identify drivers that constitute and impact scenario narratives, which is performed through a co-creation process with an interdisciplinary team of experts. Location specific conditions and data related to previous land and water utilization, coupled with crop and/or livestock priorities, inform scenario development. To validate the scenario plausibility and transform imaginaries into new agricultural practices, indicators (measurable outputs) of future trajectories are then elaborated.

Next, to further assess the scenarios, an important objective of the ECO-READY project is to quantify their impact using an ex-ante modelling framework. There are several challenges that need to be addressed - such as how to create bridges between local and macro-level analysis between specific non-economic drivers and stylized economic drivers. In this paper, we present a design of a protocol that describes linkages between micro-level drivers, intermediate-step models (agronomic, livestock

models), with the economy-wide MAGNET CGE model and LCA (Life Cycle Analysis). We use two pilot case studies to demonstrate the application of the protocol.
Keywords: ecological resilience, food security scenarios, economic modelling, LCA

Presenter 4: Di Gregorio L.[1], Latini A.[1], Stefanova M.[1], Bunnefeld N.[2], Nikoloudakis N.[3], Ó Cuanacháin D.[4], Oberc B.[4], Marino F., Rossi D.[5], Toth K.[6], Dettenhofer M.[7] and Bevivino A.[1]
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4: Title of abstract: Do the existing EU policies effectively integrate scientific data to promote a transition towards resilience in Climate Change, Biodiversity, and Food Security? The ECO-READY Project analysis.*
Di Gregorio L., Latini A., Stefanova M., Bunnefeld N., Nikoloudakis N., Ó Cuanacháin D., Oberc B., Marino F., Rossi D., Toth K., Dettenhofer M. and Bevivino A
Abstract:
In recent years, the effects of climate change and environmental degradation have put food systems under increasing pressure all over the world. Identifying the gaps between the current state and the desired future state of food security, taking into account drivers which impact the resilience of food systems, is urgent. In the framework of ECO-READY Project, we aimed at critically investigating wether the current policies are properly reflecting a transition towards Climate Change (CC), Biodiversity (BD), and Food Security (FS) resilience. For this purpose, a systematic process of policy review has been carried out for linking scientific data related to CC, BD, and FS to CAP, Green Deal and other EC Frameworks & Policies.To identify and analyse the EU policies, two Eklipse synthesis methods, Expert Consultation and Systematic Map, were considered, using CC, BD, and FS as main keywords and "environment," "water," "energy," "health," "economic," and "society" as secondary keywords. The screening analysis produced a final output of approximately 150 documents. The analysis of the selected EU policies and the identification of gaps between data and policy was carried out by identifying and using a list of 50 keywords related to the main indicators and drivers associated with CC, BD, and FS. Preliminary results have highlighted the presence of gaps related to some important drivers and indicators, primarily associated to critical issues ranging from soil health, biodiversity and soil management monitoring. Given that science consistently generates research findings that have the potential to address these needs, it is essential to ascertain if and to what degree this integration occurs. In particular, the identification of gaps between policies and scientific evidence will be crucial to build a dialogue with policymakers and ensure improvements in the monitoring and management of CC, BS, and FS.
Keywords: Climate change, Biodiversity, Foods security, Resilence, EU policies

Presenter 5: Konstantinos, Mattas
Aristotle University of Thessaloniki (AUTH), Thessaloniki, Greece
5: Title of abstract: EU citizens' response to food security and climate change*
K. Mattas[1], N. Syndoukas[1], E. Tsakiridou[1], F. Anastasiadis[2], I. Manikas[3], A. Mousiadou[4], A. Arroyo Shcnell[5], N. Bunnefeld[6], C. Morelle[7]
[1] Aristotle University of Thessaloniki, Thessaloniki, Greece
[2] Agricultural University of Athens, Athens, Greece
[3] Czech University of Life Sciences, Prague, Czech Republic
[4] White Research, Saint-Gilles, Belgium
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[6] Alternet/Eklipse University of Stirling, Stirling, Scotland
[7] IFOAM Organics Europe, Brussels, Belgium
Abstract:

