



MINISTRY OF BUSINESS,  
INNOVATION & EMPLOYMENT  
HĪKINA WHAKATUTUKI

# NZIFST Conference 2019

## POSTER A STRACTS

---

### Good Food 4



NZIFST Conference 2-4 July 2019  
CHRISTCHURCH

Christchurch Town Hall for the Performing Arts  
86 Kilmore Street, Christchurch  
[www.nzifst.org.nz](http://www.nzifst.org.nz)

---



# **CONTENTS**

**STUDENT COMPETITION  
POSTERS**

**Pg 3**

**POSTERS**

**Pg 18**

## STUDENT POSTER ABSTRACTS

### **S1: The nutritional quality of gluten-free pasta made from banana-cassava composite flour with protein fortification**

*Names of authors: Adetiya Rachman<sup>1,2</sup>, Margaret A. Brennan<sup>1</sup>, James Morton<sup>1</sup>, Charles S. Brennan<sup>1</sup>*

*Affiliations: <sup>1</sup> Department of Wine, Food and Molecular Biosciences, Lincoln University*

*<sup>2</sup> Indonesia Institute for Agricultural Research and Development, Jakarta, Indonesia:*

#### **ABSTRACT:**

The effects of egg protein and soy protein powder fortification on the nutritional quality of banana-cassava pasta were studied. The banana-cassava composite flour was 75% banana flour: 25% cassava flour. Soy protein and egg protein were added at levels of 5, 10 and 15% of composite flour (w/w) for each protein type. Pasta made from 100% durum wheat semolina and unfortified composite banana-cassava flour were controls. The addition of soy or egg protein resulted in significant differences in total phenolic capacity (TPC) and antioxidant capacity compared to semolina pasta and pure banana-cassava pasta. Type of protein and level of addition both had an effect: soy protein increased TPC and antioxidant capacity with higher levels of fortification; in contrast, egg protein decreased these values with increased protein addition. The gluten-free pastas had significantly lower glycaemic properties than semolina pasta. There were no significant effects of protein type addition to the area under curve values. However, the level of protein altered the glycaemic glucose equivalent value, lower values with an increase in protein addition. It was also found that the protein digestibility of gluten-free pasta was significantly different from semolina pasta, and was affected by the level of protein and the type of protein addition. The fortification of soy/egg protein significantly improved the nutritional quality of gluten-free pasta based on a banana-cassava composite flour.

Keywords: gluten-free pasta, banana-cassava flour, soy protein, egg protein

### **S2: Designing concept-based meat functionality from non-meat proteins using pilot scale high temperature and shear processing.**

*Names of authors: Akashdeep Singh Beniwal<sup>1</sup> Jaspreet Singh<sup>1</sup>, Alan Hardacre<sup>1</sup> and Harjinder Singh<sup>2</sup>*

*Affiliations: <sup>1</sup> School of Food and Advanced Technology, Massey University, Palmerston North, New Zealand*

*<sup>2</sup> Riddet Institute, Massey University, Palmerston North, New Zealand*

#### **ABSTRACT:**

We investigated the application of high-temperature shear processing (HTSP) as a structuring tool for alternative proteins or their blends, to develop meat analogues with wide varieties of structures and textures. Techniques such as HTSP involve thermal processing at high temperatures (<140°C) with mechanical shear to bring physiochemical and structural transformations in concentrated plant protein mixtures. Various ratios of plant protein mixtures (soy protein isolate, pea protein concentrate, mung bean protein isolate) were structured using HTSP. Microstructural and textural analysis was performed to characterise and compare the structural-textural functionality of the structured plant proteins blends with that of a natural meat-like texture. The structural morphology of resultant analogues varied from broken fibre, layered gel steak-like structure, to layered fibrous texture mimicking meat functionality. Textural hardness values obtained using a texture analyser

ranged from  $49 \pm 2$  N to  $14 \pm 7$  N for various protein mixture ratios undergoing HPSP. Microstructure analysis reveals that HTSP of a pea protein, soy blend in the ratio 3:1 resulted in fibrous layered structure simulating the sensorial properties of cooked chicken breast. FTIR spectroscopy analysis indicated significant change in amide I ( $1600$  to  $1700$   $\text{cm}^{-1}$ ) and amide II ( $1500$  to  $1600$   $\text{cm}^{-1}$ ) regions representing protein secondary structure of the protein mixture. Solvent extraction methodology quantified the amount of noncovalent (hydrogen, hydrophobic) and covalent (disulphide) interactions formed during HTSP structuring process that contributed to structural intactness and loss of protein solubility of the structured blend.

Keywords: plant-based meat, thermomechanical structuring, protein-protein interactions, FTIR

### **S3: Impact of yeast strain on perceived hop flavour in beer**

*Names of authors: Ashly A. Kumar<sup>1</sup>, Graham T. Eyres<sup>1</sup>, Andrea Warburton<sup>1</sup>, Phil Bremer<sup>1</sup>, Pat Silcock<sup>1</sup>*

*Affiliation: <sup>1</sup>University of Otago, Department of Food Science*

#### **ABSTRACT:**

Beer flavour is determined by the complex interaction of malt, hops, water and yeast. Hops contribute bitterness and a range of aroma characters in beer, including floral, fruity and spicy notes. Hop flavour in beer is complex, because it is affected by complex physical, chemical and biological changes that occur during brewing and fermentation. Yeast interacts with hop compounds to determine the final hop flavour in beer. The nature of these changes that occur during fermentation and how yeast influences the overall perception of the hoppy flavour is not well characterised. In this study, a standard wort with Motueka (late addition aroma hops) was fermented using each of twelve different yeast strains. The sensory characteristics of the resulting beer samples were evaluated using a sorting task carried out by a panel of 14 assessors. The assessors generated a total of 90 sensory attributes of which the five terms most commonly used were hoppy, fruity, sulphury, bitter and floral. There were distinct sensory differences detected between the beers. Beer fermented with 34-70 (a lager yeast strain) was described as hoppy, with WLP-730 (a wine yeast) spicy, with WY1272 (an ale yeast) sulphury and metallic, with WB-06 (a wheat beer yeast) estery, and with OTA 79 (an ale yeast) sulphury. This research has clearly demonstrated that yeast strains can have an impact on hop flavours in beer. This research will help to inform brewers of the suitable yeast strains to use to achieve specific hop flavours within a beer.

Keywords: beer, hop flavour, yeast, sensory evaluation

### **S4: Untargeted metabolomic study on milk geographic origin discrimination using <sup>1</sup>H-NMR and UPLC-QTOF-MS combined with multivariate data analysis**

*Names of authors: Dan Zhu, Gang Chen, Biniam Kebede, Russell Frew*

*Affiliation: University of Otago*

#### **ABSTRACT:**

Fraud is endemic throughout the food industry and a major concern to producers and consumers. Adulteration or substitution with inferior product may cause economic or health problems, thus it is important to establish a method to authenticate food. The aim of this work was to develop an effective toolbox to discriminate raw milk samples from New Zealand, Sri Lanka and China (Inner Mongolia), according to their geographical origin. Multiple advanced analytical techniques were combined, including <sup>1</sup>H-NMR (nuclear magnetic resonance) and QTOF-MS (quadrupole time-of-flight mass spectrometry) coupled to UPLC (ultra-high

performance liquid chromatography). Over two hundred low molecular weight compounds were detected by untargeted omics-based techniques. Following data pre-processing, multivariate analyses such as PCA (principal component analysis) and PLS-DA (partial least squares-discriminative analysis) were applied to explore groupings in the data. The milk from the different countries could be completely separated, while samples from different regions of New Zealand behaved similarly. The potential biomarkers for distinguishing samples from New Zealand and Sri Lanka, or New Zealand and China (Inner Mongolia) were selected, such as some amino acids, organic acids or their derivatives, according to the VIP values (>1.0) of PLS-DA and P values (<0.05) of Wilcoxon's Rank-Sum test. The stability of the biomarkers was further tested by storing the samples under different condition (4°C and room temperature) for periods up to 32 weeks. These results provide a better understanding of the variation in milk metabolites with geographical origin and could help with milk authentication.

Keywords: milk geographic origin, metabolomics, multivariate data analysis, storage stability

### **S5: Interactions of dietary polyphenols with dairy proteins in the form of acidified gel system**

*Names of author: Gang Wu*

*Affiliation: Lincoln University; South China University of Technology; Riddet Institute*

#### **ABSTRACT:**

Milk proteins and dietary polyphenols, both large groups of molecules with complex structures, contribute nutritive and additional health benefits, and form integrated structures via their natural affinity. Some native structures and functions of the two components are modified when combined in food products, and these modified structures alter their nutritional properties. Fortified dairy products with added dietary polyphenols are relatively common products, but little work has been conducted on the health-relevant doses with different protein matrices to create protein-polyphenol-based novel ingredients with desired properties. Therefore, the incorporation of dietary polyphenol-rich ingredients into high protein food matrices (films, hydrogels, emulsions, and micro and nanoparticles) is of interest. The effect of delivery matrix on physiological functions such as digestion, antioxidant and anti-inflammatory activities, and intestinal microbiota-modulating properties have not been thoroughly studied. This project uses acidified dairy gels to determine a fundamental understanding of bovine milk sourced protein-polyphenol interactions in the form of a hydrogel. This includes physicochemical properties and nutritional qualities of the gel, providing an overall view of the changes from food systems to digestive systems and exploring the possibility of creating a rational design for functional dairy ingredients.

