21st IUFoST World Congress of Food Science & Technology Full Programme

30 Oct 2022

08:30 | GMT+8
08:30 – 15:30 GMT+8

Room: BR 1

Pre-Congress Workshop 1 - Food Safety Validation and Verification: Key Requirements for Global Food Safety

Recent developments in Global Food Safety regulations indicate clear trend in prevention-based food safety assurance, controlling supply chain from "farm to fork" and emphasis on risk-based hazard analysis and validated strategies for their mitigation. Thus, Current Food Safety regulations are increasingly focused on prevention and preventive controls and rely on validated processes, supply chain and harmonized analytical procedures. The workshop will highlight emerging regulatory trends and legislative developments globally that are likely to impact the preventive controls, approaches to validating preservation processes, including novel and non-thermal processing and preservation techniques, as well as the methods used for the analyses. Similarly, once validation is completed, a food manufacturer needs to establish verification procedures to ensure the implemented processes are carried out effectively and consistently; and to confirm that the process is doing what is intended and is effective as well as the activities are properly documented.

The workshop will be conducted using a series of interactive lectures, including the use of industry experience and case studies. There will be ample opportunity for group interaction and discussion via small group activities. The workshop will address key topics such as global regulatory trends that are likely to impact preventive controls, basic concepts of validation and verification, validation of thermal and non-thermal processes, laboratory methods validation for microbiological methods, verification procedures and tools and industry experience on validation using case studies.

Programme:

Time	Presentation Topics
08:30 – 09:00	**Registration**
09:00 – 09:15	**Welcome and Opening Remarks** Alvin Lee, Institute for Food Safety and Health, Chicago, USA
09:15 – 09:45	**Trends and regulatory requirements for validation** Purnendu Vasavada, University of Wisconsin – River Falls, USA
09:45 – 10:30	**Risk and hazards assessment approaches for the modern world** Benjamin Smith, Singapore Future Ready Food Safety Hub & A*STAR Innovations in Food & Chemical Safety Programme

Time	Presentation Topics
10:30 – 10:45	**Morning Tea Break**
10:45 – 11:30	**Microbiology 101 in Validation** Purnendu Vasavada, University of Wisconsin – River Falls, USA
11:30 – 12:00	**Emerging and Re-emerging Hazards** Li Dan, National University of Singapore
12:00 – 12:30	**Lunch**
12:30 – 13:00	**Validation and verification in food safety: Fundamental concepts** Alvin Lee, Institute for Food Safety and Health, Chicago, USA
13:00 – 13:30	**Value of challenge studies and role of surrogates and challenge organisms** Alvin Lee, Institute for Food Safety and Health, Chicago, USA
13:30 – 14:00	**Validation of microbiological methods** Priti Amritkar, Envirocare Labs Pvt. Ltd., India
14:00 – 14:30	**Record keeping and what should I include in a validation report** Alvin Lee, Institute for Food Safety and Health, Chicago, USA Larry Keener, International Product Safety Consultants, USA Purnendu Vasavada, University of Wisconsin – River Falls, USA
14:30 – 15:15	**Non-thermal and novel processes validation and verification (Industry practices)** Larry Keener, International Product Safety Consultants, USA
15:15 – 15:30	**Panel Discussion & Closing Remarks**

08:30 | GMT+8
08:30 – 12:30 GMT+8

Room: BR 3 – BR4
Pre-Congress Workshop 2 - Food Process Engineering

Come to learn the latest developments in food processing & engineering from global experts. The topics covered at the workshop represent the latest trends in this important domain of Food Science and Technology. The presentations and discussions are in-depth as each presentation is allocated twice the time compared to most presentations at the Congress. The workshop is particularly tailored for young researchers.

Programme:

Time	Presentation Topics
08:30 – 09:00	**Registration**

Time	Presentation Topics
09:00 – 09:05	**Introduction to Workshop** Weibiao Zhou, National University of Singapore, Singapore
09:05 – 09:35	**Engineering the application of gas nanobubbles in food processing operations** Bhesh Bhandari, The University of Queensland, Australia
09:35 – 10:05	**Emerging Pulsed Electric Field processing in the bio-based domain with microalgae as a case-study** Iris Haberkorn, ETH Zurich, Switzerland
10:05 – 10:30	**Morning Tea Break**
10:30 – 11:00	**Digitalization in the F&B Industry based on Data Analytics and closed loop AI prediction** Malte Schlueter, Mitsubishi Electric, Germany Mei Horng Ong, A*STAR, Singapore
11:00 – 11:30	**Digital food manufacturing by 3D printing. Recent advancement toward nutritionally and sensory personalized food products** Antonio Derossi, University of Foggia, Italy
11:30 – 12:00	**Development of 3D-AI-Printing System for Personalized Food Production** Mitsutoshi Nakajima, University of Tsukuba, Japan
12:00 – 12:30	**Panel Discussion**

09:05 | GMT+8
09:05 – 12:30 GMT+8

Room: BR2
Pre-Congress Workshop 3 - Understanding, Improving, and Sustaining Your Food Safety Culture

Senior leaders need to assess, manage, and communicate food safety risks and foster a mature food safety culture at their companies. This proposed a pre-meeting workshop invites participants to spend a half-day working on gaining more knowledge about food safety culture including the Global Food Safety Initiative (GFSI) perspective and steps to understand and improve their organisational food safety cultures. Participants will walk away with a plan – a blueprint – specific to their company for improving and sustaining a culture of food safety. The foundation of the workshop is to demonstrate the science of culture in practical and applicable manner. Seminar participants will work with expert instructors to build their company's blueprint to improve their food safety culture.

During the workshop participants will,

- Understand possible food safety consequences of a mature culture both to their employees and the company, including impact on the bottom line.
- Discover tools to strengthen their individual company culture.

- Build their company's blueprint to a mature culture and improve food safety performance.

The workshop will include a combination of presentations and group work. It is hosted by UCLan-Cultivate, a research and knowledge transfer partnership between University of Central Lancashire (UCLan) and Cultivate SA.

Instructors: Lone Jespersen, Rachel Downey and Carol Wallace

Time	**Presentation Topics**
09:05 - 09:10am	Instructor introductions plus Objectives, and format of workshop
09:10 - 10:00am	Current state and Food Safety Purpose
10:00 - 10:50am	Changing behaviours
10:50am - 11:40am	Building habits (Metrics, rhythm, and target behaviours)
11:40am - 12:30pm	Blueprint and ownership

18:00 | GMT+8
18:00 – 20:00 GMT+8
Welcome Reception (Bayview Foyer)

31 Oct 2022

07:30 – 08:30 | GMT+8
Registration

08:30 | GMT+8
08:30 – 09:30 GMT+8
Main Plenary Room
The New Zealand Chapter: 20/20 Visions

Session Chair: Richard Archer, Massey University, New Zealand

08:30 – 09:00 GMT+8

Jeremy Hill, Chief Science & Technology Officer, Fonterra	**New Zealand Plenary 1 - Narratives for Nourishment: What can the Sustainable Nutrition Initiative® teach us?**

A challenge we face is our ability to sustainably nourish an increasing global population without exceeding the capacity of the planet. There are many narratives on how this should be done. The Sustainable Nutrition Initiative or SNi® was launched to help create a better understanding of the food system and identify practical opportunities to sustainably feed the global population with the nutrients required.

We must thoroughly understand the problems to be solved before embarking on making changes that will be difficult and slow to introduce, and extremely challenging to reverse if we get them wrong. The global food system of the future will be shaped by the shifts in thinking that we make today. The SNi® helps provide context to support this thinking, and guide decisions.

Current pandemic, conflict and climate related issues with the global supply and trade in food and associated nutrients has emphasised the importance of the global context of food security.

A model – the DELTA Model® has been created by the SNi® that can generate a wide range of possible scenarios to explore what improvements to the global food system might be possible and practical.

Using the DELTA Model® to explore global food supply, flows, consumption, and losses, the facts are not always what we think they are - or certainly not what we may have been told. The food system is already plant-based and from the perspective of production, consumption, and waste, animal-sources of food may not be as inefficient as previously thought. There is strong evidence that to nourish the global population a plant-based and animal-optimised food system is required.

09:00 – 09:30 GMT+8

Peter Gluckman, President International Science Council	**New Zealand Plenary 2 - Food and Nutritional Science: Addressing Challenges to the Global Commons**
Issues of food security have sadly grown in the context of current challenges to the global commons: conflict, Covid and climate change. The formal multilateral system has been highly variable in response to such challenges and there is an increasing awareness that track 2 organizations such as the International Science Council (IUFoST is a member) will need to take a greater role. In parallel, progress on Agenda 2030 as detailed in the Sustainable Development Goals (SDGs) has been disappointing. In such contexts food and nutrition science has much to offer but it must also consider what are the society's priorities. By way of examples: Food production still is a major producer of greenhouse gasses: yet the role of technologies in addressing the imbalance between food production and GHG emissions requires social license which is far from assured and confronts various non-tariff barriers. As the issues of non-communicable disease continue to grow in both the Global South and North, the potential for evidentiary informed health claims from nutritional products remains compelling but is constrained by academic, regulatory, and commercial considerations. Food security and adequate nutrition have implications to many of the SDGs, well beyond those most directly involved (eg SDG 2, 3, 12, 14). Food and nutrition scientists have broader and leadership roles to play as we address challenges to the global commons.	

09:30 | GMT+8
09:30 – 11:00 GMT+8
Main Plenary Room
Opening Ceremony

09:30 – Arrival of Guest of Honour Ms Low Yen Ling, Minister of State, Ministry of Culture, Community and Youth & Ministry of Trade and Industry

09:35 – Handing Over of World Congress Flag & Bell from New Zealand to Singapore

09:40 – Welcome Address

- Co-Chair Organising Committee & President SIFST
- President, IUFoST

10:00 – Opening Address by Guest of Honour and Declare the Congress Open

- Ms Low Yen Ling, Minister of State, Ministry of Culture, Community and Youth & Ministry of Trade and Industry, Singapore

10:30 – Opening Keynote Address – Singapore Food Story – 30 by 30 Initiatives

- Mr Chan Hian Lim, Deputy CEO, Singapore Food Agency

11:00 | GMT+8
11:00 – 11:30 GMT+8
Tea Break with Day 1 Poster Presentation

11:30 | GMT+8
11:30 – 12:30 GMT+8
Main Plenary Room
New Zealand Special Invited Speaker Sessions & Young Scientist Award Presentations

Session Chair: Richard Archer, Massey University, New Zealand

11:30 – 11:45 GMT+8

James Bier, Senior Technologist, The Tatua Co-operative Dairy Company Limited	**Presentation 1 - Building the Future of Specialised Dairy – New Zealand and the World**
Milk contains a wealth of components. Over the last century, dairy processors have learned to recover many of these, purifying or modifying to match the performance requirements of equally sophisticated user companies. Specialised producers in New Zealand are an example, having grown alongside technological developments. Companies like Tatua adopted milk fractionation early, making caseinates and whey products. By the early '90s it was producing lactoferrin and then dairy flavours. Dairy and vegetable peptones plus hypoallergenic hydrolysates for medical nutrition now come from the same factory. This segment of the industry invests not only in R&D behind technologies, products and applications smartly and with intent, but also in regulatory compliance and partnering with customers. Capability can be transferred across substrates and back again – applying the fundamentals of hydrolysis, fermentation, separation, and processing technologies to casein,	

whey, and vegetable protein, as well as to dairy and vegetable fats. Techniques are selected to give the best solutions for customers' particular product needs.

The future of this industry sector is a continued intertwining of people, partnership and ideas in applying science that we need. Increasingly critical is stewardship of treasured land and waters, while still generating high human values through safe, specialised food ingredients.

11:45 – 12:00 GMT+8

Nikos Patiniotakis, Head of Global Brand Development, Zespri International	**Presentation 2 - ZESPRI. Building an Unexpected Brand in the Fruit Aisle and Beyond**

Lifting fruit consumption in the general population in the modern world often requires innovative brand-building. Zespri is the world's leading Kiwifruit brand and one of the top fruit brands in most of the key markets where it is present today. It is 100% grower-owned and is present in more than 50 countries across the globe.

Zespri's success is built on two essential pillars for any brand to succeed: understanding the consumer and acting on what makes the brand unique.

On the one hand, Zespri understands how consumer selects and consumes fruit in general and how the benefits the consumer seeks to support them in the choices they make for themselves and their family today and in the future.

On the other hand, Zespri leverages its unique traits, being a brand based on a solid set of values while it is driven to deliver high value to its stakeholders. Two drivers that generate a strong value creation ecosystem. And all of that is supported by the Zespri system, our integrated system to deliver quality kiwifruit from orchard to distributor worldwide, and our innovation, as Zespri supports the world's largest natural kiwifruit breeding program. Zespri's powerful combination of innovation and brand building promises consumers an irresistible experience.

This session explores Zespri's journey and brings to life how the brand shows up in front of the consumer across the globe while it gives a perspective of what it takes to be a successful brand in the fruit bowl and beyond.

Young Scientist Awards Session 1 (Sponsored by Elsevier)

Session Chair: Yang Hongshun, National University of Singapore, Singapore

12:00 – 12:15 GMT+8

Lin Chen (Singapore)	**The Application of Foodomics in Food Safety Study**
Foodborne pathogens, one of the major concerns in the food sector, are highly adaptive to the environmental stresses. The understanding of adaptative mechanisms may help to prevent the emerging stress-resistant pathogens. Foodomics focuses on small molecules (e.g., metabolite, gene and protein) of a particular system or organism at a specific time point, providing a feasible strategy to speculate on the molecular mechanisms. In this work, metabolomics was applied to study the response mechanisms of pathogens (e.g., *Escherichia coli*, *Salmonella*) under inactivation stresses, such as lactic acid, mild heat, and essential oils. For instance, the nuclear magnetic resonance-based metabolomics revealed that the glutamic acid dependent decarboxylase/antiporter system is important in the acid adaptation of *E. coli*. In addition, under mild heat treatment, energy metabolism-related pathways were significantly induced, indicating their critical roles in heat resistance. Moreover, the integrated metabolomics and transcriptomics were applied to uncover the adaptive mechanisms of *S.* Typhimurium under essential oil treatment. The results showed that *S.* Typhimurium adopts conservative strategy under harsher stress, while more radical responses were observed under relative mild stress. These findings demonstrated the great potential of foodomics on food safety study.	

12:15 – 12:30 GMT+8

Biniam Kebede (New Zealand)	**Tackling Today's and Future Food Science and Nutritional Challenges: A Foodomics Approach**
It is becoming increasingly recognized that metabolomic fingerprinting combined with chemometric data mining has a considerable potential to tackle food science and nutritional challenges. Metabolomics focuses on the high-throughput characterization of small molecule metabolites in biological systems. It is ideally positioned to be used in many food and nutritional research areas, such as (1) component analysis; (2) quality/authenticity/safety assessment; (3) consumption monitoring and nutritional and health biomarker selection. In this talk, a summary of findings of ongoing research activities at the University of Otago will be presented. Case studies on the potential of metabolomics to aid NZ hop breeding; study origin traceability of high-value foods; investigate the impact of (non)thermal processing on quality; understanding the role of diet on gut microbiota will be presented. Challenges and opportunities of these advanced omics approaches will also be discussed. Overall, our research has successfully demonstrated that foodomics (metabolomics) have a huge potential to increase our understanding of complex food quality/safety changes to tackle food science and nutritional challenges from farm to fork and	

beyond.

12:30 | GMT+8
12:30 – 13:30 GMT+8
Networking Lunch Session with Day 1 Poster Presentation

13:30 | GMT+8
13:30 – 15:00 GMT+8
Plenaries 1 & 2 and Young Scientist Award Presentations

Session Chair: Fereidoon Shahidi, IUFoST, Canada

13:30 – 14:00 GMT+8

Hannelore Daniel, Professor Emerita (School of Life Sciences), Technical University of Munich	**Plenary 1: Food, Diet and Health in New Dimensions**
Diet and Health in New Dimensions Food systems are in transition. Products, markets, supply chains, raw materials, consumer attitudes, expectations and values are changing in an unseen manner. Consumers realize that eating is an act that is embedded into a global food system with consequences for the planet and for personal health and wellbeing. The great challenges we are facing is to provide sufficient food for a growing world population on background of climate change with expected severe reductions of agricultural yields – predominantly in the southern hemisphere and regions with the largest population increase. In developed countries in contrast, new consumer values are pushing the markets driven by concerns over the environmental impact of food production processes, animal welfare, social justice, and health. Here two major developments have created a huge momentum and are likely to change the food systems substantially and that are the products replacing traditional agricultural raw materials including meat and that are individual diet and health services. Recent years have brought across the world a vital scene of new companies that in essence revolutionize food production and the entire value chain. Moreover, it is also associated with a new level of democratization of food production and distribution in hands of many youngsters but supported by large investments of established players. This scene reaches from proteins extracted form side streams or new sources such as insects or algae to novel processes of CO2-fixation via bacterial mass, cellular agriculture with vertical farms, in vitro attempts for dairy, meat, fish etc. to complete de novo synthesis of starches or proteins. New materials and food products are explored and brought to markets, and companies offering individualized services that target diet and lifestyle to improve health and wellbeing are emerging.	

Many of those come from the biomedical arena and base their services on genotyping or microbiome analysis with the perspective of multi-omics applications serving to most comprehensively describing the individual´s status. Services include advice, individualized supplements or even complete menu plans with home-delivery. This new market is framed by the growing digital environments that provide just in time data on vital body functions, food intake and its setting or physical activity. Although these commercial offers are proliferating, scientific evidence that such concepts of Personalized Nutrition (PN) (also often called Precision Nutrition deliver substantial benefits and can improve population health), is lacking. Only a few scientific projects have assessed the efficacy of PN and revealed only limited benefit. Based on the Food4me project as the largest scientific project conducted on PN so far, I will describe the lessons learned and will provide a new concept for PN.

