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ABSTRACT BOOK

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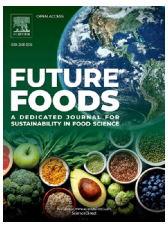

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Sustainable Food Technology

Developments of Hyperspectral Imaging Technology for Novel Food Quality and Safety Detection and Control

Da-Wen Sun

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Abstract:

Hyperspectral imaging technology combines the strengths of mature optical sensing techniques—imaging and spectroscopy. This integration enables the capture of both spatial and spectral information for every pixel in an image, distinguishing it from traditional color imaging systems. This advanced capability has led to extensive exploration and advancement of hyperspectral imaging in various fields. Particularly in the food industry, hyperspectral imaging has gained momentum due to its ability to capture physical attributes like color, size, shape, and texture, as well as intrinsic chemical and molecular properties (e.g., water, fat, protein) of food products. This technology has found successful applications in ensuring food safety and quality control. This presentation aims to provide an introduction to the fundamental principles and theoretical underpinnings of hyperspectral imaging. It then delves into a comprehensive exploration of recent advancements and applications in the realm of food safety and quality control, including the assessment and evaluation of muscle food quality and safety (salmon fillets, chicken fillets, pork, ham, minced lamb, poultry carcass), detection, analysis and grading of fruits (banana, lychee, kiwifruit, pear, citrus, strawberry, cucumber), visualization of kiwi sugar distribution, tracking tomato ripening, detection of melamine contamination in flour, etc. **Keywords:** hyperspectral imaging; food quality; food safety; nondestructive detection.

Prebiotic Tea Phenolics: Gut Microbial Conversions, Renewable Sourcing, and Sustainable Extraction

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Abstract:

Tea consumption is commonly associated with various health benefits, which have been ascribed to its high content of phenolic compounds. Tea phenolics are primarily catechins and their oxidation products. However, these compounds have relatively low bioavailability in the small intestine. Thus, they reach the colon where they undergo reciprocal interactions with the gut microbiota. We propose that tea phenolics can be considered to be prebiotics, as they confer health benefits via modulation of gut microbiota composition and via formation of health-promoting microbial metabolites, which is in many ways analogous to the prebiotic action of conventional oligosaccharide prebiotics. Therefore, it is of interest to explore strategies to increase tea phenolic intake, for example through supplementation or food fortification. These compounds should be obtained from a renewable source and old tea leaves, which form an agricultural waste stream, are

a promising raw material in this respect. Based on our analyses, we conclude that old tea leaves still contain approximately 9.5% ([w/w] dry weight) phenolic compounds, including 4.3% ([w/w] dry weight) catechins. In addition, it is essential to find sustainable alternatives to the energy-intensive and non-selective approaches that are currently used to extract phenolics from tea leaves and similar raw materials. Our results showed that pulsed-electric field (PEF) pre-treatment enhances the effectiveness of phenolic extraction from tea leaves, while potentially being up to a 1000-fold more energy-efficient than drying via heating. In conclusion, old tea leaves are a renewable source of prebiotic tea phenolics, which can be effectively extracted after energy-efficient PEF pre-treatment.

Low Temperature Electrostatic Spray Drying Improves Oxidative and Non-Enzymatic Browning Stability in Milk- and Oil-Encapsulated Powders

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Abstract:

Electrostatic spray drying (ESD) is an innovative technology combining gas-liquid atomization and electrostatic charge. Unlike traditional high-heat spray drying (SD), low voltage is applied at the time of atomization and free water is removed without significantly raising the product temperature. The drying process takes place in an inert gas environment where oxygen is replaced by nitrogen. This study compares the oxidative and browning stability of milk and oil-encapsulated powders. ESD and SD were used to make milk, infant formula, and oil-encapsulated powders. ESD powders had large, highly agglomerated structures assembled by the agglomeration of small primary particles (<20 µm) with an average water activity <0.22 and moisture <4%. The surface chemistry was altered by the electrostatic charge (5-10 kV) applied at atomization and ESD milk powders had 8-10% lower surface fat compared to SD powders. The peroxide value was reduced by ~40% to improve the oxidative stability during storage. Used as an index of heat induced browning reactions, hydroxymethyl furfural reduced by ~30% in ESD milk powders. In ESD oil-encapsulated powders (using 50% (w/w) vegetable oil as an example), the encapsulation efficiency was 97% compared to 90% for SD powders where the surface free fat was approximately 3 times greater. Peroxide values increased during storage at 22°C and 45°C, however, the increase was significantly higher in SD powders ($p<0.05$). Implemented commercially, the novel approach of electrostatic spray drying is adopted in the Americas, Asia and Australia for its proven capacity to dry at low temperatures and preserve product quality.

Unraveling the effect of wheat origin on the volatiles profile of craft wheat beers by combined multivariate statistical approaches

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Abstract:

A deeper knowledge of the causes of volatile organic compounds (VOCs) variance in craft wheat beer is crucial for its quality improvement. The VOCs profile of 17 craft wheat beers obtained by

common and durum, heritage and modern wheat varieties grown in different fields sited at different altitudes was analyzed. Data were processed by multivariate analysis, and partial least square (PLS) analysis evidenced that wheat concentration was the highest source of VOCs variance, followed by altitude of cultivation, wheat species, and ancientness. The effect of wheat variety was explored by PCA-LDA (principal component analysis tandem linear discriminant analysis), which permitted to correctly classify craft beers made with wheat of different origin (species and variety) on the basis of their VOCs profile. PLS regression analysis permitted to find a combination of VOCs able to predict the altitude of wheat cultivation as well as to correctly classify wheat beers made with wheat cultivated at different altitudes. A further 'one versus all' approach by PLS-DA permitted to find a combination of VOCs able to discriminate between beers made with different wheat species. Findings suggest that prime material has a crucial importance on the definition of the VOCs profile of craft wheat beer and that the effect of environmental stresses induced by altitude on wheat crops is more important than the wheat species effect, which, in turn, was higher than that of variety.

The Effect of Milling and Processing on the Content of Bioactive Compounds and Gliadin Immunogenic Epitopes of Tritordeum and Bread Wheat

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[2]*University of Life Sciences Prague, Department of Chemistry, Czech Republic.*

Abstract:

The growing demand for nutritionally valuable foods registered in recent years has drawn attention to non-traditional cereals characterized by increased phytochemical content. In this sense, the new species tritordeum has started to be explored due to a substantially high accumulation of carotenoids in the endosperm[1] and good bread-making properties.[2] The aim of the present work is to provide new knowledge about tritordeum as a potential novel raw material compared to bread wheat, and specifically to clarify the influence of two milling methods (roller and stone milling) and four technological processes (production of breadsticks, bread, pizza and fresh pasta) on the content of phytochemicals and gliadin immunogenic epitopes, according to a full factorial design. The type of milling contributed the most to the variation in the levels of phenolic acids, β-glucans, and antioxidant capacity, with significantly higher values in stone-mill samples than refined ones. Overall, tritordeum products had advantages over bread wheat in terms of carotenoids (+207%), soluble (+33%) and cell-wall bound (+3%) phenolic acids, antioxidant capacity (+35%), and R5 gliadins (-12%). The processing resulted in a significant reduction of the investigated phytochemicals, compared to flour, albeit at different rates in relation to the final product, with the least degradation observed in breadsticks and bread than in fresh pasta and pizza. The selection of specific milling fractions of non-traditional cereals with an initially higher content of health-promoting phytochemicals may represent a tool to retain the highest concentration in the final baked and pasta products.

Structuring Food using Alternative Proteins Extracted from Green Leaves

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Abstract:

Due to their abundance in nature, green leaves are a promising protein source with potential for improving the sustainability of the global feed. The most abundant protein in leaves, RuBisCO (ribulose-1,5-bisphosphate carboxylase/oxygenase), has a balanced amino acid profile meeting the FAO (2011) recommendations. It is also a water-soluble protein, so its techno-functional properties are promising. In our work, the structuring potential of leaf proteins extracted from endogenous green leaves, including perennial rye-grass and quinoa leaves, was explored. For this purpose, leaf protein concentrates (LPCs) obtained using different extraction approaches were used to produce model food systems, including emulsions and gels. RuBisCO was identified as the major protein in all LPCs obtained. The most simple extraction processes, based on isoelectric precipitation after tissue disruption, resulted in the highest yields (18 g/100 g crude protein in the leaves). The incorporation of an additional heating step to improve the removal of chloroplast residues considerably decreased the extraction yield, but resulted in a greater protein content (76 ± 1 % DM) and improved solubility (94 ± 6 % at pH 7). While leaf protein-based emulsions prepared at acidic pHs rapidly flocculated, the most soluble LPCs exhibited good emulsifying properties at neutral pH, comparable to those of reference proteins (i.e., whey protein isolate). The LPCs also showed good gelling properties at concentrations above 10 wt%, both by acid and thermally induced gelation. Overall, the LPCs demonstrated promising food structuring potential of interest for the development of novel plant-based food products.

Green Extraction of Phenolic Compounds from Red Radicchio of Treviso Precoce I.G.P. (*Cichorium intybus L. var. Silvestre*) by-products using Natural Deep Eutectic Solvents

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Abstract:

Recovering polyphenols, a class of bioactive compounds known for their significant health-promoting effects, is crucial, especially from sources that are considered waste by the food industry. Additionally, there is growing interest in employing a green extraction approach. Within this context, this study aimed to select and optimize the most promising natural deep eutectic solvent (NaDES) for sustainable polyphenols extraction from red chicory of Treviso Precoce I.G.P. processing residues. Among four NaDESs tested for their ability to extract phenolic compounds, the citric acid: choline chloride (1:2) NaDES stood out as the most effective. To achieve maximum polyphenol yield, a three-factor, three-level Box-Behnken experimental design along with Response Surface Modeling (RSM) was used. The key factors for optimization were the acid: choline chloride molar ratio, the water percentage in NaDES, and the ultrasound extraction time. Total phenolic content, total flavonoid content, and total monomeric anthocyanin content together with the antioxidant

activity and HPLC-DAD analyses were used to assess process efficiency. The experimental results revealed that the most favorable conditions for extraction were achieved using a citric acid: choline chloride molar ratio of 3:2, with 25% water content in NaDES, and an ultrasound extraction time of 49 minutes. This resulted in obtaining 117.43 ± 0.33 (µg/ml) of chlorogenic acid and 28.94 ± 0.22 (µg/ml) of chicoric acid. Considering NaDESs' green nature, biodegradability, and low cost, the obtained polyphenolic extracts are expected to be advantageous in industrial food and pharmaceutical applications, without demanding and expensive downstream purification steps.

Tenebrio molitor Larve as A Novel Functionalized Antihypertensive Food

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Abstract:

The use of insects for food purposes is a smart, low-cost and eco-sustainable solution. Insects provide quality nutrients, consuming limited resources. Unlike most plants, *Tenebrio molitor* larvae (TML) are a complete source of digestible proteins and essential aminoacids. In addition, we successfully enriched their antioxidant activity and functionalized their lipid content using agro-industrial by-products. In our previous work we disclosed the inhibition of the angiotensin-converting enzyme (ACE) by the water-soluble protein fraction of these insects after gastrointestinal in vitro digestion. Efficacy studies carried out on spontaneously hypertensive confirmed their promising activity. In this work, we determined the ACE inhibitory activity of the main protein fractions from TML to evaluate their nutraceutical applications. Both fractions contained YAN tripeptide, previously reported as responsible for ACE inhibition. Although YAN has been synthesized, used as a standard for LC-MS/MS quantification and IC_{50} against ACE determined, low yields of YAN from TML did not explain adequately the activity of the whole protein fraction. LC-HRMS/MS investigation led to the identification of other three peptides, which were evaluated *in silico*, synthesized and tested against ACE. Among them, tetrapeptide NIKY showed the most promising activity value of 52 µM. Our work highlights once more the potential of TML paving the way for exploitation as a novel antihypertensive food.

Enzymatic Hydrolysis to Produce Novel Oat-Based Food Ingredients: Physicochemical and Technological Attributes

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Abstract:

Oats are one of the most important grains in human diet due to their availability and nutritional

attributes. The objective of this investigation was to develop an efficient enzymatic protocol to obtain hydrolyzed oat-based food ingredients from oat flour (OTF). Three combinations of enzymatic treatments were evaluated: TRT1 (BAN®480 LS, Amylase™ AG 300, Formea® Sol), TRT2 (Viscozyme® L, Formea® Sol), TRT3 (BAN®480 LS, Maltogenase®, Formea® Sol). The hydrolysis (1h) was carried out at the optimal enzyme activity temperatures (50°C, 70°C) with different initial OTF contents (20%, 25%, 30%, 40%). The hydrolyzed solution was submitted to spray drying (SD) or vacuum oven drying (VOD) using oat fiber as drying carrier (addition 10%-40% w/v). The produced hydrolyzed oat flour powders (HOFP) had their physicochemical (composition, color) and functional (solubility, water holding capacity WHC and oil holding capacity OHC) attributes evaluated. Protein content between 8.3-11.3% and high carbohydrate content (>80%) was observed for HOFP. The best yield (42.7%) was obtained with TRT1, 25% initial OTF content and SD. For VOD, the best operational parameters were TRT1, 40% initial OTF, 15 % of oat fiber, drying temperature 45°C, 750 mmHg. For TRT1-SD using 25% of initial OTF solids, HOFP had significantly higher solubility (30.2%), WHC (7.5%) and OHC (13.1%) compared to other treatments ($p<0.05$). VOD powders presented significantly lower solubility (18.3-24.5%), WHC (2.3-8.5%) and OHC (8.7-11.5%) ($p<0.05$) and darker color compared to SD. Overall, spray drying coupled to enzymatic hydrolysis TRT1 protocol produced a final HOFP with the most desirable technological attributes.

Flavonoids- and Limonoids-Rich Extracts from Lemon Pomace By-Products: Technological Properties for the Formulation of O/W Emulsions

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Abstract:

Lemon pomace, the by-product deriving from the industrial processing of citrus fruits for juices production, is a matrix rich of flavonoids and limonoids, bioactive compounds with interesting functional properties. The work aimed to investigate the technological properties of flavonoids and limonoids-rich extracts recovered from lemon pomace in model oil-in-water (o/w) emulsions. The extracts, obtained with different extraction procedures, were characterized in terms of surface properties, either as single systems or in combination with pea protein isolate. Then, the most surface-active extract was used to enrich, at increasing concentrations (0.5, 1 and 2%), o/w emulsions (20% w/w) stabilized by pea proteins. Droplet size distributions, microstructure, flow behavior and oxidative stability were investigated. The extracts were able to lower the surface tension of the protein interfacial layer, with a concentration dependent behavior. In emulsions, depending on the amount added, the extract could significantly alter the dispersion degree, increasing oil droplets size and inducing flocculation at the highest extract to pea protein ratios. In accelerated oxidation tests, the extracts were shown to improve the chemical stability of the emulsions; however, the physical stability was impaired in the systems with the highest extract amounts. Limonoids- and flavonoids-rich extracts recovered from lemon pomace can be considered promising as multifunctional ingredients in o/w emulsions, provided that their effect on the colloidal properties is properly addressed. This research received support from the Italian Ministry

of University and Research (MIUR) under the PRIN 2017 program (grant number 2017JTNK78) titled "Good-BY-WASTE, Obtain GOOD products, exploit BY-products, reduce WASTE."

Quality Properties and Processing Performances of Waxy Hull-less Barley

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Abstract:

Hull-less barley has been preferred as it is easier to process and has higher fiber,β-glucan, flavonoid and tocopherol contents than hulled barley. Waxy phenotype is produced from the variations of DNA sequence in waxy gene responsible for amylose biosynthesis. Besides free of or low in amylose, waxy hull-less barley contain higher contents of protein, β-glucan, phenols, resistant starch, and lower total starch, and thereby present different nutritional value, health benefits and processing performances from normal HLB in food industry. Hull-less barley wholegrain flour was used to produce cookies or was incorporated into wheat bread, and the differences of products were obviously different between normal and waxy barley, including the composition, sensory evaluation, textural properties, X-ray diffraction, and in vitro starch digestibility of the products. Also, waxy barley β-glucan displayed more compact micrographic features, higher molecular weight, larger particle size, higher thermal decomposition temperature and lower rheological viscosity than normal barley β-glucan, and the interaction of β-glucan and starch were also obviously different between waxy and normal barley. Excitedly, the unmalted waxy barley had a mash filtration rate much faster than normal barley because starch and β-glucan in waxy barley were rapidly and completely digested and formed more open filter passages.

Mitigation of Acrylamide in Biscuits: Focus on Chemical and Physical Strategies

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Abstract:

Levels of the contaminant acrylamide in food are of great concern, especially in biscuits. They are extremely subject to the formation of acrylamide both for the ingredients that compose them, such as asparaginase, reduce sugars or the presence of ammonium ions from the livening agents, and for their own production process, such as the need to quickly reach high temperatures for cooking. Levels of acrylamide in food are strictly controlled by the European Food Safety Authority (EFSA), follow the Regulation (EU) n. 2017/2158 (Attachment IV). This research work aimed at mitigating of acrylamide in biscuits through strategies based on the FoodDrinkEurope Acrylamide Toolbox, while maintaining the chemical, physical, and sensory characteristics of the original products. The strategies adopted included release of steam during the baking process, optimization of time-temperature program, selection of leavening agents and optimization of their quantity, selection of flours with low concentration of free asparagine. The combination of these strategies allowed a lowering of the acrylamide content in the experimental samples, in some cases even much lower than the legal limit imposed by the Regulation (EU) n. 2017/2158 (Attachment IV), which provides

for a limit of 350 µg/kgFW. In fact, a percentage reduction between 63% and 87% was obtained compared to standard biscuits. In particular, we obtained a reduction of 87.2% in the event that there was a partial replacement of ammonium bicarbonate (from 9.0 g to 1.5 g per 500 g of flour) with sodium bicarbonate (from 4.5 g to 12 ,48g), the lowering of the temperature in the central cooking phase (from 170°C to 150°C) and in the emission of steam for 3 minutes (Lo Faro et al, 2021). Then, the use of acid in the formulation improved, even more, the reduction of the acrylamide in the samples. There is still no specific mitigation technique for acrylamide in food and in biscuits, but the combination of several techniques, as proven and demonstrated by our work, can reduce its quantity, in some cases even below legal levels.

Microencapsulation for Salt Reduction in Meat Products

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Abstract:

The addition of fish oil microcapsules, using maltodextrin and chitosan as wall material, seems to be appropriate to enrich meat products in omega-3 fatty acids, maintaining physico-chemical characteristics and oxidative stability, but increasing saltiness scores, which pointed out that the addition of this type of microcapsules may enhance the salty taste perception and so, reduce the quantity of added salt. In relation to this, an innovative and alternative approach for salt reduction is generating an uneven spatial distribution of salt that leads to taste contrasts and enhances saltiness intensity, which could be achieved by salt microcapsules. These premises let to i) evaluate the effect of fish oil microcapsules on saltiness perception in meat derivatives for developing acceptable products labelled with nutrition claims related to sodium/salt, and ii) develop microcapsules of salt using different wall material (maltodextrine, chitosan, alginate) and procedures (simple and double emulsions, liposomes) as NaCl replacers in meat products. For that, on one hand, addition of fish oil microcapsules in combination to salt reduction were evaluated in burger meats, and on the other, salt microcapsules with different wall materials were developed and used as salt replacers in meat derivatives. Obtained results pointed out that both strategies achieved acceptable meat products labelled with nutrition claims related to sodium/salt ("reduced salt" or "low salt content"), as well as the influence of the wall material of the salt microcapsules on sensory attributes of the meat products.

Exposure of Milk to Light Activates Photo-Degradative Reactions

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Abstract:

Thermal treatments applied to raw milk to make it safe for direct consumption are responsible for irreversible changes mostly involving proteins. Whey protein denaturation and protein glycosylation via Maillard reaction are commonly considered primary modifications induced by heating and derived reaction products are worldwide adopted as heat-load indicators. Nevertheless, milk

protein modifications may also occur during storage in the refrigerated cabinets at retail, where milk in clear containers, such as glass or PET bottles, is exposed to light for hours or days. Several unwanted changes have been associated to light exposure of milk, including off-flavor formation, milk discoloration, protein aggregation. Also, amino acids such as tyrosine, tryptophan or methionine are major targets for oxidative reactions in proteins. However, conditions and mechanisms of these reactions are poorly investigated in milk. In this study we have investigated some photo-oxidative reactions occurring in commercial whole and semi-skimmed pasteurized milk during 7-day light exposure in a display cabinet. Formation of di-tyrosine (di-Tyr) was quantitatively determined by a newly developed and validated HPLC-fluorescence method and using the in-house synthesized pure molecule. Riboflavin degradation was also determined by HPLC and the parallel milk discoloration was monitored performing color analysis. Formation of protein aggregates in milk was investigated by laser light scattering whereas transmission electron microscopy with immunogold labelling of di-Tyr residues allowed to detect their localization on casein micelles. The results of this study evidenced the strong need to further investigate the possible effects of lightening abuse for milk marketed in clear bottles.

Evaluation of Quality and Authenticity of Raspberry Ketone Supplements by A Multianalytical Approach

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Abstract:

Raspberry ketone [4-(4-hydroxyphenyl)butan-2-one; RK] is an aromatic compound present in red raspberry (*Rubus idaeus* L.) with potential weight loss properties [1]. As a consequence, the consumption of dietary supplements (DS) based on RK has increased in recent years. However, this sort of products are frequently subject of frauds and food alerts [2] and, therefore, the development of effective analytical methodologies to ensure their quality and authenticity are required. In this work, a multi analytical approach was followed to evaluate the quality and authenticity of RK supplements. Firstly, different methodologies based on GC-MS and LC-MS were developed, validated and compared to analyze bioactive RK; GC-MS was selected as optimal. Differences between experimental and declared RK content were detected in 30% of the analyzed DS. A number of samples presented RK contents far above the values declared, pointing at its non-natural origin, while others showed extremely low contents which question its effect for overweight control. Moreover, the presence of carbohydrates, volatiles and phenolics, characteristic of raspberry fruit, was evaluated by GC-MS (with a previous derivatization of samples), SPME-GC-MS and LC-MS, respectively. Absence of these characteristic raspberry compounds was generally observed in DS with the highest RK content, probably due to the synthetic origin of this compound. The multianalytical approach here developed is shown as a promising strategy for authentication and quality control of RK dietary supplements by both the food industry and regulatory bodies. [1] Li et al., *J. Food Biochem.* 2022 (46), e14018. [2] Fibigr et al., *Anal. Chim. Acta* 2018(1036), 1.

Milling Techniques for Obtaining Whole-Wheat Biscuit Flours with Low Sanitary Risk

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Abstract:

This study evaluates the distribution of deoxynivalenol (DON) and asparagine (ASN), the main amino acid involved in acrylamide (AA) formation during baking, in wheat kernels. It aims to understand whether the milling processes influence sanitary risks of wholemeal flour also obtained by enriching refined flour with bran components, and their baked products. Two commercial lots of soft wheat underwent to roll and stone milling in a commercial mill plant and progressive debranning in a pilot scale plant. The obtained products were analysed for ASN and DON contents and flour obtained from their various combinations (final ash content of 1.6%) used for biscuits production. Biscuits were analysed for colour and AA content. Results show that ASN is mainly concentrated in wheat germ, then in bran fractions. In debranned fractions, there is a progressive decrease in ASN from the outer layers to endosperm. The 0-5% debranned fraction accumulates 35% of DON, while in biscuits the 5-10% and 10-15% wholemeal formulations reach the highest DON levels. Levels of AA are always higher in wholemeal recipes than refined standard, with a particularly high AA/ASN ratio in biscuits with stone milling wholemeal flour. Despite similar concentration of ASN and higher contamination by DON of coarse bran than fine bran, its ash content allows for a reduced amount in wholegrain formulation, limiting sanitary risks. This study points out how an appropriate selection of milling products in the formulation of whole-wheat flour could limit the overall sanitary risks in the production of bakery products.

Emulsion-Filled Gels Application in the Food Design of Baked Goods

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Abstract:

Emulsion-filled gels (EFG) are classified as soft solid materials and are complex colloids formed by matrices of polymeric gels into which emulsion droplets are incorporated. Several structural aspects of these gels have been studied in the past few years, including their applications in food. In our study EFG based on inulin, dry-fractionated proteins from legumes and sunflower oil were added in the formulation of a vegan brioche. The resulting experimental brioches were compared to a non-vegan control and their physical, chemical and sensory characteristics were analysed. The brioches prepared with EFG had harder texture compared to control, but the increasing of oil amount and the decreasing of water used in the EFG reduced the hardness of the product. No significant difference was found in the specific volume and springiness between the samples. The volatile profile of brioches mainly depended on compounds derived from the Maillard reaction, caramelisation and lipid oxidation or fermentation process. Furthermore, the results suggested that the concentration of certain compounds such as 2-pentylfuran, nonanal or benzaldehyde increased when EFG was added in the formulations. According to the sensory evaluation the brioches obtained with EFG at the highest percentage of sunflower oil was the most appreciated for crust colour, elasticity, typical odour of brioche and overall judgment. All the vegan brioches obtained could be labelled with “low fat” nutritional claim.

Sustainable Recovery of Chlorophyll-Based Natural Green Colorant by Enzyme-Assisted Extraction

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Abstract:

The growing demand for natural pigments, more desirable to health-conscious consumers, is directly associated with the increasing need to adopt approaches inspired by the Circular Economy model also in food industry. A variety of natural pigments have been recovered from vegetal waste (such as carotenoids from unsold tomatoes, betalains from unsold beetroot) by enzyme-assisted extraction (EAE) in a mild, selective, and sustainable way, as alternative to organic solvent extraction. In gastronomy and culinary arts, the green color from chlorophyll is highly desired. However, its scarce stability, after the extraction from plant tissue, need to control many factors (such as pH, oxygen, light, heat exposure). More stable chlorophyll molecules may be obtained using divalent cations before extraction. This research proposes an innovative biotechnological combined approach, based on the simultaneous application of EAE in the presence of divalent cations (such as Zn^{2+}) for the recovery of chlorophyll from unsold spinach, to be used as food natural colorant. The concomitant use may be helpful to preserve the bright and intensity of green color during the pigment recovery from vegetal tissue. The plant matrix has been characterized in terms of cell wall polysaccharide composition and a tailored enzymatic mix, based on cellulase (40%) xylanase (41%) and polygalacturonase (19%), has been formulated. The process variables have been optimized in order to maximize the amount of recovered chlorophyll and, concurrently, the quality of the green color of the extract.

TD-WAXS Characterization of Biopolymers and Spray Dried Microparticles Incorporating Hydroxytyrosol Alkyl Esters

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Abstract:

Spray drying (SD) is a technique to convert liquid or slurry feedstocks into microparticles. The crystallinity of the resulting particles can be influenced by the feedstock, process conditions, and post-processing steps. Crystallinity in SD microparticles often starts with the crystalline structure of the solute in the liquid feedstock. If the solute is a crystalline material, the microparticles are more likely to have crystalline regions. The temperature and pressure during the spray drying process can affect crystallinity. In SD microparticles crystallinity can be assessed using X-ray diffraction (XRD), differential scanning calorimetry (DSC), or microscopy. These techniques provide information about the degree of crystallinity, crystal size and structure. Encapsulation of purified walnut oil (PWO) with Capsul® (C) as encapsulating agent and sodium alginate (SA) as outer layer was performed by SD, integrating hydroxytyrosol esters (HTE) with different alkyl chain length. Three systems were studied: (PWO-C(HTE-[C4] [C10] [C18])/SA. HTEs affected the thermal stability of

the microparticles, increasing the melting point and the oxidative stability. The highest stability of PWO-C(HTE-C10)/SA suggests a specific location of HTE-C10 at the oil:water interface, protecting PWO during drying and storage. Using Temperature Dependent Wide Angle X-ray Scattering (TD-WAXS) we assessed the influence of both matrices, capsul and walnut oil in the prepared PWO-C/SA microparticles looking for evidence of the HTE allocation, in the matrix, between 40 – 240 °C. Overall, controlling the crystallinity of SD microparticles is essential in various applications, such as food products, pharmaceuticals, and advanced materials, where the physical and chemical properties of the particles are critical for product performance.

An Assessment of Variation in Micronutrient Profile, Antioxidant Activity and Shelf Life of Non-Centrifugal Sugar (NCS)

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Abstract:

Jaggery, a non-centrifugal sugar (NCS), is used as a traditional and is considered healthier over refined sugar due to its nutritious non-sugar components. More than 80% of the total world jaggery production is done in India and Brazil. The major components of nutritional interest in NCS are sugars, moisture, minerals and bioactives. Jaggery being one of the least processed sweeteners, retains phenolics and other phytochemicals with potent biological activities and hence a need to quantify its nutrients and check for biological absorption and function. A total of 30 NCS samples were evaluated for variations in the composition of minerals, vitamins and bioactive compounds, with respect to processing conditions. The micronutrient profile, total polyphenolic content, water activity, and browning index varied between block and powder samples. Few unreported phenolics and flavonoids such as isoferulic acid, prunitrin, and maritimetin were detected in selected NCS samples which are known to have anti-inflammatory properties. Variations among in vitro antioxidant activity (DPPH EC50 = 2.5-18 mg/mL, ABTS EC50 = 0.15-0.5 mg/mL and FRAP = 8-21 µmol/g) could be correlated ($r \geq 0.5$) with phenolics (1-5 mg GAE/g NCS) and flavonoids (1-3 mg QE/g NCS) contents. Furthermore, a lower microbial count was observed with higher polyphenolic content. Thus, a standard composition of micronutrients/bioactives cannot be considered for NCS produced even at the same unit during the same season. Furthermore, this study indicates that processing conditions, region and sugar cane variety used for NCS production influence the bioactives and their potential health benefits.