Keywords: dietary polyphenols, milk proteins, interactions, complexes

### **S6: Determining the influence of emulsion composition and structural dynamics on lipaemic inflammatory response**

*Names of authors: Giovanna Castillo-Fernandez<sup>1,2</sup>; Matt Golding<sup>1,2</sup>; Fran Wolber<sup>1,2,3</sup>; Lara Matia-Merino<sup>2</sup>; Noha Nasef<sup>1</sup>; Harjinder Singh<sup>1</sup>*

*Affiliations:*

*<sup>1</sup>Riddet Institute, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand.*

<sup>2</sup>*School of food and Advanced Technology, Massey University, Palmerston North 4442, New Zealand.*

<sup>3</sup>*Centre for Metabolic Health Research Massey University, Palmerston North 4442, New Zealand.*

**ABSTRACT:**

Following food ingestion, people enter what is known as a postprandial state, for fat ingestion called postprandial lipaemia. Extended periods of postprandial lipaemia can induce oxidative stress (an imbalance of oxidants and antioxidants), which can lead to inflammation. A well-known bioactive compound such as curcumin – found in turmeric – with demonstrated antioxidant and anti-inflammatory effects can help to maintain the balance of antioxidants. Due to its hydrophobicity, curcumin is mostly provided in combination with fat as a carrier system, although fat is known to be pro-inflammatory. However, the delivery structure and composition can modulate the uptake of both digestive fatty acids and lipophilic bioactive compounds such as curcumin. In this proposed study, curcumin-containing emulsions will be subjected to in vitro digestion. Varying the composition of the emulsions is expected to modulate the digestive outcome of mixed micellar particles. To determine the postprandial bioavailability of curcumin, intestinal epithelial cells will be used to evaluate micellar particles absorption and the subsequent production of lipoproteins. These will be applied to inflammatory cells to evaluate the production of oxidative stress and inflammation markers associated with lipid uptake, and to determine whether inclusion of curcumin can modulate this.

Keywords: in vitro digestion, postprandial lipaemia, cell culture inflammation

**S7: Bacterial profile of kombucha and kefir products by 16S ribosomal DNA analysis**

**Names of authors:** Jingwen Zhan, Owen Young , Ursula Hosking, Kevin Lee, Jasmine Kaur

**Affiliation:** AUT University, Auckland

**ABSTRACT:**

In response to the negative dietary effects of high sugar drinks, fermented low alcohol/low sugar drinks are increasingly popular, being pleasant tasting and being perceived, validly or otherwise, as being ‘healthy’ beverages. These beverages are dominated by kombucha and kefir. Starting from a cottage industry base, industrial scale suppliers are now entering world markets for these products. Achieving industry aims of product consistency, safety, and lowering of production costs, requires knowledge of the microbiological profile. In broad terms kombucha and kefir are both SCOBYs (symbiotic communities of bacteria and yeasts) that have evolved opportunistically into supposedly stable communities that are ‘back slopped’ into recurrent fermentation batches. Conventional plate count technology has limitations in respect to resolution and throughput for species identification in these microbial communities. We here report limited studies of bacterial communities in kombucha and kefir fermentations. Sequencing data (16S ribosomal DNA) are being continually generated and will be reported; as of now we report that the SCOBY in one particular commercial kombucha is dominated by many strains of *Komagataeibacter* (particularly), *Gluconobacter* and *Acetobacter* spp. These are augmented by another four identified genera plus a very complex background – less than 5% of total sequencing reads – comprising more than 200 genera or species. Whether the profile can be channelled to optimise industry aims is unknown at this time.

Key words: kombucha, kefir, SCOBY, 16S ribosomal DNA

### **S8: The effects of black and red goji berry powder on physical properties of biscuits**

*Name of author: Jingyi Su*

#### **ABSTRACT:**

The research will ultimately investigate the effects of goji berries on neurodegenerative diseases and glycaemic response. Initially, the effects of goji berry powder on the physical properties of biscuits were studied. The biscuits were made according to the America Association of Cereal Chemistry method 10-50D with slight modification. The diameter and thickness of biscuits were measured by caliper. The colour of biscuits was measured according to the International Commission on Illumination standard using a colorimeter. The hardness was measured on a texture analyser with a 3-point bend rig probe fitted to a 50 kg load cell. Diameters, hardness, and colour of biscuits were affected by the incorporation of black and red goji berry powders. The diameter increased by 12.4, 16.7, and 19.2% from 5, 10, and 15% addition of black goji berry, respectively. For red goji berry, the equivalent increased percentages were 18.5, 20.0, and 23.7% respectively. Compared with the control group, biscuits with goji berry additions were darker and redder. For the textural property, the biscuits were softer with increasing amount of black or red goji berry powder. Goji berries have a high content of polysaccharide which may increase water holding capacity to expand the diameter and make the biscuits softer. The polysaccharide probably increased the darkness and redness of biscuits because of caramelisation.

Keywords: goji berry, physical properties, polysaccharide

### **S9: Chemical fingerprinting and authentication of New Zealand goat and sheep milk powder using <sup>1</sup>H-NMR and multivariate data analysis**

*Names of authors: Lorraine Jane Sanchez, Dan Zhu, Russell Frew, Biniam Kebede*

*Affiliation: University of Otago*

#### **ABSTRACT:**

Goat and sheep milk are high-value milks and can be viable alternatives for cow milk in terms of nutritional benefits and digestibility. These milk types are commonly used as a nutritional source for infants and children, particularly in milk powder form. Because of these qualities, goat and sheep milk powder can easily be a target of adulteration by low-value milk, which can pose a threat to consumers due to undeclared composition. To protect the identity of these products, this study used an advanced analytical approach by integrating <sup>1</sup>H-NMR (nuclear magnetic resonance) fingerprinting with multivariate data analysis. NMR is a quick analytical technique and can generate large amount of information, which may be useful in verifying authenticity of milk products. In this study, unique metabolite fingerprints from goat, sheep, and cow milks were determined, followed by analysis of milk mixtures of lower to higher-value milk (cow milk into goat and sheep milk, and goat milk into sheep milk). A total of 61 metabolites were detected by <sup>1</sup>H-NMR in the three milk types. Using multivariate analysis techniques such as PCA (principal component analysis) and PLS-DA (partial least squares-discriminative analysis), the milk samples were clearly differentiated from each other, but goat and sheep milk exhibited most similarity. The biomarkers of the milk mixtures for milk authentication were determined using variable identification (VID) values based on PLS-DA model. The study showed that NMR fingerprinting combined with

multivariate data analysis can be an efficient way of obtaining a comprehensive data set and in authenticating goat and sheep milk powders.

Keywords: goat milk, sheep milk, milk authenticity, NMR fingerprinting, biomarker selection

### **S10: Effect of pH on quantitation of phospholipids extracted from natural products by <sup>31</sup>P NMR**

*Mirja Kaizer Ahmmed<sup>1,3</sup>, Senni Bunga<sup>1</sup>, Sabrina Tian<sup>2</sup>, Alan Carne<sup>1</sup> and Alaa El-Din Ahmed Bekhit<sup>1</sup>*

<sup>1</sup>*Department of Food science, University of Otago, Dunedin, New Zealand*

<sup>2</sup>*Sanford Limited, Auckland, New Zealand*

<sup>3</sup>*Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh*

#### **Abstract:**

Phospholipids are major components of the biological cell membrane in microorganisms, plants and animals and play a critical role in numerous cellular processes. Compared to traditional chromatographic and mass spectroscopic methods, <sup>31</sup>P NMR has been demonstrated to be a convenient tool for the analysis and quantification of phospholipids. Sodium cholate is considered as an ideal detergent to obtain highly resolved <sup>31</sup>P NMR spectra of phospholipids. However, the separation and accurate quantification of these compounds is dependent on pH and temperature during measurement, which is not well understood for <sup>31</sup>P NMR. The objective of the present study was to determine the effect of pH on phospholipids and their stability under alkaline conditions. Salmon roe and chicken egg phospholipids were extracted and purified using ethanol and hexane as solvent. Extracted phospholipids (20 mg) were dissolved in sodium cholate solutions of different pH (7.0, 7.3, 7.8, 9.5 and 12.0) and analysed by NMR. The best resolved phospholipid spectrum was obtained at pH 12.0 that enabled the highest number of phospholipids to be identified. However, the yield of phospholipid ranged from 94% at pH 7.0 to only 20% at pH 12.0, which was also confirmed with pure phospholipid standards. Although the phospholipids were found to be quite stable at neutral pH (7.0 to 7.3), sodium cholate was not soluble at pH 7.0, leading to erroneous quantification of phospholipids. Therefore, the present study indicates that pH 7.3 is the most suitable pH for phospholipid quantification using <sup>31</sup>P NMR.