14:00 – 14:30 GMT+8

Sato Kenji, Professor, Division of Applied Biosciences, Graduate School of Agriculture, Kyoto University	**Plenary 2: Presence of Food-Derived Peptides in Body and Their Function**

Food proteins hydrolysates, mixtures of numerous peptides with different sequences, have been used as food ingredients. Peptides are also present in some fermented foods. Ingestion of such peptides has been demonstrated to exert beneficial activities beyond conventional nutritional values. Biological activities of peptides in food have been examined using in vitro assays. However, peptides in food are frequently degraded by exopeptidases, while they can resist endo type proteinases. Thus, bioavailability of most peptides in food are very low.

On the other hand, some specific peptides such as prolyl dipeptides (Pro-Hyp, Pro-Gly), aspratic isopeptides and pyroglutamyl peptides increase in lumen and bloods of animal and human after oral administration of food protein hydrolysates. The prolyl dipeptides are frequently generated from larger peptides in food during digestion process. The aspratic isopeptides and pyroglutamyl peptides are generated during preparation of food-protein hydrolysates and fermentation. Some of them exert biological activities at a similar concentration in the body, which can explain the beneficial activity by ingestion of the food protein hydrolysates.

Thus, biological activities of food-derived peptides reaching target organ rather than peptides in food should be examined for understanding molecular mechanisms for beneficial activities by ingestion of peptides.

Young Scientist Awards Session 2 (Sponsored by Elsevier)
Session Chair: Huang Dejian, National University of Singapore, Singapore

14:30 – 14:45 GMT+8

Rachma Wikandari (Indonesia)	**Development of Meat Substitutes from Filamentous Fungi Cultivated on Left Over Boiling Water of Tempeh Factory**
In recent years, there has been increased motivation to reduce meat consumption globally due to environment and health concern. Consequently, scholars within the food science industry have recently focused on the production of meat substitutes. Filamentous fungal biomass commonly known as mycoprotein is potential source since it is nutritious and has similar eating quality to meat. The bundle mycelium of mycoprotein creates a fibrous meat-like texture and this characteristic is not owned by the most meat substitutes from plant-based materials. A commercial mycoprotein production uses glucose as a carbon source. The current work studies the potential of food industrial by products i.e. a leftover boiling water in tempe factory as substrate for mycoprotein production in order to reduce the production cost. Indonesia has over 85.000 tempeh factory which release a huge amount of wastewater. The wastewater comes from processing such as boiling and soaking. This water has high organic content and some part of tempeh factory discharge directly the wastewater to river which creates an environmental problem. Since filamentous fungi has ability to produce various types of enzymes, there is a possibility to cultivate the fungi in the leftover boiling water. The leftover boiling water that has not yet been discarded into wastewater treatment unit can be considered as by products and thus can be used to cultivate the fungi. The result of the current work shows that the leftover boiling water from tempeh factory can be used to produce mycoprotein.	

14:45 – 15:00 GMT+8

Jeyan A. Moses (India)	**Advances in Food 3D Printing for Personalized Nutrition Applications**
Among various approaches to food customization, the concept of 3D printing has gained huge interest in recent years and is regarded as a disruptive technology with prospects for changing food manufacturing practices. In this talk, the focus is on one key application, its prospects in	

personalized nutrition. With 3D printing, customized foods for various age groups and special health needs can be conveniently prepared. For instance, high-protein snacks, texture-modified foods for those with swallowing difficulties, print-on-site foods for astronauts and soldiers on long-duration missions, physical-structure modified low GI foods, etc., can be prepared with both variety and aesthetic appeal. Based on demand, nutrients and functional ingredients such as probiotics and food bioactives can be supplemented to cater to individual requirements. These can be monitored in real-time using IoT and data analytics approaches integrated with the analyses of nutritional biomarkers. Additionally, with recent interventions, hybrid approaches involving encapsulation, electrospraying, etc., are finding promising potential. In food technology, 3D printing must go along with sustainability and the development of nutritious foods for a healthier population. This also implies a better understanding of the food destructuring process in the body and scientific interventions to improve nutrient bioavailability.

In recent years, there has been increased motivation to reduce meat consumption globally due to environment and health concern. Consequently, scholars within the food science industry have recently focused on the production of meat substitutes. Filamentous fungal biomass commonly known as mycoprotein is potential source since it is nutritious and has similar eating quality to meat. The bundle mycelium of mycoprotein creates a fibrous meat-like texture and this characteristic is not owned by the most meat substitutes from plant-based materials. A commercial mycoprotein production uses glucose as a carbon source. The current work studies the potential of food industrial by products i.e. a leftover boiling water in tempe factory as substrate for mycoprotein production in order to reduce the production cost. Indonesia has over 85.000 tempeh factory which release a huge amount of wastewater. The wastewater comes from processing such as boiling and soaking. This water has high organic content and some part of tempeh factory discharge directly the wastewater to river which creates an environmental problem. Since filamentous fungi has ability to produce various types of enzymes, there is a possibility to cultivate the fungi in the leftover boiling water. The leftover boiling water that has not yet been discarded into wastewater treatment unit can be considered as by products and thus can be used to cultivate the fungi. The result of the current work shows that the leftover boiling water from tempeh factory can be used to produce mycoprotein.

15:00 | GMT+8
15:00 – 15:30 GMT+8
Tea Break with Day 1 Poster Presentation

15:30 | GMT+8
15:30 – 17:00 GMT+8

Concurrent Sessions (Rooms: BR 4 – BR 9)

BR 4 - IUFoST National Committee of the Swiss Academy of Sciences

Emerging Cellular Agriculture-Based Food Production with Microalgae as Case Study

Session Chair: Alexander Mathys, ETH, Zurich, Switzerland

Liu, Shao Quan, NUS, Singapore	**Heterotrophic cultivation of protein-rich microalgae using food side streams**

To ensure an independent and resilient food/protein supply in Singapore, producing protein-rich biomass from heterotrophic microalgae (grown without light and on organic substrates) is promising due to low land demands and high biomass conversion efficiency. However, the microalgal cultivation medium (e.g., glucose, minerals) accounts for three quarters of operating costs which hampers economic viability. Food processing side-streams are not only inexpensive, but are also rich in untapped nutrients (e.g., starch, cellulose, minerals) which could replace conventional medium to cultivate heterotrophic microalgae. Here, the utilization of food processing side-streams is highlighted for cultivating heterotrophic microalgae. As a case study, brewer spent grains (from beer) and soy whey (from tofu) are utilised to heterotrophically cultivate industrially relevant Auxenochlorella protothecoides and Chlorella vulgaris. Efforts are underway to recover assimilable monosaccharides from these food-by products by optimising hydrolysis parameters aided by response surface methodology. Effects on biomass yield, productivity, and protein contents will be evaluated when the microalgae are cultivated in optimised hydrolysates compared to conventional cultivation medium. Additionally, effects of cultivation parameter manipulation (e.g., hydrolysate ratios, fed-batch processes) will be addressed to further enhance biomass yields and protein contents. It is hopeful that food processing side-streams are effective in producing protein rich microalgae biomass, thereby mitigating costs within a circular bio-economy concept, while enabling a resilient food supply system.

Haberkorn, Iris, ETH Zurich, Switzerland	**Technological advances in microalgae processing – from stimulated growth to innovative component valorization**

Cellular agriculture emerged as promising solution to establish more resilient food systems. Single-cell biorefinery concepts can aid in decreasing the environmental burden associated with today’s agri-food systems and alleviate malnutrition. By using novel raw materials such as microalgae, food security and sustainability of food supplies can be significantly improved. Innovative approaches are required to overcome constraints related to low efficiencies and high energy demands.

We will highlight examples of innovative thermal, mechanical, and combined processes for single-cell biorefinery concepts to improve their supply-chain eco-efficiency, both, during up- and downstream processing. Stress induction through nano second pulsed electric field (PEF) processing enhances microalgae bioconversion efficiency at low energy demand (up to 17.5% enhanced biomass yield of phototrophic Chlorella vulgaris). Focused process development of new microsecond PEF approaches combined with incubation or advanced separation technologies and fluid-dynamics modelling can deliver new solutions for the cascade valorisation of high-value components. The proposed solutions allow maintaining structural and techno functional properties of extracted high-value fractions, while improving nutrient bioavailability from bulk mass highlighting potentials for an application in the food domain. Challenges and opportunities of the proposed process innovations will be critically assessed regarding their implementation for single-cell biorefineries from lab- to pilot-scale.

Weingarten, Melanie A*STAR, Singapore	**Future foods and foods for the future: production of microalgae**
Increased demand for food, energy and chemical at the same time aligned with the UN Sustainability Goals has lead to research and development of renewable and sustainable sources. In this context, microalgae have gained special interest as often-called “sustainable biofactories. Today, Singapore aims to increase its domestic food supply to 30% by 2030 (currently > 90% of imports) and thus making the country more resilient. This talk will elucidate how this goal can be reached via microalgae solutions driven by economy and sustainability – always taking into consideration the health and nutrition aspect of the future food products. The development and state of the art of microalgae cultivation and downstream processing for food applications with will be presented highlighting bottlenecks, challenges and future perspectives.	
Huang, Dejian, Zhou, Weibiao, NUS, Singapore,	**Novel processing engineering approach to new foods incorporating microalgae proteins**
Microalgae has been lauded as a new food source that features low carbon foot-print to produce a variety of food products. Yet, before it can make an impact on human diet in mass scale, a great deal of post-harvest processing technology needs to be developed. To this end, we report our findings on utilizing extracted microalgae proteins as functional and flavouring ingredients in processing of seafood mimics such as salmon, abalone, and fishball mimics, which were designed by judicious choices of ingredients so that the finished products contain comparable protein and fatty acid profiles as those of respective seafood products. By applying 3D printing and high moisture extrusion technology, we expanded to application of microalgae proteins in creation of novel plant protein based foods that are well-liked by Singapore and South East Asian consumers. Results from the in vitro digestion study of extracted microalgae proteins revealed the nutritional quality and potential issues of these novel plant proteins. Our work will make contribution to nutritional security and food sustainability.	
Siegrist, Michael, ETH Zurich, Switzerland	**Consumer acceptance of algae products**
Meat production has great environmental effects, leading to decreased meat consumption being proposed as a step toward a more sustainable food system. Microalgae is a raw material that could potentially be used to replace conventional meat proteins. However, for the introduction of such meat alternatives to succeed, consumers’ preferences and perceptions must be considered. Acceptance of meat alternatives is influenced not only by the taste and price of the products, but also by the product’s category and the circumstances in which it will be eaten. For example, meat alternatives are likelier to be accepted by someone eating alone than by someone eating with friends. Consumer studies conducted in different European countries suggest that consumers perceive an algae burger to be healthier and more environmentally friendly than a beef burger. However, taste expectation is an important barrier: consumers perceive an algae burger to be less tasty than a beef burger. Food neophobia and meat commitment are also barriers to the acceptance of meat alternatives containing algae. It is important to take these consumer insights into account when developing novel products containing microalgae proteins. Otherwise, product failures are probable.	

BR 5 - International Life Science Institute (ILSI) - Commonwealth Scientific and Industrial Research Organisation (CSIRO) Scientific Session

Future of Protein – Science, Innovation and Dietary Shifts

Session Chair: Hannelore Daniel, Technical University of Munich, Germany

Kerr Dow, Co-Chair, ILSI Global Board, USA	**Introduction**
Michelle Colgrave CSIRO, Agriculture, Australia	**Future of protein**

Estimates predict that 70 per cent more food will be required to feed the growing global population which will reach 9.7 billion by 2050. The challenge will be how to meet this global food gap while maintaining our planet's health. Australia's traditional animal and plant protein offer an opportunity to address this gap, with emerging sources of protein seen as complementary. We are witnessing changing dietary patterns, with increasing numbers of flexitarians, due to concerns over the environment, animal welfare and personal health and nutrition. In response to the growing demand for protein, technologists have been searching for cost-effective, resource-efficient and environmentally friendly protein technologies and solutions that can support traditional industries or create new industries. In this presentation, the opportunities and challenges in growing Australia's protein industries will be discussed.

Jeyakumar Henry SIFBI, A*STAR, Singapore	**Issues for protein and health – identifying the gaps**

Proteins are essential components for human life. Historically, our needs for protein have been met by the consumption of animal meat, fish, poultry, whole legumes and cereals. With the global increase in the production of alternative protein-based foods, our access to protein foods have been revolutionised. Whilst embracing the new technologies used in the production of alternative protein foods, it is important for us to understand the nutritional, physiological impact that the transition from eating conventional protein sources to the consumption of alternative proteins may have. This presentation will showcase and highlight the opportunities and challenges we face in the development of next-generation alternative proteins that not only have excellent taste, texture and sensory properties, but critically, have nutritional and health advantages.

With increasing global population, we also need to consider how the "alternative protein" revolution could also include the nutritional needs of the less fortunate that approximate 3 billion people. This understanding will enable the next generation of alternative proteins to be widely accepted in our quest for planetary and human health.

Deepak Choudhury BTI, A*STAR	**Bioprocessing novel proteins - cultured meat and other bioprocessing**

It won't be an overstatement to say that innovations in Alternative Proteins have taken the world by storm. There are increasing demands from informed consumers for nutritious, delicious, affordable, and easily accessible sources of alternative proteins as traditional products. As per the Good Food Institute (GFI) estimates, the alternative proteins companies have raised a total of $11.1 billion since 2010, half of which has been raised in 2021 itself! The heart of the alternative proteins' revolution lies in the bioprocessing of relevant cells, especially for cultivated meat and fermentation-derived products. The speaker will quickly dive into innovative alternative protein-based product development, vital technological challenges, and unique proposed solutions to make the scale-up of alternative proteins a reality. The session is proposed to touch upon aspects of cells, media, scaffolds, and bioreactor hardware development, as well as how fermentation is exploited as a critical technical tool to produce various ingredients.

BR 6 - International Society for Nutraceuticals and Functional Foods (ISNFF)

Functional Foods, Nutraceuticals and Natural Health Products: Effects, Bioavailability, Metabolism, and Health Effects

Session Chair: Fereidoon Shahidi, Memorial University, Canada

Fereidoon Shahidi, Memorial University, Canada	**Omega-3 oils, phenolipids and biopeptides as functional food ingredients**
Lipids and proteins are important macromolecules in food that provide essential fatty acids and essential amino acids to the body. Meanwhile phenolic compounds that serve as secondary metabolites in food also play a major role in providing protection against adverse conditions in plants and in food as well as in the human body. Omega-3 fatty acids are important components of seafood, marine oils and algal species as well as certain oilseeds. They are well known for their anti-inflammatory properties, serve as building block of organs with electrical activity, and alleviate certain cardiovascular conditions. When coupled with phenolic compounds, they may provide additional benefits due to free radical scavenging and other activities associated with phenolic compounds. In addition, proteins upon digestion are hydrolyzed to peptides and free amino acids. The peptides can also be prepared from proteins upon hydrolysis and used as functional food ingredients and potentially in pharmaceutical and cosmetic applications. The biopeptides render benefits by lowering blood pressure and serve as angiotensin converting enzyme inhibitors and antioxidants. Examples will be given to demonstrate the role of these important functional food ingredients in food and in health and disease.	
Rotimi Aluko, University of Manitoba, Canada	**The c-terminal leucine residue potentiates antioxidant activities of calcium and iron binding of mung bean protein-derived peptides**
In this work, mung bean proteins were subjected to hydrolysis using various enzymes and their combinations, which was followed by filtration through 1, 5, 10, and 30 kDa molecular weight cut-off membranes. The permeate (<5 kDa) with strongest calcium and iron binding activities was separated by size exclusion chromatography into 4 fractions (F1 – F4), which were further tested for ion-binding potency. The most active fraction (F2) was then analyzed by mass spectrometry and amino acid sequences identified using the online FindPept tool. Peptide PAIDL was the most potent iron-binder while LLLGI, AIVIL and HADAD had the highest calcium- binding activity. LLLLG and LLGIL had the highest metal chelating activity while PAIDL (46.63%) and LLGIL (81.27%) had significantly (p < 0.05) better DPPH radical scavenging activity. PAIDL and LLGIL were the strongest scavengers of hydroxyl radicals with effective concentration that scavenged 50% (EC 50) values of 0.09 and 0.37 mM, respectively. Superoxide scavenging was highest for PAIDL and AIVIL with an EC 50 value of 0.07 mM each. Overall, the results suggest that presence leucine as the C-terminal amino acid residue was the most important contributing structural factor to the strong antioxidant properties of peptides in this study.	
Ronald B. Pegg and Phillip Greenspan, University of Georgia, USA	**Revisiting the bioavailability of tree nut nutrients and phytochemicals during digestion**
Uncharacteristic of most whole foods, the major macronutrient of tree nuts is lipids in the form of triacylglycerols; yet, the health benefits attributed to the consumption of tree nuts are greater than simply the healthful lipids. A myriad of nutrients and bioactives, including phenolic compounds, exist. The beneficial action of tree nut consumption on decreasing the risk of cardiovascular disease, reducing oxidative stress as well as maintaining body weight and glucose	

homeostasis has been demonstrated through epidemiologic and clinical/intervention studies. Yet, little is still known about the impact of gut microbiota, the metabolites that are generated, and the bioavailability of these metabolized biochemicals. A component of bioavailability is bioaccessibility, which is the relative quantity of bioactives released from the tree nut matrix in the lumen of the gastrointestinal tract that could potentially be available for further metabolism and absorption. A significant portion of the phenolic constituents in tree nuts likely remains non-absorbed in the small intestine. These compounds, which typically would include ellagitannins, gallotannins, flavan-3-ols and anthocyanins, then reach the colon where phenolic microbial metabolites such as urolithins, hydroxyphenylvalerolactones, hydroxyphenylpropionic acid, hydroxylphenylacetic acid, and simple phenolics like gallic acid and catechol, are formed. This talk will examine the knowledge available to date on the impact of digestion on selected nutrients and bioactives from tree nuts.