Investigation of Antimicrobial and Antioxidant Activity of *Eucalyptus radiata* Leaf Essential Oil and Its Nanoemulsion: *In vitro* and Meat Application

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Abstract:

The nanoemulsions of essential oils are great biomaterials with antimicrobial and antioxidant properties. Therefore, the objectives of this study (1) to determine chemical composition, antimicrobial activity, and DPPH radical scavenging activity (IC_{50}) of microwave extracted *Eucalyptus*

radiata leaf essential oil; (2) to evaluate *Eucalyptus radiata* essential oil– nanoemulsion particle size, zeta potential, whiteness index, DPPH radical scavenging activity (IC_{50}), and both in vitro and in situ antimicrobial activity. According to GC-MS analysis, the main components of eucalyptus essential oil were o-cymene (45.4%), 2-bornene (26.29%), 1,8-cineole (11.31%), and α-pinene (9.25%). The IC_{50} values for essential oil and nanoemulsion were 107.5 µg/mL and 274.66 µg/mL, respectively. The nanoemulsion had particle size of 52.04 ± 31.44 nm and zeta potential of 9.16 ± 0.63 mV. The essential oil demonstrated strongest antimicrobial activity in disc diffusion assay against *Bacillus cereus* with (24 ± 2 mm) inhibition zone, and followed by *Staphylococcus epidermidis* (20.5 ± 0.5 mm). The minimum inhibitory concentration values of eucalyptus essential oil were 0.116 mg/mL for Staphylococcus spp. and 0.233 mg/mL for Salmonella spp. In addition, eucalyptus essential oil had higher antimicrobial activity against the gram positive bacteria, while nanoemulsion had stronger antimicrobial activity against the gram negative bacteria. Furthermore, results of the time kill assay for nanoemulsion provided 1 log CFU/mL of reduction for *S. aureus* and complete inhibition (7 log CFU/mL) for *Escherichia coli*. Application of nanoemulsion as an edible coating to fresh beef chunks also demonstrated antimicrobial activity against both spoilage and pathogenic bacteria.

Lipolysis Control by Pickering Emulsion and Emulsion-Filled Beads: Mixture of Triglyceride and Tributyrin

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Abstract:

Fatty acids exert numerous beneficial effects on human health. Butyrate in body can supply energy for the body. And unsaturated fatty acids prevent hyperlipidemia, exert anti-inflammatory properties. Lipophilic compounds associated with food supplements include fat-soluble vitamins, saturated or unsaturated fatty acids, etc. However, the lipophilicity and bioavailability of fatty acids poses a major technical challenge to food industry. Herein, we used Pickering emulsion and Pickering emulsion-filled polysaccharide beads to encapsulate the prodrug of butyrate-tributyrin. The lipolysis of those systems was evaluated. The digestion and intake of gut microbes on short - and long-chain fatty acids *in vitro* fermentation were tested. In particular, the release level of fatty acids from triglyceride and tributyrin encapsulated in emulsion and emulsion-filled beads in cooperation with digestive enzymes and gut microbes were measured. Overall, the lipolysis behavior could regulated by using emulsion and emulsion-filled beads. In the early stage of fermentation, gut microbes showed the rapid growth rate and high cell viability, which reached 11.51 ± 0.1 log/mL from the beginning of 9.45 ± 0.1 log/mL of fermentation liquor. Correspondingly, the detected content of long-chain fatty acids decreased significantly, possibly indicating that long-chain fatty acids were adsorbed by gut microbes and played an important role in the growth and differentiation of them. But in the presence of butyrate, the increasing content of long-chain fatty acids indicated that the added of butyrate would affect the absorption of long-chain fatty acids and lead to faster growth of gut microbes. The absorption and functions of various fatty acids to human body are different, so precise design is needed for specific nutritional supplement.

Understanding the Structure and Functionality of Third-Generation Rice Flour Snacks Enriched with Grape Pomace Flour

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Abstract:

Extrusion can yield either an expanded product or a non-expanded pellet. In the case of non-expanded pellets, indirect expansion occurs later in a separate thermal device, forming an expanded matrix, commonly known as a third-generation (3G) snack. Structural changes in both processes are influenced by processing conditions and product formulation. However, their impact on ingredient structure formation, retention of functional ingredients (e.g., polyphenols), and overall structural development remains unclear. This study aimed to analyze the impact of extrusion temperature (110, 150 °C) and grape pomace flour (GPF) addition (0-15% w/w) using a twin-screw extruder on physical, textural, and microstructural properties, as well as total polyphenol content (TPC) and antioxidant capacity of rice 3G pellets, subsequently expanded with a microwave oven (30 s at 480 W). The results indicated that GPF addition increased bulk density (from 0.12 to 0.39 g/cm^3), hardness (from 29.5 N to 37.59 N), and crispness (from 43.67 to 110.00) of 3G snacks, while decreasing the expansion index from 1.83 to 1.65. Micro-CT results showed no influence of extrusion temperature on the microstructural parameters of 3G snacks. However, GPF addition reduced porosity, pore size distribution, and increased inner cell walls thickness. The extrusion process reduced the initial TPC by up to 52% in pellets, but microwave expansion increased their concentration by up to 37%, probably due to a rubbery transition of the glassy structure. DPPH and ORAC results of 3G snacks showed a similar trend to TPC. In summary, these findings demonstrate the potential for developing nutritionally and technologically enhanced 3G snacks by valorizing agricultural by-products like GPF.

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.

Optimization of Sensory and Nutritional Quality of Krill Protein for the Development of Novel Food Ingredients

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Abstract:

Due to the active search for alternative protein sources for human consumption, functional and nutritional products could/should? be developed from novel or underutilized marine resources. The nutritional and functional quality, as well as sensory and safety characteristics of such novel products are some of the main parameters to define their possible applications for human consumption and final acceptance by the consumers. Antarctic krill (*Euphausia superba*) protein concentrate has been produced by the Norwegian company Rimfrost. After enzymatic hydrolysis, the fat and shell fractions were separated, ultrafiltrated and spray dried. The physicochemical composition of the krill protein ingredient was 0,2 % fat, 3,9 % water content, 11,5 % ash, 78,2 % protein. All essential amino acids were present in the krill protein, and the ratio of essential to non-essential amino acids was 0,61. The peptide profiling of the concentrate by UPLC showed a predominant amount of peptides with MW below 5kDa. Antioxidant capacity in the initial ingredient was confirmed by ORAC and DPPH methods. The protein concentrate has been submitted to further deodorization trials by supercritical fluid extraction, at different process conditions, as to reduce the initial content of trimethylamine (TMA) and trimethylamine oxide (TMAO), which could be harmful in case of dietary consumption. Thus, without TMA and derivatives, and with ensured final krill protein high nutritional quality and safety, the concentrates could be part of human diets as food ingredients.

In vitro – In vivo Correlation was Improved when *In vivo* Gastric Emptying Rates were Applied for Oil-in-Water Emulsions with Different Physical Properties

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Abstract:

In vitro digestion methods are important tools in understanding how food physical properties affect their digestion which may in turn help to explain nuanced differences in nutrient absorption, with

potential implications for metabolism. In this study, the influence and intersectionality of emulsion droplet triacylglycerol crystallinity and acidic colloidal stability were investigated for a series of oil-in-water emulsions using the TIM-1 dynamic *in vitro* digestion simulator and compared with results from a randomized controlled acute meal trial with healthy men. Four 20% oil-in-water emulsions were formulated to have similar particle sizes ($D_{3,2}$ ~130 nm) and containing either partially crystalline palm stearin or liquid palm olein at 37 °C and either an acid-stable (Tween 80, 2.2%) or acid-unstable (Span 60, 2.5%) emulsifier. No significant differences were observed in terms of postprandial plasma triacylglycerol response ($p>0.05$). In contrast, the liquid stable emulsion had significantly higher cumulative TIM-1 fatty acid bioaccessibility ($p<0.05$). Notably, the attenuating crystallinity effects *in vitro* were blunted when the droplets were susceptible to acidic flocculation. Gastric ultrasonography evidenced clear differences in emulsion gastric emptying rate between the emulsions and hypothesized to explain the discrepant findings. Indeed, adjusting the TIM-1 emptying rates to align with the differences observed *in vivo* yielded similar results as the human study. These observations underscore the importance of utilizing physiologically relevant transit rates in *in vitro* digestion models when comparing foods with different physical properties (which may also change in the gastrointestinal tract) and of recognizing and rectifying such limitations of *in vitro* digestion models.

Nanostructures as Conveyors of Functionality in Foods: The Case of Cannabidiol-Based Nanostructured Lipid Carriers

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Abstract:

Nanostructures incorporating functional compounds have earned their place as a very efficient means of conveying functionality in foods. They may be used to tackle malnutrition, reduce calorie density, reduce food digestibility, increase micronutrient bioavailability, control gut health, allow personalized nutrition and provide appropriate food for the elderly, among other potential uses. Building such nanostructures, particularly when considering that they need to be edible, is a challenging task. This keynote will address the latest developments made by our research group towards tackling some of these challenges, together with our vision on what still needs to be done and which partnerships are important to lead us to further improve their performance. The incorporation of cannabidiol (CBD) into nanostructured lipid carriers (NLC) will be given as an example of a potential solution to mitigate its low bioavailability, which represents a big challenge for the development of CBD-products. Some details regarding their development (e.g., using innovative emulsifiers) will be provided and the consequences in the stability of CBD will be analysed.

Assessment of the Influence of the Mediterranean Diet in Human Life Quality Above 40s

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Abstract:

A diet rich in plant-based has been associated with multiple health benefits, including a reduction in the risk of developing non-communicable diseases caused by unhealthy habits. Soups, rich in bioactive compounds, are common food in the Mediterranean diet, being associated with an overall mortality reduction and lower risk of developing obesity, cardiovascular disease and type 2 diabetes and premature cellular aging. Anchored on a current research consortium (DM4You: "Potential of the Mediterranean Diet to increase quality of life: [+]health [+]sustainability") that gathers several Portuguese partners (13), we will follow the impact of diet on cellular aging and inflammatory response along one year in healthy individuals above 40 years old. We aim to evaluate the impact of soup and fruit diet on the blood plasma and spittle proteome for two age intervals (41-50y; 65-75y). The study considers a "crossover" system with nutritious soups (N) and basic soups (B) with a two month of "wash-out". Soups (5N and 5B) will be selected following sensory and nutritional evaluation. Targeted and untargeted proteomic approaches will be followed, and information will be conjugated with parameters such as blood pressure or BMI (Body Mass Index). With this work we aim to contribute to a better understanding of the relationship between diet, blood plasma proteome and health. **Key-words**: cellular aging; mortality reduction; vegetable soups. **Funding**: Research and Innovation Agenda for Sustainable Agriculture, Food and Agro-industry [Innovation Agenda for Agriculture 20|30] (PRR-C05-i03-I-000152-LA1.3; PRR-C05-i03-I-000152-LA1.4)

Inulin as Fat Replacer in Cream Cheese

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Abstract:

The consumers' preference for fermented milk products and the growing demand for spreadable products widen the scope of the cream cheese market. Cream cheese is an acid coagulated, unripened, soft variety of cheese. It contains approximately 55% moisture and 33% milk fat. However, in connection with the current rise in the risk of lifestyle diseases, the production of food products with beneficial health effects along with nutritive value is gaining considerable attention. An attempt was, therefore, taken to add inulin, a linear non-digestible polysaccharide into the cream cheese as a fat replacer at the rate of 0.25 g for 1 g of fat replacement in milk. The products were analyzed for sensory characteristics through a descriptive test using 100 point sensory score card, and textural and rheological properties by using a texture analyzer and rheometer, respectively. The sensory scores for flavour, body and texture, colour and appearance of full fat cream cheese were higher than the reduced or low fat cheese. Though the firmness of full fat cream cheese was higher than the reduced or low fat cream cheese, it was increased gradually with increasing the level of replacement of fat with inulin. The stickiness of cream cheese decreased gradually with

the reduction of fat content but after 50% fat reduction, the stickiness increased again with the reduction of fat content. It was observed that with a reduction of fat, the time dependent viscosity as well as shear rate dependent viscosity decreased, while with increasing inulin level the viscosity increased. The study revealed that 50% replacement of milk fat with inulin is acceptable as the changes were non-significant ($p>0.05$) up to this level of replacement. **Keywords:** Fat Replacer, Firmness, Stickiness, Time Dependent Viscosity, Shear Rate Dependent Viscosity.

Screening of Enzymatic Complexes for the *In-situ* production of Prebiotics in Dairy Products

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Abstract:

Consumers' awareness of the negative impact of high-sugar consumption on health has increased. As a result, the food industry has been pressed to develop innovative products with reduced sugar. Herein, we aimed to develop a functional fruit preparation for further inclusion into dairy products, by converting its sucrose content into prebiotic fructo-oligosaccharides (FOS) . Commercial enzymatic complexes with transfructosylation activity (Pectinex®Ultra SP-L, Viscozyme®L, Novozym®960, and Catazyme®25L) were studied in the catalysis of sucrose conversion into FOS using an *in-situ* approach. Reaction conditions were optimized to maximize the yield in FOS. The selected enzymatic complex was then applied in a commercial strawberry preparation. At optimal conditions, maximal FOS yield in a sucrose model solution ($g_{FOS}/g_{ini.sucrose}$) was attained for Novozym– 0.629±0.002 (47.4 ℃, pH 5.4, *t*=0.5 h), followed by Viscozyme– 0.624±0.003 (60.1 ℃, pH 5.7, *t*=5.5 h), Pectinex– 0.619±0.003 (58.7℃, pH 5.7, *t*=6 h), and Catazyme– 0.444±0.001 (49.1℃, pH 5.7, 2 h). Thus, Novozym was chosen for further application in the strawberry preparation, in an enzyme:substrate ratio of 1:99 (v/v). Novozym produced 293.2±0.7 g/L of FOS, yielding 0.630±0.003 $g_{FOS}/g_{ini.sucrose}$ after 1.25 h reaction in a lab-scale setup. Similar results were obtained in a pilot-plant study (290.2±0.8 g/L FOS). The *in-situ* approach proved to be efficient and suitable for industrial applications. The strawberry preparation prototype had 56% (w/w) FOS incorporated, less 85% of its initial sucrose amount, and a caloric value reduced by 27%. Results on *in-vitro* gastrointestinal digestion, gut microbiota modulation, and sensory experience with the new formulation will be presented at the conference.

Seaweeds: An Alternative Source of Proteins for Human and Animal Nutrition - Realities and Perspectives

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Abstract:

The macroalgae or seaweeds are mainly used as sea vegetables or in ingredients (phycocolloïds) in human nutrition and by the food industry. Some species belonging to the family of red seaweeds are known to contain high level of proteins. For example, the algae of genus *Porphyra*, consumed under the name of Nori, show a protein content wich can reach up to 47 % of dry weight. Another

red seaweed frequently used in Europe as sea vegetable, *Palmaria palmata* or Dulse is also described for its high level of proteins (25-35 % of dry weight). In this context, what future for the use of seaweeds as dietary proteins for human or animal nutrition? This conference takes stock of the nutritional value of algae proteins, factors limiting their digestibility and useful processes removing the anti-nutritional compounds such as polysaccharides.

Capitalizing on Dietary Bioactive Interactions for Enhanced Human Health

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Abstract:

Dietary bioactive compounds (i.e. essential nutrients, phytochemicals, and drugs) are still largely studied in silos. However, synergistic and competitive interactions between compounds arise during food processing, mixed meal consumption and digestion, and post-absorption within tissues. For example, the gastrointestinal absorption of inorganic iron from plant foods is typically inhibited by antinutrients (e.g. tannic acid, phytic acid), but facilitated with ascorbic acid. The Kopec laboratory has been leveraging both conventional and novel food processing approaches to produce more bioavailable forms of iron within plant foods, through complexation with chlorophyll derivatives, to better mimic highly bioavailable heme iron. They have also been studying the effects of different lipid formulations on carotenoid and fat-soluble vitamin delivery (vitamins A, D, E, and K), using *in vitro* digestion followed by Caco-2 incubation, to mimic small intestinal absorption. Samples are analyzed using both targeted and untargeted liquid chromatography-mass spectrometry (LC-MS)-based metabolomics to elucidate these interactions. The knowledge gained from these studies is directly applicable to better formulation of mixed food products and supplements which maximize micronutrient and fat-soluble vitamin uptake from mixed meals, and limit competitive interactions between compounds.

Strawberry Konjac Jelly as a Model for Carrying the Hydrogel-Encapsulated Beads Containing Organic Coffee Extract from Cold Brew Spent Coffee Ground: The Quality Changes of During Cold Storage

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Abstract:

In this study, the antioxidant crude extract from cold brew spent coffee ground (CSCG) was successfully extracted with high antioxidant activity and polyphenol content. The major compound found was quinic and caffeic acid. The spent coffee ground used in this study was the by-product from private cold-brew coffee company in the north of Thailand, which still contained high polyphenol content (18.9 mgGAE/g dried coffee ground). We found that the loss of total phenolic content (25.76%), caffeine (36.91%), and antioxidant potential (36.67%) from the CSCG were observed when applied thermal process (121°C, 15 min) and subjected to static simulated gastrointestinal digestion (INFOGEST method). Hence, the hydrogel-encapsulation was proposed to protect the polyphenols in CSGC with the encapsulation efficiency at 89%. These encapsulates were then

added into the food model of strawberry konjac jelly for revealing the protection efficiency and the effect of cold storage. During the storage period, the pH of the jelly was significantly decreased, while the total soluble solid was significantly increased after 30 days. The total phenolic content, vitamin C, and antioxidant activities significantly decreased along with the storage time, as well as the bioaccessibility of the polyphenols resulted by *in vitro* digestion. The hardness, cohesiveness, and chewiness of the jelly increased due to the interaction of the post-gel structure during storage. The sensorial characteristics and the texture attributes were changed at the 60 days of storage, while the microbial content was still conformed the regulations. The shelf life of the jelly product should not exceed 60 days.

Exploration of Functional Compounds in *Gardeniae fructus* and Its Industrial Application

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Abstract:

Gardeniae Fructus (Zhizi in Chinese) as a traditional medicinal food in China, is rich in iridoid glycosides (e.g.,geniposide, genipin, carotenoids (e.g., crocetin, crocin I, crocin II), flavonoids (e.g.,rutin, quercetin), saponins, polysaccharides, and phenolic acids (e.g., chlorogenic acid, ursolic acid). Among them, crocins as a precious natural pigment and bioactive compounds with health-beneficial properties, is only found in Gardeniae Fructus except saffron. Recent studies have found that gardenia fruit contains high content of oil (about 20%). It was reported that to date, Gardenia Fructus oil is the only natural oils that contains crocins (up to 100 ppm). During oil production, a large number of side streams such as gardenia husk and meal are generated. Both of the Gardeniae Fructus oil and side streams have gained our attention due to their positive correlation with several functions, *i.e* preventing diabetes, hyperlipidemia, cardiovascular diseases and neuroprotective effects. Among them we are taking more attention on its neuroprotective effects, such as anti-dementia, anti-depression, anxiolytic, hypnotic, improving cognition, memory improvement, and other brain function disorders. Based on the researches, Zhejiang Jiaozhi Technology Ltd Co was founded and till now developed several products including Gardenia oil, Gardenia tea, solid seasoning, Gardenia flower essential oil and beauty products.

Enhancement of Antioxidant Potential of *Lassi* (A Traditional Indian Yoghurt Based Fermented Milk Drink) Fortified with Indian Cottage Cheese Whey Partially Fermented by *Streptococcus thermophiles*

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Abstract:

Lassi is a popular traditional Indian yoghurt (prepared by *Lactococcus lactis* ssp. *cremoris* and

Lactococcus lactis ssp. *lactis* biovar *diacetylactis*) base fermented milk drink that possesses various functional properties including antioxidant activity. The present work was carried out with an aim to enhance the antioxidant potential of *Lassi* through the addition of partially fermented Indian cottage cheese whey.Indian cottage cheese whey was partially fermented with *Streptococcus thermophilus* @1.5% for 24h at 42^{0}C and added to the Indian yoghurt for enhancement of the antioxidant potential of *lassi*. The Antioxidant activity of *lassi* was measured following 2.2'- Azinobis (3-ethylene benzothiazoline) 6- sulphonic acid (ABTS) and 2, 2 diphenyl-1-picryl hydrazyl (DPPH) assay. *Lassi* fortified with partially fermented whey exhibited higher antioxidant activity (77.22$\pm$ 0.50 µM TEAC by ABTS and 15.90 $\pm$ 0.08 % DPPH inhibition) when compared to the *lassi* without fortification (70.05$\pm$ 0.67 µM TEAC by ABTS and 12.41 $\pm$ 0.02 % DPPH inhibition). The findings indicate that fortification of fermented milk drinks like *lassi* with whey partially fermented by *Streptococcus thermophilus* not only increases the antioxidant potential but also mitigates the environmental load and nutritional loss by using the whey produced during the processing of Indian cottage cheese.

Keywords: *Lassi*, yoghurt, whey, antioxidant activity, ABTS, DPPH

Exploring Seaweeds and Brewer´s Spent Yeast Resources towards the Iodine Deficiency Disease

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Abstract:

Iodine is the world's most prevalent micronutrient deficiency, causing several health disorders known as Iodine Deficiency Disease (IDD), and affecting pregnant women, children, and vegetarian persons. Although the universal salt iodization has been a common strategy to prevent/control IDD, it presents some chemical disadvantages. Thus, efforts have been made to develop new iodine-carrier nutraceuticals from iodine-enriched foods. This work evaluated the potential of Brewer´s Spent Yeast (BSY) – the second major by-product of brewing process, to adsorb the natural iodine from *Fucus vesiculosus*. The seaweed extract was prepared by Subcritical Water Extraction (90 °C, 100 bar, flow rate of 10 mL/min) and kinetic and equilibrium experiments were performed using lyophilized BSY biomass, at pH 4, room temperature and at predefined initial concentrations of seaweed extract and mass of BSY. The BSY, before and after the iodine uptake, was characterized by the determination of the point of zero charge, Fourier Transform Infrared analysis, Scanning Electron Microscopy with energy dispersive spectroscopy and bioaccessibility. The equilibrium was achieved in 5 min and the kinetic constant was 0.45 ± 0.08 g BSY/µg iodine.min. The maximum biosorption capacity of *Fucus vesiculosus* iodine extract by the BSY biomass was 26 ± 4 µg iodine/g BSY. The mean ingestion of 5.0 g/day of iodine-enriched BSY could satisfy between 35-60% of iodine RDA for adults and around 22-35% of iodine RDA for pregnant women. Overall, these findings suggest the potential of the iodine-enriched BSY as an efficient iodine-carrier nutraceutical for the treatment/prevention of IDD.

Bioaccessibility and Anti-Glycation Property of Ethanolic Crude Coffee Extract Obtained from Organic Cold Brew Spent Coffee Ground

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Abstract:

The effect of the thermal treatment and *in vitro* digestion on the anti-glycation property of ethanolic crude extract of cold brew spent coffee ground (CSCG) extracted with ultrasound assisted extraction was studied. From polyphenol profile analysis, the phenolic compounds found in crude extract from CSCG were 5-caffeoyl quinic acid, 4-feruloyl quinic acid, quinic acid, and caffeic acid. The simulated gastrointestinal digestion reduced the total phenolic content of the extract 10.37%. The reduction of caffeine (32.59%) and antioxidant activity (26.58%) were also observed. Moreover, the loss of total phenolic content (25.76%), caffeine (36.91%), and antioxidant potential (36.67%) on the crude extract from CSCG were observed when applied thermal process (121°C for 15 min using an autoclave) and then follow by the simulated gastrointestinal digestion. The thermal treatment could degrade the phenolic compounds and antioxidant capacity leading to lower bioaccessibility and anti-glycation potential. Nevertheless, the thermal crude extract from CSCG after simulated gastrointestinal digestion still showed the anti-glycation potential when monitor through the reduction of fructosamine content (20.10%), advanced glycation end-product (46.38%), and amyloid cross β structure content (54.61%) in the bovine serum albumin and glucose system.

Plants as a Source of Milk Clotting Agents: An Overview of Sources, Properties and Applications

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Abstract:

Plant extracts are essential in different traditional practices pivotal in necessary food processing, such as cheese production. Since ancient times, vegetable extracts have been utilized as coagulants in cheesemaking. The earliest reference is assigned to Lucius Junius Columella in his treatise De Re Rustica (c. 50 BC): '... though it can also be coagulated with the flower of the wild thistle or the seeds of the safflower, and equally well with the liquid which flows from a fig-tree.' The proteolytic activity of specific plant extracts that can coagulate milk is present in various species. These proteases, such as ficin from Ficus sp., papain from Carica papaya and cardosins from Cynara sp., are sometimes constituents of latex, fruits, roots, seeds and/or sap, but mainly of their leaves or flowers. The present study aimed to identify novel milk coagulants to be used in cheesemaking; for this purpose, aqueous extracts from different plant species were tested for their caseinolytic (CA) and milk coagulating properties (MCA) in skim milk at different temperatures. The obtained results confirm that other plant extracts are capable of coagulating milk and can also be considered as potential animal rennet substitutes. This study provides valuable insights into the development of potential vegetable coagulants that could be used for various production processes aimed at specific target consumers. **Keywords:** Curd yield; Milk clotting; Plant extracts; Proteases; Kinetic parameters

Rough Fe3O4/Gold Nanostructure Enhanced Fluorescence of Quantum Dots for *Salmonella typhimurium* Detection in Cabbage

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Abstract:

The sensitive detection of *Salmonella typhimurium(S. typhimurium)*is crucial to control the fresh vegetables-relatedoutbreaks.Here, fluorescence-based *S. typhimurium*detection in fresh cabbage has been reported using plasmon-exciton interaction between non-spherical AuNPs-coveredFe3O4NPs (Fe3O4@Au NPs) and goldquantum dots (AuQDs).At first,aseed-mediatorapproach ofFe3O4@ AuNPssynthesis usinghydroquinone wasreported.Then, a new synthesis method of Au QDs has been reported through hydrothermal method.Atwo-foldemissionenhancementand shortening of the lifetime were achieved fromurchin-likeNPs compared with thoseof spherical NPs.This finding waspotentially be expanded for the detection of*Salmonella typhimurium (S. typhimurium)*. Results revealed thatthe changes in fluorescence emission werelinearly correlated with the concentration of *S. typhimurium*(100-1000 CFU mL-1)and the limit of detection was *87*CFU mL-1infresh cabbage. The proposed detection method was highly selectiveand suitable for real-life applications.

Predicting the Linear Elasticity of Starch Dispersions During the Initial Stages of Granule Swelling

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Abstract:

Starch pasting, i.e., the process by which aqueous dispersion of starch granules thicken upon heating, greatly influences the texture of a variety of consumer products. The current industrial paradigm is to use trial-and-error approaches to manipulate starch dispersions, which requires significant testing/investment when formulating new materials for different industries. Here we discuss a first-principles approach to predict the storage modulus (G') of starch dispersions during the initial stages of granule swelling. In the first part of the talk, we show how Flory theories of polymer network swelling allow one to predict the swelling kinetics of starch granules given their chemical composition, cross-link density, and temperature. These theories yield the granule volume fraction $\phi(t)$ of the suspension, which allows one predict the dispersion's storage modulus (G') over time. In the second part of the talk, we demonstrate via Stokesian dynamics simulations and experiments that one can use rheology theories for rigid particle suspensions to predict G' for volume fractions $\phi < 0.5$. For $\phi > 0.5$, one needs to take the granule's deformability into account. In the latter regime, we find that the storage modulus G' vs granule volume fraction ϕ fall onto a master curve when G' is normalized by $\gamma/\bar{R}$, where γ is the granule-solvent

interfacial energy and $\bar{R}$ is the average swollen granule size. This master curve allows one to forecast the G' of many starches (different maize and rice varieties) and food products (soups and gravies) for arbitrary heating, if one predicts the granule volume fraction from swelling theories.

Case Studies in Modulating the Texture of Nutritious Processed Foods by Ferulic Acid

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Abstract:

We present our recent discoveries of how ferulic acid has remarkable potential to impact the microstructure, physico-mechanical properties, and in turn the texture of nutritious processed foods. Our first case study focused on cooked white rice refrigerated over two weeks, investigating whether its glycaemic potential could be lowered without retrogradation being promoted, by using solubilised ferulic acid at $\times 10^{-2}$ mM aqueous concentration during the cooking process. From multifaceted analysis through advanced approaches such as NMR, analytical ultracentrifugation, differential scanning calorimetry, and Raman mapping, it was found that ferulic acid could interfere with gelatinised amylose recrystallisation via noncovalent interaction. This not only promoted starch aggregation and reduced *in-vitro* digestibility, but also enhanced the preservation of bound moisture content, bearing positive implication for palatable consumption despite the prolonged storage. Our second case study focused on developing a plant-based mimetic of bouncy fishballs — a food staple in Asia — with high textural authenticity and high protein content (>15% w/w) at the same time. We employed unilateral compression up to 80% strain to compare the stress-strain profiles of different prototypes against a commercial real fishball. Eventually, we demonstrated that by adding non-oxidised ferulic acid at 1 mM to a composite matrix comprising soy protein and curdlan, the spatial distribution of these two main ingredients was influenced such that it reproduced the signature mechanical behaviour of a real fishball reference. Interestingly, when used in oxidised form, ferulic acid could enhance curdlan network strength for other processed food innovation, such as the structuring of unsaturated plant-based lipid.