Keywords: phospholipids, pH, <sup>31</sup>P NMR

### **S11: Transforming orphan crops into valuable source of functional water-soluble non-starch polysaccharide material for food application: the case of taro**

*Names of authors: Mylene Anwar<sup>1,2</sup>, Edward John Birch<sup>1</sup> and Alaa El-Din Bekhit<sup>1</sup>*

*Affiliation s: <sup>1</sup>Department of Food Science, University of Otago, New Zealand*

*<sup>2</sup>Department of Food Science, Central Mindanao University,*

#### **ABSTRACT:**

Taro, a tuber crop, considered an orphan crop in several parts of the world, is grown abundantly in less developed and developing countries. The presence of mucilage, a water-soluble non starch polysaccharide responsible for its slimy texture, is one of its distinct characteristics. The mucilage, often wasted as by-product of processing, can be of value if recovered and used as functional additive in food applications. A freeze-thaw extraction technique was used to extract the mucilage from taro corm yielding 9.93 % (dry weight) crude mucilage. Proximate analysis showed that the mucilage contains protein (3.0 %), ash (1.0 %), neutral sugar fraction (73.0 %), acidic sugar fraction (11.0 %) and moisture (9.0 %). It exhibited pseudoplasticity with a

high consistency index (6.24 Pa s) and a flow behaviour index of 0.30 using a 2.5 % sample dispersion. The water holding capacity of the mucilage was 89.9 g/g with a swelling index of 90.7 mL/g at 25 °C. A 0.6 % mucilage dispersion exhibited a 31.8 % emulsifying ability with high (95.5 %) emulsion stability. The mucilage exhibited good thermal stability having maximal decomposition temperature of 238°C with a low weight loss of 0.23 % at 100°C and 1.67 % at 200°C. The functional properties exhibited by the freeze-thaw extracted mucilage in this study indicate its potential use as an excellent food additive in the development of food products requiring good water holding capacity, high emulsion stability, enhanced viscosity and for products requiring high temperature processing.

Keywords: taro, orphan crop, mucilage, water soluble non-starch polysaccharide, freeze-thaw extraction

### **S12: Redirected eating using virtual reality - manipulating extrinsic sensory stimuli to influence flavour experience**

*Name of author: Nikita Mae Harris*

*Affiliation: HIT Lab NZ, University of Canterbury*

**ABSTRACT:**

This project aims to redirect peoples' eating experience using virtual reality. This is to make people believe that the tasty food they are eating in virtual reality is the actual food they are eating in the real world, when in fact the food they are eating is a 'healthy' substitute. We call this technique redirected eating. This research studies the many factors that influence the ways we have learned to enjoy our food and especially its flavour. Our perception of flavour is primarily through our chemical senses – olfactory and gustatory. However, recent research has showed that flavour is more likely to be a multisensory experience influenced by stimuli of many senses and their interplay. By studying and making use of these crossmodal precepts during our eating experience, I hope to successfully achieve my goal. Three studies have been designed for this research and so far two (feasibility and usability studies) have been conducted. The feasibility study explored how virtual visual and olfactory food cues influence our food craving. The usability study explored how easy and natural it is to eat in a virtual reality environment. The third study will be on implementation of redirected eating. So far, I have found that:

- Orthonasal olfaction (sniffing) may have the potential to influence flavour perception rather than just retronasal olfaction (mouth to nasal cavity)
- The cravings induced by virtual food are comparable to those of real food
- Eating in the real and virtual world simultaneously is possible, but technically limited and restricted by food type

Keywords: virtual reality, flavour experience, multisensory

### **S13: Phenolic composition of unfermented cocoa beans processed to resemble fermented beans**

*Author: Noor Ariefandie Febrianto<sup>1,2</sup> and Fan Zhu<sup>1</sup>*

*Affiliation:*

<sup>1</sup>*School of Chemical Sciences, University of Auckland, Auckland New Zealand*

<sup>2</sup>*Indonesian Coffee and Cocoa Research Institute, Jember, East Java, Indonesia*

**ABSTRACT:**

Quality determination of fermented cocoa beans is important for the final chocolate quality. In industrial practice the quality of fermented beans is evaluated by a so-called cut test, the success of which is highly dependent on the colour perception of the analyst. The occurrence of purple and brown colours is one of the most

important variables in the cut test. A purple colour represents less fermented cocoa bean, whereas brown colour is associated with well fermented beans. However, the brown colour of cocoa beans can be obtained not only through fermentation. In this study, different treatments to produce fermented-like cocoa beans were conducted, using a single clone. These treatments were high temperature drying and prolonged storage of wet cocoa beans. The cocoa beans obtained were analysed for their phenolic composition because of its importance on the flavour and nutritional quality of cocoa beans. Phenolic compositions of the treatments was then compared to those of unfermented and conventionally fermented cocoa beans. Results showed that the phenolic composition of cocoa beans obtained from high temperature drying was similar to that of unfermented beans, characterized by their high concentration of phenolic compounds. However, beans treated by prolonged storage contained different polyphenol characteristics compared to unfermented and fermented cocoa beans. This study showed that quality determination of cocoa bean should not be based solely on the colour.

Keywords: cocoa bean, storage, drying, phenolic, fermented-like beans

#### **S14: Deodorisation of protein hydrolysate from hoki skin**

*Names of authors:* <sup>1</sup>Nur Sharim, <sup>2</sup>Sabrina Tian, <sup>1</sup>Richard Archer and <sup>1</sup>Marie Wong

*Affiliations:* <sup>1</sup>School of Food & Advanced Technology, Massey University; <sup>2</sup>Sanford Ltd., Auckland.

##### **ABSTRACT:**

The fishing industry is economically important to many countries including New Zealand. Most countries are increasingly interested in utilising fish wastes. Now that high quality industrial proteases are available, a favoured approach is the production of fish protein hydrolysates (FPH). Direct enzymatic hydrolysis is used to solubilise protein on bones or in skin yielding nutritionally valuable peptides. One common problem in hydrolysing fish wastes is the formation of off-odours. The aim of this research was to determine suitable methods to reduce or remove off-odour in hoki (*Macruronus novaezelandiae*) skin protein hydrolysate (HSPH) using selected deodorants. Key measures of off-odour are likely to be concentrations of total volatile base nitrogen and trimethylamine (TMA). These were used to assess efficacy of competing deodorisation treatments applied to HSPH. The flash profiling method for sensory analysis was used for quantitative and qualitative analysis. The results demonstrated that phenolic compounds in green tea can neutralise amines, thus reducing TMA concentration in HSPH. A positive correlation between the TMA concentration and sensory analysis suggests that TMA concentration is a potential marker to determine the off-odour profile of HSPH. This research provides a stepping stone towards the commercialization of hoki skin protein hydrolysate.

Keywords: hoki skin protein hydrolysate, deodorisation, off-odour control, trimethylamine, phenolic compounds

#### **S15: Milk sphingomyelin interactions with cholesterol in binary mixtures**

*Names of authors:* Patrick Tai, Harjinder Singh, David Everett

*Affiliations:* Massey University School of Food & Advanced Technology, Riddet Institute

##### **ABSTRACT:**

The consumption of milk fat globule membrane (MFGM) has been clinically shown to reduce blood cholesterol. This anticholesterolemic effect has been ascribed to sphingomyelin (SM) which makes up about 5% of the MFGM. Sphingomyelin complexes with cholesterol on the surface of the MFGM to produce a lipid raft.

However, there is a lack of evidence showing milk-SM binding to free cholesterol during digestion, and so impeding its absorption. Our preliminary study sought to confirm an interaction between milk-SM and cholesterol. Briefly, milk-SM and cholesterol were dissolved in chloroform:methanol (4:1 v/v). They were then added to water in specific molar ratios (100, 80 and 60% SM) of concentrations lower than the solvent's solubility limit in water. The mixtures were vortexed and held for 24 h before re-vortexing. The particle sizes of any structures that had self-assembled were examined 0, 20, and 40 min after the second vortexing using dynamic light scattering (Zetasizer) at 20 °C. Samples that contained cholesterol showed a bimodal particle size distribution indicating an agglomeration that was absent in the controls. This agglomeration was attributed to the condensing effect of cholesterol, thereby providing evidence of an interaction between milk-SM and cholesterol. Further work is planned to look into cholesterol's effect on the intermolecular hydrogen bonding of these mixtures using attenuated total reflectance-FTIR and Raman spectroscopy. These results may shed further light on the importance of the MFGM in human nutrition.

Keywords: milk fat globule membrane, sphingomyelin, cholesterol, digestion

### **S16: A multivariate approach to fingerprint the headspace volatile and lipid fractions for 11 types of legume seeds**

*Names of authors: Prit Khrisanapant<sup>1,2</sup>, Biniam Kebede<sup>1</sup>, Sze Ying Leong<sup>1,2</sup>, Indrawati Oey<sup>1,2</sup>*

*Affiliations:<sup>1</sup> Department of Food Science, University of Otago, Dunedin, New Zealand*

*<sup>2</sup> Riddet Institute, Palmerston North, New Zealand*

#### **ABSTRACT:**

Legume seeds are an economical and nutritious source of protein, carbohydrates, minerals, and unsaturated fatty acids. However, the presence of undesirable odours prevents their full utilization. The objective of this study was to characterize the volatile and fatty acid profiles of 11 types of legume seeds, and identify discriminant marker compounds associated with each legume. Soybean, orange lentil, chickpea, cowpea, pea, fava bean, green mung bean, and four cultivars of the common bean (navy, kidney, adzuki, and black bean) were purchased from the local market in Dunedin. The seeds were ground into flour, and volatile compounds were extracted using headspace solid-phase microextraction and analysed by gas chromatography mass spectrometry. Seed lipids were solvent-extracted, derivatised into fatty acid methyl esters, and analysed with gas chromatography flame ionisation detection. Data was integrated and processed using multivariate data analysis, and discriminant compounds identified using partial least square discriminant analysis (PLS-DA). Volatiles comprising aldehydes, alcohols, ketones, esters, aromatic hydrocarbons and terpenes were identified across the 11 types. The abundance and profile of volatiles of legumes varied depending on species, and more than 97% of seed lipids were comprised of palmitic, stearic, oleic, linoleic and  $\alpha$ -linolenic acids. Aldehydes, alcohols and terpenes were consistently identified as distinct markers for different legume species. According to PLS-DA, soybean was separated from the other legumes, and the four *Phaseolus* cultivars were grouped. The study also demonstrates that a multiplatform approach can identify correlations between fatty acids and volatiles.

