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ABSTRACT BOOK

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Mushrooms and Plants as a Source of Natural Ingredients for Food Application

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Abstract:

Human have been exploiting natural matrices as sources of bioactive molecules. This extensive exploitation started with the traditional medicine that used several mushrooms species and plants among other species as potential health promoters. The main sector aiming at using natural additives is the food industry, given the potential toxicity and allergenic issues related with the use of artificial ones. Besides the food industry, also the pharmaceutic sector searches for bio-based ingredients to develop bioactive formulations for application in medicinal treatments. These bio-based additives are of great value because they can colour, preserve, and confer bioactive properties, without hazardous effects [1]. Given their richness in high added-value compounds, mushrooms and plants have been widely explored for this purpose and considerable advances have been reached concerning extraction methodologies, stabilization techniques, and application in the food cosmetic and pharmaceutic industries. Given their antioxidant and antimicrobial properties, polyphenol extracts from Arbutus unedo L. (strawberry-tree), Ocimum basilicum L. (basil), Melissa officinalis L. (lemon balm), Castanea sativa Mill. flowers (sweet chestnut), Foeniculum vulgare Mill. (fennel), and Matricaria chamomilla L. (german chamomile) were used for preservative purposes in loaf bread, cupcakes, yogurt, cheese, wine, and cottage cheese, namely flavonoids (catechin, quercetin and luteolin derivatives), phenolic acids (rosmarinic, chicoric, lithospermic, caffeic, caffeoylquinic acids), and hydrolysable tannins (trigalloyl-HHDP-glucoside) [2,3]. Also, bioactive colouring molecules like betalains (gomphrenins, isogomphrenins) from Gomphrena Globosa (purple globe amaranth) and anthocyanins (cyanidin, delphinidin, and malvidin derivatives) from Rose canina (rose), Calendula officinalis L. (dahlia) and Centaurea cyanus L. (centaurea), strawberry-tree, Hibiscus sabdariffa L. (roselle), Vaccinium myrtillus L. (blueberry), Prunus avium L. (sweet cherry), Ficus carica L. peel (fig), Prunus spinosa L. epicarp (blackthorn), among others, were applied in yogurt, waffles, and donut topping, among other food products [4]. Regarding the bioactive properties, ergosterol and vitamin D2- enriched extracts from mushrooms were used for functionalized dairy beverages and cheese, and flours, respectively [5]. These results reflect the efficacy of natural extracts from mushrooms and plants in functionalizing, colouring and preserving foodstuff, also highlighting their potential to combat a highly contagious virus, a current global need. In addition, these studies are considered very interesting for the scientific community and different areas of the industrial sector (food, pharmaceutical, cosmetics, among others), because all these results show that several matrices can have a beneficial purpose for man and the environment, and the possibility of having high added value when processed and transformed. In this way, highlights the bioactive, colouring and preservative potential of a vast diversity of ingredients obtained from natural products, at the same time which reinforces the valorisation of these products, widely produced and often discarded by the agri-food sector. The incorporation of these naturally-based ingredients into widely consumed and appreciated food products proved the promising practical applicability and reliability of the study at an industrial/commercial level. **Acknowledgments:** The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CIMO (UIDB/00690/2020). Also, to the European Regional Development Fund (ERDF) through the Regional Operational Program North 2020, within the scope of the projects Green Health (Norte-01-0145-FEDER-000042).

Comparison of Different Extraction Methods of Vitamin K from Plant Samples by the UPLC-APCI-MS Method

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Abstract:

The analytical procedures of plant constituents determination involve the application of a sample preparation method to fully isolate and/or pre-concentrate the analyzed substances from the plant matrix. Most procedures of plant constituents analysis involve the application of long-lasting liquid extraction methods. Nevertheless, at present there are available enhanced extraction techniques, including i.e. ultrasound-assisted solvent extraction (UASE) and pressurized liquid extraction (PLE), which allow for the full recovery of the components of interest from the sample matrix in a short time1,2. The great advantage of these techniques is that they could be performed with high efficiency in low temperatures, what is very beneficial for the isolation of unstable analytes such as vitamin K. The term "Vitamin K" is a generic name and does not imply a single compound. It represents many structurally related molecules containing the 2-methyl-1,4-naphthoquinone group substituted with different hydrocarbon side chains at the C3 position. Nowadays, there are lots of reports about pro-health properties of vitamin K, including its anti-cancer activity3. However, the speculation that it may be helpful in the fight against diseases of old age has led to marked increase in the interest of researchers in the accurate analysis of vitamin K in various types of samples. This study presents the results of research on the application of UASE and PLE for the isolation of vitamin K1 from the following plant materials: iceberg lettuce, cucumber, spinach, broccoli, bean, pepper, arugula, kale, brussels sprouts, chives, parsley, dill, avocado.

Adducts Formed Between Rutin and Methylglyoxal in Foods and in-vivo, and Their Safety Concerns

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Abstract:

Methylglyoxal (MGO), belonging to 1,2-dicarbonyl compounds, acts as the precursor for advanced glycation end products (AGEs) in foods and *in vivo*, which are associated with various chronic diseases. Polyphenols with meta-phenol structure have been reported to easily react with MGO, and scavenge it. However, the safety of the neo-formed adducts between polyphenols and dicarbonyl compounds remains largely unknown, which brings potential threats to food safety. Recently, we investigated the elimination capacity and mechanism of rutin, a typical and widely distributed plant polyphenol, for MGO and detected identified the adducts formed between rutin and MGO. Interestingly, different from the adducts reported between other flavonoids and MGO, new rutin–MGO adducts with dione structures on the moiety of MGO were identified and proven to occur in various foods and in vivo. Therefore, we further evaluated the cytotoxicity of the adducts against gastrointestinal tract, blood vascular and neural cell lines, and found the formation of adducts between rutin and MGO remarkably reduced the cytotoxicity of MGO. The results provides further promise for the application of rutin as a scavenger of dicarbonyl compounds by dietary supplement and addition in foods.

Why Are Some Apple Varieties Less Allergenic than Others? - Insights into Parameters Which Might Be Relevant

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Abstract:

Due to their bioactive compounds apples contribute to a healthy diet. However, the structural homology between the birch pollen allergen Bet v 1 and the Mal d 1 in apples is responsible, that in Northern and Central Europe up to 70% of patients suffering from birch pollinosis develop an adverse reaction to fresh apples. Consumer surveys and clinical studies indicate a marked difference in the allergenic potential of different varieties. In particular, for traditional apple varieties from orchard meadows a reduced allergenicity is proposed. Discrepancies in allergenicity cannot be sufficiently explained by the Mal d 1 content and therefore, an impact of the isoallergen profile and interactions with polyphenols are discussed. To get a deeper insight into cultivar and exogenic factors influencing the allergenicity of an apple variety we studied several traditional apple varieties and commercial breeds. We investigated the Mal d 1 contents and isoallergen profiles for flesh and peel by mass spectrometry using a bottom up proteomics approach. Individual phenolics were characterized and quantified by HPLC-DAD-MS. The release (bioaccessibility) of individual phenolic structures and the Mal d 1 during the oral phase was studied under in vitro digestion conditions. Furthermore, activity of the polyphenol oxidase was determined for fresh apples and the interactions of some major phenolic structures with recombinant expressed Mal d 1 were studied by Isothermal Titration Calorimetry and Saturation Transfer Difference NMR. Combining the data improves the understanding of parameters which influence the allergenic potential of apples.

Virgin Olive Oil-Derived Nitro-Fatty Acids: Relationship to Cultivar, Fruit Ripening, Polyphenol Content and Protection of Mitochondrial Function in Non-Alcoholic Fatty Liver Disease

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Abstract:

Nitro-fatty acids (NO2-FA) are being formed in Virgin Olive Oil (VOO), exhibiting pleiotropic anti-inflammatory responses. We analyzed fatty acid profile, polyphenols, pigments and NO2-FA levels in two contrasting olive cultivars, Arbequina and Coratina at two ripening conditions. During in vitro gastric conditions, the extent of nitro-conjugated linoleic acid (NO2-cLA) and nitro-oleic acid (NO2-OA) in Coratina VOO was higher at the intermediate stage. In contrast, Arbequina VOO did not present changes on NO2-FA formation. The presence of polyphenols in Arbequina VOO promoted fatty acid nitration while their absence switched nitration to lipid oxidation processes. In Coratina, the absence of polyphenolic compounds did not affect NO2-FA levels. Based on these results, we set the conditions where the composition of VOO promotes the formation of NO2-FA to enhance their health beneficial properties in a mice model of Nonalcoholic fatty liver disease (NAFLD). Nitro-fatty acids formation was observed during digestion in mice supplemented with VOO and nitrite. Mice fed with a high-fat diet (HF) presented lower plasma NO2-FA levels than normal chow, and circulating concentrations recovered when the HF diet was supplemented with VOO plus nitrite. Under NO2-FA formation conditions, body weight and fat liver accumulation significantly decreased. Mitochondrial

dysfunction plays a central role in the pathogenesis of NAFLD while NO2-FA has been shown to protect from mitochondrial oxidative damage. Accordingly, an improvement of respiratory indexes was observed when mice were supplemented with both VOO plus nitrite favoring NO2-FA formation. Overall, our results strongly suggest a positive correlation between VOO-derived NO2-FA and the health benefits associated with VOO consumption.

Revalorization of Industrial Pineapple (*Ananas comosus* (L.) Merrill) by-products as Antioxidant Source: Optimization of Ultrasonic-Assisted Extraction of Phenolic Compounds

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Abstract:

During the pineapple processing stages, around 60 wt. % of by-products are generated, such as crown, skin and heart of the pineapple, which represents high economic losses. Pineapple wastes have been used as a source of bromelain, carbohydrates, essential oils, and polyphenols, mainly catechin, ferulic acid, gallic acid, and epicatechin. Therefore, the present work aimed to use pineapple core wastes to obtain an antioxidant extract by the optimization of ultrasonic-assisted extraction of phenolic compounds. An optimization of polyphenol`s solid-liquid extraction conventional process from the pineapple wastes has been carried out by using different solvents (water, ethanol 50 % and a H_2O:MeOH:HCl 1% (70/28/2)) obtaining the best results in terms of antioxidant capacity when using ethanol 50%. In addition, an ultrasound-assisted extraction (UAE) procedure to isolate phenolic compounds from pineapple byproducts was optimized by using a multivariant approach. A three-level, three-factor Box-Behnken experimental design was used to evaluate the effect of the extraction time, amplitude and cycles, on total phenolic content (TPC) and antioxidant activity. The best extraction conditions were achieved using 70 % of amplitude, cycles of 2 seconds, and an extraction time of 5 minutes. Under these conditions, the result obtained by using UAE are not significantly different from the ones obtained by the conventional extraction procedure. However, the ultrasound-assisted extraction is a good alternative in case of a semi-industrial extraction processes since only one extraction step is needed in contrast to conventional solid-liquid extraction method in which two extraction steps are required. The results show the potential of pineapple wastes as a natural source of phenolics and the effectiveness of UAE for the reutilization of these by-products.

Chemical Fingerprints of Pomegranate (*Punica granatum L.*) Seed Oil: Correlation of Bioactive Compounds with Origins

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Abstract:

The chemical fingerprinting of bioactive compounds presents in different *Punica granatum* seed oils was performed in order to evaluate the quality of samples and their potential use as a functional food ingredient. Five classes of compounds (tocopherols, terpenoids-triterpene,

phytosterols, FAMEs and polyphenols) in pomegranate seed oil have been analyzed with different analytical procedures. The analytical protocol for determination and quantification of unsaponifiable fraction has been optimized. β, γ, δ -Tocopherols, Terpenoids-triterpene and phytosterols have been identified and quantified at the same time. The fatty acids composition of the seed oils was determined by GC-FID analysis. Concerning the unsaponifiable fraction composition, squalene was found as primary terpenoids in all samples, with a certain variability between them; β-tocopherol was found as the main vitamin E isomer, while significant differences between oil samples were because of the presence of the other isomers; β-sitosterol is the main phytosterol found in oils, with a slight variability between samples. The percentage of punicic acid is ranging from 0,5 % up to 80 %; only one sample has showed a lower % of punicic acid and a different fatty acid composition, probably because of a pomegranate seed oil adulteration. The most important differentiations in the fingerprinting map will be also because of the minority biomolecules besides the main representative markers. Therefore, multivariate statistical analyses, including principal component analysis (PCA), partial least squares discriminant analysis (PLS-DA), and orthogonal partial least squares discriminant analysis (OPLS-DA), were performed to identify differences in samples and create a fingerprinting map.

Non-thermal and Thermal Treatments Impact the Structure and Microstructure of Milk Fat Globule Membrane

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Abstract:

There is an increasing interest in the potential use of milk fat globule membrane (MFGM) as an ingredient in food and nonfood applications. This study investigated the effectiveness of dielectric barrier discharge (DBD) plasma reactor on MFGM as a non-thermal alternative through analyzing the fatty acid composition, lipid oxidation, protein profiles, MFGM recovery, particle size and morphology. The saturated fatty acid concentration in the pasteurized sample was lower than that in plasma-treated MFGM samples. Cold plasma treatment reduced the Escherichia coli, Salmonella spp. and Staphylococcus aureus growth inhibition width of inoculated plasma-treated MFGM samples by 37%, 35% and 34%, respectively. The weakness of casein and whey protein bands of plasma-treated MFGM indicated the protein–MFGM interaction. Plasma might affect the small MFGs, which resulted upon the isolation stage more than the large MFGs, and induced the possibility of its interaction with milk proteins or even its accumulation on the large MFG surface. MFG size increased by increasing the plasma treatment time, which indicates the aggregation of fat globules into large globules.

Rabdosianone I, A Bitter Diterpene from An Oriental Herb *Isodon japonicus* Hara -Identification of its Direct Targets in Cancer Cells and Elucidation of Anticancer Mechanisms of Action

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Abstract:

Isodon japonicus Hara (Lamiaceae), known as Enmeiso, which means "grass of longevity" in Japanese, has been used as a bitter stomachic in Japan. Enmeiso was also permitted for use as one of the natural food additives to enhance flavor for bitterness in Japan. Natural products have numerous bioactivities and are expected to be a resource for chemopreventive and anticancer drugs. However, how *I. japonicus* may contribute to disease prevention and treatment including

anticancer activity is not well characterized. We then isolated a bitter diterpene from *I. japonicus*, determined its chemical structure, and named it rabdosianone I. We found that rabdosianone I markedly inhibited the growth of human colorectal cancer cells by downregulating the expression of DNA synthase thymidylate synthase (TS). Next, to elucidate the binding proteins of rabdosianone I in cancer cells, we immobilized rabdosianone I onto nano-magnetic beads and identified two mitochondrial inner membrane proteins, adenine nucleotide translocase 2 (ANT2) and prohibitin 2 (PHB2), as direct targets of rabdosianone I. Consistent with the action of rabdosianone I, the depletion of ANT2 or PHB2 using siRNA reduced TS expression in a different manner. The knockdown of ANT2 or PHB2 promoted proteasomal degradation of TS protein, whereas that of not ANT2 but PHB2 reduced TS mRNA levels. Thus, we uncovered a previously unknown mechanisms of the pleiotropic regulation of TS by ANT2 and PHB2 and proposes the possibility of rabdosianone I as a promising lead compound of a novel TS suppressor for chemoprevention and anticancer treatment.

Microscopic Insight to Sweetness

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Abstract:

Sugars are thought to owe their sweet taste to the particular pattern of bonds formed between atoms in sugar molecules and the receptor on taste buds. But most types of sugar have a similar arrangement of atoms, so why some taste sweeter than others have proved puzzling. Neutron diffraction experiments, augmented with computer modeling, have been performed to investigate and compare the structure of the hydration shell of natural sugars (both mono- and di-saccharides) and of artificial sweeteners. It is found that these solutes interact with the neighboring water molecules by forming H-bonds of different length and strength. Our results show that the strength of sugar (or sweeteners) - water hydrogen bond interaction is one of the

factors influencing sweetness, another being the number of water molecules within the first neighboring shell of the solute, whether bonded or not. In turn, this observation implies that small differences in stereochemistry between the different sugars determine a relevant change in polarity, which has a fundamental impact on the behavior of these molecules in the process of taste perception.

Production of Natural Colorants from Plant Pigments: Stability Enhancement of Pigments via Modification of Their Molecular Structures

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Abstract:

Natural colorants from plant-based pigments have gained increasing popularity due to health consciousness of consumers. These pigments nevertheless exhibit low stability and in many cases experience molecular structure changes upon being heated or pH change during cooking or industrial food processing. Such changes lead in turn to color variations of the pigments, which clearly affect their usability as food colorants where color stability is required. Approaches that can be used to enhance the molecular and color stabilities of the pigments are clearly desired. This presentation explores and discusses some techniques that can be used to enhance the molecular and color stabilities of selected pigments, namely, chlorophylls and carotenoids. An alternative plant pigments giving yellow-red color viz. brazilein, which is of interest due to

its absence of unique flavor and taste, is also mentioned. Degradation mechanisms are first discussed in order to build up understanding on how each pigment degrade and how molecular and color stabilities can be enhanced. Focuses are made on such stability enhancement techniques as metal complexes formation in the case of chlorophylls, protein complexes formation in the case of carotenoids and methylation as well as organic acids co-pigmentation in the case of brazilein.

NMR and MS as Toolset in Metabolomics Analysis of Apple Juice and the Use of Membrane Operations for Partial Removal of Sugar

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Abstract:

Whole apples are incredibly healthy food as they can prevent chronic heart and vascular diseases, diabetes, respiratory and pulmonary dysfunctions, obesity, or cancer, among others [1]. All these quality properties are ultimately based on the metabolic composition of the fruit. On the other hand, clear apple juice has been associated with adverse effects, mainly related to its high fructose and low fiber content [2]. Therefore, partially removing sugar in apple juice without changing bio-functional properties and composition is a great technical challenge [3]. In the present work, apple juice was initially characterized using Nuclear Magnetic Resonance (NMR) and Mass spectrometry (MS) coupled with HPLC-UV. To reduce the sugar content and preserve its phenolic composition, the juice was clarified by ultrafiltration and then nanofiltered through a combination of diafiltration and batch concentration processes. Three different nanofiltration membranes with MWCO in the range of 200-600 Da were tested. D-glucose and D-fructose were enzymatically determined in the NF products, while the total phenolics content was determined by the Folin-Ciocalteu assay. Among the investigated membranes, a thin-film composite membrane with the lowest MWCO (200-300 Da) represented a good compromise to remove up to 60% of sugars from apple juice with minimal losses of phenolic compounds.

Mechanism Exploration of the Reduced Allergenicity of Shrimp (*Macrobrachium nipponense*) by Combined Thermal/Pressure Processing

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Abstract:

Shrimp allergic reactions seriously affect the life quality of allergic people. More attention has been paid to reducing allergenicity through food thermal processing technology. This study aimed to explore the underlying mechanism about combined thermal/pressure processing on the allergenicity of shrimp (*Macrobrachium nipponense*) by analysis of sensitizing and eliciting capacity, structural changes and gastrointestinal fate, and mapping linear epitopes. Mice treated with steamed + reverse-pressure sterilized shrimp exhibited lower specific IgE and IgG_1 concentrations, degranulation, histamine and mMCP-1 levels, vascular permeability and allergic symptoms than those fed raw shrimp or steamed shrimp (p<0.05). The lung, spleen and jejunum tissues showed neat tissue morphology and no obvious inflammatory cell infiltration

in mice treated with steamed + reverse-pressure sterilized shrimp. At the same time, the protein structure was unfolded, hydrophobic groups were exposed, protein bands were dispersed and degraded more quickly, the digestibility was significantly higher (p<0.05) after combined processing of steaming and reverse-pressure sterilization, while the steamed shrimp retained high allergenicity due to protein aggregation. In addition, the disappearance of immunodominant linear epitopes in β-actin (Gln361-Ser366) and tropomyosin (Glu177-Ser188) were the main reasons for the decreased allergenicity of shrimp. Meanwhile, the linear epitopes inside the arginine kinase were difficult to bind to IgE, thus maintaining the hypoallergenicity of shrimp. In conclusion, combined processing of steaming and reverse-pressure sterilization can change the structure of shrimp proteins, alter their gastrointestinal digestive behavior, and thus affect their linear epitopes and reduce allergenicity, which is a potential processing for the production of hypoallergenic shrimp products.

Simple and Fast Method for the Determination of Caffeic Acid in Wine Using a Molecularly Imprinted Polymer and a Screen-Printed Electrode

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Abstract:

Caffeic acid (CA) is an efficient antioxidant found in wine, in plants and can be extracted from by-products of food industry. A simple and fast method was developed for the determination of CA in wine using a molecularly imprinted polymer (MIP) specific to CA and a cyclic voltammetry detection. A CA-MIP was prepared by radical polymerization using N-phenylacrylamide as functional monomer, ethylene glycol dimethacrylate as cross-linker, and azobisisobutyronitrile as initiator. Rebinding activities between the polymers and CA were promoted by an indirect method and characterized by cyclic voltammetry (CV) using a screen-printed carbon electrode (SPCE). It is a fast method, which requires simple and portable instrumentation. The polymer showed a high selectivity toward CA and a good repeatability. CA-MIP was then applied in wine samples spiked with CA, and the results were compared to those obtained by a chromatographic method. With a limit of detection of 0.06 mM in wine, the recovery values confirm that the method is suitable for further applications.

LC-ESI-QTOF-MS/MS Study on Phosphopeptide Profile of Kefir and Peptides from Kefir-Type Soy Drink

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Abstract:

Kefir is a known probiotic product with several health-promoting properties due to both microorganisms themselves, and several compounds present in kefir, such as peptides. Likewise the scientific interest and the consumption of kefir-types drinks, from innovative and traditional

vegetable sources, is constantly growing. Besides, the advancement and the most widespread use of analysis techniques such as high-resolution mass spectrometry makes increasingly feasible the molecular characterization of compounds newly formed by fermentation process and the chance to evaluate their bioactivity. A comprehensive characterization of potentially bioactive peptides, including caseino-phosphopeptides, was recently performed, in our laboratory, in kefir obtained with kefir grains under different production technologies, using Liquid Chromatography-ElectroSpray Ionization-Quadrupole-Time of Flight-tandem mass spectrometry (LC-ESI-QTOF-MS/MS). As a result, seventy-three phosphopeptides, mostly arising from caseins and all including from three to five serine residues in their sequences, were identified. Seventy-one of them showed the typical motif "SerP-SerP-SerP-Glu-Glu", which is crucial for the ability of caseins to bind to minerals. Several peptides were observed, for the first time, from the 1–40 region of β-casein. As for the effect of production technology, phosphopeptide profiles of kefirs obtained under different conditions of temperature, pH and grain use, were different, showing that technology can modulate phosphopeptide formation. Several peptides were also characterized in soy drink kefir. In the present work, our recent results on the structural characterization of peptides from kefir and soy drink kefir and a survey on the potential of mass spectrometry application in this field are then reported.

Enzymatic Recovery of Natural Pigments from Unsold Vegetables: Process Optimization and Stability

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Abstract:

Color is an essential attribute for the sensory quality of a food product. Nature offers a color palette and most of such pigments may be extracted from plant sources and used as natural food colorants. Despite significant efforts recently made to improve the recovery yield of food pigments from natural sources, the development of green and sustainable biotechnological approaches is currently under investigation. Within the context of circular economy, food wastes represent a cheap source for the recovery of valuable compounds including food colorants, such as carotenoids and betalains. In this study, tailored enzyme-assisted protocols have been developed for the extraction of carotenoid-containing chromoplasts from unsold tomatoes and betalains from unsold red beets, avoiding the use of organic solvents. The recovery of such pigments was carried out by a tailored enzymatic mix [i. for the former (carotenoids from tomatoes): cellulase (57%), xylanase (17%) and pectinase (26%); ii. for the latter (betalains from red beets): cellulase (37%), xylanase (35%) and pectinase (28%)], blended considering the polysaccharide composition of the corresponding vegetable cell wall. The optimal process conditions (i.e.; temperature, pH, enzymatic mix dosage and processing time) for enhancing the extraction yield have been investigated. Finally, the stability of both recovered pigments (i. carotenoid-containing chromoplasts compared to the free carotenoid-based extract; ii. betalains as betaxanthins and betacyanins) has been evaluated under dark and UV-light exposure at different temperatures (4, 25 and 40 °C) by the kinetic degradation model (UV–visible spectrophotometer assay) and by the color attributes (CIELab* parameters).

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Does High-Speed Cold Centrifugation of Milk Impair Quality of Hard Cheese?