Rheological and Tribological Implications in the Design of Soft Solid Foods for a Safe Swallowing

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Abstract:

The intersection of food design issues and health practices often remains poorly coordinated. This research borders between food formulation technology and applied soft matter and aims to be useful in medical nutrition practices. Soft solid preparations were designed for people with

swallowing difficulties, formulated with physiophatic pears, which do not enter the market for fresh consumption and will be therefore upcycled into targeted products. Proteins (whey, spirulina) were added in the formulated pear purees to ensure a better nutritional intake. For patients with oropharyngeal dysphagia, the viscosity of foods they consume must be adapted to avoid cough after swallowing and *ab ingestis* pneumonia more generally. To test different suitable consistencies, enzymatic treatments and texturing by means of carboxymethylcellulose allowed to range the perceived texture from a slightly thick to an extremely thick consistency, according to the International Classification for Dysphagia Diet Standardization. Besides the quantification of the flow behavior, the rheological properties of the formulated purees were evaluated by thixotropy and back-extrusion tests. Finally, the tribological aspect were considered that can provide an understanding of the interaction with the oral surface. As expected, the proteins, the thickening agent and possibly the pectinase significantly influence the viscosity of the dispersions. Together with the increase in the viscosity of the purees, the thickener caused a considerable increase in the recovery of the thixotropy, a weakening of the gelling dispersion and a drastic increase in the mucoadhesiveness. Findings contribute to understand the implications of oral processing in designing foods for dysphasic patients.

Effect of enzymatic hydrolysis on solubility and surface properties of pea, rice, hemp, and oat proteins with high protein concentrations

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Abstract:

Understanding the optimum circumstances and cost-effective way for using proteolytic activity to increase plant protein functionality can help industry and other researchers efficiently use plant protein hydrolysates in food and pharmaceutical markets. Accordingly, pea, rice, hemp, and oat proteins at 5% and 10% concentrations were modified using controlled hydrolysis by Alcalase® and their solubility and surface properties were measured. An increase in the degree of hydrolysis at 30, 60, 120, and 300 min intervals showed a progressive proteolytic activity at both protein concentrations that led to the free amino groups' exposure. Increasing the hydrolysis time to four, five, and ten times more than 30 min further increased protein solubility by producing small-sized polypeptides in all plant proteins at both protein concentrations with increased negative charges on the oat protein surface. The relative fluorescent intensity and the protein profile suggest that hemp was the best responsive plant protein for hydrolysis as the basic subunits with hydrophobic groups were intensified by hydrolysis. Although pea protein hydrolysates were greatly soluble, hydrophobic patches diminished after hydrolysis. The complex conformation of rice protein restricted Alcalase® from accessing the protein structure and limited surface properties. Proteins with balanced interfacial properties can greatly interact together and with other food components, strengthening the food matrix to form a better structure and quality. Prolonged hydrolysis and higher protein concentration increased attractive forces in protein hydrolysates. Hence, hydrolysis was essential for developing protein-rich beverages because it prevented proteins from aggregation, particularly in a solution with increased protein concentration.

State Diagram of Freeze-dried Sardine and their Applications in Determining Stability

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Abstract:

State diagram is used to determine the stability of dried and frozen foods during their processing and storage. In this study, state diagram of sardine was developed by determining freezing curve, glass line, solids melting-decomposition line and maximal-freeze-concentration conditions. Glass transition temperature decreased with the decrease of solids content (i.e. increasing water) and it was modeled using modified Gordon-Taylor equation. The glass transition of dry-solids and critical temperature were 184.1 and 9.5°C, and model parameter was estimated as 4.1°C, respectively. Solids melting-decomposition temperature was modeled by Flory-Huggins equation; and dry-solids temperature, and solids-water interaction parameter was determined as 199.4°C and 0.956, respectively. Freezing point of fresh sardine was observed as -1.3°C with ice melting enthalpy of 186.3 kJ/kg, and it decreased with the decrease of solids due to the freezing point depression. Freezing point was modeled by Chen equation based on Clausius-Clapeyron equation. The ultimate maximal-freeze-concentration temperatures, $(T_m')_u$ and $(T_g''')_u$ were determined as -18.6 and -25.1°C, respectively and maximal-freeze-concentration solids was estimated as 0.93 g solids/g sample (i.e. un-freezable water 0.07 g water/g sample). This indicated that frozen sardine could be most stable if stored below -25.1°C, and dried fish below glass transition. **Keyword:** sardine, dtate diagram, glass transition, oxidative stability

Native Sweet Maize Before and After Toasting: An Integral Comparative Study in Whole and Milled Kernels

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Abstract;

Sweet maize, with unique endosperm, creates vast interest, mainly because it has specialty kernels to consume as a non-conventional whole ready-to-eat maize. That consists in converting raw seeds into edible maize kernels using traditional or microwave toasting. Sweet maize kernels with 14 g/100 g moisture content (T0) were subjected to a pan (T1) and microwave (T2) toasting. The kernels were packed in sealed paper envelopes for microwave maize and subjected to six microwave heating-toasting times from 0 to 390 s. Pauses every 60 s for a rapid manual shaking compensated for the non-uniformity of microwave volumetric heating. The comparative evaluation by kernel conditions (raw and toasted processes) revealed structural variations in starch granule size measured by scanning electron microscopy (SEM), ATR FTIR band intensities, relative crystallinity, blue value, and intrinsic viscosity. The toasting conditions generated kernel expansions studied

through the geometric, gravimetric, surface color, instrumental texture, milling average particle size, and hydration properties. The kernel size approaches reflected that water migration rates depended on the shape and size of kernels. The maximum rates displayed significant differences between the spatial $(S/V)^2$ and distance $(GMD/2)^2$ approaches, revealing a notable lack of consistency with the distance $(GMD/2)^2$ method. Surface color difference (ΔE^*), internal porosity, milling average particle size, and flour hydration properties displayed curves adequately described by simple and nonlinear regression models. The elastic/viscous modulus ratio decreased, unveiling rheological differences associated with microwave heating-toasting time effect on the structure of sweet specialty Andean maize kernel used for toasting.

Plant-Based Pizza Cheese: A Techno-Functional Characterization, Physicochemical Evaluation and Cooking Behavior of Three Commercial Products

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Abstract:

In recent years, a growing demand for plant-based alternatives to dairy products has been observed. To be accepted by consumers, these products should have functional and sensory characteristics similar to those of animal origin. In this context, the present study evaluated, from a techno-functional and sensorial point of view, three different plant-based pizza cheeses available on the Italian market, comparing their characteristics with products of animal origin. The cooking behavior of both plant-based samples and dairy references was measured by texture extensibility tests and oiling off. Moreover, the sample's melting behavior was evaluated by the rheological frequency sweep test and by differential scanning calorimetry (DSC), heating the products under a controlled temperature ramp. Proton relaxation times by ^{1}H-NMR was instead measured on the raw products. Finally, a sensory acceptability test was also performed. Significant differences were observed between the samples, based on their formulation. Texture and rheology showed that the plant-based products resulted in general less extensible than the dairy ones, with the higher elasticity observed for the sample containing starches and carrageenin. The reference samples showed higher release of oil during cooking, except when compared to the plant-based cheese containing nuts, coconuts, and olive oil. The samples' chemical composition also affected DSC thermograms and ^{1}H-NMR profiles, especially in relation to the type of fat and the presence of ingredients capable of binding water. Higher sensory scores were obtained for the dairy samples in comparison to the plant-based ones, especially when texture parameters were evaluated.

Novel Palm Shortening Substitute Using a Combination of Linseed Meal, Beta-Glucan and Rapeseed Oil

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Abstract:

The food industry is looking for sustainable alternatives to palm shortening, however there is currently none that is both functional and nutritionally-balanced. This study investigated the

potential of a novel ingredient (PALM-ALT) composed of defatted linseed meal, beta-glucan and rapeseed oil to mimic palm fat functionality in a cake formulation. The linseed and beta-glucan components were co-processed with rapeseed oil at specific ratios via high-shear mixing. The PALM-ALT ingredient was characterised by proteomics, laser diffraction and microscopy. Madeira cake products prepared with either palm shortening, rapeseed oil or PALM-ALT were characterised by sensory and instrumental analyses and microscopy. A number of emulsifying proteins including oleosins and conlinins were identified in the linseed meal. The PALM-ALT ingredient displayed a stable oil droplet size (25 µm). The PALM-ALT ingredient qualified for a reduced saturated fat claim in comparison with palm shortening, while the PALM-ALT cake qualified for reduced saturated and total fat claims and low saturated fat claim. The rapeseed oil cake proved more sour and less sweet than the palm fat control ($p < 0.05$), while the PALM-ALT formulation proved similar to the control. The PALM-ALT product scored a higher overall sensory quality than the rapeseed one ($p < 0.05$) while 60% of panellists preferred the PALM-ALT formulation. This study highlighted that a novel sustainable combination of defatted linseed meal and beta-glucan was able to mimic palm fat functionality, allowing to replace it with healthier rapeseed oil. Current work involves upscaling the PALM-ALT production and extending its range of palm-free applications.

Leaf Waste Management for Herbal Teas Formulation in the Mediterranean Area

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Abstract:

The global market of herbal teas has rapidly increased in the last year, especially after the pandemic Covid-19, due to the consumer interest in healthy food consumption. To support the growth of this market, which is projected to reach USD 4.38 Billion by the year 2030, new herbal teas are required, especially to meet the rising demand for caffeine-free products. Otherwise, the production of herbal teas from agronomic wastes could be of great interest in the context of sustainable productions which aim to find their possible reusing. It is well known that the leaves of different plant varieties which are disposed of after the agronomic treatments, are still rich in bioactive compounds such as phenolic compounds with well-known healthy pharmacological activity. The aim of this research was to evaluate the possibility of using the leaf wastes from the pruning activity of different Mediterranean agronomic productions for the formulation of herbal teas. The interest has been firstly paid to a common traditional plant, *Capparis spinosa* L. (capper), and different *Persea americana* Mill. (avocado) varieties whose cultivation is increasing in the Mediterranean area due to climatic change. The leaf wastes have been first chemically characterized; thus, they have been dried by traditional and innovative technologies; the effects of the drying technology on the amount of bioactive compounds such as phenolics, the antioxidant activity, the aroma compounds, and sensory characteristics have been evaluated. The herbal teas have been prepared and consumer acceptability tests have been also carried out to evaluate their commercial potential.

Food Packaging Materials containing Clay-Based Nanofillers as Active Agents

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Sabanci University SUNUM Nanotechnology Research Center, Turkey

Abstract:

A remarkable solution to today's challenge of preventing food losses and related economic and health problems is being provided by nanotechnology-based active food packaging materials. The presentation will cover the design and application of active food packaging materials containing natural, non-toxic clay-based nanofillers as active agents. Active food packaging materials in the forms of flexible packaging films or foam pads with different functionalities including antibacterial, ethylene release inhibition, ethylene scavenging and moisture scavenging properties have been developed. The designed food packaging materials have been shown to increase the time food products remain fresh compared to control packaging materials which did not contain the clay-based nanofillers as active agents.

Protein Extraction from Agro-Industrial Byproducts as Alternative for Animal-Derived Proteins in Bioactive Peptides Production

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Abstract:

Aquaculture and agriculture play an important role in the world economy, as the main sectors in agro-based industries with high production growth. According to FAO, total production of aquaculture and agriculture were 179 million tons and 9.3 billion tonnes in 2020, respectively. This growth is accompanied by numerous amounts of wastes, that can significantly impact the environment. In the bioeconomy context, plenty of alternative agro-industrial byproducts need to be explored. Thus, the aim of this work was to valorize different agro-industrial wastes, i.e., red Tilapia (*Oreochromis* spp.) scales and sunflower meal as potential protein source for protein hydrolysate production. For this propose, the first step was to extract the proteins. Gelatin protein (TSG) was extracted from Tilapia scale by a demineralization process followed by thermal water extraction, whereas, salt-assisted extraction followed by isoelectric precipitation was applied for sunflower protein isolate (SPI). The obtained protein isolates (protein content > 90%) were subsequently used to produce protein hydrolysates by single and sequential enzymatic hydrolysis treatments, which were respectively Alcalase® and Alcalase® followed by Flavourzyme® for TSG while Protamex® and Protamex® followed by Flavourzyme® were applied to SPI. The hydrolysates were characterized by their physico-chemical properties (degree of hydrolysis and molecular weight profile) and their Fe^{2+} and Cu^{2+}-chelating activities. Overall, TSG and SPI extracted from byproducts exhibit a high potential to be used as replacers for animal proteins in hydrolysates production. Moreover, upon sequential hydrolysis, TSG and SPI hydrolysates enhance the Cu^{2+}-chelating properties, whereas, Fe^{2+}-chelating ability results are better for single enzymatic treatments.

Essential Oil Nanoemulsions (*Cymbopogon citratus*) as Antimicrobial Agent in Edible Coatings

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Abstract:

Fungal diseases can affect fruits and to avoid post-harvest losses coatings with natural antimicrobials added with essential oils (EO) could be an alternative. Few studies have been carried evaluating the potential use of EO in nanoparticles. Thirty-four nanoemulsions with lemongrass essential oil (*Cymbopogon citratus*) were synthesized by varying stirring speed, EO concentration, mixture of surfactants (Span 80/Tween 80) and hydrophilic-lipophilic balance (HLB). Analysis to characterize particle sizes and stability were carried at time intervals of 0, 24 and 168h. Thermal gravimetric analysis (TGA) was used to evaluate nanoemulsion thermal stability. Antifungal activity of *C. citratus* nanoemulsion was evaluated against the fungi *Colletotrichum gloeosporioides* and *Alternaria alternata* by direct contact method. Among all synthesis, optimal stability was shown with a hydrodynamic size of 83.42 nm, zeta potential of -20.29 mV, attributed to a HLB value of 9.3, lower EO concentration (1%) and surfactant blend (10%). Surfactants must surround the oil to prevent the droplets from coalescing. TGA analysis revealed a degradation temperature of 247 °C, indicating that the nanoemulsion could protect the EO against thermal degradation for an extended period. The nanoemulsion of *C. citratus* showed minimum inhibitory concentration (MIC) values of 500 uL/L against the fungi *C. gloeosporioides* and *A. alternata*. These findings suggest that *C. citratus* nanoemulsions hold promise as effective antimicrobial to be added in edible coatings, offering a potential solution to combat fungal diseases and preserve fruit quality.

Screening of Enzyme Activities for Improvement of Bread Quality by Potato Peel Addition to the Yeast Growth Medium

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Abstract:

Bread staling is defined as physicochemical changes in bread during storage, which results in undesirable changes in bread quality. It has always been one of the serious problems of the industrial sector throughout history. At the same time, vegetable waste, including potato peel (PP), is considered a serious problem to the environment. For this reason, PP has been used in this study to increase enzymatic activities of the yeast Saccharomyces cerevisiae, considered to have positive effects on bread quality. The goal of this study is to design a microbial system to facilitate human activities in industry, both joining the production of valuable enzymes by yeasts and recycling PP in the same medium. As a result, in our study, the highest growth rate of S. cerevisiae was recorded in the treatment with 2% PP present in the yeast growth medium. Also, no microbial growth, from baked bread samples, was observed due to proper storage of the loaves of bread in closed nylon bags at 4 ◦C for the duration of ten days. Moreover, treatments with 4% PP increased cellulase and invertase activities significantly ($P < 0.05$), in comparison to treatments with no peel and with 2% peel. While amylase activity has been increased significantly ($P < 0.05$) in treatment with 2% peel. In conclusion, treatment with 4% peel is recommended for improving enzymatic activity, in general, and bread quality in particular.

Starch-Based 3D Printing Concept Covering Ink and Process

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Abstract:

3D-printing applied to food systems is using different technics; cold or hot extrusion of a gel, hot melt deposition (i.e. for chocolate), powder bed concept using laser sintering, and layer deposition (i.e. pizza). One of the major issues faced in the case of 3D printing of a gel is the solidification of the gel needed before the deposition of an additional layer. Increasing the flow rate in 3D printers requires a low-viscosity ink capable of rapid hardening after deposition. This presentation proposes an overview of a new concept covered by the patent EP2022/058028 "Method of additive manufacturing by hot-extrusion". The patent concerns an ink and an associate process. The ink is based on modified starches with enhanced gelling properties thanks to Dry Heat Treatment (DHT), ozone, or pulsed electric field (PEF) processing; such starch is dispersed in pregelatinized starch gel to prevent sedimentation of the non gelatinized starch. The process using this ink is based on a dual-temperature hot extrusion system combining a heated feeding reservoir and a heated printing die ensuring starch gelatinization during inflow thermal treatment. This combination provides a low-viscosity ink and a possibility to enhance the mass flow rate compared to cold extrusion. Also, the firmness of the gel allows rapid superposition of layers. The best results were obtained with DHT flour which is known to enhance water-holding capacity of starch. These issues will be discussed and recent results obtained with this concept will be presented showing its advantage compared to concepts that are more conventional.

3D Food Printing from Nutritional Advice to Personalized Product

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Abstract:

Personalized nutrition has gained popularity over the years due to the increasing awareness of the health benefits of a personalized diet. Based on individual-specific information, a personalized nutritional advice can be given describing the nutritional requirements. This, however, is only the first part of the challenge. The main challenge is determining the selection and amount of ingredients from which a personalized product is made so that it matches with the personalized nutritional advice. When only a few nutritional values and ingredients are involved manually matching the advice is easy, but when the amount of nutritional values and ingredients increases this becomes sheer impossible. 3D food printing is uniquely suited for creating personalized food products. With 3D food printing a personalized product can be made by printing a product out of several different formulations. Each formulation will be extruded through a nozzle, similar to Fused Filament Fabrication (FFF) used in Additive Manufacturing (AM), to build a personalized product in a layer-by-layer fashion. Each formulation is designed to have a specific known nutritional content while adhering to all the boundary conditions necessary for 3D food printing. The goal of our

IMAGINE project is to go from a personalized nutritional advice to a fully personalized printed food product having the specified nutritional values. For this, we have created a mathematical model that is capable of solving an N-dimensional optimization problem that determines the optimal ingredient distribution to best match a given nutritional advice.

Definitions in 4D Printing of Dynamic Foods – Foundational Considerations and Future Prospects for Programmable Transitions

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Abstract:

4D food printing is the processing of foods that exhibit programmable time-dependent behaviors. Such programmable time-dependent behaviors of food structures include changes in appearance and functionality which are triggered through various stimuli. As an emerging application, concrete scientific definitions and categorizations are needed for creating a solid foundation in 4D food printing research. Therefore, this theoretical work introduces new scientific definitions in 4D food printing which presents a unique opportunity for an open scientific debate. In addition, it presents a comprehensive overview about the current developments and previous considerations in the 4D food printing research.

4D food printing introduces appealing and functional food structures through the introduction of triggered variable color gradients and thermally-stimulated variable food shapes and textures. Based on engineering applications, 4D printing expands the domain of 3D printed food structures through the addition of one extra dimension which is time. Since its introduction in food applications, many definitions and dimensional extensions have emerged in the 4D printing domain. However, due to the lack of consensus in published research, the classification of further dimensions (5D or 6D) through the superposition of multiple time-dependent transformations can be found. Some analogies found in literature lead to the resolution that all thermally treated foods could be considered as 4D foods. In conclusion, based on scientific analogies, deductions and published research, imperative definitions and future considerations are introduced to serve as a scientific foundation for 4D food printing research.

Development of an Integrative Multi-Level Cooking System for 3D-Printed Food

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Abstract:

The emerging applications of 3D printing technology have led to a rising interest in the food industry, particularly in creating customized healthy food. However, the quality of 3D-printed food can be compromised by post-processing treatments such as baking and air-frying. This study proposed

a multi-level cooking solution integrated with an extrusion-based 3D printer to maximize the quality of 3D-printed food. Cookie dough composed of soft wheat flour with fine green tea leaves as the fortified ingredient was selected as the investigating food model. The proposed method enables simultaneous printing and multi-level cooking techniques that preserve the printed food's shape and nutritional value. An integrative infrared cooking device was designed and mounted on the printer to cook the printed food simultaneously, resulting in significant shape retention and preventing the printed food from collapsing. UV-visible absorption spectroscopy revealed at least 80% higher phenolic compound concentration of green tea in the infrared-treated cookie dough than the air-fried cookie dough made with the same ingredient formulation. To achieve the selective area browning effect of the printed cookie dough for texture customization, an integrative laser unit (450 nm, 5 W) was designed to conduct selective cooking of each printed food layer based on software-programmed control at a high resolution of up to 2 mm^2. The results of this study may contribute to the development of 3D-printed functional food with highly controllable and programmable post-processing methods.

Integration of Atmospheric Non-Thermal Plasma Electrohydrodynamic Devices Generated by Corona Discharge in 3D Food Printers

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Abstract:

Microbial contamination control is an important part of food processing. Improving the security of 3D printed food is necessary to ensure the health safety and to increase consumer acceptance[1]. Innovative methods for the reductions of microorganisms and particles in-situ in the 3D processing itself, as well as a protective atmosphere, bring advantages in food production. It also reduces food post-processing. The use of non-thermal processes to obtain food sterility is also an advantage from the point of view of maintaining food properties. Several studies have shown the high efficiency of non-thermal atmospheric plasma technology for viral and bacterial inactivation and food preservation.[2] However, the optimization of these devices for specific applications requires a thorough understanding of their fluid-dynamic[3], chemical behavior and, inactivation mechanisms. In this work, the integration of non-thermal atmospheric electro-hydro-dynamic plasma systems generated by corona discharge into 3D food printers is proposed for the maintenance of a bacteria-free environment. The advantage of the system is that it provides a high degree of inactivation, together with flow generation without the need for moving parts, resulting in a noiseless operation, with low power consumption and low concentrations of chemical compounds. Design proposals of EHD-plasma devices for their coupling in 3D food printing systems are presented, as well as results of bacterial inactivation kinetics with *Escherichia coli* and *Listeria monocytogenes* as a function of device power and exposure time in enclosure chamber. Laboratory prototypes of the EHD devices are fabricated using 3D printing, enabling the rapid and cost-effective generation of different geometries for testing and optimization.

Texture Modulation of Starch-based Materials using Micro Structuring assisted Additive Manufacturing

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Abstract:

Additive manufacturing methods have shown a great potential as a novel approach for the production of food products. Therefore, intensive research focuses on the development of 3D printing technologies and, among others, implementation of structuring approaches to modulate the texture of 3D printed food materials. This study focused on implementing a micro structuring assisted additive manufacturing approach using chemical leavening agents. The aim was to characterize the effects of *in-situ* gas generation on the printing and deformation behavior as well as generated morphologies of micro-foamed 3D printed starch-based materials. Different leavening agent systems, composed of sodium bicarbonate and leavening acids (glucono-delta-lactone (GDL), monocalcium phosphate (MCP), sodium acid pyrophosphate (SAPP)), were utilized to control and trigger the amount of carbon dioxide released during distinct phases of the printing process. Therefore, kinetics ranging from instantaneous release during material preparation (MCP) to temperature-triggered release (SAPP), as well as consistent leavening gas release (GDL) were applied. Elucidation of material's printing behavior and geometrical analysis of 3D printed structures was performed by an automatic on-board camera-based morphology analysis. Furthermore, textural properties in dependency of the type and concentration of chemical leavening agents were characterized after thermal stabilization. In general, porous, open-cell foam structures exhibited significantly lower hardness values (e.g. 1.10 ± 0.09 *N* for SAPP-based food inks) compared to the unleavened reference material (3.94 ± 1.05 *N*). This approach facilitates the production of 3D printed open-cell foam structures with defined dimensions by combining structuring-assisted techniques with additive manufacturing and improving our understanding of structure-property relationships.

3D Food Printing Experience from Spain

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Abstract:

Food 3D printing is one of the most promising and innovative techniques in the food industry. Over time, this technology has undergone a fascinating evolution, giving rise to several revolutionary applications in gastronomy, personalized nutrition, and the creation of cutting-edge ingredients. In this work authors present the results obtained in this area during the last few years. The authors studied the effect of temperature, composition, or printer parameters on the characteristics of printed samples. Also, the use of different printing materials is evaluated. Rheological and textural properties of samples before or after the printing process are discussed to validate their use as variables to define sample printability. On the other hand, the use of two head printer is shown as a tool to obtain inhomogeneous distribution on several components by 3D printing. Finally, new technologies to apply heat during the printing process are presented. All these results describe

the works developed by the group i-Food from Universitat Politècnica de València supported by several projects in the last years.

Structuring Crispy Vegetables-Based Food Products by Additive Manufacturing for a More Sustainable and Healthy Diet

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Abstract:

The current global food strategies tackle the urgent challenges of the agri-food sector with the aim to make food systems fair, healthy and environmentally-friendly. To enable this transition there is the need of feasible technological innovations capable to trigger the adoption of a more healthy and sustainable diet, and to reformulate nutritious foods based on natural and/or new ingredients, affordable and minimally processed, and personalized on consumers' needs and preferences. In this context, additive manufacturing represents a breakthrough in the food sector being able to realize unrestricted food shape and internal structure for customized sensory perception and nutritional characteristics. This study integrates 3D food printing with the air-frying as post-printing process to realize novel and healthy 3D printed crispy snack, using a vegetable-based food formula. Virtual models were 3D printed by varying the nozzle diameter and infill density. Then, the post printing was performed by modulating the temperature and time of air-frying. The kinetics of air-frying for all 3D printed snacks were mathematically described evaluating the moisture content and water activity. Then, colour, texture and flavour were analysed. In addition, the printing quality was evaluated by assessing the morphological properties, and the microstructure of the samples was quantitatively and qualitatively ascertained by using 2D/3D X-ray CT images. The results showed that the deformation can be reduced and the crispness can be improved by modifying the printing variables, attesting the feasibility of the proposed strategy to obtain innovative snack with the ambition to contribute to the health status of people.

Internal Structure and Textural Properties of a Milk Protein Composite Gel Construct Produced by Three-Dimensional Printing

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Abstract:

Three-dimensional (3D) printing technology is an emerging technology that can be used to fabricate food products composed of milk protein composite gel with desired structures. In this study, the products were printed by an extrusion-based 3D printer with the variation of perimeters (3, 5, and 7), infill patterns (Hilbert curve, honeycomb, and rectilinear), and infill levels (10%, 40%, and 70%). The textural properties, geometrical accuracy, and internal structure of the products were evaluated by texture analyzer, camera, and scanning electron microscope, respectively. The

geometrical accuracies of products were all apparently close to 100%. Gumminess and hardness were bound with the infill level and perimeters. However, the gumminess and hardness were not associated with the infill pattern, which was created to fill the products. In addition, only the infill percentage affected Young's modulus and firmness. Productsexhibited uniform internal structures, and the hardness of products with 100% infill level was still lower than that of nonprinted material. Three-dimensional extrusion behavior will modify the textural and structural properties of products by adjusting the infill level and perimeters, offering a new method for improving the biophysics of sensory properties of products that are suitable for people with different chewing abilities.

A New Domain Ontology to Integrate Data on Food and Bioproducts Engineering in a Circular and Sustainable Approach

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Abstract:

To address the challenge of reconnecting agriculture, environment, food and health, collections of large datasets must be exploited, which are by nature heterogeneous and multidimensional as they cover multidisciplinary disciplines. In this context, ontologies may play a relevant role as they provide a formal representation of knowledge and a machine-readable format for integrating data in line with data interoperability and reusability. We present a new domain ontology on food and bioproducts engineering for data integration in a circular agri-food system. This ontology is based on a core model for a generic process, the Process and Observation Ontology (PO2), which has been specialized to provide the required semantics to describe any biomass transformation process and to characterize the inputs and/or outputs of these processes. As our main driver was data stewardship, a very strong constraint was to ensure backward compatibility with existing datasets from former projects. Non-semantic resources were transformed into linkable data thanks to the semantic web standards and transformed to be compliant with the PO2 core model. This work of harmonizing vocabularies and sharing a common structure enables us to build interconnected knowledge graphs which can further be combined with probabilistic models to assist food eco-design in relation with consumer's perception and preference. Further works will aim to align to other ontologies to create an ontology network for bridging the gap between upstream and downstream processes in the food system in a circular bioeconomy and sustainable approach.

Exploring Morphing Food as Strategies for Novel Sensory Experience and Beneficial Impacts on the Sustainability of the Food Sector

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Abstract:

Morphing food means the creation of 3D food shapes from a flat structure. The process can be triggered by cooking food structures designed with inhomogeneous composition or anisotropic shape and internal properties. This strategy opens for innovative sensory experiences and beneficial effects on the sustainability of the food sector. More specifically, morphing food would allow to save space during transportation and packaging materials, and it would extend the sensorial experience of the consumers – e.g. personalized food properties – thus reducing the food waste and helping for a more nutritious and healthy diet. At first, the dough was sheeted with a semi-manual processing to get two different thickness. Then we designed and created flat dough with grooves on one side with modulated paths, angles and depth. This step was performed by stamping the sheet doughs by using 3D printed molds with two different shape and groove. Particularly, the stamping was performed by modulating the pressure adopted during the stamping thus modifying the depth of the grooves. Then the samples were baked by using conventional oven with temperatures ranged between 140°C and 220°C. The kinetic of the baking was described for the main physical (morphological properties, texture, colour) and the changes in moisture content and water activity. Results proved that the proposed strategy would enable to create innovative food forms and sensory properties starting from a flat shape which could save space, and plastic material for packaging and transportation.

