2020 AOCS Annual Meeting & Expo Protein and Co-Products Abstracts

June 29 to July 3, 2020

Hosted online by the American Oil Chemists' Society (AOCS)

For more information, please visit https://annualmeeting.aocs.org.

Presentations dated Friday, January 1, 2021, were provided on-demand.

Protein and Co-Products

Monday, June 29, 2020
Session Time: 1:00 AM - 2:00 AM
Presentation Time: 1:00 AM - 2:00 AM
Track: Protein and Co-Products

(P7) Regulatory Issues

Presenting Author: Christopher Marinangeli

Monday, June 29, 2020
Session Time: 1:00 AM - 2:00 AM
Presentation Time: 1:00 AM - 2:00 AM
Track: Protein and Co-Products

(P8) Improving Canola Meal Composition

Presenting Author: Dave Charne

Monday, June 29, 2020
Session Time: 8:25 AM - 10:10 AM
Presentation Time: 8:55 AM - 9:20 AM
Track: Protein and Co-Products

(3741) Rice Albumin Hydrolysates Suppress Glucose Absorption from the Small Intestine by Dual Function

Presenting Author: Hitomi Kumagai, PhD - Nihon University

Diabetes mellitus is a serious disease because it often leads to serious complications such as retinopathy, nephropathy and neuropathy. Most of the patients suffering from diabetes mellitus are categorized into type 2 that shows the symptom of insulin resistance and/or deficiency. In order to prevent type 2 diabetes, it is important to suppress postprandial hyperglycemia by an

appropriate daily food intake. We have already shown that rice albumin of 16 kDa (RA) effectively suppresses postprandial hyperglycemia even after glucose loading though it does not suppress mammalian α-amylase and only inhibits insect α-amylase. This study presents the mechanisms of action of RA on prevention of postprandial hyperglycemia. Intraperitoneal glucose tolerance test (IPGTT) showed that orally-administered RA did not suppress the increase in blood concentration of glucose that was intraperitoneally injected. This indicates that RA exerts its function not in the blood but in the gut. RA was hydrolyzed to a high-molecular peptide of 14 kDa (HMP) and low-molecular peptides (LMP) by digestive enzymes, and HMP and LMP fractions were orally administered to rats together with glucose to examine which peptide contributed to the function of RA. Beyond our expectation, both HMP and LMP suppressed the elevation in blood glucose level. HMP was shown to adsorb glucose and retard its diffusion rate like dietary fibers. On the other hand, LMP suppressed the expression of SGLT1 in STC-1 cells. Therefore, RA is hydrolyzed into HMP and LMP in the gut and effectively suppresses postprandial hyperglycemia by dual functions.

Monday, June 29, 2020
Session Time: 10:25 AM - 12:10 PM

Presentation Time: 10:30 AM - 10:55 AM

Track: Protein and Co-Products

(3682) Chlorogenic acid oxidation induced greening and antioxidant capacity in sunflower butter cookie dough in the presence of thiol-containing compounds

Presenting Author: Lilian M. Were, PhD - Chapman University

When free amines nucleophilically attack oxidized cholorogenic acid (CGA), a natural green trihydroxy benzacridine (TBA) pigment forms. Besides the loss of CGA, this oxidation induced greening can be undesirable in products such as refrigerated sunflower butter dough, as it can intensify to a deep olive-green color with time. Since thiols competitively react with oxidized CGA to lower greening in a concentration dependent manner and simultaneously increase antioxidant capacity, two thiol-containing antioxidants (cysteine and glutathione), were studied as a mitigation strategy for more aesthetically pleasing green cookies with higher antioxidant capacity. Cysteine and glutathione (0 – 5 mM) were tested in sunflower butter cookie doughs formulated with all-purpose (AP) or gluten-free (GF) flours. The doughs were stored at refrigerated temperature for 5 d. The overall surface Hunter L, a, b color changed till day 5 and then plateaued. The individual and interaction effects of time, thiol concentration, type of thiol and type of flour all significantly affected overall color change. Water activity and dough texture after 5 d were not affected by the type of thiols and flours while pH and Folin-Ciocalteau reducing capacity (FCRC) were affected. Greening in AP doughs were moderately correlated with texture, pH, and FCRC, while weakly correlated in GF doughs after 5 d storage. The results suggested that thiol-containing antioxidants can prevent the dark olive-green coloration in favor of a more pleasant green color. The simultaneously formed thiol-CGA conjugates are able to compensate for antioxidant loss in the formation of green TBA.

Monday, June 29, 2020
Session Time: 10:25 AM - 12:10 PM

Presentation Time: 11:20 AM - 11:45 AM

Track: Protein and Co-Products

(3922) Chemistry and biological significance of the interaction of peptides with food components

Presenting Author: Chibuike Udenigwe, PhD - University of Ottawa

Food-derived bioactive peptides have gained significant interest as functional agents for developing food products with health benefits. The peptide structure is highly susceptible to chemical modifications, which can subsequently influence their physiological behavior and bioactivities. This presentation highlights the peptide structure modifications occurring with major food components during processing and associated changes in peptide properties and biofunctions. Major interactions of peptides with food components include reactions with carbohydrates, lipids and phenolic compounds, and formation of complexes with divalent metals. Amino acid residues of peptides determine their susceptibility to modification when interacting with food components. Notably, food processing can facilitate these reactions and further influence the biostability and bioactivity of the peptides. Food component-peptide interactions as well as the correlation between the structural modification and bioactivity of peptides are largely uncharacterized. Targeted and untargeted omics approaches present a tremendous opportunity in addressing this knowledge gap, especially in characterizing peptide derivatives and complexation products, and monitoring their structural dynamics, in food products and biological samples. Given the modification propensity of peptides, it is imperative to characterize the nature, biofunctions, gut activity, bioavailability and safety of modified peptides towards achieving pragmatic food applications of bioactive peptides.

Tuesday, June 30, 2020
Session Time: 8:25 AM - 10:10 AM

Presentation Time: 8:25 AM - 8:30 AM

Track: Protein and Co-Products

Introduction: Sustainable Technologies for Protein Extraction and Ingredient Impacts

Co-Chair: Hui Wang, Iowa State University, USA
Co-Chair: Mian Riaz, Texas A&M University, USA

This session focuses on sustainable technologies for protein extraction and their effect on protein functionalities such as solubility, dispersability, texturization, etc. Technologies covered in this session include dry milling, membrane separation, enzyme modification and traditional wet processing. In addition, this session includes the trend of green technologies, less processing, and clean labelling in vegetable protein processing and applications.

Tuesday, June 30, 2020
Session Time: 8:25 AM - 10:10 AM

Presentation Time: 9:45 AM - 10:10 AM

Track: Protein and Co-Products

(3843) Using Cysteine to Lower Greening During Sunflower Protein Isolation

Presenting Author: Akira K. Ishii - Chapman University

Chlorogenic acid (CGA) oxidation induced formation of green trihydroxy benzacridine (TBA) derivatives can occur in alkaline isolated sunflower protein resulting in undesirable discoloration. Since cysteine can preferentially react with oxidized CGA to form colorless thiol-CGA conjugates, cysteine was investigated as an anti-greening strategy for sunflower protein isolation without de-phenolization. Alkaline supernatant of buffered sunflower protein solutions with 0-5.6 mM cysteine was acidified to pH 5.6, the isoelectric point of helianthinin sunflower proteins. After isoelectric precipitation, the precipitate was lyophilized for 12 hours. Color intensity and composition were determined by Hunter L*a*b*, HPLC and LC-MS respectively, along with nitrogen solubility. Conformational changes of sunflower protein were measured by FTIR. Cysteine was found to limit TBA formation in the lyophilized isolates as green discoloration was lowered with increasing cysteine. Addition of cysteine had a protective effect on CGA during protein isolations, as more CGA was retained in protein isolate at higher cysteine levels. Addition of cysteine during isolation increased the beta-sheet: alpha-helical structure ratio in a concentration-dependent manner. Formations of green TBA and cysteinyl-CGA conjugates were confirmed by LC-MS. Findings suggested that addition of cysteine could be a potential anti-greening strategy for sunflower protein isolation, which could retain a higher antioxidant phenolic content while simultaneously enhancing protein solubility.