Keywords: legumes, volatiles, fatty acids, characterization, multivariate data analysis

### **S17: Optimising processing of beef lung protein powder to provide a nutritious ingredient rich in proteins and minerals**

*Names of authors: S.Reshan Jayawardena<sup>1</sup>, James D. Morton<sup>1</sup>, Charles S. Brennan<sup>1</sup>, Zuhaib F. Bhat<sup>1</sup> and Alaa El-Din A. Bekhit<sup>2</sup>*

*Affiliations: <sup>1</sup>Department of Wine Food and Molecular Biosciences, Lincoln University, Lincoln 7647, Christchurch, New Zealand*

*<sup>2</sup>Department of Food Sciences, University of Otago, P.O. Box 56, Dunedin 9054, New Zealand*

#### **ABSTRACT:**

Beef lung is an underutilised coproduct of the meat industry that has enormous potential as a protein-supplement ingredient for cereal foods. The present study aimed to develop a dried beef lung powder (BLP) and to evaluate its nutritional value and protein digestion kinetics during in vitro gastrointestinal digestion. The BLP was included in fresh semolina pasta and its effects on the nutritional and quality characteristics of pasta were evaluated. Beef lungs were minced and dried in different time-temperature combinations: 50°C for 23 hours, 70°C for 10 hours and 100°C for 6 hours to prepare BLP. BLP had a protein content of 87% (dry weight basis), and its amino acid score was 1. The total amino acid profile of BLP did not change with drying temperature. However, a significant ( $P < 0.05$ ) decrease was observed in the release of free amino acids during in vitro digestion as drying temperature increasing ( $21.3 \pm 0.4$  mM at 50°C,  $11.1 \pm 0.5$  mM at 70°C and  $9.1 \pm 0.8$  mM at 100°C). In vitro protein digestibility marginally but significantly decreased with increasing temperature ( $96.4 \pm 0.1$  mg/mL,  $95.9 \pm 0.6$  mg/mL and  $95.6 \pm 0.4$  mg/mL at 50, 70 and 100°C, respectively). Release of minerals such as Cu, Fe, and S, was also affected by the drying temperature during in vitro gastrointestinal digestion. Because BLP contains 1 mg/g iron, 8 to 17 g of BLP can easily fulfil human dietary requirements for iron. Incorporation of 10% industrially dried BLP (60°C for 32 hours) improved the indispensable amino acid score (IAAS) of the pasta from 0.48 to 0.91.

Keywords: beef lung, in vitro digestion, indispensable amino acid score, mineral, protein

### **S18: Effect of high hydrostatic pressure on physicochemical properties and bioactive compounds of different sweet potato varieties**

*Names of authors: Rongbin Cui, Fan Zhu*

*Affiliation: School of Chemical Sciences, University of Auckland, New Zealand*

#### **ABSTRACT:**

High hydrostatic pressure (HHP) at 200 to 600 MPa affects physicochemical properties and bioactive compounds of sweet potato flour (SPF). Complete starch gelatinization occurred at 600 MPa in two SPF varieties (Purple Dawn and Red), while starch in another variety (Orange Sunset) only partially gelatinized at the same pressure. With increased pressure (up to 500 MPa), peak viscosity of SPF gels increased due to the inactivation of  $\alpha$ -amylase. After HHP at 600 MPa, the particle size of SPF flour was decreased significantly. Compared with native samples, HHP-treated samples showed higher in vitro starch digestibility in uncooked conditions, but lower digestibility in cooked conditions. HHP significantly improved the extractability of bioactive compounds from SPF due to cell wall disruption. Depending on the variety, HHP caused a 22 to 42% and 4 to 30% increase of total phenolic content and in vitro antioxidant activity, respectively, compared to native samples. The content of most of the hydroxycinnamic acid derivatives in SPF significantly increased as a result of the increased HHP. The contents of

anthocyanins were rather stable to HHP. The results showed that application of HHP in SPF may create novel functionalities and better retention of bioactive compounds that can be used in functional food formulation.

Keywords: non-thermal processing, *Ipomoea batatas*, thermal property, pasting property, phenolic compound

### **S19: Analysis of long chain polyunsaturated fatty acids in salted Chinook salmon (*Oncorhynchus tshawytscha*) fish roe during drying or fermentation processing**

*Names of authors: Senni Bunga<sup>1</sup>, John Birch<sup>1</sup>, Alan Carne<sup>2</sup> and Alaa El-Din Ahmed Bekhit<sup>1</sup>*

*Affiliations: <sup>1</sup>Department of Food science, University of Otago, Dunedin, New Zealand*

*<sup>2</sup>Department of Biochemistry, University of Otago, Dunedin, New Zealand*

#### **ABSTRACT:**

Fish roe is a low value by-product from fish processing, which contains significant omega 3 and omega 6 long chain polyunsaturated fatty acids (LC-PUFAs), e.g. eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), linoleic acid (LNA) and arachidonic acid (ARA). While fresh fish roe is not highly regarded by consumers, processed roe products are prized in countries such as Japan, Italy, Greece, Spain and several other Mediterranean countries. The aim was to evaluate the effects of salt-drying (SD) and fermentation (FERM) of Chinook salmon fish roe on the LC-PUFA composition. The SD and FERM of the salmon roes were carried out at 4°C and 20°C over 20 and 30 days, respectively. Samples (n = 3) were obtained at Day 0, 20, and 30 for the raw, SD, and FERM roe, respectively. Total lipids were extracted using the Bligh and Dyer method and LC-PUFAs were analysed using gas chromatography with flame ionization detection. Total lipid in unprocessed fresh roe was 10.3% and increased to 12.0 and 18.1% in FERM and SD roe samples, respectively. DHA was the major LC-PUFA both in processed and unprocessed roe lipids (ranging from 11 to 16%), followed by LNA (6 to 10%), EPA (4 to 5%), and ARA (2 to 4%). Other LC-PUFAs occurred at low levels (< 2%) and were C22:5n3, C18:2n6 trans, C18:3n6, C18:3n3, C20:2n6, and C20:3n6, except for FERM samples, for which the C20:3n6 content was > 2%. Salt-drying and fermentation offer alternative ways to safely increase the shelf life of fish roe and maybe retain or improve the nutritional (polyunsaturated) values of the fish roe.

Keywords: salmon roe, salt-drying, fermentation, long chain PUFAs

### **S20: The future of augmented reality in food**

*Names of authors: Simon Hoermann<sup>1,2</sup>, Clara Bah*

*Affiliations: <sup>1</sup>School of Product Design, <sup>2</sup>Human Interface Technology Lab NZ, University of Canterbury*

#### **ABSTRACT:**

Human-computer interaction research on food, or human-food interaction (HFI), has recently emerged as an area of significant interest. Associating the use of digital technologies to food and what is loosely referred to as 'food practices', for example production, growing, shopping, eating, cooking, and disposal, have become central topics. Augmented reality (AR) has been described as one of the top ten emerging technologies of 2018. AR is an interactive experience of a real-world environment where the objects that reside in the real-world are augmented by computer-generated perceptual information. Augmentation can occur across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory. Thus,

AR is used to enhance natural environments or situations, and to offer perceptually enriched experiences. Within the food industry, the future of AR is boundless as businesses realize the potential of AR and see it as a worthwhile investment. Three main areas, human resources training, customer experiences, and food products have seen the most concentration of AR development so far and will likely continue to push the development of AR uses within the industry. AR can add value by providing a meaningful and branded interaction, play an authentic role in communications, and be a gateway to a new reality of brand engagement. In this poster, we will discuss the ways in which AR is currently used, and how it can shape the future of food. Examples of how we are using AR with food in our laboratory will also be shown.