Non-thermal Technologies for the Inactivation of Emerging Viral, Bacterial and Protozoan Pathogens on Fruit and Vegetable Products - TECH4PATH

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Abstract:

Foodborne diseases have long represented a considerable burden to public health and continue to challenge health systems worldwide. Besides the traditional food borne hazards, safety of the food chain is facing new and unprecedented challenges, for emerging pathogens that have been underdiagnosed and underreported so far. The TECH4PATH project is principally aimed to study, optimize and create basic protocols for the application of 2 non-thermal technologies (cold plasma-CP and High Hydrostatic Pressure-HHP) as strategies for the decontamination of emerging pathogens of fruit and vegetable food products (FVPs). *E. coli* has been chosen as reference bacterium, while *Cronobacter* and *Arcobacter* spp. will be considered as emerging pathogens. Moreover, as emerging safety hazards, the protozoan parasites *Giardia intestinalis* and *Cryptosporidium spp*. and the foodborne viruses Norovirus and Hepatitis A (HAV) will also be considered. Beside the decontamination efficacy, effects of the tested technologies will be evaluated on the quality and nutritional aspects of FVPs in order to ensure safe, healthy and high-quality products; the overall environmental impact will be also assessed. Information gained by this project will be useful in assessing the potentialities of non-thermal technologies for this purpose,

representing a good opportunity for extending their use beside the microbial decontamination and fostering their adoption in the food supply chain. The project "TECH4PATH - Non-thermal TECHnologies FOR the inactivation of emerging viral, bacterial and protozoan PATHogens on fruit and vegetable products" is founded by MUR - Ministero dell'Università e della Ricerca - PRIN: Progetti di Ricerca di Rilevante Interesse Nazionale, Bando 2022.

Comparison of Industrially Friendly Extraction Methods of Mushroom Proteins (*A. bisporus* and *P.ostreatus*) and Their Functional Characteristics

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Abstract:

Our objective was to evaluate the protein extraction of White Button (*A. bisporus*, AP) and Oyster mushrooms (*P. ostreatus*, PO) using ultrasonication (US), followed by isoelectric precipitation (IEP) or salt-induced thermal coagulation (SITC) and investigate the functionality of spray dried mushroom powders. For IEP, the effect of solid-to-volume ratio (STV, 5, 10 and 15%), acid type (hydrochloric or acetic), and US power (no US, 50% and 100%) on the percentage of protein content (PC) and protein yield (PY) were evaluated. For SITC, a fixed STV (12%), calcium derivatives (acetate, lactate, chloride), hydrochloric and acetic acid, and similar US levels were tested. For AP-IEP, 50% power with acetic acid at STV 5% gave the highest PY (88.3% ± 18.5; PC 44.8% ± 5.3). For PO-IEP, the best attributes (PY 35.6% ± 1.7, PC 45.3% ± 2.6) were achieved with STV 5%, 100% power, and hydrochloric acid. For AP-SITC, 100% power and calcium chloride produced the highest PY (91.0% ± 1.8) and expressive PC (55.5% ± 1.1) while for PO-SITC when no US, and calcium acetate were used the higher PY was observed (33.6% ± 1.3%), concomitantly to PC of 45.0% ± 0.9. Mushroom proteins obtained by US-IEP and US-SITC at prioritized conditions were tested for water holding WHC and oil absorption capacity (OAC), emulsifying activity index EAI, emulsifying stability index ESI, foaming capacity FC and stability FS. The WHC (274.1-281.7%) and OAC (142-164%) of AP-IEP and AP-SITC were similarly good, but AP-IEP protein had EAI 9 times higher (227.2 m^2/g, $p < 0.05$) compared to STIC protein (25.6m^2/g), and approximately double the ESI (AP-IEP: 32.3 min, AP-SITC; 17.7 min). FC was not significantly different (52 – 64%, $p>0.05$). The WHC of PO-IEP and PO-SITC were similar (293.3-300.0%), while AOC of PO-IEP (177.6%) was significantly higher than PO-SITC (151.6%, $p<0.05$). Remarkably, the EAI of PO-IEP (206.6 m2/g) was 20-fold higher than PO-SITC (10.9m2/g, $p<0.05$). Overall, this work shows that IEP and SITC are efficient strategies to produce mushroom protein with good functionality attributes.

Metal-Complexing Peptides: How Can We Screen and Separate these Biofunctional Peptide from Protein Hydrolysates?

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Abstract:

Metal-Complexing Peptides are biofunctional molecules able to bind metal ions and form complex via the formation of covalent coordination bounds. According to the complex metal ion, such peptides can find various potential applications notably in nutrition and cosmetics in link with their antioxidant properties. Indeed, *in vivo* but also in various industrial matrices, the Haber-Weiss and Fenton reaction catalyzed by Fe^{2+} and Cu^{2+} are responsible of the production the Reactive Oxygen Species (ROS). Thus, while complexing such metal ions, MCP could inhibit the ROS formation and act as indirect antioxidants. After introducing the potential applications of MCPs, this presentation will focus mainly on the way MCPs can be produced either by biotechnological routes involving proteolysis or by chemical synthesis and how their can be screened and separated using some technologies based on peptide-metal ion interactions. Among the various approaches developed in our group these last years, we will focus mainly on screening based on surface plasmon resonance, fluorometry, mass-spectrometry and separation process such as immobilized metal ion affinity chromatography.

Potential Markers of Protein and Lipid Oxidation in Food Irradiation

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Abstract:

Radiation technologies are widely used in many fields of science and technology, including the food industry. Finding evidence of undeclared radiation processing of imported food products is a serious issue right now. A number of food categories cannot be shown to have been exposed to ionizing radiation according to current international standards. Collaboration of scientists from Physics and Chemistry Departments of MSU is engaged in research on the detection of biochemical markers in irradiated chilled products using gas chromatography-mass spectrometry. The research is aimed at the following: - the development of physical methods for the analysis of biological objects (fluorometric and spectrophotometric methods, peptide mapping, study of electrophysical properties) after radiation processing; - the search for potential biochemical markers of exceeding the effective dose range for certain product categories after radiation processing. Aldehydes including hexanal, heptanal, and pentanal have been found to increase with an increase in radiation dosage during the first four days of storage, according to research done so far. Additionally, it was found some volatile organic compounds for certain product categories that act as irradiation product markers. These researches were funded by the Russian Science Foundation, grant number 22-63-00075, for Lomonosov Moscow State University.

Comparison of Three Drying Methods Applied to *Lacticaseibacillus rhamnosus GG* and *Chlorella pyrenoidosa*

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Abstract:

Advances in drying techniques for bacteria and algae are essential for upgrading large-scale productions. Spray drying (SD) is known for detrimental effects on bioactive molecules at high temperatures. Freeze-drying (FD) is a reference technique capable of drying sensible organisms at low temperature. In this study, a novel drying technique, electrostatic spray drying (ESD) was utilized to encapsulate the lactic bacteria *Lacticaseibacillus rhamnosus GG* (LGG) and the micro-algae, *Chlorella pyrenoidosa* (CP). ESD was compared with conventional SD and FD techniques. Matrices such as maltodextrin and skim milk were used to encapsulate the microorganisms. Cell viabilities after drying and cell stability during storage were studied. Morphologies, particle sizes, shapes and water activities were also compared. As a result, SD at inlet air temperature of 170°C degraded the cell viability and varied the powder's attributes. ESD at intermediate temperatures (inlet/outlet = 90°C/44°C) produced microparticles with better powder characteristics and higher survival ratio than SD. Skim milk was proven to be the best protectant for LGG, regardless of the drying process or storage time. Huge reduction of cells number (loss of about 4 log CFU/g) was observed with maltodextrin using SD, meanwhile it was protected with minimum loss (loss of 0.5 log CFU/g) with ESD. On the other hand, for micro-algae, maximum viabilities and chlorophyll characteristics were retained after ESD. Therefore, Overall, ESD is an efficient alternative to FD, which is often considered time consuming and expensive process.

Comparison Physical and Chemical Properties of the Water-Conserving Honey Coffee Method Versus the Water-Intensive Wet Process

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Abstract:

Coffee taste and aroma vary widely based on processing method. While traditional wet coffee processing (WCP) uses large amounts of water, honey coffee processing (HCP) represents a more sustainable alternative because it requires very little water. HCP, also called "de-husked cherry", "pulped natural", or "partially washed" removes the skin and leaves the pulp (mucilage) on the seed before drying. Although all coffee processing methods produce green coffee beans, pre-roast processes can affect coffee's chemical composition. This study compared roasted HCP and WCP coffee across three common extraction methods, (espresso, French press, and filtered) and light, medium and dark roast degrees, maintaining particle sizes from 1 mm to < 355 um. Analysis included quantifying total dissolved solids (TDS), °Brix, density, color, pH, titratable acidity (TA),

extraction yield, 3-caffeoylquinic acid (CGA), caffeine, and phenolic content (PC). Relative to WCP, HCP had higher TA levels 0.40 to 0.25 mL NaOH, and PC 4000 to 3000 MEQ Gallic Acid/100 g of coffee respectively, which can contribute to its distinctive flavor profile. Roasting degree affected CGA and PC in coffee beans. Dark roast had lower values than light roast coffee in both coffee processes. Smaller particle size was associated with higher caffeine, CGA, and TA per mass basis. Highest TDS (2.74 ± 1.0), and Brix (3.05 ± 1.3) were for espresso, compared to filtered 0.88 ± 0.02 and 1.07 ± 0.5 for both processes. Although extraction methods led to quantitative coffee beverages different, HCP is promising, and it possible to obtained beverages with different profiles.

Value Addition to Oat Flour as a Novel Stabiliser for Developing Plant-Based Pickering Emulsions

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Abstract:

A substantial portion of our diet consists of food that is either emulsion-based or processed through emulsion technology. Traditionally, emulsions are stabilised with food additives to reduce interfacial energy between two immiscible liquids and improve the shelf life of food products. However, some synthetic additives can be toxic towards beneficial microorganisms and may also exhibit harmful side effects on human health. Supporting the need for sustainable and clean-label food products, this study aims to design plant-based Pickering emulsions (PBPEs). Wholesome oat flour which is rich in proteins, polysaccharides, and dietary fibres, was used for developing oil-in-water PBPEs with varying oil content (10%, 20%, 30%, and 40% w/w). To further improve emulsifying properties of oat flour, it was used without modification (control, CO) and after mild-chemical treatment (CH) as Pickering stabilisers. The resulting emulsions (OPEs) were characterised for particle size, creaming stability, and microstructure. The OPEs exhibited exceptional stability against creaming and coalescence. After 21 days of storage at 4°C, the OPEs with higher oil fraction (20-40%) showed low creaming indices (CI) (0 – 20.8%), indicating improved storage stability. CH-OPEs with 40% oil content, in particular exhibited significantly smaller droplet sizes ($D_{3,2}$= 8.96 µm) and the lowest CI (0.01%) in contrast with 40% oil content CO-OPEs ($D_{3,2}$= 14.52 µm, CI: 10.40%). This improvement in emulsification properties of CH was attributed to the increased availability of proteins, leading to enhanced stability of CH-OPEs as compared to CO-OPEs. Thus, these findings can be vital for developing plant-based Pickering systems in form of functional foods.

Shelf-Life, Acceptability and Nutritional Quality of Next Generation Vegan Supplement for Children

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Abstract:

Undernutrition, according to the World Health Organization (WHO), refers to deficiencies in a person's intake of energy and/or nutrients. One of the major cause of undernutrition is low quality

diet wherein there is overconsumption of high-energy, low-nutrient-dense foods with added sugars is involved. Besides that, supplements available in the global market are extremely expensive and therefore may not reach the underprivileged population where they are needed the most. While the practice of compositing/blending of foods has been applied for centuries at a household level to enrich grain foods with key macronutrients, food-to-food fortification (FtFF) is now viewed as an emerging strategy wherein micronutrient-dense foods are added to food recipes (household level) to increase the micronutrient quality. Therefore, present research aimed to develop a vegan sprinkler formulation that can be used as an add-on to home cooked recipes. Sprinkler has excellent amount of macro and micronutrients present to support required amount of growth and development in children. Moreover, the sprinkler is shelf-stable for 6 months in standard environmental conditions and in extreme conditions as per accelerated shelf-life studies. The sprinkler does not contain any additive chemicals or preservatives. Since sprinkler is a vegan product, antinutrients have been reduced to obtain greater mineral bioavailability. Also, Sensory analysis has been completed with the target population. Metabolic simulation study indicates that the sprinkler is capable to improve anthropometric parameters in the children if consumed on regular basis.

Identification of Soft Wheat and Minor Cereals with Low Sanitary Risk for Bakery Products Supply Chain

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Abstract:

The study investigates the content of the mycotoxin deoxynivalenol (DON) and asparagine (ASN), precursor of acrylamide (AA) formed during baking, considering 25 cultivars of soft wheat with different breadmaking aptitude and 15 cultivars of minor cereals (durum wheat, emmer, spelt, rye, triticale, barley, tritordeum). All genotypes were cultivated in 3 growing seasons (2020, 2021, 2022) in an experimental field, by applying the same agronomic practices. Cereal grains were milled in a pilot scale plant and wholemeal flours analysed for ASN and DON contents. The average ASN content in rye (1017 mg/kg) is the highest and more than 3 times higher than soft wheat weak flour (307 mg/kg). DON contamination is remarkable in tritordeum (3910 µg/kg) and with an important variability within the soft wheat cultivars (from 667 to 6253 µg/kg). Selected whole flours based on ASN content were used for biscuit production and then analysed for AA content. AA in biscuits reach the highest concentration in a rye flour formulation (1121 µg/kg), decreased 2 times in triticale and shows the lowest value in some varieties of soft wheat without significant differences respect to other minor cereals. Considering simultaneously DON and ASN accumulation, we discriminated varieties of soft wheat and spelt with a low overall sanitary risk, while some varieties of tritordeum, durum and soft wheat were reported as particularly susceptible to DON accumulation. This study affirms the importance of variety selection as key component in the cropping system to minimize sanitary risks respecting standards of cereals supply chain.

Evernia prunastri Biopolymer Matrices for Potential Food Applications

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Abstract:

Traditionally used as dyes, in fragrance or in folk medicine, lichens have also had some known applications in food. For example, *Evernia prunastri* used to be incorporated in bread flour during food shortage periods in estern/northern Europe countries. Nowadays, lichens are investigated for their bioactive compounds that exhibit great antioxidant, antitumoral, antibacterial activities. Moreover, among lichen biopolymers are β-glucans which are known for lowering cholesterol and reducing the risk of diabetes and cardiovascular diseases. The objective of this work is to extract and characterize β-glucans and bioactive compounds from Evernia prunastri, using microwave assisted extraction and to developed matrices for food applications. The antioxidant activity of the extracts, their phenolic and polysaccharide contents were determined by spectrophotometric methods and high-pressure liquid chromatography. The anti-inflammatory, anti-tumoral and anti-tyrosinase activity of the β-glucan polymers were evaluated as well as their rheological and gelling properties. Results highlighted the impact of the microwave extraction temperature on the recovery of the compounds. When the greatest biopolymer yield was obtained at 160°C, the greatest antioxidant activities and total phenolic compounds of the soluble extracts were achieved at 140°C. The soluble extracts at 140°C and 200°C and the polymer obtained at 160°C showed anti-tyrosinase properties which could be interesting to avoid food browning. A matrix that exhibits the rheological properties of a gel was formed with the β-glucan polymers extracted at 160°C. Works are now carried on to investigate the potential of these β-glucan matrices in the food industry as packaging biofilms or as nutraceuticals.

WASI as a Useful Tool to Identify Mechanisms of Enzymatic Active Plant-Based Fractions in Food

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Abstract:

Enzymatically active wheat malt has a complex matrix and a variety of functional enzymes. The functionality of wheat dough can be significantly influenced by the addition of these malts: Wheat malt induces reduced dough stability, increased dough softening, and resulted in other product properties such as increased crust browning, increased volume and changes in crumb hardness. To understand the mechanisms behind these influences, it is necessary to differentiate between the effects of the individual malt matrix components and the enzymatic activity. Model matrices, substitution experiments or thermal inactivation of enzymes can be used for this purpose. However, this approach leads to matrix changes of the malt and the dough itself. Therefore, we chose a biological inactivation of targeted enzymes. This was achieved by endogenous inhibitors from the investigated plant-based material. For this purpose, the endogenously acting wheat-α-amylase/subtilisin inhibitor (WASI) was selected. To produce the inhibitor a Ligase-independent cloning (LIC)

method was developed and used. A concentration of 651 µg/mL WASI inhibited cereal α-amylase from a wheat malt with an activity of 87.0 ASBC/g by 71.0 ± 1.1%. In addition, the bacterial protease Subtilisin A was inhibited to 98.0 ± 0.03 % with a concentration of 651 µg/mL WASI. Hereby, a suitable tool for the elucidation of mechanisms of action was obtained, which does not cause any change in the matrix and thus allows the elucidation of synergisms and antagonisms. In addition to elucidation, inhibitors can also be used for targeted control and influencing technical processes.

Polyphenols Inulin-Amorphous/Semicrystallin Spray-Dried Microparticles as a Gastrointestinal Antioxidant

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Abstract:

Nowadays, bioactive compounds as polyphenols with health benefits are gaining interest in the food industry, particularly in the design of healthy or functional ingredients. Inflammatory bowel disease (IBD), including Crohn´s disease and ulcerative colitis, are chronic disorders characterized by gastrointestinal tract inflammation that are rising worldwide. Conventional therapies in the treatment of IBD can be complemented by phenolic compounds. Conventional spray-drying, encapsulation usually leads to amorphous powders. Thus, a new strategy not yet addressed in spray-drying is to study the physical state of the polyphenols microparticles powder (amorphous/semicrystalline) on the polyphenols release pattern and target in *in-vitro* simulated digestion. Spray-dried polyphenols (ellagic acid and quercetin)-based microparticles were elaborated with inulin applying different strategies including modification of the spray-drying process (feed temperature and inlet air temperature) and infeed formulation variables (inulin: inulin crystallite dispersion ratio, ethanol and seed inulin HPX as crystallinity). Microparticles were characterized by total and surface polyphenol (EA and Q), encapsulation efficiency, crystallinity degree by wide angle X-ray Scattering (WAXS), moisture, water activity, hygroscopicity, particle size and their distribution by laser light diffraction (LLD); shape and external morphology of the particles by scanning electron microscopy (SEM); glass transition temperature Tg by modulated differential scanning calorimetry (MDSC). The release of the polyphenols from microparticles during simulated in vitro digestion showed that the surface polyphenols were steadily released and those encapsulated were mostly released in the simulated colonic phase due to the inulinase action.

Unraveling the Biological Activities and Growth Kinetics of Mycelium Biomass and Exopolysaccharides from *P. ostreatus*

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Abstract:

Pleurotus ostreatus is one of the most widely consumed mushroom species all over the world. Apart from its unique taste and flavor, it has a plethora of bioactive compounds. The current study aims to analyze the biological activities of *P. ostreatus* in submerged cultivation. Cultivation parameters

such as pH, temperature, inoculum density and cultivation time with different carbon and nitrogen sources were optimized to obtain a high yield of biomass and exopolysaccharides (EPSs). The maximum biomass and EPS obtained were 24.66±0.2 g/l and 4.8±0.1 g/l respectively on the 8th day of cultivation. We observed an increase in the protein content with mycelial growth and achieved a maximum of 0.936±0.005 g/l of protein. However, the total phenolic content in the mycelium biomass obtained was 16.484±0.06 mg GAE/g. The antioxidant activity of the aqueous extracts of the EPS was obtained as 49.59±1.09 %. Furthermore, different kinetic models were studied to observe to growth behavior of mycelium biomass. The best fit was obtained for the contois model which gave the maximum specific growth rate of (μmax, hr^{-1}) of 0.0235 hr^{-1} and R^2 value of 0.976.

Untargeted UHPLC-QTOF Analysis: New Molecules Discovery in Italian White Truffle (*Tuber magnatum Pico*)

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Abstract:

Truffles are hypogenous ascomycetes fungi that grow in symbiosis with the roots of plants. In certain European regions, such as Italy and France, truffles are important as traditionally used in regional recipes because of its wonderful taste and aroma. One of the main reasons of truffle value growth is the rural economy impact, in fact it can help in biodiversity preservation. The White truffle (*Tuber magnatum Pico*) is the most expensive edible truffle. The growing environment, including soil properties, temperature, microclimatology, mesofauna, fungi, bacteria, yeasts and plant hosts, has the greatest impact on truffles characteristics. In this research, characteristic features and molecular signatures of white Acqualagna truffle were studied with authentication aim. A first characterization of volatile and non-volatile profile using several techniques including GC-MS, elemental mapping through ICP-MS, microanalysis CHNS and spectrophotometric antioxidant activity assays was performed. After that, an UHPLC-QTOF untargeted analysis was performed, for the first time, to investigate the overall metabolites in White truffles. The spectra analysis allowed the identification of more than 400 molecules from both positive and negative acquisitions with a score threshold of 60%. A total of 10 annotated metabolite were selected for their biological interest. Three of them were previously identified in black truffles but not quantified, the other were never been found in truffles. A targeted method was applied using analytical standards to quantify the newly discovered features. Six new bioactive molecules were confirmed and quantified for the first time in white truffle.

Valorization of an Old Variety of *Triticum aestivum*: Study of Its Aptitude for Breadmaking Focusing on Sensory and Nutritional Quality

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Abstract:

"Avanzi 3-Grano 23" (G23) is an old variety of Triticum aestivum from mountain areas of Lunigiana (north Tuscany, Italy), where traditional farming communities have contributed to its evolution and on-farm conservation. Its flour, traditionally used for typical food products, is characterized by peculiar nutritional and sensory traits, but it shows technological properties which limit its aptitude for breadmaking. The aim of this work was to evaluate how to enhance the G23 through the optimization of bread formulation, by leveraging both flour blending and leavening system. During the preliminary test, 3 different mixes between G23 flour and a strong flour (C) were tested in terms of their leavening power as a function of leavening agent (baker's yeast or sourdough). The selected M2 flour, composed by G23:C (1:1 w/w), was used for further breadmaking trials while 100% C flour was utilized as control. The sourdough bread obtained with M2 flour (SB-M2) showed an improved sensorial profile if compared with the related control (SB-C). Furthermore, the SB-M2 exhibited the best aromatic (high content in aldehydes, pyrazines and carboxylic acids) and phytochemical profile (total polyphenols and flavonoids content and antioxidant activity). Instead, the use of baker's yeast, although optimal from the point of view of breadmaking, has not obtained the same levels of aromatic complexity because it tends to standardize the product, without valorizing the typicality of flour. In conclusion, in the experimental conditions adopted, the old wheat variety appears to be suitable for the production of sourdough bakery products.

Optimization of an Emulsion Filled Gel with Chickpea Protein Isolate

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Abstract:

The growing interest in healthiness and sustainability has focused attention on developing lipid systems that can reduce the amount of food fat content and act as possible carriers of important bioactive compounds extracted from food wastes. A face-centered Central Composite Design (CCD) was applied to develop an emulsion filled gel, considering as main factors the corn oil concentration (15, 37.5, and 60% v/v) and chickpea protein isolate (ChickP, Rehovot, Israel) concentration in the water phase (8, 12, and 16% w/v). For comparison, the CCD was applied also to a single emulsion with the same levels of corn oil and lecithin as emulsifier (0.5, 1.5, and 2.5% w/v on the water phase). Chickpea proteins confirmed their outstanding gelling properties, giving apparent viscosity values up to 2380 ± 123 mPa·s, whereas lecithin emulsions only reached up to 144 ± 11 mPa·s. Creaming stability was at the highest (i.e., 100%) until 14 days of storage at 4°C for both the gelled and the single emulsions. On the contrary, stability index was significantly lower in lecithin emulsion than in emulsion filled gels. Response Surface Methodology and desirability function were applied for optimization of each type of emulsion, obtaining 2.5% lecithin and 58.5% corn oil for single emulsion, and 16% chickpea protein isolate with 60% corn oil for emulsion filled gel. The promising results pave the way for the application of these advanced systems as carriers of bioactive compounds to design food products with low-fat content, clean labels, and an improved nutritional and technological profile.

Hue-Change Based Lateral Flow Dipsticks for Visually Semi-Quantitative Detection of Food Pathogens

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Abstract:

Rapid detection of food pathogens is of critical importance to ensure food safety. Lateral flow assay is one of the most widely and popular used methods for rapid detection. However, present lateral flow assays mainly depend on AuNPs as the signal reporters, making it hard for semi-quantitative detection by naked eyes. To realize visibly semi-quantitative detection, we have developed a hue change-based lateral flow assay. Two kinds of microspheres with red fluorescence emission and green fluorescence emission, respectively, are used as signal labels for the strip. The green, fluorescent microspheres are pre-fixed on the T line of the test strip. The red, fluorescent microspheres are pre-sprayed on the conjugated pad, and can be captured by the antibody on the T-line through antigen labeled ssDNA probe, changing the fluorescent emission of the T-line from green to red. Specific gene sequences from the target pathogens will activate CRISPR/Cas12a and lead to the trans-cleavage of antigen-labeled ssDNA, so that the red fluorescent microspheres cannot be captured on the T line. In this way, the T-line emits green fluorescence. The color change of the T line from green to red is closely related to the concentration of ssDNA, making it feasible for semi-quantitative detection. The strip has more sensitive visual discrimination capability than the AuNPs-based strip, without changing the positions of C line and T line. By combining the strip with recombinase polymerase amplification (RPA) and CRISPR/Cas12a, the method could detect as low as one copy of inv A gene from Salmonella. It also demonstrates the semi-quantitative detection capability between 0 ~ 4×10^3 CFU Salmonella. This detection method is simple to operate, free of sophisticated instruments, and extremely suitable for in-situ detection. Besides food pathogens, the method can be extended to the detection of food species for preventing food adulteration.

Impact of Plant-Based Ingredients on Acrylamide Formation in Yeast-Leavened Bread

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Abstract:

Acrylamide is found in foods exposed to high temperature and low moisture contents, such as wheat-based products. Over the past years, various strategies have been established to reduce acrylamide in baked goods, including reducing the content of acrylamide precursors in raw materials, prolonging yeast fermentation time, and increasing dough moisture or humidity in the baking chamber. However, these approaches are simple application approaches and lack a more profound insight, especially in complex dough systems, where special ingredients can elevate acrylamide

levels due to precursor content or intrinsic acrylamide. To address this gap, we conducted a study to examine the impact of special ingredients and dough hydration on acrylamide content in crust and crumb. Yeast-leavened wheat breads with different levels of dry carrot stripes or potato flakes at three hydration levels were baked. The addition of both demonstrated some significant linear correlations between acrylamide formation in the crumb and crust, such as for potato breads (crumb: r=0.84 and crust: r=0.87, p≤0.001) and for carrot breads (crust: r=0.87, p≤0.001). The hydration level showed a significant negative correlation with acrylamide in carrot breads (crumb r=-0.84, p≤0.01). These results could be attributed to multiple factors, such as temperature reduction at increased crust humidity, enhanced yeast activity at higher water contents, and improved diffusion of potential acrylamide-altering substances. Based on the results, dough hydration levels of special ingredients are considered an important acrylamide-influencing factor. Moreover, the potential of further rehydration strategies for acrylamide mitigation, such as high-pressure water-jet, ultrasound and alternating current is discussed.

Enhancing The Functional Properties of Plant Proteins through Thermal, Ultra-Sound or Enzymatic Treatments

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Abstract:

Due to their amphiphilic nature and their large molecular size, proteins are essential ingredients to stabilize foamed or emulsified food systems. They are also suitable for their gelling properties. There is growing interest in plant proteins as sources to formulate low animal content food matrices. However, animal proteins present the best functional properties. Commercial plant proteins may exhibit, on the contrary, insufficient functional properties after the extraction process. Here, we examined several pathways, namely thermal treatment, sonication, and enzymatic proteolysis, to improve the functional properties of a pea protein concentrate to replace egg proteins. Thermal treatment unfolds proteins, sonication breaks-up large insoluble aggregates/particles, and enzymatic proteolysis modifies the molecular weight distribution of proteins by generating peptide compounds. Functional properties of plant proteins such as water solubility, foaming and emulsifying capacities were studied in response to each treatment individually. The study addressed both the water soluble and insoluble fractions. Applicative work on high-protein content dispersions was done. Enzymatic proteolysis was an efficient way to improve the foamability of the protein's dispersions. Rheological characteristics of the foams were studied and compared to eggs foams, as the reference system. Differences in the foams stability over time were found and studied as well.

Lipidomics and volatilomics reveal the changes in lipids and their volatile oxidative degradation products of brown rice during accelerated aging

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Academy of National Food and Strategic Reserves Administration, China

Abstract:

Brown rice exhibits higher nutritional value and attracts more and more attentions; however, lipid alteration in brown rice during aging is poorly understood. In this study, lipidomics and volatilomics were employed to investigate free fatty acids, triglycerides, and volatile oxidative degradation products of lipids in brown rice during accelerated aging for 70 days. The results showed that the total free fatty acids in brown rice increased significantly (2.90–4.14 times) while triglycerides decreased remarkably at the initial stage of aging. Monounsaturated and polyunsaturated aldehydes, ketones, and acids increased obviously in brown rice during accelerated aging for 70 days. The screening of significantly different compounds indicated that the enzymatic hydrolysis of triglycerides (EHT) and enzymatic oxidation of lipids (EOL) were the main biochemical behaviors at the initial stage of aging (0–28 day) while automatic oxidation of lipids (AOL) was the primary chemical reaction for 28–70 days aging.