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 8:25 AM - 8:30 AM

Track: Protein and Co-Products

Introduction: AOCS Special Session on Plant-Based Protein

Co-Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Join plant-based protein industry leaders for this AOCS featured session. Presentations will cover the following topics: Consumer behavior and consumer trends Feedstocks Protein measurement Overview/update from Protein Industries Canada Regulatory issues Plant breeding Emerging technologies for alternative proteins

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 8:30 AM - 9:00 AM

Track: Protein and Co-Products

(P1) Plant-Based Protein: What Consumers Think

Presenting Author: Kristie Sigler, BS, MBA - FleishmanHillard
Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 9:00 AM - 9:30 AM

Track: Protein and Co-Products

(P2) Innovating Plant Protein in Western Canada

Presenting Author: Lisa Campbell, MSc - Protein Industries Canada
Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 9:30 AM - 10:00 AM

Track: Protein and Co-Products

(P3) Plant-Based Proteins: Measuring Content and Quality

Presenting Author: James D. House, PhD - University of Manitoba
Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 10:00 AM - 10:30 AM

Track: Protein and Co-Products

(P4) Canada: Scalable Source of Novel Protein

Presenting Author: David Dzisiak
Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 10:45 AM - 11:15 AM

Track: Protein and Co-Products

(P5) Pioneering Better Plant-based Food Experiences

Presenting Author: Jonathan McIntyre
Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Tuesday, June 30, 2020
Session Time: 8:25 AM - 11:45 AM

Presentation Time: 11:15 AM - 11:45 AM

Track: Protein and Co-Products

(P6) Processing for Purpose

Presenting Author: Carrie A. Lendon, PhD - Cargill
Chair: Phil S. Kerr, PhD - Prairie AquaTech, LLC

Wednesday, July 1, 2020
Session Time: 11:40 AM - 1:00 PM

Presentation Time: 11:40 AM - 11:45 AM

Track: Protein and Co-Products

Introduction: Protein-based Hydrocolloids for Food and Biomedical Applications

Co-Chair: Lingyun Chen - University of Alberta
Co-Chair: Chibuike Udenigwe, PhD - University of Ottawa

Protein-based hydrocolloids provide excellent emulsifying, foaming and gelling properties. This session focuses on current techniques to develop novel protein-based hydrocolloids for improved

food stability, texture and quality. Their non-food applications will be presented as well, such as novel delivery systems and biomedical materials.

Wednesday, July 1, 2020
Session Time: 11:40 AM - 1:00 PM

Presentation Time: 12:10 PM - 12:35 PM

Track: Protein and Co-Products

(3815) Assembled Prolamin Proteins: an Effective Way to Build Electrospun Nanofabrics with Unique Performance

Presenting Author: Yixiang Wang, PhD - McGill University

Based on the understanding of different prolamin protein conformations in solution, we presented an assembled nanofabric prepared by incorporating compact zein nanoparticles in electrospun hordein networks. Zein particles in one aspect acted as the plasticizer to decrease the strong hydrogen-bonding interactions among extended hordein molecules. In another, they also played as the reinforcing filler in the flexible hordein matrix. The assembled fibers exhibited significantly improved tensile strength and wet stability in both water and ethanol. The alignment of electrospun fibers further strengthened the nanofabrics in both tangential and normal directions to 17.26 ± 1.41 and 14.02 ± 0.74 MPa, respectively, stronger than that of cancellous bones (5-10 MPa). It has also been discovered that, by simply altering the applied voltage, the resultant hordein/zein nanofabrics can rapidly (within 30 s) form either flat sheets or self-rolled tubes when they were immersed in water. All the fibers demonstrated low toxicity in human primary dermal fibroblast cell culture. Moreover, the electrospun fabrics exhibited a strong resistance to protein adsorption and cell attachment, and the release experiment indicated that they could serve as a carrier for controlled-release of incorporated bioactive compounds into phosphate-buffered saline. Therefore, these electrospun prolamin protein fabrics represent an ideal and novel platform to develop nonadherent drug delivery systems for wound dressing and other biomedical applications.

Thursday, July 2, 2020
Session Time: 11:45 AM - 2:20 PM

Presentation Time: 12:15 PM - 12:40 PM

Track: Protein and Co-Products

(3747) Stability and rheology of canola protein isolate stabilized concentrated oil-in-water emulsions

Presenting Author: YanRan Tang, MSc. - University of Saskatchewan

The aim of the work was to utilize salt-extracted canola protein isolate (CPI) from the cold-pressed meal in the development of concentrated oil-in-water (O/W) emulsions and investigate the effect of various environmental factors on the stability and structure-functionality. CPI (1-

4w% at pH 7) was used to stabilize 50wt% O/W emulsions using a high-pressure homogenizer. The emulsions were characterized by the droplet size, zeta potential, rheological properties, accelerated creaming velocity and confocal microscopy. As CPI concentration increased from 1 to 4wt%, droplet size decreased from 16.4µm to 3.8µm while the droplet charge remained constant (-12 mV). All emulsions flocculated over 30 days but exhibited exceptional resistance to coalescence. Storage moduli of all emulsions were higher than the loss moduli at all CPI concentrations, suggesting a gel-like structure. Emulsion stability was also investigated by adding vinegar (10wt%) and salt (1wt%). No significant change in droplet size was observed with the addition of either vinegar (pH3.7, droplet charge 20 mV) or salt (pH7, droplet charge -6 mV). However, in the presence of both (pH3.7, droplet charge 7 mV), the droplets were extensively aggregated leading to a gel-like non-flowing structure. Heating the emulsions at 80 °C led to a ten-times increase in gel strength irrespective of CPI concentration, which could be attributed to protein thermal denaturation leading to droplet aggregation. These findings may extend the application of CPI in viscoelastic foods such as salad dressing

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products

(4056) Interaction of peptides with peroxyl radicals

Presenting Author: Apollinaire Tsopmo, PhD - Carleton University

Peptides are known for their various biological activities. Amongst them, is their ability to interact with peroxyl radicals in biological, food and model systems. In these systems, peroxyl radicals are formed during normal metabolisms, exposure to toxicants, storage or processing of foods. Peptides by acting as peroxyl radical scavengers quench or react with oxidative species thereby, restoring the redox balance or preventing further oxidation. In this work, we are interested in determining the reaction products of five selected oat peptides in the presence of peroxyl radicals (i.e. ROO• from AAPH). The tested peptides are YFDEQNEQFR (P1), GQLLIVPQ (P2), SPFWNINAH (P3), INAHSVVY (P4), and RALPIDVL (P5). In the presence of ROO•, peptide P3 only retained 4% of its original structure while other peptides maintained 69 – 89% of their structures. This is an interesting finding, and the structures of oxidative products from each peptide are being determined by infrared and nuclear magnetic resonance.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products

(3904) Encapsulation of Multiple Bioactive Nutrients Using Protein-based Carriers

Presenting Author: Li Liang - Jiangnan University

Functional foods containing bioactive nutrients offer benefits beyond basic nutrition. There appears to be interesting market opportunities for functional foods fortified with a range of bioactive nutrients and offering multiple health benefits. Low solubility and environmental sensitivity limit the application of bioactive nutrients in food industry. Encapsulation can be used to overcome these limitations. It is thus necessary to develop the carriers than can simultaneously encapsulate a plurality of bioactive nutrients. It is difficult to co-encapsute bioactive nutrients with different solubility in a carrier. Proteins have been widely used as carrier materials because of their ability to form emulsions and gels and to interact with bioactive nutrients and poysaccharides. Based on ligand-binding property, hydrophobic, amphiphilic and hydrophilic nutrients were simultaneously bound to β-lactoglobulin and bovine serum albumin. Based on ligand-binding property and emulsification, hydrophobic and amphiphilic nutrients were co-encapsulated in oil/water emulsions and emulsion gels. The co-encapsulation might synergistically improve the stability and activity of bioactive nutrients.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products