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Abstract:

Innovation in dairy technology often represents a chance for improving process efficiency as well as solving challenges. However, when an innovative step shall be included in a traditional process, such as the cheesemaking of Grana Padano PDO, unwanted changes might be induced to the typical features of the final product. The aim of this study was to assess the impact of single or double high-speed cold (<40 °C) centrifugation of milk intended for Grana Padano cheesemaking on quality traits of cheeses ripened up to 20 months. Industrial cheesemakings, including control cheesemakings from non-centrifuged milk, were conducted over two years for a total of 18,300 cheeses considered. A multidisciplinary approach involving microbial, chemical, biochemical, and structural traits was adopted to analyze milk and cheese samples. Centrifugation of milk was effective in reducing spore number in milk thus preventing the "late blowing defect" in cheeses. However, impedometric analysis indicated that also a preferential removal of rod-shaped lactic acid bacteria took place in milk. This altered microbiota was confirmed in cheese where it caused a different proteolysis of αs-casein during ripening as well as a different accumulation of free amino acids deriving from microbial pathways. Confocal microscopy revealed the presence of a mechanical damage of fat matrix in cheese. Cheeses at 9-, 15- and 20-month ripening underwent sensorial evaluation to assess consumer acceptability and perception threshold of differences respect to control cheeses. Finally, principal component analysis was carried out to study the whole dataset and defining principal variables affected by milk centrifugation.

Catalytic Properties of Lipoxygenase Extracted from Different Italian Varieties of Olive Fruit (*Olea europaea* L.)

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Abstract:

Lipoxygenases (linoleate:oxygen oxidoreductase, LOX, EC 1.13.11.12) are a class of widespread dioxygenases catalyzing the oxygen addition to polyunsaturated fatty acids (PUFAs) containing a (1Z, 4Z)-pentadiene system. The hydroperoxides produced by LOX reaction are rapidly converted into a different compound involved in plant development and response to abiotic and biotic stresses. LOXs have a fundamental role in the production of volatile molecules that can positively or negatively influence the flavour or aroma of many plant products. In olive, the compounds enzymatically produced from the oxidation of PUFAs are implicated in olive oil aroma. Scarce information is available on the biochemical properties of the olive LOX. The present study tries to fill these gaps by determining the catalytic efficiency of the LOX extracted from nine Italian varieties of *O. europaea* [Canino (Cn), Carboncella (Cr), Frantoio (F), Itrana (I), Leccino (L), Maurino (Mu), Moraiolo (Mr), Rosciola (R) and Sirole (S)], selected at the same maturity level. The raw extracts showed different catalytic properties, with Frantoio and Rosciola that expressed the highest LOX activity. To complete the biochemical characterization, all crude LOX extracts were examined for their optimal pH and temperature. Concluding, our results can be considered a suitable index for managing the lipid oxidation during the extraction process without compromising the aroma of virgin olive oil. **Keywords:** lipoxygenase; olive drupes; crude extracts; catalytic properties

Effects of Processing on Proteinaceous Nutrients Bio-Accessibility

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Abstract:

The dietary shift to sustainable sources of proteins, to guarantee nutrition security to the growing world population by reducing the negative environmental impact of the food production chain, is at the core of the European "Farm to Fork Strategy". The flexitarian diet is enlarging the demand for plant-based foods and is important for expanding the selection and lower the cost. On the one hand, plant-based-ingredients can be a source of bioactive proteins and peptides, but the presence of anti-nutrients interferes with nutrients bio-accessibility. The development of approaches to characterize the ingredients and evaluate the effect of processing on their nutritional quality is essential. We evaluated germination as a low-cost bio-process and physical approaches (protein isolation) as approaches for improving the nutritional quality of plant derived proteins. The digestibility was assessed using the INFOGEST model implemented with the jejunal digestion phase carried out by the brush boarded membrane enzymes (BBM). The products of digestion (peptides and amino acids) were monitored by advanced proteomic approaches to evaluate the effect of food processing. Physical removal of cellulose and polyphenols improved the digestibility of proteins derived from Moringa leaves and hemp seeds. The digestion of pulses' exudates, a by-product of the canning industry, showed at a molecular level the presence of peptides with potential bioactivity, like the Bowman-Birk inhibitors. Germination can increase the amino acid bioavailability of flour chickpea. The proteomic characterization of the ingredients and of the digestome can guide the selection of processing approaches successful in improving the protein's bio-accessibility and availability.

Gluten-Friendly Bread Exerts a Bifidogenic Effect and a Modulating Action on Celiac Gut Microbiota: A Prebiotic-Like Effect or A New Mode of Action?

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Abstract:

Celiac disease (CD) is a chronic multiorgan autoimmune disorder that is triggered by dietary gluten proteins in genetically predisposed individuals. Environmental factors such as gut microbiota variations may be implicated in the pathogenesis of CD. In fact, gastrointestinal dysbiosis is linked with the inflammatory milieu in celiac patients. In CD patients, the mucosal layer fails to stabilize the gut microbiota, exposing the host to harmful antigens and pathogens. Such dysbiosis is characterized by a reduction of intra and inter-genera biodiversity, showing an imbalance between beneficial bacteria and potentially pathogenic or pro-inflammatory species, as compared to healthy subjects. Gluten Friendly™ (GF) is a new type of gluten achieved through a patented, physicochemical process that is applied to wheat kernels before milling. Based on early *in vitro* investigations, this process reshapes the tertiary structure of gluten proteins, without altering the secondary or primary structure. The modified gluten maintains most of its organoleptic and viscoelastic properties, but gains unprecedented qualities. "Gluten Friendly" proteins have shown in vitro and in vivo, a significant reduction of their inflammatory potential;

high digestibility; creation of a fertile ground for the proliferation of good bacteria in the celiac gut; remodeling of the celiac gut microbiota towards homeostasis, by boosting butyrate-producing species; protection of the intestine by antibacterial effects against Salmonella and Staphylococcus aureus and by stimulating mucus production. Therefore, this communication is focus on the bioactive properties of the "Gluten Friendly" proteins and their potential as possible future therapy to protect the gastrointestinal tract from inflammation and pathogens.

Food Structuring and Customized Nutrition

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Abstract:

Now more than ever, food customization and personalization are emerging as concepts with significant research and commercial interests. Consumers look for a range of variety and food consumption is perceived way different than merely satisfying hunger or even nutritional needs. Given this, there have been enormous dynamics in new product development and these changes are incessant. In the context of nutrition, significant focus is being given to the development of customized foods, meeting the demands and preferences of various age groups, health conditions, job types, populations, etc., among other variables. Accordingly, several approaches are being considered for the development of foods with customized nutritional content, appearance, texture, appeal, etc. This presentation will focus on emerging concepts of food structuring for customized nutrition applications and will emphasize the interface with gastronomy. Techniques such as gelation, food 3D printing, micronization, encapsulation, texturization and sous vide cooking will be elaborated, focusing on recent advances and futuristic requirements. Importantly, these concepts are required to be viewed from the physics-engineering-chemistry perspective and ultimately consider the biological fate of structured foods. In particular, the role of food constituents and their impact on food structuring and destructuring processes requires a critical thought. Overall, interfacing food structuring and customized nutrition can support newer and stronger concepts for improved health and well-being.

Preheat-induced Soy Proteins with Enhanced Thermal Stability and Their Application

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Abstract:

Recently, there is a growing interest in developing protein-enriched beverages with improved nutritional and functional properties. However, this is challenged by heat-induced aggregation and gelation of edible proteins, which limits their practical applications in high protein systems. Therefore, the authors aimed to produce soy proteins with anti-aggregation behavior upon heating. Studies demonstrated that desirable thermal stability of soy proteins can be prepared through preheating treatment at lower protein concentrations, and the lower concentration, the higher thermal stability. The SPPs structures were found to be highly unfolded, denatured, compact, and reduced surface energy. In addition, these particles exhibited lower viscosities and higher flow behavior index without gelation. We further prepared high-protein emulsions stabilized by SPPs, and these emulsions exhibited appreciable heat stability, whereas SPs gelled

when both samples were tested at an identical concentration (10%, w/v). These results provide useful insights on how heat stable soy proteins can be prepared, which extends their further application in protein-enriched beverages and relevant products.

Mitigation of Acrylamide Formation in Biscuits through the Use of Alternative Ingredients: Effect of Legume Flour Types and Preparations

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Abstract:

Acrylamide (AA) is an undesirable food compound classified as "probably carcinogenic to humans" (Group 2A) because of its toxicological effects. AA is formed mainly during the heat treatment of food under low-moisture conditions from asparagine and sugars as part of the Maillard reaction. In recent years, authorities and regulations have become more restrictive regarding AA levels allowed in foods and beverages to encourage the application of mitigation strategies. The aim of this research project was to investigate the impact of some formulation strategies to reduce AA in biscuits, one of the most consumed products at risk for AA. In detail, the potential of using 20, 40 and 60% of lupin and chickpea flours compared to 100% wheat flour was examined by standardizing the initial asparagine content in biscuit formulations to highlight the impact of different flour characteristics on AA formation. Furthermore, the effect of red kidney bean flour preparations with intact or broken cotyledon cell walls on the formation of AA in biscuits was investigated, as it was hypothesized that intact cell walls might modulate the dehydration rate and reduce the availability of asparagine during baking. Ingredients, raw doughs and biscuits were analyzed for the content of AA and its precursors; the baked biscuits were also described in terms of key quality characteristics. Comprehensive results showed that the most promising formulation strategies investigated to reduce AA while maintaining some desirable biscuit properties were the use of 20 and 40% of chickpea flour and bean flour with intact cotyledon cell walls.

The Sustainable, Nutritious and Functional Power of Algae as the Future Functional Food Ingredients

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Abstract:

Nowadays, especially in light of the COVID-19 pandemic and the long COVID-19 implications, pronounced market pressure has been observed both in the food industry and consumers to develop sustainable and functional food ingredients. Functional and nutritional attributes, as well as the potential sustainability benefits of algae, are driving demand and positioning it as a promising food of the future. Spirulina blue-green algae (Arthrospira platensis), for example, contain up to 70% dry weight protein with all the essential amino acids, vitamins and minerals. Its added value in becoming a functional ingredient for the food industry lies in its bioactivities such as immune modulation. In our research, we have focused on discovering and further developing new bioactivities from Spirulina. Spirulina may be cultivated under different

conditions and extracted using various techniques, which may affect the bioactive metabolite content of Spirulina. Under certain conditions, for instance, irradiation by light-emitting diodes (LED) to control photosynthesis, algal bioactivity such as anti-inflammatory properties may be. In this study, we exposed macrophages and monocytes activated by the pathogenic stimulator lipopolysaccharide (LPS) to different doses of Spirulina extracts, cultivated in either full-range solar spectrum or controlled light conditions. We found that an aqueous extract of a photosynthetically controlled Spirulina (LED Spirulina) but not Solar Spirulina, inhibits TNF-α secretion by over 70% from LPS-activated macrophages and over 40% from LPS-activated monocyte cells. Adding LED-Spirulina as a functional ingredient to food products would be a great strategy to enrich our diet with many nutrients and health-beneficial components.

The Role of Lipid Nanoparticles in the Development of Emulsion Formulations able to Carry/ Deliver Multiple Actives

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Abstract:

The development of lipid nanostructures that can exhibit the two-fold functionality of simultaneously acting as active carriers and (Pickering) emulsion stabilisers has been recently proposed as a promising approach to achieve co-encapsulation and independently controlled active co-release (Figure 1). Solid lipid nanoparticles (SLNs) and nanostructured lipid carriers (NLCs) are two types of lipid-based colloidal carriers, that have been utilised either as o/w emulsion stabilisers, or suitable carriers and delivery vehicles of poorly water-soluble actives, though not in tandem. To harness their potential and attain tailored performances, careful selection of materials and tuning of their microstructural characteristics are required. Herein, SLNs and NLCs in the form of aqueous dispersions, were prepared using different formulation parameters (i.e. solid-to-liquid lipid mass ratios, surfactant type) via a melt-emulsification-ultrasound method. Lipid screening studies facilitated the choice of lipid matrix components that achieved encapsulation efficiency and loading capacity as high as 99% and 5% (respectively) for curcumin; used as model hydrophobic active. Compatibility between the chosen components, and liquid lipid/active addition were shown to greatly influence the polymorphism/crystallinity of the fabricated colloidal lipid particles. The developed lipid particles with sizes in the 100-200 nm range were subsequently used within o/w emulsion systems to assess their Pickering capability. The stabilisation mechanism and their ability to retain their previously defined attributes while in aqueous dispersions (e.g. release performance) will be discussed. Although this work has strong routing in Pharmaceutical applications, the fundamental understanding and formulation knowhow reported here, would greatly benefit other sectors, amongst these that of Foods.

The Effects of Water Characteristics on the Physicochemical and Sensorial Properties of Water Kefir

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Abstract:

Fermented beverages have been considered important by the consumers due to their natural

functional benefits since the outbreak of Covid-19 pandemic. Besides its naturally sparkling, low sugar taste profile and being vegan, water kefir is preferred due to its health benefits such as anti-oxidant, anti-carcinogenic, anti-inflammatory and gastro-protective properties. This beverage is produced by fermenting a sugar solution to which fruits are added, with water kefir grains. Kefir grains contain lactic acid bacteria, acetic acid bacteria and yeasts living in a symbiotic way. Since water is the major component of a beverage, characteristics of the water used in the production should be considered as it has crucial impacts on the taste, appearance, stability, and fizziness of the final product. Mineral composition of the water affects sensorial properties and depends on the particular geological environment. Therefore, in this study production of water kefir was done with four different types of water and the effects on the pH, total solids(%) and color of the beverage during fermentation of 72 hours were investigated. Total solids(%) increased and pH decreased for all samples. Sensory analysis was conducted and water kefir prepared mineral water with 91.5 mg/L magnesium, 163 mg/L calcium and 5.55±0.03 pH had the highest scores in terms of smell, mouthfeel, taste, fizziness and preference parameters. L, a and b values of the sample with the highest sensory scores were found as 11.37±0.45, -0.45±0.31 and -4.36±0.47, respectively.

Exopolysaccharide Produced by *Lactiplantibacillus plantarum* Y12 Inhibits the Biofilm Formation and Virulence Genes Expression of *Shigella flexneri*

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Abstract:

The Exopolysaccharide (EPS) of *Lactobacillus* strains has been widely reported as an effective inhibitor of pathogen biofilm formation. Exopolysaccharide secreted by *Lactiplantibacillus plantarum* Y12 (L-EPS) was composed of mannose, L-glucuronic acid, amino galactose, glucose and galactose, xylose (mole ratio 32.26:0.99:1.79:5.63:0.05:4.07). The biofilm formation of *Shigella flexneri* was significantly decreased by different concentrations of L-EPS ($p<0.05$). While, *S. flexneri* secreted EPS (S-EPS) plays an important role in the formation of *S. flexneri* biofilm, and also enhances the adhesion, invasion and toxicity of *S. flexneri* to HT-29 monolayer cells. L-EPS could significantly ($p<0.05$) reduce the polysaccharide content in *S. flexneri* extracellular polymeric matrix, and inhibit the adhesion and invasion of *S. flexneri* to human colon cancer cell line HT-29 monolayer. Furthermore, L-ESP could significantly down-regulate the gene expression of *S. flexneri*, including *fimF*, lipopolysaccharide synthesis (*rfc, wzzE, lptE, lptB, rfaQ*), anchor protein repeat domain (*arpA*), virulence factor (*lpp, yqgB*), antibiotic resistance (*marR, cusB, mdtL, mdlB*), and heavy metal resistance (*zraP, mtgA, mdoB, mdoC*). The intraperitoneal injection of *S. flexneri* induced physiological phenomena of dense fecal diarrhea, lethargy, weight loss, colon shortening, and splenomegaly in Balb/C mice. While the Balb/C mice intraperitoneal injected with *S. flexneri* and L-EPS exhibited alleviating adverse physiological symptoms compared to the Balb/C mice intraperitoneal injected with only *S. flexneri*. As the main metabolite of *L. plantarum* Y12, L-EPS has a promising application in control of *S. flexneri* infection.

Recovery, Metabolic Characterization, and Reuse of Waste Materials from Olive Oil Production Chain: Olive Mill Wastewaters (OMWs) and Leaves

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Abstract:

Olive mill wastewaters (OMWs), essentially consisting of process waters and the aqueous fraction of squeezed olives, are always considered a highly polluting agri-food waste to be disposed as special. Therefore, OMWs as well as other waste materials such as leaves derived from the olive oil production process, present a high concentration of bioactive compounds very interesting for the cosmetical, pharmaceutical and food industry [1,2]. Indeed, if properly managed, these matrices could be classified as secondary raw materials providing both environmental and economic advantages [3]. An interesting application could be the insertion of polyphenolic extracts from olive process waste in active packaging film including plant-based polymers (e.g., cellulose, starch): the aim is to ensure a long-term stability and shelf-life of foods. For this purpose, DSC, TG/DTG, rheological measurements, FT-IR and NMR spectroscopies, are essential for the physical-chemical characterization and compatibility of bio-based polymers with different compositions. Nuclear Magnetic Resonance (NMR) Spectroscopy, employed in this work for the metabolic analysis of OMWs and leaves, is an alternative technique to the traditional used in the agri-food industry to investigate the composition of these waste materials and to evaluate the recovery and the preservation of the bioactive metabolites (polyphenols, amino acids, fatty acids) if the original matrix is treated in different ways. In particular for the identifications of the low molecular weight compounds presents in OMWs and olive leaves, high resolution NMR experiments have been used including 1D (1H, 13C-{1H} and 17O NMR) and 2D homo and heteronuclear (1H-1H COSY, 1H-13C HSQC, 1H-1H *J*-Res) NMR spectra.

Effects of Microwave Radiation on the Bioactive Properties of Peppers

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Abstract:

Microwave processes are mainly used to induce thermal changes in food, which depend on processing time, microwave power and the amount of food processed. Thermal changes are related to the modification of the bioactive properties in food. The aim of the study was to investigate the effect of microwave radiation on the total antioxidant capacity (TAC) and the content of polyphenolic compounds in three types of red, yellow and green peppers. The TACs were analyzed for both fresh and microwaved vegetables. Heating was performed in a microwave oven for 15 minutes. with a rated power of 800 W and a frequency of 2450 MHz. In methanol and ethanol homogenates, the antioxidant potential was assessed using the DPPH, ABTS and FRAP methods, as well as the content of polyphenols using the F-C method. Microwave radiation caused significant ($p \leq 0.05$) changes in bioactive properties. In yellow peppers, the TAC was reduced to a greater extent than in red peppers. The greater reduction in TAC (25%) observed for red peppers may be due to the specific thermolabile compounds typical for the red peppers. This observation in fact open the discussion about the microwave treatment impact on TAC of treated vegetables As at the same time, microwave treatment did not change the total polyphenol content of the yellow pepper. This suggests that consuming microwaved plant foods may not be associated with reduced health benefits.

The Potential of *Rosmarinus officinalis* L. Extracts Obtained through Green Methodologies to Enhance Bread Organoleptic Properties

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Abstract:

The food industry has increased its requirement for alternative flavouring agents to substitute synthetic additives. In this sense, plant volatile fractions have been introduced to add value, extend shelf life, and enhance the sensory quality of edible products[1]. *R. officinalis* is recognised as a source of natural aromas and the potential of its extract as a food ingredient was evaluated by GC-MS, sensory perception and description, and cytotoxicity against Vero cells[2]. The non-polar mixtures were obtained by hydrodistillation and supercritical carbon dioxide fluidic extraction (SFE-CO_2), resulting in an abundance of α-pinene, eucalyptol, *S*-verbenone, and camphor terpenes, which have contributed to the green, fresh, citric, and woody sensory notes. The odour threshold of the most promising extract, obtained by SFE-CO_2, was detected at 3.0×10^{-3} μg·mL^{-1}, while its cytotoxic potential was found to be about 220 μg·mL^{-1}. This extract was used to enrich bread doughs and the final volatile profile of bread crumbs and crusts revealed 34 compounds, as characterised by GC-MS through HS-SPME over time. Furfural mainly contributed to the bread crust aroma and persisted over four hours of storage. The sensory profile of bread samples was evaluated by 19 panellists in a Multiple Comparison Test (MCT) resulting in increased pleasant bread fragrance in the enriched samples. This study represents a stepping stone for the use of natural aromas as ingredients for the development of innovative food products. **Acknowledgments:** This work was funded by the European Regional Development Fund (ERDF) through the Regional Operational Program North 2020, within the scope of Project Mobilizador Norte-01-0247-FEDER-024479: ValorNatural®. This work was also supported by LA/P/0045/2020 (ALiCE), UIDB/50020/2020 and UIDP/50020/2020 (LSRE-LCM), and UIDB/ 00690/2020 (CIMO) funded by national funds through FCT/MCTES (PIDDAC).

In Depth LC-ESI/LTQOrbitrap/MS/MS^n Guided Phytochemical Analysis of Fresh and Roasted Hazelnut (*Corylus avellana* Cultivar "Nocciola Piemonte")

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Abstract:

Food and Drug Administration (FDA) has recognized hazelnuts as "heart-healthy" foods (1). The Italian "Nocciola Piemonte" (*Corylus avellana* L.), known as "Tonda Gentile Trilobata" as well as "Tonda Gentile delle Langhe", is a Protected Geographical Indication (PGI) product that contributes largely to the production of national hazelnut (2). In the present work, a detailed

and comprehensive characterization of the *n*-butanol extract of fresh and roasted hazelnut kernels (without skin) was performed by using high-performance liquid chromatography coupled to multiple-stage linear ion-trap and orbitrap high-resolution mass spectrometry (LC-ESI/LTQOrbitrap/MS/MS^n), in both negative and positive ionization mode. This methodological approach enabled the identification of a wide range of compounds as polar lipids including oxylipins and intact high molecular weight lipids, such as phospholipids, sphingolipids, and glycolipids, besides to highlight the occurrence of some phenolic compounds. With the aim to unambiguously identify the latter, the phytochemical analysis of the *n*-butanol extract was undertaken and the isolated compounds were characterized as flavonoid and diarylheptanoid derivatives by 1D and 2D NMR experiments. Finally, in order to explore the antioxidant ability of the isolated compounds, their inhibitory effect on human plasma lipid peroxidation induced by H_2O_2 and H_2O_2/Fe^{2+} was evaluated by measuring the concentration of thiobarbituric acid reactive substances (TBARS). Both the biological activities reported for lipid classes found in hazelnut kernels and their effects on human health, and the antioxidant properties showed by phenolic compounds therefrom isolated support the use of hazelnuts in human nutrition as a food rich in bioactive and healthy phytochemicals.

Breeding of Faba Beans for Feed and Food Production

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Abstract:

With the increasing population, more protein for feed and food is needed. Generally, legume seeds are high in protein and especially soy is a good protein source and widely used for both feed and food. With the challenge of cultivating high yield soybeans in Northern Europe, the focus has been on developing other legume species for locally produced protein. Here, faba bean is a promising candidate due to a high protein content in cultivars grown in Northern Europe, however, further breeding is needed to increase the protein content and improve the amino acid composition for a better protein source for feed and food. In collaboration with plant breeders, we have developed a near infrared spectroscopy (NIR) model for measuring protein- and water content in mature faba bean seeds. Furthermore, we have separated the globulins and estimated the relative quantities of the tryptophan/tyrosine ratio in different cultivars. The globulins were further divided into legumin, vicilin and convicilin for assessing the ratio between these three major storage globulins. In addition, we dehulled mature seeds of different cultivars to make flour and assessed physicochemical properties prior to using the flour in different recipes substituting wheat flour partly or fully. The outcome was different good tasting foods, which also varied in taste between the different cultivars.

Biogenic Amines and Other Unconventional Indexes as New Markers of Qualitative Decay in Packaged Chicken Meat

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Abstract:

Following the chicken meat quality decay remains a tricky procedure. On one hand, food companies need of fast and affordable methods to keep constant higher sensory and safety standards. Despite the Thiobarbituric Acid Reactive Species assay (TBARS) still remains a powerful tool for chicken goods, its exclusive use may not be enough to explain quality loss. So, unconventional indexes have been considered, as the evolution of carnosine and anserine, vitamin B3, biogenic amines and biogenic amines index (BAI, as sum of putrescine, cadaverine, tyramine, and histamine). These indexes were compared with TBARS development aiming to find more precise parameters to control packaged chicken cuts decay. Results confirmed that the TBARS assay remains a screening method to check the oxidative state of a sample not explaining the nature of the oxidated products. Carnosine and anserine registered fluctuations for all samples during the entire shelf life, making them unaffordable in tracing the deterioration in packaged chicken samples; vitamin B3 is not always detectable and, in general, as its levels decreased regardless of packaging or chicken's cut, is not suitable. Conversely, the BAI was useful to monitor the qualitative decay in all samples marking differences among packaging' solutions and cuts analysed. This index can also give indirect information on the microbiological quality of the samples eliminating further investigations and plate counts. In some cases, the BAI can predict deterioration before TBARs values. Principal component analysis makes clear how the MAP packaging is the most protective concerning biogenic amines (BAs) accumulation and that breast fillets are the less sensitive to qualitative decay.