Keywords: augmented reality, digital technology, human–food interaction

### **S21: Effect of chronic heat stress on faecal microbiota and pig production**

*Names of authors: Yadnyavalkya Patil<sup>1</sup>, Dongliang Gong<sup>2</sup>, Ravi Gooneratne<sup>1</sup>, Jin Jun Chen<sup>2</sup> and Xianghong Ju<sup>2</sup>*

*Affiliations: <sup>1</sup>Department of Wine, Food & Molecular Biosciences, Lincoln University, New Zealand.*

*<sup>2</sup>Department of Veterinary Medicine, Guangdong Ocean University, Guangdong, China.*

#### **ABSTRACT:**

Heat stress has a marked effect on animal production. The intestinal microbiota and growth pattern of pigs exposed to chronic heat stress (CHS) were studied. Six pigs were subjected to temperatures of  $35 \pm 2^\circ\text{C}$  and 6 control pigs to ‘normal’ temperature of  $23 \pm 2^\circ\text{C}$  for 21 days. An increase in anal temperature (control:  $37.6^\circ\text{C}$  vs CHS:  $40.5^\circ\text{C}$ ,  $P < 0.001$ ) was evident in the CHS group on Day 2, and forehead temperature on Day 3 (control:  $36.7^\circ\text{C}$ , CHS:  $39.3^\circ\text{C}$ ,  $P < 0.001$ ). Body weight gains per week in the CHS group were 2.9, 1.2, and 0.35 kg on Days 7, 14, and 21, respectively, significantly lower than in the control group. Intestinal microbiota in fresh faeces collected on Days 1, 7, 14, 21 showed marked changes in the composition of major phyla in the microbiota of the CHS pigs. In CHS pigs, the major phylum, Gram-positive Firmicutes decreased whereas Gram-negative Bacteroidetes increased from Day 7 onwards. Other major potential pathogenic phyla such as Campylobacteriales, Megasphaera, Proteobacteria and Spirochaetes also increased in CHS pigs throughout the study. It appears that continued exposure to heat stress results in changes to intestinal microbiota from predominantly Gram-positive to a Gram-negative majority. In conclusion, heat stress increases pathogenic gastro-intestinal tract (GIT) bacterial strains, mostly Gram-negative types, potentially exposing pigs to sub-clinical infections, which at least may partly explain the decrease in pig weight gain.

Keywords: heat stress, GIT microbiota, immunity

### **S22: Lactoferrin from deer milk whey**

*Names of authors: Ye Wang<sup>1</sup>, Sue Mason<sup>1</sup>, James Morton<sup>1</sup>*

*Aladin Bekhit*

*Affiliations: <sup>1</sup>Lincoln University, <sup>2</sup>University of Otago, Dunedin, New Zealand*

#### **ABSTRACT:**

Lactoferrin, an iron binding glycoprotein of the transferrin family, exhibits strong antimicrobial activity. Little is known about the characteristics of milk lactoferrin from species other than cow. Deer milk has potential commercial value to the deer industry because New Zealand has a large population of farmed deer and mated

hinds. Understanding the benefits of deer milk and its components to human health can support our long term goal of establishing a deer milk industry in New Zealand. The objectives of this study were to: 1. Fractionate lactoferrin from deer milk, and 2. Sequence the amino acids of deer lactoferrin. Deer milk lactoferrin was fractionated by ion exchange chromatography. Isolated lactoferrin was analysed by SDS-PAGE for purity and by LC-MS for amino acid sequence. Lactoferrin was successfully fractionated from deer milk for the first time. The average concentration of lactoferrin in deer milk whey was  $0.40 \pm 0.10$  g/L. Deer lactoferrin had similar isoelectric point to that from cow. It is positively charged and binds to a cation exchange resin at pH 7. It has a similar molecular weight to cow lactoferrin, around 78 kDa. It contains 707 amino acids which is one less than cow lactoferrin. Deer lactoferrin is highly homologous with cow lactoferrin with only 7.91% difference. This difference indicates deer lactoferrin and the bioactive peptides encrypted in it might have different bioactivities compared to cow lactoferrin. Further analyses of antimicrobial activities of lactoferrin and its peptides are currently in progress. Keywords: lactoferrin fractionation, lactoferrin amino acids, deer milk

### **S23: Where is my fruit? – channel members' perceptions toward traceability in China**

*Names of authors: Ying Yi, Phil Bremer, Damien Mather and Miranda Miroso*

*Affiliation: University of Otago, Dunedin*

#### **ABSTRACT:**

Food traceability is an ongoing challenge for all food companies, as consumer expectations in a digitally connected world evolve and food safety accidents regularly make headlines around the world. A reliable and transparent traceability system builds trust with consumers while helping to prevent or minimize scandals. To establish a strong, reliable and transparent traceability system within a food industry, there is a need to understand the channel members' (suppliers, distributors, retailers, etc.) attitudes towards traceability, information sharing and transparency. This understanding is required because people are the key players in the operation of any traceability system, and their attitudes and behaviours influence the implementation and operation of any system. Twenty two channel members in China were interviewed to determine the main factors affecting the diffusion of transparency practices in terms of traceability into a fresh horticultural product supply chain, and to determine how they acted as barriers or enablers. To ensure the traceability system is well implemented in China, more training is required to support the importance of traceability. New Zealand companies exporting food to China need to provide training to all channel members and need to make a long term advantages of traceability clear to them.

Keywords: diffusion of innovation, traceability, transparency

### **S24: Does pulsed electric field have a role in sodium reduction strategy?**

*Names of authors: Zuhaib F. Bhat<sup>1</sup>, James D. Morton<sup>1</sup>, S. L. Mason<sup>1</sup>, Reshan Jayawardena<sup>1</sup> and Alaa El-Din A. Bekhit<sup>2</sup>*

*Affiliations: <sup>1</sup>Department of Wine Food and Molecular Biosciences, Lincoln University, New Zealand*

*<sup>2</sup>Department of Food Sciences, University of Otago, New Zealand*

#### **ABSTRACT:**

The present study was conducted to evaluate the possible role of pulsed electric field (PEF) in sodium reduction strategy for development of reduced-sodium meat products. Beef jerky was used as a model to study the effects of different levels of

sodium chloride, 2.0% (control), 1.2% ( $T_1$ ), and 1.2% along with PEF processing ( $T_2$ ; 10 kV, 20 Hz, 20  $\mu$ s, 0.52 kV/cm), on physicochemical properties, sensory, microbial and oxidative stability, and mineral profile. A significant lowering effect ( $P < 0.05$ ) of PEF was observed on shear force (N) and toughness (N/mm sec) without any adverse effects on colour, yield and oxidative stability of the products. PEF treated samples ( $T_2$ ) had significantly ( $P < 0.05$ ) lower sodium content compared to control (2.0%) and scored higher sensory scores than  $T_1$  (1.2%) samples during sensory analysis. PEF has a sodium reduction potential and can have a positive impact in public health by implementing it as a sodium reduction strategy.  
Keywords: pulsed electric field, sodium reduction, microbial and oxidative stability, colour and sensory analysis, mineral profile

## **S25: New anti-counterfeit scheme for New Zealand food products**

*Names of authors: Caixia Ivy Gan, Jack Long*

*Affiliation: School of Business, University of Auckland, Auckland*

### **ABSTRACT:**

In respect of product authenticity, consumers ascribe some level of responsibility to authentic manufacturers to maintain or improve their anti-counterfeit measures, so that consumers can have confidence in the genuineness of purchased items. Many food products bear simple barcodes on packaging as a measure of anti-counterfeit protection, even though barcodes can be easily decrypted and simulated. This poster describes a new anti-counterfeit scheme to protect and increase product exports by suppressing counterfeit production and sales. The proposed scheme applies an advanced QR code system to provide consumers with accurate information regarding the genuineness of purchased products, and which cannot be easily simulated or copied by counterfeiters. Applying this QR code system to product packaging can significantly increase the cost of counterfeit products. Thus, the authentic manufacturers can be better protected. Further, this anti-counterfeit system could help food brands to gain more consumer trust because genuineness would be much more likely. In turn, authentic manufacturers could gain competitive advantage and so achieve better market performance. This anti-counterfeit scheme would be particularly useful for New Zealand food products, such as milk powder and honey, which are aimed at overseas markets like China, where counterfeit food products are a major consumer concern.

Keywords: anti-counterfeit scheme, QR code system, genuineness, trust

## **S26:**

### **Membrane-bound protease from two strains of *Bacillus licheniformis* obtained from a gelatine production system: extraction and application in feather degradation**

*Names of authors: Neysa Wendy Setyadi, Thirawat Tantamacharik, Alaa El-Din Bekhit*

*Affiliation: Department of Food Science, University of Otago, Dunedin, New Zealand*

### **ABSTRACT:**

A large amount of feather waste is generated by the international poultry industry and can pose negative impacts on the environment if not disposed of properly. Feather is a protein-rich material that contains up to 90% keratin. The recalcitrant structural properties of keratin make it resistant to breakdown by many proteases and chemical processes. In this study, two strains of *Bacillus licheniformis* (CP7 and D1) were obtained from a gelatine production system and were examined for their ability to produce feather-degrading proteases. These two isolates have previously

been shown to utilize feather as their sole carbon and nitrogen source for growth. The two strains were cultured in feather growth medium (2% sucrose, 1% feather, 5% NaCl, 70 mM K<sub>2</sub>HPO<sub>4</sub>) and incubated for 24 h at 50°C, 200 rpm, at pH 7.5 for isolate CP7 and at pH 9.5 for isolate D1. The extracellular proteases were obtained in supernatants after centrifugation at 10,000 gravities for 15 min at 4°C, while the cell pellets were treated with high speed homogenization, sonication and a lysis buffer to extract the membrane-bound proteases. The characteristics of extracted proteases were evaluated with a keratinase assay. Their ability to degrade feather was investigated by incubating the proteases in 50 mM Tris-HCl (pH 8.0) containing intact chicken feather. Both extracellular and membrane-bound proteases are capable of hydrolysing feather but exhibiting different optimal temperatures and pH. Further work is currently optimizing the yield of these proteases and investigating their ability to generate bioactive compounds from feather.