Stability of Gel Emulsions of Sacha Inchi Oil and Flour Emulsified with Isolated Soybean Protein

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National University of Colombia, Institute of Food Science and Technology-ICTA, Bogotá D.C, Colombia.

Abstract:

The food industry has increased its interest in using new sources of raw materials that not only provide functionality to foods but also provide nutritional benefits. The production of gel emulsions with unsaturated oils and proteins as emulsifiers has become increasingly important in recent years because to their functionality in foods, especially in meat products as analogs of saturated fats of animal origin, which are one of the major causes of cardiovascular diseases. Sacha Inchi (*Plukenetia* spp) is an Amazonian native species that contains a high content of polyunsaturated Omega 3 fatty acids (48-51%) in its oil and protein-rich flour (58-61%) containing all 9 essential amino acids, fiber (15-18%), and minerals, making it an alternative ingredient in the production of gel emulsions and providing nutritional and techno-functional properties to foods. The objective of this study was to evaluate the stability of gel emulsions (O/W) based on Sacha Inchi oil and flour and isolated soy protein. A control and four treatments were established with different inclusions of Sacha Inchi flour in relation to isolated soy protein (10, 20, 30, and 40%), thermally treated. Their stability was evaluated in relation the pH, water and oil retention capacity, texture (TPA), and color and their behavior was evaluated over 14 days (1, 7, and 14). The results showed stability in pH and color, a decrease in water and oil retention capacity, and variations in texture with an increase in Sacha Inchi flour concentration over time. In conclusion, gel emulsions based on ingredients such as Sacha Inchi oil and flour can be used an alternative to enrich meat products with Omega 3 and complete protein; a sector of interest for application.

Cookable Milk Gels

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University of Copenhagen, Denmark.

Abstract:

Heat and acid-induced milk gels do not melt or flow upon cooking or frying and can therefore be

considered non-melting cheeses, making them interesting as a dairy-based meat alternative. Milk composition and processing conditions, like acidification temperature, affect the properties of the gel formed. Acidification temperature was found to greatly impact on gel formation and chemical interactions within the protein network. Altering the milk composition, either by changing the milk sources, i.e. cow milk or buffalo milk, or by the addition of whey protein or casein micelles, showed that both concentration and protein type influenced the gel formed. Furthermore, increasing whey protein content resulted in a significantly moister and softer gel. Upon cooking the gel becomes significantly softer. Using Low-Field nuclear magnetic resonance a better understanding of the structure of the gel as affected by processing or milk composition was found. The findings presented constitute a significant advancement to the body of knowledge on the relationship between composition, protein interactions, and protein ratio of heat and acid-induced milk gels. These insights can be exploited and used by the dairy industry for modulating acid milk gel functionality.

Production of Indian Cultured Butter (*Makkhan*) from Cow Creams with Varying Size of Fat Globules: Effects on Fermentation, Churning and Quality Characteristics

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Abstract:

Indian cultured butter (*makkhan*) is a widely produced and consumed product of Indian subcontinent. Conventional *makkhan* production practices using whole milk (cow or buffalo milk) as raw material cannot improve scale of production and produce products with variable qualities. By virtue of production style *makkhan* contains a good proportion of high melting fraction of milk fat, which has strong relation with size of milk fat globules (MFGs). Therefore, the present study was aimed to evaluate impact of cow creams with varying size of MFGs in comparison with whole milk on characteristics of *makkhan*. For production of creams a two-stage modified centrifugal separation approach was employed. In order to produce *makkhan* selected protocols for standardization, processing, fermentation and churning were followed. Fermented samples were evaluated for pH, titratable acidity, lactic count. Yield of *makkhan*, fat recovery, fat loss in butter milk and churning time were analysed during churning. Produced *makkhan* were characterised in terms of physicochemical, thermal, rheological, sensory and storage properties. There were no significant variations among the fermented samples in terms of pH, titratable acidity, lactic count. Fermented cream containing MFGs with highest average size took less time for churning, prevented fat loss in buttermilk significantly, *makkhan* produced with significantly higher yield and increased fat recovery, improved proximate composition, microbiological properties, acceptable amount of flavour, higher amount of conjugated linoleic acid, lower amount of saturated fatty acid, and possessed good spreadability at 22°C. *Makkhan* produced with improved characteristics didn't show any significant change in microbial properties during frozen (-18°C) and refrigeration (5°C) storage. However, titratable acidity, acid and peroxide values in the samples stored at 5°C were found to increase. Production of *makkhan* from creams with higher average size and higher proportion of large MFGs brought significant improvement in quality of *products*, and that process could be recommended for large scale production of *makkhan*.

Material Balance of Nutritional Components in a Jaggery Processing Unit

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Abstract:

Traditional sweetener jaggery, a non-centrifugal sugar, is regarded as a good source of minerals and bioactives. The production of jaggery involves various unit operations involving continuous heat and mass transfer, where effectiveness of juice clarification plays an important role in maintaining the nutritional quality and storage life of jaggery. The work aims to study the potential flow of materials within a jaggery processing unit by combining sampling, analyses and quantification. The sugarcane juice, clarified juice, scum and jaggery were analysed for its overall mass balance, total polyphenols, mineral content, sugars, moisture, antioxidant potentials and ash content, to establish a mass balance and clearly understand where the nutritional losses occur, if at all. A closure of 98% was obtained where the yield of jaggery and scum varied in the range of 13-18% (dry basis) and 0.8-2.4% (dry basis), respectively. The total ash content in raw cane juice, scum and jaggery was found to be in the range of 0.17-0.28%, 1.2-2.3% and 1.7-1.9% (dry basis), respectively. It was found that almost 50% of the mineral contents from sugarcane juice was lost in scum ($p<0.05$). However, through HR-LCMS it was seen that most of the polyphenols (75%) such as p-coumaric, ferulic acids, rumexoside, oryzarol, hydrobenzoic acids etc. that positively influence human health were retained by the jaggery. A positive correlation ($r>0.5$) could be established between the total polyphenolic contents, antioxidant potential and α-glucosidase inhibition property of jaggery. In order to retain maximum minerals in jaggery and to ensure appropriate amount of scum removal, there is a need to study the technological upgradations and optimise and standardize the clarification step.

Innovative Technologies for Studying the Diffusion Mechanisms that Influence Wine Evolution

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Abstract:

Wine is a beverage produced and studied from centuries despite the numerous literature available, there are still many aspects related to its evolution and preservation which could be investigated to reduce the use of additives which could induce intolerance or allergy. The evolution of a wine depends on its biophysical composition but also on the environmental conditions (like temperature, composition of storage atmosphere) and its packaging. The winemaker must be able to maintain the high quality achieved in the cellar and/or ensure an optimal wine evolution. In recent years,

ageing under the sea has been growing in importance, supported by evidence of softer tannins and greater complexity in a shorter time than in the cellar even if supporting scientific studies are limited. Merging common competences from different areas, in 2021 a project to study the mechanisms that influence wine in marine abysses started thanks to the support of "La Cura" winery, in Tuscany. The aim of the research was to understand the reasons and the mechanisms of under the sea ageing can influence wine evolution in comparison to the one in cellar. Among the main factors influencing the life of a wine, oxygen and temperature play a fundamental role. During this research, the monitoring of these two parameters was carried out using non-destructive methods: oxygen concentration was monitored using laser spectroscopy while temperature and pressure monitoring was carried out using specific sensors developed on purpose. The results of these studies will be used to develop innovative capping of wine bottles.

Technological Improvement of Selected Wheat Varieties for Organic Production

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Abstract:

Over the last few years, there has been a considerable increase in awareness and interest in environmental sustainability and the preservation of our planet, with a focus on the origin, production method and nutritional value of the products. The effects of this trend have been felt above all in the agri-food sector, which has been a rapidly increase in demand for organic and, in general, more sustainable products, stimulating farmers to use organic and environmentally friendly practices. Considering this, it becomes crucial to increase the availability of germplasm suitable for organic production (Eu Lex. 848/2018). The aim of the present research was to assess the breadmaking suitability of three varieties of wheat selected on the basis of their agronomical properties. The flours obtained by the grinding of the grains were used for the production of sourdough bread. In the first phase of the research, a characterization of the biga and doughs derived from the flours of the three selected wheat varieties was carried out to assess their compositional properties. Subsequently, the bread samples obtained were characterized both by chemical and technological point of view. Bread samples were also characterized in terms of flavor profile by SPMEGC-MS and their sensory profiles were evaluated. Finally, the shelf-life of the three breads were also evaluated as a function of the temperature and storage atmosphere.

Microbial Growth and Storage Behaviour of Refrigerated Sweet Potato Purees

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Abstract:

Sweet potatoes known as an important source of nutrients could represent a proper substrate for

lactic acid bacteria (LAB). Accordingly, the study aimed to determine if LAB for plant-based food matrix could survive in processed mashed sweet potatoes during storage. Four types of thermal treatments were used to process the sweet potatoes mainly boiling, steaming and steaming coupled with ohmic heating at two different voltage gradients 17.5 V/cm and 20 V/cm respectively. The samples were stored at the refrigeration temperature of 4°C for 28 days. Microbial growth, color and dynamic viscosity were evaluated during the storage days with 7 days frequency. The initial LAB population was approximately 9.5 log CFU/g on fresh samples. The general evolution of the LAB growth in all the samples is similar excepting the sample treated by steaming coupled with ohmic heating at 20 V/cm. During 21 days of storage at refrigeration temperature, the LAB population fluctuated between 6.15 log and 7.01 log CFU/g. The color of the samples was insignificantly affected, the dynamic viscosity had decreased with 5-10% for all the samples. In conclusion sweet potatoes are an important substrate for the growth of LAB for plant-based. Further studies are necessary to evaluate other possible implications on the sweet potato purees.

Spirulina, A Sustainable Microorganism to Enrich Baked Goods with Precious Nutrients

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Abstract:

The search for new low-cost, good quality and low environmental impact protein sources represents a frontier to be explored urgently. In fact, the production chain of proteins of animal origin presents critical issues and environmental impacts due to the intensive exploitation of primary natural resources. In addition, the demand for products of plant origin is constantly increasing, due to a growing number of consumers who are approaching flexitarian, vegetarian or vegan diets. Within these environmental challenges of the agri-food sector and changes in food habits, Spirulina (*Arthrospira platensis*) is an attractive alternative, representing a crop with minimal environmental impact, while providing an excellent protein source, high quality lipids and a varied amount of micro- and macro-elements. Spirulina can enrich staple food, such as bread, due to its peculiar nutritional profile. In this study, two different composite mixtures were obtained by adding different percentages (1% and 2%) of Spirulina powder to "Italian type 1" semi-wholemeal flour (W = 300) after which chemical, physical, rheological, and sensory analyzes were carried out versus samples of control bread (Montevecchi *et al*., 2022). Spirulina caused drastic rheological changes when added in concentrations higher than 2%. However, the protein concentration significantly increased in the samples enriched with Spirulina 1% (3.17%) and Spirulina 2% (5.12%), while reducing the amount of gluten. The total amount of essential amino acids in the 1% and 2% Spirulina spiked samples were significantly higher than in the control, even after the cooking process, thus improving the specific deficiencies of the wheat flour. **Acknowledgements:** This research study was partially funded by the Camera di Commercio di Reggio Emilia: "Bando per sostegno a programmi di ricerca e sviluppo delle imprese – 2015" and partially supported by the "Fondo di Ateneo per la Ricerca 2020 – University of Modena and Reggio Emilia (FAR Impulso 2015) (grant no. CUP: E42F20000170001)" entitled: 'Design of flour and bakery products with functional properties and strategies for the mitigation of process contaminants'.

Sustainable Processing of Meat Analogue Using Plant Protein Isolate, Vegetable Oil and Food Grain By-Product

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Abstract:

Due to a growing population and rapid economic growth, global meat consumption has increased by 58% over the past two decades. The current trend in meat consumption poses a serve burden on the environment, resulting in water pollution, land degradation, deforestation, biodiversity loss, climate change and other detrimental effect. Consequently, plant-based meat alternatives have gained popularity as healthier and more environmentally friendly alternatives. However, the current production of plant-based meats relies heavily on additives to achieve satisfactory sensory properties. Meanwhile, extensive attention was paid to the sophisticated technologies involved in the construction of meat analogues, which required a considerable amount of mechanical power. In order to further enhance the sustainability benefits of plant-based alternatives, it is desirable to use sustainable materials and processing methods that require minimal energy input. This work presents a sustainable processing methodology for developing meat analogue using plant protein isolate, vegetable oil, and an industrial by-product of food grain (i.e., brewers' spent grain) without the use of external texture enhancers. By showcasing the processing of formulations with characteristics comparable to commercial meat analogue products, this work demonstrates that meat analogues can be processed in a sustainable manner and proved the potential for spent grain to serve as a binding agent in meat analogue.

Combining Chitosan-Fish Oil-Green Tea Extract as A Potential Active Coating for Fresh Atlantic Bonito Fillet Preservation

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Abstract:

Sustainable bio-based packaging materials are gaining increasing attention by food manufacturers and consumers, as possible substitutes for synthetic plastic materials. In particular, edible biopolymer coatings/films could be applied to highly perishable food products to preserve their freshness and increase shelf life. Atlantic bonito (*Sarda sarda*) is a well-known fish from Atlantic Ocean with pleasant taste and high nutritional value. However, it is susceptible to lipid oxidation and spoilage. Therefore, a sustainable and active coating formulation composed by chitosan (CH)-fish oil (FO)-green tea extract (GTE) was developed to be apply on Atlantic bonito fillets' surface to extend its shelf life. CH, FO and GTE were selected due to their well-known antioxidant and antimicrobial effects. A Central Composite Rotational Design was developed to evaluate the effect of coating/film compounds' concentration – CH (0.5-2.31%, w/w), FO (0.20-0.44%, w/w) and GTE (2%, w/w) – on their physicochemical and functional properties (e.g., mechanical, barrier, surface properties).

The changes in quality of fish fillets were also assessed, such as pH and textural analysis. Based on surface contact angle results, 1.25% CH-0.30% FO-2% GTE formulation (78°) was the most promising one due to good coating adhesion ability on fish fillets' surface. Also, this formulation showed to be a good barrier to water vapor (2.29×10^{-6} g/(m.s.Pa)) as well as good mechanical properties comparing to other tested formulations. The developed CH-FO-GET coating/film displays properties that allow its use as an environmentally friendly active food packaging system to be applied to Atlantic bonito fillets.

Characterization of the *Sacha inchi* Oil Processing By-Products from Different Regions and Valorization Proposal in a Biorefinery Context

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Abstract:

The Sacha Inchi oil industry has showed a continuous growing in Colombia in the recent years. The main by-products of the Sacha Inchi oil processing are the oil press-cake and the shell of the kernels. The sustainable processing of the Sacha Inchi seeds may provide socio-economic benefits to local communities, while contribute to promote compliance with the Sustainable Development Goals. However, proposing a valorization route of the SIS in a circular economy context (CEC), requires the knowledge of both their chemical composition, and the possible transformation processes. The aim of this study was to characterize the Sacha Inchi shell (SIS) from 22 different regions of Cundinamarca (Colombia), in terms of their proximal composition (moisture, fat, ash, protein, carbohydrates, total dietary fiber, and contents of magnesium, calcium, and potassium). The results indicated that SIS is rich in carbohydrates (79-83%) and total dietary fiber (69-80%). The content of phenolic compounds (up to 27 mg GA/g) with extraction yields amounting up to 25%. Moreover, SIS contains important amounts of potassium (up to 490 mg/100g) and calcium (up to 280 mg/100 g). The content of magnesium ranged between 50 and 80 mg/100g. Considering this chemical composition an evaluation of the feasibility of a valorization route was carried out for the SIS in a biorefinery concept, in which emerging processes for obtaining phenolic antioxidant compounds and dietary fiber could be obtained for potential food applications, and for making the Sacha Inchi agroindustry more sustainable.

Can Nonvolatile Tastants be Smelled during Food Oral Processing?

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Abstract:

While accumulating evidence implied the involvement of retro-nasal sensation in the consumption of nonvolatile taste compounds, it is still unclear whether it was caused by the taste compounds themselves, and if so, how can they migrate from the oral to nasal cavity. At first, we proposed

aerosol particles as an alternative oral–nasal mass transfer mechanism. The high-speed camera approved that aerosol particles could be generated by the typical oral and pharynx actions during food oral processing; while the narrow-band imaging of nasal cleft and mass spectrometry of nostril-exhaled air approved the migration of aerosol within the oral–nasal route. Then, the "smelling" of taste compounds within the aerosol particles was testified. The four-alternative forced choices (4AFC) approved that the potential volatile residues or contaminants within the headspace air of pure taste solution cannot arouse significant smell, while the taste compounds embedded in the in vitro prepared aerosol particles can be "smelled" via the ortho route. The "smell" of sucrose is very different from its taste and the "smell" of quinine, implying its actual olfaction. The sweetness intensity of sucrose solution was also reduced when the volunteers' noses were clipped, indicating the involvement of retro-nasal sensation during its drinking. At last, the efficiency of aerosol as a mechanism of oral–nasal mass transfer was demonstrated to be comparable with the volatile molecules under the experimental condition, giving it the potential to be a substantial and unique source of retronasal sensation during food oral processing.

Multiphysics Modeling of Electrohydrodynamic Thin Film Drying for Food

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Abstract:

Drying plays a pivotal role in food production, traditionally performed by hot air drying. However, this conventional method often leads to undesirable product quality and high energy consumption. Electrohydrodynamic (EHD) drying offers a milder and more efficient alternative. This emerging technology uses a high voltage between electrodes to create an ionic corona wind. This wind, combined with the electric field in the product, enhances heat and mass transfer, improving the drying process. The intricacies of EHD drying are studied through a multiphysics model in COMSOL. This presentation showcases model development and current findings. It comprises two components: a maltodextrin-based thin film drying model and an EHD model, forming the basis for future integration. The thin film drying model combines mass and heat transfer of internal moisture with evaporation-induced shrinking in a maltodextrin film. Results depict typical moisture and temperature changes during drying, instilling confidence in its applicability to a wide range of thin-film drying systems. Additionally, the multiphysics model allows us to extract data from any point within the system, facilitating in-depth exploration of complex thin-film systems. Concurrently, the present EHD model simulates the flow pattern of the corona wind generated by the EHD system. This corona wind exhibits a direct correlation with the applied voltage and the spacing between the electrodes. This valuable insight is essential in refining the design of EHD dryers for future applications.

PFAS (Per- and Polyfluoroalkyl Substances) Based Coating in the Case of Domestic and Industrial Baking Applications

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Abstract:

This presentation is about per- and polyfluoroalkyl substances (PFAS) based non-stick-coating for domestic cookware and baking applications. PFAS and silicon based non-stick-coatings are the most widely used. Alternative coatings such as ceramic coatings are too fragile to be used in industry use, while metal pans require the use of a non-stick-fluid. There is a growing pressure for a possible ban on PFAS in food processes. A literature review will be followed by results obtained with 11 frying-pans. Successive cooking of water (model food) was done. PFAS detection based on LC-MS/MS (triple quadrupole systems) or LC-HRMS (Orbitrap system) was developed with LOD (Limit of Detection) as low as 0.1 ng/kg for 13 PFAS oligomers including PFOS (Perfluorooctanesulfonate) and PFOA (Perfluoroctanoic acid). Presence of PFAS was detected on the first usage (< 0.5ng/kg) and declined for further cookings (test done for 5 cookings). The results of the National "SATIN-BAKING" project (2012-2016) for bread will be presented; 28 different PFAS analytes were investigated with LODs of 10 pg/g f.w. (fresh weight) (PFOS) 10-100 pg/g f.w. (PFOA) and 5/1000 pg/g f.w. (other analytes). The samples (breads baked in industry and under laboratory conditions) did not show any significant contamination by the various PFAS analytes. In conclusion, the results obtained indicate that the release of PFAS analytes from non-stick coatings to food is very low. The risk of transfer may occur during initial use or at the end of coating lifetime's (1000-2000 cycles), showing that measures can be envisaged to anticipate the risk of transfer.

Pectin-Based Hydro-Films for Applications in Active Packaging

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Abstract:

The global fruit market has been predicted to grow to be worth over $280 billion by 2027. However, this increased in fruit production also implies and ever increasing % of fruit based wastes and post-harvest losses. Concurrently, there is, an increased requirement for versatile biopolymer-based biodegradable films and gels for applications in drug delivery, food preservation etc. The current work is an attempt to address both of these issues by employing green approaches to fabricate biodegradable pectin films derived from renewable fruit waste feedstocks. In this work we report a method for creating insoluble pectin films by crosslinking pectin with poly-ethylene glycol di-glycidyl ether (PEGDE). Furthermore, in order to improve the physico-chemical characteristics of the films, a physical blend of pectin with a complementary bio-polymer, carboxymethyl cellulose (CMC) was also tested. The crosslinking led to the formation of films that were not only insoluble in water but showed significantly better tensile strength. The films fabricated were then combined with known antimicrobial agents such as Manuka Honey and Bismuth Chloride in order to to investigate their potential applicability in state-of-the-art food packaging and preservation applications such as "active packaging" and "intelligent packaging". This method for creating films with tuneable physical properties from pectin can solve dual problems of waste management and find further high value applications in fields like food preservation, drug delivery and other antimicrobial applications.
Keywords: pectin, biopolymers, hydrogels, food preservation.

Colorimetric Food Freshness Detection System using Coaxial Electrospun Hybrid Nanofibers with Zeolitic Imidazolate Framework-8

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Abstract:

Food safety and assurance is a growing global public health problem. In today's world, packaged foods have been widely consumed as being more accessible. However, food freshness cannot be monitored after delivery to the market in a conventional package, which mainly acts as a barrier by minimizing the adverse effects of the external environment on the food. This study aimed to explore a robust colorimetric sensing scheme based on smart hybrid materials of stimuli-responsive conjugated polymers and zeolitic imidazolate framework-8 (ZIF-8). The developed stimuli-responsive smart hybrid material-based nanofibrous films of polydiacetylene (PDA) changed color upon exposure to food spoilage indicators, namely TVB-N compounds. This color change was analyzed to monitor the real-time freshness status of the food within the package. For this purpose, thermal, structural, and morphological characterizations were performed on the synthesized ZIF-8 nanocrystals. Next, chitosan, ZIF-8, PEO, and PDA were electrospun coaxially to produce colorimetric PDA-PEO-Chitosan-ZIF-8 (PPCZ) nanofibrous films. Chitosan/ZIF-8 (core) and PEO/PDA (shell) nanofibers were characterized to determine the best ZIF-8 concentration in the core region using TEM, FESEM, XRD, TGA, FTIR, mechanical and colorimetric analysis. The developed food freshness detection system was tested with the chicken sample and monitored the real-time status of the chicken successfully. Overall, the developed detection system would offer a great advancement in protecting consumers against potential foodborne illnesses and preventing global food waste offering an ultimate contribution to the United Nations Sustainable Development Global Goals.

Is Food Preference Innate Instinct Driven or Human's Free Will?

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Abstract:

The question whether food preference decisions are controlled by innate instincts, or a conscious decision-making process is still open. Innate instincts trigger involuntary and unconscious psychic processes while conscious decision-making processes are considered as the "free will" of humans. Humans, as only species, possess the ability to gain conscious control over instinctive behavior and to transfer consciously controlled processes into instinctive behavior. Food preference decisions are -amongst others- dependent on the flavor processing outcome, the hedonic value associated with it, cultural habits and our autobiographical memory. To answer the question raised is important not only for neuroscientists, psychologists and philosophers but also for food scientists and developers. Looking from different perspectives involved in food preference decisions could not only settle a long ongoing debate but also pave the way to understand why people prefer to eat what they eat.

PLASMAFOOD – Italian Project on the Study and Optimization of Cold Atmospheric Plasma Treatment for Food Safety and Quality Improvement: Results and Future Perspectives

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Abstract:

The main objective of the PLASMAFOOD project was to provide a deeper knowledge of the aspects of Cold atmospheric plasma (CAP) treatment of foods, which have been hardly investigated, in order to fill the gaps identified in the literature and thus investigating the possibility to promote the application of this novel technology. Five different categories of food products were selected based on their different characteristics, different kinetics of quality degradation and different safety aspects, specifically, minimally processed fruit and vegetables (MPFV), semi-dried fruit (SDF), dried fruit (DF), fish products (FP) and mollusks (M). The project was divided in six Work Packages, each of which addressed a specific aspect, such as: processing; safety in relation to pathogenic microorganisms, moulds and mycotoxins and formation of biogenic amines; quality in relation to colour, enzymatic activity, lipid oxidation and microstructure; and nutritional issues in relation to bioactive components content, antioxidant activity and in-vitro effects on cell lines, which were studied through the collaboration of the five Research Units involved in different activities according to their specific expertise. The main results obtained during 4 years of research will be presented, highlighting the need for further research and new perspectives for the application of CAP in the food sector. The project "PLASMAFOOD - Study and optimization of cold atmospheric plasma treatment for food safety and quality improvement" is founded by MIUR - Ministero dell'Istruzione dell'Università e della Ricerca - PRIN: Progetti di Ricerca di Rilevante Interesse Nazionale, Bando 2017.

Efficacy of Cold Atmospheric Plasma Treatment on the Inactivation of Foodborne Viruses

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Abstract:

Enteric viruses are important foodborne pathogens. Among these, Hepatitis A virus (HAV) and Norovirus (NoV) are responsible for the largest part of outbreaks worldwide. In this study we evaluated the efficacy of Cold Atmospheric Plasma (CAP) treatment for the inactivation of HAV and Murine Norovirus (MNV), an animal surrogate for human Norovirus, whose infectivity cannot be experimentally assessed due to the lack of cell culture systems. Surfaces of inert material (borosilicate glass) and surface of soft fruits (strawberries) were experimentally contaminated with 5 µl of HAV (4.6×10^6 $TCID_{50}$/ml) and MNV (3.2×10^6 $TCID_{50}$/ml) suspensions and subjected to two different conditions of treatment: i) Ozone-mode=33,3 W for 30 and 60 min; ii) NOx-mode=332,9 W for 5, 10, 15, 20 and 30 min. Frp3 and RAW 264.7 cell lines were used to determine the viral

infectivity of HAV and MNV, respectively. Experimentally contaminated samples not subjected to the treatments and blank samples treated with CAP were used as controls. After the treatments, viral particles were detached from glass surfaces and strawberries by repeated washing with cell culture medium and using the ISO 15216 method, respectively. The recovered viruses were then subjected to titration to calculate the viral titre. The ozone-mode treatment caused a reduction of viral infectivity below the detection limit of the method (20 $TCID_{50}$/ml) for both viral species and surface types (glasses and strawberries) after 60 min of treatment. Applying the NOx-mode treatment, a reduction below the detection level was instead achieved in the time range between 15 and 20 min for HAV and after 30 min for MNV. Considering that MNV displays a natural decay of infectivity at room temperature, the net reduction due to the two treatment conditions was 1.2 log for MNV both for borosilicate glass and strawberries surface, and ranged from 1.7 log (glass) to 2.3 log (strawberries) for HAV. In conclusion, the results of this study showed that the application of CAP is effective for Hepatitis A virus and Norovirus inactivation both on inert surfaces and soft fruits. The effect of the ozone-mode is depended on exposure time, which was related to the increase of ozone in the CAP chamber, while shorter times are needed using the NOx-mode, possibly due to higher reactivity of nitrogen species. Therefore, the CAP technology is a promising non-chemical and non-thermal treatment for the application in the food industry as an alternative to traditional food preservation methods. **Acknowledgments:** project "PLASMAFOOD - Study and optimization of cold atmospheric plasma treatment for food safety and quality improvement" founded by MIUR - Ministero dell'Istruzione dell'Università e della Ricerca - PRIN: Progetti di Ricerca di Rilevante Interesse Nazionale, Bando 2017.

Cold Plasma-Based Approaches for the Decontamination of Fresh Products

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Abstract:

Cold Plasma is a promising technology for the decontamination and preservation of several foods by reducing bacteria, fungi and mycotoxins. Increased consumption of ready-to-eat products is associated with increasing foodborne disease outbreaks due to the presence of contaminated matrices. In this study, two strategies were used, i.e. Cold Atmospheric Plasma (CAP) for fruit e.g. strawberries and Plasma Activated Water (PAW) for washing leafy vegetables (rocket leaves). Strawberries underwent CAP treatments for times up to 30 min using two gas regimes: O_3 and NOx. Results showed that O_3 had minimal impacts on main spoilage microbiota. On the contrary, NOx reduced moulds in 10 min, yeasts and mesophilic counts in 20 min and lactococci in 30 min. Overall, none of the treatments altered the products' chemical or physical characteristics. After PAW production, rocket leaves were washed for different times and the microbial and quality features compared to washing with hypochlorite. Significant reductions in mesophilic counts and enterobacteria occurred after 10 min (1.2 and 1.7 Log units). Extending treatments to 20 min did not further improve decontamination. After 2-days storage, spoilage microbiota had 1-1.5 Log

counts lower than control, but pH and visual quality remained unaffected. Overall both NOx-CAP and PAW can be promising technologies for the decontamination without affecting the overall chemical-physical quality of fresh produce. This work is part of the project "PRIN 2017 -PLASMAFOOD - Study and optimization of cold atmospheric plasma treatment for food safety and quality improvement" founded by MIUR - Ministero dell'Istruzione dell'Università e della Ricerca, PRIN2017.