Keywords: Chicken meat, biogenic amines, carnosine and anserine, vitamin B3, qualitative deterioration, packaging

Brassinosteroids control the inflammation, oxidative stress and cell migration through the control of mitochondrial function on skin regeneration

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Abstract:

Brassinosteroids (BRs) are the class of phytohormones with recognized importance in agriculture and with great potential for diverse benefits on human welfare, including treating skin diseases. In this sense, BRs are a valuable tool for promoting skin regeneration. Therefore, the objective of the present work was to analyze the effect of BRs in wound healing repair. Mainly in the inflammatory and proliferative phases and their influence on migratory abilities in human dermal fibroblasts adult (HDFa) cells, and consequently, understand the mitochondrial metabolism. Therefore, we measured nine natural and synthetic BRs for the inflammatory response in lipopolysaccharide (LPS)-stimulated murine macrophage (RAW 264.7) cells, and we evaluated the migration activity in HDFa modeling promotion of wound closure after BR's exposure. In addition, we evaluated the 84 genes profiles linked to wound healing response using RT² Profiler PCR array and examined cellular bioenergetics using an extracellular flux analyzer. As important results were possible to see that LPS-induced cells had around 10% lower reactive oxygen species and nitric oxide accumulation when treated with some BRs compounds. HDFa treated with homobrassinolide-based, and homocastasterone-based compounds resulted in the greatest migratory activity and present the best results for mitochondrial responses. Based on this context, these results together provided strong evidence for BRs' ability to promote skin health, particularly through contributions to both reducing excessive oxidative stress and

controlling the inflammation process resulting in the best HDFa cell migration through the control of mitochondrial function.

Effects of Tannins on Physicochemical and Sensory Properties of Stirred-Type Yogurt

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Abstract:

Yogurt is one of the most consumed and favoured dairy products over the world due to its beneficial effects on the intestinal and immune system of the consumers. There are increasing interests on the applying fruits and their derivatives as functional ingredients since they are rich source of polyphenols that are not present in yogurt. However, seasonal production of fruits, economic considerations, and high demand for fresh fruits in the market urged researchers to introduce alternative strategies for the bio-production of natural compounds. This study focused on the phenolic enrichment of yogurt, by addition of six vegetable tannins at two different concentrations (0.5% and 1%). Microbiological, sensory, and physicochemical characteristics such as pH, acidity, syneresis, color, sugars, acids, total phenol content and radical scavenging activity of the yogurts were investigated in the day of production and after 7, 14 and 21 days of storage. Results showed that the addition of tannins did not significantly affect the concentration of lactic acid bacteria, while all the other parameters were influenced. These changes were not influenced by the tannin type but only by the percentage of fortification and the storage time. Over the time, the total acidity and a^* increased in all samples, while pH and syneresis reduced. All products were accepted by the consumers with an inverse correlation respected to the percentage of fortification and significant differences among tannins. Obtained results confirmed the possibility of using vegetable tannins as additive in yogurt or other fermented milk products.

Extending Shelf Life and Enhancing Safety through Food Design and Modeling

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Abstract:

Foods are rarely single-phase systems; instead, they are multiphasic with extremely large interfaces leading to non-uniform quality deterioration. The multiphasic nature of foods also leads to the uneven formation of toxicants (e.g., acrylamide) within a food matrix during processing. Expanding our knowledge on the role of composition and (micro)structure in different processes/events (shelf-life, formation of toxicants, and functionality) and enhancing our modeling capabilities by coupling matrix morphological changes and reaction kinetics with mass and heat transfer models of a matrix during processing are integral to addressing the causes of spoilage and formation of processed related toxicants to effectively pinpointing long-lasting solutions. This presentation will discuss the results of a) a study that applies a multi-length scale approach to better understand the deteriorative processes of a material (zein nanowowens loaded with a corn oil) to determine the main compositional and structural factors limiting its shelf life and b) an integrative modeling approach to identify scenarios that lead to minimizing the formation of acrylamide during the production of the baked good while retaining desirable characteristics such as color. Using matrix design approaches to lay out

structural features to arrest food deterioration and integrated modeling techniques to better pinpointing the effects of processing on formation of toxicants such as acrylamide will reduce food waste and health concerns related to food production.

Valorisation of Waste from Fish and Tomato Processing, To Generate Biodegradable Food Packaging with Hydrophobic Properties

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Abstract:

Valorisation of food by-products is an important step towards sustainability in food production. The global fish processing industry generates approximately 130 million tonnes of waste annually. The nature of the waste translates to very high disposal costs. This waste, mainly consisting of skins and bones, is very rich in collagen, from which gelatine can be extracted. In this study, fish gelatine was used to generate bioplastic material, which was then analysed to determine its mechanical and physical properties and characteristics. The main findings show that, although the bioplastics had good mechanical properties, their hydrophilic nature promoted microbiological growth and poor barrier properties, both of which were detected in standard food packaging tests. The aim of this study is to mitigate this by the means of a hydrophobic surface treatment, using cutin extracted from tomato peels. 160 million tonnes of tomatoes are processed every year of which 4% is waste. This translates to 6.4 million tonnes of tomato skins and seeds. Currently, this waste is composted or used as low value animal feed, but higher value could be achieved if these waste streams are symbiotically re-appropriated for cutin production. Using ingredients generated from waste products from the fish and tomato processing industries has great potential for the generation of bioplastics, which can compete with petroleum-based plastics. These bioplastics could possibly fill in the gap in the market as a sustainable alternative for food packaging.

Mycoprotein As Novel Functional Ingredient: Mapping of Functionality, Composition and Structure Throughout the Quorn Fermentation Process

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Abstract:

This study characterised the functional profile of mycoprotein material throughout the Quorn fermentation process in relation to changes in its composition and structure. The different fermentation streams and their centrifugation deposits and supernatants were investigated: broth, RNA-reduced broth (following a heat-shock RNA-reduction process) and centrate (following a second heating step and centrifugation). The broth, RNA-broth and their deposits showed high viscosities while their hydrogels displayed high viscoelasticities in comparison with a whey protein concentrate (WPC) control. The RNA-broth and centrate supernatants showed higher foaming ability and stability than WPC. Oil-in-water emulsions prepared with

the broth or its supernatant displayed similar emulsifying activity, emulsifying stability and oil droplet size distribution to WPC. Large hyphal structures were observed in the broth, RNA-broth and their deposits, which contributed to their high rheological properties, while small fungal fragments contributed to oil droplet stabilisation in emulsions prepared with these samples. A cerato-platanin was found in higher concentrations in the RNA-broth supernatant and centrate as a result of cell damage following the two heating steps and contributed to their higher foaming properties. Proteomic and metabolomic analyses showed evidence of upregulation of the mRNA decay pathway following the two heating steps. As a result guanine and guanosine derivatives were reported in higher concentrations in RNA-broth and centrate samples and contributed to their foaming, emulsifying and rheological properties. This study highlighted the potential of mycoprotein material as novel alternative to functional ingredients of animal origin and the possibility to modulate its structure and functionality by heating.

Valorization of Aquaculture Waste Side Streams

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Abstract:

In recent years, the aquaculture industry has emerged as the fastest-growing food production sector becoming one of the largest contributors to food waste. From filleting processes, the skin and bones alone make up about 30% of this waste. In Singapore, the combined annual consumption of fish and frog flesh is estimated to be around 100 million kilograms with their discards making up two of Singapore's largest aquaculture waste side streams. Such food wastes are rich in collagen and its derivative, gelatin. Gelatin is rich in protein and has a unique amino acid profile that gives it many potential health benefits. Therefore, it can be harvested, reconstructed, and upcycled into food products. Gelatin derived from aquaculture sources also reduces the risk of transmission of diseases present in commercially available gelatin obtained from mammalian sources and is also more widely accepted by different religions and cultures. As such, gelatin was extracted from the discarded skins of Salmon, Barramundi, and Bullfrog for this study. These three species thrive in different environmental conditions with the Salmon being a cold-water fish, Barramundi a warm-water fish, and the bullfrog an amphibian that lives both in water and on land. As such, the properties of gelatin extracted from these species are expected to vary. The extraction yield percentage, gelling point, physical and chemical gel properties, and thermal stability were investigated to gain a deeper understanding of the gel properties to enable their use in a myriad of food applications turning aquaculture food waste into a valuable resource.

Development of a Colorimetric Indicator Based on Metal Nanoparticles for Monitoring Deterioration of Chicken and/or Fish Meat, with Potential Use in Smart Packaging

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Abstract:

Chicken and fish meat are important sources of nutrients for the human body; however, they are highly perishable, being susceptible to microbial and enzymatic spoilage. Various techniques have been developed to determine if the food is fit for consumption, however, in some cases

these involve too much analysis time, destruction of the sample and specific equipment. Due to this, it is necessary to develop simpler, cheaper, and easier strategies for the rapid evaluation of the state of the meat product. The objective of this work is to develop an indicator film using the casting technique based on metallic nanoparticles and a biodegradable polymer capable of indicating by means of a color change when a muscular food (fish) is suitable for consumption. For this, silver nanoparticles (AgNP) used as detectors were synthesized, being characterized by UV-visible spectrophotometry, observing the appearance of absorption peaks at 400nm, due to the Surface Plasmon Resonance (SPR) on the surface of the electrons in the band of silver conduction (Buccolieri et al., 2018) coinciding with values obtained in other previous studies (Mendis et al.,2019). Furthermore, these AgNP results in the presence of amino groups showed changes not only in the color of the AgNP solution, but also a significant drop in surface plasmon resonance. In conclusion, these results showed that colloidal AgNPs can detect ammonia, a product associated with meat spoilage. This indicated that a simple and easy colorimetric indicator can be developed for the rapid detection of meat spoilage products (biogenic amines) by relying on the SPR of silver nanoparticles.

Sustainable Re-Use of Brewer's Spent Grain for the Production of High Protein and Fibre Pasta

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Abstract:

Brewer's spent grains are one of the principal by-products of the brewing industry. This by-product, for protein and fibre content, represents an interesting raw material to be reused for manufacturing many other products. To maximize the nutritional characteristics of this by-product, in this study, ingredients derived from brewer's spent grains were included in the design of innovative dry pasta. Two brewer's spent grains derivative ingredients, one enriched in proteins and the other in fibre were blended with semolina. Based on the rheological evaluation, the optimal amount of the two ingredients for producing pasta was determined. In particular, pasta responding to the claims "High Protein" and "High Fibre" was realized using the formulation enriched with 15% of protein-rich ingredient and the claim "High Fibre" and "Source of proteins" using the formulation enriched with 10% of fibre-rich ingredient. The final products were compared to 100% semolina and 100% wholegrain semolina pasta for composition, color, texture, and cooking quality, revealing excellent quality characteristics. The newly formulated pasta represents a successful match of technological aptitude, nutritional/sensorial quality, and sustainability.

Development of Films Based on Andean Potato Starch/Chitosan/Propolis as Promising Biopackaging Materials

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Abstract:

Active packaging is an emerging technology in food packaging because this material can

interact with food, improving its shelf life. The objective of this work was to evaluate the effect of the propolis aqueous extract concentration (EPR) on the properties of Andean potato starch/chitosan films. Starch was isolated from *Yana Winku* potato by wet milling method. The films were produced by the casting method using the starch: chitosan ratio (1:1) at different EPR concentrations (0, 0.5, 10 and 30% in relation to the solute). The mechanical properties were measured by perforation test using a TA Instrument Texturometer (TX Plus model). Increasing the EPR concentration (from 0 to 30% relative to the solute) in the film resulted in a decrease in the tensile strength (from 12.88 MPa to 3.82 MPa), elongation at break (from 57.77% to 39.63%) and an increase in the solubility (from 5.94% to 54.16%) and moisture (from 18.55 to 22.44%) of films. The films were more hydrophobic (contact angle from 91.87° to 63.96°) and less crystalline due to the amorphous composition of the propolis (from 27.2% to 18.9%). Furthermore, the addition of EPR increased the bioactive properties of the starch/chitosan film, obtaining higher values of antioxidant capacity measured by ABTS and total phenolic compounds (1724.66 μmol TE/100g film and 506.50 mg of GE/100g film, respectively). In conclusion, the incorporation of EPR into the polymeric matrix of starch/chitosan allowed to develop active packaging for oxidation-sensitive foods.

Effects of Different Modifications on Composition and Technological Properties of Lingonberries (*Vaccinium vitis-idaea*) Pomace

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Kaunas University of Technolgy, Lithuania

Abstract:

Lingonberries are popular berries, particularly in the Northern countries. Due to their sour taste, lingonberries are rarely consumed fresh and more often processed into various products, including juices. The production of juices produces large amounts of by-products, also called pomace, which retain up to 70% of the polyphenols, natural pigments and large amount of cell wall polysaccharides (pectin, hemicelluloses, cellulose), which can be used as a source of dietary fiber (DF). Insoluble fiber usually dominated in berry pomace and the ratio of soluble (SDF) to insoluble fiber (IDF) is not nutritionally appropriate. Various DF modification techniques can be used to increase the amount of SDF. The aim of this work was to determine the influence of supercritical CO_2 extraction, enzymatic hydrolysis and extrusion on the composition and technological properties of lingonberry pomace and to evaluate its suitability for the development of value-added food products. Commercial enzyme preparations from Novozymes A/S (Denmark) that are suitable for degradation of pectin, hemicelluloses and cellulose (Viscozyme, Pectinex Ultra Tropical, Celluclast) were selected for hydrolysis. The influence of modification methods on such technological properties as color characteristics, bulk density, swelling capacity, water and oil retention capacity and emulsion stability were analyzed. The content of SDF and IDF, soluble proteins, oligosaccharides, and bulk density had the greatest influence on the technological properties of lingonberry pomace and its products. Experimental studies revealed that lingonberry pomace and its modified products can be used as cheap and valuable ingredients to improve nutritional value and technological properties of food products.

Effect of Different Modified Packaging Atmospheres on the Shelf-Life of Sourdough Bread

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Abstract:

The short shelf-life of the sourdough bread limits its distribution in markets close to the production area, affecting its commercial success and the economic return by the operators of this supply chain. In this context, the aim of this study was to evaluate the effect of different modified packaging atmospheres on the shelf-life of sourdough bread. Slices of bread were stored individually in plastic bags at 23 °C in six different atmospheres (Air (79% N_2, 21% O_2), Ar (100%), N_2 (100%), CO_2 (100%), Mix N_2 (70% CO_2, 30% N_2), Mix Ar (70% CO_2, 30% Ar)). Samples were analyzed daily for different parameters as weight loss, penetrometer, water activity, presence of mold and sensory tasting. Results showed that pure gases (CO_2, N_2, Ar), despite not shown significant differences among them, have good qualities as storage atmospheres, compared to Air. Instead, Mix N_2 and Mix Ar were the best in reducing weight loss, slowing down the staling process, thus doubling the shelf-life, compared to other atmospheres. Comparing the chemical-physical evaluation with the sensory ones, all the breads in the atmosphere containing CO_2 and Air showed a low level of acceptability after seven days of storage because these atmospheres affect the taste of the bread. Only the use of Argon appears better because it allows to preserve the initial aromas and taste. In conclusion, the Argon, as a storage atmosphere, seems to be the best solution for extending the shelf-life of sourdough bread, especially in order to reduce food waste.

Novel Bioplastics Obtained from Glycerol-Plasticized Films Functionalized with Spent Coffee Grounds Phenolic Extracts

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Abstract:

The massive production of plastic in the past years led to an accumulation of this material in the nature causing, as a consequence, a huge environmental pollution. To overcome this problem, at least a small portion of the fossil-based plastic should be replaced with bioplastics produced from renewable resources such as proteins and polysaccharide. In this regard, pectin that is a heteropolysaccharide, can be considered as one of the suitable renewable resources for developing bioplastics since it can be found abundantly in all terrestrial plant. The present study reports the ability of pectin to give rise by casting to the films in the presence of glycerol used as a plasticizer. Moreover, active pectin-based films were prepared in the presence of different concentrations of phenols extracted from spent coffee grounds. The particle size and zeta potential of pectin-based film forming solutions (FFSs) containing different concentrations of phenols were studied. Furthermore, the derived films were analysed for mechanical properties, opacity, Fourier transform infrared (FTIR) spectroscopy, moisture content, contact angle, antioxidant and antimicrobial properties. The obtained results revealed an improvement in the mechanical properties of the films containing phenols and the interaction between phenols and pectin in the film matrix was demonstrated by the FTIR spectra. Furthermore, the film containing the highest concentration of phenols depicts the highest antioxidant activity and it is endowed with antimicrobial effect against the food spoilage microorganism Micrococcous luteus. Therefore, all these data suggest a possible utilization of the obtained active bioplastic in food and pharmaceutical sector.

Properties of Different Cattle Hide Sources in Relation to Co-Extruded Sausage Casings

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Abstract:

Sausage casings are an essential component in the transformation of comminuted meat into a finished product. The strength of the casing, together with the texture of the meat, determines the sensory perception "bite" when presented to the consumer. Traditionally, meat has been stuffed into natural casings, but nowadays alternatives, such as the co-extruded collagen casings (introduction of a semi-liquid material onto the meat surface that is consecutively quickly cross-linked in place), are emerging. Currently, bovine hide split collagen is the primary source. However, due to rising costs, availability of natural casings, and increasing need for kosher/ halal products collagen producers are searching for alternatives. Consequently, the manufacturers' interest in factors influencing extracted collagen quality is increased. This requires insight and understanding of the biochemistry of the collagen. Overall, the performance of obtained collagen is not only influenced by extraction, but environmental factors, such as animal age, and breed as well. The objectives of this study were to investigate whether cattle type affects extracted collagen quality from cattle hide (American calf, Dutch Heavy Veal, Danish Ox Heifer and Heavy German Cow), focusing on its application for co-extruded sausage casings. The study includes results from SDS-PAGE, rheology (e.g., modulus of rigidity and elasticity), Differential Scanning Calorimetry, and texture analyses of the different collagen preparations to better understand the influence of 4 cattle types to aid in the design of new dispersions for co-extrusion. The results of the study will be presented at the conference.

Optimization of High-Pressure Homogenization for Modification of Functional Properties of Pea Pod Proteins

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Abstract:

Plant proteins from alternative sources have been gaining attention due to recent strategies for sustainable food production and consumer preferences for diversified nutrition. Pea pod (PP) is an agricultural by-product of pea production and could be a potential protein source for the development of value-added protein-based food formulations. High-pressure homogenization (HPH) is one of the emerging technologies to modify the functional properties of plant-based proteins. In this study, optimization of HPH for PP protein concentrates (70% protein) obtained by alkaline extraction/isoelectric precipitation was performed by response surface methodology. Pressure level (50–150 MPa) and protein concentration (1–3 g/100 mL) were considered as independent variables while antioxidant activity and solubility were monitored as response variables in the central composite design. HPH was conducted at three cycles, and temperatures below 40 °C. Antioxidant activity and solubility varied between 5.2–11.9 μM Trolox/g and 63–

129%, respectively. Regression analysis showed that the change in antioxidant activity was best described by a quadratic model (R^2=0.9945) where pressure level and protein concentration were significant terms while solubility is maximized in accordance with the linear model (R^2=0.4808) in which the pressure level was the only significant term. Optimum HPH conditions can be identified as 150 MPa and 2.3% of protein concentration for maximal solubility and antioxidant activity of PP proteins. This work contributes to sustainable processing approaches to produce functional protein-based ingredients by using environmentally friendly technology and valorizing pea pod as an alternative protein source. This study was funded by the Scientific and Technological Research Council of Turkey (TUBITAK, Project Number:1190488)

Functional and Nutritional Properties of Fava Bean Ingredients Processed Using Extrusion

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Abstract:

Legumes are important in food applications due to their high nutritional value, desirable functional properties and low cost. Their utilization is almost limited to soybean seeds, whereas other plants, like fava beans (FB), have drawn less attention. High protein content (32.5%, dry basis) and well-balanced amino-acid composition make FB suitable for novel food ingredients. In this context, our objective is to tailor functional and nutritional properties of FB ingredients using extrusion process. For this purpose, FB flour (FBF), starch concentrate (FBS) and protein concentrate (FBP) were processed by twin-screw extrusion at a large range of specific mechanical energy (SME=100-3000kJ/kg). The pasting properties of these extruded ingredients were evaluated by a rapid visco-analyzer, and their emulsifying properties were assessed through oil-to-water emulsion droplet size. Their protein digestion was evaluated using a standardized in vitro static protocol (INFOGEST). Results showed that FBF and FBS ingredients extruded at a low SME level presented the highest hot and cold paste viscosity, due to the limited starch degradation. FBF and FBP display the lowest emulsion droplets size (13-40 µm vs ~100 µm for FBS) due to their high protein content (33-68% dry basis), making them suitable to act as surfactants. Smaller the size of emulsion droplets, better the emulsifying properties. It was found that extrusion increases protein hydrolysis degree during digestion, likely because of the inactivation of anti-nutritional factors like trypsin inhibitors. This investigation highlight the technological and nutritional potential of extruded FB ingredients. In further works, they will be incorporated into current dairy and meat foods to create innovative products with improved organoleptic and nutritional characteristics.

Recovery of Anti-Glycative Compounds from Rice Husk (*Oryza sativa* L.)

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Abstract:

In the last years, the European Commission itself defined long-term strategies for a sustainable

development, in order to support a circular economy and give a second life to wastes [1]. The aim of the present research was the valorization of rice husk (*Oryza sativa* L.), a promising by-product of the milling process, as source of compounds with a potential positive impact on health [2,3]. Two green extraction methods, i.e. conventional maceration and microwaves assisted extraction, were set-up to recover phenolic compounds using traditional hydro-alcoholic mixtures and innovative natural deep eutectic solvents [4,5]. The effects of extraction parameters were studied using an experimental design and the extraction yield was monitored by high-performance liquid chromatography (HPLC). The higher extraction yield of polyphenols was obtained by microwave assisted extraction using traditional hydro-alcoholic mixtures. The richest extract was chemically characterized by HPLC coupled with mass spectrometry and it was tested for its potential anti-glycative activity using different *in vitro* systems monitoring different steps of the glycation reaction. In particular, the inhibition of Amadori products and of advanced end glycation products (AGEs) formation was evaluated by NBT assay and BSA-based system, respectively. The results indicated that the extract was able to inhibit 70-90% of AGEs generated in the used in vitro systems, in addition to a good capacity to directly trap glyoxal and methylglyoxal, well known AGEs precursors. The research is going on with extract bioaccessibility-bioavailability and stability studies in order to obtain a rice husk-based ingredient for food supplement.

Optimizing Liquid Smoke Conditions for the Production and Preservation of Innovative Fish Products

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Abstract:

The global demand for smoked fish products is recently growing due to an increased consumers' preference for their typical flavour and taste. The traditional smoking process is based on the combustion of wood shavings or sawdust and, if it is not properly controlled or excessively prolonged, smoke could lead to the formation of toxic polycyclic aromatic hydrocarbons (PAH) into the final products. Thus, in the last decades the use of liquid smoke is worldwide spreading, since it is practical to use, economic, fast to dose, able to control the presence of PAH and, above all, with reduced environmental impact, unlike traditional smoking systems. Although this technique has undoubted environmental and economic advantages, there are a number of critical issues that need to be overcome to encourage its use: the main one concerns the low antibacterial activity. A strategy to increase the effectiveness of the process could be the use of liquid smoke in combination with other natural molecules able to control fish spoilage and extend the product shelf-life. In this context, the objective of this study was to design the production of an innovative fish product using liquid smoke in combination with natural compounds (citrus extracts and organic acids) through two subsequent phases: 1) optimization of the process (smoking liquid composition and process parameters) using modelling predictive tools, i.e. tertiary and secondary models; 2) product realization and its evaluation in terms of microbiological profile (specific spoilage bacteria), chemico-physical parameters (pH, aw, colour), nutritional content (proteins, lipid, carbohydrates), and consumers' acceptability.

Bioconversion of HO.RE.CA. Waste Through Black Soldier Fly (*Hermetia illucens*) Larvae and Fractionation of the Mature Larvae to Obtain Protein Intended for Food and Feed

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Abstract:

The SCALIBUR project (Scalable Technologies for Bio-urban Waste Recovery – Horizon 2020 – CE-SFS-25-2018) aimed to explore innovative and sustainable solutions, including the use of black soldier fly larvae (BSFL, *Hermetia illucens*, Diptera, Stratiomyidae) for the bioconversion of waste deriving from the HO.RE.CA sector (Hotel-Restaurants-Catering) to cope with the management of bio-urban waste (Barragan et al, 2017; Liu et al, 2019. Research efforts have been focusing on the validation of technologies with a high TRL (7) and obtaining products with high commercial value. The proteins isolated from the BSF larvae represent one of the cutting-edges of the entire project and are intended for animal and human use (Miron et al, 2019; Montevecchi et al, 2021). This report describes some of the main results of the research carried out in recent years, in particular the development of the HO.RE.CA. waste homogenization plant, the rearing of BSF larvae, the fractionation of them into essential components (proteins, fats, and chitin) (Hadj Saadoun et al, 2020; Montevecchi et al, 2020) and, finally, the applications of isolated proteins for the preparation of food and feed.