Cesarettin Alasalvar, Tubitak, Turkey	**Development of phytosterol-enriched functional ice tea and dietary supplements from black tea**

Diet-related chronic diseases have been on the rise, representing 60% of all deaths in the world. Tea is one of the most popular beverages consumed worldwide. Therefore, it is important to develop some value-added products from tea. This study was aimed to develop phytosterol-enriched functional ice tea (P-EFIT) and anti-diabetic dietary supplement from black tea. Two different experiments were carried out. Firstly, cardio-protective effects of P-EFIT was assessed using a clinical trial. Compared with baseline, consumption of P-EFIT significantly decreased the concentrations of total cholesterol by 5.6% ($P < 0.001$) and low-density lipoprotein cholesterol by 8.7% ($P < 0.001$). The data indicate that consumption of P-EFIT is an excellent beverage for delivering phytosterols and has several beneficial cardio-protective effects in subjects with mild hypercholesterolemia. Secondly, streptozotocin and high-fat diet induced T2D in vivo model was developed in male mice for anti-diabetic effect from black tea polysaccharides (BTP). The results showed that the water-soluble BTP significantly decreased the blood glucose level ($P < 0.05$) in diabetic mice even fed with high-fat diet and improved the insulin resistance compared to the control diet. Water-soluble BTP can be used as anti-diabetic dietary supplement. This presentation will cover details of these two original studies.

BR 7 - Food Chemistry and Ingredients 1

Session Co-Chairs: Suzana Lannes, IUFoST, Brazil; Mark Richards, Nanyang Polytechnic, Singapore

Benedikta Imelda, National Pingtung University of Science & Technology, Taiwan	**Roast Time and Temperature for Optimal Antioxidant Activity in Sumatra Coffee (C. arabica)**

Coffee is recognized as a source of phytochemicals that may enhance physiological performance and protect against ailments linked to free radical damage. Roasting converts some of the compounds that make the bulk of antioxidant properties in coffee beans into those responsible for the characteristic flavor, aroma, and color of coffee beverages. This study intended to find the roasting time and temperature for optimal retention of antioxidant activity levels in Sumatran wethulled coffee beans. Roasting time and temperature combinations generated through central composite design resulted in medium and dark-roasted beans with moisture content in the permitted 1% range. Beans roasted to higher temperatures lost more weight and had darker color. Temperature was also significant ($p < 0.05$) to DPPH free radical scavenging activity, total phenolic content, and ferricyanide reducing power. Roasting time seem to only affect phenolic content in

lower final temperatures. Coffee beans roasted to 200°C had 77.90 ± 0.14 to 78.12 ± 0.60 percent radical scavenging activity. Unlike the linear response of radical scavenging activity and total phenolic content, ferric reducing power responded to temperature in a quadratic manner. Optimal antioxidant activity in Sumatra coffee can be achieved by roasting to 200°C in 11 minutes.

Towhid Hasan, School of Science, Monash University Malaysia	**Influence of the types of protein on the physical and thermal properties of dairy-free frozen dessert mix**

There is an increasing demand for frozen desserts (i.e., ice cream) without milk/dairy ingredients, particularly among individuals having lactose intolerance, cow milk allergy, or vegan. Protein composition contributes largely to the characteristics of the frozen dessert mix that is before freezing and whipping. Hence, the objective of this study was to assess the effects of types of protein on the physical and thermal properties of dairy-free frozen dessert mix. Results indicated that creaming stability was significantly increased for frozen dessert mixes containing soy, pea, and brown rice protein compared to the frozen dessert mix with milk protein; however, the adsorbed protein concentration was lower for the former mixes. All the samples exhibited shear thinning behavior, with the frozen dessert mixes containing soy, pea, and brown rice protein being more viscous (247.17, 301.10, and 119.10 mPa·s, respectively) than those of milk protein (74.71 mPa·s). Concerning crystallization behavior, soy, pea, and brown rice proteins showed higher crystallization enthalpy (-52.12, -41.72, and -39.54 J/g, respectively) than milk protein (-38.92 J/g), indicating enhanced crystalline fat content. These findings reveal that soy, pea, and brown rice protein can be potential alternatives to milk protein for dairy-free frozen desserts application.

Jianping Wu, University of Alberta, Canada	**Challenges and opportunities of bioactive peptides against metabolic syndrome**

Metabolic syndrome is a cluster of several comorbidities increasing the risk of an individual to cardiovascular diseases and diabetes in later life. Insulin resistance and adipose tissue dysfunction play key roles in the pathogenesis of metabolic syndrome. Food proteins containing encrypted bioactive peptides in their structures could be released after enzymatic digestion. Bioactive peptides have shown antihypertensive, antioxidant, anti-inflammatory, anticancer, anti-microbial, and immunomodulatory activities. Emerging studies suggest on the potential of bioactive peptides on glucose homeostasis and insulin resistance. The recent discoveries of pathways and target cells in the management of glucose and energy metabolism have opened up new opportunities for identification of novel bioactive peptides on enhancing adipocyte differentiation and insulin signaling, glucose uptake, cholecystokinin receptor expression and activation, as well as insulin mimetics and incretin stimulants. However, as yet, clinical evidence on the efficacy of such bioactive peptides is rare but is inevitable to establish their applications against glucose intolerance and insulin resistance. This presentation will address the challenges and opportunities of bioactive peptides against metabolic syndrome.

Diana Bogueva, The University of Sydney and Curtin University Sustainability Policy CUSP Institute	**Assessing Generation Z's consumer attitudes and readiness for alternative proteins**

Alternative proteins, ranging from cultured meat to plant-, algae- and insect-based, are presented as promising technological solutions for reducing the environmental impact of food. They are seen by consumers as promising but also as complex and uncertain, provoking some concerns and controversies. Generation Z (born between 1995 and 2010) is caught at the crossroad of these developments. Understanding this diverse, important and increasingly trendsetting influential group, representing 20% of Australia's and 30% of

the world's population, can guide the future – acceptance or rejection – of the alternative proteins.

This paper presents a study of Australia's Generation Z consumers exploring their perceptions, acceptance and preferences for alternative proteins. The findings show that 72% are not ready to accept cultured meat with the remaining 28% accepting only "if we can master it". A third of the participants rebuff cultured meat and edible insects but accept plant-based substitutes as more natural; however, 17% reject all alternatives because of being "chemically produced" and "heavily processed".

As Generation Z's influence on the market continues to grow, the alternative proteins' future is under scrutiny. Their consumer attitudes towards new products will determine the level of potential market penetration and thus impact on environmental, social and dietary shifts.

Lorraine Jane Sanchez, Malayan Colleges Mindanao, A Mapúa School, Philippines	**Volatile flavour changes during storage of goat whole milk powder: From fingerprinting to kinetic modelling**

This study provided first insights regarding volatile flavour changes in goat whole milk powder(GMP) during its shelf-life. Using an integrated gas chromatography-mass spectrometry-based fingerprinting and chemometrics, a total of 14, 21, and 39 volatile compounds were found to be significantly changing when stored at 20, 30, and 40 â„ƒ for up to 44 weeks, respectively. These volatiles showed an increase in concentration over time and can be associated to lipid oxidation and Maillard reactions. In addition, the suitability of these volatiles as potential shelf-life markers was further investigated. 11 Candidate shelf-life markers were selected including pentanal, heptanal, hexanal, (E)-2-octenal, octanal, 1-octanol, 1-pentanol, 1-hexanol, 1-octen-3-ol, 3-octen-2-one, and
2-heptanone. These compounds have key roles in the odour of dairy-based products. For all the markers, the increasing concentration during storage can be best described by a one-step logistic model. The volatiles exhibited a clear effect of storage temperature as the lag phases were shorter and the rates of volatile formation were higher at increased storage temperatures. Moreover, their increased formation during storage indicates possible flavour changes and can be useful to monitor product quality during the shelf life of GMP.

Chloe Gao Jie, Ingredion, Singapore	**Novel Product Development Approach To Increase Consumer Preference By Integrating Early-Stage Market Research and Sensory Evaluation**

Sensory analysis is widely used in product development cycle to quantify consumers' product experience and provide direction for product optimization. Leveraging sensory in early stage concept development phase can further complement data from market research and increase consumer liking.

By utilizing sensory preference-based approach to further elaborate concepts, it helps shed lights on how well a physical product captures the essence of an abstract concept. This enables manufacturers to better define the desired attributes of the finished food and beverage products.

This study outlines a novel approach to integrate early stage market research with sensory evaluation by applying consumer segmentation thus allowing manufacturers to tailor their products for a diverse group of consumers. Meal replacement beverages were selected to facilitate the development of this approach

BR 8 - Food Processing and Engineering 1

Session Co-Chairs: Pingfan Rao, IUFoST, China ; Raffael Osen, Agency for Science, Technology and Research, Singapore

Shin Yee Wong, Singapore Institute of Technology, Singapore	**Near-Infrared as a process analytical technology for the milk powder blending process**
This study aims to evaluate the suitability and reliability of PAT in monitoring milk powder blending process. The uniformity end point was predicted using Near-Infrared (NIR) probe, and subsequently validated using offline Fourier Transform Infrared Spectroscopy (FTIR). A standard milk formulation (SMF) made up of 50 % lactose, 40 % skim milk powder, and 10 % whey protein concentrate was used. Additionally, the detection limit of the NIR probe was investigated using Vitamin C powder as a representative micronutrient. The average predicted uniformity end point using the online NIR fixed reference (63.89 ± 2.06 min) and dynamic reference conformity test (63.00 ± 5.25 min) were comparable with the offline FTIR measurement (56.6 ± 0.71 min). A three-component Partial Least Square Regression (PLSR) model was constructed and validated for Vitamin C. The detection limit is 0.11%, which is higher than the micronutrient level commonly found in most infant milk formula (0.035%).	

Zhongli Pan, University of California, Davis, USA	**Effect of hot air and infrared drying on the retention of cannabidiol and terpenes in industrial hemp (Cannabis sativa L.)**
This study aimed to investigate the drying effects on the retention of cannabidiol and terpenes in the industrial hemp (Cannabis sativa L.). Hemp inflorescence and leaves from Pipeline, Maverick and Queen-Dream-CBD varieties were dried with hot air (40, 50, 60, 70, 90°C), and sequential infrared and hot air drying (infrared preheating for 1 and 2 min, then hot air drying at 40 and 60°C). Ambient air drying and freeze drying were conducted as control groups. As the drying temperature increased from ambient to 90°C, drying time reduced from 1800 to 210 min, cannabidiolic-acid conversion increased from 0.2% to 14.1%, and total terpene retention decreased from 82.1% to 29.9%. The total cannabidiol retention (ranging from 83.8% to 98.6%) was affected by the drying methods and conditions. The findings suggested that drying conditions should be tailored to the requirements of the final products, which provides important information to the industry for improving the postharvest drying, downstream processing and product development.	

Joel Zink, ETH Zurich, Switzerland	**Processing of high quality, clean label gluten free bakery products by controlled high-pressure extrusion foaming**
The consumption of gluten-free (GF) baked goods has significantly increased over the last few decades due to the rising awareness and knowledge of consumers intolerance to gluten. Such higher demand for GF baked goods brings new opportunities, but also new challenges for food manufacturers due to the lack of the network forming gluten proteins. This typically results in	

products of lower quality compared to gluten-containing analogues which is often counteracted by an extended additive list. A combination of high-pressure (HP) extrusion foaming, gentle foam dosage and subsequent thermal treatment processing has proved to enable optimal baking volume and crumb texture adjustment for GF bakery products, but not restricted to these. A co-rotating twin-screw extruder allowed us to combine mixing, kneading, and foaming of the doughs in a single continuously operated device. Gas (e.g. CO2), was injected under high pressure into the dough system and largely dissolved in the continuous water phase. Upon pressure release, the gas
nucleates forming a foam that is stabilized in a subsequent heating process. The presentation summarizes latest technological improvements of this HP micro-foaming process with respect to inline gas dissolution and gentle dosage control, taking viscoelastic dough rheology and composition dependent bubble nucleation characteristics into account.

Sanami Okamoto, Tokyo University of Marine Science and Technology, Japan	**Two-step textural changes in long-term cold-aged greater amberjack (Seriola dumerili) sashimi owing to protein degradation**

Fish sashimi aged by refrigeration for more than one week has garnered attention as a new food type because of its rich umami taste and unique texture. The extended shelf life of aged fish contributes to the sustainable utilization of marine resources. However, the details regarding the textural changes remain unclear. Thus, the greater amberjack muscle was aged at 1 °C for 14 d to elucidate its textural properties. In the fish fillet, the breaking strength and Young's modulus decreased after aging for 0−5 d and 1−7 d, respectively. In the strain sweep test, the loss modulus of fish mince increased in a time-dependent manner, especially after aging for 7−14 d. Conversely, its storage modulus changed minimally. Proteolysis in the sample aged for 0−5 d was observed at an approximate molecular weight of 500 × 103. Furthermore, its myosin heavy chain degraded after aging for 5−14 d. The viable bacterial count in the aged samples had no problems for food use. Therefore, the sample exhibited a soft texture during the 0−7 d aging, and its viscosity increased during the 7−14 d aging. These two-step changes were presumably induced by the degradation of specific proteins.

Shaba Noore, University College Dublin, Ireland	**Effects of novel extraction strategies on the recovery of phycobiliproteins from Porphyridium purpureum**

Phycobiliproteins (PBPs) present in red microalgae (Porphyridium purpureum) are hydrophilic pigments made up of apoproteins, which are covalently bound with phycobilins. PBPs are primarily classified into three basic categories, namely phycoerythins (PEs), phycocyanins (PCs), and allophycocyanins (APCs). PBPs are used in the formulation of nutrient-rich products due to their antiviral and anti-inflammatory properties. The two main objectives of this study were: 1) investigation of the effects of novel extraction strategies using distilled water combined with ultrasound-assisted extraction (UAE), microwave-assisted extraction (MAE), pulsed electric field assisted extraction (PEFAE) and conventional assisted extraction (CAE) for the extraction of PBPs from microalgae (Porphyridium purpureum); and 2) characterization of the PBPs extracted using SDS-PAGE and LC-MS. Fifteen extraction strategies (i.e., UAE (n=4), MAE (n=4), PEFAE (n=4), CAE (n=2) and a control method (n=1)) were investigated in this study. Based on the concentration of PBPs (PEs; PCs and APCs) analyzed in the crude extracts using UV-spectrometric methods, selected samples (n=13) were further analyzed using SDS-PAGE and LC-MS. Cell culture studies were carried out to measure the antioxidant properties of the crude extracts. Scanning electron microscope (SEM) analysis was also carried out on the treated microalgae residues to analyze surface damage

after extraction. The results indicated that the highest content of PBPs (0.56 ± 0.07 mg/ml) and the highest antioxidant activities was observed in UAE extracted samples.

Keywords: Porphyridium purpureum; phycobiliproteins; novel extraction strategies; SDS-PAGE; LCMS; SEM

Fung Ho-Ki, Singapore Institute of Technology, Singapore	**Simulation-based projection and optimization of inflight meals' production in response to post-COVID consumer preference changes**

The COVID-19 pandemic has impacted almost all industries, with aviation and its supporting industries among the ones particularly hard-hit. As countries begin to ease into the reopening of borders, more consumers will resume air travel, but their consumption behaviour and their preferences for inflight meals might be different compared to pre-COVID time.

Despite an increasing number of studies on the impact of the pandemic on consumer behaviours, there is scant evidence to date that is specific to Singapore-based air travellers, who are the major end customers of our industry partner which produces airline meals in the country. To this end, we carried out a survey on a representative sample of the local air travellers to gauge the dimensions and magnitudes of changes, if any, of their preferences for in-flight meals caused by the COVID-19 pandemic. With data analytics techniques, we also performed segmentation analysis on these consumers to find sub-groups among them who had suggested similar statistically significant preference changes for in-flight catering in the survey.

With this updated consumer understanding, we projected and optimised the inflight meal production process at our industry partner's site using discrete-event simulation of its business operations. The process was simulated based on the concurrent production of six representative inflight meals on the Rockwell Arena platform. The model was validated against the actual process using historical data on raw material consumption and meal output. It was projected with the consideration of incorporating different extended shelf life technologies such as frozen meals, pasteurisation and thermoforming, and was optimised using the built-in OptQuest function on the platform.