(4157) Pea Protein Functionalization: Exploring Cold Plasma

Presenting Author: Baraem Pam Ismail - University of Minnesota

While pea protein is gaining traction, functionality limitations is hindering its market growth. Improving pea protein functionality will enable its successful utilization in various food products. There are several reports on pea protein functionality and applications, but much is still not known about the effect of different processing and modifications on the structural and associated functional changes in pea protein. Cold plasma, a non-thermal processing technique, is being explored as a novel means for protein functionalization. Cold plasma technology involves the exposure of plasma, a partially ionized gas to proteins. The reactive species, generated by cold plasma can induce several chemical reactions including oxidation, bond cleavage, and/or polymerization. This presentation will demonstrate the effect of various cold plasma treatments on pea protein structural and functional properties. Pea protein isolate (PPI) is subjected to several cold plasma treatment conditions. Reactive species and changes due to potential chemical reactions are monitored. Specifically, changes in the protein tertiary, secondary and primary structure will be evaluated, and chemical reactions will be elucidated.

The impact of structural change on protein functionality will be highlighted. This research will provide for the first time a controlled evaluation of the impact of cold plasma on pea protein structural and functional characteristics. Cold plasma treatment may lead to the production of a viable pea protein ingredient with functional properties that are comparable or better than those of traditional protein ingredients.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products

(3952) Assessing plant protein functionality and physicochemical characteristics for uses as animal protein alternatives

Presenting Author: Yonghui Li - Kansas State University

Developing meat, dairy, and egg alternatives from plant proteins have been of increasing interest in recent years due to the perceptions of health and environmental impact. Functional properties are important in determining the usefulness of plant proteins as animal protein replacement. Different food applications require specific protein functional characteristics. Factors dominating protein functionality include intrinsic physicochemical properties of the proteins, processing methods, and product formulation. In this presentation, we will provide an overview of available methods in assessing the functionality and physicochemical characteristics of plant and animal proteins, how they are affected by protein sources and processing methods, and how they would impact product quality attributes. Protein functionality in terms of solubility, water/oil binding, viscosity/elasticity, gelation, emulsion, and foaming, and protein structural features and physicochemical properties will be discussed. This updated information will be helpful to researchers in selecting appropriate proteins and tailoring their structures and properties that could better mimic animal protein characteristics.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products

(3965) Pea protein acylation and impacts on interaction, physicochemical properties and the delivery of curcumin

Presenting Author: Ogadimma D. Okagu, PhD candidate - University of Ottawa

The impact of pea protein acylation on the nature and strength of interaction with curcumin for a potential role in encapsulation and delivery was investigated. Acylation increased the negative charge on the protein from -34.4 ± 0.2 to -59.9 ± 0.9 and decreased the surface hydrophobicity from 47,474.7 ± 2843.77 to 16,059.3 ± 1047.58. The overall binding constant, K, of 6.9 (± 0.21)

× 10<4> M<-1> and 4.2 (±0.05) × 10<4> M<-1> was obtained for the native protein – curcumin and acylated protein – curcumin interaction respectively. The number of bound curcumin molecule per protein (n) was found to be approximately 1.0 for both the native and acylated protein – curcumin interaction. Differential scanning calorimetry revealed increased thermostability on protein modification and on interaction with curcumin. Transmission electron microscopy and dynamic light scattering revealed the formation of spherical nanocomplex within the size range of 151.5 to 194.5 nm. FTIR showed that curcumin is stabilized more in the native protein complex than in the acylated form. Polyelectrolyte complexation with chitosan by electrostatic interaction stabilized the acylated protein – curcumin complex. The encapsulation efficiency decreased with decrease in protein hydrophobicity as a result of acylation from 34.65 ± 0.10 in native protein - curcumin to 24.92 ± 0.03 % in acylated – protein – curcumin and from 85.01 ± 1.43 for native protein – curcumin - chitosan to 62.05 ± 2.95 % in acylated protein – curcumin – chitosan nanocomplex. The release profile using simulated oral and gastrointestinal models revealed a controlled curcumin release.

Tuesday, June 30, 2020

Session Time: 8:25 AM - 10:10 AM

Presentation Time: 8:30 AM - 8:55 AM

Track: Protein and Co-Products@@@Edible Applications Technology

(3757) Isolation and characterization of gelatin based scaffolds from Priacanthus hamrur for food and biomedical applications

Presenting Author: Radhika Rajasree S.R. - Kerala University of Fisheries and Ocean Studies

In this study, for developing a scaffold for food and biomedical engineering from fish processing wastes, a hierachial collagen/gelatin/chitosan novel porous scaffold was fabricated using blends of collagen and gelatin extracted from the skins of Marine big eye snapper Priacanthus humrur. Scaffolds were developed by mechanical spinning of chitosan and by mixing of collagen and gelatin solutions followed by freeze drying and subsequent crosslinking of polymers. The scaffolds were evaluated for rheological properties – porosity, apparent density and swelling capacity to assess their mechanical property.Gelatin/chitosan composition shown very high porosity(81.02%) and incorporation of collagen shown higher density in Collagen/gelatin/chitosan scaffolds (0.0522g/cm3) and collagen/chitosan scaffolds (0.0468 g/cm3).Morphology of the prepared scaffolds were analyzed by Scanning Electron Microscopy which showed reduced pore size of 10 to 20µ in Collagen/gelatin/Chitosan composite, 5 to 10µ in gelatin/chitosan composites and 2-5µ in collagen/chitosan composites. FTIR analysis showed intense peaks ranging 1120 -11267 cm−1 in the three different scaffolds that are denoted as CH groups. In-vitro antioxidant investigation through DPPH assay showed that the composite 3 in 1 mg/ml concentration exhibited higher antioxidant potential (70%). In contrast, ABTS scavenging assay identified composite1 in 1 mg/ml had good antioxidant activity with highest percentage of inhibition (29.5%). The scaffolds were also evaluated for anti microbial properties through disc diffusion assay.

Tuesday, June 30, 2020
Session Time: 8:25 AM - 10:10 AM

Presentation Time: 8:55 AM - 9:20 AM

Track: Protein and Co-Products@@@Edible Applications Technology

(3799) Effect of Processing Conditions on Emulsifying Behaviour of Pulse Proteins

Presenting Author: Supratim Ghosh, PhD - University of Saskatchewan

The processing conditions used to prepare pulse protein ingredients could be directly responsible for their solubility and functional properties in food products. Freeze-dried soluble and insoluble fractions of faba bean protein (FBP) and pea protein (PP) concentrates, isolates and de-flavoured fractions were prepared and characterized for their structure-functional properties. FBP showed a significant drop in oil-water interfacial tension compared to PP. The FBP and PP isolates showed higher protein content but lesser solubility in water compared to the concentrates, which could be attributed to their processing conditions. Oil-in-water model salad dressing emulsions were prepared with 40% oil and an aqueous phase containing 2% proteins and 0.25% xanthan gum using a high-shear mixer. Emulsions were stored for two weeks and characterized by droplet size, zeta potential, rheology, and accelerated stability analysis using a photocentrifuge. All emulsions were stable without any visible phase separation at pH 7, while at pH 2, except the emulsions stabilized by FBP fractions, phase separation occurred, leaving a clear aqueous phase at the bottom. There was a significant reduction in the droplet diameter of all emulsions at pH two compared to the emulsions at pH 7. Protein fractions with coarser particle size formed larger emulsion droplets compared to the finer fractions. All emulsions at pH 2, except the ones prepared with FBP fractions, showed a large drop in apparent viscosity compared to pH 7. Overall, processing conditions and preparation methods of protein ingredients influence their structure and physicochemical properties, which could be used to predict their emulsification behaviour.