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Advancing Green Biorefining from the Bottom-Up: from Grass to Food Protein and Ingredients Aided by Proteomics and Bioinformatics

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Abstract:

Grasses are generally not suitable for consumption by humans and monogastric animals due to digestive aspects, but green biorefining is proving game-changing for exploiting this abundant source of protein. While early attempts have indeed yielded protein rich products (green protein), these are not suitable for foods due to quality concerns. For the most part, Ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO) has been the primary protein of interest based on high abundance, but also its functional properties for e.g. food applications. Nevertheless, the grass proteome is complex and may include other proteins with desirable properties, yet to be explored. Here, we show how mass spectrometry (MS)-based proteomics can provide novel and quantitative insight on the grass proteome and how proteomics can be applied for process evaluation, development, and optimization. We also show how application of advanced membrane processes (MPs) can transform grass into a high-quality extract (white protein) with improved quality and perspectives for food applications. Compared to white protein obtained using conventional extraction methods (heat/acid), we showcase how MPs can produce superior extracts, as proteins are retained in their native and functional form. Furthermore, we illustrate how *in silico* protein analysis can aid in identifying functional/bioactive peptides embedded in abundant proteins, potentially improving functionality and value of extracts further. With

this work, we both illustrate how grasses can play a major role in the green transition, but also how MS-based proteomics, bioinformatics, and application of advanced MPs can accelerate the development of not only green biorefining but food protein technology altogether.

Vine Shoot Xylooligosaccharides as a Prebiotic Ingredient to Develop a Functional Spreadable Cheese

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Abstract:

Nowadays there is a wide variety of dairy functional foods in the market that include probiotics and prebiotics in their composition. The interest in prebiotic oligosaccharides as functional ingredients has gained attention due to their ability to benefit human health. Xylooligosaccharides (XOs) are receiving increasing attention in the recent years. These oligomers are formed by xyloseunits linked through β-1,4 glycosidic bonds and they could present arabinosyl, acetyl, uronic or phenolic groups as substituents. XOs can be obtained from different lignocellulosic residues such as vine shoots, a vineyard waste generated by pruning, with a production estimated per year of about 1–2 tons per hectare. The main objective of this work was the sustainable production of a functional spreadable cheese made with goat milk with improved nutritional characteristics. Goat milk was chosen due to its nutritional properties, such as a higher content of oligosaccharides with respect to bovine or sheep milk. Steam explosion was applied on vine shoots to obtain an extract rich in XOs. After the characterization of sugar profile, the extract was added to the cheese throughout a kneading phase with the aim to reach a minimum quantity of 3g of oligosaccharides per 100 g of cheese. The obtained cheese, after pasteurization, was subjected to the determination of the physico-chemical, textural, sensory and volatile aroma compounds characteristics. The effect of XOs on probiotic growth, fecal media and intestinal microbiota were also evaluated. Overall, the investigation allowed to develop a prototype enriched in prebiotic XOs by upcycling vine shoots.

Development of an Active Edible Coating Loaded with Hydroxyapatite/Lactoferrin/Quercetin Complexes for Food Preservation

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Abstract:

A new packaging strategy to preserve quality and extend the shelf life of food products is represented by edible films and coatings obtained by natural biopolymers and loaded with antioxidants and antimicrobial compounds. Among several techniques adopted to protect the bioactive compounds, such as polymeric nanoparticles, nanoemulsions, and nano-systems, hydroxyapatite crystals seem to be attractive candidates for this application. Hydroxyapatite is an emerging bioceramic, which is widely used in various biomedical applications, mainly in orthopaedics and dentistry due to its close similarities with the inorganic mineral component of bone and teeth. Thanks to its interesting properties such as biocompatibility, degradability and biomimetic dimensions, hydroxyapatite could be used as a potential carrier for active

compounds: the use of hydroxyapatite as a carrier in food active packaging could protect the active compound from environmental factors, processing and storage conditions allowing to maintain the compound's antimicrobial, antioxidant properties to extend the shelf life of foods.

Based on the above, hydroxyapatite was studied as a carrier for quercetin glycoside compounds and lactoferrin as active compounds in food applications. Physical and morphological characterization of hydroxyapatite/lactoferrin/quercetin complexes was performed using Scanning Electron Microscopy, Zeta potential and Fourier Transform Infrared Spectroscopy analysis. Then, hydroxyapatite crystals complexed with lactoferrin and quercetin glycoside compounds were loaded into an alginate-based edible coating and its ability to release the active compounds in an aqueous medium was investigated. Finally, the effect of developed alginate-based active edible coating on the shelf-life extension of meat products was evaluated.

Mechanistic and Machine Learning Driven Modelling to Predict and Understand Taste

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Abstract:

Nature has developed fascinating screening mechanisms to detect healthy or dangerous chemical compounds in food. One of the most important control systems of food and drink intake is the sense of taste, a complex emergent property characterized by a multi-scale nature. Understanding the complex relationships that, starting from the chemical composition of a food, determine its organoleptic profile and the connections between this profile and the long-term impact on homeostasis is still an important subject for scientific research applied to health, food supplement market and diet. In this regard, the talk will consider mechanistic modelling and machine learning tools for the development of predictive models able to provide information on molecular, sub-cellular and cellular features underlying the complex biological mechanisms that regulate taste and the relationships between perceived taste and long-term effects on our organism. State-of-the-art tools and methods and the original results from the VIRTUOUS project (https://virtuoush2020.com) will be taken as examples of interdisciplinary approaches to develop multiscale/multiphysics models capable of capturing the relationships between chemistry, structure, and function of taste. In general, this modelling paradigm has already proven to support the way we understand, model and treat physiological and pathological phenomena, and challenges in the near future to increasingly support us in the development of new strategies against diseases, or in the promotion of nutritional best practices for a healthier lifestyle.

Future Super Food: Comprehensive Investigation of New Mixed Fruit Juice

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Abstract:

Consumers are demanding new products to fit their hectic lifestyles and nutrient intake is one of the most main concerns of consumers and producers. This study is an attempt to address a portion of these issues. Therefore, we aimed to clarify the characteristics of a new mixed fruit juice as a super food for fulfilling this goal. In this project, two types of mixed fruit juice (M_1 and M_2) including orange and pomegranate fresh juice (M_1FJ), orange, pomegranate and prickly pear reconstituted juice (M_2RJ) and orange, pomegranate and prickly pear fresh juice (M_2FJ) were employed. M_2RJ and M_2FJ samples were purified and pulpy juice, respectively. Second mixed fruit juice (M_2) is a novel functional product in food industry. In this project, prickly pear was mixed with orange and pomegranate juice for the first time in the fruit juice industry. Prickly pear is a valuable natural resource as ingredient to enrich products in pigments (betanin) and pectin production and due to its biological activity such as antimicrobial, antioxidant, anti-inflammatory, anticancer, anti diabetic, neuroprotective or hepatoprotective effects. The aim of this research was to evaluate the sensory attributes, volatile profile, physiochemical, and antioxidant characteristics of mentioned novel fruit juice. It is worth noting that sensory analysis was performed by affective and descriptive tests using 100 (untrained) and 15 (trained) panelists, respectively.

Sensory Profile of Italian Espresso Brewed Arabica Specialty Coffee Under Three Roasting Profiles with Chemical and Safety Insight on Roasted Beans

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Abstract:

Specialty Coffee shows in the last decades a continuous increasingly interest from the consumers that appreciate on one hand, the traceability of these lots and, on the other, the possibility to perceive peculiar aromatic notes from each origin. As well-known, the post-harvesting processes to which coffee fruits underwent to get green coffee, they characterize the beans in terms of content of macromolecules acting as substrates during the key unitary operation in the coffee chain by the sensory and chemical quality side: the roasting. Therefore, well identified and physical characterized Specialty lots have been roasted to be further submitted to Italian espresso extraction and then sensory analysed with the aim to evaluate if the different roasting profiles had been able to exalt the profile obtained by the suppliers via cupping in origin countries. Once identified the most consistent roasting level for espresso extraction, roasted beans were characterized for physicochemical features. Sensory analysis demonstrated that the intermediate roasting level paired with espresso extraction better emphasize the sensory attributes from in-Origin cupping. Then, easy-to-use chemical analyses were able to discriminate among roasting levels, to assure the compliance with the food safety standard and to prove that roasting process can modify the physicochemical profile of a SC, overcoming the sample original variability. pH, titratable acidity, melanoidins, polyphenols clustered samples from different Origin within the same roasting level. Results also confirmed the formation and degradation trends for acrylamide during roasting. Taken together, these results open the floor to further studies aimed to investigate in depth correlations between physicochemical attributes of green and roasted beans and cup profile.

Advancements in the Omega-3 Fatty Acids Enrichment in Meat Products

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Abstract:

The objective of the present study was to evaluate the possibility of adding microcapsules from different types of fish oil emulsions (monolayered (MO) and multilayered (MU)) to elaborate meat derivatives labelled as *source of omega-3 fatty acids*, with appropriate quality characteristics and high bioaccessibility of the added bioactive compounds. Three batches (control and enriched with MO and MU) of Frankfurter and dry-cured sausages were elaborated and analysed by means of nutritional composition, microstructure, oxidation stability, sensory analysis, and *in vitro* digestion. The addition of MO and MU enriched the meat derivatives in omega-3 fatty acids without affect their main quality characteristics, however, it decreased the intensity of some flavor attributes and increased the salty taste perception. The acceptability and purchase intent of the enriched products increased when the information on the composition and the nutritional claim *source of omega-3 fatty acids* were included. Meat derivatives added with MU showed greater intestinal bioaccessibility and protection against the formation of volatile lipid oxidation compounds. It is also noted a different influence in enrichment and bioaccesibility depending on the meat products. Thus, the use of MO and MU is suitable for enriching meat derivatives in omega-3 fatty acids, being necessary to adjust the content of salt, flavorings and showing a precise information on the label. Besides, it is also recommended tailoring the type of microcapsules to each meat products to improve the enrichment and bioaccesibility of omega-3 fatty acids.

Effect of Different Content of 'Maiorca' Common Wheat Malt in Bread Production on Physico-Chemicals and Sensory Characteristics of Products

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Abstract:

Bakery products constitute an important part of the worldwide diet. They are eaten as a breakfast, snack and bread. Malt is one of the main ingredients used in bakery productions since it improves several attributes. The addition of malt in wheat flour improves the functional properties of the flour, the stability of the dough with desirable changes in the microstructure and physico-chemical properties and also improvements in organoleptic characteristics as color, taste and aroma. In the last years, some old landraces of wheat have been individuated in Italy that show great aptitude for malt production and therefore were analyzed to use as natural improvers for bakery purposes. This study aims to evaluate the effect of replacement of different levels of 'Maiorca' wheat malt flour (0.5, 1.0, 2.0%) with common wheat flour on the physico-chemical and sensory properties of bread and suitability of 'Maiorca' malt in breadmaking. The critical issue in the case of the replacement of a new ingredient is the sensory profile; it is important to employ the optimum substitution level through the sensory analysis in order to correlate the results of instrumental analysis to human perception. To reach the proposed goal, the physico-chemical and technological characteristics and enzyme activities of 'Maiorca' malt

flour in comparison with commercial malt flour were evaluated. The results obtained showed that the sample with 2.0% of substitution gave the best results, especially in terms of loaves volume and the porosity of the crumb.

Chemical Characterization of *Moringa oleifera* Leaves for Cookies Formulation

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Abstract:

Moringa oleifera belongs to the *Moringaceae* family and is the best known of the native *Moringa oleifera* genus. For centuries, it has been used as a system of Ayurvedic and Unani medicine and has a wide range of nutritional and bioactive compounds, including proteins, essential amino acids, carbohydrates, lipids, fiber, vitamins, minerals, phenolic compounds, phytosterols and others. The aim of this work was to formulate new functional cookies enriched with different amounts of *Moringa oleifera* leaves (0%, 2.5%, 5%, 7.5% and 10%). The chemical composition of *Moringa oleifera* leaves and seed oil were also determined. The formulated cookies were evaluated for their physicochemical, textural and sensory characteristics. Results revealed that Moringa oleifera leaves contained various bioactive components, proteins, fibers, vitamins and antioxidants. Gas chromatography revealed that the major fatty acid in *Moringa oleifera* seed oil was oleic acid (82.32%). The *Moringa oleifera* leaves added cookies demonstrated higher phytochemical and antioxidant activities than control cookies prepared without *Moringa oleifera* leaves. All cookie samples were generally accepted, but the panelists indicated a higher preference for cookies containing 2.5% of *Moringa oleifera* leaves.

Key words: *Moringa oleifera*, leaves, seeds oil, formulation, cookies, quality.

Evaluation of Different Storage Conditions on Chemical Composition and Bioactive Compounds of Voghiera Garlic PDO

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Abstract:

Garlic (*Allium sativum L.)* is considered one of the most important vegetables, with various uses throughout the world, either as a raw vegetable for culinary purposes, or as an ingredient of traditional and modern medicine, and proper storage conditions are crucial to retain the high quality of garlic bulbs and its by-products, taking into account the high importance of organosulfur and phenolic compounds1 . Time/temperature storage combination is an important factor since

it can affect chemical composition and consequently the final bioactivity potency of garlic. This study aims to examine different storage temperature and time/temperature combination on the chemical composition and quality of Voghiera garlic PDO (a white ecotype with long tradition in Ferrara district2). In detail we considered -3/-4°C (industrial storage) for short, medium and long times (3,6 and 9 months); -3/-4°C for 3 months and then +3/+4°C for other 3 months; +3/+4°C for 3 months (home conservation). We focused our attention on the organosulfur compounds content, phenolic compounds and related antioxidant activity since they highly contribute to the effective bioactive properties of garlic and improve the shelf-life of the product. We observed a decrease in sulfur compounds after 6 months both at -3/-4°C and +3/+4°C while phenolic compounds were stable during the storage period. To evaluate the bioactive compounds, the extracts at different time/temperature storage were administered to breast cancer cell lines and measured antioxidant and anti-inflammatory activity on macrophage RAW 264.7 cells. The results highlighted a decrease also in bioactive effect and suggested the storage at -3/-4°C to better preserve the antioxidant and bioactive property.

Application of 3D Printing for Morphing of Food

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Abstract:

Morphing food involves a shape change effect on food during processing. The change in shape is desired to provide a predetermined shape to improve the appearance, texture and functionality of foods. The shape change is observed during heating or frying, dehydration, hydration, extrusion or other processing operations. The shape change is practiced for many snack foods and in some cases the fast foods. Various factors are responsible for the shape change such as differential stress within the food, diffusion of moisture, softening or hardening due to temperature, melting, memory effect etc. The extent and the direction of the shape change could be designed by various technologies or methods. 3D printing is one these technologies that can provide a precision of the shape change by manipulating the composition of printed layers, changing the patterns of printing, infill levels and thickness of the printed objects. The morphing of the 3D printed food is usually refereed as 4D printing of food. This presentation will highlight the current progress on utilization of 3D printing for the application of morphing of foods.

Designing Mechanical Properties of Starch-Protein-Based Foods by Additive Manufacturing

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Abstract:

During a traditional production process of the starch-protein-based food bread, a physico-chemical transition of the cereal-based biopolymers and the transition of a viscoelastic closed-cell foam to a solid open-cell foam with specific textural and thus mechanical properties occurs. The textural properties of this food are the sum of its intrinsic material functionalities of a solidified matrix, based on the structures formed during processing of its intermediate dough. To simplify this complexity, we applied a radical redesign of the current process by additive manufacturing. This enables completely new possibilities for the understanding of the traditional processes. Additive manufacturing (3D food printing 3DFP) gets more and more

important for scientific and application reasons in the food sector. We connect the knowledge from traditional food science with this highly flexible process. 3DFP is not just a new processing technology, it is also an analytical tool to find new insights for other processes. In the short run 3DFP enables tremendous insights in the relations between structures in foods and its sensory qualities. In the long run fundamental material science approaches are necessary for designing those structures, textures and qualities. As first steps, an inline quality assurance system was established to enable a texture and sensory design of cereal-based food foams. A hardness-driven model was developed to predict and control the texture of the printed edible products. These studies enable future developments and new impulses for the texture design of edible starch-protein based products. 3DFP will lead to an unbounded texture design of foods.

Modulating 3D Food Architecture for New Sensorial Perceptions

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Abstract:

Although the demand of healthy food products keeps growing as result of the current obesity epidemic and diet-related diseases, the reduction of sugar concentration in food is challenging mainly for its essential effects on the structural and sensory attributes. Among the recent strategies for sugar reduction, the modification of 3D food architecture deserves attention since its impact on the release of taste molecules and the interdependency with mastication behaviour that plays an essential role for oral perception. In this scenario, additive manufacturing technologies represents an intriguing opportunity to realize innovative food structures conferring texture, microstructure and other physical properties never thought before. This work wants to improve our understanding regarding the qualitative and quantitative effects of the three-dimensional food structure on the mechanical and sensory properties, mastication behaviour an co-related potential effects on the daily diet. All these information has been obtained by manipulating the microstructure of foods through using 3D food printing technology. For this purpose, different geometries and nozzle sizes have been employed to create innovative cereal-based snacks at reduced sugar content, unavailable by common technologies. Results showed that 3D food architecture affects how foods breakdowns in the mouth leading to different sensorial perception. For this, by carefully modulating the food structure, with the help of the 3D food printing technology, it would be possible to design and realize innovative sensorial characteristics for food products, that can help in the development of human health.

Fruit- and Seafood-Based Formulations for 3D Printing of Foods: Effect of Thickener Agents

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Abstract:

We live in a world of limited biological resources and ecosystems, which are essential to feed people. Therefore, it is necessary to find alternatives to the food surplus in order to avoid waste and to valorize species of low market value. 3D printing (3DP) has enormous potential for the development of novel foods, given that by creating layered structures it offers the ability to use alternative sources of ingredients, such as fruits that do not meet industry requirements (small or visually unattractive) or fish species that consumers are not used to eating. One of the main factors in 3DP is the formulation's rheological behavior because it must be able to flow through a nozzle and maintain its structure once printed1. Therefore, understanding the effect that different thickening agents will have on fruit- and fish-based materials is essential to enable the development of formulations with the appropriate properties for printing. Considering this, fruit and fish based formulations were developed and the effect of different types of proteins (pea and soy protein), starch (corn starch), and carbohydrates (agar, gelatin, carrageenan) on the rheology behavior was evaluated. As expected, the formulations exhibited rheological differences depending on the main raw material used. Furthermore, it was possible to verify the differences that the gelling agents had in the formulations, thus proving that there were types of gelling agents more suitable for each raw material. These differences were also noted during 3DP, with the performance and accuracy being negatively affected.

Bottlenecks and Possible Solutions to Increase the Throughput of 3D Printers in the Case of Food Application

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Abstract:

3D food printing investigations are for the most dealing with flowrates in the range of few ml per minutes more or less. Such flow rate allow the production of small sized food samples, food prototypes or personalized food corresponding to a niche market. The major application of food ADM (additive manufacturing) with high throughput is without any doubt the pizza manufacturing, based on a layer-by-layer approach. The levers towards high throughput 3D printers based on extrusion are based on managing the viscosity of the ink to allow high mass flowrate, on enhanced heat transfer in the printing noozle and on strong gelling capability for the most. These issues will be discussed and possible solutions will be proposed to achieve higher production capacity based on starch based printing ink and phase change systems.

keywords: starch-based inks, extrusion-type 3D printing, rheological properties.

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Accelerating The Process Development of Innovative Food Products by Prototyping Through 3D Printing Technology

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Abstract:

While new discoveries and co-related applications of the 3D Food Printing keep growing with a large set of articulated results such as the utilization of several edible-inks, rheological properties, printing variables, post-printing process, as well the modern approaches of 4D and 5D printing, we have completely forgot the main principle that lies at the core of 3D printing: the Rapid Prototyping. So, beyond the use of 3DP to generates unavailable and personalized food products, we want to introduce the opportunities and benefits of food prototyping. Some prototypes of cereal-food based snacks, have been generated and analyzed for their kinetic of baking with effect of cost reduction, sustainability, and productivity. The experiments explored the effects of two shapes (cylindrical and cubical), three infill levels (30%, 60% and 100%) and two infill paths (grid and gyroid) for a total of 8 digital models. After printing, the samples have been studied by analyzing and modelling the changes in temperature, moisture content, weight loss and color. The variation in moisture content was satisfactory modeled by a zero-order kinetic ($r > 0.98$) enabling to estimate and successfully validate the baking time to get a moisture content lower that 5 gH_20/g. The results proves that 3D printed structures with infill of 30% and 60% delivered a reduction in baking time between 6 and 15 mins. These and others results indicate that 3D Food printing may be used as important prototyping tools extending and accelerating the process of manufacturing of innovative food products with many effects at economic, societal and environmental level.

Creating Digital Solutions to Improve 3D Food Printing Efficiencies

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Abstract:

3D food printing is an emerging technology that can customize food designs and produce personalized foods that tailor towards specific consumer needs. Extrusion-based 3D food printing is the most popular printing technique thanks to its simplicity and suitability to print a wide range of food materials. However, printing food still suffers from low accuracy and high failure rates due to the diversity of food compositions and material properties. To combat these challenges, we apply digital solutions based on computer vision (CV) and machine learning (ML) to reduce trial-and-error experiments and improve the 3D food printing efficiency. We develop CV-based measurements to non-invasively and automatically measure printed object geometries, filament flow velocity, and filament temperature (IR thermography). The obtained measurements offer rapid quality assurance and provide guidance to printing parameter calibrations and optimizations. The quantitative data from CV measurements can be connected to printing parameters and food rheological properties to develop ML algorithms and guide printing controls. The combination of CV and ML creates robust predictive models that can estimate printing accuracies of a range of common food printing materials. These digital methods are based on modular designs and open-source software, which can be integrated to existing 3D food printers and digital database. The simplicity and automation offered by the digital methods reduce labors and resources needed to operate 3D food printers. They also improve the adaptivity of 3D food printers to achieve timely and accurate printings of various food materials.

Improving the Precision and Efficiency of 3D Printing Movements for Superior Food Structures

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Abstract:

A critical and frustrating challenge is the full handling of the design process and control of precise, complex printing movements for the actual exploitation of the degree of freedom of the additive manufacturing techniques. For this, there is a need for new design approaches that solve the current limitations of the traditional CAD and slicing software, especially regarding controlling printer movements. Following these principles, we have compared different design approaches 1. A typical multi-step process involving CAD and slicing software; 2. the 'Full control Gcode designer', a new tool that allows the users to precisely define every segment of the printing path along with all printing parameters. Three virtual models have been created and printed with three levels of morphological complexity to analyse the efficacy and efficiency of such an innovative framework. The complex structures have been created using the mathematical equation in GCode designer, while traditional CAD modelling software uses the integration of geometrical shapes. Analysis regarded not only visual appearance, morphological properties, and printing fidelity but also GCode file size, percentage of the printing and travel time, etc. Samples with medium and high levels of complexity were satisfactory printed using the GCode designer while exhibiting several errors with the traditional approach or even failure in printing due to the impracticable dimension of STL files. Also, we proved that there is the opportunity to modify the printing path and the printer movements, especially in reducing travel movements, with enormous benefits in terms of printing time and printing fidelity/quality, attesting to the power of the GCode designer.

3D-Printing of Food for Personalized Nutrition

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Abstract:

3D-printing has received high attention globally as an emerging technology in personalized meal production and customized food design for its potential advantages over traditional processing. Especially the possibility of developing nutritious and appetizing foods to accommodate needs of special consumer groups is an exciting application. 3D-printing foods includes tailoring the shape, taste, texture and nutrient content of printed foods to suit the preferences and nutritional requirements of specific individuals. From a food technology point of view a very challenging part of implementing the technology is to achieve the texture of the inks and provide the right composition of the final foods. For a material to be printed it needs to be easily extruded from the nozzle of the printer and it needs to hold its structure after deposition. Additives such as thickening and gelling agents can be used to achieve suitable structure for printing. The work presented here covers two cases of application in personalized nutrition i) specialized food for hospitalized patients and ii) personalized sports nutrition for athletes. The first case focuses very much on studies on layering, food structure and composition and patient acceptance in final patient studies. In the second case focus is on achieving snack bars with high protein-content with a suitable texture for printing and an acceptable taste to achieve the form of custom-made on-demand protein bars.

Preliminary Study of the Use of 3D Printing to Prepare Meat Mimics from Plant-Based Protein and Hydrocolloids: Effect of Texture Modifiers

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King Mongkut's University of Technology Thonburi, Thailand

Abstract:

The present study aimed at investigating the feasibility of using 3D printing to prepare meat mimics from a mixture of pea protein isolate and alginate gel. To better imitate the animal meat fibrous structure, the 3D-printed meat mimics were modified by transglutaminase (TG) and κ-carrageenan (KC) at either 0.3, 0.6 or 0.9% (w/w); the sample without TG and KC was used as the control. All meat mimics were also pan-fried at 150 °C until their core temperature reached 80 °C. Textures of both the raw and cooked meat mimics were analyzed and compared with those of the raw and cooked animal meats, i.e., pork tenderloin, chicken breast, salmon meat and Spanish mackerel. Addition of TG at 0.9% (w/w) could increase the hardness of the raw meat mimics, while KC at 0.9% (w/w) could increase the hardness of the cooked meat mimics. In terms of chewiness and springiness, meat mimics in all cases exhibited lower values of these textural parameters than the control, except in the case of the cooked meat mimics with KC at 0.9% (w/w). Texture of the raw 3D-printed meat mimics with TG at 0.9% (w/w) TG was closer to that of salmon meat. Texture of the cooked meat mimics with KC at 0.9% (w/w) was closer to that of cooked salmon.