Role of Mono- and Disaccharides on the Inactivation of Peroxidase and Polyphenol Oxidase Induced by Cold Atmospheric Plasma

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Abstract:

Polyphenol oxidase (PPO) and peroxidase (POD) are among the most detrimental enzymes in plant-processed foods responsible for enzymatic browning, off-flavors, and loss of bioactive compounds. Among innovative technologies cold atmospheric plasma (CAP) revealed great potential in the inactivation of these enzymes. However, plant foods are complex matrices, and some constituents may counteract the CAP effects. This study investigated the effect of different CAP exposures on the activity of POD and PPO in phosphate buffer and in model systems with different concentrations of monosaccharides (glucose, fructose) and disaccharides (sucrose, trehalose) to evaluate the potential role of sugars in enzyme inactivation. Spectroscopic analyses (fluorescence, circular dichroism, UV-Vis absorption) were conducted to highlight structural modifications possibly accountable for the enzyme inactivation. In buffered systems, the inactivation induced by CAP was dependent on the enzyme, the treatment time, and the ozone concentration in the chamber. Sugars were shown to modify the POD and PPO activity and the enzymes' ternary and secondary structure to a varying extent depending on their type and concentration. Notably, sucrose and trehalose, especially at the highest concentrations, highlighted a protective effect on the functionality of both proteins. Structural modifications were retained to explain only partially the different protective effects of sugars on HRP and PPO; indeed, other factors, such as the different abilities of sugars to quench plasma reactive species, reduce the system mobility, and stabilize the protein by the hydration shell preservation, possibly played a role in the reduction of enzymes' inactivation induced by CAP.

Assessment of Biogenic Amines Producing Bacteria using Non-Thermal Plasma on Sardine Fillets

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Abstract:

Beside the non-thermal nature of cold atmospheric plasma (CAP), one of the interesting features is the capability to produce active species, among which reactive oxygen species (ROS) and reactive nitrogen species (RNS). The above mentioned species, together with UV radiation and charged particles, exercise a great potential of inhibition against bacteria, guaranteeing an appropriate safety of the food products (Silvetti et al; 2021). The aim of this work was thus to assess the microbial inactivation and detect the presence of biogenic amines during 13 days of storage at 4 °C in sardine fillets processed with CAP using the device "Plasma Assisted Sanification System" (PASS), developed by AlmaPlasma srl (Bologna, Italy) in NOx-mode=332,9 W for 30 min. Microbial loads were only slightly affected by the CAP treatment, however, during storage, a growth inhibition was observed for CAP treated samples compared to untreated ones. Immediately after the treatment spermidine and spermine were mainly identified respectively in control and treated sample, while starting from day 8 a significant increase of putrescine, cadaverine and tyramine were observed in non-treated fillets. At day 13 of storage lower level than control, of previous mentioned amines was found in plasma treated sardine. Therefore, CAP might be a promising technology able to increase the shelf-life of sardine fillets, ensuring product safety. The present work is part of the project "PRIN 2017 -PLASMAFOOD - Study and optimization of cold atmospheric plasma treatment for food safety and quality improvement" founded by MIUR - Ministero dell'Istruzione dell'Università e della Ricerca.

Tailoring Isothiocyanate Profile in Rocket Salad (*Eruca sativa L.*) by means of Plasma Activated Water (PAW)

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Abstract:

The project investigated the effect of Plasma Activated Water (PAW), generated by a high-power atmospheric pressure corona discharge source, on isothiocyanate content in rocket salad and specifically, on erucin and sulforaphane. PAW was obtained using distilled water and immediately after generation, 20 g of rocket salad samples were dipped in 400 mL of PAW and kept under constant agitation at room temperature for 20 min. PAW-treated samples were compared with untreated ones (UNT). Erucin analysis was carried out by GC-MS, while sulforaphane determination was obtained by liquid chromatography/mass spectrometry analysis (UHPLC/MS). Identification of both molecules was confirmed by the comparison with pure authentic standards.

The relative abundance of erucin detected in PAW-20 rocket salad extracts was about 20% lower than that detected in the UT samples. Similarly, quantification results revealed a significant lower concentration (t-test, $p<0.05$) of sulforaphane in PAW-20 extracts (134±2 µmol/L) than in UNT extract (365 ±7 µmol/L). Interestingly, previous results indicated an increase of glucosinolate (glucoraphanin and glucoerucin) relative percentages (around 44 and 50%, respectively) in PAW-20 extracts compared to the UNT extracts. As glucosinolates were the precursors of sulforaphane and erucin, these results suggested that PAW could affect the enzymatic hydrolysis of glucosinolates into their corresponded products probably by inhibiting the myrosinase reaction. PAW treatment could be an interesting and emerging technology for tailoring bioactive profile in fresh product by acting on enzymatic pathways. Further studies are necessary for better understanding the mechanism of action.

Effect of Plasma-Activated (PAW) Water on the Rheological, Pasting, and Thermal Properties of Potato Starch during Annealing Treatment

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Abstract:

The present study investigates the application of annealing and plasma-activated water (PAW) for starch modification, as alternative methods compared to the chemical one. Native potato starch was subjected to PAW, annealing with distilled water (DW_ANN), and the combination of the two (PAW_ANN) at different incubation times (1, 4, 8, and 12h). The change in rheological, pasting, and thermal properties were evaluated. The results showed that all treatments promoted significant modifications of the investigated parameters. In particular, while the pasting properties of the potato starch remained unchanged after the PAW treatment, G' (elastic) and G'' (viscous) of the PAW-treated starch were significantly higher than those of the native. DW_ANN significantly increased all rheological parameters and reduced peak viscosity, breakdown, and setback and significantly incremented pasting temperature, holding strength, and final viscosities of the potato starch. The combination of the treatment (PAW_ANN) showed a synergistic effect, resulting in a strong gel formation. In conclusion, the combined treatment results as a promising novel green method to modify the properties of starch and improve its stability within a short treatment time.

Effectiveness of CAP on Emergent *Alternaria* Toxins in Naturally Contaminated Dried Tomatoes

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Abstract:

In the last decade, the attention towards *Alternaria* toxins, belonging to the group of so-called emerging mycotoxins, has increased, as well as the adoption of non-thermal treatment to reduce their occurrence in food. This study investigated the efficacy of cold atmospheric plasma (CAP) treatment in degrading the *Alternaria* toxins as pure molecules and, for the first time, those naturally present in dried tomatoes. Two different CAP conditions were compared: ozone (O_3) and nitrogen oxides (NO_x) regimes. Five different mycotoxins produced by *Alternaria alternata*, such as alternariol (AOH), alternariol monomethyl ether (AME), tentoxin (TEN), altenuene (ALT), and tenuazonic acid (TeA), were selected. O_3 regime was found to be very efficacious against all the mycotoxins tested (60-99% reduction), while the CAP under NO_x regime exhibited variable efficacy depending on the mycotoxin molecular structure. To evaluate the CAP efficacy, twenty-five batches of dried tomatoes were analysed for the presence of *Alternaria* toxins. HPLC-MS/MS analyses revealed that more than 40% of the samples were contaminated by TeA, one by AOH, while other *Alternaria* toxins were not detected. Selected contaminated batches were subjected to CAP treatments for 15, 30 and 60 minutes in both regimes. It was observed that mycotoxin degradation increased with increasing treatment time, and the major reduction (52%) was achieved after 60 min of CAP under O_3 regime. Our findings contribute to the understanding of CAP treatment as a potential method for reducing mycotoxin contamination in food products and provide insights for further optimisation and application of CAP in food safety practices.

Elimination of Emerging Contaminants using Plasma Activated Water (PAW)

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Abstract:

The treatment of water with cold atmospheric plasma generates what is known as Plasma Activated Water (PAW). PAW therefore is a water which properties have been altered, reducing its pH, increasing its Oxide Reduction Potential (ORP)and its conductivity. This happens because a lot of reactive species with very sort life span are formed. When plasma is generated using air, species derived from Nitrogen and Oxygen are formed. Some of the reactive species from Oxygen and Nitrogen (RONS) formed are radical hydroxide (•OH), singlet oxygen ($_1O^2$), ozone (O_3). Most of this species quickly reacts to form more stable compounds such as nitrite (NO_2^-), nitrate (NO_3^-), nitric acid (HNO_3) or hydrogen peroxide (H_2O_2) (Simoncelli et al., 2019). Nowadays, there is a growing concern about certain contaminants that are difficult to eliminate, and which concentration is increasing in water resources. The oxidative capacity of the PAW makes it a perfect instrument to reduce partial

or totally a large number of contaminants of emerging concern, namely microorganisms or certain antibiotics (Fang et al., 2022; Li et al., 2019; Murugesan et al., 2020). This work seeks to analyses the capacity of simultaneous inactivation of *Enterococcus faecalis* and the antibiotic tetracycline to regenerate wastewater with agricultural purposes. *E. faecalis* is a Gram-positive bacteria that is found in wastewater, and without the proper elimination has the capacity to affect the crops and may cause damage to human health. While tetracycline is an non-biodegradable antibiotic that is not removed from wastewater treatment, so that their presence in irrigation water can have adverse effects on health and the environment. The work will be completed with phytotoxicity study.

Antioxidant and Antiproliferative Potential of Red Cabbage (*Brassica oleracea* var. capitata f. rubra) Submitted to Different Drying Methods

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Abstract:

Red cabbage good source of biocompounds like anthocyanins, glucosinolates, flavonoids and ascorbic acid. These are related with benefits on human health, reducing risks of different types of cancer (gastric, breast, bladder and prostate). However, due to its high water content, red cabbage is highly perishable, so preservation techniques are necessary. Drying is a well proved process that allows the maintenance of biocompunds. The aim of this investigation is to evaluate the effect of different drying methods to red cabbage on antioxidant potential and antiproliferative activity on adenocarcinoma gastric cells (AGS). Red cabbage was cut, blanched and dehydrated at 60 °C by 5 drying methods: Convective (CD), Vacuum (VD), Infrared (IRD), Low Temperature and Vacuum (LTVD at 20 °C) and Freeze Drying (FD). Control sample was blanched cabbage. Antioxidant potential was determined by ORAC and DPPH assays. Cell viability was measured by MTS method and IC50 was calculated. High values of antioxidant capacity were determined by DPPH assay where vacuum is included, between 45-50 µmol TE/g d.m., statistically similar to the control sample. ORAC assay reported the highest values of antioxidant potential for IRD samples (191.94 µmol TE/g d.m.), which may be due to the liberation of compounds with this potential. Antiproliferative activity in AGS cells was present in all samples, being higher for fresh sample (IC50: 12.2 mg/mL), but still having strong *in vitro* antiproliferation on dried samples. These results may establish the basis for further analysis about drying of cabbage and the effect on antiproliferative activity.

Gastrointestinal Digestion using the INFOGEST Protocol to Assessing Bioaccessibility of Mg, Fe and Zn in Plant-Based Burgers

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Abstract:

Plant-based burgers (PBBs) are a worldwide trend in the food sector, being considered alternative

products to meat-based burgers (MBBs). However, the nutritional potential regarding the content of essential elements may vary, due to the raw material used in the formulation and the availability of these nutrients for absorption by the body. Therefore, the objective of this study was to simulate *in vitro* gastrointestinal digestion, with the INFOGEST 2.0 protocol, to estimate the bioaccessibility of the Mg, Fe and Zn in 4 commercial PBBs (chickpea, mushroom, peas, and soybean), and 1 commercial MBB, for to compare. The average of essential elements content, expressed in mg/100 g, ranged from 26.77 (peas) to 84.44 (soybean) for Mg, 4.28 (mushroom) to 9.76 (peas) for Fe, and 1.04 (soybean) to 2.39 (peas) for Zn. The Mg, Fe and Zn content for MBB was 20.08, 1.83 and 5.42 mg/100 g, respectively. Chickpea PBB stood out for its high bioaccessible percentage for Mg (84.68%) and Zn (47.97%), and the soybean PBB for Fe (51.19%). Pea PBB also showed higher bioaccessible percentage for Fe (50.72%) and Zn (41.42%), while MBB only showed featured for Mg (64.80%). It is concluded that most of the evaluated PBBs are alternative foods for ingestion and Mg, Fe and Zn available for absorption. However, the total replacement of meat and/or derivatives by any PBB should be evaluated with caution, as the supply of essential elements can be reduced, depending on the type of product consumed.

Bioaccessibility of Calcium in Organic Bovine Milk Assessed by Static *in vitro* Digestion Method

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Abstract:

Organic milk has been consumed in several countries and it is associated to healthiness. However, studies assessing bioaccessibility of minerals in organic (ORG) compared to the non-organic (CNV) milks, based on the recent *in vitro* digestion INFOGEST protocol, are no existent. In this context, this study aims to estimate the bioaccessibility of calcium (Ca) in ORG and CNV samples, assessed by the INFOGEST 2.0 protocol. Five samples of ORG and CNV pasteurized milk were evaluated. Calcium was determined by FAAS with diluted acid in wet mineralization. Total mineral concentration was higher in ORG varying from 105.88 to 115.26 mg $100g^{-1}$ whereas in CNV from 92.56 to 95.15 mg $100g^{-1}$. The bioaccessibility of Ca showed higher results for ORG, amongst 13 and 28%, meanwhile CNV presented values between 11 and 12%. Results indicated that ORG showed greater bioaccessible Ca content, which could be associated to differences in the behavior of κ-casein hydrolysis as well as in the formation of insoluble soaps among ORG and CNV. Calcium bioaccessibility indicated that the ORG is adequate to reach to daily needs of Ca, according to the expected for organic products. Additionally, it was observed that the INFOGEST protocol was able to mimic *in vitro* digestion conditions, for bovine milk, although there are critical points that must be observed to estimate the bioaccessibility of minerals, as Ca, with the method, such as the efficiency of lipids digestion, the interaction of the electrolytes with the sample and the degree of proteins hydrolysis.

Influence of Ultrasound Time and Amplitude and Drying Temperature on Antioxidant Properties of Dehydrated Pumpkin Seeds

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Abstract:

This study aims to optimize the processes of ultrasound and convective drying in pumpkin seeds. An experimental design of 2^3+3 central points was made to define the levels of variables: drying air temperature, ultrasound amplitude, and ultrasound time. The drying air temperature was the variable that most influenced the water content of the flours. The water activity showed lower values in samples submitted to higher ultrasound amplitudes and drying temperatures. The lowest value obtained for this parameter was 0.25. The pH of the samples ranged from 6.90 to 7.04, and the total titratable acidity ranged from 1.83 to 2.39. Therefore, it can be inferred that the samples are close to neutrality. Milder ultrasound experiments promoted more remarkable preservation of vitamin C than the others, presenting values ranging from 15.76 to 26.02 mg/100g. There was no correlation between ultrasound and lipid content, which ranged from 34.51 to 37.93 g/100g. The increase in drying air temperature caused more significant protein denaturation. The antioxidant potential was not affected by the application of the ultrasound process. The multivariate analysis was used to evaluate the influence of ultrasound process in phenolic and fatty acids profile a similar fact was observed concerning the phenolic profile. Among the compounds evaluated in the phenolic profile, Procyanidin B2 and Gallic Acid components were predominantly present. The most abundant fatty acids in the samples were oleic and linoleic, indicating that most fatty acids are unsaturated.

Optimization of Ultrasound and Convective Drying Processes of Pumpkin Seeds: Effects of Ultrasound Amplitude, Ultrasound Time, and Drying Temperature

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Abstract:

Convective drying is commonly used to preserve seeds of fruits and vegetables, however can cause the degradation of nutritional compounds. Therefore, several studies have been carried out using ultrasound pretreatment to promote the optimization of the process. An experimental design of 23 + 3 central points was made to define the levels of variables: drying air temperature (50, 60, and 70°C), ultrasound amplitude (30, 50, and 70%), and ultrasound time (5, 10 and 15 min). The drying kinetics of the seeds was carried out in an oven with air circulation until the equilibrium water content was obtained, later the empirical models (Page, Midilli and Henderson & Pabis) were adjusted to the experimental data. Page's model was better adjusted to the experimental data of

drying in most experiments when compared to the others. Therefore, it presented superior values of the coefficients of determination greater than 0.99 in all experiments and low values of quadratic deviation (less than 0.02). The drying time ranged from 450 to 690 min for the control samples, while the samples submitted to the ultrasound process had reduced drying time (510 to 210 min), evidencing that the increase in drying temperature, time, and frequency of ultrasound generate the increase of the effective diffusivity, the mass transfer coefficient and consequently the drying rates. The distribution of the water content of the product does not occur homogeneously and can be evaluated throughout the drying process using the finite volume method.

Effect on the Water Vapor Permeability Properties of Polysaccharide Based Film at Different Temperature Conditions

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Abstract:

Food-packaging-environment comprises a complex system of interactions: migration, sorption, and permeation, which can influence the permeability of materials and the performance of packaging materials. The present work aimed to evaluate the water vapor permeability of the polysaccharide film (average thickness 40 µm) under different conditions of temperature and humidity in the system. The analysis was performed according to ASTM E96-95/E96M-05, under controlled conditions, 25 ± 2 °C/ RH of 30 ± 1%, and uncontrolled, ambient conditions, 32.4 ± 2 °C/ RH of 44 ± 1%, for 24 h. Water vapor transmission rate, water vapor permeability, water vapor permeability, and relative humidity in the headspace of the permeation cell were evaluated. Preliminary results under controlled temperature conditions show that there is no significant difference ($p < 0.05$) in the parameters, following Fick's first law. On the other hand, in environmental conditions, there was a significant difference ($p > 0.05$) in all parameters. In this case, the vapor pressure of the environment is greater than the vapor pressure in the cell, requiring time for equilibrium between cell-environment, according to Henry's law (law of gas solubility), so that there is no false result of permeability of the material. Such results impact the objective of the applicability of packaging materials for different types of food and storage conditions. However, the present research is in progress with other types of materials and, therefore, without conclusive answers.

Presence of Mycotoxins in Brazilian Cereal-Based Baby Foods

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Abstract:

Baby foods are formulated with mixture of products, including cereals that can be contaminated by a wide range of mycotoxins, with aflatoxins B1 and B2 (AFB1, AFB2), ochratoxin A (OTA), toxins T2 – HT2, deoxynivalenol (DON) and zearalenone (ZEN) the most frequently reported ones. Due to

the limited data on mycotoxins in Brazilian baby foods, the objective of this study was to evaluate the presence and levels of AFB1, AFB2, DON and its acetylated forms (3-ADON, 15-ADON) and ZEN. Sixty Brazilian cereal-based baby food samples acquired, extracted with QuEChERS and analyzed by HPLC-MS/MS. Mycotoxins were detected in 98.3% of the samples, with 81.6% of co-occurrence. Most of them were contaminated by ZEN (85%), DON (80%), 15-ADON (72%) and 3-ADON (65%); only three samples (5%) were contaminated by AFB1 and none by AFB2. The maximum levels found were 75.6 ng/g (DON), 16.5 (ZEN), 9.6 (15-ADON), 8.1 ng/g and 3.5 ng/g (AFB1). Multicereals and corn-based baby foods were contaminated with the highest levels of mycotoxins as well as most of the types of mycotoxins investigated. Despite low AFB1 occurrence, one sample presented concentration of 3.5 ng/g, which is above the limit established by the European Commission and the Brazilian Health Regulatory Agency (0.10 ng/g and 1.0 ng/g). The other samples presented levels within the limits established by the government agencies. Although the majority of the samples presented low levels of mycotoxins, it is important to highlight the high co-occurrence of these contaminants, indicating that further studies considering toxic synergistic interactions are necessary.

Quantification of Key Genes Involved in Mycotoxin Biosynthetic Pathways through Quantitative PCR (QPCR) for Rapid Screening of High Levels of *Fusarium* Toxins in Barley Grains

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Abstract:

Mycotoxins, such as type B trichothecenes (deoxynivalenol/DON and nivalenol/NIV), enniatins (ENNs) and zearalenone (ZEN) are known *Fusarium sambucinum* species complex's secondary metabolites and food contaminants. Therefore, quick methods for their estimation, including DNA quantification by qPCR, have become relevant over the years. The aim of this study was to validate a qPCR assay for screening DON, NIV, ZEN and ENNs as well as their producing fungi (*F. graminearum sensu stricto (s.s.)* and *F. poae*). To this purpose, 53 barley samples were chosen for mycotoxin quantification by UPLC-MS/MS, mycobiota analysis and the quantification of *TRI12*/15-ADON (15-ADON genotype), *TRI12*/NIV (NIV genotype), *ZEB1*, *ESYN1* and *EF1-α* (grain reference gene) by qPCR. Pearson correlation analysis was carried out using the software Prism version 9. qPCR validation exhibited adequate results for quantifying DNA in barley samples. *ZEB1* was the most detected gene, which corroborated with higher occurrence of *F. graminearum s.s.* in barley. This gene, as well as *TRI12*/15-ADON showed significant correlations to this species, whereas *TRI12*/NIV and *ESYN1* were positively correlated with *F. poae's* occurrence. No significant correlations were observed among *TRI12*/NIV and nivalenol and *ZEB1* and ZEN, possibly due to the lower occurrence of these toxins in barley grains. Significant correlations were obtained between *TRI12*/15-ADON and DON, as well as between *ESYN1* and ENNs. Based on the results, qPCR is a possible tool to predict high levels of *Fusarium* mycotoxins, as well as the occurrence of their producing fungi in grains.

Phenolic Profile and the Anti-TNF Properties of Açaí (*Euterpe oleracea*) Meal

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Abstract:

The mechanical extraction of oil from Brazilian açaí (*Euterpe oleracea* Mart) produces significant amounts of a byproduct known as "meal", which is frequently discarded in the environment as a waste material. In the present study, we evaluated the phenolic composition and anti-TNF activity of a hydroethanolic extract from açaí meal. Initially, the phenolic composition of the extract was analyzed by LC-ESI-QTOF-MS/MS. For the *in vitro* studies, RAW 264.7 macrophages transfected with the NF-κB luciferase reporter gene (CQB 022/97) and activated with LPS 10 ng/mL were used. TNF-α quantification was analyzed by ELISA and NF-κB activation was measured by luminescence intensity. According to the results, the main compounds identified in the extract by high resolution mass spectrometry were anthocyanins, flavones and flavonoids. Additionally, rhamnocitrin is reported for the first time in an açaí byproduct. Regarding the results in macrophage culture, açaí meal inhibited NF-κB activation at 10 and 100 µg/mL, as well as TNF-α levels at 100 µg/mL. Collectively, the results demonstrated that the açaí meal extract is rich in polyphenols and showed the ability to inhibit the inflammatory response of stimulated macrophages. These findings demonstrated the potential use of açaí residue as a novel natural and bioactive ingredient by the food and nutraceutical industries.

Development of Beverage with Sugar Cane Juice and Matcha with Anxiolytic Activity in Adult Zebrafish

Tereza Raquel Pereira Tavares[1*], Lucicléia Barros de Vasconcelos[1], Roberta Targino Hoskin[2], Sacha Aubrey Alves Rodrigues Santos[3], Adriana Rolim Campos[3].

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Abstract:

Cases of depression, anxiety and other stress-related problems have increased, leading to an increase in the consumption of controlled-use drugs, such as antidepressants and anxiolytics. Alternatively, much research indicates that some foods and medicinal plants can be used to improve neurological and cognitive properties, relieving the effects of stress and promoting a sense of well-being. Several studies attribute these effects to the composition of the raw materials used, due to the presence of bioactive compounds, amino acids and other constituents with this potential. The development of foods seek to contribute with aspects directly related to health, constitutes one of the main trends for the coming years, with an emphasis on functional beverages. Therefore, this research aims to develop a functional beverage with anxiolytic potential, based on matcha (*Camellia sinensis*) and sugar cane juice. For this, the formulations created was subjected to analysis of total antioxidant

activity (ABTS method) and *in vivo* test, using the anxiolytic model for adult zebrafish (*Danio rerio*). The best combination of the beverage was successfull with antioxidant activity for matcha 540,65 µM trolox/ g sample and for sugar cane juice 1872,0 µM trolox/L sample. *In vivo* test with zebrafish indicated that the beverage exerted potential anxiolytic activity compared to the Naive group, through the light/dark test, however no changes were observed in the locomotion of the animals during the open field test. This beverage can represent a potential product in the food industry for people who suffer from anxiety and those seeking well-being.

Effects of Conventional Process of Andean Lupin (*Lupinus mutabilis* Sweet)

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Abstract:

Andean lupin also known as Tarwi or Chocho is an appreciated grain since ancient times due to its nutrients and bioactives. Processing of Andean Lupin is required, before human consumption. Water de-bittering aiming to wash out quinolizidine alkaloids is required. After this process, some other conventional process might be applied by the food industry such as drying, spray drying and extrusion. This research project studied in different ecotypes changes in chemical composition and nutritional value ("*in vitro*" digestibility and centesimal composition). De-bittered tarwi is very rich in Protein (average range 45.5 – 55.4 g/100g db) and lipids (average 16.2 g/100g). Extrusion increased digestibility (68.1 %). Thermal damage indicators studied were (furosine, glycosylisomaltol (GLI) and hydroxymethylfurfural (HMF) among them only furosine was detected but at low values in extruded products. Drinks prepared using de-bittered chocho were process by spray drying and presented limited values of GLI and HMF. The degree of conservation of bioactive compounds, total phenolic and antioxidant capacity was identified for processed lupines (Lupinus mutabilis). Among the pending tasks for the food industry are to explore new forms of consumption and to characterize new processes.

Production of a Bioactive Color (Prodigiosin) by Isolated *Serratia marcescens* (CMS 2) by Sustainable Approach: Food Color

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Abstract:

Prodigiosin is a natural colorant and potential replacement for synthetic food colours. Use of such

natural colorant will reduce the health risks associated with synthetic food dyes and provide a sustainable and eco-friendly alternative. It can be produced by various bacteria species. Pigment prodigiosin is used in the nutraceutical, biomedical and food industries. Its production cost and low yield limit its use. This study used a soil-isolated strain (*Serratia marcescens*) to optimize fermentation conditions (pH, substrate concentration, rpm, and inoculum size) for prodigiosin production using rice straw-derived xylose as a carbon source. Peanut de-oiled cake increased prodigiosin production 1.9 times in this inexpensive medium. The standard and purified prodigiosin were compared using UV-Vis, FT-IR, UPLC, TLC, and GC-MS. Prodigiosin pigment's UV-Vis spectra were 535 nm, and its derivatives' GC-MS peak was 324.96 m/z. Encapsulating prodigiosin with polysaccharides increased its water solubility, making it suitable for food use. This study's cost-effective media yielded an economic gain and made it economically viable in a competitive market.

Effect of Storage Conditions on Volatile Composition of Functional Bergamot (*Citrus bergamia*) Extravirgin Olive Oil

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Abstract:

The aroma of extra virgin olive oils (EVOO), greatly conditioned by their volatile composition, is a sensorial attribute of paramount importance as regards acceptance by consumers and trading value. Whereas it is well established that EVOO volatile composition is affected by storage conditions, this effect has not been previously evaluated in functional EVOO. In this study, EVOO from Calabria (South Italy) obtained by malaxation and functionalized with Bergamot (*Citrus bergamia*) fruits, has been subjected to different storages to simulate either producer's bottling conditions (with no headspace) or domestic consumption (with 50% headspace). Both sample sets were stored in the absence of light under accelerated conditions (55°C, 14 days) or under ambient temperature for up to 9 months. Solid-phase microextraction followed by gas chromatography coupled to mass spectrometry (SPME GC-MS) analysis, under previously optimized conditions (T=44°C, t_{eq}=10 min, t_{ext}=60 min), showed no significant changes for most volatiles (except for *p*-cymene) in EVOOS stored with no HS, irrespective of the temperature considered. However, storage under domestic conditions favored the loss of a number of volatiles (e.g. sesquiterpenoids), this effect being more evident for extended storage. In conclusion, volatile profiling by SPME GC-MS of functional bergamot EVOO as affected by different storage conditions may contribute to provide useful information for both consumers and producers if preservation of original bergamot EVOO volatile composition is intended.

Multi-Omics Analysis Reveals B-Glucan Content Increases in *Waxy*-Mutated Barley Along with Great Changes in Stress Response

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Abstract:

Mixed-linked (1, 3; 1, 4)-β-D-glucan (MG) rich in barley grains provides health benefits also affects processing. The generally negative correlation between MG and amylose content in barley grains suggest that *Waxy* gene affect MG content. In this study, two mix pools were constructed from recombinant inbred lines, one consisted of *Waxy-mutated* lines with extremely high MG content (HGC) and the other was wild types with extremely low MLG content (LGC). The differences between HGC and LGC during grain development were investigated through transcriptomics, proteomics, and metabolomics analyses. The results showed the 29th days after anthesis was a special period that MG content started to differ distinctly between HGC and LGC. HGC was characterized by enhanced starch and non-starch polysaccharides metabolism, lipid metabolism, amino acids metabolism, sulfur-containing compounds metabolism, cell wall formation, pathogenesis-related proteins expression and stress response. *CDPK11* and *ASR* gene involved in ABA signaling process were found affect MG biosynthesis. It suggests *Waxy* gene mutation leads to the concentration change of sugars that can serve as signal molecules to initiate a series of changes associated with stress response then affect MG synthesis in barley grains.