Food security and climate change are the most important challenges of today. As the planet experiences shifting and extreme weather patterns, the ability to produce and access an adequate supply of nutritious food for a growing population becomes increasingly uncertain and challenging. Thus, listening to European citizen reflections and suggestions on those issues is essential to devise more effective and well-received policies on food security issues. In order to create more resilient food systems and address the aforementioned challenges, the input of all stakeholders, including citizens/consumers, is critical. Current work presents the most important needs, challenges and trends of stakeholders in relation to food security and climate change, through a two-round Delphi framework. The first-round questionnaires are in the form of SWOT analysis, trying on one hand to understand the aspects on the current situation (Strengths-Weaknesses) and on the other hand to study the views on the future of the food system and its impact on climate change and food security (Opportunities-Threats). Subsequently, the questions on which no consensus was achieved will form the content of the second-round questionnaires, which will lead to the conclusions and the factors that may affect consumer behavior. The results of the research will provide a holistic approach to society's awareness of climate change and food security and contribute to the development of consumer-driven resilience strategies.
Keywords:
Climate change, Food security, Stakeholders, Consumers, Food system, Agri-food chain, Consumer behaviour

Presenter 6: X. Wang, W. Mu, W.F. Hoenderdaal, H.J. van der Fels-Klerx, A. Hürriyetoglu, B.H.M. van der Velden
Wageningen Food Safety Research, Wageningen, The Netherlands
6: Title of abstract: Feasibility of an AI-powered observatory for crop yield prediction using satellite images*,**
X. Wang, W. Mu, W.F. Hoenderdaal, H.J. van der Fels-Klerx, A. Hürriyetoglu, B.H.M. van der Velden
Abstract:
Cropland maps provide important and timely information for strategic decision-making in agriculture such as crop growth stage monitoring and crop yield prediction. Traditional methods of gathering cropland information involves time consuming manual data collection. The purpose of this study was to assess the feasibility of artificial intelligence (AI)-powered cropland segmentation on satellite images, ultimately to be used for crop yield prediction. An nnU-Net deep learning framework was implemented for cropland segmentation. Sentinel-2A satellite images of 3,500 km2 (35,000,000 pixels) in the Netherlands were analyzed. Input to the nnU-Net were thirteen-band multispectral images. Output were binary segmentation maps for maize, extracted from the Dutch Basisregistratie Gewaspercelen (BRP) database. Data was split into train set (80%) and hold-out test set (20%) based on geographical location, ensuring a fair train/test split. Performance was assessed using Dice coefficient and intersection over union (IoU). The hold-out test set had a Dice coefficient of 0.88 and an IoU of 0.78, demonstrating automated cropland segmentation. This study showed that automated cropland segmentation using deep learning is feasible. In future work, we will extend this using time-series satellite data from entire Europe enabling Europe-wide crop yield prediction. This will be implemented in the AI-powered observatory that is currently developed in the ECO-READY project.
Keywords:
Artificial Intelligence, crop yield prediction, food security observatory
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EFFoST2023 Conference Programme