Fermentation, Bio-Preservation and Probiotication: Ancient and Modern Approaches for Food Valorization

Antonio Bevilacqua*, Maria Rosaria Corbo, Barbara Speranza and Milena Sinigaglia

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Abstract:

Fermentation probably represents the first approach for shelf-life prolongation and bioconversion of a perishable raw material into a product, as shown by the ancient traditions among Sumerians or Indians. Moreover, in the last decades the controversy between standardized and natural fermentations led to the isolation, design, and scaling up of autochthonous strains (bacteria or yeasts) able to valorize the micro-imprinting of traditional foods. Fermentation is a valuable tool to improve biological value, texture, and sensory traits of some foods; in addition, some microorganisms involved in fermentation could have a positive impact on health and well-being, above all those coming from traditional processes. However, the limit is that these processes could be rarely applied for foods and in situations different from original ones. Therefore, this communication is focused on some virtuous case-studies on fermented vegetables showing how scaling up traditional processes to industrial flowsheets, without compromising the traditional micro-imprinting, focusing on three main routes: replication of natural fermentation through biotechnological approaches, probiotication (use and or addition of probiotic strains in foods and/or throughout food processes) and biopreservation (prolonging the shelf life of perishable raw materials through microorganisms).

The Effect of Microbial Succession on the Quality of Chinese Traditional Fermented Fish and Its Industrialization

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Abstract:

China's traditional fermented fish products have a long history, distinct flavor, and high nutritional value. However, most processing methods are still relied on natural fermentation, resulting in unstable quality and long fermentation time. Understanding the structure of the microbial community and its impact on product quality is the key to achieving controlled fermentation and the industrial development of traditional fermented products. We collected several types of traditional fermented fish (*Chouguiyu*, *Suanzhayu*, and *Yucha*) products from various regions, studied their basic physicochemical properties and microbial structure composition, and clarified the specific characteristics of these products. The structure evolution of the microbial community was then studied using cultivable and non-cultivable methods during the fermentation process. Key microorganisms and key metabolites were identified by analyzing the relationship between physicochemical properties, nutrients and flavor substances, and microbial structure changes. Furthermore, starter cultures were developed using the isolated key native microorganisms. Flavor enhancement, harmful substance (biogenic amines) reduction, and fermentation cycle reduction were achieved using bacterial control or enzyme-bacteria coupling control technology. Finally, we conducted industry survey on the *Chouguiyu* industry (4 billion yuan in 2021), established the group standard of "Frozen fermented mandarin fish", promoted the technology to the *Chouguiyu* enterprises, which facilitate the industrialization of traditional fermented fish in China.

Ultrasound Pretreatment Enhances Anti-Inflammatory and Hypoglycemic Activities of Edible Bird's Nest Hydrolysate

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Abstract:

Edible bird's nest (EBN) is the solidified saliva of swiftlet *Aerodramus fuciphagus*. It is an expensive premium health food has long been consumed, especially in China. However, the broken EBN pieces left behind after cleaning process have low market value due to high contaminants, particularly fine feathers. Thus, EBN hydrolysate (EBNH) is the best downstream product to add value to this low-grade EBN. This study aims to investigate the advantages of ultrasound (US) technology in the enzymatic process of EBNH production. Initially, the grade E EBN was subjected to US treatment at different amplitudes (30, 60, 90%) and times (15, 30, 45 min), then hydrolysed for 1.5 hrs at 60°C using papain enzyme (pH 7). Viscosity, degree of hydrolysis (DH), total soluble protein (TSP), DPPH activity, anti-lipoxygenase activity and α-amylase inhibition activity of the EBNHs produced were determined. Results suggest that US amplitude exerted more significant effect than time in lowering viscosity of EBNH. Viscosity of EBNH dropped by 4.4 folds to 6.58±0.10mPa·s after 30min US at 90% amplitude. Under this condition, EBNH produced exhibited 61.66±2.89% anti-lipoxygenase activity and 77.40±5.41% α-amylase inhibition activity, which were 14% and 44% higher than the control. However, US had exerted no significant effects on DH, TSP and DPPH activity. These findings speculate that US enhances bioactivities of EBNH by modifying intermolecular interactions between glycopeptides and glycoproteins. This study proved that US is a promising green pretreatment technology in EBNH production. This research provides an insight into the importance of pretreatment in functional

EBNH production. **Keywords:** Edible bird's nest, ultrasound, hydrolysate, anti-lipoxygenase activity, α-amylase inhibition activity

Organoleptic Quality and Processing Ability According to the Variety and Location in Yam (*Dioscorea alata)*

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Abstract:

Worldwide, yam is an important source of energy, providing mainly starch, and of bioactive nutrients for 300 million people that consumed it daily. However, there is paucity of information on the nutritional, organoleptic and functional quality of yam. Regarding quality, most studies have dealt with determining the chemical composition of this root crop, in particular starch characteristics. The present work aims to assess the organoleptic and functional quality of five varieties of yam of the species *Dioscorea (D.) alata*. Three of them are amongst the most often used by local producers. The study was carried out in the French West Indies, in Guadeloupe island. The tubers come from two separate sites with different pedoclimatic characteristics. They have been studied via a multi-criteria approach for their processing ability, their texture and their physicochemical composition. Our results showed a large variability within the D. alata species for textural and chemical characteristics, as well as for some items characterizing processing ability. The dry matter content of crude yam ranged from 25.5 to 30.4%, and its ash content was between 3.3 and 4.1% in relation to variety. When yam pieces were boiled, the textural properties measured by penetrometry, the cooking time and the shift in pieces'weight due to cooking depended on both variety and location. We obtained no correlation between cooking time and textural properties. Our data clearly indicate that organoleptic quality and processing ability are closely linked to the genotype and the location in yam.

Sustainability Assessment of Food Waste Biorefineries as the Base of the Entrepreneurship in Rural Zones of Colombia

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[2]*Universidad de Caldas, Colombia;*

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Abstract:

Biorefineries are facilities dedicated to upgrading biomass in energy vectors and value-added products in a sustainable way (i.e., considering economic, environmental, and social perspectives). The design of these facilities can be carried out using different methods based on either the knowledge of the designer or mathematical approaches. These facilities are boosting the introduction of biomass sources as potential raw materials in different productive sectors promoting an economic model change (i.e., transition from oil-based economy to bioeconomy). Furthermore,biorefineries contribute to the establishment of sustainable communities. Biorefineries play an important role in the transition to a bioeconomy by reducing the use of fossil fuels and contributing to complete the UN targets. This strategy is applied to three groups of raw materials from poor rural zones of Colombia: food loss (avocado, sugarcane and plantain),

food waste residues (fruits and vegetables from small markets for consumers), food additives waste (annatto) as well as exotic fruit residues (acai). As a result the technical, energy, economic and environmental analysis is done to demonstrate the real possibilities of implementing these ideas as entrepreneurship in these zones. The first main result was the higher dependence on the products to get the feasibility. The second main result was the requirement of higher scales that makes possible the integration on different value chains actors.

In-Mouth Metabolism and Production of Flavor Sulfur Compounds by Oral Microbiota Enzymes

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Abstract:

Flavor perception is the main factor in the acceptance of food. Cysteine derivatives are aroma precursors present in a number of plant-based foods (vegetables, fruits, as well as beverages such as wine). They have low odorant properties, but become odorant when metabolized into aroma sulfur compounds in the oral cavity. These sulfur compounds are sometimes associated with food aversion. Therefore, it is desirable to improve our knowledge of the entailed enzymatic mechanisms and design strategies aiming at controlling their release in-mouth. The involved enzymes are presumably carbon-sulfur lyases (C-S lyases) from the oral microbiota, but evidences are scarce. Recently, we showed that saliva metabolizes allyl-cysteine into odorant sulfur metabolites, with evidence suggesting that pyridoxal phosphate-dependent C-S lyases are involved. Protein sequence analysis of C-S lyases in *Fusobacterium nucleatum* was carried out and led to the identification of several putative targets. The C-S lyase FnaPatB1 from *F. nucleatum animalis*, showed high activity with a range of aroma precursors. FnaPatB1 metabolizes cysteine derivatives within a unique active site environment that enables the formation of flavor sulfur compounds. Among a food compounds library, we identified several inhibitors able to reduce the C-S lyase activity of FnaPatB1 in vitro, which paves the way for controlling the release of odorant sulfur compounds from their cysteine precursors in the oral cavity.

Evaluation of Phytochemical Screening, Antibacterial, Antioxidant, and Nutrition Value of Libyan Date Palm Pollen

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Abstract:

The aim of this research was to examined the phytochemical screening, antioxidant, antibacterial, and nutritional values of date palm pollen (DPP; Phoenix dactylifera L.) cultivated in Libya. The phytochemical screening of DPP revealed the presence of phytosterols, flavonoids, coumarins, tannins, phenolic compounds, amino acids, protein, a small amount of saponin, and fats. The antioxidant test results indicated that the water-extract of palm pollen grains showed the best DPPH scavenging activity (IC50 = 0.0005). The DPPH scavenging activities recorded for palm pollen grain methanol extract were IC50 = 0.233 mg/ml and IC50 = 0.224mg/ml at 70°C and 45°C, respectively. The methanol extracts of DPP grains showed no remarkable inhibition of

methacillin resistant Staphylococcus aureus (MRSA) ATCC 43300, Staphylococcus aureus ATCC 29213; Klebsiella pneumonia ATCC13883, Escherichia coli ATCC 25922, and Pseudomonas aeruginosa ATCC 9027 at concentrations of 12.5mg/ml, 25mg/ml, 50mg/ml, and 100mg/ml. The proximate nutritional value showed that the DPP grains contained 18.19% moisture, 5.41% ash, 67% crude fiber, 7.32% crude fat, and 27.36% crude protein. Furthermore, neither mortality amongst the graded dose groups of animals nor behavioral changes at the highest dose of 5,000 mg/kg in the acute toxicity test. **Keywords:** Date palm pollen, antioxidant, antimicrobial, nutritional values, phytochemical screening

In-Silico Modelling of Digestion, Absorption, Hormonal Responses and Sensations of Hunger and Satiety, Applied to Food Systems

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Abstract:

A mechanistic computer model for food digestion has been developed that combines many aspects described in the open literature of the processes of food breakdown, enzymatic digestion, viscosity and structure-modulated absorption with the feedback loops in the gastrointestinal tract, including gastric emptying, gastric acidification, digestive fluid composition and secretion, small intestinal absorption rate, small intestinal transit times and incretin hormone release. This model allows simulating the digestion and absorption processes relevant for normal adults, but through adjusted parameterization can be adapted for target groups and individualized nutrition. Foreseen is a future coupling to data-driven modelling that will allow the use of large sets of data, obtained from nutritional and analytical studies, which is also required for including the complexity of the microbiome. In its current form, the model has been used for explaining the physiological effect of the consumption of a variety of foods and has been used to extrapolate and design new experimental studies on the basis of previous result obtained from in vitro and in vivo studies. Its validity will be illustrated by comparison with the results of a number of human intervention studies, including the effect of the type of sugar and starch on glycemic and insulinemic excursions, the effect of gastric protein coagulation on post absorptive blood leucine excursions and the effect of enzyme inhibitors on absorption and blood values of absorbed nutrients.

Effects of Plasma Activated water on Rheological, Thermal, Hydration and Pasting Properties of Normal Maize, Waxy Maize and Potato starches

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Abstract:

This study aimed to investigate the effect of plasma activated water (PAW) on the pasting,

rheological, thermal, and gel hardness properties of waxy maize, normal maize and potato starches. As PAW contains highly reactive species (nitrite, nitrate, hydrogen peroxide, ozone an acidic environment), it is expected to cause evident modifications in the characteristics of starch treated. The starches were subjected to the PAW treatment of input voltages 15kv for 20 min of exposure. A significant reduction ($p < 0.05$) in pasting, rheological and gel hardness was observed in waxy maize; on the other side, in normal and potato starches, these parameters showed a significant ($p < 0.05$) increase. Differential scanning calorimetry analysis shown that PAW gelatinization temperatures and enthalpy increased for potato while decreased for normal maize. The swelling power of starches treated with PAW was higher compared to that of the native, while the water absorbing index was reduced for waxy maize. The analysis of pasting characteristics depicted that PAW caused an increase of the peak viscosity, breakdown and final viscosity for potato and normal maize, while a decrease for waxy maize. Rheological measurements of G' and G'' moduli showed a decrease in the elastic region and tendency of dominance in viscous region upon PAW treatment. The results obtained in this study show highlighted PAW as a promising novel green and uniform alternative treatment method to modify the properties of starch.

Impact of Plasma Activated Water (PAW) Treatments on the Oxidation of Mussels' Lipids

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Abstract:

Plasma-activated water (PAW) can be a potential and promising tool for food decontamination from both biological (microorganisms) and chemical (pesticides, food allergens, mycotoxins) contaminants in different type of food. However, consider that the food decontamination occurs through the activity of the highly reactive species (e.g. hydrogen peroxide and ozone), this one can be induced undesired chemical changes as well, thus leading to a deterioration of sensory and nutritional properties, such as peroxidation of food lipids. Aim of this work was to evaluate of the extent of positive (microbial inactivation) and negative (lipid oxidation) events in mussels' (*Mytilus galloprovincialis*) samples, treated by PAW on following condition: 500 ml of distilled water exposed for 4 min to a pulsed corona discharge driven by a high voltage power generator (AlmaPulse, AlmaPlasma s.r.l.), peak voltage of 18 kV and a pulse repetition frequency of 5 kHz.). PAW dipping times of 5, 10, and 15 minutes were explored vs controls dipped, for the same times, in demineralized water. Following Bligh and Dyer (1959) method, total lipids were extracted from PAW-treated samples and controls and analyzed for non-volatile (oxysterols) and volatile lipid oxidation products and fatty acids profile. The aldehyde n-nonanal, and the ketone 3,5 octadien-2-one (E,E) were the one of higher concentration; n- octanal showed a significant increase once lengthening the dipping time. 27 fatty acids were identified and quantified. Three hydroxy-sterols and one cheto-sterol were identified. Two phytosterols and 2 types of cholesterol: dehydrocholesterol and dehydrocholesterol, were also found. No significant differences of total COPs content and Fatty Acids were observed between PAW processed and control samples.

The present work is funded by the Italian Ministry of University and Research (PRIN 2017, Project "PLASMAFOOD").

Role of Sugars on Horseradish Peroxidase Inactivation by Cold Atmospheric Plasma Treatment

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[2]*University of Bologna, Italy.*

Abstract:

Enzymatic inactivation is one of the greatest challenges in fruits and vegetables. Peroxidase (POD), one of the most thermostable food enzymes, has been reported to be involved in enzymatic browning, causing deterioration and loss of food quality. Several chemical processes and physical treatments have been developed at industrial level to control POD activity. However, the limitations of traditional processes have articulated the need for novel technologies. Among those, cold plasma has emerged with great potential in the inactivation of endogenous food enzymes. Nevertheless, foods are complex systems and some of their components, such as sugars, could influence the protein unfolding due to cold plasma treatment. Thus, the present work aimed to evaluate the influence of different sugars on POD inactivation during cold atmospheric plasma (CAP) treatment. For this purpose, different model systems were prepared using a commercial POD enzyme and different concentrations of glucose, fructose, sucrose and trehalose. Successively CAP treatments were applied from 5 to 30 min. Spectrophotometric analyses were conducted (fluorescence, circular dichroism, atomic absorption UV-VIS) to evaluate the enzymatic activity and the structure of the enzyme. Cold plasma treatment determined a significant reduction of the enzymatic activity in all the investigated systems and this effect was time-dependent. Sugars differently interacted with the POD and modified its structure and catalytic activity depending on their type and concentration.

Static Magnetic Field SMF Treatment Impact on Functional Characteristic of Buckwheat Flour

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Abstract:

The impact of magnetic fields like static magnetic field, pulsed magnetic and electromagnetic field can cause many changes in plant metabolism. The experiments done on different seeds revealed the growth parameters improvement as accelerated time of seeds' germination, grater dry mass accumulation in shorter time and others, like higher content of minerals. Those effects are supposed to result of an enzymatic activity modulation caused by the magnetic field influence. State magnetic field was applied at buckwheat grains BG. BG were hydrated up to 10, 15, 10, 20% of water content and exposed to static magnetic field. Static magnetic field was generated by lab built device based on ferrite magnet. The magnetic field values was in range of 80-120 mT. After treatment grains were dried, milled and analyzed. Pasting properties, polyphenolic compounds content and antioxidant status were assessed. The results revealed the significant impact of the static magnetic field on the techno-functional features of buckwheat flour. The amylolytic activity measured indirectly by viscosity modification of flour and pasting properties showed significant changes in function of moisture level and the antioxidant status of flour was improved. The obtained results suggest that such mild treatment can introduce the significant changes in flour proprieties.

Monitoring of Canola Protein Gels Digestion by Rheology and Small-Angle Scattering Techniques

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Abstract:

Proteins are crucial macronutrients, but also structure elements of ingested food. They form structures at multiple spatial scales, in particular in gels. In this work, we study gastro-intestinal digestion of two different canola protein gels, resulted from heating of protein solutions at different pH. We focus on physical aspects of digestion, with multi-length and multi-time structural information, with intrinsic heterogeneity of samples in mind. We coupled Small-Angle Scattering techniques (SANS, SAXS) with Rheometry, to get insights about nanostructures and flow/deformation of the gels, respectively. For SANS and Rheometry, a 10mm samples (mimicking in-vivo food particles) were pre-infused with inactivated enzymes for further homogenous digestion. For SAXS, we monitored digestion as a function of time *t* and height *z*, by vertical scanning of gels in 0.15µm capillaries, submitted to enzymatic diffusion from the top of samples. Differences in initial gel structures (either compact or unfolded proteins, induced by preparation pH) influenced their evolutions under digestion. In Rheometry, we observed opposite gastric effects on modulus for the two gels and different intestinal degradation rates. We related moduli evolutions to both aggregates destruction and protein conformational changes, monitored in SANS. Low scale (high scattering vectors Qs) information on protein sizes and shapes reveal their level of compacity/unfolding, or aggregation. Synchrotron SAXS enables quick real-space accurate investigation of diffusion-reaction, through many (*z*, *t*) pairs, over long digestion times. Some parameters, sometimes showing back and forth variations, evidence that deconstructions paths are not obligatorily the simplest ones. **Acknowledgements:** Beam-time at LLB and SOLEIL (SWING) is gratefully acknowledged.

How to Control the Torque of Plant-Based Protein Extrusion?

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Abstract:

Macroscopically fiber-like structure, where the curled protein molecules are stretched into chains never contracted, is considered to be an important quality characteristic of plant-based meat analog. Plant-based raw material with high torque during extrusion or high viscosity has longer relaxation time and easier to be stretched than low viscosity one, based on the entropy elasticity. The extrusion torque of soybean protein isolate (SPI) raised with the increasing of 15% concentration protein gel storage modulus (3,800 to 5,400) Pa and bulk density (0.41 to 0.47) g/cm^3. When the helix angle of conveying elements turned from forward (45°) to reverse (-37.5°), the disc width of the kneading elements decreased from 7.5 mm to 5 mm, and when the disc stagger angle turned from forward (45°) and forward (90°) to reverse (-45°), the extrusion torque increased. SPI/gluten/starch blends with higher starch enthalpy changes (ΔH) leaded to higher extrusion torque. When SPI treated with sodium sulfite (Na_2SO_3) under low temperature (50°C) extrusion, the free sulfhydryl content significantly increased (98.46 to 449.64) µmol/g and the torque significantly increased (16.4 to 22.8) Nm. It suggested that Na_2SO_3 breaks disulfide bonds in SPI, which accelerates protein molecule denaturation to promote peptide disentanglement. The relationship between torque and quality of plant-based protein needs to be further investigated.

Relationship between the Physicochemical Properties of Soybean Protein Isolate and Its Extrudate Based on High-Moisture Extrusion Torque

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Abstract:

This study investigated the relationship between nitrogen soluble index (NSI), bulk density and gel storage modulus of soybean protein isolate and torque during high-moisture (50%) extrusion, and analyzed the influence to extrudate texture by the moisture content and the expansion degree of extrudate. The results showed that in the range of NSI of 21%-74%, bulk density of 0.41-0.47 g/cm3 and gel storage modulus of 3,800-5,400 Pa, the torque and specific mechanical energy raised with the decrease in NSI and the increase in bulk density and gel storage modulus. The lower the moisture content of the extrudate was, the higher its hardness. Nevertheless, when the extrudate occurred expansion, bubble cavities formed on the surface of the extrudate could reduce the stress on the probe of the texture analyzer, resulting in the decrease in the hardness of the extrudate (from 13124 g/sec to 11736 g/sec and 4840 g/sec). Overall, the hard extrudate can be produced from soybean protein isolate with low NSI and high bulk density and gel storage modulus via high-moisture extrusion, at the same time appearing in an expanded structure that reduces the test value of extrudate hardness.

Effect of Glucose Levels on the Rheo-Fermentation Properties of Dough During Fermentation

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Abstract:

In this study, recombinant dough and simulated dough medium were used to study the effect of different glucose levels on quality of dough. With the increasing of glucose levels (3, 6, 9, 12, and 15 g/100 g mixed flour) in recombinant dough, the water absorption and extensibility of the dough decreased significantly. Compared with the control group, the maximum height of the dough added with glucose gradually increased, and the CO_2 retention rate decreased slightly. There was almost no growth of yeast in the sugar-free medium (0%), while 6% and 15% glucose levels inhibited yeast growth and yeast entered the stable phase earlier. Compared with 3% glucose levels, yeast produced much more glycerol content and ethanol content in 6% and 15% glucose medium, which affected rheological properties of dough. Different glucose levels affected the fermentation state of yeast and metabolites significantly, 3% glucose medium was more suitable for the dough fermentation and growth of yeast during dough fermentation.

Four Levels of Data Visualization in Food Science

Min Chen

University of Oxford, UK

Abstract:

In this talk, the speaker will examine the objectives of visualization at four different levels,

namely, (1) disseminative, (2) observational, (3) analytical, and (4) model-developmental levels. The four levels correspond to different complexity classes in computer science. While the objectives of visualization at Level 1 are widely appreciated, those at Level 4 have been overlooked, until now. The importance of visualization in model development, especially in machine learning and epidemiological modelling, became apparent in recent years. The speaker will use several visualization applications to illustrate the main characteristics of the four levels, while envisioning how different visualization techniques may be used in food science.

Segmenting Countries Based on the Values of Global Food Security Index: Biclustering Approach

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Abstract:

Food security gains significant attention due to its impact on political, economic, and humanitarian decisions governments make. The topic of food security has been an important one in the previous decades, but in the light of the COVID-19 pandemic and other global occurrences, it more than ever paramount to measure it and act preventively. So far different approaches to measuring food security have been devised. One direction is towards using individual indicators. Although this approach can be useful, it is believed that single indicators cannot measure the complexity of the food security. Therefore, approaches based on the use of multiple indicators have been proposed. Within this direction, several sub-directions emerged. One of them encompassed the use of statistical multivariate analysis on multiple indicators, while the other strived to create a single metric – composite indicator, based on values of multiple indicators. Among several composite indexes that aim to measure food security, the Global Food Security Index (GFSI) stands out for its solid methodology and reliable data sources. This paper attempts to combine the two above-presented approaches: to use advanced statistical methods on the data initially collected to create a composite indicator. The aim of the paper is to apply biclustering, a method of unsupervised learning which segments both entities (in this case countries) and indicators thus creating specific groups. It is believed that the results of the study could indicate which countries are more food secure and other in specific aspects food (in)security. At the same time, our approach can serve as a foundation for future research on multivariate analysis of global food security.

Exploiting Comprehensive Two-Dimensional Liquid Chromatography for Pesticides Determination in Food Real-World Samples

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[3]*Chromaleont s.r.l., c/o Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Messina, Italy;*

[4]*Department of Sciences and Technologies for Human and Environment, University Campus Bio-Medico of Rome, Rome, Italy.*

Abstract:

Food safety represents an everyday challenge for the globalization of production and the

lack of traceability of products. To keep up with the high standards and to rapidly solve new problems there is a continuous need of rapid, ultrasensitive, selective, sustainable, and possibly green analytical methods to determine contaminants in food. For analysis of food contaminants, the current technology based on gas and liquid chromatography coupled to tandem mass spectrometry offers the feasibility of developing new approaches thanks to the increasing sensitivity and possibility of full scan analysis. The use of advanced gas and liquid chromatography methods e.g. comprehensive two-dimensional LC could represent a valuable tool, because of the extreme separation power, for reducing matrix effects and reduce the need for the amount of solvents. The present contribution illustrates the advantages of the LC×LC technique for the determination of pesticides in complex food matrices; in addition, the capability of dedicated software for data processing will be pointed out. **Acknowledgment:** The authors are thankful to Shimadzu and Merck Life Science Corporations for the continuous support. The research were performed within the framework of the Research Project PRIN 2017: At the forefront of Analytical Chemistry: disruptive detection technologies to improve food safety – ACTUAL, supported by the Italian Ministry of University and Scientific Research, no. Prot. 2017RHX2E4.