Optimization of Ultrasound-Assisted Extraction to Obtain Multifunctional Extracts from Garlic (*Allium sativum* L.) by Products

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Abstract:

Within the context of the circular economy, there is special interest in the valorization of agri-food waste or by-products to obtain bioactive ingredients. Garlic (*Allium sativum* L.) processing generates large volumes of these products including leaves, stalks and skins, with a high potential as new sources of bioactive compounds. Different beneficial health properties have been described for garlic, which have been mainly associated with its content of organosulfur compounds, prebiotic carbohydrates and amino acids. Therefore, the development of advanced methodologies for their efficient, fast and environmentally friendly extraction is of great interest in different fields. Thus, in this work, an ultrasound-assisted extraction (UAE) method was optimized to obtain multifunctional extracts from garlic by-products and results were compared with those obtained by conventional solid-liquid extraction (SLE). First, a Box-Behnken experimental design was used to optimize UAE operating conditions. Extraction time (10-60 min), temperature (40-80°C) and the sample amount/solvent ratio (50-150 mg mL^{-1}) were considered as variables to maximize organosulfur compounds, prebiotic carbohydrates and amino acids. To this aim, samples were analyzed by liquid chromatography coupled to mass spectrometry (HPLC-MS). Optimal conditions (60 min, 40°C and 77 mg mL^{-1}) provided the maximum extraction of prebiotic carbohydrates (24 mg g^{-1} dry sample), organosulfur compounds (1.29 mg g^{-1} dry sample) and amino acids (9 mg g^{-1} dry sample). The here optimized UAE method is shown as a good alternative to conventional SLE for the production of multifunctional extracts from garlic byproducts.

Effect of Process Variables on Properties of Curcumin-Loaded Microparticles by Supercritical Fluid Extraction of Emulsion for their Potential Use in Functional Foods

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Abstract:

Curcumin is a polyphenolic compound recognized for its antitumor, antioxidant, antimicrobial and anti-inflammatory properties. However, its application as a bioactive compound is limited due to its low water solubility and poor bioavailability. One of the strategies to overcome these limitations involves its encapsulation based on biopolymers. The supercritical fluid extraction of emulsions (SFEE) process is one of the most widely used encapsulation techniques in recent years. The objective of this work was to study the effect of SFEE process variables (CO_2 pressure and operation time) on the physical-chemical properties of modified starch microparticles loaded with curcumin. The nanoemulsions were obtained by homogenization with ultrasound assistance. 0.25 %w/w of surfactant tween 80 content, 0.5 %w/w of modified starch content were used and ultrasonic time of 20 min. Droplet size were measured in dynamic light scattering equipment. Subsequently, they were taken to a solvent removal step from the emulsions using supercritical CO_2 to 9-13 MPa and time from 30-180 min at 40°C for the capsules precipitation and subsequent freeze-drying. The powders were characterized by encapsulation efficiency, physicochemical, structural and thermal properties. The results showed emulsions with a droplet size between 600-900 nm. At 9 MPa and operation time of 90 min, higher encapsulation efficiency around 85% and more defined core-shell morphologies were obtained. Also, the structural and thermal properties confirmed the powders stability with the curcumin incorporation. In conclusion, curcumin/starch microparticles obtained by SFEE process have a potential for the development of product with potential use in functional foods.

Revalorization of Inedible Fractions of Broccoli by Recovery and Microencapsulation Process of Polyphenolic Antioxidants Compounds

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Abstract:

Broccoli leaves and stems are generally discarded in market centers due to the lack of knowledge of their nutritional values and health benefits. Their high content of polyphenolic compounds makes attractive the search for technological alternatives that allow their recovery and valorization as a food additive. The objective of this work was to study the effect of different coating materials on the yield and encapsulation efficiency of concentrated polyphenol extracts with antioxidant capacity obtained from inedible fractions of broccoli. For this, polyphenol content (PC) was determined by Folin-Ciocalteau method and antioxidant activity (AA) by FRAP method of concentrated extracts by vacuum process and lyophilized microcapsules. Also, factorial design was performed

for encapsulation study of these extracts, the factors were maltodextrin: gum arabic ratio 1:0, 1:1, 0:1; extract: coating material ratio 1:1, 1:2, 1:3; and concentrated extract of 500, 1100 and 1800 [mg GAE/L]. The results showed broccoli leaves content PF of 153 [mg GAE/100$g_{fresh-solid}$] and AA of 190 [mg Fe^{+2}/100$g_{fresh-solid}$]. The recovery and concentration step by vacuum evaporation allowed quadrupling the concentration of the extracts to 1788 [mg GAE/L]. The highest yields and encapsulation efficiencies were obtained for 100% maltodextrin, extract/coating material ratios 1:3 and a concentration of total polyphenols in the extract of 500 [mg GAE/L] with 98.9 and 99.2%, respectively. Additionally, microcapsules were obtained that presented polyphenol contents between 162-1012 [mg GAE/100 $g_{capsules}$]. In conclusion, it was possible to recover polyphenolic compounds from broccoli leaves with high antioxidant activity and effectively encapsulate them in maltodextrin/gum arabic coating materials.

Optimization of Drying Conditions for the Production of Fiber-rich Ingredients from Blueberry Pomace

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Abstract:

Optimization of convective drying conditions is crucial for obtaining high-quality blueberry pomace ingredients. This study aimed to investigate the impact of temperature and time on the techno-functional properties, antioxidant properties, and process modeling of blueberry pomace drying. Blueberry pomace was obtained through juice extraction, followed by convective drying at different temperatures (50-90°C). Moisture content was monitored at 30-minute intervals until a constant weight was achieved. The collected data were used for process modeling using various models. Additionally, sorption isotherms were evaluated for all samples at 25°C. After drying, the influence of temperature on the techno-functional properties, antioxidant capacity, and anthocyanin content of the blueberry pomace was assessed. The drying time decreased significantly by up to 75% with increasing temperature. Among the models tested, the Page model exhibited the highest accuracy in predicting drying time (R^2=0.9983). Temperature had a notable impact on the sorption isotherms, with higher temperatures accelerating evaporation and increasing adsorption capacity, while lower temperatures resulted in greater moisture retention and decreased adsorption capacity. Moreover, the temperature affected the techno-functional properties. Specifically, at 70°C, the highest water (9.82 mL·g^{-1}) and oil retention (3.53 mL·g^{-1}) capacities were observed, along with a significant swelling capacity (7.55 mL·g^{-1}). Elevated temperatures (>70°C) were correlated with higher levels of total phenolics (13.75 µgGAE·g^{-1}), with 70°C yielding the highest anthocyanin levels (4.34 mgC3G·g^{-1}) and antioxidant capacity (15.01 µgAAE·g^{-1}) with statistical significance ($p<0.05$). These findings highlight the potential of 70°C to achieve desirable outcomes, offering opportunities for novel blueberry pomace-based products.

Valorization of *Chondrus crispus* Bioactive Material through an Ultrasound-assisted Extraction Integrated Approach

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Abstract:

Chondrus crispus has reached particular attention due its high content in bioactive compounds and carrageenan's with functional uses as gelling, thickening, or protein-suspending agents. This study explores the use of the Ultrasound-Assisted Extraction (UAE) technique to recover bioactive compounds (pigments, phenolics, proteins and carrageenan) from *C. crispus*. The first step consisted in pigment extraction using UAE, comparing the performance of an ultrasonic probe (20 kHz, 750 W) and a bath (40 kHz, 120 W) for 20 or 40 min was compared. The second step corresponded to protein extraction and the third step was the carrageenan formation. Step 1 extracts contained two carotenoids (fucoxanthin and lutein), 5 chlorophyll-a derivatives and pheophythin- a, phenolic compounds and revealed moderate antiradical activity against DPPH$^{\bullet}$, ABTS$^{\bullet+}$ and $O_2^{\bullet-}$, but no activity against $^{\bullet}$NO and cholinesterases. Proteins and carrageenan`s yields were between 3.6 % – 41 % and 29.7 % – 36.1 %, respectively. UAE performed with a bath for 40 minutes retrieved the highest yields for valuable compounds, as well as allowed obtaining extracts with the strongest antioxidant activities in Step 1 of the extraction. These findings showed that even choosing the least costly source of sonication (bath versus probe), high extraction yields can be achieved, which is very important from an economic point of view and therefore more attractive for industrial purposes. Overall, the results obtained here could be extended to other red seaweeds, to obtain fractions enriched in pigments/phenolics or proteins or polysaccharides for future application in food or pharmaceutical industries.

Investigation of Analytical Methods for Determining the Eating Quality of Convenience Rice: An Explanation from the View of Leached Molecules and Morphological Characteristics

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Abstract:

The convenience rice market is expected to grow continuously due to the diversity of type of households and changing the lifestyle. However, the practical and analytical methods for evaluating the eating quality of convenience rice are not existed. The objective of this study was to develop the decisive analysis way with leached molecules and morphological characteristics of rice according to processing technologies and amylose content of raw rice. The correlation between the textural characteristics and leachate from the convenience rice was also investigated. The leachate was obtained by rinsing cooked rice with hot distilled water (~ 95 ℃). Super-heated steaming (SHS), auto-electric cooking (AEC), and pressurized-steam cooking (PSC) were used to investigate the effect of the processing technology on the leachate and morphological characteristics of cooked rice. PSC had higher total solids and amylopectin amount in the leachate than SHS and AEC, resulting in its higher adhesiveness. The degree of disruption in the starch structure and the pore size were substantially large in PSC due to its cooking with pressure condition, affecting the easy elution of components in rice. The total solids and amylopectin amount in the leachate were

positively related with the stickiness obtained from the sensory evaluation. The adhesiveness was positively and negatively correlated with amylopectin amount of leachate and the proportion of long amylopectin chains, respectively. These results indicate that the leachate and morphological characteristics might be a useful predictor for evaluating the eating and textural qualities of convenience rice in food industry.

Effect of Starch-Protein Interactions on Anti-Staling and Quality Characteristics of Muffin

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Abstract:

The muffin is one of the most popular products worldwide due to its sweet taste and consumed as a breakfast or snack food. However, muffin become tough and rigid by starch retrogradation within a few days and thus less consumer acceptance. With the increased popularity of protein, incorporation of proteins into starch-based products is more commonplace. The aim of this study was to investigate the influence of starch-protein interactions on anti-staling and quality characteristics of muffin. The corn starch-whey protein isolate blends (CW) were treated by microwave radiation in cycles of 20 s radiation and 40 s downtime for total of 8 (MWT-8), 16 (MWT-16), and 24 cycles (MWT-24). The physical mixture of starch-protein (CW-PM) and MWT-24 had higher gelatinization temperature and lower gelatinization and retrogradation enthalpies than the other samples. Microwave treatment and protein addition enhanced viscoelastic moduli of corn starch. The starch-protein blends and MWT-24 resulted in decreasing setback and gel hardness during storage as compared to native starch, indicating retardation of starch retrogradation. Confocal micrographs showed that starch granules were surrounded by the proteins, proving the interactions between starch and protein. Muffin containing MWT showed relatively higher height and volume, and lower hardness than control muffin with wheat flour. Besides, muffins containing MWT showed a low degree of firming during the storage for 3 days at 4℃. Muffin containing MWT had greater consumer acceptance than muffin with untreated flour. The overall results suggested that microwave treatment could be valuable procedure to improve anti-staling and quality of muffin.

Application of Kinetic-Based Optical Sensing Strategy to the Estimation of Irradiation Doses in Foods

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Abstract:

Food irradiation is widely used for its shelf-life extension, combating pests and pathogens, inhibition of sprouting and other purposes. Estimation of doses after irradiation is important because exceeding recommended doses may cause negative effects. This research is aimed at developing simple and rapid method for detection and estimation of dose in raw potato and

ground beef irradiated by X-rays at 0, 100, and 1000 Gy. We used a reaction-based optical sensing strategy, which depends on running indicator reactions in the presence of samples. Oxidation of dyes (carbocyanines, Rhodamine, and Crystal Violet) by hypochlorite, bromate, and hydrogen peroxide (totally 12 systems) was studied as indicator reactions. The samples were extracted by water at 25 or 70°C during 1 or 24 h and the resulting solutions were introduced to the reaction mixtures. The procedure involved mixing the dye and the sample in a 96-well plate and measuring absorbance or near-IR fluorescence intensity every several minutes. The obtained photographic images of the plate were digitized and processed by linear discriminant analysis (LDA). For the most efficient reactions, the order of magnitude of the absorbed dose can be estimated with almost 100% accuracy. The developed system is technically simple, rapid and does not require expensive equipment. Thus, the proposed method has a good prospect for the estimation of doses of other foods.

Effects of 1 MeV Electron Irradiation on the Concentration of Volatile Organic Compounds in Meat and Fish

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Abstract:

In recent years radiation technology has been increasingly used to insure food safety. Ionizing radiation reduces contamination by microorganisms, thereby extending the shelf life of products. In addition to the inhibition of biological microflora, molecules in foodstuff, such as lipids, undergo oxidation as a result of radical processes. Therefore, it is important to study the changes in chemical parameters occurring in the irradiated foods. The aim of this research was to assess how a 1 MeV accelerated electron beam influenced the concentrations of volatile organic compounds (VOC) in beef, turkey, and salmon. The samples were irradiated (UELR-1-25-T-001, SINP MSU, Russia) at dosages of 0.25, 0.5, 1, 2 and 5 kGy an average dose rate of 5.9 Gy/s. The VOC concentrations were determined using a gas chromatography-mass spectrometer (Shimadzu GCMS-QP2010 Ultra, Shimadzu, Japan). The dependences of the concentrations of identified VOC on the radiation dose followed some general trends. At doses of 0.25-0.5 kGy, an increase in the concentrations of compounds was observed due to the decay of "primary molecules", the destruction of which occurred within doses up to 0.5 kGy. When a dose of 1 kGy was reached, the process of decomposition of the VOC became predominant due to their decomposition and recombination with other molecules. The decay of "secondary molecules," whose destruction necessitates doses above 0.5 kGy, resulted in a rise in compound concentration at doses between 1 kGy and 5 kGy.
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An Overview of Inorganic Arsenic Levels in Different Groups of Foodstuffs

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Abstract:

Arsenic (As) toxicity depends on its chemical form: the inorganic forms are more toxic compared to the organic forms. Therefore, obtaining occurrence data on inorganic arsenic (iAs) at national and European level in different kinds of foodstuff is necessary in order to assess more accurately the dietary exposure of the population to this contaminant. This is a challenging task given the extremely low levels of iAs in most of the food matrices. As speciation has been the subject of much attention for decades but most of the studies focused on fish and seafood, algae, and rice and rice-based products. This study investigates the levels of inorganic arsenic in several categories of foodstuffs prepared as consumed as fish and seafood, cereal, especially rice, cereal-based products, fruits and vegetables and beverages. The determination of iAs (as the sum of As(III) and As(V)) was performed using an internal method adapted from the European Standard NF EN 16802. Briefly, the As(III) into As(V) species from fresh or dried samples were extracted using a solution nitric acid in oxygen peroxide and a closed microwave system. Using this extraction procedure, As(III) is oxidized to As(V) which allows to determine the iAs fraction (the sum of As(III) and As(V)). The oxidized As(V) form is separated from the other co-extracted As species by anion exchange-high performance liquid chromatography and detected on-line by Inductively coupled plasma - mass spectrometry. A robust method validation was carried out using the accuracy profile approach. The method was proved to be highly suitable for the routine determination of iAs all types of foodstuffs with satisfactory analytical performances hence allowing accurate risks assessment related to ingestion of iAs from food.

A Comparative Study of Minor Winter Cereals and Bread Wheat: Agronomic Assessment, Grain Quality, Phytochemical Composition and Flour Rheology

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Abstract:

In recent decades, there has been a renew interest in underutilized grains in response to consumer's demand for sustainable and value-added foods.[1] However, the successful reintegration of ancient and minor cereals requires comparative studies with modern reference varieties.[2] In the present work, the quality of cultivars of ancient (einkorn, emmer, spelt) and old varieties of bread wheat, minor cereals (barley, rye, triticale, durum wheat) and new species (tritordeum) was studied in terms of the main agronomic, qualitative, nutritional, and sanitary traits. Overall, twenty genotypes have been compared in a field experiment carried out over three growing seasons in north-west Italy according to a full factorial design, using the same agronomic technique for all genotypes. Rye, triticale, tritordeum and ancient wheats were characterized by significantly lower yields compared to bread wheat, ranging from -27% to -46%. Tritordeum and the old wheat variety had the highest protein contents, but weaker flours. Barley and rye showed, respectively, the highest content of soluble and bound phenolic acids. Tritordeum emerged for high concentrations of total phenolic acids, carotenoids and tocols, while the β-glucan content was similar to that of bread wheat. The sanitary risks were found to be relevant for durum wheat and tritordeum, both showing high levels of regulated and emerging mycotoxins. The extensive intra-species variation examined in this study suggests the possibility of selecting the best genetic material with good yield and quality performance for different major and minor crops, to fully exploit the health-promoting grain composition in high value-added supply chains.

Potential of Microencapsulation Based on Multilayer Double Emulsions to Protect Probiotic Bacteria

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Abstract:

Most probiotic bacteria are very sensitive to stress conditions and are affected by processing, storage, and gastrointestinal conditions. Baked goods are one of the underexplored food matrices for probiotic supplementation. However, the main limitation of this type of product is the effect of high baking temperatures on bacterial viability. The aim of this study was to develop a microencapsulation process based on the formation of a multilayer double emulsion to protect *Limosilactobacillus reuteri* during a heat treatment and *in vitro* digestion. *L. reuteri* was dispersed in canola oil to form a simple emulsion (Lr/O). This emulsion was added dropwise to a casein solution (1.7% w/v) to form the double emulsion (Lr/O/Cas). A layer of pectin (1% w/v) was then electrostatically deposited (pH 3.5) on the surface of the double emulsion droplets (Lr/O/Cas/Pec) and subjected to ionic crosslinking with $CaCl_2$ to produce the multilayer double emulsion (Lr/O/Cas/Pec-Ca). The thermal stability of microencapsulated *L. reuteri* after a heat treatment at 95 °C for 30 min and viability during in vitro digestion (INFOGEST) were evaluated. In addition, the survival rate of microencapsulated *L. reuteri* was determined after a consecutive heat treatment and *in vitro* digestion process.

The maximum protection of *L. reuteri* during heat treatment and digestion process was observed in the Lr/O/Cas/Pec-Ca emulsion, achieving a viable cell count of 6.5 and 6.1 Log CFU/mL respectively. While after a heat treatment followed by a digestion process, only the *L. reuteri* encapsulated in the Lr/O/WPI/Pec-Ca emulsion was able to survive, reaching a viable cell count of 5.6 Log CFU/mL. This microencapsulation process could be an interesting alternative to supplement baked goods with probiotics.

Moisture Sorption Isotherms and Thermodynamic Properties of Potato Starch using Plasma-Activated Water (PAW)

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Abstract:

In this study, potato starch is subjected to plasma-activated water (PAW), annealing with distilled water (DW-ANN), and annealing with plasma-activated water (PAW-ANN) for 4 hr generated using corona discharge for 1 min using a voltage of 15kV, a fixed frequency of 5 kHz and 500 mL distilled water grounded and placed in an Erlenmeyer flask on a stirrer (700 rpm). The untreated and treated starches were analyzed for solubility, swelling power, pasting clarity, syneresis, textural profile

analysis, structural viscosity (the gel formation speed as the rate of change of G′ with time), sorption isotherms, and thermodynamic properties. As PAW contains different nitrogen and oxygen reactive species such as H_2O_2, O_3, OH^*, NO_2^-, and NO_3^-, high oxidation redox potential, high electrical conductivity, and low pH value, it is expected to cause noticeable modifications in the attributes of treated starch. There has been a significant reduction ($p < 0.05$) in paste clarity (T %) from 92.59 (untreated) to 32.12 (PAW-ANN), syneresis (%) value of starch from 37.41(untreated) to 31.72 (PAW), 7.24 (PAW-ANN) and 17.13 (DW-ANN) and also reduced solubility (%). PAW treatment also led to a change in the specific surface area, and thermodynamic properties such as enthalpy of sorption (qst), sorption entropy change (△S), and Gibbs' free energy (△G) during the sorption isotherms (adsorption and desorption) at different temperatures (25, 35 and 45 °C). Annealing with PAW may be used as a novel technique to modify starch without enzymes, acids, or cross-linking agents to improve the techno-functionality, thermal resistance and stability.

Green Strategies to Improve Chemical, Mechanical and Gas-Barrier Properties of Casein Films Obtained from Expired Pasteurized Milk

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Abstract:

Unsold pasteurized milk that reaches the expire date is downgraded to waste. However, this milk contains around 25g/L of casein that can be destined to high-value applications. Casein can be easily recovered from milk as soluble caseinate. Na-caseinate is able to produce films having good mechanical and gas-barrier properties, but also has a high water vapor permeability that may cause limitations to subsequent film usage in some applications. This study aimed at exploiting green-chemistry strategies to increase structure stability of casein-based films thus improving their performance in packaging industry. Two approaches have been undertaken. The first involved the exposition of Na-caseinate solution to LED light, also in presence of a photosensitizer, to induce the formation of protein crosslinks resulting from photooxidation reactions. The second implied the promotion of β-elimination reactions at high pH values and high temperature, also leading to casein crosslinking. Both processed solutions of Na-caseinate were hydrolyzed and analyzed by HPLC/fluorescence detection and LC-MS to monitor and quantify the formation of various crosslinks. The derived films, produced through solution-casting with a dry thickness of 120-130 µm, were characterized for structure (CLSM, SEM), mechanical properties, color, and O_2/Water-Vapor permeability. Obtained results and the properties of the films achieved through the two approaches will be presented.

PAA-FOOD Project: Plasma Activated Aerosol for the Preservation and Decontamination of Fresh and Minimally Processed Plant Foods

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Abstract:

Among cold plasma technologies, plasma activated water (PAW) has shown promising results on plant foods in terms of microorganisms, mycotoxin, and pesticide degradation thanks to the synergistic effect given by low pH, high concentration of reactive oxygen, and nitrogen species (RONS), and high oxidative-reduction potential. However, the effects of PAW on plant food enzymes, sensory and functional properties, and production of harmful chemical compounds still need clarification; moreover, common PAW experimental setups have limitations of in-batch processes and do not enable in-situ and on-demand dispensing of RONS. The PAA-FOOD project aims to overcome PAW drawbacks by designing, developing, and testing "plasma-activated aerosol" (PAA) systems for the surface decontamination and preservation of fresh produce (FP) and minimally processed plant foods (MPFV). Two prototypes will be developed for PAA generation, i.e., a system producing plasma-activated water coupled with an aerosolization device, and a system allowing for the in-situ generation of Plasma-Aerosol. Both systems will undergo a comprehensive assessment, including energy efficiency, aerosol characteristics, concentrations of reactive species in aerosol droplets, plasma behavior, and gas-phase composition. Additionally, the PAA systems will be tested on selected FP and MPFV products to evaluate their effects on products' quality and biochemical properties, microbiological and chemical hazards, and nutritional and functional properties. By identifying transient and long-lasting radical species, the project will also provide insights into safety considerations crucial for regulatory approval. The PAA-Food project was founded by MUR—Ministero dell'Università e della Ricerca—PRIN: Progetti di Ricerca di Rilevante Interesse Nazionale, Call 2022.

Preliminary Study for Using Grape Pomace and Seeds as Functional Ingredients

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Abstract:

Wine grape pomace (GP) and seeds (GS) suggested us that they contain high amounts of bioactive compounds, mainly polyphenols, both non-flavonoids (phenolic acids, stilbenes, etc.) both flavonoids (flavanols, anthocyanins, flavonols) exerting many health-promoting properties, including antioxidant, antimicrobial, heart protection and cancer prevention (Onache et al., 2022). Characterization of phenolic compounds by using spectrophotometric assays (1,1-diphenyl-2-picrylhydrazyl reducing activity (DPPH), total polyphenol content (TPC) and total flavonoid content (TFC)) and HPLC-MS-MS chromatography analysis of GP and GS, respectively from red and white variety (provided by 3 different wineries) have been performed. In relation to the grape cultivar, white grape pomaces are considered a good source of flavan-3-ols, while red grape pomaces are a good source of anthocyanins. Catechin and epicatechin are representative compounds in both red GS and white GP samples, while malvidin-3-galactoside and petunidin-3-glucoside are the most abundant compounds in red grape pomace samples of all wineries. Higher TPC and DPPH reducing activities were observed in red seed samples than red pomace samples. Therefore, the wine by-products of all varieties appeared to be a good source of phenolic compounds. GP and GS of all varieties represent a promising source for the development of high-added-value products, such as nutraceuticals and functional foods from one side, and cosmeceutics from the other. This work has been funded by the European Union – NextGenerationEU under the Italian Ministry of University and Research (MUR) National Innovation Ecosystem grant ECS00000041 - VITALITY - CUP J13C22000430001.

Impact of Covering Liquid Composition on the Evolution of Physico-Chemical Characteristics of *Mozzarella di Bufala Campana* PDO during Shelf Life

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Abstract:

Mozzarella di Bufala Campana is a protected designation of origin (PDO) cheese characterized by a typical stretched structure, a high moisture content (up to 65%) and a short shelf life (<30 days) (Gianferri et al., 2007). The cheese is normally stored at 4°C in a covering liquid that is usually composed of water containing NaCl and organic acids (lactic and/or citric acid) in different concentrations. Despite the microbial growth has been reported as the first cause of quality deterioration (Devirgiliis et al., 2008), physico-chemical phenomena (e.g. water and solutes migration, enzymatic reactions, etc.) can also play a crucial role in determining the quality and sensory acceptability of the product. This study investigates the effect of different percentages of NaCl (1, 2%) and types of organic acids (lactic acid, citric acid, and a 1:1 mix of both, at a fixed acidity level of 6.5°SH/50 mL) added to the covering liquid, on the evolution of some physico-chemical characteristics of the cheese (pH, electrical conductivity, color, expressible serum, texture, meltability, rheological properties) during a 30-days refrigerated storage period. Eight different batches of cheeses, collected from eight different dairies associated to the PDO Consortium were considered as replicates of the study by applying a full-factorial design. The results highlighted that the % of NaCl showed a significant and important effect on different structural, physico-chemical characteristics of the cheeses during its shelf life; a NaCl concentration of 2% caused a greater extent of casein swelling during storage, accompanied by a softening of the cheese structure.

Emerging Technologies for the Recovery of Polyphenolic Compounds from Pisco Grape Processing By-Products: Skin, Seeds, and Grape Pomace

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Abstract:

In Chile, the production of pisco is a highly relevant activity, but this industry generates a large amount of pomace waste, which consists of a mixture of seeds, skin, and stalk that is equivalent to 30% of the pressed grape mass, which is composed of polyphenols, tannins, and natural pigments. Total polyphenols in grapes are present in only 10% pulp, 60-70% seeds, and 28-35% skins. Obtaining the polyphenols present in grape pomace has shown increasing interest as an alternative for recovery and utilization since they have been associated with beneficial health effects. Conventional methods are generally used to extract the compounds of interest. However, emerging technologies promise to recover bioactive compounds to promote a faster and "greener" technology. The overall **objective** of this study was to evaluate different emerging extraction techniques compared to a conventional extraction to obtain an extract rich in polyphenolic compounds from Pisco grape pomace. In the **methodology**, different extractions were performed:

agitation (EA), enzyme-assisted (EAE), pressurized liquid (PLE), ultrasound (US), EAE+EA, and EAE+US. Total polyphenols, antioxidant capacity, and phenol profiling were determined. The **results** showed that EAE+EA and PLE had the highest values of total polyphenols between 40-50 mg EAG/g m.s and antioxidant capacity. Seeds showed the highest polyphenol values compared to skin and pomace (60-70 mg AGE/g d.m.). Among the polyphenols found were gallic acid, catechin, epicatechin 4-hydroxybenzoic acid, quercetin, and kaempferol. In **conclusion**, combining enzymatic action and pressurized liquid enhances the release of polyphenols compared to conventional agitation of pisco grape pomace.

Desalting Process of Directly Brined Table Olives

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Abstract:

Table olives constitute an important part of the Mediterranean diet. The commercial presentation "directly brined olives" (processed without lye treatment) are gaining progressive acceptance between the consumers because of the current preference for natural and biological products. The desalting process is an essential step for packaging table olives in a reduced NaCl or fortified mineral nutrient brine. The work studies for the first time its effect on the physicochemical characteristics and mineral content of seasoned cracked table olives "PDO *Aloreña de Málaga*". The desalting process was performed at the pilot plant scale. Periodically, olive and desalting solutions were taken and analysed for moisture, Na, K, Ca, Mg, P, Fe, Cu, Mn, and Zn changes over time. Besides, the colour and firmness of olives before and after desalting were measured. The results showed that the fruits' surface colour was slightly brownish, olives became a little softer, mineral macronutrients (mainly) and micronutrients decreased, but flesh moisture increased. Overall, the process caused slight quality damage and a sensible decrease in the mineral concentration in the flesh; then, the product was somewhat affected. The work offers quantitative information on these changes that may affect the commercial value of the final products.