BR 9 - Food Processing and Engineering 2

Session Co-Chairs: Bhesh Bhandari, University of Queensland, Australia; Mei Yin Wang, Singapore Institute of Technology, Singapore

Anand Mohan, University of Georgia, USA	**Development and evaluation of shelf-stable food flavoring using lemon waste**

Food loss/food waste totals a trillion dollars, and recent research shows minimal effort to redirect food waste/loss to improve the agri-food industry. With the rapid growth in the world's human population, using agricultural waste could help support sustainable food production systems. Efficient use of agricultural food waste presents potential applications in various food products. Lemon peels are a solid byproduct produced during lemon processing and frequently discarded as agricultural waste. Efficient and economical use of lemon peel may be suitable and sustainable for

various food products, including fruit and vegetable food products. This study was designed to develop and evaluate a shelf-stable flavoring ingredient from lemon byproducts that can be used as a natural flavoring and an ingredient in cooking. Our findings show lemon peel gel can benefit the agri-food industry by transforming food waste into a value-added product. The study evaluated carrageenan as an effective thickening agent with a 0.1% antioxidant as the most effective formulation for this product. We created small scale-up processing using three independent batches. Each batch was thermally processed using the hot-fill-hold method above 72 °C. The final product demonstrated that solid lemon gel was thermally stable, safe, and high quality.	
Petras Rimantas Venskutonis, Kaunas University of Technology, Lithuania	**Zero waste biorefining of small fruit pomace into functional ingredients by the innovative fractionation processes**
Berries are rich sources of health beneficial compounds. Large parts of berry harvests are used for pressing juice, generating large amounts of by-products, which currently are used inefficiently or even discarded as a waste causing the loss of nutrients and environmental pollution. Consequently, there is an urgent need of developing effective pomace valorization technologies. This study applied biorefining concept for the efficient recovery of high value components from berry pomaces using consecutive isolation of soluble substances by supercritical CO2 (scCO2E), pressurized liquid (PLE), ultrasound (UAE) and enzyme assisted (EAE) processes. Depending on berry species, optimized scCO2E, recovered 3-20% of lipids composed of polyunsaturated triacylglycerols, tocopherols, carotenoids and phytosterols. Next step, PLE or UAE with green solvents recovered 20-60% of soluble fractions containing high amount of polyphenolics. Finally, EAE of the residue enabled to recover additional water-soluble fractions. Phytochemical composition and bioactivities of fractions were determined by various chromatographic techniques and bioassays. In conclusion, applied technology enables obtaining lipophilic, 2-3 soluble higher polarity products and insoluble residue, consisting of dietary fiber, proteins and minerals. The products may be further fractionated for obtaining tailor-made concentrates of target compound groups. All of them may find purposeful applications in functional foods and/or nutraceuticals.	
Bianca Wassmann, ETH Zurich, Switzerland	**Introducing microalgae-based foods in Singapore: First insights into consumers' perceptions and needs**
The cultivation of microalgae—which are associated to nutritional, health, and sustainability benefits—has the potential to contribute a sizable portion of Singapore's future domestic food supply. However, to maximize the future acceptance of novel microalgae-based food products, consumer research aligning demand and supply is needed. To this end, the current study aims to establish a basic understanding of Singaporean consumers' perceptions, palate, and needs related to microalgae-based foods. Using a Singaporean sample, focus group discussions were conducted (N = 50). During these, participants' basic perceptions of microalgae and their perception of it in different product categories (e.g., noodles, meat and fish analogues) were assessed. Furthermore, possible motives (e.g., nutrition, health, and sustainability benefits) and barriers (e.g., expected taste, premium price) regarding the willingness to buy and eat these products were investigated. The interviews were transcribed and analyzed using qualitative analysis techniques. The results are discussed in respect to the conceptualization and development of potentially successful microalgae-based food products targeted towards the Asian/Singaporean market in a design-thinking approach.	
Yvan Llave, Tokyo University of Marine	**Ohmic cooking of rice at 20 kHz an experimental and computer simulation approaches**

Science and Technology, Japan	
Electric rice cooking (ERC) has been reported to be time- and energy-intensive with limited energy efficient. An approach to solve this problem is proposed here using ohmic cooking (OC) at a high frequency. Quality attributes such as texture, water content and its distribution, and gelatinization degree were analyzed. Two approaches to evaluate the electrical conductivities (EC) of rice/water system were evaluated considering temperature, moisture content, and gelatinization dependency: a rice grain system and a whole rice/water system. Simulation of the temperature profiles and distribution of rice during OC was conducted by coupling the electromagnetic field analysis and the heat conduction analysis, considering the two EC approaches, by two finite element-based software. Processing parameters such as voltage, time and temperature were fine-tuned by simulation and validated by experimentation to mimic as much as possible those observed during ERC. As a result, close texture characteristics under similar thermal schedules were obtained comparing both cooking methods. However, shorter process time and less amount of power consumption (< 50%) were obtained during OC compared to ERC, regardless of whether the rice was soaked or not. Results are of importance for the design of novel OC systems.	
Jie Hong Chiang, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**Improving the functional properties of mycoprotein and its application in wheat gluten-mung bean protein composited meat analogues**
Mycoprotein (MCP) is a fungal protein derived from the fermentation of filamentous Fusarium venenatum, which can be found in the market as alternative meat. MCP is considered nutritious with a high protein digestibility corrected amino acid score. However, the use of MCP in food applications is often limited by its poor functionalities. This study aimed to investigate methods of modifying the functional properties of MCP through ultra-sonication or pH shifting, or in combination. At 15% and 30% replacements, untreated and modified MCP were subsequently incorporated into meat analogues made with wheat gluten-mung bean protein composite using the protein elongation process. Results showed that the solubility and gelling properties of MCP increased when subjected to a combination of ultra-sonication and pH shifting methods. Meat analogues with 15% untreated and modified MCP exhibited the most visible aligned macrostructures upon tearing. At 30% MCP, the fibre formation was less defined, and its hardness increased with a decrease in springiness. Scanning electron microscopy analysis also showed that fibrous structures were the most prominent in meat analogues with 15% modified MCP. It was concluded that modified MCP shows potential as a protein ingredient in meat analogues with good microstructure formation.	
Luca Serventi, Lincoln University, New Zealand	**Treatment of legume processing water to develop sustainable bioactives for cardiovascular health**
More than half of freshwater is processed by the food industry, with large volumes of waste. For example, tofu production waste 1.5-10 L water/kg of product, costing about 130 US$/m3 in treatments. On the contrary, processing of such wastewater can reduce costs, while concentrating bioactives to improve human health, thus adding value to the chain and lowering its footprint. For example, wastewater of the legume industry (beans, chickpeas, soy and others) is produced during soaking, boiling, blanching and tofu making. Concentrates of legume water have been shown to contain prebiotic fibre, bioactive peptides, saponins and minerals.	

Legume water can be concentrated and specific bioactives isolated, possibly preventing and treating cardiovascular disease. Freeze-drying and spray-drying have been proven successful, but other technologies are available.

Our studies have shown that the processing water of broad beans and peas can reduce cholesterol bioavailability in vitro and the glycemic index of bakery products, respectively. The 3D printing technology allows design of specific food structures, aiming at enhanced sensory acceptance and optimal bioavailability. These clean technologies unlock the health potential of legume water, reducing industry footprint (less waste, no treatment), increasing its productivity (extraction of bioactives) and improving human health (cardiovascular activity).

Competition

Global Food Industry Award Judging (Peony Plenary Room / IUFoST Board Meeting Room) – Sponsored by K. H. Roberts

Juries:

- Vish Prakash, President IUFoST, India
- Aman Wirakartakusumah, President Elect IUFoST. Indonesia
- Lim Chee Kian, SIFST, Singapore
- Pavinee Chinachoti, GOIR Working Group, IUFoST, Thailand
- Sebastiano Poretta, IUFoST Board of Director, Italy

1 Nov 2022

08:30 | GMT+8
08:30 – 10:15 GMT+8

Main Plenary Room
Plenaries 3 & 4 and Young Scientist Award Presentations

Session Chair: Hongda Chen, IUFoST, USA

08:30 – 09:00 GMT+8

Yrjö H. Roos, Full Professor (Food Technology, School of Food and Nutritional Sciences), University College Cork	**Plenary 3: Advances and Misconceptions - Food Materials Science**
Biological materials including foods are complex dispersed and heterogeneous assemblies of substances where disorder rather than order is the norm. Noncrystalline states and molecular heterogeneities often dominate food materials properties. Superficial macroscopic characterization is common but provides limited knowledge for engineering needs and food product development. Microstructural heterogeneities and varying components affinity to water may explain unexpected phenomena and kinetics. Glass transition gained popularity in explaining dramatic changes in food solids properties, as it closely relates to kinetics and dynamics in foods of low water content or in frozen states. A frozen state is particularly complex because of temperature and food composition -dependent quantity of dispersed ice. Significant advances have been made in understanding food structure – properties relationships while ignorance of multicomponent microstructural heterogeneities and their impact on food performance in processing and storage is poorly described, and misconceptions of underlying causes may arise.	

09:00 – 09:30 GMT+8

Ratchanee Sydney Teepprasan, Director, Research & Innovation, Charoen Pokphand (CP) Group	**Plenary 4: Scientists to the Rescue: Food Security**
Are we going to run out of food? Where do we turn to if the supply chain is disrupted? How to prepare for resiliency in case the next pandemic hits? Is there a better way to feed the world? Can we rely on the free market mechanism to provide? What good are money and gold if they can't fill the hungry stomach of a billionaire? These are no longer just hypothetical scenarios. Covid-19, US-China geopolitical fights, the war in Ukraine .. all these turmoils make those big questions become real. This is a call to action. Scientists and researchers must join forces with innovators, entrepreneurs, investors, corporate and government executives, and public at large to prepare for and find solutions to tackle the impending doomsday.	

Young Scientist Awards Session 3 (Sponsored by Elsevier)

Session Chair: Richard Khaw, IUFoST & SIFST, Singapore

09:30 – 09:45 GMT+8

Mohsen Gavahian (Taiwan)	**Pineapple Core Valorization by Ohmic Heating: Bioactives, Antioxidant Activities, System Performance Efficiency, and Energy Consumption**
Ohmic heating is an energy-saving extraction technology and has been proposed to be used instead of traditional extraction protocols which are time- and energy-consuming. Due to fibrous texture, pineapple core is usually considered as a processing by-product, specifically in fresh consumption and in the canning process. Extraction through the application of emerging technologies, such as ohmic heating, can be used as an approach to produce value-added products from this agricultural/food processing waste. This research aims to assess the possibility of bioactive compound extraction from pineapple core by applying ohmic heating, to analyze the physical and chemical characteristics of the extract, and propose a platform for the production of possible health-promoting value-added products. An ohmic extraction system equipped with titanium electrodes at a voltage of 110 V was used to extract the bioactive from pineapple cores which were sliced to the circular-shape pieces with a dimension (diameter×thickness) of 3×1 cm. Water was used as the extraction solvent with two times the weight as compared with the pineapple core. This emerging thermal technology was then compared with conventional thermal extraction using a hot oil bath as the heating source to perform the extraction through conduction mode of heat transfer. Come-up time, heating rate, energy consumption, and system performance efficiency were then calculated based on thermal and electrical parameters. Besides, extracts were analyzed for antioxidant activity (ABTS•+ and	

DPPH radical scavenging activity) as well as total phenolics. All the tests were performed with three replications and significant differences were identified by SPSS software at a level of 0.05 among the means.

The results showed that ohmic heating reduced the come-up time by 17.28% and increased the heating rate by 31.36%. Also, this emerging technology reduces energy consumption by about 62%. It was also observed that the system performance efficiency can be improved by about 3 times when the conventional method was replaced by ohmic heating about. The extracts obtained in this study were rich in phenolics (142-201 GAE mg/ 100 g FW) and showed antioxidant activities. In addition, the extracts obtained by OHAE had higher antioxidant activity (IC50 of 20-216 and 25-413 mg/g FW according to the results of DPPH and ABTS assays, respectively). The valorization approach studied in this research can be employed to develop value-added products at a commercial level. This can also enhance the profit for the food processing industry and farmers. Besides, such an approach can reduce environmental concerns related to processing by-products/waste and boost resource efficiency to help with obtaining SDGs (sustainable development goals).

09:45 – 10:00 GMT+8

Iris Haberkorn (Switzerland)	**Leveraging Cellular Agriculture through Technological Innovation – Emerging Pulsed Electric Field Processing for Single-Cell Biorefinery Applications**

Today's society needs to find solutions ensuring global food security while maintaining planetary health. Concatenating technological innovation with novel raw material exploitation can aid establishing more climate-smart food systems. Cellular agriculture is gaining momentum, but the economization and sustainability of associated value-chains remains hampered. High costs owing low efficiencies in up- and downstream processing are a main bottleneck.

This research highlights emerging pulsed electric fields (PEF) as a holistic biorefinery concept leveraging cellular agriculture. Upstream, nsPEF enhances single-cell bioconversion efficiency up to 17.5% inducing intracellular abiotic, sub-lethal stress. Systematic investigations show the applicability to multiple organism domains (microalgae, yeast, bacteria). nsPEF also stimulates intracellular components, like phycocyanin, a high value-added colorant from microalgae. Downstream, µsPEF enables gentle component recovery maintaining structure and techno-functionality. During cultivation, µsPEF-induced reversible pore formation maintains cell viability allowing for multiple extraction cycles (up to 96.6 ± 4.8% of free soluble protein). Post-cultivation, µsPEF triggers autolysis induced membrane permeation stimulating endogenous enzymes for gentle component release.

PEF can become a high-impact technology resolving challenges hampering the economization of cellular agriculture tackling main bottlenecks of upstream efficiency enhancement and

downstream component recovery. It supports future food system development based on more sustainable scenarios sustaining a growing population.

10:00 – 10:15 GMT+8

Shimadzu "Food Sustainability World Lab Network" Memorandum of Understanding Signing Ceremony

09:45 – 10:15 GMT+8
Rooms: BR 1 & BR2 - Scientific Session
Waters Satellite Event - Waters TA@IUFoST - "Future Food Laboratory"
Registration and Tea Reception Networking Session - Posters & Technology Spotlight

Krishna Prasad, Waters Pacific, Malaysia	Opening and Introduction to Future Food Laboratory

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10:15 | GMT+8
10:15 – 10:45 GMT+8
Tea Break with Day 2 Poster Presentation

10:45 | GMT+8
10:45 – 12:15 GMT+8
Concurrent Sessions (Rooms: BR 1 – BR 10)

BR 1 & BR 2 - Waters Satellite Event - Waters TA@IUFoST - "Future Food Laboratory"

Future Food Laboratory

Dejian Huang, Department of Food Science & Technology, National University of Singapore, Singapore	Hungry for More?! A Researchers' Point of View on World of Modern Food Sciences and Measurement
Benjamin Smith, Future Ready Food Safety Hub, Singapore	We Are What We Eat: Understanding the Chemical Composition, Safety and Chemophobia of Novel Foods

Emerging Trends & Future Food Manufacturing Testing

Simon Hird, Waters Corporation, UK	Real-time Laboratories: Direct Analysis in Food Industry
SK Chua, TA, Singapore	Advanced Thermal Analysis Techniques in Quality Improvements for Food Industry
Simon Hird, Waters Corporation, UK	Future Proofing your Lab and Reveal the Unseen in your Samples

BR3 & BR 4 - Shimadzu 3rd Global Food Summit 2022

Natta Wiriyakun, NSTDA Characterization and Testing Service Center, Thailand	Driving Sustainable Food Innovation
Michiya Matsusaki, Osaka University, Japan	The Rise of Future Meat Technology: 3D Bio-Printing for Artificial Protein
Kaushik Banerjee, ICAR-National Research Centre for Grapes, Pune, India	Emerging Contaminants Analysis in Various Food Matrices
Joni Kusnadi, Central Laboratory for Life Sciences, Brawijaya University, Indonesia	Reliable and Compliant Halal Testing
Vandana Tripathy, Indian Agricultural Research Institute (IARI), Delhi, India	Overcoming Challenges to Pesticide Regulation at National Laboratories
Wang Tianhua, Singapore Institute of Technology, Singapore	Novel Insights into Food Adulteration and Microplastic Research
Sandhya Nargund, Shimadzu (Asia Pacific) Pte Ltd	Discover Living Laboratory for Safe and Sustainable Food

BR 5 - Ingredion - Be What's Next™ Innovation Session

Chandra Susilo, Regional Growth Platform Lead, Clean and Simple, Asia Pacific	Take on your toughest clean-label challenges with Ingredion
Finna Natacia, Innovation Lead, Bakery Solution, Asia Pacific	Deliver convincing meaty textures in plant-based meat and seafood
Thng Suh Fang, Innovation Lead, Dairy Solution, Asia Pacific	Deep dive into dairy alternatives
Melina Teo, Senior Food Technologist, Asia Pacific	Let's talk next gen tapioca: a versatile ingredient with multi-textural benefits
Sohan Singh, Regional Technical Lead, Asia Pacific	Cost-effective and clean-tasting sugar reduction solutions with innovative Stevia molecules

BR 6 - Food Chemistry and Ingredients 2

Session Co-Chairs: Fereidoon Shahidi, IUFoST, Canada; Peter K.C. Ong, K.H. Roberts, Singapore

Joy Sim, University of Otago, New Zealand	**Can near infrared spectroscopy predict coffee roasting volatile changes?**
The popularity of coffee worldwide continues to grow rapidly, with an increasing consumer demand for specialty coffee. Specialty coffee is premium grade coffee, known for its distinct flavour profile, sustainable production practice, and production from a single precisely defined origin. Coffee is traditionally graded through cupping, which involves the subjective method of tasting coffee to identify its flavour. To protect the producers and consumers of specialty coffee, more objective techniques are needed to verify the flavour and origins of the bean. In this study, green coffee beans originating from three continents, eight countries and 24 regions were investigated to address the link between origin and flavour. The samples were analysed using a multi-omics approach, integrating gas-chromatography mass spectrometry (GC-MS), nuclear magnetic resonance (NMR), vibrational spectroscopy, and geochemical analysis of trace elements and stable isotopes. Machine learning chemometrics and data fusion techniques were employed to produce an effective classification model. The coffee samples were successfully classified based on their origin using the applied multi-omics approach. It was demonstrated (i) that GCMS and NMR data can be integrated to understand flavour in specialty coffee, and (ii) origins can be linked to the flavour of the bean with potential geographical quality indicators identified.	
Mito Kokawa, University of Tsukuba, Japan	**Analysis of foods using spatially factorized spectroscopy**
We introduce a novel method for analyzing the chemical components of foods, namely, Spatially Factorized Spectroscopy (SFS). This method uses the spatial information acquired by hyperspectral micro-imaging to separate mixed spectra into their pure spectra and concentrations. In this presentation, we use simple O/W emulsions as samples and show that the acquisition of Raman spectra at microscopic points enables the separation of water and oil spectra. O/W emulsions were adjusted to oil ratios at 10 to 50%, and a droplet was mounted on an aluminum plate for measurement. Raman spectra were measured for 2500 points at 10-?m intervals. Multivariate Curve Resolution - Alternative Least Squares (MCR-ALS) and N-finder were used to separate mixed spectra into the sum of pure spectra. Data acquired using SFS were compared with one-point measurements on the same samples, and SFS was shown to be more effective in separating mixed spectra into their pure spectra. One of the largest challenges of non-destructive analysis is to separate target component information from irrelevant noise. SFS has shown to have high potential for achieving this separation.	
Jonina Marie J. Tengco, Institute of Food Science and Technology, College of Agriculture and Food Science, University of the Philippines	**Co-digestion of Bignay [Antidesma bunius (L.) Spreng] Pomace and Locally Consumed Grains Affects Starch Digestibility**
The Philippines is highly abundant in indigenous berries that offer health benefits beyond that of basic nutrition. One of these berries is bignay [Antidesma bunius (L.) Spreng], which is well utilized in the development of food products such as jam, fruit juices, and wine. The residues from bignay processing, called pomace, were found to contain high amounts of dietary fiber and bioactive compounds. This study evaluated the impact of bignay pomace on the hydrolysis of starch in locally consumed grains (rice, adlai, and white corn grits) and rice composites (50:50, rice:adlai	

and 70:30, rice:corn grits). A two-stage simulated in vitro gastrointestinal digestion was performed to determine the kinetics of starch digestion, hydrolysis index and estimated glycemic index (eGI) of the different grain samples before and after the addition of powdered bignay pomace. Results showed that co-digestion of grains and rice composites with powdered bignay pomace significantly reduced the rate and extent of starch digestion. Thus, there could be potential benefits associated with incorporating powdered bignay pomace into starchy foods to slow down starch digestion and lower the glycemic index.