Innovative Mobile Application for Reducing Food Insecurity and Food Waste in Qatar

Sana Abusin[1*], Brian Washington[2] and Noor AlEmadi[3]

*Affiliation (QATAR University, Qatar) {*Social *and Economic Survey Research (SESRI), Qatar University, Doha, Qatar.*

Abstract:

Food security in Qatar is a research priority of Qatar University (2021-2025) and all national strategies, including the Qatar National Vision 2030 and food security strategy (2018-2023). Achieving food security requires three actions: 1) transforming surplus food to those who are insecure; 2) reducing food loss and waste by recycling food into valuable resources such as compost ("green fertilizer") that can be used in growing food; and, finally, 3) establishing strong enforcement agencies to protect consumers from outdated food and promote healthy food. Currently these objectives are approached separately and not in a sustainable fashion. The aim of the study is to develop an innovative mobile application that supports a sustainable solution to food insecurity and food waste in Qatar. The application will provide a common solution for a number of different users. For producers, it will facilitate easy disposal of excess food. For charities, it will notify them about surplus food ready for redistribution. The application will also benefit a second layer of end-users in the form of food recycling companies, who will receive information about available food waste that is unable to be consumed. While it is beyond the scope of our project to include all functionality of the application in Phase 1, over the course of the proposed project our solution will achieve a Technology Readiness Level (TRL) of TRL5, approaching TRL6 by the end of the project. It aims to motivate the young generation toward innovation and creation, and to encourage public-private collaboration in this sector.

Impact of Mediteranian Cricket (*Gryllus bimaculatus*) Powder Addition on the Viscometric Profiles of Millet Flour Blends

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Abstract:

Mediteranian cricket (*Gryllus bimaculatus*) can be an important source of protein and is perceived as a food product ingredient. The main constituents of the cricket body are protein, chitin and fat, which are distributed in the cricket body. Crickets usually contain about 71-73% of water, therefore, in dried mass the distribution is quite different. As protein, fat, and chitin are perceived as ingredients impacting the viscometric behaviour of flour mixtures, such characteristic should be taken when planning their wider usage in products. Commercially available cricket flour contains 69,1% of protein, 18,5% of fat and 7,7% of fibre, other carbohydrates 0,7% and salt 1,03%. Such high content of proteins and fat can significantly impact the viscosity of flour blends. The main objective of this study was to investigate the viscosity changes by the viscometric profile obtained with an RVA standard 1 method of flour mixtures composed of two different millet flours flour and cricket powder. Both flours where purchased commercially and four mixtures were prepared to contain 5%, 10%, 15%, 20% of insect powder.

The progressing addition of cricket flour gradually lowered the peak viscosity (PV) of mixtures. The pasting temperature was constantly rising with an increasing amount of cricket in blends, while the final viscosity differences were lower between samples indicating the additional activity present. The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

Composition and Physico-Chemical Properties of Milk from Indoor Feeding *versus* Pasture at Different Altitudes in the Production of Formaggella Della Valle Di Scalve Cheese in Bergamo Province

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Abstract:

The aim of the research was to study the physico-chemical and technological properties of milk destined to the production of Formaggella della Valle di Scalve, a semi-cooked traditional cheese, made from whole milk in a mountain area of Bergamo province (north of Italy). During two years, a total of 19 cheesemaking trials were conducted in summer for three different experimental theses: six milk sampling (S-milk) were kept from a farm rearing cows indoor (at valley floor, about 1000m asl), fed permanent meadow hay and grass. Six sampling (P-milk) were made in a farm still located at valley floor but raising cows at pasture. Seven sampling (A-milk) were made in a herd at mountain pasture (altitudes higher than 1000m up to 2300–2500m). Chloride and somatic cells resulted higher in A-milk than in S-milk. Lactose and titratable acidity showed higher values (4.66 vs 4.50 g/100g; 3.28 vs 2.97 °SH/100mL; $P<0.05$) in S-milk than in A-milk. Moreover, fat of S-milk was characterised by higher percentages of medium-chain fatty acids (FA) (50.41% S vs 43.85% P vs 40.68 A; $P<0.001$). Furthermore, long-chain FA were higher in P- and A-milk than in S-milk (40.43% S vs 48.03% P and 51.42% A; $P<0.01$). Monounsaturated FA, and in general unsaturated FA, were higher in P- and A-milk, while saturated FA were higher in S-milk than in P- and A-milk (68.61% S vs 63.39% P and 60.98% A; $P<0.05$). Finally, CLA were higher in P- and A-milk, while Omega3 in P-milk, compared to both S- and A-milk.

Improving and Developing Environmentally Sustainable Methods for Food and Feed Analysis

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Abstract:

The growing threat of global climate change greatly amplifies the urgent need for individuals, corporations, and governmental bodies to do more on environmental sustainability. As food chemists, we can play important roles by choosing, selecting, and/or developing environmentally sustainable methods for food and feed analysis. Once these analytical methods are adopted or used by others, a ripple effect is created, where an individual effort is transformed into the effort of a large community or even at an industrial level. Although there are many innovative ways to achieve sustainability when food technologists are at work, reducing uses of water, energy, and chemicals, and generating less or no wastes are the key strategies. To illustrate how an individual chemist can contribute environmental sustainability, in this presentation I discuss two analytical methods improved or developed at our USDA lab over the past few years. The first one is the significantly improved method for measuring trypsin inhibitor activity in soybean and other legume products. It uses half amounts of reagents and has recently been adopted by American Oil Chemists Society as an Official Method, Ba 12a-2020. The second method refers to a new method in measuring acid insoluble ash, which omits a re-ashing step. The two methods are now being used or evaluated by the relevant industries or parties. Hopefully, in the age of growing world population, depleting natural resources, and devastating climate change, we all can make efforts to tackle the problems and save our earth for benefiting current and future generations.

Impact of UV-Light Irradiation on Sensory Properties and Volatile, Fatty Acid and Tocopherol Composition of Peanuts (*Arachis hypogaea L.*)

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Abstract:

The high content of unsaturated fatty acids (mainly oleic and linoleic acids) present in peanuts (*Arachis hypogaea L*) makes them highly susceptible to lipid oxidation reactions, which not only deteriorate the lipids, but also degrade proteins, vitamins, and pigments. In many of the oxidative studies carried out in nuts, a too long time (around 7 months) is needed. Consequently, the commonly used accelerated methodology consists of subjecting nuts to high controlled temperature (40-70 ºC). However, temperature can roast peanuts acquiring a darker colour due to the decrease of the b* value. Thus, a new accelerated oxidation methodology in peanuts by using UV light has been developed and results were compared with a conventional oxidation treatment by using temperature. After 3 and 7 days of UV irradiation exposition, the peanut oxidation is confirmed since α-, β-, and γ-tocopherol content started to decrease significantly. However, unsaturated fatty acids composition only experienced a significant decrease after 2 months applying 70 ºC. Chemical composition confirmed that the peanut samples which were in the oven were more oxidised than those which were under UV light. Nevertheless, results clearly exhibited SPME measurements were a good indication of rancidity in agreement with sensory evaluation: The large amount of different volatile compounds generated by UV-light (mainly nonanal and hexanal) produce an oxidation perception in the consumer. Moreover, it

does not compromise the sample colour. Even so, UV-light irradiation is intended to be a new accelerated oxidation methodology for peanuts.

Use of Alternative Ingredients to the Neapolitan Pizza Topping

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University Mediterranea of Reggio Calabria- Department of AGRARIA, Italy

Abstract:

Pizza is one of the most consumed products of Italian gastronomic culture in the world and dates back to 2010 the official attribution of the quality mark "Traditional Specialty Guaranteed" (TSG) of the European Union to Neapolitan Pizza, produced according to a specification that fixes its quality, related to the use of specific ingredients, as extravirgin olive oil and Buffalo and Fiordilatte Mozzarella cheeses, and to the processing technique according to tradition handed down for several generations. With the global spread of this food production, with variants more or less distant from the typical traditional recipe, the question arises of maintaining quality despite the use of different ingredients, especially in topping. In recent years, consumers have increasingly turned to the consumption of quality food, with pleasant organoleptic properties and greater health components. This work evaluates any differences in the physical-chemical quality of the Pizza following the use of various types of oils and cheeses on the topping. This feedback will provide useful information for the production of quality Neapolitan Pizza, even with ingredients other than those considered up to now.

The Impact of Environment on Micro and Macronutrients in Meat

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Abstract:

Chicken, beef, pork, and other meat types have been part of the human diet for hundreds of years. The nutritional profile of meat products has been, and still is, extensively investigated by researchers worldwide. This project's goal is to determine how various factors affect meat's nutritional profile and how meat industry's distribution and promotion of certain meat products and claims, are supported or challenged after nutritional analysis. We will also attempt to determine if meats nutritional composition depends on environmental factors such as (i.e., animal feed and farming methods). This can be possible by developing a nutritional profile by measuring concentration of proteins, fats, vitamins, minerals, and carotenoids etc. that will allow us to measure differences between meat categories such as Organic or free range. Price variations have been observed for different retail meat products i.e., organic VS free range VS standard meat. Higher prices are based on meat properties such as: limitation of antibiotic and hormone use in animals' diet (organic meat), pasture-raised livestock and high concentrations of beneficial nutrients in final meat product. However, a remaining question is whether those prices observed in the market are truly reflective of beneficial properties or nutritional composition and if the differences between meat attributes are significant, since consumers spend a significantly larger amount of money to obtain what they perceive as better-quality meat.

Environmental and Mechanical Properties of Starch Protein Blend Bioplastic Packaging

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Abstract:

Single-use plastic films are made from non-renewable materials and are typically either not recyclable or are challenging to recycle. They end up in landfills or are discarded, contaminating the environment, and posing a threat to animal and human health. The current alternatives for more sustainable bioplastics, such as thermoset starch-based bioplastics, have suffered criticism for not having mechanical characteristics comparable to petroleum-based plastics, and for competing with unsustainable food resources. This study intends to analyse the environmental impact and mechanical properties of starch-protein blend thermoset bioplastics (SPBB) when different, more sustainable, starches are used in their composition. The degradation of different starches used in each formulation was analysed using soil oxitop chambers, with preliminary results showing that all synthesised bioplastics will completely degrade within 6-8 weeks. The toxicity to plant life was studied, along with the ecotoxicity of algae for aquatic environment. Marine toxicity results showed that the bioplastics increased algae growth depending on the concentration of SPBBs. Preliminary plant toxicity data indicated that bioplastics would impact plant growth positively. In addition, all bioplastics indicated tensile strength and elongation-to-failure which were consistently comparable to currently used plastics. In conclusion, the improved usable characteristics of the SPBB's generated in this study from more sustainable starches show potential for their use in the production of the next generation of bioplastics.

Effect of Process Variables on the Physico-Chemical Properties of B-Sitosterol Nanoparticles Encapsulated in Polycaprolactone for their Potential Use in Nutraceutical Products

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[2]*Laboratory of Membrane Separation Processes (LabProSeM), Chemical Engineering Department, Engineering Faculty, University of Santiago de Chile, Chile;*

[3]*CEDENNA, Center for the Development of Nanoscience and Nanotechnology, Chile.*

Abstract:

β-sitosterol has demonstrated hypocholesterolemic effects for the prevention of cardiovascular diseases. However, its application as a bioactive compound remains a challenge due to its low water solubility and poor bioavailability. Therefore, the encapsulation process by emulsification and solvent evaporation becomes a promising alternative to overcome these limitations. This technique combines the particle engineering of emulsions together with an organic solvent extraction step, which allows obtaining homogeneous nanoparticles, with high encapsulation efficiency and storage stability in aqueous systems. The objective of this work was to obtain β-sitosterol nanoparticles, using polycaprolactone as a coating material. The nanoemulsions were obtained by homogenization with ultrasound assistance. A factorial design experiment was carried out: the polycaprolactone content between 2-4 g/L; the tween 80 concentration between 0.5-1.0 % w/w; and ultrasonic time between 5-10 minutes. Droplet size were measured

in dynamic light scattering equipment, in addition to physical stability for 90 min. Subsequently, the solvent was removed using a steam rotator at 40°C for the capsules precipitation and subsequent drying using a freeze dryer, obtaining powders that were characterized in terms of encapsulation efficiency, in addition to their physical and thermal properties. As result, homogeneous and physically stable nanoemulsions were obtained with droplet size of 264 nm, with a model fit of 98%. The powders characterization showed a good encapsulation efficiency. The structural and thermal properties confirm the presence of the bioactive compound inside the powders. In conclusion, it was possible to develop β-sitosterol nanoparticles for potential application in nutraceutical products or functional foods.

Variability of Grain Albumen Minor Components and Technological Quality of Wheat

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Abstract:

Technological wheat quality can be defined as its ability to meet the specifications needed for a given end-use. But this quality assessment is becoming more challenging due to climate change, agro-cultural practices and changing societal demands. EVAGRAIN is funded by the French National Research Agency and coordinated by the INRAE research unit BIA. The aim of this project is to design a Decision Support System (DSS) that would be able to give a quality assessment of wheat for various end-uses in the industry. Many studies worked on the genetic and environmental impact on components of wheat grain but mainly focusing on starch and protein. Although these components have a proven role in bread making, minor components, such as lipids and pentosans should also take as much attention. Indeed, lipids have ability to interact with starch polymers and proteins, and have multiple impacts on the dough properties. Pentosans, which are cell wall polysaccharides, are known for their strong water retention capacity, and water control is crucial in bread making. This project is part of EVAGRAIN by integrating new wheat evaluation criteria through the study of these minor components of wheat flour. This work will provide a better understanding of the role of minor components on the quality of grain products. The interconnection of the data and knowledge will allow to create a DSS and determine the most relevant wheat quality criteria for a given use.

Effect of Extrusion-Cooking Process Parameters on Selected Characteristics of NSP-Rich Wheat Flour Enriched with Fungal Xylanase Addition

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Abstract:

The technological tests of combined extrusion-cooking and enzymatic treatment were carried out with the use of a single-screw extruder in two versions of the plasticizing system L/D = 16 and L/D = 20. Wheat flour type 750 was fortified with the addition of xylanase in the amount of 50 and 100 ppm, moistened up to 23, 25 and 27% of initial moisture and subjected to extrusion-cooking at the screw speeds of 40, 60 and 80 rpm. The extrudates were dried in a shelf dryer to a final moisture content below 12%, ground and tested. Selected physical and rheological characteristics were tested in extruded flours without and with the addition of an enzyme: water absorption according to ICC standard method 173 on a Mixolab® apparatus and rheological

properties at variable temperature using Mixolab® according to PN-EN ISO 17718-1: 2015-01. The results obtained for the extruded flours showed differences in water absorption as well as in rheological characteristics. The most significant differences were observed if different versions of the plasticizing unit L/D = 16 and L/D = 20 were used. Water absorption increased when longer version of the extruder was applied. Lower initial moisture level of extruded wheat flour caused higher water absorption. Application of xylanase enzyme at the level of 50 and 100 ppm in extruded wheat flour limited retrogradation tendency and could elongate bread shelf life. In next steps the obtained modified flours will be used in bread baking tests.

Spectroscopy Tools in the Authentication of Debittered Tarwi

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Abstract:

Grains from Lupinus mutabilis, sweet (Tarwi) are water-debittered before human consumption, Peruvian regulations required that its quinolizidine alkaloids were below 0.02–0.07%. Processing facilities for tarwi are traditional farms with limited access to quality control laboratories. The accepted method for checking alkaloid levels is titration. Novel analytical methods that allow rapid screening and authentication in foods such as the use of spectroscopy techniques (FT-MIR) using portable devices have not been explored in Tarwi. With the aim to use spectroscopy and chemometric analysis in the discrimination of bitter (toxic grains) from debitterd grains, FT-MIR spectra using portable and bench top devices were determined in 49 genotypes of dried and milled Tarwi (bitter and debittered) whose alkaloid levels were previously characterized by GC-FID. In all cases, Soft Independent Modelling by Class Analogy (SIMCA) analysis of spectra was able to discriminate bitter from debittered class. Main discrimination power was between 700 and 1800 cm-1. Interclass distance ICD were 4.9 and 10.64 for portable and benchtop device respectively. This indicates that a change in chemical composition due to debittering earlier reported allows this discrimination. Thus, the implementation of spectroscopy techniques for monitoring bitter and debittered Tarwi will be possible. Further spectroscopy studies could be done to achieve quantitative alkaloids-based determinations for this food. This will ensure the safety of the product and will allow consumers to make profit of nutritive and bioactive components of those grains.

The Effect of Oven drying, Dehydrator Drying and Freeze-drying Process on Physicochemical Properties and Bioactive Compounds of Beetroot (*Beta vulgaris L.*)

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Abstract:

Beetroot (*Beta vulgaris L.*) is a root vegetable with numerous nutritional and health benefits. However, processing such as drying can induce negative changes in some beneficial properties of beetroot. The aim of this study was to evaluate the effect different drying methods on physicochemical properties and levels of bioactive compounds of beetroot. Fresh Pablo (FP) beetroot was sliced evenly and subjected to oven drying (OV) at 70°C for 6h, dehydrator (DH)

at 70°C for 9h and freeze-drying (FD) at -59°C for 24h. Colour, moisture content, rehydration capacity, texture and water activity of the samples were determined. Total Antioxidant Capacity (TAC), Total Betalains Content (TBC), Total Phenolic Compounds (TPC) were also analysed. Drying methods changed product physiochemical properties and decreased the level of bioactive compounds at different rates. Colour change was calculated as 3.35±1.69 (OV), 5.02±2.02 (DH) and 3.60±1.97 (FD) from 7.66±3.06(FP). Moisture contents (g/100g dry matter) were 8.15±0.61 (OV), 7.50±0.51 (DH) and 14.36±4.77 (FD) from 473.06±208.25 (FP). Water activity were 0.329±0.026 (OV), 0.299±0.065(DH) 0.375±0.004(FD) from 0.983 ± 0.008 (FP). Firmness(g) recorded were 10709±5646 (OV), 5925±3266 (DH) and 6031±1701 (FD) from 10280±5646 (FP). Recorded TAC [g AAE/100g dry matter], TBC [g/100g dry matter] and TPC [g GAE/100g dry matter] levels for OV were 49.45±1.80, 119.48±16.33 and 498.97±57.59 respectively. Recorded TAC, TBC and TPC levels for DH were 45.44±1.87, 218.48±26.70 and 869.75±234.4 respectively. Recorded TAC, TBC and TPC levels for FD were 47.83±1.20, 397.13±45.37 and 1055±27.34 respectively. Further research is needed to optimise drying conditions and investigate the use of different pre-processing technologies and combinations of drying methodologies that will help maintain product quality and minimise deterioration of bioactive components in dried beetroot.

Volatile and Odour-Active Compounds of Air-Classified Faba Bean Fractions

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Abstract:

Faba bean is an interesting alternative to animal proteins due to environmental, food functionality and nutritional benefits. Air-classification is a dry process based on the separation of the coarse fraction (starch fraction) and the fine fraction (protein fraction). Volatile compounds, and especially odour-active ones, contribute to pulse's off-notes that decrease the consumer acceptability. Degradation of amino acids, carotenoid and free fatty acid oxidations are the origins of these molecules and happen during plant growth, storage and transformation stages. Today, a little is known about volatile and mainly odour-active compounds of faba beans. To better understand the volatiles involved in faba bean off-notes, different cultivars and air-classified fractions (flour, starch and protein) were studied. SAFE (Solvent-Assisted Flavour Evaporation) extraction, GC-MS (Gaz Chromatography-Mass Spectrometry) and GC-O (GC-Olfactometry) methods were conducted. A total of 147 volatile compounds were identified by GC-MS whose origin was related to the literature for 67 of them. Free fatty acid oxidation was common to all fractions, and especially in the protein ones, correlated to important LOX (lipoxygenase) activity. However, one cultivar presented greater quantity of volatiles from amino acid breakdown that suggested an intense endogenous secondary metabolism or microorganism contamination. Then, 35 odour-active compounds where identified by GC-O and 10 new attributes were highlighted for the first time in faba bean. Protein fractions with greater quantity of volatiles were also characterized by important detection frequency. This approach could be extended to identify cultivars and processes that limit the presence of off-notes in faba bean and pulses.

Phenolic Compounds Profile of *Aronia melanocarpa* L. Extract Identified by UPLC-PDA-ESI-TQD-MS/MS and Their *in vitro* Antioxidant, Potentially Anti-Diabetic, Anti-Obesity Potencies

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Abstract:

The objective of this study was in-depth identification of polyphenolic compounds of *Aronia melanocarpa* L by UPLC-PDA-ESI-TQD-MS/MS. An additional aim was to assay their antioxidant (ABTS-online, ABTS, and FRAP) and *in vitro* biological activities (the ability to inhibit pancreatic lipase, α-amylase, and α-glucosidase activity) of five new and old cultivars (Hugin, Galicjanka, Nero, Viking, Aron). Most of the chokeberry cultivars analyzed in this study have not been examined in this respect until now. Study results noted of 32 bioactive compounds, including 9 phenolic acids, 11 flavonols, 8 anthocyanins, 4 flavan-3-ols and 1 flavonon. Fruit contained of polyphenolic compounds 12 to 21 g/kg fresh weight. In the polyphenols, anthocyanins predominated (52%) with cyanidin-3-*O*-galactoside the most abundant. The antioxidant activity tested by ABTS and FRAP assays was mainly formed by polymeric procyanidins and phenolic acids, which was confirmed by ABTS on-line profiling. In addition, strong correlation between antioxidant activity and phenols can be effective in removing reactive oxygen species. *Aronia amelancher* L. fruit showed high potential for inhibition of α-amylase and α-glucosidase especially Hugin cultivar. The data present that the fruits can be important for health promotion. This research was funded in whole by National Science Centre, Poland [grant no. 2020/39/D/NZ9/01810].

Nutraceuticals from Agro-Waste: Green Extraction and Innovative Formulation

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Abstract:

Agro-waste represents universally available source of biologically active compounds so strategies for its reduction should focus on development of innovative utilization approaches that would result in both, reduced ecological footprint, and development of value-added products. Our research is focused on the development of sustainable processes for extraction of functional components from olive pomace (OP) and tomato pomace (TP) and formulation of OP- and TPbased nutraceuticals with satisfactory technological and functional characteristics. Ultrasound-assisted extraction processes were developed requiring only food grade solvents, relatively short extraction times and reduced energy consumption. Formulation of dry extracts was focused on two innovative approaches: formation of inclusion complexes with cyclodextrins (CDCs) and adsorption on the surface of selenium nanoparticles using novel green synthesis protocol (forming functionalized selenium nanoparticles (fSeNPs)). CDCs and fSeNPs showed improved organoleptic/technological characteristics(particle size, bulk density, tap density, color, smell) and stability in comparison to native compounds (pure polyphenolic extracts, selenite or non-functionalized SeNPs). Innovative formulation approaches significantly improved in vitro bioavailability of Se and polyphenols in both, plants, and human models (Caco-2 cell model). CDCs and fSeNPs were shown effective as antimicrobials (antifungal activity) and antioxidants in different food-model systems (β-carotene emulsion model, meat model, oil model) indicating the possibility of application as natural antioxidants for food. Different in vitro biological models (plasimde DNA and cell models) confirmed significant antioxidant activity and cytoprotective effects of novel formulations. Obtained results shed a new light on usage of simple, efficient, and green formulation and utilization of highly potent agro-waste derived nutraceuticals.

Bio-Purification of Plant Proteins: Elimination of Off-Flavours

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Abstract:

To meet the food demand of an increasing world population in a sustainable and healthy manner, the transition from consuming mainly animal-derived proteins towards incorporation of more plant-derived proteins is inevitable. Currently, one of the main challenges within the protein transition is the presence of undesired molecules in plant-protein products, including off-odours, off-tastes and anti-nutritional factors. Off-odour in plant proteins is caused by the presence of volatile compounds, such as certain aldehydes (e.g. hexanal) that have a characteristic grassy or beany smell. Off-tastes, such as bitter, astringent and metallic, are mainly linked to non-volatiles such as saponins, tannins and simple phenolics. Additionally, non-volatiles, such as polyunsaturated fatty acid containing lipids, may also act as precursors for formation of volatile off-odours. The concept of using microbes, such as lactic acid bacteria and yeast, in the removal of undesired compounds from food and feed has shown promising results. The aims of our research project are (i) identification of undesired non-volatiles that negatively affect the flavour profile of plant protein isolates, and (ii) quantification of the effect of fermentation on the non-volatile profile of the samples. To this end, commercial plant proteins were subjected to fermentation with different lactic acid bacteria and yeast strains. Our compositional analysis of non-volatiles in the plant proteins indicated that saponins, lyso-phospholipids and oxylipins are the main targets for bio-purification. Based on our results, we conclude that fermentation can reduce the content of undesired saponins, oxylipins, and lyso-phospholipids in plant proteins.