Keywords: membrane-bound proteases, *Bacillus licheniformis*, feather degradation

### **S27: Interactions between oat bran and phenolic compounds from blueberry and blackcurrant**

*Name of author: Xiaodan Hui*

*Affiliation: Lincoln University, Lincoln, New Zealand*

#### **ABSTRACT:**

A diet with high glycaemic index can lead to an increased risk of type 2 diabetes. Studies have shown that bioactive compounds such as polyphenols have strong antioxidant and certain hypoglycaemic properties. Increasing the intake of bioactive components may be an effective way to stabilize the blood glucose. Blackcurrant and blueberry are rich sources of polyphenols. Prior studies have been with pure components but may not reflect a realistic situation because functionality of foods is highly influenced by the interactions between food components. A simple oat paste product was developed and used to investigate the effect of the interactions between oat bran and phenolic compounds on viscosity and physicochemical characteristics, as well as their antioxidant activities. Also compared was how additional and replacement levels (10, 15 and 25%) of berry phenolic compounds affected the predictive glycaemic values of such products. Increasing replacement with a 10 and 15% proportion of blackcurrant and blueberry in oat pastes resulted in a decrease in glucose release after in vitro digestion ( $P < 0.05$ ), while the additional proportion and replacement to 25% increased glucose release compared to the control. Incorporation of blackcurrant and blueberry in oat pastes increased the antioxidant capacity significantly ( $P < 0.01$ ). Oat pastes with specific proportions of berry pastes have the potential to reduce the glycaemic index of such pastes.

Keywords: blackcurrant, blueberry, glycaemic glucose equivalent, phenolic content, antioxidant

## RESEARCH POSTER ABSTRACTS

### **P1: Developing palatability in pet food made from untanned leather waste**

*Names of authors: Bizhu Li<sup>1,2</sup>, David Thomas<sup>1</sup>, Rafea Naffa<sup>2</sup>, Mark Waterland<sup>1</sup>*

*Affiliations:*

<sup>1</sup>*Massey University, Palmerston North, New Zealand*

<sup>2</sup>*NZ Leather & Shoe Research Association, Palmerston North, New Zealand*

#### **ABSTRACT:**

The market demand for pet food for domestic cats is increasing globally. However, more fundamental research is still required to optimise the flavour of products. Palatability is vital for the cat food industry as a measure that indicates acceptance or preference of one food over another. There has been limited investigation of bovine or ovine by-product sources for cat food. This study seeks to utilise the untanned leather waste stream to obtain palatable additives. Unprocessed waste from the hide and skin industry, which is normally discarded, is rich in protein. The dominant protein in hide and skin waste is collagen, but native collagen is difficult for cats to digest due to its stable triple helix structure. In this work, through optimised acidic or enzymatic hydrolysis, collagen has been hydrolysed into smaller peptides. The isolated collagen peptides were analysed using several analytical techniques, such as amino acid analysis, SDS-PAGE, HPLC, gel filtration chromatography, IR, MS and NMR. The palatability of selected peptides will be assessed by in vivo studies with real-time monitoring using panels of cats. Other proteins in hide and skin waste, such as keratin, will be the focus in the future work. This program is intended to generate positive environmental and economic benefits. Keywords: palatability, pet food, hydrolysis, collagen peptides, leather waste

### **P2: Physicochemical properties of New Zealand chestnut flour from different processing methods**

*S. M. C. S. Samarakoon<sup>1</sup>, P. Jeongyunb<sup>2</sup>, B. Olayo<sup>3</sup>, D. Klinac<sup>4</sup>*

<sup>1</sup>*Waikato Institute of Technology, Hamilton, New Zealand*

<sup>2</sup>*Kyngpook National University, Daegu, South Korea*

<sup>3</sup>*FF instrumentation Ltd, Christchurch, New Zealand*

<sup>4</sup>*New Zealand Chestnut Council, Hamilton, New Zealand*

#### **ABSTRACT**

Chestnuts are a relatively new nut crop to New Zealand, growing well in local conditions. Physicochemical properties of chestnut flours obtained through dry milling (DC), wet milling (WC) and freeze drying (FC) methods were investigated to understand their potential in food industries. All chestnut flours showed significantly higher solubility ( $S > 38\%$  at  $70^{\circ}\text{C}$ ) and swelling power ( $SP > 64\%$  at  $70^{\circ}\text{C}$ ), lower moisture content ( $MC < 4\%$ ), and higher stability against heat and mechanical treatment than wheat flour ( $S = 9.5\%$ ,  $SP = 43.2\%$ ,  $MC = 11.1\%$ ) and corn flour ( $4.4\%$ ,  $38.4\%$ ,  $14.1\%$ ). All chestnut flour samples showed slightly higher pH values (DC and WC = 6.3; FC = 6.4) compared to wheat (6.0) and corn (5.9) flours. DC showed highest syneresis at Day 4 ( $90.1 \pm 0.4\%$ ) followed by WC ( $86.0 \pm 0.6\%$ ), wheat flour ( $85.5 \pm 0.2\%$ ), and corn flour ( $83.0 \pm 1.5\%$ ), while FC showed the lowest syneresis at  $81.7 \pm 0.3\%$ . WC had highest bulk density ( $0.921 \text{ g/mL}$ ), and FC had lowest ( $0.799 \text{ g/mL}$ ). Paste clarity was  $< 1\%$  of light transmittance at  $650 \text{ nm}$  for all

flour types. Chestnut starch granules were oval shaped. FC granules were smallest (<2.5  $\mu\text{m}$ ) and DC and WC granules were between 5.0 and 7.5  $\mu\text{m}$ . All chestnut flours exhibited apparent shear thinning behaviour. DC had the lowest viscosity (peak = 811 cP, final = 1,015 cP) and FC had the highest viscosity (peak = 3,263 cP, final = 1,587 cP). The results of this study support the potential utility of New Zealand chestnut flour as a thickening substitute to corn flour.

Keywords: physicochemical properties, chestnut flour

### **P3: Physicochemical properties of dodecenyl succinic anhydride (DDSA)-modified quinoa starch**

*Names of authors: Guantian Li, Fan Zhu*

*Affiliation: The University of Auckland*

#### **ABSTRACT:**

Quinoa (*Chenopodium quinoa* Willd.) has become popular due to its attractive nutritional properties. Starch is the major component of quinoa seed. Quinoa starch has a small granule size ( $\sim 1.5 \mu\text{m}$ ) and low amylose content ( $\sim 10\%$ ). Quinoa starch granules were esterified with dodecenyl succinic anhydride (DDSA) to various degrees of substitution (DS) (0.0023 to 0.0095). Physicochemical properties and emulsification capacity of the modified starch were studied for Pickering emulsion formation. Increasing DS increased the particle size, water solubility, and swelling power, while decreasing the gelatinization enthalpy change and relative crystallinity of the starch. The DDSA groups are proposed to be mostly located in the amorphous region of starch granules. Rheological analysis showed that viscosity and storage modulus ( $G'$ ) of starch first increased before decreasing with increasing DS. The DDSA-modified quinoa starch efficiently stabilized oil-in-water Pickering emulsions. Increased DS led to a decreased droplet size of the emulsions and to higher emulsion stability over 10 days storage. This study suggested a potential application of DDSA-modified quinoa starch as a stabilizing emulsifier in Pickering emulsions.

Keywords: Pickering emulsion, starch rheology, chemical modification, *Chenopodium quinoa*, starch gelatinization

### **P4: Exposure to PCBs can cause intestinal abnormalities**

*Authors: Jinjun Chen<sup>2</sup>, Fanghong Nie<sup>1</sup>, Yunpeng Yu<sup>2</sup>, Hongying Lin<sup>2</sup>, Danju Kang<sup>2</sup>, Xianghong Ju<sup>2</sup>, Fan Yang<sup>2</sup>, Kwame Ayisi Lartey<sup>2</sup>, Aftab Qamar<sup>2</sup>, Junling Yang<sup>2</sup>, Zhijun Lu<sup>2</sup>, Hwa-Chain Wang<sup>3</sup>, Ravi Gooneratne<sup>4</sup>,*

*Affiliations: <sup>1</sup> Department of Food Safety, Guangdong Ocean University, Zhanjiang, China*

*<sup>2</sup>Department of Veterinary Medicine, Guangdong Ocean University, Zhanjiang, China*

*<sup>3</sup>College of Veterinary Medicine, University of Tennessee, Knoxville, USA,*

*<sup>4</sup>Faculty of Agriculture and Life Sciences, Lincoln University, New Zealand.*