Thursday, July 2, 2020
Session Time: 11:45 AM - 2:20 PM

Presentation Time: 1:05 PM - 1:30 PM

Track: Protein and Co-Products@@@Edible Applications Technology

(3625) Effect of Salts and Concentration on the Formation of Heat-Induced Pulse Protein Gels

Presenting Author: Burcu Guldiken, PhD - University of Saskatchewan

This study examines the effect of salts (0.5M NaCl or 0.25M $CaCl_2$) and protein concentration (7.5-15%) on the gel-forming abilities of lentil (LPI), yellow pea (YPI), and faba bean (FPI) protein isolates. The chemical composition (protein, lipid, ash, and moisture), zeta potential (pH 1.5-7.0) and surface hydrophobicity (pH 7.0) of protein isolates were analyzed, along with their thermal and rheological properties. Morphologies of the gel networks were imaged using confocal laser scanning microscopy (CLSM). At pH 7.0, the surface hydrophobicity of YPI (84.8

arbitrary units, a.u.) was found to be lower than LPI (147.2 a.u.) and FPI (135.0 a.u.), whereas the surface charge for LPI, YPI, and FBI was -37.8, -28.4, -29.3 and mV, respectively. The minimum gelling concentration for LPI, YPI, and FPI were found 10%, 12.5%, 10% in distilled water; 7.5%, 12.5%, 10% in 0.5M NaCl solution; 7.5%, 10%, and 10% for $CaCl_2$ solution, respectively. The gelation temperature was found to decrease with increasing protein concentrations and with the presence of salts. LPI and FPI produced firmer structures relative to YPI as evident by higher storage moduli. Network strength became stronger as the protein concentration increased or in the presence of NaCl or $CaCl_2$. LPI and FPI also appeared to have a more ordered structure as evident by CLSM. Multiple endothermic peaks were determined in each protein sample associated with protein unraveling and network formation. Findings from this study showed the effect of salts and protein concentration on gel strength.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Edible Applications Technology

(3607) Interaction of Gelatin with Hydrocolloids, Acids and Nutritional Supplements in Gummies

Presenting Author: Haiyan Ge - Pharmavite LLC

Gelatin based gummy products provide elastic texture to consumers. The gelatin network in gummies and its gelation can be modified by hydrocolloids, acids and nutritional supplements. These effects have been investigated by dynamic rheological measurements: small amplitude oscillatory shear (SAOS) tests and large amplitude oscillatory shear (LAOS) tests. SAOS evaluates the gelatin network at linear elastic region, where the gelatin network maintains its structure. Hydrocolloids such as pectin, agar-agar can raise the gelation temperature of the gelatin network by forming internal structure sets. Relative lower concentration of acids compared with gelatin can still maintain the elasticity of gelatin network with negligible gelatin denature. Nutritional supplements such as inulin and whey protein can interact with the random coils of gelatin to form strong gelling network and to delay the random coils transforming into partially ordered triple helices when gummy temperature decreases. LAOS evaluates the gelatin network at nonlinear elastic region to probe its flexibility under deformation. Gummy samples with higher soluble solids showed decreased extent of non-linear behavior under LAOS. This suggests a greater structural stability to deformation.

Monday, June 29, 2020

Session Time: 8:25 AM - 10:10 AM

Presentation Time: 8:30 AM - 8:30 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3653) Neuroprotective effects of bioactive peptides derived from fermented rice beverage in scopolamine-induced amnesic mice

Presenting Author: Shigeru Katayama, PhD - Shinshu University

Amazake is a traditional Japanese fermented-rice beverage and this non-alcoholic drink is produced using rice koji by saccharification. The purpose of his study was to investigate the protective effects of amazake-derived peptides against scopolamine-induced cognitive impairment in mice and their potential mechanisms. Mice were intraperitoneally administered amazake peptides at dose of 25 and 100 mg/kg for 7 days, followed by intraperitoneal injection of scopolamine. The administration of amazake peptides suppressed scopolamine-induced cognitive impairment in passive-avoidance test and significantly upregulated levels of brain-derived neurotrophic factor (BDNF) in the hippocampus. Amazake peptides administration also induced significant increases in the phosphorylation of cAMP response element binding (CREB) protein and extracellular signal-regulated kinase (ERK) in the hippocampus of the mice. On the other hand, scopolamine-treated mice showed significantly decreased acetylcholine levels and increased acetylcholine-esterase activity in the hippocampus as compared with controls, whereas these changes were suppressed by the administration of amazake peptides. Among the fractions separated by size-exclusion chromatography, the non-glycosylated peptide fraction suppressed H2O2-induced neuronal damage in SK-N-SH cells by upregulating BDNF expression. The amino acid sequence of the major peptide in this subfraction was identified as a hexadeca peptide with a molecular weight of 1848.87 Da. These results demonstrated that amazake peptides prevented cognitive impairment and the underlying mechanism might involve the activation of ERK/CREB/BDNF signaling pathway. Our findings suggest amazake-derived peptides as a potential agent for the prevention of age-related cognitive decline and dementia.

Monday, June 29, 2020

Session Time: 8:25 AM - 10:10 AM

Presentation Time: 9:20 AM - 9:45 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3754) Overview of the Effects of Food Proteins and Peptides in Human Nutrition

Presenting Author: Rotimi E. Aluko, PhD - University of Manitoba

The aim of this presentation is to provide a detailed review of studies, which have shown the potential use of food proteins and peptides as suitable agents to improve human health. The presentation will cover the health-promoting benefits of hemp seed, yellow field pea, flaxseed and canola proteins and peptides. In a pioneer work that used a polycystic kidney disease rat model and an 8-week feeding period, inclusion of hemp seed proteins in the diet resulted in

significant ($p < 0.05$) reductions in kidney size, cyst growth, cyst volume, fibrosis, heart weight, serum creatinine and inflammation when compared to casein. To test the antihypertensive efficacy, hemp seed protein hydrolysate (HPH) was prepared by consecutive hydrolysis of the proteins with pepsin and pancreatin. Oral administration of HPH to spontaneously hypertensive rats (SHRs) resulted in significant ($p < 0.05$) reductions (up to 30 mmHg) in systolic blood pressure (SBP) after 8 weeks. The work also showed that HPH consumption led to significant ($p < 0.05$) reductions in plasma levels of angiotensin converting enzyme (0.047–0.059 U/mL) and renin (0.040–0.054 µg/mL), the two main enzymes that modulate mammalian blood pressure. In a similar work, the 5 kDa membrane pea protein hydrolysate permeate produced through thermoase hydrolysis of pea protein isolate was shown to reduce SBP (up to 26 mmHg) when consumed by SHRs. Additional data will also be presented to show other nutritional benefits such as antioxidant and anti-obesity effects of flaxseed and canola protein digests.

Monday, June 29, 2020
Session Time: 8:25 AM - 10:10 AM

Presentation Time: 9:45 AM - 10:10 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3824) Dual Hypocholesterolemic Effect of Lupin-derived Peptides

Presenting Author: Carmen Lammi - University of Milan

Proprotein convertase subtilisin/kexin type 9 (PCSK9) is a promising target for the treatment of hypercholesterolemia. In fact, the main role of PCSK9 is the degradation of low-density lipoprotein receptor (LDLR) protein with an increase of the LDL cholesterol levels. Some natural mutations in PCSK9 affect its affinity for the LDLR. In particular, the gain of function (GOF) mutant D374Y binds more avidly to the LDLR than the wild-type (WT) PCSK9 with an approximately tenfold increased capacity of reducing the LDLR protein level. In this panorama, lupin protein hydrolysates, obtained by the hydrolysis with pepsin and trypsin, show complementary hypocholesterolemic effects through the modulation of both 3-hydroxy-3-methylglutaryl coenzyme A reductase (HMGCoAR) and PCSK9 targets. With the aim of identifying lupin peptides able to impair the binding of PCSK9WT and/or PCSK9D374Y to the LDLR, biochemical and cellular experiments were assessed. Results suggest that both P5 (LILPHKSDAD) and T9 (GQEQSHQDEGVIVR) show an in vitro hypocholesterolemic effect through the modulation of both HMGCoAR and PCSK9WT activities, whereas only T9 is active also against the PCSK9D374Y. Both P5 and T9 display a dual-inhibitory cholesterol-lowering behavior. This unique feature frames them in the context of multifunctional peptides with potential application for the prevention of cardiovascular disease.