Strategies Facilitating Edible Foods Acceptance

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Abstract:

Edible insects, rich in proteins and minerals, are a valuable component of the diet in many world countries. It is estimated that more than 2000 edible insect species are consumed worldwide. Interest in entomophagy is growing in the West society. The United Nations Food and Agriculture Organization (FAO) and the European Food Safety Authority (EFSA) are largely responsible for popularizing edible insects' into the human diet. Their widespread use in the human diet may help solve the problem of global malnutrition. Openness to new, valuable products allows to enrich a diet, which protects against nutrient deficiencies. Despite the actions of FAO and EFSA, the concept of consuming edible insects in Western countries causes reluctance, fear and disgust. Therefore, the study aimed to define actions to change attitudes towards edible insects. Students of the University of Economics in Wroclaw, Poland, participated in the study. The essential activities of the study participants indicated the education of preschool children, encouraging the consumption of edible insects by famous people, and organizing meetings during which participants can prepare and try products based on edible insects on their own. The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

Microbiological, Physicochemical and Phytochemistry Compounds of Three Ecotypes of Andean Lupin (*Lupinus mutabilis*) Flours Evaluated in Two Altitudes

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Abstract:

Andean Lupin (*Lupinus Mutabilis*) is a legume with a high protein content comparable to that of soybeans and for safe consumption requires the removal of alkaloids through a multi-step deburring process. The aim of this research was to calculate: the physicochemical composition, the phytochemistry compounds (alkaloids, fatty acids, phytosterols), the antioxidant activity and the microbiological quality of flours from three ecotypes of Lupin: *Altagracia*, *Cholo Fuerte* and *Comun* harvested at two different harvesting heights (2,700 and 3,300 m.a.s.l.) analyzed by a full factorial design, obtaining six (6) treatments. Lupin flours showed a high protein content ranged from 48.8 to 52.2 g/100 g dry matter (dm) while the fat content oscillated between 23.5 and 25.9 g/100g dm. All flours were rich in phytosterol content (318-453 mg/100 g dm), antioxidant activity (9.45-60.6 μmol TE/100g dm DPPH; and 408 - 669 μmol TE/100g dm ABTS) and total phenolic compounds (21.7- 31.4 mg GAE/100g dm). The most predominant fatty acids in raw lupin flours were: oleic (n-9 18:1, 42.40%) and linoleic (n-6 18:2, 35.32%). Microbiological analyses showed the absence of Salmonella spp. and low mold counts (10 to 30 CFU/g). Statistical differences (p value<0.05) were detected in the physicochemical composition and bioactive compounds for the flours, highlighting the lupin *Comun* ecotype harvested at 2700 m.a.s.l. for its high protein value (52.2 g/100g dm). In conclusion, Andean lupin flours present a potential for use in the food industry due to their phytochemistry composition rich in protein and bioactive compounds.

Keywords: alkaloids, fatty acid, phytosterol, antioxidant activity.

Development and Characterisation of a Hybrid Beef/Plant-Based Burger Patty

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Abstract:

Due to climate issues policymakers in many parts of the western world are pushing for a reduction in consumption of animal derived foods, and beef in particular. The goal is to replace as much of the animal derived foods with plant-based, in order to reduce the carbon footprint of the diet. Protein derived from legumes, such as soy, pea and faba bean, has been successfully processed by extrusion cooking into plant-based meat alternatives, which are then used to make plant-based burger patties. However, surveys indicate that consumers are still not satisfied with the sensory quality of these products. Therefore, to reduce the climate impact, but also retain as much of the sensory characteristics of a traditional beef patty as possible, we developed a 50%/50% hybrid beef/plant-based burger patty. The hybrid burger patty was evaluated in a consumer survey as well as analysed for sensory and nutritional quality using texture analysis and biochemical assays, respectively. There was no statistically significant difference in the liking of the hybrid burger patty compared to a beef patty in the survey. The hybrid burger patty had a slightly poorer amino acid score than the beef patty, but conversely had an approx. 50% lower carbon footprint than the beef patty and tended to retain more moisture during cooking as well as being more tender.

Biomimetic Oxidative Coupling of Phenol-Agmatine Amides with Horseradish Peroxidase

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Abstract:

Oxidative coupling of phenol-agmatine amides in barley (*Hordeum vulgare*) and related Hordeum species is part of the plant defence mechanism. Three linkage types have been reported for dimers of phenol-agmatine amides, but knowledge on oxidative coupling reactions underlying their formation is limited. In this study, the monomers coumaroylagmatine, feruloylagmatine and sinapoylagmatine were each incubated with horseradish peroxidase. The coupling reactivity was in line with the order of peak potentials measured: sinapoylagmatine (248 mV) > feruloylagmatine (338 mV) > coumaroylagmatine (501 mV). Purification and structure elucidation of fourteen coupling products revealed linkage types that are also naturally present in Hordeum species, namely the 4-*O*-7′/5-8′-linkage, 2-7′/8-8′-linkage, and 8-8′/9-*N*-7′-linkage. Furthermore, two novel linkage types that were not previously reported for phenol-agmatine amide dimers were identified, namely the 8-8′-linkage and 4-*O*-8′-linkage. Our results show that oxidative coupling by horseradish peroxidase can be used for biomimetic formation of natural antifungal phenol-agmatine amide dimers from barley.

The True Behind the Myth of Pomegranate Bark: Proofs on Nutraceutical Properties of Pelletierine

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Abstract:

Pelletierine is an alkaloid extracted by bark of pomegranate tree. Many authors affirm its anticancer and anthelmintic activities in mammals, without any supporting evidence, not even reporting its mechanism of action or its metabolism. In this work, the anticancer activity, in colon cancer, was tested by permeability studies using Caco2 cell line and transwell plates equipped with micropore filters that allow the passage of metabolites. Three different concentrations (100uM, 200uM,1000uM) and five times (15, 30, 45, 60 and 90 minutes) were tested. After each treatment, supernatant, cell lysate and filtrate were collected and analyzed. A new LC-MS method was optimized in order to identify different metabolites involved in biological activity. In addition, the anthelmintic and insecticidal activity assay were performed on helminthic and insect-parasites such as *Meloidogyne javanica, Spodoptera littoralis, Myzus persicae, Rhopalosiphum padi*. Therefore, we explored the biological activity of pelletierine to provide a set scientific data to support the evidence observed in many works and attributed to this compound.

Assessment of Microbiome and Mycotoxins Contamination in Different Processing Fractions of Brazil Nuts (*Bertholletia excelsa*)

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Abstract:

Brazil nut is an extractive forest product from the Amazonia region susceptible to aflatoxins (AF) contamination. The present work sought, through omics and biomolecular tools, to microbiologically characterize fungi, bacteria, and mycotoxins from the fractions of nuts during their processing. Sequential analyses of conserved DNA regions of fungi and bacteria (16S and ITS) and the determination of AF by HPLC-FD / KobraCell®. The shell sample presented the most abundant bacteria Streptomycetaceae/ *Streptomyces* (26%), *Cellulomonas* (8%), and Bradyrhizobiaceae (6%). The kernel and cake showed a low bacterial presence. The oil presented *Rothia* (24%), *Sphingomonas* (12%), and Micronosporaceae (4%). The shell and kernel fractions showed an unidentified fungus as the most abundant. The kernel presented *Alternaria* (26%), *Cladosporium* (11%), and Nectriaceae (10%). The cake presented mainly *Aspergillus* (60%) and *Trichoderma* (10%), while in the oil it was observed *Penicillium* (24%), Lodderomycetes (21%), and Eurotiomycetes (11%). AF were detected in the shell 0.615 and 1.48 µg/kg for AFB_1 and AFG_1, respectively; in the kernel 0.655 and 0.255 µg/kg for AFB_1 and AFG_1, respectively; and in the cake 11.57, 0.365, 33.55, and 0.425 µg/kg for AFB_1, AFB_2, AFG_1, and AFG_2 respectively; and in the oil 3.66, 0.105, 5.345 and 0.11 µg/kg for AFB_1, AFB_2, AFG_1 and AFG_2, respectively. The oil and cake presented more diversity of fungi and mycotoxins. These results show the need to implement good hygiene practices and microbiological-sanitary control during the steps of selection of raw material for further Brazil nuts processing to obtain products with good quality, safety, and more sustainable.

The Use of Yellow Mealworm *(Tenebrio molitor)* Powder in the Functional Biscuits Production

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Abstract:

The use of yellow mealworm powder to improve nutritional value of biscuits made of wheat white flour was investigated. Among of biscuits enriched with 2%, 3.5% and 5% yellow mealworm powder subjected to sensorial analysis, those containing 3.5% yellow mealworm powder (BYMP-3.5%) were selected for further investigations, due to their high overall acceptability from the consumers. Essential amino acids leucine, isoleucine, phenylalanine, histidine, and lysine were founded 3-, 1.9-, 3.13-, 2.92- and 6.35-fold higher in BYMP-3.5%, as compared with biscuits made of 100% wheat white flour (BWWF-100%) considered as reference. As expected, linoleic acid C18:2, *n*-6 (25.34%) was the most abundant fatty acid in the BYMP-3.5%. Polyunsaturated (PUFAs) and monounsaturated fatty acids (MUFAs) account for 65.12% and 25.57% in BWWF-100%, while in BYMP-3.5% they represent 32.53% and 12.38%, respectively. Despite the discrepancy, lower values for the atherogenic and thrombogenic indices were noticed in BYMP-3.5% than in BWWF-100%. Considering the mineral element concentrations, one can assume that BYPM-3.5% are richer source of K (4.10 mg/g), Zn (0.32 mg/g) and Fe (0.11 mg/g), compared

to BWWF-100% (2.11 mg/g, 0.23 mg/g, 0.09 mg/g). Higher 3-fold amount of polyphenols was also measured in the BYMP-3.5% (521.23 mEq gallic acid) as compared to BWWF-100% (173.74 mEq gallic acid/g). The experimental results shed light on the possible contribution of yellow mealworm powder to mitigate some nutritional deficiencies in terms of amino acids, mineral elements and polyphenols without affecting the dietary scores.

The Consistency Factor and the Viscosity Exponent of Soybean-Protein-Isolate/Wheat-Gluten/Corn-Starch Blends Using a Capillary Rheometry

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Abstract:

Blends with different proportion of protein or starch show different rheological behavior, which may be related to the fibrous structure formation of extruded textured plant proteins. The consistency factor *K* and the viscosity exponent *n* of soybean-protein-isolate (SPI)/wheat-gluten (WG)/ corn-starch (CS) blends were investigated through a capillary rheometry. All blends exhibited shear-thinning behavior at 80℃ and 50% moisture. CS content in SPI/CS blends or WG content in SPI/WG blends showed positive relation with the viscosity exponent *n*, and negative relation with the consistency factor *K*. However, there was no correlation between CS content in WG/CS blends and *n* or *K*. R^2 of the linear relationship between K and mass fraction in SPI/CS, SPI/WG/CS, SPI/WG and WG/CS decreased from 0.872 to 0.073. SPI was more likely to form a non-interactive structure, while wheat gluten was more likely to form a highly interactive structure. It turned out that the materials with globular morphology, like soybean protein isolate and corn starch, are likely to form a non-interactive structure.

Regression Analysis of Dough Stability Time and Extensibility Based on Physicochemical Characteristics of Wheat Milling Streams Flour Protein

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Abstract:

In order to verify the influence of protein quantity and stretching degree on the rheological properties of dough, 28 different milling streams flour from one wheat variety Shiluan 02-1 were selected as experimental materials. Protein content, dry gluten content and glutenin macropolymer (GMP) content were considered as protein quantitative indexes. Gluten water-holding capacity and GMP storage modulus per unit concentration were regarded as aggregate stretching degree indexes. Three models, quantity-based model, stretching-degree model, (quantity × stretching-degree)-based model were evaluated by regression analysis. The results showed that the (quantity × stretching-degree)-based model of dough stability time is more significant (P=0.004) than that of quantity-based model (P=0.177) and stretching-degree model (P=0.468). However, the (quantity × stretching-degree)-based model of dough extensibility is similar significant (P=0.000) as that of quantity-based model (P=0.00) and stretching-degree model (P=0.003). It is approved that both dough stability time and extensibility could be relatively well predicted by the (quantity × stretching-degree)-based model, compared with by only quantity-based model or only stretching-degree model.

Relationship Between Structure and Function of Soybean Protein Components Based on Literature Review

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Abstract:

Glycinin and β-conglycinin are two major types of proteins in soybean. Their different structure results in different functionality. High-mannose glycans, at the N-terminal of β-conglycinin subunit, make it more solubilized than glycinin under neutral conditions. Hydrophobic amino acids are active sites for protein thermal aggregation. There are more Val, Leu, Ala in the basic peptides of glycinin, which makes it easier for them to aggregate continuously during heat treatment, and finally produce insoluble aggregates with compact interior and loose surface. The hydrophilic polysaccharides on the surface of β-conglycinin not only hindered the aggregation, but also ensured the stability of aggregate solubility. Under the same treatment conditions, the G' and fracture stress of glycinin thermal gel are usually greater than β-conglycinin, which may be due to the different types of interaction for each protein. Glycinin contains more sulfur amino acids, so its thermal gel is mainly formed through disulfide bonds and electrostatic interactions, while the thermal gel of β-conglycinin was formed by hydrogen bonds. At low protein concentration (6%), the intrinsic viscosity of rich glycinin was stronger. However, with the increase of concentration, G' of the β-conglycinin increasesed faster. Thus, the intermolecular interaction of β-conglycinin is stronger.

Development of An Isoallergene-Specific Quantification Method for the Apple Allergen Mal D 1

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Abstract:

Clinical studies and consumer survey demonstrated that various apple varieties exhibit different allergenic potentials in regards to Mal d 1, one of the four major allergens in apple and a structural homologue to the birch pollen allergen Bet v 1. So far this effect could not be solely explained by the total Mal d 1 content present. Therefore, an effect of the isoallergen-profile on the allergenicity of an apple is postulated. To further elucidate this question an isoallergen-specific quantification method is required, but the immunochemically methods and gene expression studies used so far for the quantification of the Mal d 1 are insufficent to distinguish between isoallergens. Hence, an isoallergen-specific quantification method using a bottom-up proteomics approach and isotope dilution analyses was developed. Markers peptides for the isoallergens 1.01-1.03 and 1.06 were found as well as two global markers, which allows determination of total Mal d 1 (Mal d 1.01-1.09). The identification of combination markers, representing several isoallergens, enabled the verification of the specific isoallergen contents and highlighted missed cleavage sites in two of the individual marker peptides. To optimize the protein extraction and correct possible variances in extraction efficiencies among the apple varieties a r-Mal d 1.01 was added as an extraction standard. Significant differences in extraction efficiencies between the varieties were observed, underlining the importance of an internal standard.

Antibacterial Activity of a Commercial Propolis Ethanolic Extract against *Staphylococci* Isolated from Skin

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Abstract:

Due to the rising concern of antibiotic resistant bacteria, researchers are exploring new approaches for treating bacterial infections. Propolis is natural product derived from honeybees that has been known for its antimicrobial, antioxidant, and anti-inflammatory properties. The chemical nature and antibacterial effects of different propolis extracts have been researched, specifically with respect to Gram-positive pathogens, including *Staphylococcus aureus* and methicillin-resistant *S. aureus*. However, the effects of commercial grade propolis on the staphylococcal flora of the skin has not been thoroughly examined. In this study, the *in-vitro* antimicrobial properties of a commercial ethanolic extract of propolis (EEP) against staphylococci isolated from human skin was investigated. The presence, in the isolated strains, of genes involved in biofilm formation was also investigated. Strains of *Staphylococcus* spp. were isolated from the skin of seven healthy individuals, and identified to the species level using a commercial biochemical identification test. A suspension of approx. 1.0×10^7 CFU/mL of each isolate was prepared in TSB broth supplemented with EEPs of different final concentrations (0.5 mg/mL, 1.0 mg/mL and 1.5 mg/mL) and incubated at 37 °C without shaking. Growth was monitored by optical density readings at 600 nm. Depending on concentration and strain, EEP exerted different degrees of antibacterial activity against skin staphylococci. The presence of the *icaADBC* operon genes, involved in biofilm formation, was confirmed in three out of the seven strains. Additional research is underway to determine the effect of propolis on biofilm formation and virulence gene expression of skin staphylococci.

Palmaria Palmata- Extraction of Polyphenols and Determination of Antioxidant Activity

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Abstract:

Seaweeds are one of the most captivating subjects concerning biomass value and have gained interest over the past decade in the Western world, with their valuable compounds and properties. Seaweeds are accessible, easy to process and a rapid source of energy for animals and humans. We have determined and analyzed the total phenolic content (TPC) and the antioxidant activity of *Palmaria Palmata*, red alga. The alga was extracted in water then filtrated and diluted. The results for TPC varies between 2.64 and 2.66 mg equivalent propyl gallate /g freeze dried algae, for radical scavenging activity using DPPH (2,2-Diphenyl-1-picrylhydrazyl**)** assay the values are between 25.88% in the extract and as it's diluted goes from 47.08%(dilution 1:10), 59.96%(dilution 1:25) to 66.70% (dilution 1:50. Ferrous ion chelating ability was also determined and the average value was measured at 96.03%. The Folin-Ciocalteu (FC) assay was used to determine TPC, and three methods DPPH for radical scavenging activity assay, ABTS

(2,20 -azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) assay and ferrous ion-chelating ability assay were used to evaluate the antioxidant activity of the red algae. Correlations were found between the total polyphenol content (CPT) and the neutralizing capacity of DPPH rapids, between the total phenolic content (CPT) and the reduction capacity and chelating ability of metal ions. In addition to test correlations, there may be other compounds, such as fucoxanthin, polysaccharides, proteins, and peptides, that may contribute to the antioxidant activity of algae extracts.

Technology of the Hopping Process and the Quality of Non-Alcoholic Beer

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Abstract:

In recent times a significant increase in the production and sale of low- and non-alcoholic beer is observed all over the world. Lower production costs and lower tax burdens bring significant economic benefits to breweries, but the consumption of this type of beer also brings some benefits for consumers: no negative effects of alcohol consumption, lower caloric and supply of vitamins, polyphenols and minerals. Therefore, the interest of this products is constantly growing as they can be a good alternative to sweetened soft drinks. Improving the production processes of non-alcoholic beer seems to be an important and justified research area for scientists. The aim of the research was to determine the impact of the hopping technology on the quality of non-alcoholic beer. 13 different beer were produced in the experiment (including the control sample), differing in the degree of bitterness at the level: 40 and 60 IBU. Two varieties of hops 'Marynka' and 'Magnum' were used in 3 forms: extract, granules and cones. The non-alcoholic beer were obtained by a biological method using special yeast *Saccharomycodes ludwigii* WSL17. The alcohol content in the beer was at the level <0.5%v/v. All beer were tested for basic physicochemical parameters (NIR), carbohydrate profiles, by-products of the fermentation process (HPLC) and volatile compounds profiles (GC/MS). The final beer were also tested for their microbiological purity, as well as their sensory properties. This work was supported by the Wrocław University of Environmental and Life Sciences (Poland) as the Ph.D. research program "Innowacyjny naukowiec, no. N060/0010/21"

Effect of Different Processing Technologies on Chemical and Sensory Properties of Dried Caper (*Capparis spinosa* L.) Powder

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Abstract:

The market of dried food products has shown considerable increasing interest in the last years mainly for fruits and vegetables which are recognized as healthy for human consumption. Recently, an increasing interest in using dried caper (*Capparis spinosa* L.) powder is demonstrated by gastronomes and professional chefs who prepare it by themselves starting from the dry-salted fermented product. This process, taking more than 40 days, does not seem to be adapted to an industrial scale. So, this research aims to develop a time- and energy-saving process that, starting from the fresh caper buds, allows producing a dried powder with good sensory features and well-accepted by the consumers. Several processes, differing in salting method and/or drying

conditions, were applied and their effects on chemical composition, sensory characteristics, and consumer's acceptability of the obtained dried caper powders were investigated. Statistically significant differences were observed for most of the analyzed parameters depending on the production processes. Caper buds salting in brine at 60°C for 3 hours and then dried at 50°C for 24 hours gave a caper powder with a high amount of antioxidant compounds and lacking in compounds interfering with the typical caper aroma. This caper powder was very appreciated by the consumers for its sensory features suggesting that its production process could be of great interest to move on to industrial dimensions with an important impact on the economy of the caper production area.

Hemp Seed Flour Enriched Fresh Pasta: Nutritional, Technological, and Sensory Properties

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Abstract:

Hemp (*Cannabis sativa* L.) seed flour is a by-product of hemp oil production and is a rich source of nutrients, such as protein, dietary fiber, minerals, and unsaturated fatty acids, that make it an interesting product to be reused for improving the nutritional value of other foods. In line with the objectives of food sustainability aiming, among others, to boost the readmission of by-products and food waste into the productive food chain, in the present research hemp seed flour enriched fresh pasta, namely potato dumplings, has been developed. Among fresh pasta products, potato dumplings, called "gnocchi", are a very popular typical recipe in Italian cuisine. Since Gnocchi is mainly a starchy food the aim of the present research was the enhancement of their nutritional value via hemp seed flour addition to gnocchi dough. Different percentages of hemp seed flour (5%, 10% e 20%) have been used and the impact of gnocchi enrichment on their nutritional, technological and sensory quality, and on consumers' acceptability has been assessed on raw and cooked samples. The substitution of wheat flour with hemp seed flour allowed to enhance the nutritional value of gnocchi, and gnocchi samples enriched with 10%, or more, of hemp seed flour gained the nutritional claim of "source of fiber". In addition, the fortified gnocchi had a high technological quality in terms of cooking loss, cooking resistance and textural properties, and average sensory quality. However, the bitter taste and the vegetable and hemp odor make them not well appreciated by consumers. Further studies are necessary to improve the hemp seed flour's taste and odor in order to meet consumers' satisfaction.

Influence of Gellan Gum on the Rheological Properties of New Enteral Food Formulations

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Abstract:

One of the most significant social problems is a health problem related to inadequate nutrition. Statistics indicate that malnutrition caused by untimely and inadequate nutritional therapy affects 20-60% of hospital patients. Malnutrition is associated with many adverse outcomes including depression of the immune system, impaired wound healing, longer lengths of hospital stay, higher treatment costs, and increased mortality. Food for special medical purposes - enteral food - plays a key role in the diet of malnourished patients and patients at risk of

malnutrition. The proposed investigation aims to develop new clinical nutrition formulations. The study investigated the preparation of new formulations by adding different concentrations of a polysaccharide stabilizer, to evaluate an effect on the rheology and microstructure of the formulations. The viscosity of the formulations increased with an increase of a concentration of a gellan gum. The viscosity values determined at a shear rate of 1 s^{-1} were from 45 mPas to 300 mPas. The sample with the highest amount of a gellan gum after UHT treatment showed viscosity of 903 mPas. The shear-thinning behaviour of the new formulations was generally noticed within a shear rate range between 0.1 and 1000 s^{-1}. The oscillatory measurements confirmed liquid like shear-thinning properties of all examined samples with loss modulus (G'') values higher than storage modulus (G') values. In the case of an addition of 50% and 100% of overall concentration of a gellan gum we have noticed a structural organization in an amplitude sweep, frequency sweep and 3ITT thixotropy test.

Rheological Investigation of the Effect of Low-Fat Cocoa Powder on Different Composition of Enteral Food Formulations

Nataša Šijaković Vujičić[1]*, Ivona Kurečić[1], Jelena Miličević[2], Marijana Ceilinger[2], Danijela Čukelj[2], Ivanka Jerić[1], Lenkica Penava[2] and Marijeta Kralj[1]

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Abstract:

Malnutrition is prevalent around the world and is a burden on patients and especially on health care facilities. That is the condition that develops when the body is deprived of vitamins, minerals, and other nutrients it needs to maintain healthy tissues and organ function. Enteral nutrition can provide complete nutrition to patients with a variety of illnesses. The proposed investigation aims to develop new clinical nutrition formulations for patients which need nutritional support. In the development of cocoa drinks, cocoa particle sedimentation represents a technological challenge to be resolved by the food industry. The study investigated the preparation of new formulations by adding law fat cocoa powder to formulations of different composition, to evaluate an effect on the rheology and microstructure of the formulations. Three types of formulations differing in composition of added sugar and/or fibers were prepared. The identical composition of before mentioned ingredients with addition of a low-fat cocoa powder followed preparation of new cocoa formulations. The shear-thinning behaviour was noticed for all prepared formulations. The oscillatory measurements confirmed liquid like shear-thinning properties of all examined samples with loss modulus (G'') values higher than storage modulus (G') values. The cocoa powder influenced a viscosity profile through wide shear rate range, microstructural ordering, and thixotropic behaviour. In all examined formulations the samples containing a low-fat cocoa powder showed higher viscosities, and for specific formulations structural ordering was confirmed through dynamic rheological parameters.

Continuous Enzymatic Treatment for the Chill Haze Prevention in Beer

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Abstract:

The development of green and sustainable approaches for preventing chill haze formation is currently a hot topic in brewing research. The conventional approach for the removal of haze active (HA) phenols, involved in haze phenomena, is usually based on the the static

separation of colloidal particles after the adjuvant addition (e.g. polyvinylpolypyrrolidine, gelatin, nylon and lucilite TR). The current work focuses on the development of an innovative and sustainable biocatalytic approach for the continuous treatment of beer, based on the application of a phenolic-degrading enzyme immobilized on *Aspergillus niger* chitosan beads. The immobilization procedure has been optimized for maximizing the specific activity of the biocatalyst and the best performance have been reached using an immobilization solution at a suitable initial protein concentration. The immobilized biocatalyst has been characterized in model beer in terms of optimum pH and temperature and kinetic parameters. Afterwards, the continuous treatment of beer in fluidized bed reactor has been optimized varying the flow rate and the amount of biocatalyst, in order to achieve the selective hydrolysis of HA phenols and the full prevention of chill haze.