	Auditorium 1	Auditorium 2	Auditorium 3	SC 1 + 2	Special session room SC 3 + 4	Special session room SC 8	Special session room SC 6 +7
Day 1: Monday 6 November 2023							
08:30 - 18:30	**Registration**						
08:30 - 12:30			**08:30 - 12:30 Young EFFoST Day 2023**				
14:00 - 14:30	**EFFoST Welcome & Opening Session** | Auditorium 1						
14:30 - 16:00	**Plenary Session 1: Food, Microbes and Industry 4.0: A roadmap towards 2030 Agenda** | Auditorium 1						
16:00 - 16:30	**Refreshment Break** | Exhibition area & **Networking session of the EFFoST Working Group on Sustainable Food Systems** | EFFoST stand						
16:30 - 18:30	Innovative food processing technologies	Profiling and identification of novel compounds	Food microbes and fermentation	Innovative food processing technologies	Healthy Foods for all – the essential role of food processing	ENOUGH project: Technologies, tools and methods to achieve climate neutral food businesses	Career and Personal Development for Young Scientists and Industry Professionals – Kickoff Meeting of the EYE Mentorship Programme
18:30 - 20:00	**Welcome Reception & Pub Quiz** | Exhibition area & Auditorium 3						
Day 2: Tuesday 7 November 2023							
08:30 - 10:00	**Plenary Session 2: Sustainability in food processing and microbes** | Auditorium 1						
10:00 - 10:30	**Refreshment Break** | **Poster Session 1** | Exhibition area & Multi-purpose room 1 [P1.1] & Multi-purpose room 2 [P1.2, P1.3]						
10:30 - 12:30	Development of sustainable food production systems	Valorization of bioactive compounds from food side streams	Food microbes and fermentation	New techniques and technologies for tailored food design	Microbes4SustainableFoods – Designing future fermented foods, Part 1	Sustainable and digital transformation of the spanish agri-food sector for a greener and healthier future	
12:30 - 14:00	**Lunch** | **Poster Session 1** | Exhibition area & Multi-purpose room 1 [P1.1] & Multi-purpose room 2 [P1.2, P1.3]						
14:00 - 16:00	Innovative food processing technologies	New techniques and technologies for tailored food design	Food-Microbiota data integration	Innovative food processing technologies	Microbes4SustainableFoods – Designing future fermented foods, Part 2	FOX: Small-Scale, Big Impact – Innovative Approaches for Local Food Processing	
16:00 - 16:30	**Refreshment Break** | **Poster Session 1** | Exhibition area & Multi-purpose room 1 [P1.1] & Multi-purpose room 2 [P1.2, P1.3]						
16:30 - 18:30	Innovative food processing technologies	Profiling and identification ofnovel compounds	*In vitro* vs *in vivo* assays: implications on health	Application of digital technologies and new trends in the food chain and food sectors	GIANT LEAPS project: Filling knowledge gaps on alternative proteins to accelerate the dietary shift	Health Grain Forum: From innovation to product development gaining consumer acceptability – building sustainability in food system	
20:00 - 23:00	**Conference Dinner** | Palau de les Arts						
Day 3: Wednesday 8 November 2023							
08:30 - 10:30	Responsible consumption and production	Application of digital technologies and new trends in the food chain and food sectors	Food-Microbiota data integration	Development of sustainable food production systems	TITAN project: Enabling transparency in food supply chains via implementation of digital technologies to boost health, sustainability and safety	FOODPathS 'Modus Operandi' at the Living Labs. Food for Life-Spain Case Study	
10:30 - 11:00	**Refreshment break** | **Poster Session 2** | Exhibition area & Multi-purpose room 1 [P2.1] & Multi-purpose room 2 [P2.2, P2.3]						
11:00 - 13:00	Development of sustainable food production systems	Application of digital technologies and new trends in the food chain and food sectors	Food and Microbes	Valorization of bioactive compounds from food side streams	FOODPathS-FOOD*force*: Shaping our Future Sustainable Food Systems	ECO READY project: Achieving ecological resilience for the European food system through consumer-driven policies	
13:00 - 14:30	**Lunch** | **Poster Session 2** | Exhibition area & Multi-purpose room 1 [P2.1] & Multi-purpose room 2 [P2.2, P2.3]						
14:30 - 16:00	**Plenary Session 3: Tailored design of food products and processes** | Auditorium 1						
16:00 - 16:30	**Refreshment Break** | **Poster Session 2** | Exhibition area & Multi-purpose room 1 [P2.1] & Multi-purpose room 2 [P2.2, P2.3]						
16:30 - 17:10	**Awards & Conference Closing remarks** | Auditorium 1						
17:10 - 17:30	**EFFoST2024 announcement** | Auditorium 1						