Monday, June 29, 2020
Session Time: 10:25 AM - 12:10 PM

Presentation Time: 10:55 AM - 11:20 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3769) Development of Encapsulated Vitamin D Fortified Mayonnaise

Presenting Author: Wahab Ali Khan, PhD - National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan

Vitamin D lost its functionality during processing and storage, thus, the aim of the current study was to develop encapsulated vitamin D fortified mayonnaise (VDFM) using whey protein isolates (WPI) and soy protein isolates (SPI) as encapsulating materials. Mayonnaise samples were evaluated for change in rheological, textural, microstructural, apparel and sensorial properties. Highest consistency index was detected in WPI based encapsulated VDFM due to gelling effects of proteins. Increased shear stress decreased the apparent viscosity of VDFM that was concluded to be as shear thinning behavior resulting from structural deformation. The addition of encapsulates significantly affects the loss modulus values. Encapsulant materials effects the particle size of mayonnaise formulations by forming three dimensional structure that positively influenced the textural properties of mayonnaise. Intrinsic properties with reduced particle size of WPI showed better results as compared to SPI in prepared VDFM. Treatment with WPI based vitamin D encapsulates depicted best results in terms of size and dispersion uniformity of oil droplets. Tristimulus results indicated that L*, a*, b* and Chroma showed non-significant variations while hue angle and total change were significantly differs among treatments. The highest value for overall acceptability was acquired by M3 and proceed for in-vivo trials. The highest value for serum vitamin D level was observed in rat group treated by encapsulated VDFM (58.14 ±6.29 nmol/L) that was significantly higher than control group (37.80±4.98 nmol/L). Conclusively, WPI & SPI encapsulates have the potential to improve the bioavailability of vitamin D with extended stability.

Monday, June 29, 2020
Session Time: 10:25 AM - 12:10 PM

Presentation Time: 11:45 AM - 12:10 PM

Track: Protein and Co-Products@@@Health and Nutrition

(3925) The Effects of Species and Strain-type on Self-assembly of Protein Nanofibrils

Presenting Author: Derek R. Dee - University of British Columbia

OBJECTIVE: Protein nanofibrils, or amyloid fibrils, could serve as building-blocks for functional nanomaterials in a range of applications, including in food. Rational design of functional amyloid materials requires a better understanding of nanofibril self-assembly. This study examined cross-seeding reactions between two unique nanofibril polymorphs, one long and flexible and the other short and rigid, of lysozyme from two species (human and chicken). METHODS: Different nanofibril polymorphs were formed under conditions of pH 2 and pH 6.3,

and these were subsequently treated by sonication and proteolysis to replicate processing and digestion conditions to create 'seeds'. The kinetics of nanofibril formation were measured using ThT fluorescence, and fibril morphology was analyzed using TEM. RESULTS: Both polymorphs could cross-seed aggregation across species, but this reaction was markedly reduced under physiological conditions. For both species, the pH 6.3 fibril polymorph was dominant, seeding fibril growth with a faster elongation rate at pH 2 than the pH 2 polymorph. Based on fibrillation kinetics and fibril morphology, we found that the pH 2 polymorph was not able to faithfully replicate itself at pH 6.3. CONCLUSIONS: These results show that two distinct amyloid polymorphs are capable of heterologous seeding across two species (human and hen) of lysozyme, but that the pH 6.3 polymorph is favoured, regardless of the species, likely due to a lower activation barrier to accessing this particular misfolded form. These findings contribute to our better understanding of amyloid strain propagation across species barriers, which has implications for understanding pathological amyloid and engineering functional amyloid.

Wednesday, July 1, 2020
Session Time: 11:40 AM - 1:00 PM

Presentation Time: 12:35 PM - 1:00 PM

Track: Protein and Co-Products@@@Health and Nutrition

(3901) Proteinaceous Microgels in Bulk and Interface: Applications in Food

Presenting Author: Anwesha Sarkar, PhD - University of Leeds

Proteinaceous microgels are hydrogel microparticles with well-defined deformability that arises from the swollen nature of the integral biopolymeric network. These colloidal gel particles are extremely important to address fundamental biophysical research questions on oral tribology or digestion when they are present either in bulk phase or at the oil-water interface, respectively. Using a combination of multiscale experimental techniques and theoretical considerations, this invited talk will present an overview on the bio-functional performances of soft protenaceous microgels. Specifically, one case study will focus on the oral lubrication properties[1-3] of the microgels, where these microgels present in the bulk phase act as viscosity modifiers and demonstrate high lubrication performance in elastomeric contact surfaces (with different wetting properties) emulating oral surfaces. Microgels showing aqueous 'soft ball-bearing' abilities depending upon their volume fraction will be highlighted[2-3]. Also, a case study will be presented on how these proteinaceous microgels can be fused when present at the oil-water interface to alter lipid digestion kinetics[4] of Pickering emulsion droplets. These recent advances on bio-functional properties of microgels hold promise for designing foods in the future with tailored properties. References [1] A. Sarkar, et al., Curr. Opin. Colloid Interface Sci 39, 61-75 (2019). [2] A. Sarkar, et al., Langmuir 33, 14699-14708 (2017). [3] E. Andablo-Reyes, A. Sarkar, et al., Soft Matter 15, 9614-9624 (2019). [4] A. Sarkar, et al., Soft Matter 12, 3558-3569 (2016). Acknowledgements The European Research Council is acknowledged for its financial support (Funding scheme, ERC Starting Grant 2017, Project number 757993) for this work.

Thursday, July 2, 2020
Session Time: 8:25 AM - 1:00 PM

Presentation Time: 11:45 AM - 12:00 PM

Track: Protein and Co-Products@@@Health and Nutrition

(3920) Review of Current Data for Digestible Indispensable Amino Acid Scores (diaas) Determined for Human Foods

Presenting Author: Hannah M. Bailey, MS - University of Illinois at Urbana-Champaign

Research to determine digestible indispensable amino acid scores (DIAAS) for human foods began in 2013. However, more human foods require evaluation, therefore, the objective of the Stein Monogastric Nutrition Laboratory is to determine DIAAS for a variety of raw and processed human foods. To determine DIAAS, growing pigs are surgically fitted with a T-cannula in the distal ileum and randomly allotted to experimental diets. Each diet is fed for 7 d, with the initial 5 d for adaptation to the diet followed by 2 d of ileal digesta collection for 9 h. A nitrogen-free diet is also fed to determine basal endogenous losses of amino acids (AA), enabling the calculation of standardized ileal digestibility and DIAAS for three age groups. For children > 3-y, cereal grains have DIAAS between 25 and 70 with lysine being first limiting. Peas, pistachio nuts, rapeseed protein, and soy protein have DIAAS ranging from 70 to 100 and the first limiting AA is the sulfur containing AA. Milk protein, beef, and pork, generally have DIAAS > 100, regardless of processing method. However, the first limiting AA in animal proteins varies with histidine being first limiting in whey proteins, and leucine, sulfur containing AA, histidine, and valine all observed to be first limiting in beef and pork depending on processing method. In conclusion, animal proteins have DIAAS > 100, which indicates that these proteins may complement lower quality proteins, and as DIAAS for additional proteins become available the protein value of mixed meals can be calculated.