Acknowledgements: The research project was funded by LazioInnova Spa, Lazio Region (Italy) - StaBirVino project "Enzimi immobilizzati per la stabilizzazione sostenibile di birra e vino" (Grant A0375-2020-36649, Progetti Gruppi di Ricerca 2020).

Antioxidant Activity of Digestion-Resistant Whey Peptides in Glial Cells

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Abstract:

Oxidative stress is considered part of the pathogenesis of several neurodegenerative diseases. Much research has been dedicated to searching natural agents capable of protecting brain cells against oxidative damage. Whey protein hydrolysate (WPH) have been shown to exert oxidative protection on neuronal cells; however, less attention has been paid to the potential effects on glial cells, the main cells of the brain's immune system. In this work we evaluate the antioxidant potential of whey protein digests on glial cells. Whey protein isolates were hydrolyzed by simulated gastric digestion, following the international recognized Infogest protocol. WPH showed high protein concentration (64,6 ± 0,1%) and degree of hydrolysis (35.2 ± 2,4 %). The WPH ultrafiltrate (5kDa) showed most of the peptides in the molecular range of 200 to 400 Da (40,7 %) evaluated by molecular exclusion in FPLC system. Peptides showed intermediate hydrophobicity analyzed by reversed-phase liquid chromatography. Low fraction of WPH did not compromise cell viability, by MTT assay, and were able to attenuate ROS elevation in microglial and astrocyte cell lineage. On astrocytes C6 lineage, WPH at 2 mg/ml reversed glutathione content reduction induced by LPS. WPH at all concentration (0.5 -2 mg/mL) was able to reduce NO secretion induced by LPS on stimulated microglial BV-2 cells. Our results show that food peptides, resistant to the digestion process may be more likely to have functional effects on cells. The antioxidant capacity of WPH on glial cells revealed more physiological response and big potential for the production of new supplements.

Bioaccessibility of Sunflower Flour Compounds Released after Simulated *in vitro* Digestion

Maria Teresa Bertoldo Pacheco[1*], Mariana Bisinotto[1], Daniele C. da Silva Napoli[1], Fabiana Galland[1], Fernando Simabuco[2], Rosângela Bezerra[2] and Adriane E. C. Antunes[2]

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[2]*Faculdade de Ciências Aplicadas/Universidade Estadual de Campinas, Brazil.*

Abstract:

This study aimed to evaluate potential antioxidant and prebiotic compounds released after *in*

vitro gastrointestinal digestion from sunflower meal. After chemical characterization defatted meal was submitted to *in vitro* digestion and soluble (SSF) and insoluble (ISF) sunflower fractions were obtained. The phenolic compounds, molecular weight (MW) distribution profile of peptides and antioxidant capacity by several methods, such as DPPH, ABTS, ORAC and DNA protection were determined in soluble sunflower fractions. The probiotic bacteria growth capacity regarding the insoluble sunflower fraction (ISF) was evaluated in MRS medium. The SSF protein and total phenolic content were 52.41 % and 20.10 mg GAE / g, respectively. The MW distribution showed 73.47 % of compounds with MW< 3 kDa in SSF. The antioxidant capacity was higher in SSF than in the original meal, showing 264.28 by DPPH and 187.37 by ABTS and 923.3 by μmol Trolox eq/g sample in ORAC method. Regarding the DNA supercoil protection a similar response was observed when comparing SSF to the original meal. The ISF (32.63 g/100 g of dietary fiber) was not able to stimulate the proliferation of any probiotic bacteria tested. Moreover, new approaches to developing prebiotics from sunflower bran must be applied and thus, human food security can be sustained through the incorporation of by-products from the sunflower industry.

Green Emerging Technologies Adding Value to Sunflower Oil Manufacturing Byproduct

Maria Teresa Bertoldo Pacheco[1*], Mariana Pacífico dos Santos[2], Eric Keven Silva[2], Daniele Cristina da Silva Napoli[1], Fabiana Galland[1], Vìtor Lacerda Sanches[3] and Maurício Ariel Rostagno[3]

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Abstract:

Sunflower (*Helianthus annuus L*) occupies the fourth worldwide position of cultivated oilseeds. Its oil production by-product has a promising protein of good nutritional value due to an appropriate amino acid balance and the absence of anti-nutritional factors. However, it has been little explored regarding its use in human feeding. In this context, this study aimed to obtain a novel flour from sunflower by-product with high protein and low phenolic and fat content, employing green emerging technologies. The sunflower flour was defatted with supercritical CO2 (ScCO2), and phenolic compounds were extracted with ethanol assisted by high-intensity ultrasound (HIUS). Moreover, phenolic compounds were identified and quantified. HIUS nominal power of 400 W during 3 min in continuous mode and a 50% ethanolic solution were used. Under the selected conditions, a yield of 90% in oil extraction and removal of 83% of the phenolic compounds were achieved. Scanning electronic microscopy and FTIR analysis evidenced that the HIUS disrupted the plant cell structure without changing its functional groups. The chlorogenic acid was the major phenolic compound. Electrophoresis and DSC results showed that the protein was not broken or denatured after all treatments. Thus, combined eco-friendly technologies obtained a novel high protein product with interesting potential applications in foods and beverages.

Food for 9 Billion People: Meat Vs. Edible Insects

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Abstract:

Climate changes entail changing energy conversion from coal to solar and wind and shifting from combustion-powered vehicles to electric, hydrogen or biofuels. For the sake of the Planet

and future generations, a remodeling of lifestyles is needed, the pillar of which will be food produced based on organic production systems with consideration for animal welfare. Livestock production entails much higher consumption of water, space, and electricity and higher greenhouse gas emissions compared to the production of insects. Therefore, can edible insects become an alternative to meat, an important source of energy and nutrients, providing high levels of protein, vitamins and minerals? This study aimed to compare the composition of edible insects and meat in terms of energy value, protein, fat, fatty acids (saturated, monounsaturated and polyunsaturated), minerals (Na, K, Ca, P, Mg, Fe, Zn, Cu, Mn, I) and vitamins (A, E, B1, B2, B3, B6, B12, C). The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

Impact of Drying Methods on the Yield and Chemistry of *Origanum vulgare* L. Essential Oil

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[2] *Institute of Food Science, CNR Italy.*

Abstract:

Oregano (*Origanum vulgare* L.) is mainly cultivated, both as fresh and dried herb, for several purposes, such as aliments, drugs, and spices. However, fresh plants have limited use; in contrast, the dry form of the spice is frequently used in the food industry [1]. To evaluate the influence of some drying methods on the chemical composition of the essential oil of oregano, its aerial parts were dehydrated by convective drying techniques (shade, static oven), microwave-assisted heating (three different treatments) and osmotic treatment. The oils were analyzed by GC-FID and GC–MS. The highest essential oil yield was achieved from microwave and shade drying methods. In total, 39 components were found, with carvacrol (ranging from 56.2 to 81.4%) being the main constituent; other compounds present in lower amounts were *p*-cymene (1.6–17.7%), γ-terpinene (0.8–14.2%), α-pinene (0.1–2.1%), thymol methyl ether (0.4– 1.8%) and thimoquinone (0.5–3.5%). The essential oil yields varied among the different treatments as well as the relative compositions. The percentages of *p*-cymene, γ-terpinene and α-pinene decreased significantly in the dried sample compared with the fresh sample; on the other hand, carvacrol, isoborneol and linalool increased significantly in the dried materials. The obtained data revealed that the applied drying method performed as dehydration pretreatment of aerial parts has an impact on quantitative and qualitative oil features and appears crucial in reference to the percentage presence of components that can direct the essential oil toward an appropriate use.

The Content of Antioxidants and Polyphenols in the Fruit of Selected Hybrid Grape Varieties from Poland

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Abstract:

The growing popularity of health-promoting nutritional trends among consumers contributes

to the search for raw materials and products with high antioxidant and bioactive values. The antioxidant properties and the content of selected polyphenolic components in the fruits of five hybrid vines grown in Poland were characterized. The highest mean antioxidant activity, measured by DPPH method, was observed in grape skin, which ranged from 3.31 mg to 4.34 mg of Trolox equivalent, for Alwood and Beta, respectively. The highest mean AA of the skins as measured by the ABTS method, ranging from 2.36 mg to 6.60 mg TE/g f.m. found in grape skins for Alwood and Beta varieties, respectively. The highest average reducing activity in grape skin, ranging from 2.33 mg to 4.08 mg $FeSO4^{-}_{2}$/g f.m., was observed for the Beta and Alwood cultivars, respectively. The highest mean total polyphenolic compound content was observed in grape skin, which ranged from 2.58 mg to 16.33 mg gallic acid equivalent/g f.m. for the Beta and Alwood variety respectively. The highest value of total flavonoid content was observed in the flesh of fresh fruit, where the flavonoids ranged from 133.6 to 311.2 μg of quercetin equivalent /g f.m. for Michigan and Alwood, respectively. The highest values of the total content of anthocyanins were recorded in the peels, where the anthocyanins ranged from 0.33 to 2.38 mg of delphinidin equivalent/g f.m. for Michigan and Alwood, respectively. The conducted research shows that non-commercial varieties of hybrid grapevine can be a valuable raw material for food applications.

Influence of Pasture Feeding from Winter to Spring on Volatile Profile of a 4-Months Ripened Ewe Cheese

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Abstract:

Pasture feeding has been demonstrated to deeply influence the volatile profile of milk and consequently its sensory properties. On the other hand, the cheese sensory properties are also influenced by the technological process and is not clear the extent by which pasture-fed milk contributes to the aroma of the final product. The aim of the present study was to evaluate the influence of pasture from February to June in a specific Apulian area on the volatile profile and sensory perceptions of a 4-month ripened ewe cheese. Instrumental data highlighted remarkable differences in the volatile profile among the cheeses produced in different months. February cheese resulted to be characterized by high amount of butanoic acid, 2-heptanone, 2-nonanone and ethanol. March cheese was mainly characterized by alcohols (ethanol), sulfur compounds (Methane isocyanol) and others such as butanoic acid ethyl ester, acetic acid. April cheese had high amounts of ketones (2-heptanone), esters (butanoic acid ethyl ester) and other as butanoic and hexanoic acid. These latter were high also in the cheese of May, whereas June had the highest amount of terpenes (à-pinene) and aldehydes (acetaldehyde). Very little differences were found on the sensory point of view by expert panelists, but they could probably be very difficult to be detected by consumers.

Use of Pulsed Electric Field Pre-Treatment to Enhance Drying Characteristics of Chilean Abalone (*Concholepas concholepas*)

Roberto Lemus-Mondaca[1]*, Luis González-Cavieres [2], Mario Pérez-Won [2], Anais Palma-Acevedo [2], Erick Jara- Quijada [2] and Gipsy Tabilo-Munizaga [2]

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[2] *Food Engineering Department, Universidad del BíoBío, Chile.*

Abstract:

The Chilean abalone is a gastropod mollusk and lives exclusively on the coasts of Chile and

Peru. This seafood is highly valued, has a high commercial price, and is classified as a gourmet product. However, one of the main factors limiting export is the short shelf life thereof. In the present study, the processes of vacuum microwave drying (VMD) with a rotary system with 5 rpm speed, freeze-drying (FD) with a vacuum of 0.0021kPa and -55°C, and hot air drying (HAD) at 60°C, along with the previous application of pulsed electric fields (PEF) as pretreatment (2 kV/cm), were researched and compared in terms of processing conditions (drying kinetics, diffusivity, energy consumption, and CO_2 consumption), and product proprieties (rehydration ratio and microstructure). The VMD process was carried out in laboratory-scale designed equipment, using an initial power intensity of 7.74 W/g for 10 min and then 16.77 W/g with a vacuum pressure of 40 kPa. The treatment that presented the highest diffusivity was VMD (3.28×10^{-9} m^2/s) and a processing time of 69 minutes, on the other hand, the treatment that presented the lowest diffusivity (7.30×10^{-10} m^2/s) and the longest process time (9 h) was FD. In terms of energy consumption, there was a difference of 97% between FD and VMD; however, the FD rehydration ratio was the one with the best results. Therefore, it is possible to conclude that both treatments have advantages that should be used according to requirements.

High Hydrostatic Pressure (HHP) Effect on Proteins Profile of Wheat Flour

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Abstract:

High Hydrostatic Pressure (HHP) treatment alters the structure of food biopolymers such as proteins and starch, providing the possibility to produce foods with novel textures and chemical changes. The present work investigated the impact of different HPP pressures treatments on wheat flour by the assessment of the protein profiles obtained by SDS-PAGE. Commercial wheat flour was solubilized in water at a 2:3 ratio (w/v). Mixture was introduced in plastic bottles and treated by HPP for 10 minutes at different pressures 60, 100, 200, 400, 500, 500 with discontinue treatment (step 1: 3 minutes, step 2: 7 minutes) and 600 MPa). After that, treated samples were assayed by SDS-PAGE under reducing conditions using commercial Bolt Tris gels and MES as running buffer during 35 minutes at 200V and stained with coomassie blue. Gel was photographed and densitometry analysis was performed. All the HPP treatment conditions showed 15 bands at different molecular weight except for the 500 MPa (3+7 minutes) for which 13 bands occurred in the gel. For all the studied treatments, bands at 55, 38 and 12 KDa reached the highest lines percentage. For data interpretation bands were grouped according Wieser 2007 (1) as aggregates (MW>105KDa), HMW-glutenins (65-78 KDa), 5- and 1,2-gliadins (45-55 KDa), LMW-glutenins overlapped with α/β-gliadins (31-38 KDa) and proteins fragments (<25KDa). With the reported results, it can be concluded that the treatment at 600 MPa was the one that most fragmented wheat flour proteins (≈47%) and the 500MPa discontinue treatment provided the highest aggregates and HMW-glutenins percentages (≈21%).

Vitamin D_2 and Phytochemicals Enhanced King Oyster Mushrooms (*Pleurotus eryngii*) Decrease Plasma oxLDL in Metabolically Unhealthy Overweight/obese Adults: a Randomized Controlled Trial

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Abstract:

Edible mushrooms are highly nutritious. Their caloric content, sodium content, and cholesterol level are low, while they contain protein, vitamins, minerals, lovastatin, ergothioneine, and essential amino acids. We previously showed that King oyster mushrooms cultivated on a substrate containing grape marc (GPC) had increased phytochemical content and antioxidant capacity (1), and amino acid content (2). Additionally, King oysters regulate postprandial glycaemia and appetite (3). Herein we aimed at evaluating their effects in adults with MS. King oyster mushrooms cultivated on GPC, were cut into 2mm thick slices, and after flavoring they were baked. To enhance vitamin D_2 content, sliced mushrooms were subjected to UV-B irradiation. Baked and irradiated slices were packed in silver aluminum foil packs (6g/pack) to be included in the diet of the intervention group (1 pack/day), whereas the control group received no snacks. Both arms were given standard nutritional counseling for MS throughout the 3-month trial. Protocol compliance and dietary data were collected throughout the trial. Anthropometrics and biochemical profile were assessed pre- and post- intervention. General linear models for repeated measurements were used to analyze the data. The sample consisted of 100 participants (50 in intervention, 50 in control) with mean age 54.3 years (SD=11.28). Study groups were similar in terms of sex, age and anthropometrics ($p>0.05$). Interestingly, a significant decrease in oxLDL levels was found in the intervention (mean difference=-0.02 (U/l), SD=0.05, $p=0.044$). In control no significant changes were remarked for oxLDL ($p=0.243$). BMI and body fat decreased significantly only in the intervention (mean difference=-0.79, SD=1.12, $p<0.001$, and mean difference=-2.0, SD=2.76, $p=0.001$, respectively), no changes found in control. Median vitamin D_2 remained unchanged in control while an increase was found in the intervention (median increase: 5.2 ng/ml, $p=0.002$). ClinicalTrials.gov Identifier: NCT04081818

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A Novel Nutraceutical Supplement Regulates Blood Inflammation and Oxidative Stress in Patients with Knee Osteoarthritis

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Abstract:

Through inflammation and oxidative stress (OS), osteoarthritis (OA) induces the gradual

deterioration of the cartilage of joints. In search of novel opportunities to refine the existing treatments in clinical practice, nutraceuticals have attracted great interest. A well-established body of literature confirms their potent contribution in OA treatment (1). Herein we aimed at evaluating the synergistic effect of nutraceuticals with established efficacy in OA in a double blind randomized clinical trial. Patients with knee OA received either a nutraceutical supplement with Curcuma phospholipid, Rosemary extract 40%, Resveratrol extract 98%, Ascorbic acid, VIVAPHARM® HPMC, E50 – Hypromellose, and magnesium stearate (PhAA, n=16), or ascorbic acid (AA, n=17) for three months. Primary outcomes included changes in Visual Analog Scale (VAS) and Western Ontario and McMaster Universities Osteoarthritis (WOMAC) pain subscale. Secondary outcomes were changes in WOMAC stiffness and functionality subscales as well as regulation in systemic inflammation. Both arms were given standard nutritional counseling throughout the 3-month trial. Medical history and dietary data were collected throughout the trial. Anthropometrics, biochemical profile, inflammatory, and OS biomarkers were assessed. General linear models of analysis of covariance (ANCOVA) were used to analyze the data. The study groups were similar in terms of sex, age and anthropometrics ($p>0.05$). VAS decreased only in group PhAA ($p<0.01$), but not in AA, with the post-treatment difference in the two groups being significant ($p=0.004$). Additionally, WOMAC physical function score decreased significantly only in the PhAA group ($p=0.006$). The pro-inflammatory TNF-a decreased significantly only in the PhAA group ($p=0.05$). The anti-inflammatory cytokine IL-13 increased only in the PhAA group. Additionally, the oxidative stress markers oxidized LDL and myeloperoxidase decreased in the PhAA group whereas in the AA group increased. Our results support the hypothesis that the use of phenolic nutraceuticals to battle OA is promising. **ClinicalTrials.gov Identifier:** NCT04783792

Effect of Treatments and Washing on the Bitterness Perceptions as Assessed by a Sensory Analysis

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Abstract:

Bitterness is the principal objection consumers report to table olives' acceptability. However, studies related to study specifically this attribute and the variables that may influence its presence have scarcely been reviewed. The work investigated the bitterness levels in directly brined table olives, using some of the most popular Spanish-cultivars (Manzanilla, Gordal, Aloreña and Hojiblanca). The study was carried out with olives fermented at different salt levels and packaged at 5% NaCl concentration. All packages were preserved by physicochemical characteristics. A previous checking of the panellists's behaviour showed significant discrepancies among assessors regarding the perception and evaluation of the bitterness. Notably, one showed a completely different trend than the panel as a whole. Besides, the analysis allowed the detection of two main trends with five and ten assessors. There were sensible discrepancies between them but a high degree of agreement within them. However, the inconsistencies did not separate any of them from the panel. In addition, there was found a significant interaction panellists*session. Regarding cultivars, the lowest scores were found for Gordal while Manzanilla was the presentation with the highest score. In any case, significant effects were detected for cultivars (diverse presentations), washing, and sessions, while the significant interactions were for treatments*washing, washing*panellist, and washing*panellist*session. Besides, washed olives always received the lowest scores, but the differences were not as great as expected. Furthermore, regardless of samples, the bitterness scores assigned in the first session were always higher than those given in the second and third, with the perception progressively lower.

3D Printed Rigid Food Packaging Based on Polylactic Acid Modified with Nano-Silver for the Storage of Cow Cheese

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Abstract:

Polylactic acid (PLA) is a biodegradable biopolymer obtained from renewable resources, such as corn, wheat or potatoes starch (Balla et al. 2021). It can replace polymers of petroleum origin, thus reducingthe gas emissions. Due to its compatibility with different compounds, PLA can be modified either by surface deposition or by incorporation. Among the modified agents are silver ions that exert antimicrobialactivity (Balla et al. 2021). The purpose of this study was to prepare a rigid biodegradable packaging of PLA by 3D printing (Figure 1), to modify it with nano-Ag and to test its preservative action while keeping fresh cow cheese inrefrigerated conditions. The results showed that the rigid packaging PLA-nano-Ag preserved the organoleptic characteristics of the cow cheese until day 12 of storage, compared to the unmodified PLA, where the cheese showed slight changes from day 6 of storage followed by sharp deterioration (Figure 2).Also, the lowest variation in the cheese moisture and acidity was recorded in the case of cheese kept in therigid packaging PLA-nano-Ag, due to the nano-silver`s antimicrobial effect. According to the Romanian Standard (SR 1981 / January 2008), the cow cheese can be stored in safety conditions for a maximum of 10 days in the unchanged PLA package and in the PLA-nano-Ag package more than 12 days.

Phycocyanin Enrichment of Minimally Processed Organic Apples

Jessica Genovese, Joel Armando Njieukam, Francesca Patrignani, Urszula Tylewicz, Silvia Tappi, Santina Romani, Marco Dalla Rosa, Pietro Rocculi and **Maria Alessia Schouten***

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Abstract:

Recently microalgae have become promising resources to obtain functional ingredients to be used to increase the nutritional value to foods. Spirulina platensis, also known as spirulina or Arthrospira, is a blue-green filamentous prokaryotic cyanobacterium with a protein content of 55–70%, which includes the entire range of essential amino acids, many vitamins, minerals, essential fatty acids and pigments such as phycocyanin. In the present study the phycocyanin was used to enrich organic fruits. For this purpose, apple tissues were selected for trials and a solution containing phycocyanin extracted from the microalgae Arthrospira platensis was used to obtain a nutrient-enriched product. The optimised vacuum impregnation (VI) process (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). The enriched apples were stored under refrigerated conditions and their shelf-life was monitored for 10 days. Various quality-related and nutritional analytical determinations were carried out throughout the storage period. In addition, the microbiological quality of the MP apples was monitored for 10 days in refrigerated conditions. Based on the physical and microbiological determinations, the shelf-life of the product was set at 7 days, which is in line with similar products already on the market, but not enriched with Arthrospira platensis. 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).

Bio-based Seaweed (Fucus spiralis and Phorphyra dioica) Edible Coatings for Enhancing the Shelf Life of Salmon Fillets

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Abstract:

Seafood is characterized by a short shelf life, being bacterial growth, autolytic reactions of endogenous enzymes, color changes and lipid oxidation[1]. The application additives that make it possible to maintain the food quality of these products is a good option, however, consumers have become increasingly concerned about health and the environment. So, it is important to research new products that are more natural and sustainable. Algae constitute a renewable source of natural compounds with antioxidant and antimicrobial capabilities, being increasingly used in the formulation of these additives[2]. The objective of this work is to develop a coating containing hydro-ethanolic extracts from the algae Fucus spiralis and Porphyra dioica in order to improve the quality of salmon fillets. Salmon samples (Salmo salar) were immersed for 2 minutes in two solutions with 2% of seaweed extract, A: seaweed extract, glycerol, gelatin and lemon essential oil (2:5:25: 1) and B: seaweed extract, glycerol, gelatin (2:5:25). In addition, an immersion in a control (synthetic additive) was also carried out. Microbial (total microorganisms at 30ºC and psychrotrophic), chemical (ABVT and TBARS), sensory and physical (pH, humidity and color) qualities were evaluated after 0,3,4 and 5 days of storage at 4°C. The results showed that coatings A and B have the same effectiveness (extending shelf life) compared to the control. Thus, the application of this methodology for the conservation of refrigerated fresh fish products is of interest since it is possible to replace a chemical additive with a natural additive from a renewable source.

Towards Sound-Assisted Fermentation: A New Sustainable and Environmentally Friendly Industrial Process to Improve the Speed of Production

Giulia Chicarella[1*], Federico Ortenzi, Alessandro Contaldo[2], Luca Buccarello[2] , Laura Bruno[1] and Blasco Morozzo della Rocca[1].

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Abstract:

This project aims to use new methods to ensure the fermentation process. Fermentation is an anaerobic process in which energy is extracted by microorganisms and enzymes and is generally associated with the production of carbon dioxide. Fermentation is one of the most common processes in the food and industrial sector. Many studies have shown a correlation between irradiation with ultrasound and enzymatic activity. It has been shown that depending on the characteristic of the wave (such as frequency and power) and the microorganism used there are different responses to stimulation. In order to irradiate the must with ultrasound we designed and built a sonobioreactor starting from a fermenter. This has been modified by adding two boards, one located on the lid of the fermenter where a carbon dioxide sensor and a temperature monitoring probe were placed and the other is located outside the fermenter, equipped with circuits to control the input and frequency of the ultrasonic waves, an amplifier,

an external memory and a wireless module that transmits the data collected by the sensors to an online server, that can be used to monitor the data in real time. We set up the first preliminary fermentation experiments, with and without ultrasonic irradiation and we saw that with the stimulation there was up to a 25% reduction in fermentation time. The process has been sped up with no significant damage to the yeast cells or cell death.

----------THE END----------

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