Christofora Hanny Wijaya, IPB University, Indonesia	**Opportunities and challenges on the development of functional drink based on traditional wisdom: lesson learned on java tea-based drink**

"Djamoe" is a traditional Indonesian heritage used to maintain community wellness. Many active compounds with physiological benefits and biological activities are available in the utilized ingredients. A functional drink based on Java tea (Orthosiphon aristatus B.Miq) enriched with other djamoe ingredients from herbs and spices such as ginger, sappan wood, curcuma, and flavored with citruses has been developed. Series of reformulation efforts since 2016 have provided a drink with significant antioxidants and anti-hyperglycemic capacities; also sensorial accepted as a modern functional drink. The concentrate of this drink has been successfully commercialized since 2020. Further study to improve the bioactivity of the drink by nanotechnology approaches has also been conducted and showed promising results. Moreover, the addition of carotenoids rich "Papua" red fruit oil emulsion improved the stability and color acceptance of the product. However, the flavor and emulsion stability are still challenging. The presentation will highlight the brief story of the Java tea-based functional drink development.

Keywords: antioxidant, "Djamoe" reformulation, functional drink development, herbs and spices, java-tea

Shaun Yong Jie Sim, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**Efficient separation of plant protein fractions for targeted food and nutrition applications**

Plant proteins represent a promising solution to the escalating demand for proteins due to their long history of crop use and cultivation, lower cost of production, and better environmental sustainability. Beyond achieving high protein content, it has been recently observed that different plant protein fractions (e.g., albumin, vicilin and legumin) exhibit various techno-functionalities (i.e., solubility, emulsifying, foaming, and gelling), which could be captured for targeted food and nutrition applications. However, existing techniques to fractionate proteins – such as chromatography and the use of buffer systems – require expensive instruments or involve multiple dialysis steps, posing challenges for scale-up. To overcome this problem, we present a range of physical and green chemistry strategies to induce selective aggregation and separation of plant protein fractions based on their complex molecular structures. The successful separation was confirmed by liquid chromatography and gel electrophoresis analyses. Next, we will demonstrate the improved techno-functionalities (e.g., enhanced solubility and foaming properties) of the separated protein fractions compared to conventional protein isolates and their tunability for an array of food applications. Most importantly, we will discuss how our approaches can be adopted by existing food manufacturing processes, enabling large-scale production of fraction-enriched plant protein ingredients.

Xiying Li, The University of Melbourne, Australia	**Texture and collagen characteristics differ between pork longissimus and biceps femoris**
Connective tissue is considered to influence the toughness of meat. However, contradictory results on the relationship between collagen characteristics and meat texture have been reported. This study aimed to characterize the texture and collagen of pork Biceps femoris (BF) and Longissimus thoracis et lumborum (LTL). Cooking loss, Warner-Bratzler shear force (WBSF), texture profile analysis (hardness, springiness, chewiness, resilience and cohesiveness), collagen content and solubility, the percentage of Type III collagen relative to Type I and III collagen, and proteoglycan content were measured on BF (N=12) and LTL (N=11). The BF had higher WBSF (31.4 vs 21.6 N, p=0.004), resilience (0.453 vs 0.431, p=0.047) and collagen content (6.15 vs 4.52 mg/g meat, p<0.001) than LTL, but they did not differ in other texture and collagen parameters. Collagen content was positively correlated (p<0.05) with WBSF (r=0.47), hardness (r=0.49), cohesiveness (r=0.50), chewiness (r=0.58) and resilience (r=0.63). The percentage of type III collagen content was negatively correlated (p<0.05) with WBSF (r=-0.68) and hardness (r=-0.58). Collagen content was correlated (p<0.05) with WBSF (r=0.75) and hardness (r=0.61) in LTL and with cohesiveness (r=0.74) and resilience (r=0.63) in BF. Collagen characteristics contribute to pork texture in both muscles, although the relationships vary between muscles.	

BR 7 - U.S. Dairy Export Council (USDEC) Scientific Session

Pathways to Sustainable Nutrition: Consumer Voices and Dairy's Journey

Vikki Nicholson-West, Executive Director, USDEC Singapore Ltd	Opening Remarks, Introductions
Anvaya Sharma, Director, Ipsos Singapore	Food sustainability in Southeast Asia: what do consumers know, think and do
Frank Mitloehner, University of California, Davis, USA	The path for climate neutrality in the dairy sector
Panel Discussion	Q&A / Discussion

BR 8 - IUFoST – WG 1.2 Education Session 1

Lessons for the Future: A Post-Pandemic New Context for Food Studies Teaching Methods

Session Chair: Ferruh Erdogdu, Turkey and Cristina L.M. Silva, Catholic University of Portugal, Portugal

Fátima A. Miller, Portugal; Estela Nunes, Brazil; and Cristina L.M. Silva, Portugal	**Introduction: a post-pandemic new context for food studies teaching methods**
Before the COVID-19 pandemic, several technological tools were already being used in the educational environment of the food area.	

Cristina L.M. Silva, Catholic University of Portugal, Portugal	**Teaching methods adopted worldwide during the covid-19 pandemic in food studies**
Digital technologies occurred in a more dynamic way in the research sector, while in the teaching-learning system, it happened with a little more prudence, either due to insufficient infrastructure or poor familiarity with such technological resources. As a consequence of adopted sanitary measures, social isolation implied a very fast implementation of the digital transformation in the educational environment to avoid disruption and minimize the impact on learning processes. The new configuration brought challenges to educators and students and also promoted the development of capabilities and skills necessary to explore a range of new tools. The promotion of theoretical and practical knowledge in an integrated, dynamic, sustainable, responsible, and flexible way requires a reflection between traditional and new teaching methods. This session will discuss the barriers and established strategies to access learning platforms, communication tools, methodology for assessment, virtual classes, and others. It is important to assure the excellence and front position of leadership of education for the food area and support public policies in making decisions that will define the future of food studies in production, processing, and consumption.	
Azis Boing Sitanggang IPB University, Indonesia	**Perception and satisfaction level of students regarding the teaching practices during the covid-19 pandemic**
The COVID-19 pandemic caused an unanticipated shift in the way classes were delivered. Institutions moved towards online teaching as the only way to provide lectures and laboratory work. Both instructors and students had to quickly adapt to this challenging change. The objective of this study was to examine students' perspectives and levels of satisfaction in food-related majors regarding the teaching practices adopted. A questionnaire was created and distributed through professional networks and universities that offer food-related degrees worldwide. Participants were asked to rate their degree of satisfaction with virtual classes through a five-point Likert scale ranging from 1 «strongly disagree», 2 «disagree», 3 «neither agree nor disagree», 4 «agree» to 5 «strongly agree». Out of 388 student participants, about 49% were satisfied with the general formats of their online classes. Completing a discipline remotely took more effort than if it was taught in a face-to-face modality was felt by 66% of participants, and 56% were not motivated to attend the online classes. About 34% believed that remote learning would negatively affect their professional future, whilst 24% alleged the opposite. Additionally, about 52% of students shared that it would be better for some disciplines to be remotely taught in the future.	
Estela Nunes, Embrapa Swine and Poultry, Brazil and Cristina L.M. Silva, Catholic University of Portugal, Portugal; Ferruh Erdogdu, Turkey; and Adewale O. Obadina, IUFoST, Nigeria	**Challenges and solutions for future food studies education in different world regions**
The unprecedented outbreak of the COVID-19 pandemic has required the adaptation of faculty and students to adapt challenges and rapid transition from usual face-to-face studies to e-learning formats through virtual classrooms for future food studies. While most institutions are focusing on how to achieve this, the following challenges are given less consideration: less motivation for students to attend classes online, students are less resilient in classroom with decreased in attention, some students face challenges in adapting to this abrupt change in the delivery of the curriculum. The following approaches can be adopted to facilitate students' involuntary transition to virtual classrooms and maintenance of appropriate e-learning behaviours, establishment of	

working groups including several departments to work on solving issues and sharing experiences, blended learning for future food studies education, proper financing, and academic support for future food studies education to institutions who are having issues with e-learning. With this assistance, all institutions can establish universal platforms to function with the most updated management systems. All these should lead to the promotion of interaction and creation of warm(er) learning environment.	
Ferruh Erdogdu, Turkey and Cristina L.M. Silva, Catholic University of Portugal, Portugal	**Round table discussion**

BR 9 - Food Chemistry and Ingredients 3

Session Co-Chairs: Stephane Guilbert, IUFoST, France; Dejian Huang, National University of Singapore, Singapore

Neda Irvani, University of Otago, New Zealand	**Optimisation of high-speed shear homogenisation assisted with pH-shifting for protein extraction from Arthrospira platensis.**
Securing adequate protein supply in the future needs new initiatives to address the environmental impact of current large scale and intensive meat-derived protein production systems. Microalgae have potential as an alternative protein source, as they can be produced at an industrial scale, and contain almost a complete complement of amino acids. Arthrospira platensis is a high protein containing microalga, but there are challenges with achieving optimal protein extraction under foodgrade conditions from microalgae. The aim of this study was therefore to investigate the effect of high-speed shear homogenisation at different speed and time combinations followed by incubation at various pH, on the extraction of soluble proteins from A. platensis. The microalgae suspension (8% w/v) was subjected to high-speed shear homogenisation at various speeds (3000, 13000 and 23000 rpm), homogenisation times (1 to 3 min), and pH (2.0 to 12.0). It was found that compared to acid treatment, alkaline treatment in combination with homogenisation pretreatment effectively degraded the algal cell wall, resulting in a higher yield of extracted soluble protein. Increasing shearing speed from 3000 to 23000 rpm resulted in a substantial increase in the yield of extracted soluble protein. The maximum extracted soluble protein yield (405.34 mg g-1 DW) was obtained at pH 12.0 with a homogenisation speed of 23000 rpm for 3 min, and the lowest extracted soluble protein yield was obtained at pH 3.0 (14.51 mg g-1). Alkaline pH, combined with high-speed shear homogenisation, can achieve an economical method for extracting soluble protein from A. platensis and is industrially scalable.	
Keshun Liu, U.S. Dept. of Agriculture - Agricultural Research Service, USA	**Chymotrypsin inhibitor assay: expressing and standardizing inhibitor activity in absolute amounts of chymotrypsin inhibited**
Historically, trypsin inhibitor activity in soybeans and other legume products has been of primary interest for measurement. However, as plant proteins are increasingly used for food or feed in recent years, there is a growing interest in monitoring chymotrypsin inhibitor activity (CIA) in these products. Recently, at our USDA lab, a robust method was developed for accurately measuring CIA. Like all previously reported methods, the new method expresses CIA as chymotrypsin units inhibited (CUI)/mg sample. This makes comparison of results among reports impossible. To solve the problem, we carried out a new study, using the newly developed method with three	

chymotrypsin preparations having different specific activities. We then determined the relationship between absorbance and chymotrypsin concentration for each enzyme preparation. Since
conversion factors between CUI and chymotrypsin inhibited correlated highly with chymotrypsin specific activities, it became necessary to determine a standardized conversion factor against a reference chymotrypsin having a specific activity of 60 Nα-benzoyl-L-tyrosine ethyl ester/mg protein. Upon standardizing against this reference chymotrypsin based on specific activities of the three chymotrypsin preparations, a standardized conversion factor of 1.7 between CUI and chymotrypsin inhibited was determined. The new method can now express results in mg chymotrypsin inhibited/g sample.

Yoga Pratama, School of Food Science and Nutrition, University of Leeds, England	**Towards more diverse dairy products: highlighting differences in buffalo and cow milk fat crystallization behavior**

Buffalo milk (BM) has immense potential for solid-based dairy products such as butter and cheese due to its higher level of milk solids, particularly its milk fat content. The physical characteristics of dairy products are largely contributed by the presence of milk fat crystals. The present study aims to outline the key compositional differences between BM and CM fat and how this affects their crystallization behavior. Applying LCMS, 37 triacylglycerols have been identified from BM and CM fat samples where 20 species are presented in significantly different quantities. DSC and X-ray scattering measurements show that BM fat crystallizes and melts at higher temperatures than CM fat. On cooling from the melt at 2 °C/min, two main crystal lattices, α-2L and α-3L formed with dspacings of 48 Å and 72 Å, respectively. Interestingly, the early nucleation in BM fat is followed by a
slower formation of a more stable β‘-polymorph, as observed at lower cooling rates (0.5 °C/min). The delayed β‘-crystal formation is mainly attributed to higher olein content in BM fat. Promoting enhanced usage of BM in the currently cow-dominated dairy industry provides more diverse food options for better global food security.

Dong Uk Ahn, Iowa State University, USA	**Separation of ovoinhibitor from egg white and its potential applications**

A simple and scalable separation method of ovoinhibitor from egg white was established. After sequentially removing lysozyme, ovomucin, ovotransferrin, and ovomucoid from egg white using Amberlite FPC 3500 ion exchange resin, pH adjustment, acidic ammonium sulfate, and ethanol (35% final concentration, v/v) respectively, the resulting ovalbumin-rich precipitant was homogenized with 4 volumes of distilled water and then centrifuged. The extraction was done twice, and the extracts containing crude ovoinhibitor were pooled, concentrated using ultrafiltration, and then subjected to 35% saturation ammonium sulfate (final concentration) precipitation. The precipitated ovoinhibitor was dissolved in acidic water (pH 3.0), desalted and concentrated, and
then lyophilized. The product had 90.8% purity with a yield of 70.0%, and the MALDI-TOF MS/MS confirmed its identity. The inhibitory activity of the separated ovoinhibitor showed that it maintained protease inhibitory activities against elastase, trypsin, É‘-chymotrypsin, and subtilisin. This result indicated that the protocol was highly efficient, scalable, and environmentally friendly for separating ovoinhibitor from the egg white. Since the ovoinhibitor separated has strong protease inhibitory activities against elastase, trypsin, and subtilisin, it has great potential for food processing to prevent over-hydrolysis and in biological studies to prevent cell damages.

Lee Fong Siow, Monash University Malaysia	**Effect of selected alternative sweeteners on the physicochemical and sensory properties of dark compound chocolate**

Sucrose-free chocolate has been increasingly popular due to the rising health awareness of consumers for healthier choice food options. Sucrose substitution in chocolate is challenging owing to the multi-functionality of sucrose. This study aimed to determine the physical and sensory properties, and the storage stability of sucrose-free dark compound chocolate by replacing sucrose with inulin, fructo-oligosaccharides (FOS), trehalose, or maltodextrin (M10 and M30) on a volume basis along with stevioside as a sweetening agent. Sucrose substitution had no significant impact on the melting and crystallization behaviour in a compound chocolate model system. However, all sucrose-free dark compound chocolate displayed lower Casson viscosity, yield value and hardness than sucrose-containing dark compound chocolate, which may be due to the weaker particle-particle interaction in sucrose-free dark compound chocolate. Sucrose-free dark compound chocolate had a lower sweetness and stronger bitterness compared to the sucrose compound chocolate. Trehalose was the most suitable sucrose replacer in dark compound chocolate among the sucrose alternatives because it resulted in dark compound chocolate of similar rheological and sensory properties as the sucrose-containing dark compound chocolate. The trehalose-containing dark compound chocolate also exhibited greater resistance to bloom formation after 12 weeks of storage.

Sachin M Eligar, CSIR-Central Food Technological Research Institute, India	Effect of pretreatment on xylanase assisted arabinoxylan oligosaccharide production from pearl millet bran: characterization and their bioactivities

Arabinoxylan oligosaccharides (AXOS), important nutraceutical carbohydrate molecules, are made up of β-1,4 linked xylose backbone substituted with arabinose via α-1,2/1,3. The current study utilized an unexplored agro-processing by-product, pearl millet bran (PBM), to produce AXOS, characterize, and understand their bioactivities in vitro. PMB was subjected to sonication or autoclaving before digesting with xylanase (*Trichoderma viride*) to extract AXOS. Autoclaving enhanced 3.2 fold increase in AXOS production compared to sonication. UPLC, GC, and FTIR-spectra confirmed the presence of xylose backbone, arabinose and phenolic acid substitution, degree of polymerization, and degree of substitution in AXOS. The AXOS showed 74.4 and 81.1% inhibition of AGEs formation at 1 mg/mL in the BSA-glucose and BSA-fructose models, respectively. Antioxidant potential of AXOS was determined by DPPH (78% at 200 µg/mL) and ABTS (77% at 1 mg/mL) inhibitions. AXOS also showed a metal chelating activity (63% at 1 mg/mL). Further, AXOS strongly inhibited the growth of human duodenal adenocarcinoma cells HuTu-80 in a dose-dependent manner. The highest inhibition of 80% was observed at 1 mg/mL after 48 h. Pearl millet is the most widely cultivated millet, and the present study amply indicates that PMB can be an important natural source for producing nutraceutical AXOS molecules that can be used to develop functional foods.

BR 10 - Food Chemistry and Ingredients 4

Session Co-Chairs: Adewale Obadina, IUFoST, Nigeria; Shao Quan Liu, National University of Singapore, Singapore

Mohd Dona Bin Sintang, Nestle Research and Development Centre Singapore	**Flow properties of model gellan-guar aqueous systems comprising dairy protein**

Hydrocolloids such as gellan gum (GG) is important in formulation because of its weak-gel formation property that imparts unique rheological behavior. GG may be used in combination with other gums to achieve performance that is lacking in single system. Secondary gum inclusion affects GG's rheological behavior and textural quality.
This study investigated the flow properties of GG guar (GR) aqueous systems (AQ) in the presence of dairy protein at two storage temperatures, 30°C and 37°C. Overall, all GG and GR combinations exhibited non-Newtonian flow, with apparent viscosity decreased over shear. Power law model was used to generate flow behavior index (FI). GG provided strong ST behavior as indicated by the decrease in FI as its concentration increased in AQ. Increased GG concentration from 0.06 to 0.13% exhibited drastic decrease in FI as, higher concentration induced greater polymer overlapping, forming weak-gel. Combination of GG and GR exhibited increase in apparent viscosity and FI. Moreover, increasing GR in combinations increased viscosity and decreased ST, leading to alteration in rheological properties. Rheological response was contributed by the phase separate hydrocolloids network which was confirmed by confocal microscopy observation. Similar flow properties of AQ were observed at 37°C storages. Ultimately, this study shown the importance of an optimal ratio of GG with GR to ensure desired rheological and textural properties are attained.