#### **ABSTRACT:**

Polychlorinated biphenyls (PCBs) released into the environment enter aquatic sediments, bioaccumulate in fish and enter the food chain. Histology, microbiology and immunology of zebrafish (*Danio rerio*) intestine were used as biomarkers to indirectly detect marine sediment PCBs. PCBs extracted from offshore Zhanjiang (China) sediment, were purified and measured using gas chromatograph-mass spectrometry. Sediment PCB concentrations ranged from 27 to 35  $\mu\text{g}/\text{kg}$ . Zebrafish were exposed to four doses (0, 5, 10, 15  $\mu\text{g}/\text{L}$ ) of PCB extracts and 1 dose (10  $\mu\text{g}/\text{L}$ ) of PCB 81, and sacrificed at 1, 3, 5, and 7 days after exposure. Gut

histopathology, high-throughput sequencing analysis of gut microbiota and expression of zebrafish intestinal mucosal immune cytokines, TNF- $\alpha$  (tumor-necrosis-factor- $\alpha$ ), IL-1 $\beta$  (interleukin-1 $\beta$ ) and chemokine IL-8 (interleukin-8) mRNA were monitored. PCBs induced dose-responsive degeneration, necrosis and intestinal epithelial cell detachment. The dominant intestinal microflora phyla in zebrafish were Proteobacteria, Fusobacteria, Firmicutes, Bacteroidetes. Exposure to PCBs decreased abundance of Proteobacteria but significantly ( $P < 0.05$ ) increased Fusobacteria on Days 5 > 7 > 3 > 1. The dominant intestinal genera were Cetobacterium, Aeromonas, Vibrio, and Gemmobacter. On exposure to PCBs, the abundance of Cetobacterium increased on Days 3 and 5 but declined on Day 7. This indicates that at the phylum or genus level, the abundance of dominant microflora is affected by the length of exposure rather than the dose. PCBs increased ( $P < 0.05$ ) the relative expression of TNF- $\alpha$  mRNA, IL-1 $\beta$ , and IL-8 in a dose responsive manner, indicative of intestinal inflammatory response. Thus, consumption of PCB contaminated foods can lead to multiple damage to the intestines.  
Keywords: PCB, zebrafish, intestine, microflora, immunity

### **P5: Consumer sensory perception of fermented dairy products: insights from focus groups in China**

*Names of authors: Julia Low<sup>1,2</sup>, Jing Feng<sup>1,2</sup>, Catriona Hay<sup>1,2</sup>, Li Day<sup>3</sup>, Di Lu<sup>3</sup>, Joanne Hort<sup>1,2</sup>*

*Affiliations:*

<sup>1</sup>*Riddet Institute, Massey University, Palmerston North, New Zealand*

<sup>2</sup>*MIFST, Massey University, Palmerston North, New Zealand*

<sup>3</sup>*AgResearch, Palmerston North, New Zealand*

#### **ABSTRACT:**

Consumer demand for low temperature and ambient (room temperature) yogurt or fermented milk drinks has increased in China, but the sensory factors that influence their choice and consumption are unknown. The aim of this study was to understand consumer sensory preference of drinkable fermented milk products among Chinese consumers in China. Three consumer focus group interviews involving 30 articulate and regular consumers of drinkable fermented milk products (17 males and 13 females, aged 21 to 40 years; n = 10 in each session) were conducted in Beijing, China. Focus group sessions each lasted around two hours and were video recorded using an overhead camera in a focus group facility room fitted with a one-way mirror. During the sessions, participants first assessed the sensory characteristics (flavour, texture, after-taste) of three naturally flavoured Chinese commercial drinkable fermented milk products, two low temperature and one ambient product. These were served blinded at chill temperature, and were followed by three strawberry flavoured products. An experienced moderator conducted the discussion using a defined discussion guide, with three main themes – sensory properties, importance of provenance, and safety – using imagery associations, third-party projections, and role playing techniques. The study revealed interesting results concerning the link between sensory attribute preferences and provenance perception among urban Chinese consumers of fermented milk drinks. This approach and findings will help New Zealand dairy companies to formulate drinkable fermented milk products for export markets with different sensory drivers and cultural expectations to their own.

Keywords: cross cultural studies, Chinese consumers, consumer and sensory perception, dairy

## **P6: Bioavailability of iron from spray dried whey protein concentrate-iron (WPC-Fe) complex in iron-deficient rats**

*Names of authors:- Kamal Gandhi<sup>1</sup>, Rajan Sharma<sup>1</sup>, Bimlesh Manne<sup>1</sup> and Vanita Pandey<sup>2</sup>*

*Affiliations: <sup>1</sup>Dairy Chemistry Division, National Dairy Research Institute, P.O. Box 132001, Karnal, India*

*<sup>2</sup>Quality and Basic Sciences, Indian Institute of Wheat and Barley Research, P.O. Box 132001, Karnal, India*

### **ABSTRACT**

Whey is the by-product of the cheese industry and is mostly disposed of as waste, causing environmental pollution. Whey proteins have ability to bind significant amount of iron and hence can reduce chemical reactivity of iron and incompatibility with other components in foods. In the present study, iron was complexed with WPC to make it compatible for its addition to foods. After complex formation, centrifugation and ultrafiltration (UF) techniques were employed to remove the insoluble and free iron from the solution. Spray drying technology was also employed to facilitate the availability of whey protein concentrate-iron (WPC-Fe) complex in the powder form for fortification in different food products.

Bioavailability of iron from spray dried whey protein concentrate-iron (WPC-Fe) complex in weaning and anaemic rats was assessed. A significant ( $p < 0.05$ ) increase in haemoglobin level, % apparent digestibility coefficient and % retention/intake on 7th and 28th days was observed in weaning and anaemic rats. Additionally, WPC-Fe supplementation reduced nitric oxide (NO) production, serum triglycerides, total cholesterol, Low-density lipoprotein (LDL), Very-low-density lipoprotein (VLDL) and atherogenic index but enhanced high-density lipoproteins (HDL). Simultaneously, it also decreased the superoxide level and lipid peroxidation while increased the iron related antioxidative superoxide dismutase (SOD) and catalase enzyme activity. The iron delivery/transport molecules like liver ferritin and transferrin synthesis and the serum level were enhanced. Thus, WPC-Fe complex could be a better and innovative organic iron fortificant with enhanced bioavailability of iron.

Keywords: whey protein concentrate, iron, anaemia, bioavailability, haemoglobin

## **P7: Starch as edible nanoencapsulation vehicle for delivery of rutin**

*Names of authors: Mejo Remanan, Fan Zhu*

*Affiliation: School of Chemical Sciences, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand.*

### **ABSTRACT:**

Polyphenols in the native form or their metabolites exert beneficial effects in health maintenance and disease risk reduction. But their efficacies are limited due to poor water solubility and bioavailability. Bioefficacy of polyphenols can be enhanced using food grade nanoencapsulation vehicles. This study was conducted to determine rutin encapsulation using starch nanoparticles (NP). Quinoa and maize starch NPs were selected to encapsulate rutin by an ultrasonication method. The encapsulation efficiency (EE), zeta potential (ZP), polydispersity index, particle size and objective colour were determined. Thermal and structural characterization was studied by differential scanning calorimetry and Fourier transform infrared spectroscopy, respectively. The release behaviour and antioxidant properties were studied under simulated gastrointestinal conditions. The average particle size, EE and ZP of quinoa and maize NP were 107 and 222 nm, 68 and 66 %, and -18 and -18.5 mV respectively. Structural and thermal studies revealed effective rutin encapsulation into starch NP. In vitro studies revealed sustained rutin release from

NP and better retention of antioxidant properties in NP made with quinoa starch. Sonication is an effective, economic and environmentally friendly method for encapsulating rutin in starch NPs. Further studies are required to explore the interactions between rutin and gut microbiota and in vivo studies should be conducted as a guideline to the optimal design of rutin fortified functional foods. Keywords: starch, nanoencapsulation, rutin, ultrasonication

### **P8: Preparation of curcumin-loaded emulsion using milk fat globule membrane material as emulsifier**

*Names of authors: Taciana Lunelli, Aiqian Ye, Manohar Garg, Harjinder Singh*

*Affiliation: Riddet Institute, Massey University, Palmerston North*

#### **ABSTRACT:**

The use of natural products in the prevention and treatment of diseases has been suggested by the scientific community, especially because of their minimal side effects and health promoting properties. Among these, compounds as coconut oil and curcumin have been recognized for their ability to promote anti-inflammatory and antioxidant properties. In this context, the main aim of this research was to design food formulations that contain natural bioactive compounds, such as curcumin and medium chain fatty acids. Curcumin has been recognized for its health promoting properties, however, its application is limited by poor water solubility and bioavailability. To overcome this problem, we encapsulated curcumin in coconut oil droplets (source of medium chain fatty acids) in emulsions prepared by high pressure homogenization with milk fat globule membrane (MFGM)-derived materials: phospholipid concentrate (PLC1) and beta serum powder (BSP2). The encapsulation efficiency was 95.8% for PLC1 and 96.3% for BSP2. In vitro release kinetics of curcumin from emulsions by simulated gastrointestinal analysis showed that the emulsion system was relatively resistant to pepsin digestion, but pancreatin caused curcumin release. The bioaccessibility of curcumin was 56% for PLC1 and 50% for BSP2. Thus, the results suggest that MFGM-derived materials are effective in the preparation of stable emulsion over time and they improve curcumin bioaccessibility compared to free curcumin. These results are promising for future development of a functional food for prevention or treatment of diseases, such as Alzheimers.