Exploring the Environmental Impact of Wheat-Chickpea Crop Rotation in Mediterranean Climates

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Abstract:

Wheat is an essential crop for food security due to its wide distribution and consumption worldwide [1]. Although it is mainly grown in monoculture regimes to obtain high yields [2], recent studies indicate that these intensive regimes reduce wheat yield and quality over time, forcing farmers to increase the dose of fertilizer supplied to compensate for these negative effects [3-5]. Given the significant environmental burdens associated with mineral fertilization [5], alternative agricultural models are of paramount importance. In this regard, the EU is promoting rotation systems as a more environmentally friendly approach that, among many other advantages, have been proven to enhance soil fertility while maintaining yields [6]. Of particular interest is the rotation with leguminous plants, as they can fix atmospheric nitrogen and provide it in a form ready to be absorbed by plants,

thus allowing a reduction in fertilizer use [7],[8]. This study aims to evaluate the environmental performance of a biennial rotation system consisting of chickpea (year 1) and wheat (year 2) in the Apulia region (Italy), one of the main wheat production areas on a national scale [9]. An Attributional Life Cycle Assessment has been conducted considering one hectare of managed land as functional unit. The environmental impacts are presented in terms of global warming (GW), biodiversity loss (PDF) and soil quality (SOC). GW scores as 4.42 t CO_2 eq, PDF as 1.26·10-8 potential species loss·year and SOC as 23.69 t soil organic carbon deficit·year. Mineral fertilization is the main factor determining GW profile and, since wheat is the most fertilizer-intensive crop in the agricultural system, it contributes the most to the GW load. For the other impact categories, PDF profile is mostly determined by land-transformation and SOC by land-occupation pressures occurring in the agricultural field (foreground system). In future studies, it is intended to expand the impact categories and functional units considered, as well as compare the results with the monoculture system (based on wheat) to have a more comprehensive assessment and demonstrate the benefits of incorporating chickpea under Mediterranean conditions. **Acknowledgments:** This research is part of the R+D+I project Transition to sustainable agri-food sector bundling life cycle assessment and ecosystem services approaches (ALISE), funded by MCIN/AEI/10.13039/501100011033/ and the European Union NextGenerationEU/PRTR. The authors belong to the Galician Competitive Research Group (GRC ED431C 2017/29) and to the Cross-disciplinary Research in Environmental Technologies (CRETUS Research Center, ED431E 2018/01).

Unraveling The Impact of COVID-19 on the Eating Patterns of Andalusian Population

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Abstract:

Since the onset of the COVID-19 in Europe, a range of actions have been implemented to combat the pandemic, such as the imposition of lockdowns or the rollout of vaccination campaigns. The disruption of daily routines has left a profound mark on Spain by increasing the reliance on online food services. These alterations not only have consequences for our personal health but also pose challenges to global environmental health, potentially jeopardizing the attainment of Sustainable Development Goals. Consequently, this research sought to outline how the COVID-19 has affected food consumption trends in Southern Spain (Andalusia). We conducted an analysis of changes in dietary carbon footprint (CF) and water footprint (WF) over a span of six years. This analysis applies a Life Cycle Assessment methodology to allow a comprehensive assessment of the CF and WF. The functional unit selected was the average daily dietary intake per capita. The findings indicated that COVID-19 had an adverse effect on the progression of CF and WF from 2015 to 2021. Notably, there was a substantial surge in both indicators in April 2020, primarily attributed to heightened household spending on groceries. Additionally, 2021 witnessed a conspicuous decline, mirroring the gradual easing of limitations in tandem with the advancement of the vaccination campaign. These results imply that the pandemic constituted a setback, influencing the food-related habits in southern Spain. A comprehensive grasp of the repercussions of COVID-19 is crucial for addressing potential long-term health effects and holds great significance for the successful realization of the 2030 Agenda.

Determination of Degradation Products of Dithiocarbamates (Ethylene-Thiourea and Propylene-Thiourea) in Foodstuffs by HPLC Hyphenated to Inductively Coupled Plasma-Tandem Mass Spectrometry

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Abstract:

Dithiocarbamates (DTC) are one of the most largely used fungicides in agriculture as they are cost-effective against a broad spectrum of fungi and plant diseases. DTC are highly instable and they tend to decompose in foodstuffs matrix into ethylene-thiourea (ETU) and propylene-thiourea (PTU). Currently, these contaminants are determined using organic-based mass spectrometry techniques (MS or MS/MS) coupled to high performance liquid chromatography (HPLC). Due to the sulphur (S) moiety in their structure, they can also be determined using inorganic based MS techniques such as inductively coupled plasma-triple quadrupole mass spectrometry (ICP-QQQMS or ICP-MS/MS) coupled to HPLC. This study reports a novel approach allowing the simultaneous determination of ETU and PTU in fruits and vegetables by (reverse phase) HPLC coupled to ICP-MS/MS. A baseline HPLC separation of ETU and PTU was achieved in less than 5 min. A robust method validation by using the accuracy profile approach was performed by carrying out four measurement series in duplicate at six different levels over a timespan of four weeks (different days). The spike recovery factors range from 87%-101% for ETU and from 98-99% for PTU (depending on the spiking level). Good coefficients of variation in terms of repeatability and intermediate-reproducibility were also obtained. The limit of quantification was 0.022 µg kg-1 (wet weight) for ETU and 0.010 µg kg-1 (ww) for PTU. This approach was proved to be highly robust for the determination of ETU and PTU in foodstuffs. In our knowledge, it is the first reported method in the literature to deal with the analysis of ETU and PTU from fruit and vegetable samples using ICP-MS based detection techniques.

Valorization of a New Local Food Community: The Case Study of Acqualagna White Truffle by Using a UHLC-Q-ToF Untargeted Approach

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Abstract:

White Truffle is the most expensive edible underground mushroom, and it is appreciated food for its extraordinary aroma. This study is the first step of a research project with an integrated territorial valorization strategy on the case study of white Acqualagna truffle and includes its analytical characterization. The volatile profile was identified by GC-MS, and it was compared with the descriptors obtained by sensory analysis. The elemental composition was investigated through

ICP-MS. To analyze the non-volatile profile of *Tuber magnatum* an untargeted metabolomics approach using UHPLC-Q-ToF was applied. Analysis was performed both in positive and negative polarity acquisition modes allowing the identification of 322 and 134 potential metabolites. More than 60 compounds, in a total of 456, reported a total identification score match greater than 90%. This untargeted approach enabled the discovery of potential white truffle metabolites that have not yet been studied. Four metabolites such as azelaic acid, riboflavin, miltefosine and 2-Isopropylmalic acid were detected and quantified with UHPLC-Q-TOF for the first time in white truffes. The results of target analyses shown the presence of 2-Isopropylmanlic acid in concentrations similar to those identified in some Italian wines (Ricciutelli et al. 2019). In conclusion, this project is the first step for the original chemical valorization of a new local food community with high impact. The paper's results contribute to the scientific knowledge of local product in terms of opportunities for implementing an integrated valorization of the agri-food system strategy of the case-study area.

Physicochemical, microstructural and textural characterization of the wild berry Ribes magellanicum

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Pontificia Universidad Católica de Chile, Chile

Abstract:

Over the past two decades, the consumption of commercial berries, such as strawberries and blueberries, has increased due to their flavor, texture and health benefits. Furthermore, consumers value foods with unique geographic origins and connections to indigenous culinary traditions, such as zarzaparilla (Ribes magellanicum), a wild berry that grows in Chile. This study aims to investigate some physicochemical, textural, and microstructural characteristics of the Patagonian berry Ribes magellanicum to enhance its use as a food source. A fruit diameter of 5 mm, a number of seeds of 17, a juice yield of 59.2%, soluble solids of 15.5, and a pH of 4.3 were determined. The adsorption isotherm for the freeze-dried fruit was determined in the aW range of 0.11 to 0.85 and fitted to the GAB model, having the following parameters: m0 = 10.56; c0 = 32.01 and k= 0.94, with a regression coefficient (r2) of 0.99. The color parameters L*, a* and b* for the fruit were 28.0, 16.9 and 5.9, respectively. For textural characterization, instrumental analysis of puncture force was conducted in a specially designed configuration, revealing higher firmness for the fruit with pedicel (1.75 N) compared to the fruit without pedicel (0.86 N). Scanning electron microscopy and X-ray computerized microtomography were employed to observe the internal structure of the fruit, revealing the distribution of seeds and various characteristic structures of this type of fruit. This allowed us to understand key attributes to processing, extraction, or addition into food formulations. Overall, this work provides a microstructural approach for the development of new processes and foods that enhance the value of this endemic fruit.

Development, Characterization and Exploitation in Food Systems of Functional Ingredients Obtained from Artichoke By-products Phenolic Extracts

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Abstract:

The study aimed to assess the technological properties of phenolic-rich extracts from artichoke bracts, stems, and leaves using various extraction methods (maceration and ultrasonic assisted extraction - UAE) for emulsion formulation. The process involved several phases: initially, the bioactive compound content and antioxidant properties of the extracts were analyzed. Over 78 days of storage at 25°C in the dark, in all extracts the content of polyphenols remained quite stable, except for leaf extracts obtained via ultrasound (LU). Next, the extracts were examined for their surface activity and emulsifying properties in 50% w/w oil-in-water model emulsions stabilized by pea protein concentrate. The extracts reduced the surface activity in a dose-dependent manner, with LU displaying the highest surface activity. From a colloidal perspective, the extracts increased oil droplet size and induced flocculation. Chemically, the extracts delayed oxidation, as indicated by a significantly higher Induction period (IP) compared to the control sample ($p<0.05$). In a third step, one extract was selected for encapsulation through spray-drying using MD as a wall material. The encapsulation process exhibited an Encapsulation Efficiency of 90.21% and a Yield of 93.18%. The encapsulated extract was then incorporated into commercial vegan mayonnaise, and the release of polyphenols during in vitro simulated human digestion was assessed. This research received support from the Italian Ministry of University and Research (MIUR) under the PRIN 2017 program (grant number 2017JTNK78) titled “Good-BY-WASTE, Obtain GOOD products, exploit BY-products, reduce WASTE.”

Screening of Microbial Yeast and Lactic Acid Bacterial Cultures to Improve Quality and Nutritional Value of Foods

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Abstract:

The development of healthier foods is possible through the formulation of new concepts which include ingredient upgrading (from nutritious to functional) and technological solutions (from intense to mild). The need to guarantee an adequate shelf life to foods often relies on thermal treatments, which compromise their nutritional value, or preservatives which are negatively perceived by consumers. Natural alternatives can be based on ingredients derived from plants or also from agri-food by-products due to their antioxidant and antimicrobial activity. Moreover, the use of bioprotective/probiotic/tailored starter cultures is indicated to preserve shelf life and safety, and possibly to enrich food with relevant functional and nutritional compounds. In this context strains of lactic acid bacteria and yeasts from the Industrial Microbial Culture Collection of University of Bologna were tested for several antagonistic features, i.e. ability to produce bacteriocin, phenyl lactic acid, ɣ-aminobutyric acid and exopolysaccharides. Also their growth ability, acidification and volatile aroma compounds production when using by-products as substrate was evaluated. This work is part of the project funded under the National Recovery and Resilience Plan, Mission 4 Component 2 Investment 1.3 - Call for tender No.341 of 15 March 2022 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU; Project code PE00000003, Concession Decree No.1550 of 11 October 2022 adopted by the Italian Ministry

of University and Research, CUP D93C22000890001, Project title "ON Foods - Research and innovation network on food and nutrition Sustainability, Safety and Security – Working ON Foods" (Spoke 4 -Food Quality and Nutrition).

Chemical Profiling of Umami Taste Related Compounds in Various Dutch Seaweeds

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Abstract:

In order to produce high quality seaweed products that are compatible with European palatability, it is imperative that we develop the knowledge to chemically assess the umami taste of seaweeds. Free amino acids have been found important contributors to the taste of seaweeds. They can impart a sweet, sour or bitter taste depending on the amino acid and its concentration. Free amino acids are also key contributors to the characteristic umami taste of seaweed, and this taste sensation is known to be enhanced by free 5′ -monophosphate nucleotides, contributing to the perceived end-taste. Umami compounds in seaweed have various potentials such as taste stimuli for elderly people and improving appetite in oncology patients. Umami compounds can be used to lower the salt, sugar and fat content in food without affecting palatability. We developed and applied a method for the simultaneous extraction, separate clean-up and analysis of 21 free amino acids and 10 free nucleotides by reversed phase and mixed-mode HPLC respectively. A distinguished composition in umami taste between investigated groups was found: red seaweed species had a more intense umami taste, whereas the examined green seaweed species were milder. Profiling free amino acids and nucleotides in seaweed allows us to estimate relative umami intensity and guide species selection and processing towards palatability.

Bioaccessibility of Lycopene in Tomato Extracts Microcapsules: Influence of the Wall Material

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Abstract:

There is a great interest in fortifying foods with natural extracts rich in bioactive compounds (many of them antioxidants). However, they have a low bioavailability and high sensitivity to environmental, processing and storage conditions, being needed their microencapsulation. Spray-drying, with maltodextrine as wall material, is the most used method for this purpose. In the present study, both sodium caseinate (CAS) and pea protein isolate (PPI) have been used as wall material to microencapsulate by spray-drying a tomato extract (rich in lycopene), determining the bioaccesibility of lycopene by means of an *in vitro* digestion protocol. High lycopene quantity was achieved in both types of microcapsules (10.63 and 14.02 ug lycopene/g microcapsule in PPI and CAS, respectively). At the end of the oral phase, the release of lycopene was similar in CAS and PPI microcapsules, while it was higher in CAS than in PPI at the end of gastric and intestinal phases.

Thus, the bioaccesibility of lycopene was higher in CAS (around 100%) than in PPI microcapsules (around 66%). These findings indicate the capability of these materials to microencapsulate tomato extract by spray-drying and even to protect the bioactive compounds during oral and gastric phases, leading to a high lycopene release in the intestinal phase. However, there is a clear influence of the wall material in the release of lycopene throughout the *in vitro* digestion and then in the bioaccesibility, being more suitable the use of CAS.

Antibacterial and Antibiofilm Effect of different types of Honey against Bacteria Isolated from Chronic Wound Infections

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Abstract:

Honey is a cost-effective food-based material for diabetic foot ulcer (DFUs) treatment [1]. The honey's anti-inflammatory and antibacterial properties have shown to be effective against bacterial biofilms and multidrug-resistant bacteria, highlighting its promissory role in DFUs management [2]. However, the physical-chemical features, which differ among different honeys, as well as the concentrations used, might lead to different bacterial responses[3]. Therefore, this study evaluates the effect of different types of honey and its concentrations against bacterial biofilms. Seven types of honey were added at different concentrations: i) 1x Minimum inhibitory concentration (MIC), ii) 5x MIC, and iii) 10x MIC, to individual bacterial biofilms of *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Candida albicans*. Biofilm removal was higher in honey type-3 and type-4 in comparison with type -5 (p=0.008; p=0.001), type -8 (p=0.022; p=0.003) and type -9 (p=0.009; p=0.001) for Candida albicans at the same concentrations. Similarly, honey type-2 and type-4 were also more effective than type-10 (p=0.016; p=0.004, respectively) for *Escherichia coli*. The highest concentration of honey evidenced a greater biofilm removal for Candida albicans and *Escherichia coli* (p=0.004, both), as well as a higher biofilm metabolic inactivation for *Candida albicans* and *Klebsiella pneumoniae* (p=0.004, both) and *Pseudomonas aeruginosa* (p=0.048). Principal Component Analysis suggests correlations between the pollinic content and antimicrobial activity. Therefore, honey was effective for bacterial biofilm removal and metabolic inactivation, especially at higher concentrations. Differences between bacterial responses to different honey treatments might be related to honey's physical-chemical features and differences in bacterial strains' sensibility.

Enzymatic-Assisted Hydrolysis Applied to the Extraction of Okra (*Abelmoschus esculentus*) Polysaccharides: Physicochemical and Functional Properties

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Abstract:

Okra, an African-native vegetable, is a low-calorie concentrated source of fibers, and micronutrients and constitutes an underexplored natural source of polysaccharides with outstanding functional properties. This study aims to develop enzyme-assisted protocols for the extraction of okra polysaccharides (OP), recognized for their efficient emulsifying and stabilizing activities. Three enzymatic hydrolysis protocols were carried out: treatment 1 (Viscozyme® and BAN®), treatment 2 (Viscozyme®), and treatment 3 (Viscozyme® and Formea Sol®). The enzymatic treatments were carried out for 30 min at the enzyme's optimal activity temperatures. After hydrolysis, the solids were separated by centrifugation and the okra polysaccharides (OP) were precipitated with ethanol (1:3 v/v), followed by vacuum oven drying (110F, 750 mmHg, 12h). The proximate composition, physicochemical and functional attributes of OP were determined, and the percentual extraction yield was calculated as the relation between final OP weight and initial okra weight. Treatment 1 showed the highest ($p < 0.05$) OP extraction yield (11.54 ± 1.16 %) among enzymatic extraction protocols. All OP treatments showed low fat (0.32-82%) and ash content around 11.42-15.09%. Technological attributes (solubility and* water holding capacity) were similar ($p > 0.05$) among treatments. Solubility and water holding capacity ranged between 17.72-21.01% and 4.28-9.78 gH20/g, respectively. Treatment 2 had the highest emulsifying activity (3.86 m^2/g, $p < 0.05$), however, similar emulsion stability ($p > 0.05$) was observed for all treatments (range 13.7-22.1 min). Overall, these results indicate that enzymatic hydrolysis coupled to drying is a promising strategy to produce powdered okra polysaccharides with desirable technological attributes for diverse food applications.

Valorization of *Sacha inchi* Oil Press-Cake by Means of the Isolation and Characterization of Its Protein Fractions

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Abstract:

The growing interest in plant-based food protein sources gives opportunities for valorizing the agri-food by-products, driving the food industry towards a more sustainable development. In this study, three extraction procedures (varying the pH value (7.0 and 11.0) and the addition of salt (0 and 5%)) were investigated to obtain seven different protein fractions (SIPF) from Sacha Inchi oil press-cake (SIPC), which were characterized in terms of their protein content, electrophoretic profile, secondary structure, and techno-functional properties. Extractions at pH 11.0 without salt addition, produced the highest values of protein content, extraction yield, protein recovery

and protein concentration increase (84.0%, 24.7%, 36.5%, 1.5-fold, respectively). Under these extraction conditions, the electrophoretic analysis indicated that most of the SIPC proteins were extracted. SIPF displayed excellent oil-absorption-capacity (4.3-9.0 w/w), and interesting foam-activity (36.4-133.3%). The solubility and emulsifying-activity of the albumin fractions were significantly higher than that the others (~87 *vs.* <15.8%, and 280-370 *vs.* <140 m^2/g, respectively). Correlation analysis showed that the SIPF' secondary structure influence significantly their techno-functional properties. These results indicate that SIPC is a by-product of great potential for proteins extraction processes, as a valorization strategy for technical cycle solutions for the Sacha Inchi productive chain into the circular economy context.

Determination of 2-Chloroethanol (2-CE) as a Marker for Fumigant Ethylene Oxide (EtO) in Ramen (Instant Noodle) and Sesame Products by Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS)

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Abstract:

Food commodities are fumigated with ethylene oxide (EtO) gas to control insects and microorganisms. 2-Chloroethanol is formed when it reacts with natural chlorides present in the food matrix. 2-Chloroethanol, a known carcinogen, may persist for extended periods even after processed food. As a consequence of the harmful health effects of these compounds, several countries are gradually regulating or banning the use of EtO as a fumigant for food commodities. According to current European regulations (EC) 396/2005, the maximum concentration of 2-chloroethanol in nuts, oil fruits, and oil seeds is 0.05 mg/kg. This study aimed to detect and quantify 2-chloroethanol as a marker for EtO fumigation in 20 Ramen (Instant Noodle) samples and 11 sesame seeds and their products (Tahini sauce). A determination method of 2-chloro-ethanol (2-CE) in foods, especially those with high-fat content, by gas chromatography-tandem mass spectrometry (GC-MS/MS) was achieved. The analysis was performed with a 30m x 0.25mm i.d. x 0.25 µm df DB-WAX Ultra Inert. 2-CE, and isotope internal standard 2-chloroethanol-d4 (2-CE-d4) were extracted by QuEChERS method and analyzed by gas chromatography-mass spectrometry (GC-MS/MS). The calibration curves were linear with a coefficient of determination (R^2) > 0.99. The validation was done and recovery values ranged from 96-99%, with a relative standard deviation (RSD) of 0.83 -1.03 %. The limit for the quantification (LOQ) was 0.02 mg/kg. Fortunately, all analyzed samples were below LOQ, which means the investigated products are safe for human consumption. Moreover, our results reflect the efficiency of the SFDA's regulations for monitoring and controlling foods in Saudi markets.

Choline Chloride-based Deep Eutectic Solvents as Green Extraction Media for Bioactive Phytochemicals from High-oleic Palm Oil Distillate Fatty Acids (*Elaeis guineensis Jacq.* × *Elaeis oleifera [Kunth] Cortés*). Can Such Extracts be Used as Food Ingredients?

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Abstract:

"Green" technologies have emerged as responsible, sustainable, effective, and highly applicable alternatives for obtaining products rich in biologically active substances. Choline chloride-based deep eutectic solvents (ChCl—DESs) have been proven to be not only more affordable and allow faster extraction of biologically active phytochemicals, but also more environmentally friendly and efficient, with higher yields than harmful organic solvents commonly used for similar processes. The aim of this study was to optimize ChCl—DESs extraction conditions to obtain oily extracts rich in phytochemicals from high-oleic palm oil distillate fatty acids (HOPO—DFA) (tocopherols, tocotrienols, phenols, and other antioxidants) by implementing liquid–liquid extraction and solid-phase extraction (absorption/desorption). The objective also included the incorporation of the extract obtained under the best experimental conditions into an ingredient for the formulation of fermented dairy food. Different parameters affecting the extraction efficiency were also evaluated, such as the type of ChCl—DESs (including molar ratio) and temperature (50–80 °C), and the mechanisms used for their preparation (stirring and ultrasound), extraction temperature (40–60 °C), and extraction time (1–3 h). An extract with an average concentration of 68.863 mg·kg—1 in vitamin E and 10.810 mg·kg—1 in total phenols was obtained from HOPO—DFA under the optimal conditions of this study using a DES consisting of choline chloride–malonic acid. Finally, the extract was evaluated for the formation of an HOPO—based food ingredient for the preparation of a fermented milk drink fortified with vitamin E and antioxidants.

An Assessment of the Prevalence of Aflatoxin M1 Level in Milk and Milk Powder in Saudi Arabia using High Performance Liquid Chromatography

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Abstract:

Milk is known to be susceptible to mycotoxin contamination, especially with regard to the toxin Aflatoxin M1 (AFM1). Aflatoxin has been linked to liver cancer in both human and various animal species for almost 60 years. «Naturally occurring combinations of aflatoxins» have been classified by the International Agency for Research on Cancer (IARC) as a group 1 human carcinogen. Exposure to aflatoxin M1 mainly occurs through the consumption of contaminated milk. Previous investigations showed that about 25% of milk samples exceeded the limit for Aflatoxin M1. Since then, the (SFDA) has taken strong actions to limit the contamination of milk with AFM1, increase the control of aflatoxin and modify the regulation. The aim of the study was to assess the effectiveness of SFDA monitoring measures and evaluate possible exposure to Aflatoxin M1. To achieve that, 363 Milk samples were randomly collected from different regions in Saudi Arabia (168 Milk and 195Milk powder) and analyzed using LC/MS-MS. The control of mycotoxins in Saudi Arabia played an important role in reducing the contamination of aflatoxin M1 in Milk and is not considered to be a serious threat to human health It is at low risk levels, >94.5% of the samples were within limits (>5.5% aflatoxin M1 were out of limits). The results were found to be similar to those reported by many related studies from around the world.

Effectiveness of CAP on Mycotoxins in Naturally Contaminated Cocoa Bean

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Abstract:

Cocoa is the world's third most popular raw resource, behind sugar and coffee. Mycotoxins in cocoa beans and chocolate products are a significant public health problem, as well as the adoption of non-thermal treatments to reduce their presence. This study investigated the occurrence of mycotoxins in cocoa beans and the efficacy of cold atmospheric plasma (CAP) treatment in degrading mycotoxins in cocoa beans naturally contaminated. Two different CAP conditions were compared: ozone (O_3) and nitrogen oxides (NO_x) regimes. HPLC-MS/MS analyses revealed that out of twenty cocoa samples from Colombia, 40% were contaminated by beauvericin (BEA) and 25% by ochratoxin A (OTA). Only one sample was contaminated with more than two mycotoxins: BEA, OTA, ochratoxin B (OTB), aflatoxin B1 (AFB1), and aflatoxin B2 (AFB2); instead, aflatoxins G1 and G2 (AFG1 and AFG2) in none of the samples were detected. Our results suggested that the efficacy of CAP on mycotoxin degradation was regime, time exposure, distance from the source and molecule structure dependent. The reduction of the mycotoxins was OTB>AFB2>AFB1>OTA>BEA. For the first time we reported the efficacy of CAP-O_3 in reduce mycotoxins in cocoa beans.

Functionalization of Yeast Proteins from Fermentation Side-Streams for Functional Food Systems

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Abstract:

In order to ensure the supply of proteins for a growing global population even in times of ecological and geopolitical crises, a shift from animal-based to more sustainable protein sources are imperative. Aside from plant-based proteins, other promising approaches exist such as the production of single cell proteins from microorganisms. The objective of this study was to investigate the potential for optimizing the functionality of yeast proteins through its targeted modification for the potential application in staple food systems. To modify the functional properties, thermal, ultrasound and enzymatic treatments were used where solubility, gel formation, gel hardness and foaming stability were characterized. The thermal treatment of the yeast proteins was carried out at 5 temperatures between 35 °C and 55 °C. Enzymatic treatments were carried out using Transglutaminase prepared at pH 5 and pH 7 and at incubation times of 20 minutes and 60 minutes. The concentration of transglutaminase was 1.5% (w/v) corresponding to an enzyme activity of 10 U per gram of protein. All modifications were carried out at 15% protein dispersions. A mild temperature treatment at 40 °C was able to increase the gel strength from 1.12 N to 1.2 N. The foam stability, increased by thermal treatment at 35, 40 and 45 °C. At these temperatures, partial unfolding of the globular proteins occurs, exposing hydrophobic groups and thus increasing interfacial activity. Finally, application tests were performed to investigate the performance of the modified yeast protein in food systems such as sausage systems and baked products.

Ultrasound-Assisted Extraction of Bioactive Compounds from *Eryngium planum*: Optimization, Characterization, and Comparison with Conventional Extraction

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Abstract:

Eryngium planum L. (EP), also known as Chochagh or Zolang in Iran, is a medicinal plant with a wide range of therapeutic properties, including nerve relief, anti-inflammatory, and anti-heartburn effects. This study aimed to determine the most effective extraction method for EP extract by comparing ultrasound-assisted extraction (UAE) with conventional extraction. The effects of temperature (24.82-60.18 °C), and time (29.75-120.25 min) for conventional extraction and power (5.5-149 w), and temperature (5.05-14.95 °C) for UAE were optimized using RSM-CCRD. Quantitative analysis of bioactive components, such as total phenolic compounds (TPC), flavonoids, and chlorophyll a and b, was performed on extracts obtained from the raw material. Additionally, antioxidant was evaluated using the DPPH and FRAP methods, and extraction yield was determined through oven drying. The optimized conditions obtained through RSM for the UAE method were 10.97 min of time and 105.75 w of power. For the conventional method, the optimal conditions were 49.37 °C of temperature and 90.37 min of extraction time. Under these conditions, the conventional method yielded the highest levels of TPC (26.55 mg/g GAE), flavonoids (16.10 mg/100 g), yield (61.85%), DPPH (71.56%), FRAP (0.71), chlorophyll a (30.38 g/100g), and chlorophyll b (22.10 g/100g). However, the UAE method exhibited significantly higher predicted values for various response, including TPC (35.48 mg/g GAE), flavonoids (24.50 mg/100 g), yield (81.53%), DPPH (81.53%), FRAP (0.76), chlorophyll a (32.85 g/100g), and chlorophyll b (23.10 g/100g). These findings highlight the positive impact of UAE on the extraction of bioactive compounds from EP.

Influence of Acoustic Power, Specific Energy, and Ultrasound Intensity on the Size of Eco-Friendly Hydrated Carbon Oxide Particles – NHK-BIO

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Abstract:

The use of ultrasound technology, combining frequency and power, associated with factors such as time and temperature, can be an efficient tool in reducing particle sizes, through the phenomenon of acoustic cavitation. The present work aimed to evaluate the influence of acoustic power, specific energy, and ultrasound intensity at different nominal powers and sonication times on the size of hydrated carbon oxide (NHK–BIO) particles. The analysis was performed using state-of-the-art ultrasound with the aid of a thermostatic bath at 15 °C. The nominal potentials, 120 and 280 W for 60, 120, and 180 min were studied. Particle size was evaluated using dynamic light

scattering. Preliminary results of sonication of NHK-BIO suspensions show that the cavitation process for particle size reduction was efficient. However, due to the diameter of the probe (22 mm), there may have been a reduction in ultrasound intensity, ranging from 0.108 to 0.086 W.cm-2, when subjected to 280 W/60–180 min. Furthermore, the binomial time/amplitude promotes the obtaining of nanostructured materials (diameters <100 nm). However, due to subprocesses such as high power and long time, it can cause sintering and reagglomeration of the material. In this case, it was possible to observe diameters of 200–396 nm. The results impact the applicability of composite materials. The use of composites in eco-friendly polymer matrices, obtained from agro-industrial residues, can act as improving agents (structural and barrier) in food packaging. This research is in progress with other types of eco-friendly materials.

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