Vassilis Kontogiorgos, The University of Queensland, Australia	**Adsorption kinetics and dilatational rheology of plant proteins at the air- and oil-water interfaces**

Adsorption kinetics and dilatational rheology of plant protein concentrates at the air- and oil-water interfaces were investigated at pH 7.0 in the presence of salt. Three interfaces (air, triglyceride and terpene) and four proteins (soy, pea, rice and mung bean) were investigated in the present work. The dynamic interfacial properties of the proteins were monitored by recording the temporal evolution of surface pressure using axisymmetric drop shape analysis. Kinetic modelling of the early and advanced stages of protein adsorption was carried out using the Ward-Tordai and GrahamPhilips thermodynamic approaches. Data modelling revealed that adsorption kinetics is independent of protein composition. Adsorption kinetics was similar between the different interfaces indicating that diffusion from the bulk to the interface is the main driving force. However, protein
rearrangement at the interfaces was an order of magnitude faster at the oil-water than at the airwater interfaces highlighting the role of protein hydrophobicity and amino acid composition. Dilatational rheology measurements and creation of Lissajous plots revealed differences in the strength of the interfacial layers depending on the prevailing conditions. Results show that an indepth understanding of the surface physical chemistry is required to select the optimum stabilisation strategy for food emulsions and foams using plant proteins. The above findings pave the way for the rational design of multiphasic foods using plant proteins.

Huei Hong Lee, International Food and Water Research Centre, Waters Pacific Pte Ltd	**Rapid Recognition of Monofloral Stingless Bee Honey using Ambient Mass Spectrometer with Chemometrics Analysis Software**

Stingless bee honey (SBH) has been used traditionally to treat various illnesses due to the abundance of bioactive compounds. This study presents a rapid recognition workflow to differentiate botanical sources of monofloral SBHs. Principal component analysis (PCA) and linear discriminant analysis (LDA) successfully clustered monofloral SBHs from different botanical sources, with cross-validation results showing a correctness score of up to 94.4%. SBH produced from Acacia Mangium nectars form a distinct cluster among the botanical sources studied, and prominent spectral markers of m/z 183, 189, and 207 were observed in positive polarity and m/z 270 in negative polarity. The potential identity of shortlisted markers was deduced from LC-HRMS results of the same honey samples, and the results suggest the presence of a flavonoid compound,

naringenin in Acacia honey. Acacia honey is also shown to have outstanding antioxidant activities of ABTS (29.85 ± 1.68 mM TE/mg), FRAP (89.27 ± 2.44 mM Fe2+/mg), and ORAC (167.55 ± 2.14 mM TE/mg) among the botanical sources studied. This study presents a rapid workflow for the untargeted analysis of SBH based on chemical fingerprints, which not only allows real-time recognition of botanical sources but also the chemical features conferring unique antioxidants which could be used for grading purposes.

Sofia Papadaki, National Technical University of Athens, Greece	**Formulation of functional food ingredients derived from marine invasive alien species in Mediterranean basin**

In the present study, the exploitation of marine alien species Lagocephalus sceleratus, Pterois miles and Fistularia commersonii was examined through the recovery and valorization of added value compounds with potential application on food products. In particular, polyunsaturated fatty acids and collagen were extracted from the flesh, skin and bones of the three studied species. The efficient recovery of the pre-mentioned marine derived components was achieved through the optimization of proper protocols and application of state of the art extraction techniques. Moreover, analytical techniques, such as GC-MS, HPLC, FTIR and spectrophotometric methods, were used in order to fully characterize the produced extracts. Finally, in order to cover the unpleasant odor of
fish origin bioactive compounds and to protect them from adverse environmental conditions, their encapsulation in natural origin polymeric matrices, such as whey protein, zein, modified starch, is necessary. For the formulation of final food ingredients spray drying and electrohydrodynamic process were evaluated as efficient encapsulation techniques. The present study can turn the problem of invasive alien species into a "Win-Win" solution by bringing to the food sector new formulations based on unique products origin and also controlling the invasive fish stocks in the Mediterranean achieving positive ecological and economic impact.

Marjia Sultana, Monash University Malaysia	**Calcium alginate-carboxymethyl cellulose hydrogel beads for co-encapsulation of L. casei and tocotrienol-enriched flaxseed oil**

The aim of this study was to co-encapsulate L. casei and tocotrienol-enriched flaxseed oil in calcium alginate-carboxymethyl cellulose (CA-CMC) hydrogel beads by extrusion-dripping technique. The hydrogel beads were spherical with 1.74 ± 0.01 mm in diameter. The encapsulation efficiency of oil and L. casei was 88.3 ± 0.74 % and 84.8 ± 2.0 %, respectively. The beads were shrinking and swelling in the simulated gastric and intestinal fluid, respectively. In vitro digestibility of the beads was also assessed regarding the release of the oil and the viability of the L. casei in the simulated gastrointestinal ï¬,uids (SGIF). Higher oil release percentage was observed in the intestinal fluid compared to the stomach fluid. Viability of the co-encapsulated L. casei with flaxseed oil
irrespective of the presence or absence of tocotrienol was higher in the SGIF and during storage at 4 °C for 30 days than the free and encapsulated L. casei without oil. Tocotrienol (400 ppm of oil) protected oxidation of the encapsulated oil during 30 days of storage at 4 °C and co-encapsulation with L. casei further improved its oxidative stability. CA-CMC hydrogel beads may be a good vehicle for the simultaneous delivery of L. casei and tocotrienol-enriched flaxseed oil.

Johannes Magpusao, University of the Philippines Visayas, Philippines	**Impact of mechanical processing on rheological and compositional properties of microalgal suspensions**

High pressure homogenisation (HPH) is a mechanical processing technology that has potential to modify the functionality of different food systems. Microalgae are a promising food source rich in proteins, polyunsaturated fatty acids, and other health-relevant bioactive compounds. Direct

incorporation of microalgal biomass as functional ingredients into food can result in modification of structural and organoleptic properties. This study investigated the rheological and compositional properties of aqueous suspensions (8% w/v) of two commercially relevant microalgae species, Arthrospira sp. and Tetraselmis sp., as impacted by HPH at different operating pressures. HPH effectively disrupted the algal cells and resulted to distinct rheological behaviour of the microalgal suspensions. The results show that HPH clearly disrupted the cells of Arthrospira sp. leading to an increase in viscosity and exhibited possible network formation based on particle size distribution
and microscopy analysis. Additionally, disruption by HPH led to increased pigment release, specifically chlorophyll a, for the treated microalgal suspensions. In contrast, Tetraselmis sp. displayed weaker network structure with HPH. Nonetheless, this demonstrated the potential of HPH as a structure-enabling process to alter the rheological properties of algal suspensions that could be tailored to suit specific food product applications.

Competition

BR 11 - Food Safety Without Borders Graduate Students Paper Competition – Supported by Singapore Food Agency

Competition Juries:

- Shen Ping, Singapore Food Agency, Singapore
- Conrad O. Perera, The University of Auckland, New Zealand
- Aman Wirakartakusumah, IUFoST, Indonesia
- Carol Wallace, University of Central Lancashire, UK
- Purnendu Vasavada, University of Wisconsin – River Falls, USA

Thomas Hay (Australia)	Profiling of alkaloid and cyanogen glycoside content of Piper hederaceum, a new bushfood crop for industry development
Yingyue Li (Singapore)	An antimicrobial surfactin producing Bacillus subtilis was able to promote plant growth but showed limited effectiveness in prevention of Salmonella enterica internalization
Peiru Gao (Malaysia)	Identification of anthropogenic particles in marine fish from Kota Kinabalu, Malaysia
Yue Wang (Singapore)	Membrane phospholipids and nucleotide derivatives in 'big six' Escherichia coli are targets of chlorine-based sanitisers during lettuce decontamination
Dipon Sarkar (Australia)	A Probabilistic Model for Assessing L. monocytogenes Risk from Paneer Consumption: A Case Study of Indian and Australian Supply Chains

12:15 | GMT+8

12:15 – 13:30 GMT+8

Main Plenary Room
Networking Lunch Symposium by U.S. Dairy Export Council with Day 2 Poster Presentation

Vikki Nicholson-West, U.S. Dairy Export Council Singapore Ltd.	**Welcome and Introduction**
Martin Teo, U.S. Dairy Export Council SE Asia	**Expanding Innovation Possibilities with Dairy Ingredients for Health and Nutrition**
	Networking

BR 1 & BR 2 - Waters Satellite Event - Waters TA@IUFoST - "Future Food Laboratory"
Exclusive Lunch with Waters – Poster & Technology Spotlight

13:30 | GMT+8
13:30 – 15:00 GMT+8
Concurrent Sessions (Rooms: BR 1 – BR 10)

BR 1 & BR 2 - Waters Satellite Event - Waters TA@IUFoST - "Future Food Laboratory"

In Partnership to Advance Future Food Innovation

Alois Schiessl, International Food & Water Research Centre, Singapore	Introduction to International Food & Water Research Centre (IFWRC)
Qi Lin, Abbott Nutrition R&D Pacific Asia Center, Singapore; Shao Quan Liu, National University of Singapore, Singapore; Max Rye, TurtleTree Labs, Singapore; Li Yan Chan, International Food & Water Research Centre, Singapore; Shrinivas Joshi, Waters & President India Section of AOAC International, India	Panel Discussion - Collaborations are Key to Moving Forward

Feeding the Future - Innovative Nutrition Laboratory

Sherry Zhang, Nihon Waters, Japan	Learning from Japan: Get Faster, More Reliable Food Analysis with the Ultra-Small Mass Detector
Daniel Ng, International Food & Water Research Centre, Singapore	A Novel Method to Screen for Bioactive Garlic Metabolites in Human Plasma with AccQ•Tag™ Reagents and UPLC™-ESI-MS/MS System

BR 3 & BR 4 - Unilever - Plant-based Protein: Unilever Vegetarian Butcher Perspectives

Plant-based Protein: Unilever Vegetarian Butcher Perspectives

Session Chair: Pavlic, Jasmine, Unilever Food Solutions

BR 5 - International Society for Nutraceuticals and Functional Foods (ISNFF)

Zero Waste Processing and Value-Added Food by-Product Utilization

Session Chair: Fereidoon Shahidi, Memorial University, Canada

Fereidoon Shahidi, Memorial University, Canada and Guangwei Huang, Almond Board of California, USA	**Use of processing by-products in generation of bioactive food ingredients: almond hull-derived functional products and beyond**
Processing by products of food, including cereal grains, legumes, oilseeds and nuts provide valuable sources of raw material for production of bioactive ingredients for use in a myriad of applications. These bioactives are present in a concentrated form in the hull/skin that are removed and often discarded as processing waste. Almond hulls are rich in fiber and phytochemicals, a special property that makes hulls unique for value-added utilization. Almond hulls contain 36% dietary fiber, including 6.5% soluble fiber, and contain up to 42% extractable sugars with about 9% non-fermentable sugars. Extracted phenolic compounds make up about 4 to 5.5% of almond hulls. Several food ingredients, such as functional dietary fibers, emulsifier, functional syrup, antioxidants, and a functional beverage drink powder, have been prepared from hulls by our collaborators at ABC. The products made from hull-derived ingredients have shown greater processing functionality and antioxidant capacity than popular commercial products. Based on preliminary economic analysis, the derived ingredients can increase hull value by 10 to 50 times after processing costs. Therefore, processing discards provide important ingredients for use in food and as value-added functional ingredients.	
Eric Decker, University of Massachusetts, USA	**Control of lipid oxidation and use of antioxidative by-products to help minimize food waste**
Lipid oxidation is one of the major forms of chemical deterioration in a variety of products that results in food waste. Lipid oxidation can be controlled by antioxidant strategies that scavenge free radicals, chelate metals and control oxygen. With current clean label trends, most antioxidant strategies currently originate from natural compounds. However, these natural antioxidants are often not as effective as synthetic antioxidants so research continues to focus on developing natural solutions. Certain antioxidant combinations can produce synergistic activities that greatly exceed the activity of the individual antioxidants. One good example if tocopherols and the amino-containing phospholipids, phosphatidylserine (PS) and phosphatidylethanolamine (PE). Unfortunately, PS and PE are currently too expensive for use as food additives. This challenge can be overcome by enzymatically converting commercial lecithin to high PE or PS lecithin that synergistically inhibit oxidation in both bulk oils and oil-in-water emulsions. Another synergistic combination is tocopherol and myricetin. Current research shows that this combination inhibits	

oxidation by the regeneration of tocopherol by myricetin and not by myricetin's ability to chelate prooxidant metals. Both of these synergistic antioxidant combinations present unique opportunities to improve the activity of natural antioxidants and thus achieve consume desired clean ingredient labels.

Chibuike Udenigwe, University of Ottawa, Canada	**Upcycling of agri-food by-products to promote better nutrition and health**

The agri-food industry generates a large amount of byproducts. For instance, several million tonnes of food waste materials are produced globally by the agri-food industry, including fish byproducts, eggshell, egg yolk, whey, oilseed meals, and others. These food materials contain significant amounts of usable biomacromolecules and micronutrients as well as non-nutrients such as bioactive phytochemicals, which can be reincorporated into food products. To promote a circular agri-food system, there has been a growing emphasis on the development of efficient processing methods to enhance the downstream processing of the byproducts for recovery of their constituents. This presentation discusses the prospects of various bioprocessing and emerging technologies for the recovery of various valuable molecules from agri-food byproducts, with the generation of limited secondary wastes. For example, bioprocessing methods have facilitated the recovery of natural peptides from dairy byproducts, with strong prospects for use as functional biomaterials, health promoting, and nutrient delivery agents. The challenges of upscaling and application of emerging technologies, especially in resource-constrained settings, are also discussed. The upcycling of agri-food byproducts has the potential to enable effective resources utilization for food/nutrient diversification, production of novel functional products, human health promotion, environmental sustainability, and global food security.

Hongda Chen, USDA, USA	**Innovations for value-added products from food waste by-products**

Food waste and loss are recognized globally as a significant threat to the food and nutrition security for humanity and the future sustainability. As reported by the United Nations, about 14% of food produced is lost between harvest and retail, and an estimated additional 17% of total food production is wasted in households, food service, and others. Unutilized portion of foods necessary during food processing and manufacturing, or known as byproducts, adds further to the already high percentage of the food W&L. Food science professional and practitioners have launched numerous efforts worldwide to develop innovative ideas and technologies to turn the loss into opportunities for addressing this grand societal challenge. This presentation will highlight a few examples of the current R&D efforts to create value-added food products from food waste and byproduct in the USA. They include 1). Upcycling fresh produce and fruits of sub-standards; 2). Additive technology for individually tailed nutrient delivery in 3D printed foods; 3). New food functional ingredients from plant protein precipitation side streams; 4) Extending shelf-life and improving quality of delicate fruits using nano cellulosic materials; and 5) Synthetic biology for manufacturing high value compounds and micronutrients from biomaterials derived from agricultural and food byproducts. These innovative efforts, along with many others around the world, will effectively minimize food waste and loss, and turn them into the value-added products for improving food and nutrition security and the sustainability. The future food processing system will be a significant contributor to the emerging trends of pursuing the circular bioeconomy.

BR 6 - Thermo Fisher Scientific: Scientific Session

Comprehensive solutions to protect our food supply

Dhaval Patel, Senior Manager, Application Scientist, Thermo Fisher Scientific	**Workflow innovations in food analysis: "Food for Thought"**
Valerie Louise Pietsch, Application Specialist, Thermo Fisher Scientific	**High moisture extrusion of plant-based meat: A small-scale approach to analyze the technological properties of plant proteins**

While the global demand for plant-based meat alternatives continues to grow rapidly, many consumers still lack diversity in marketed products, especially in terms of meat types and variety of protein sources. To meet consumers' demands, new products need to be developed that mimic taste, aroma and texture of meat as authentically as possible.

Generally, high moisture extrusion is considered as key technology for continuous production of plant-based meat. However, mechanisms involved in structure formation are not fully understood and individual for every protein source. This contribution addresses the application of a lab-scale twin-screw extruder as solution approach to gain insights into structuring mechanisms, facilitate product innovations and test novel protein sources at early development stages.

Since typical product characteristics of plant-based meat such as anisotropy and fibrousness are imparted into plant proteins by the flow pattern in the extruder die, a modular die was designed. Results show, how parameters such as die length and die entrance flow profile allow adjusting the die flow pattern and lead to different product structures. The influence of these parameters on product structure were evaluated using electron microscopy and image analysis. To asses mouthfeel, rheological measurements and texture analysis were performed and compared to meat.

BR 7 - Food Chemistry and Ingredients 5

Session Co-Chairs: Pingfan Rao, IUFoST, China; Conor Delahunty, Symrise, Singapore

Divya, Indian Institute of Technology Delhi (IITD), India	**Effect of methanol and aqueous extract asparagus racemosus root and treatment on antioxidants, bioactive constituents profiling lc-ms/ms**

Asparagus Racemosus (Asparagaceae; Liliaceae) plant wild due to increased industrial demand has necessitated its conservation and cultivation. Its tuberous roots, reversed for several therapeutic attributes in Ayurveda and characterized by steroidal saponins, are used in commercial preparation. This work aimed to study the Nepal variety, and analyse moisture, ash, saponin, and total starch content using the mega-enzyme kit and phytochemical characterisation i.e. bioactive constituents profiling and elemental analysis. The antioxidant activities (DPPH, FRAP, ABTS), phenolic and flavonoid content of the crude methanolic and aqueous extract of the dry powdered root of the Asparagus Racemosus were investigated. The total starch content in dry root powdered 52.81%, moisture content 9.82%, ash content 7.06%, ICP-MS – Sr,Ba,Rb,Zr,Cr, (10.13, 5.70,3.10,2.61,1.48 mg/kg) Cu,Zn,Pb elements not found. Methanolic extract show the strongest inhibition of DPPH activity (IC50 13.69 ug/ml), showing less potency than the standard ascorbic acid (IC50 7.47 ug/ml), FRAP (IC50 51.36 ug/ml) and ABTS (IC50 26.22 ug/ml), aqueous extract

(IC50 18.95, 74.91 and 60.21ug/ml). The value obtained for the concentration of total phenols is 12.90 ± 0.002 mg/g dry weight and flavonoid 0. 80 ± 0.001 mg/g dry weight in methanolic extract. The methanolic extract had higher total phenolic and antioxidant activity than the aqueous extract.