Thursday, July 2, 2020
Session Time: 10:25 AM - 12:35 PM

Presentation Time: 12:10 PM - 12:35 PM

Track: Protein and Co-Products@@@Health and Nutrition

(3790) Impacts of Germination on the Digestibility and Quality of Pigeon pea (Cajanus cajan) Seed Proteins

Presenting Author: Ikenna C. Ohanenye, PhD - University of Ottawa

Objective: Digestibility is a concern for pigeon pea and other legumes proteins, due to co-existing compounds in the seed matrix hindering protein accessibility. Germination was used to investigate the digestibility of the underutilized pigeon pea proteins. Methods Used: Pigeon pea seeds (10 g) were washed and sterilised with 70% ethanol and distilled water, placed in a petri dish and incubated at 25°C for 48 h. Control samples were collected prior to incubation (0-h), with other sampling points at - h (pre-germination), 24-h (at germination) and 48-h (post-germination). Seeds were cut across and used for scanning electronic microscope imaging

(SEM). Samples were freeze-dried and pulverised; prior to alkaline solubilization and acid precipitation protein extraction. Lowry assay and SDS-PAGE were used to determine the protein contents and profile of the protein isolates. Pulverised samples from each sampling point were subjected to in vitro gastrointestinal digestion and the degree of hydrolysis (DH) was quantified by ortho-phthalaldehyde method. Digested and non-digested 0-h and 48-h samples were used for amino acid composition and PDCAAS analyses. FTIR was used for proteins secondary structure analyses of 0-h and 48-h samples. Results: Germination altered the seed microstructure, increased the α-helix content (5%), DH (15.6%), PDCAAS (25%), total amino acids (19.4%), sulphur-rich (62.8%) and essential amino acids (18.2%) contents; nonetheless, extractable protein isolate yield (13.5%) and the β-sheets (4%) decreased. Conclusions: Germination increased the total amino acids content, protein quality and digestibility, therefore, could be used to enhance pigeon peas nutritional qualities towards improving the utilization of these proteins.

Thursday, July 2, 2020
Session Time: 11:45 AM - 2:20 PM

Presentation Time: 12:40 PM - 1:05 PM

Track: Protein and Co-Products@@@Health and Nutrition

(3536) Spent Hen Muscle Protein Hydrolysate Reduces Blood Pressure in Spontaneously Hypertensive Rats

Presenting Author: Hongbing Fan, PhD - University of Alberta

Spent hen, a major byproduct of the egg industry, is under-utilized while carries a disposal issue that negatively affects the environment. As a rich source of protein, spent hen proteins can be enzymatically transformed into bioactive peptides with enhanced health-beneficial effects. We previously reported that anti-inflammatory and angiotensin converting enzyme (ACE) inhibitory activities of spent hen hydrolysate. Thus, we hypothesized that spent hen muscle protein hydrolysates can reduce blood pressure in spontaneously hypertensive rats, an animal model similar to human essential hypertension. A number of enzymes have been used to prepare and screen the hydrolysates based on in vitro ACE inhibitory activity, and finally a hydrolysate prepared by thermolysin was selected based on its potency and yield. Oral administration of the hydrolysate at two doses (1,000 and 250 mg/kg body weight per day) over 20 days reduced blood pressure significantly. Results showed that administrating the hydrolysate reduced the level of circulating vasoactive components (e.g. angiotensin II) and inflammatory cytokines (e.g. tumor necrosis factor alpha). In addition, the treatment modulated endothelial dysfunction through improving vasodilation and attenuating vascular inflammation and oxidative stress. This study evidenced the antihypertensive potential of spent hen muscle proteins, which will contribute to developing a value-added solution for spent hen utilization.

Thursday, July 2, 2020
Session Time: 11:45 AM - 2:20 PM

Presentation Time: 1:30 PM - 1:55 PM

Track: Protein and Co-Products@@@Health and Nutrition

(3561) Solid-state Fermentation to Prepare Proteins and Peptides from Heat-stabilized Defatted Rice Bran, and Antioxidant Activity

Presenting Author: Navam S. Hettiarachchy, PhD - University of Arkansas-Fayetteville

Rice bran undergoes a heat stabilization step to preserve oil quality, and the defatted bran is termed, Heat-stabilized Defatted Rice Bran (HDRB). During defatting the proteins are denatured and aggregate with other cellulosic components in the rice bran making the proteins difficult to be extracted. Our objective was to explore solid-state fermentation (SSF) using Bacillus subtilis natto to extract proteins and protein hydrolysates from HDRB and evaluate for antioxidant activity. The Response Surface Methodology (RSM) was used to optimize the effect of Bacillus subtilis inoculum log, initial water content, and time as independent variables on the extraction of the maximum water-soluble proteins (WSP) and protein hydrolysates (WSPH). The solubilized proteins and hydrolysates were subjected to TCA precipitation, and SDS-PAGE separation to determine their molecular size. The antioxidant activities of WSP and WSPH were determined. The optimum conditions for extracting proteins and WSPH were: water content of 41 % v/w, fermentation time of 48 h, and inoculum size of 106 CFU/g of HDRB. The WSP and WSPH produced were 81%. The SDS-PAGE showed 12 bands with molecular sizes ranging from 5 KDa to 100 KDa. The antioxidant activity with DPPH assay showed higher scavenging activity of 72 % ± 2.3 compared with protein extracts from non-fermented HDRB (12% ± 1.7) at the same concentration. The SSF method is an efficient method to extract proteins and hydrolysates from HDRB and can find application as an ingredient in suitable products. Furthermore, the higher antioxidant activity is indicative of its potential function in emulsified food.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3688) Microwave treatment increased protein digestibility of pigeon pea (Cajanus cajan) flour: Elucidation of underlying mechanisms

Presenting Author: Xiaohong Sun - University of Ottawa

Objective: Pigeon pea is rich in proteins but has low protein digestibility like other legumes. The objectives of this study were to improve the protein digestibility of pigeon pea flour by physical treatments, and to increase pigeon pea utilization in food product development. Methods Used: Pigeon pea flour was treated by microwave, ultrasound, grinding and soaking, and non-treated pigeon pea flour was used as a control. The microstructures of pigeon pea flours and proteins

were visualized by scanning electron microscope. Proteins were extracted from the pigeon pea flours by alkaline solubilization and acid precipitation method. The protein contents and profiles were determined by Lowry assay and SDS-PAGE. Pigeon pea fours were subjected to in vitro digestion. Degree of hydrolysis was measured by ortho-phthalaldehyde method. The secondary structures of proteins were analyzed by Fourier Transform Infrared Spectroscopy. Results: Only microwave treatment significantly increased in vitro protein digestibility from 54.4±2.5% to 71.6±4.2%. SDS-PAGE showed the most abundant proteins in all samples were 7S vicilin subunits. After microwave treatment, the starch granular structures of pigeon pea flour changed to clusters, and protein secondary structures lost 5% β-sheet and gained 5% random coil, which contributed to the increased protein digestibility. Microwave decreased protein water solubility from 94.4±0.8% to 48.1±6.5% and increased disulfide bonds content by 42%. The increased protein digestibility is attributable to the relatively smaller particle size (166.6±38.6 nm) and higher zeta potential (-35.2±2.6 mV) of the microwave-treated sample. Conclusions: Microwave is a promising approach for increasing pigeon pea protein quality and utilisation

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3771) In vitro Antioxidant and Antihypertensive Properties of Edible Cricket (Brachytrupes menbranaceus) Protein Derived Membrane Peptide Fractions.