Keywords: curcumin, delivery system, milk fat globule membrane, functional food

### **P9: Optimal non-phytate phosphorous level for maximal broiler (Huaixiang) bone strength and growth**

*Names of authors: Wang Runlian,<sup>1,2</sup> Jingwen Chen<sup>1</sup>, Cuiping Liang<sup>2</sup>, Tianyi Liu<sup>2</sup>, Ravi Gooneratne<sup>3</sup>*

*Affiliations: <sup>1</sup>Shenzhen Institute of Guangdong Ocean University, Shenzhen, China*

*<sup>2</sup>Department of Animal Science, Guangdong Ocean University, Zhanjiang, China*

*<sup>3</sup>Department of Wine, Food & Molecular Biosciences, Lincoln University, Lincoln, New Zealand*

#### **ABSTRACT:**

Influence of dietary non-phytate phosphorous (NPP) on growth performance, bone characteristics and serum calcium (Ca) and phosphorous (P) concentrations were investigated to determine the NPP requirement of Huaixiang broilers aged from 1 to 28 days. A total of 300, 1-day-old broilers were assigned to 1 of 5 treatments with 6 cage replicates of 10 birds each using a completely randomized design, and fed a corn-soybean meal-based diet (1% Ca) containing either 0.32, 0.39, 0.46, 0.53 or 0.60% NPP for 28 days. The daily weight gain and feed efficiency significantly

improved ( $P < 0.05$ ) in a dose-responsive manner as the dietary NPP increased where the best-fit models were fitted broken line ( $R^2 = 85\%$ ) and quadratic regression ( $R^2 = 90\%$ ). The dietary NPP significantly increased ( $P < 0.05$ ) tibia bone strength, tibia ash content, tibia Ca concentration, toe dry weight, toe Ca and P concentrations, where the best-fit models were quadratic regression ( $R^2 = 89\%$ ), fitted quadratic broken line ( $R^2 = 90\%$ ), broken line ( $R^2 = 90\%$ ), quadratic regression ( $R^2 = 80\%$ ), and the same broken lines ( $R^2 = 69\%$ ,  $R^2 = 69\%$ ) respectively. The serum P concentration also showed a best-fit broken-line ( $R^2 = 96\%$ ) effect as the dietary NPP increased. Thus, all the above parameters were sensitive indicators for estimating broilers NPP requirement. Based on this study, a statistically derived recommended NPP level for maximal weight gain, bone strength and feed efficiency of Huaixiang broilers fed a corn-soybean meal-based diet from 1 to 28 days was 0.47%.

Key words: broiler, non-phytate phosphorous, growth, bone quality, serum

### **P10: Heat stress activates TLR4/NF- $\kappa$ B signalling leading to inflammatory bowel disease in pigs**

*Names of authors: Canying Hua<sup>1,4</sup>, Yanhong Yong<sup>2</sup>, Patil Yadnyavalkya<sup>3</sup>, Junyu Li<sup>2</sup>, Tianyue Yu<sup>1</sup>, Lianyun Wu<sup>1</sup>, Ravi Gooneratne<sup>3</sup>, Xianghong Ju<sup>2,4</sup>*

*Affiliations:*

<sup>1</sup> *Department of Animal Science, Guangdong Ocean University, Zhanjiang, China*

<sup>2</sup> *Department of Veterinary Medicine, Guangdong Ocean University, Zhanjiang, China*

<sup>3</sup> *Department of Wine, Food and Molecular Biosciences, Lincoln University, Lincoln, New Zealand*

<sup>4</sup> *Shenzhen Institute of Guangdong Ocean University, Shenzhen, China*

#### **ABSTRACT:**

Heat stress (HS) can induce intestinal mucosal damage and inflammation, impact growth and affect the quality of pork. Understanding the mechanism of HS-induced intestinal inflammation is important for the control of pork quality. We hypothesised that the TLR4/NF- $\kappa$ B signalling pathway plays a role in HS-induced intestinal inflammation in pigs. Forty eight pigs (24 each of control and HS treatments) weighing  $15 \pm 2$  kg were used in the study. The control animals were exposed to 21°C and 75 to 85% relative humidity. The HS animals were subjected to heat stress at a higher temperature (34°C) at a similar humidity. The pigs were sacrificed on Days 1, 7, 14, and 21 to collect faeces and colon tissues for microbiome and genomics analysis. Western blot was used to investigate the expression of key proteins in the TLR4/NF- $\kappa$ B signalling pathway. Faecal bacteria were transplanted into mice to explore the role of faeces bacterial in activation of the pathway. On Days 7 and 14, fever and diarrhoea developed in HS pigs. The expression of key proteins (TLR4, p65) in the signalling pathway and relative levels of cellular inflammatory factors (IL6, IL8, IL17) were upregulated. Mice transplanted with Day 7, 14 HS pig faeces showed significant intestinal microbiota changes and activated the TLR4/NF- $\kappa$ B pathway and expression of TLR4 compared with the control group. Intestinal flora activates the TLR4 signalling pathway and promotes bowel inflammation in heat stressed pigs.

Keywords: heat stress, TLR4/NF- $\kappa$ B signalling pathway, inflammatory bowel disease, microbiota

### **P11: Effect of blanching and fortifying potatoes with vitamin E, vitamin C and calcium on in vitro starch digestibility**

*Names of authors: Duarte, Yudy<sup>1</sup>; Vega, Oscar<sup>1,2</sup>; López-Barón, Nataly<sup>3</sup>; Singh, Jaspreet<sup>4</sup>*

*Affiliations: <sup>1</sup>BIOALI Research Group, Department of Food, Faculty of Pharmaceutical and Food Sciences, Universidad de Antioquia, Medellín, Colombia*

*<sup>2</sup> Faculty of Engineering, Corporación Universitaria Americana, Medellín, Colombia*

*<sup>3</sup> University of Alberta, Edmonton, Alberta, Canada*

*<sup>4</sup> Riddet Institute and School of Food Advanced Technology, Massey University, Palmerston North, New Zealand*

#### **ABSTRACT:**

Potato is a promising food for the development of innovative food products with health benefits, due to its high worldwide consumption. Starch is the major component in potatoes amounting to approximately 15 to 20% of fresh weight. Native potato starch is resistant towards enzymatic digestion, but thermal processing dramatically increases its susceptibility to amylase hydrolysis. The aim of this study was to evaluate in vitro small-intestinal starch digestibility and estimated glycaemic index (eGI) of potatoes blanched, then fortified with vitamin E, vitamin C and calcium. Potatoes were cut, blanched, fortified using a vacuum impregnation technique, and then microwave vacuum dried to a 7% moisture content. The starch hydrolysis of fortified potato was significantly lower than that of unfortified (control) potato during in vitro digestion. Approximately 42 and 63% of the starch was hydrolysed within the first 10 minutes of small intestinal digestion for the fortified and control treatments, respectively. At the end of digestion (120 min), fortified potatoes showed only 74% hydrolysis compared to the control (95%). The eGI for fortified and control potato was calculated at 73 and 85 respectively. The addition of fortifying agents has thus been observed to delay as well as decrease the extent of the starch hydrolysis during in vitro digestion. The information gathered through this investigation may help the food industry to develop of potato based food products with low glycaemic features.

Keywords: fortified potato, in vitro starch digestion, estimated glycaemic index

### **P12: Radioactivity in New Zealand shellfish: contribution of the naturally occurring radionuclide polonium-210**

*Names of authors: Sarah Guy<sup>1</sup>, Sally Gaw<sup>1</sup>, Andrew Pearson<sup>2</sup>, Oksana Golovko<sup>3</sup>*

*Affiliations:*

*<sup>1</sup> University of Canterbury, Christchurch, New Zealand*

*<sup>2</sup> Ministry for Primary Industries, Wellington, New Zealand*

*<sup>3</sup> Institute of Environmental Science & Research, Christchurch, New Zealand*

#### **ABSTRACT:**

Exposure of the New Zealand population to radionuclides from ingestion, originates mostly from naturally occurring radionuclides, with an appreciable contribution from polonium-210 through shellfish. Polonium-210 is a radionuclide from the decay chain of uranium-238 with a half-life of 138.4 days. Naturally occurring processes and human activities can lead to the presence of polonium-210 in the marine environment and consequently in seafood. Concentrations of polonium-210 in New Zealand shellfish were determined for 14 locations around the New Zealand coast from February 2018 to March 2019. Results ranged between 5 and 324 Bq kg<sup>-1</sup>. Significant spatial variability was observed with enhanced polonium-210 activity concentration in two sampling sites located on the west coast of the Northland region. Dose assessment showed that individuals who consume large quantities of

shellfish (10 g per day or more) taken from areas with enhanced polonium-210 would be exposed to an annual committed effective dose from polonium-210 higher than the recommended dose above background levels. An accompanying diet survey collecting information on quantity, seasonal variation and type of shellfish consumed in Northland is being undertaken to obtain accurate shellfish consumption values. This will enable evaluation of the population's exposure to ionising radiation from polonium-210 through diet. Typical levels of polonium-210 in shellfish, results from the polonium-210 variability study, dietary estimates, and design of the diet study will be presented.

Keywords: polonium-210, shellfish, ionising radiation, diet

### **P13: The effects of fungal lipase-treated milk lipids on bread making**

*Names of authors: Zhiguang Huang, Charles Brennan*

*Affiliations: Department of Wine, Food and Molecular Biosciences, Lincoln University, Lincoln, New Zealand*

#### **ABSTRACT:**

Milk lipids have been frequently used as functional ingredients in bread making. However, incorporation of enzymatically-treated milk lipids into bread recipes and their effects on bread properties has not been explored. This study ascertained the impact of lipase-treated milk lipids on bread quality in comparison with untreated bread controls. Dough was strengthened as a result of lipase treatment and loaf volume was also improved. In vitro digestion revealed that the glycaemic load of lipase-treated breads was significantly lower than that of control bread ( $p < 0.05$ ). In addition, lipase treatment reduced crumb water activity and delayed spoilage by moulds. The study provides a novel and practical method to improve bread functionalities and modulate product glycaemic response, without detrimental effects on the quality (e.g. crust colour) of final products.

Keywords: rheological characteristics, texture profile analysis, glycaemic response, complexing index, anti-staling