KEYWORD: Asparagus Racemosus root, extractions, LC-MS/MS, ICP-MS, mega-enzyme kit, antioxidant activities DPPH, ABTS, FRAP assay, phenolic and flavonoid content.

Nandan Sit, Tezpur University, India	**Dual modification of black kidney bean (*Phaseolus vulgaris*) starch using ultrasound and dry heat and its application in yoghurt**

The present study investigated the effects of dry heating (DH) (120ËšC, 2 h) and ultrasound (US) (35kHz, 30 min) modification and their combinations (DH-US and US-DH) on the physicochemical and functional properties of black kidney bean (Phaseolus vulgaris) starch. Significant changes in the modified starches were observed. The SEM images for kidney bean starch show mostly oval and round shaped particles. The surface irregularities with slight surface crakes have found to be imparted after US and US-DH dual modifications. Minute changes in colors as well as declination in the value of Lightness is noticed after modifications, where the ultrasound treated starch shows the lowest L value (47.043) among all. Although swelling power and solubility has been increased for all the modified starches. Moreover, improvement in freeze thaw stability and enhancement in Resistant starch (RS) content are also attributed after single and dual modification of the kidney bean starch. Shear-thinning behavior has seen in 10% starch gels after rheological test. Further, native and modified starches are applied in yoghurt preparation. Changes in the pH, Titratable acidity, syneresis, texture, color and rheological properties of starch blended yoghurt has been evaluated in reference to the control yoghurt.

Alejandra Acevedo-Fani, Riddet Institute, New Zealand	**Oil bodies extracted from hempseed: Structural and physical properties**

This study investigated the physicochemical and structural characteristics of oil bodies from hemp seeds (HOB). The microstructure of oil bodies in hemp seeds and after extraction was studied with cryo-SEM and CLSM. The proteins in HOB were characterized using polyacrylamide gel electrophoresis (SDS-PAGE). To understand the properties of interfacial components in HOB, the particle size and electrical charge were measured at different pHs and ionic strengths. HOB had an spherical shape with 3 to 5 µm diameter and sporadically distributed in the cell. The CLSM of extracted HOB revealed the uniform distribution of phospholipids and proteins at their surface. Polyunsaturated fatty acids are predominant in the fatty acid fraction; linoleic acid accounts for 60.7% of the total fatty acids. The SDS-PAGE analysis of washed and purified HOB revealed the major bands in purified oil bodies were around 15 kDa and 25-35 kDa. The colloidal stability of HOB in different pH and ionic strength conditions indicated that the isoelectric point was between 4 and 4.5 and aggregation was observed at these pHs. These results provide new knowledge on the structure, composition, and colloidal properties of HOB, which could be used as natural emulsions or lipid-based delivery systems in food products.

Fabrizio Sarghini, University of Naples Federico II, Italy	**Use of sugar substitutes as a mitigation measure in the acrylamide formation**

Acrylamide (AA) is a neo-formed toxicant that develops above 120 °C, during the heating process in certain foods. Its occurrence in baked products depends upon the concentrations of some precursors, mainly reducing sugars and asparagine, and its levels in the finished products should not exceed the threshold limits set by UE Regulation 2017/2158. As sugar plays a crucial role in the formation of AA, its partial replacement with sugar substitutes could be a reliable mitigation

measure to reduce the concentration of this compound. Therefore, this study set out to find the percentage of maltitol and erythritol to be added in place of sugar to minimize the AA formation. The biscuits were made from a basic short dough recipe and baked at 185 °C for 25 minutes then cooled at room temperature for 30 minutes before GC-MS analysis through pre-column derivatization by bromination. According to preliminary results, as low as 10% of replacer (maltitolerythritol mix 50:50 w/w), the AA levels in the baked biscuits showed a statistically significant decrease in the range of 5-15%.

Joseph Robert Nastasi, University of Queensland, Australia	**Potential of Australian native foods as new global food products: a case study on the functional, bioactive and compositional properties of *Araucaria bidwilli* (bunya) flour.**

The Bunya Nut (Araucaria bidwilli), traditionally known in the Indigenous language of Waka-Kabi as “Boonyi” is an important part of Australian Indigenous culture and for many thousands of years were a key source of nutrition in the Indigenous diet. Currently, there is a growing interest, both in domestic and international markets, for new flavours and textures of food, and Australian native foods can meet that demand. This study investigates the composition of macro and micro-nutrients in bunya and the structure and the functionality of the starch in the context of new food applications for the first time. The molecular chain length distribution of the starch chains before and after cooking revealed the presence of high intrisic enzymatic activty and unique branching patterns of amylopectin. Pasting and thermal properties of the starch indicate rapid granule swelling
and water holding capacity suggesting application of the starch as a bulking or thickening agent. In addition, the flour generated from Bunya was found to be gluten-free. Untargeted and targeted metabolomics of the bunya flour in comparison with rice and wheat flour further demonstrated the rich micronutrient profile of bunya flour which is hign in potassium, amino acids, and phenolic compounds with associated antioxidant activity.

Kieren Watkins, University of Melbourne, Australia	**Optimisation of seafood colour measurement with regard to machine, sample thickness and background**

Colour is one of the most important attributes for consumer acceptance of seafood, which makes its measurement by seafood producers, both conventional and alternative, an important capability. Colour data is normally collected using colorimeters such as Minolta CR400 and presented in the CIE L*a*b* colour space, but researchers have noted the dissimilarity in colour results to the sample. Machine vision using a camera coupled to a computer for image processing has been tested for improving colour measurement accuracy with favourable results in comparison to Minolta and Nix colorimeters, which produced colours that were at least similar to one another. The Nix and Minolta were however less affected by the tile colour behind the sample and also the thickness of
the sample. Finally, the number of technical replicate measurements required to obtain a sufficiently precise measurement was lower for the machine vision system than Nix or Minolta. Open-source code is provided to streamline photo processing for colour measurement. Given the greater precision and apparent accuracy of this machine vision system it is recommended for researchers studying the colour of seafood both raw and cooked.

BR 8 - Singapore Agency for Science, Technology and Research (A*STAR) Scientific Session

Raffael Osen (Session Keynote)	**Food rheology technology**

Elaine Wan Yi Peh, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**Influence of plant-based emulsion gels as pork fat replaces in Chinese luncheon meat**

There is a high prevalence of cardiovascular disease (CVD) in Asia, with a greater age-adjusted mortality rate from CVD than seen in Western countries. Dietary fat has been recognised as a risk factor for CVD. However, the total elimination or replacement of fat in food products may not be feasible due to the important role that fat plays in mouthfeel and flavour. In order for "fats" to maintain the product properties but minimise their impact on CVDs, a series of Emulsion gels (EG) prepared using rice bran oil, water, emulsifier (mung bean protein isolate) and konjac were developed. These EG were used to replace 25, 50, 75 and 100% of pork fat in Chinese luncheon meat. The nutritional, textural, and structural properties of Chinese luncheon meat were characterised. The results were compared with Chinese luncheon meat made from 100% pork fat as the control. When EG was used at 50% substitution of pork fat, the product had no significant difference to the control formulation of 100% pork fat in terms of textural properties. These results confirm applying EG as a fat substitute in various traditional Asian foods.

Phoon, Pui Yue, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**Development emulsion gel hybrids structured by natural food fibres**

The incorporation of healthy unsaturated fat in solid food formulation, e.g. vegan meat alternatives, is globally championed. However, this is challenged by limitations in the textural attributes and processability of oil. This requires new strategies to modify the rheological behaviour of oil. Here, we report the first characterisation of novel, oil-rich emulsion gel hybrid templates, created through maneuvering natural food fibre structurants such as citrus fibre, soy polysaccharides, curdlan gum, and konjac glucomannan. We accomplish the feat of creating physically stable templates with 40-85% sunflower oil content. The templates exist in classes of oil-in-water or water-in-oil emulsions, or with both classes co-existing in the same formula. The oil-water ratio has no straightforward influence over which format would dominate. At ambient temperature, the templates exhibit a wide range in storage modulus (<100 to >2500 Pa, 10 Hz). This stems partly from the influence of aqueous phase viscosity (<1200 to >64,000 mPa.s, 10 Hz) and, as evidenced by fluorescent-microscopy and micro-rheology analysis, partly from the extent of closeness in dispersed phase packing on the micro-scale. The varied characteristics of the templates bear implications on their thermal and rheological attributes when processed at high temperature and shear flow, which would be studied next.

Yvonne Chow, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**Raspberry ketone production in fluidized bed bioreactor**

Raspberry ketone (RK) is the main component of raspberry flavour and has high commercial value in the food and healthcare industries. Extraction of the micro amounts from fruits is not practical, and the current chemical synthesis creates an environmental footprint due to its high-energy consumption and pollutive by-products. The raspberry biochemical pathway is uncommon in unicellular microorganisms, hence microbial production of this compound has not been very

successful to date despite genetic engineering efforts. In this study, a clean and sustainable bioprocess to produce natural RK by fungal fermentation of *Nidula niveo-tomentosa* is proposed. This species possesses a natural pathway converting sugar and phenylalanine to raspberry ketone, known to further react to produce raspberry alcohol. A 3-phase fluidized bed bioreactor for fungus of pellet morphology was designed by 3D printing, where the fungal pellets may be suspended by the liquid nutrient medium and air supply circulation. Our results show that gas sparger design, orifice size and gas flowrate affect pellet fluidization and subsequent RK production, but not biomass growth concentration. As biomass increases during the fermentation, the pellets gradually settled into a packed bed if the sparger orifice size was too small. Compared to literature reports of small-scale production by *Nidula niveo-tomentosa* at least 3 times higher maximum RK concentration could be achieved using our bioprocess. This study points towards a cleaner and sustainable approach for RK production at mild conditions.

BR 9 - Traditional and Future Foods

Session Co-Chairs: Sebastiano Poretta, IUFoST, Italy; Jeroen Schmitt, Agency for Science, Technology and Research, Singapore

Siegrist Michael, ETH Zurich, Switzerland	**Will alternative proteins substantially reduce meat consumption?**
Animal-based foods tend to have a high environmental impact. A reduction of meat in the diet has been proposed as a strategy to reduce the environmental impact associated with food production. It is widely assumed that alternative proteins, such as highly processed plant-based meat alternatives, cultured meat, insects, or algae, could substantially reduce animal protein consumption, and that this may result in a more sustainable food system compared with the current one. However, we have some serious doubts that these alternative proteins will result in a substantial decrease in animal protein consumption. The per capita consumption of highly processed plant-based meat substitutes is low. There are also several challenges and barriers to overcome before cultured meat plays an important role in people's diets, and insects as food face a lack of consumer acceptance. It remains to be seen to what degree alternative proteins will be substitutes for meat and to what degree this will result in higher consumption of animal protein. We have some serious doubts that technological food solutions will be sufficient to solve the problems associated with meat consumption. A quick change from animal proteins to alternative protein sources should not be expected.	
Ruihong Zhang, University of California, Davis, USA	**Mycoprotein foods produced through microbial conversion of agricultural by-products**
Microbial biomass, produced under controlled environmental conditions, can be used to produce safe, nutritious and sustainable foods. At University of California, Davis, new technologies were developed for producing edible, protein-rich fungi and microalgae using the nutrients extracted from agricultural byproducts, such as almond hulls, pomegranate peel, carrot pomace, red beet peel and coffee ground.One of the novel foods created is called BioBoba, which were produced from cultivated Aspergillus awamori and other filamentous fungi. It has over 20% protein and low contents of sugar and fat, and can be used to replace boba in the bubble tea or put in the ready-to drink or eat food products. The BioBoba can be made into different colors, flavors and textures. A novel method was developed and used to produce the fungal pellets of complex structures. The precultured fungi was coated with biopolymers and then allowed to grow further to form the	

complex structure. The coated pellets were compared with un-coated pellets regards to their texture, color, shape, and bioactivity. It was found that the biopolymer-coating process improved the texture of mycoprotein pellets, based on the texture measurement of chewiness, adhesiveness, hardness, and springiness. The findings of this research and product development are important for producing healthy and shelf-stable mycoprotein-based food products.

Ruchita Rao Kavle, University of Otago, New Zealand	**Macro- and micro-nutrient content and nutritional indices of wild harvested Huhu grub (*Prionoplus reticularis*) edible insect at various development stages**

Prionoplus reticularis (or Huhu grubs) are edible insects unique to New Zealand. Although edible insect research has been steadily increasing in the past decade, there is no information on Huhu grubs' nutritional value and safety. Therefore, this study aimed to determine Huhu grubs' nutrient content and nutritional indices of four identifiable development stages (small, medium, and large larvae and pupae). Huhu grubs contained substantial levels of nutrients (26.2-30.5% protein, 32.1-58.4% fat, and 1.5-3.2% ash, DW basis) and 28 minerals were identified. The most abundant minerals were potassium (5936.7-11200.0 mg/kg), zinc (50.2-70.2 mg/kg), magnesium (1233.3-1306.7 mg/kg), and iron (28.0-37.0 mg/kg). Cadmium and lead were the only two heavy metals that could be detected. Palmitic acid, oleic acid, and linoleic acid were the most abundant saturated,
monounsaturated, and polyunsaturated fatty acids. The ω6/ω3 ratio ranged between 16.23 and 29.54. The atherogenicity indices ranged between 0.32 and 0.37, and thrombogenicity index range was 1.63 – 1.99. This study indicates that all the Huhu grub development stages are nutritious, but they differ in their nutrient, mineral content, and lipid nutritional indices. In conclusion, wild harvested Huhu grubs are nutrient dense.

Priti Mudgil, United Arab Emirates University, UAE.	**Dipeptidyl Peptidase IV (DPP-4) inhibitory bioactive peptides derived from traditional emirati cheese (Chami) prepared from milk of different domestic animals**

Chami, an Emirati traditional soft cheese, is prepared via natural lactic acid fermentation mainly from bovine milk or from mixture of goat, sheep and bovine milk. It is commonly consumed during breakfast and possess nutritional benefits. Besides providing nutrition, Chami could be a potential source of bioactive peptides with health beneficial properties. However, to the best of our knowledge, there is a lack of scientific literature regarding exploration of bioactive peptides with health beneficial effects derived from Chami. Therefore, this study aimed towards identifying biologically active peptides with antidiabetic potential from Chami. The water-soluble peptides (WSP) from Chami cheese were extracted by hot water extraction and further subjected to ultrafiltration using 10 kDa & 3 kDa filters to attain 4 different molecular weight (kDa) sample sets More than 10 kDa (MT10), Less than 10 kDa (LT10), between 3-10kDa (B3-10) and and less than 3 kDa (LT3). Results obtained suggested that among unfractioned control samples from sheep Chami peptides showed least DPP-IV IC50 values (99.37 µg protein equivalent), followed by camel Chami peptides (104.4 µg protein equivalent). Interestingly, fractionation led to an increase in DPP-IV IC50 values indicating that these peptides act synergistically towards inhibition of DPP-IV. Peptidomic profiling of WSP from each type of chami revealed that from camel, bovine, goat and sheep Chami a total of 8, 9, 6 and 10 peptides were found to be potential bioactive peptides as per their peptide Ranker score. Among these peptides, FLPVCS from camel Chami, QRGLPLL from bovine Chami and PAGLPHL from Sheep Chami were found to strongly interact with DPP-IV enzyme active sites and hotspot residues. Hence, it can be concluded that products like chami can be used as an important source of bioactive peptides, and this research will possibly enable the industry to expand their range of products and consumer market in the United Arab Emirates (UAE).

Lijing Ke, Food Nutrition Sciences Centre, Zhejiang Gongshang University, China	**Magnesium, iron and copper ions regulate oxidative responses and inflammatory cytokines of macrophages**

The body ‘cooling’ and ‘warming’ effects of food and medicine have recognized and utilized by traditional Chinese medicine for hundreds of years. The principal components of fruits and vegetables corresponding to these effects have been identified to be magnesium, iron and copper ions in combination. The metal ions play decisive role in regulating redox balance of cells and subsequentially alter cellular functions. This study aims to elucidate the regulatory effects of the triple ions’ solutions on the oxidative responses and inflammatory cytokines in RAW264.7 macrophage cells. Two ‘cooling’ solutions and two ‘warming’ solutions were prepared with MgSO4, FeSO4, and CuSO4. The contents of three ions were calculated with a previously established regression equation and set to the physiologically meaningful levels (at ppm). It was found that the 'cooling' solution exhibited antioxidative and anti-inflammatory effects in the cells. They reduced the intracellular ROS level and restored the mitochondrial respiratory of the AAPH-insulted macrophages, while suppressing the LPS-induced expression of TNF-α, IL-1β, and IL-6 in the macrophage. Conversely, the 'warming' solutions exhibited pro-oxidative and pro-inflammatory effects as they increased the intracellular ROS level and promoted the expression of inflammatory cytokines in normal cells. It demonstrates the significant regulatory effects of the cocktails of magnesium, iron and copper ions in oxidative and inflammatory responses of murine macrophages.

Kong Yan, National University of Singapore, Singapore	**Functional composite microbeads for cell-based meat culture**

Hydrogel microbeads are promising supports for cell-based meat culture but there is a lack of functional microbeads that are food compatible with good cyto-affinity and cyto-proliferation. Herein we report the development of functional microbeads with the desired diameters using electrospray technology. While naked alginate microbeads have poor cyto-affinity, different gelatins derived from animals and gelatin mimics derived from plants, were grafted onto the beads to enhance cytoaffinity suitable for meat culture. The modified microbeads can maintain round shape of alginate microbeads with mean diameters of 94.81 to 159.5 µm. C2C12 cells were used to identify gelatin mimics from scores of plant proteins and hydrolysates with the best performance in stimulating cells adhesion and proliferation. We found that certain plant proteins as well as animal derived
gelatins could achieve 17-fold proliferation of C2C12. With the successful differentiation of C2C12 and proliferation of 3T3-L1 adipocytes and primary porcine myoblasts on plant-based gelatin, cells and microbeads can form clusters and finally become spheroids, illustrating that our plant-based microbeads are promising microcarriers for mammalian cell culture and cell-based meat production. Cell adhesion peptide RGD was identified from the plant proteins, therefore, the plant proteins are possible to replace animal derived ECM materials.