Presenting Author: Abraham T. Girgih - University of Agriculture

The aim of this study was to determine the in vitro antioxidant and antihypertensive properties of edible cricket protein meal (CRIPM), cricket protein hydrolysate (CRIPH) and its peptide fractions. CRIPM was digested sequentially using pepsin and pancreatin enzymes to mimic gastrointestinal digestion in human beings. The resultant CRIPH was then separated by membrane ultrafiltration into peptide fractions with sizes of <1, 1-3, 3-5 and 5-10 kDa. The protein content of CRIPM (61.7%) was significantly (P<0.05) lower than that of CRIPH (79.9%) and the peptide fractions (78.8-83.0%). The fractions also showed significantly (p<0/05) higher DPPH (81-85%), Superoxide (80-84%) and Hydroxyl (15-45%) radicals scavenging activities than glutathione (GSH) with 66, 58 and 12%, respectively. GSH had the highest IC50 value of 0.45 mg/mL compared to the other samples IC50 value range of 0.34-0.41 mg/mL. CRIPM, CRIPH and their membrane fraction peptides significantly (p<0.05) chelated metals (31-69%) and reduced ferric ions (38-83%) compared to GSH (37 & 61%). Membrane fractionation resulted in peptides with excellent ACE and moderate renin inhibitory activities (77-91 & 58-66%, respectively). Molecular weight distribution of CRIPM and CRIPH showed that the samples were predominantly composed of Low Molecular Weight peptides (0.03-0.81 kDa) that could be responsible for the observed bioactivities. The study suggests that CRIPM, CRIPH and peptide fractions are potential therapeutic ingredients for the development of functional foods and nutraceuticals for the prevention and amelioration of oxidative stress and hypertension.

Results could promote increased farming of edible crickets, thus providing economic benefits to all stake holders.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3565) Anti-Inflammatory Properties of Lunasin Protease Inhibitor Concentrate *in vitro* and in Ulcerative-Colitis-Model *in vivo*

Presenting Author: Andrea Nieto-Veloza - University of Tennessee Knoxville

Lunasin Protease Inhibitor Concentrate (LPIC) is a novel combination of soy bioactive peptide Lunasin, Kunitz and Bowman-Birk protease inhibitors. The recognized anti-inflammatory and anticancer properties of each one of them suggest LPIC as a promising candidate for treatment of inflammatory-related diseases. Our objective was to assess the *in vitro* and *in vivo* anti-inflammatory properties of LPIC. An *in vitro* test was performed in lipopolysaccharide (LPS)-activated RAW 264.7 murine macrophages by measuring production of IL-6 and TNF-α cytokines as inflammatory markers. For the *in vivo* model, 20 C57BL/6 mice were randomly divided and treated as follows: 3% dextran sodium sulfate (DSS) in drinking water was administered to DSS group (n=8) and LPIC group (n=6) in order to induce ulcerative colitis, while normal drinking water was administered to control group (CG, n=6). LPIC group treatment was performed via daily intraperitoneal injection of 50mg/kg body weight of LPIC. DSS and CG were injected with sterile water. Colonic myeloperoxidase activity (MPO), presence of pro-inflammatory cytokines in blood and colon, changes in the architecture and expression of inducible Nitric Oxide Synthase (iNOS) in colonic tissue were used as markers of disease progression. LPIC significantly reduced the expression of pro-inflammatory cytokines *in vitro* (30% IL-6, 40% TNF-α) and *in vivo* (33% IL-6, 42% IL-1β in the colon, and 44% TNF-α in serum), decreased MPO in the colon (47%), ameliorated disruption of colonic architecture, and reduced relative expression of iNOS in colonic crypts (60%). These results suggest that LPIC can contribute to the alleviation of inflammatory-related diseases.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3996) Fermentation performance and nutritional profile of some physically-modified legume-protein ingredients

Presenting Author: Bibek Byanju, MA - Iowa State University

Significant amount of legume nutrients, including dietary fibers, proteins, minerals, and vitamins are not bio-available in humans or animals when consumed. Anti-nutritional factors (ANFs) like phytic acid, tannins, and enzyme inhibitors are the major factors that reduce the bioavailability of nutrients. These ANFs could be reduced or modified during fermentation or physical modification. In this research, effect of combination of physical treatments (sonication/extrusion) and fermentation on ANFs was evaluated. Flours of soybean, lentil, and green peas were sonicated for 2 and 4 min at 100% amplitude (Power density ~ 2.5) at a 1:8 ratio (substrate: water) and fermented. Physically-modified flours were inoculated with Lactobacillus plantarum and Pediococcus acidilactici at 108 CFU/mL and fermented in shake flasks for 72 h at 37 °C, with shaking at 200 rpm. The microbial growths and pH were measured at 6, 12, 24, 48, and 72 h. The pH dropped from 6.5 to 4.5 at the initial 24 h and microbial growth was highest at 24 h. The population doubling time of L. plantarum was lowest for green pea (1.28 h) and highest for soybean (1.5 h). Similarly, the doubling time for P. acidilactici was lowest for extruded lentil (1.08 h) and highest for soybean (1.59 h). Total phenolic contents were significantly ($p<0.05$) reduced for all fermented substrates compared to non-fermented controls except for lentil. We expect to see the reduction in the ANFs present in pulses and improvement in-vitro digestibility of protein and carbohydrates as the result of these treatments.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Health and Nutrition

(3564) Hollow Soy Protein Microspheres Templated on Porous Calcium Carbonate Microparticles

Presenting Author: Xiaonan Sui, PhD - Northeast Agricultural University

The trend of using proteins as microcarriers for diverse applications, such as emulsification, encapsulation, and delivery vehicle, is progressively increasing. Porous calcium carbonate ($CaCO_3$) vaterite microparticles have been introduced a decade ago as sacrificial cores and becoming nowadays as one of the most popular templates to fabricate microcarriers. Herein we present a fabrication method of soy protein microspheres by templating on porous $CaCO_3$ microcores (Fig. 1). The $CaCO_3$ microcores with a controlled particle size (appx. 3-4 μm) were harvested at supersaturation by mixing Na_2CO_3 (3.0 M) and $CaCl_2$ (3.0 M) solutions at an equal

volume ratio under vigorous stirring at 1000 rpm. The formation yield of CaCO3 microcores was about 47%. Soy protein solutions at varied concentrations from 0.05 to 0.25% (w/v) were introduced in the CaCO3 microcores suspension (16 mg/mL) to fabricate microspheres. Templated soy proteins were internally cross-linked using the enzyme transglutaminase (TGase). Results showed that the highest encapsulation efficiency of 87.9% was achieved at the protein concentration of 0.05%, but at this condition the protein loading radio was the lowest (26.6 μg/mg). The microspheres fabricated at soy protein concentration of 0.15 mg/mL CaCO3 suspension brought about 62.2% encapsulation efficiency with the highest protein loading ratio of 55.5 μg/mg. Confocal laser scanning microscopy (CLSM) and scanning electron microscopy (SEM) images showed that the protein loaded CaCO3 microspheres has a spherical shape. In comparison, hollow protein microspheres formed by dissolving the carbonate templates were partially collapsed and then fused. This study illustrates the feasibility to apply soy protein in the fabrication of microspheres by porous calcium carbonate microparticles templating.

Tuesday, June 30, 2020

Session Time: 8:25 AM - 10:10 AM

Presentation Time: 9:20 AM - 9:45 AM

Track: Protein and Co-Products@@@Processing

(3814) Protein Isolate Production from Chilean Grenado Beans

Presenting Author: Levente L. Diosady, PhD, PEng,CEng,CFS - University of Toronto

Granado beans are native to Chile. There is indication in the literature that the bean's protein may contribute to the prevention of diabetes. The objective of this cooperative program between the Catholic University of Chile, Solutec and the University of Toronto was to develop technology for the extraction and purification of the protein for eventual testing of its anti-diabetic properties. A process based on the alkaline extraction of protein, dissociation of attached phenolic compounds, membrane purification and isoelectric precipitation was developed. Three protein products were produced: an isoelectric protein, an acid soluble protein and a meal residue. The bean protein's isoelectric range was centered around pH 4.2, where some 80% of the extracted protein was recovered. The protein content of the isoelectric protein isolate was 87%. The acid soluble protein contained only 59% protein, indicating that the extract contained high molecular weight carbohydrates. The isolates are promising starting materials for further research into granado bean proteins' physiological function and discovering diabetes preventative protein fractions.

Wednesday, July 1, 2020
Session Time: 11:40 AM - 1:00 PM

Presentation Time: 11:45 AM - 12:10 PM

Track: Protein and Co-Products@@@Processing

(3777) Providing Industrial Wood Bond Strength with Protein Adhesives

Presenting Author: Charles R. Frihart, PhD - Forest Products Laboratory
Presenter: Christopher Hunt

Despite a lot of academic research claiming to make satisfactory adhesives out of oilseed proteins, only a couple of routes have been commercialized as wood adhesives. This leads to the question of what factors influence the design of a water-resistant wood adhesive. Certainly the structure of the protein is a critical factor that leads to an adhesive that coalesce into a strong film after rewetting. The comparison of proteins to poly(vinyl acetate) provides an interesting model. This depends upon what is meant by and results from denaturation and agglomeration. The wood bond strength for various tests for oilseed adhesives are compared to the current model for protein adhesives.

Thursday, July 2, 2020
Session Time: 11:45 AM - 2:20 PM

Presentation Time: 11:50 AM - 12:15 PM

Track: Protein and Co-Products@@@Processing

(3603) Non-Thermal Ultrasound Drying to Enhance the Solubility of Almond, Lentil and Pea Proteins

Presenting Author: Nahla Kreidly - University of Illinois At Urbana-Champaign

Novel plant protein products are currently of high interest due to consumer preference over the use of animal proteins, but the functionality of plant proteins remains a challenge. Ultrasound (US) has become a technology of interest to the food industry due to its ability to remove water and solvents without significantly raising the temperature of the load. The effect of ultrasound drying of vegetable protein gels on the solubility of resulting dried proteins was investigated. Protein gels were prepared by hydrating almond, lentil, and pea protein concentrate powders (10-20% w/v) for 2 hours. Ethanol (30-80% v/v) was then added to the protein solution. All proteins formed instantons gels immediately upon contact with ethanol. Viscoelastic properties of ethanol-induced gels were determined with an ARES-G2 rheometer. Ultrasound drying of protein gels was performed with a custom-designed direct contact system consisting of a transducer box that vibrated at 40 kHz (1kW). The transducer box was submerged in a water jacket for temperature control. Drying temperature was 28C, drying time was 8 minutes. On average, final moisture content was 1% and residual ethanol was 0.001 mg/g. The microstructure of US dried samples was examined by CT scan. It consisted of thin films of uniform structure. US drying significantly enhanced the solubility of plant protein gels, from 9 g/100mL for pea

protein concentrate to 40g/100mL for US dried pea protein gel, on average. This work aims to enhance the functionality of vegetable protein powders by using non-thermal processing.

Thursday, July 2, 2020
Session Time: 11:45 AM - 2:20 PM

Presentation Time: 1:55 PM - 2:20 PM

Track: Protein and Co-Products@@@Processing

(3797) Proteins from Seafood Processing Discards: Recovery and their Food Applications

Presenting Author: V. Venugopal, M.Sc., PhD - Kerala University of Fisheries and Ocean Studies

The demand for proteins is rising with increasing awareness of their health benefits, which has resulted in search for proteins from alternate sources. The processing of food all over the world results in tremendous amounts of waste. There is much scope for secondary processing of food waste for the recovery of proteins. Current total fish production is around 170 million tones, 90% of which is used for human consumption. Commercial processing of seafood results in enormous amounts of solid discards, offal or by-products. These discards, on dry weight basis, contain up to 60% proteins, consisting mostly of myofibrillar proteins, collagen, enzymes, and also soluble nitrogenous compounds. The proteins in the discards have valuable biochemical, nutritional as well as functional properties. In addition, these proteins are also sources of bioactive peptides associated with diverse functions. In view of these properties, seafood discards offer valuable resources for interesting nutritional and health applications. Efforts in this direction will help better utilization of harvested and farmed seafood besides significantly reducing seafood-associated environmental problems. Iso-electric pH solubilization precipitation is a plausible and gentle method for the recovery of proteins from fishery discards. The recovered proteins are comparable with conventional surimi in gel forming and other functional properties. Other approaches for protein recovery include mechanical deboning of fish frames, development of weak acid-induced gels, protein dispersions, and treatment of the discards by proteolytic enzymes. This presentation will discuss recovery of proteins from seafood processing discards and their uses as food additives and nutraceuticals

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Processing

(3854) Hydroxyl Radical Generated During High Power Sonication of Soy Proteins and Its Effect on Protein Structure

Presenting Author: Md Mahfuzur Rahman - Iowa State University

Abstract High power sonication (HPS) is shown to alter protein structure, thus, its functionality, via intermolecular interactions. This study evaluated the effects of HPS of soy proteins in aqueous medium on molecular structure. Free radicals generated during HPS, were quantitated using the 5,5-dimethyl-l-pyrrolin N-oxide (DMPO) spin trap method . Electron paramagnetic resonance (EPR) was used to identify them as mostly hydroxyl radicals, and quantified. The minimum saturation concentration of spin trap was determined to be 500 mM of DMPO in water when exposed to 5 W/cm3 ultrasound power density (PD) for 10 min; subsequently, this concentration was used for quantitating radicals in protein samples. Five aqueous soy protein systems, namely, 5% soy protein isolate (SPI), 5 % isoflavonoids removed SPI (NO-ISO SPI), subunits: 1% glycinin (11S) and 1% β conglycinin (7S) as well as soy flakes (1:10 in water), were sonicated at PD of 2.5 and 5 W/cm3. Only hydroxyl radical adducts (DMPO-OH) was detected in these aqueous systems. Highest concentration (3.68 µM) of DMPO-OH adduct was measured in 11S solution at 5 W/cm3, whereas lowest (0.67 µM) concentration was in soy flakes protein. PD 5 W/cm3 generated higher concentration of radicals in 7S subunit solution, NO-ISO SPI, and soy flakes protein, compared to sonication at PD 2.5 W/cm3. No change in the protein electrophoretic pattern was observed. However, some changes in the estimated secondary structure and tertiary structure as well as in the content of free sulfhydryl bonds and disulfide bonds were observed after HPS.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Protein and Co-Products@@@Processing

(3692) Aquafaba, a new emulsifier and foaming agent emerging from pulses processing

Presenting Author: Rana Mustafa - Government of Saskatchewan

The global market for plant-based food ingredients is growing and aquafaba (AF) is one of the most innovative and accessible pulse-based emulsifiers and foaming food additives. While the number of AF users continues to rise, commercial AF production becomes crucial. However, the inconsistency in AF quality and the leftover cooked seed are the main challenges for most AF producers. The objectives of our work are to develop a zero waste and cost-effective process to extract AF from chickpea, and to explore potential uses of AF in food formulation. The composition of AF is s studied extensively and has first been published by our group. Aquafaba

contains mostly polysaccharides (55-66%) followed by low molecular weight proteins (20-27%) which, in combination, confer similar functionality to egg white. We have previously developed a hybrid process that combines dry and wet fractionation of chickpea seeds. Our published data show that AF composition depends significantly on processing methods (pre-soaking, cooking and industrial dehydration), solution conditions (pH, temperature, pressure and treatment duration), genotype (Kabuli or Desi chickpea), and additives. Our results also show that AF liquid can be dried using commercial processes and then included in prepared food without altering either flavour or colour and without the need of a co-emulsifier. Undoubtedly, AF functionality has the potential to be the driver of innovation in pulse-based food and processing.