BR 10 - Agri- and Aquaculture

Session Co-Chairs: Suzana Lannes, IUFoST, Brazil; Sin Bin Chua, Haidilao, Singapore

Yuki Tsutsumi, Tokyo University of Marine Science and Technology, Japan	**Novel and simple image analysis for evaluating the bleeding level in horse mackerel muscles**

Bleeding (or blood removal) is an important procedure to maintain fish quality that contributes to the effective utilization of marine resources. The bleeding level is commonly evaluated by analyzing hemoprotein content in fish muscles. However, the typical analysis requires time and effort, and thus, is not used by the seafood industry. Therefore, the development of a simple technology for evaluating the bleeding level in fish muscles is desirable. Thus, a visible image analysis for measuring difference in blood vessel area was investigated. A horse mackerel (Trachurus japonicus) was bled by cutting its gill, branchiostegal membrane, or tail. Subsequently, the dorsal muscle was solubilized in a 10 % SDS solution and its hemoprotein content was spectrophotometrically determined. Dorsal blood vessels, such as segmental arteries and veins, were photographed under visible light and image analysis was performed using Image J. Hemoprotein content and blood vessel area were found to decrease owing to bleeding, which was dependent on the cut location. Furthermore, the linear regression between the hemoprotein content and blood vessel area had a high correlation (correlation coefficient R = 0.9). Therefore, a visible image analysis is useful for estimating hemoprotein content and evaluating the bleeding level in fish muscles.

Adrian Fuhrmann, ETH Zurich, Switzerland	**Adapting black soldier fly rearing to the urban environment**

Black soldier fly (Hermetia illucens) larvae could play an important role in transforming the food system. The larva can feed on a variety of organic wastes. The arising larval biomass can be used as high-quality feed, whereas the residue from the process serves as plant fertilizer. For the spacelimited urban food system, this circular-economy technology is largely underdeveloped. Further, its sustainability performance depends on the in-situ utilization of residues from rearing. As a solution, we propose a decentralized approach consisting of small, semi-automatized rearing systems. As a first step we seek to identify parameters relevant for a self-regulating autonomous rearing system. To prototype our proposition we designed air-conditioned, sensor-equipped modules in the laboratory. Further, in a pot study, we investigated influences of the residues on the plantassociated microbiome and soil fertility using high throughput sequencing with ribosomal markers.
Our rearing units have the potential to reduce labor costs and to deal with varying organic waste inputs in urban settings. Whereas our findings suggest that residues impact soil fertility by biotic and abiotic factors, thus providing urban farming with locally sourced, sustainable fertilizer. Together, our research aims to support the development of a circular food system in urban areas like Singapore.

Alexander Mathys, ETH, Zurich, Switzerland	**Efficient black soldier fly larvae-based biowaste utilization to produce more sustainable animal feed**

Novel animal feeds based on black soldier fly larvae (BSFL), Hermetia illucens, promise benefits for the affordability, quality, and sustainability of monogastric livestock production. To realize these benefits, BSFL need to be grown on heterogenous biowastes with typically high fibre contents however, this mainly leads to variable BSFL rearing performance. Our research identified that biowaste pre-treatments and formulations of biowaste mixtures are promising approaches for more efficient and predictable rearing. In comparison to individual wastes, biowaste formulations resulted in a higher rearing performance and lower variability. The bioconversion rates for the individual wastes were 25% below the benchmark chicken feed. In contrast, formulations of the same wastes
lay 9% above the benchmark. Physical, chemical, or biological pre-treatments could further increase bioconversion rates by enhancing fibre digestibility. Digesting biowastes in the first in vitro simulation of BSFL digestion delivered estimates of digestibility for optimized formulation and the model could indicate in vivo outcomes. These innovations need to be considered in comprehensive life cycle assessments of relevant industrial productions. Our results indicate that

high-protein BSFL meals can have lower environmental impacts than fishmeal but impacts remain higher than soybean meal. These impacts could be lowered by using pre-treatment and biowaste formulation
concepts.

Rahel Suchintita Das, University College Dublin, Ireland	**Investigating the potential of innovative pre-treatments and ultrasound assisted enzymatic extraction for the recovery of protein from the brown macroalgae *Alaria esculenta***

This study aims to explore the impact of pre-treatments (using ultrasound, microwave and combination of both) followed by application of enzyme alone or combined with ultrasound for enhancing protein extraction from Alaria esculenta. As pre-treatments, ultrasound-assisted extraction (UAE: 25-100 W), microwave-assisted extraction (MAE: 336-1340 W), and combined ultrasound–microwave-assisted extraction (UMAE at the same power ranges) were investigated for 5, 10 and 20 min using a fixed macroalgae:water ratio of 1:10 (w/v). Pre-treatments achieving highest protein yields from each method were UAE (200 W, 20 min), MAE (1340 W, 10 min), with the overall highest protein yield being achieved by UMAE (ultrasound: 100 W; microwave: 1340 W; 20 min). The residues from these 3 technological pre-treatments, were selected for further extraction using ultrasound (25 and 45 kHz) alone, Viscozyme™ (0.25% (v/v)) addition alone, and combination of ultrasound and Viscozyme™ (UAEE) at the aforementioned conditions using a fixed residue:water ratio (1:20 (w/v)), for 3 and 6 h. Enzyme addition, alone or in combination with ultrasound, did not improve protein extraction, with the highest protein yields being achieved by ultrasonication alone (25 kHz, 6 h). Hence, it can be proposed that, simultaneous ultrasound and microwave (UMAE) as pre-treatment, followed by further ultrasonication at low frequency (25 kHz) can facilitate the protein extraction process from Alaria esculenta.

Tong Thi Anh Ngoc, Can Tho University, Vietnam	**Prevalence of antibiotic resistance *Escherichia coli* isolated from Pangasius catfish (*Pangasius hypophthalmus*) fillet during freezing process at two factories in Mekong Delta Vietnam**

Total of 261 samples of fish and environmental samples (i.e. wash water, swabs of hand/gloves of workers, fish contact surfaces i.e. knives, cutting boards and working tables) were collected from two Pangasius processing factories (PPF1 and PPF2). A total of seventy-one (71) isolates of Escherichia coli were selected to study the prevalence of antibiotics resistance using disk agar diffusion method. Overall, it was determined that 61% (22/36) of PPF1 isolates were resistant except to colistin while 68.57% (24/35) of PPF2 isolates were resistant except kanamycin. High resistance was against ampicillin in both PPF1 and PPF2 isolates (47.22% and 42.86%), followed by cefotaxime (33.33% and 40%) respectively. Varying resistance response to all other tested antibiotics such as streptomycin, meropenem, tetracycline, sulfamethoxazole/trimethoprim and nalidixic acid was also observed among the E. coli isolates from both factories. About 50% of the multidrug resistant (3-9 antibiotics) among PPF1 were observed whereas there were 45.83% multidrug resistant (3-7 antibiotics) among PPF2 isolates. The result from this study reflected that there was a prevalence of multi-drug resistance of E. coli isolated during the processing of Pangasius at the studied factories. Therefore, there is a need for an effective risk management assessment models and management plans from stakeholders involved in the Pangasius value chain (i.e. farmers, processors and government) to ensure the food safety of production chain.

Chou, Yu-Jou, National Taiwan University, Taiwan	**Effect of processing gas on the ability of atmospheric plasma to improve the vigor of mung bean**

Mung bean is rich in nutrients but is not easily absorbed nutrition due to its containing of antinutritional factors, such as phytic acid and trypsin inhibitor. Germination could increase dietary fiber, promote protein utilization, and reduce anti-nutritional factors in bean. However, many environmental factors could decrease seed vigor and limits the rate of germination and the

resulting appearance of the sprout. Atmospheric cold plasma is a non-thermal processing technology that can promote seed growth and increase its production of bioactive components. Reactive species in the plasma is significantly affected by processing gas used to generating it. Therefore, the purpose of this study is to investigate the effects of different processing gas on the ability and efficiency of plasmas to improve seed vigor. Processing gases including nitrogen, argon and air were used to
treat bean, which is later cultivated for the evaluation of bean vigor. The results showed that the activity of mung bean after all plasma treatment increased regardless of processing gas. However, air-plasma contains more ROS and RNS species showed more significantly improvement. Thus, plasma generated from air containing higher concentration of active oxygen species was found to be the most suitable source for promoting the mung bean germination.

Kuan-Chen Cheng, National Taiwan University, Taiwan	**Surgarcane bagasse via coaxial electrospinning as the support for *Kluyveromyces marxianus* k21 immobilization in bioethanol production**

Microbial immobilization is a kind of the potential technique for the related application of bioenergy, which maintains highly content, stability and biological activity, and prompts the growth and reproduction of microorganism to be rapid under suitable conditions. In this study, a novel approach to increase mechanical properties of carriers for Kluyveromyces marxianus K21 immobilization was modified by coaxial electrospinning, which combined the poly vinyl alcohol (PVA) and the agricultural waste - sugarcane bagasse (SB). To optimize the SB extraction, the response surface methodology (RSM) was used, and the results showed that the optimized conditions of SB extraction were added 6.34% SB concentration into the 1.84% H2SO4 solution at 70.85oC for 30 min, which may obtain 0.43 mg/g polysaccharides. The bioethanol production was about 18.8 mg/L
ethanol by K. marxianus K21 immobilization after 12 hours cultivation, comparing to the free bacterium group, the ethanol production efficiency was no significant difference. In the reusability, the immobilized K. marxianus K21 on PVA/SB still had the same ethanol production ability after being stored for 8 days or reused for 8 cycles, which showed great storage stability and reusability. Therefore, the PVA/SB carrier by coaxial electrospinning had the potential for the promotion of bioenergy production with friendly environment.

Competition

BR 11 - Undergraduate Students Product Development Competition Session 1 – Sponsored by Cargill

Competition Juries:

- Pavinee Chinachoti, GOIR Working Group, IUFoST
- Jairo Romero, IUFoST, Colombia
- Johanna Tan, Temasek Polytechnic, Singapore
- Sebastiano Poretta, IUFoST, Italy
- Alvin Lee, Institute for Food Safety and Health, Chicago, USA

Team Name	Institution & Country	Title of Project
Balistar	Atma Jaya Catholic University of Indonesia, Indonesia	Plant-Based Balinese Satay Lilit using Fermented Rice Bran and Durian Seed Starch

Okhana	Monash University Malaysia, Malaysia	Okhana
APEX Food Craver	Universiti Sains Malaysia, Malaysia	Jack Kwa
Acesteria	Singapore Polytechnic, Singapore	"Twist & Gel" Jelly Drink
Silkworm Pupa cheese (Video Recording)	Jiangnan University, China	Silkworm Pupa Cheese

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15:00 | GMT+8

15:00 – 15:30 GMT+8

Tea Break with Day 2 Poster Presentation

15:30 | GMT+8

15:30 – 17:00 GMT+8

Concurrent Sessions (Rooms: BR 1 – BR 10)

BR 1 & BR 2 - Waters Satellite Event - Waters TA@IUFoST - "Future Food Laboratory"

Feeding the Future - Innovative Nutrition Laboratory

SK Chua, TA, Singapore	**Analysis of Chocolate Using Tribo-Rheometry and its Correlation to Mouth-Feel**
Sateesh Tummala, Waters Corporation, Singapore	**Integrated Workflows in a Single Dashboard**

BR 3 & BR 4 - International Association for Engineering and Food (IAEF)

Novel Thermal Processing

Session Chair: Hosahalli Ramaswamy, McGill University, Canada

Sudhir Sastry, Jin Hong Mok, Chaminda Samaranayake, The Ohio State University, USA	**Electric fields and their effects on vegetative microorganisms, spores and enzymes**
Interest in the use of electrotechnologies for food processing was revived in the 1980s due to industry interest in delivering improved food quality while assuring safety. A notable development	

has been the discovery that under the right temperature conditions, low-frequency (< kHz) electric fields result in inactivation of bacterial spores at a greater rate than purely thermal methods. The efficacy of combined electrical and thermal (electrothermal) approaches suggests that the electric field interacts with specific components within the spore to cause inactivation. Studies on the effects of electric fields a number of enzymes, including pectin methylesterase, alpha amylase, peroxidase and cellulase, have shown activation of the enzyme at sub-optimal activity temperatures, and accelerated inactivation at above-optimal activity temperatures. Further, studies on the effect of frequency have shown enhanced activity below specific frequencies.

Hosahalli Ramaswamy, McGill University, Canada	**Current research on microwave osmotic dehydration: Effect of solute mixtures**

Microwave osmotic dehydration (MWOD) has the ability to enhance moisture loss (ML) and limit solids gain (SG) as compared with conventional OD treatments. MWOD has been shown to be effective both in the medium immersion mode (MWODI) and medium spray mode (MWODS) with MWODS showing better performance than MWODI. Several studies have demonstrated the importance of using binary mixtures of solutes for enhancing the moisture loss in osmotic dehydration processes. This paper highlights the judicious use of solute mixtures in conjunction with MWODS to not only enhance the ML but also limit the SG. In these studies the conventional solute sucrose (S) was supplemented with dextrose (D) and different grades of maltodextrins (MD) for preparing osmotic solutions. Among the solute supplements, maltodextrin (10DE) in the ratio S:MD::85:15 provided the best combined influence resulting in excellent results. Optimal conditions were achieved using a response surface experimental model. Results demonstrated higher ML and lower SG than what has been reported in literature within a short time. This combination also gave a product with better texture and appearance factors. Simple air drying was sufficient as the second stage finish drying technique without much loss in quality.

Sakamon Devahastin, King Mongkut's University of Technology Thonburi, Thailand	**Superheated steam as alternative drying and roasting medium for foods: some recent advances**

Drying and roasting are among the popular methods for processing and preservation of foods. Hot air has traditionally been used as the drying and roasting medium although it is well recognized that such a medium results in many adverse effects on the final dried and roasted product quality. Physical (e.g., color, shape and size, rehydration capability), physicochemical (e.g., bioactive compounds contents, micro/molecular structure) and sensory properties are all known to be affected. To alleviate the aforementioned drawbacks of hot air, superheated steam has emerged as an alternative drying and roasting medium. Recent research results have shown that superheated steam drying (both at atmospheric and low pressures) and roasting yield products of superior quality than hot air drying and roasting. In this presentation, selected results based on the author's experience on superheated steam spray drying and roasting will be given. Examples will be shown on the use of such processing technologies to produce high-quality natural food colorant powder and to enhance the quality of roasted coffee beans. Brief explanation on how each process is developed, tested and implemented will be given to allow better understanding of the process and how products of superior quality can be produced.

Ferruh Erdogdu, Ankara University, Turkey	**Design and optimization of radio frequency tempering/thawing process with air impingement effects**

Radiofrequency (RF) processing, with its volumetric heating ability and a longer wavelength, is preferred for larger size food products. However, overheating problems are observed at corners and edges with a significant temperature non-uniformity. This is more pronounced in tempering/thawing processes and leads to certain quality losses. Electrode gap, charged electrode

potential, sample-electrode geometry, and sample-electrode moving conditions in industrial-scale systems were investigated for temperature uniformity in the literature, but there has not been a confirmed solution presented specifically for thawing. Therefore, the air impingement process with various nozzle configurations was presented in this study using a developed and experimentally validated computational model for defrosting frozen tuna blocks. Computational studies were carried out using Comsol Multiphysics (Comsol AB, Stockholm, Sweden) with "Electrostatics, Conjugate Heat transfer, and Laminar flow" physics modules. The single RF cavity included the impingement nozzles located on the side walls. Air impingement velocities of 0.25, 1, 5 m/s were applied to observe the impingement effect on improving the process temperature uniformity. The results of this study were used for designing systems and optimizing the process for industrial-scale RF thawing/tempering applications.

C. Anandharamakrishnan, CSIR, India	**Spray freeze drying: emerging food applications**

Spray freeze drying is an emerging drying technique providing benefits of both spray and freeze drying in terms of flowability, quality and the ability to retain heat-sensitive ingredients. A typical process involves droplet formation, freezing and sublimation; the physics involved is intricate and these stages require precise controls. The process has proven benefits for a range of food drying applications apart from being an excellent encapsulation approach for the delivery of bioactives, probiotics, enzymes, biomolecules, and several other high-value heat-liable ingredients. This also includes capabilities for targeted and controlled release applications. Over the years, significant research has focused on scaling up the technology for commercial applications. Challenges exist in terms of process optimization, convenience, safety and cost-benefit aspects. Nonetheless, in certain applications, they offer unmatched merits, making the approach the preferred choice. Given their uniqueness, hybrid applications such as the integration of microfluidics, 3D printing, etc. have also emerged. With established applications in the pharmaceutical industry, this talk will focus on its potential for food applications. This will also consider the biological fate of spray freeze dried particles.

BR 5 - IUFoST Working Committee of Japan

Rheology and Colloid Approach in Developing Palatable and Healthy Foods

Session Chair: Katsuyoshi Nishinari, Osaka City University/Hubei University of Technology, Japan/China

Katsuyoshi Nishinari, Osaka City University/Hubei University of Technology, Japan/China	**Comprehensive approach to food palatability, texture and flavor**

To develop further the sustainable food processing, it is necessary to understand the palatability in relation with texture, taste and odor. By synthesizing the recent achievement in texture studies, physiological and psychological studies, comprehensive understanding and industrial development is expected to be advanced by collaboration among different disciplines. Much efforts have advanced the understanding of the palatability, taste and aroma sensation in neuroscience and food science related chemical senses, however, most of them were limited to liquid foods which require no mastication in the area of psychological approach. On the other hand, texture scientists tended to use semi-solid foods without taste and aroma to simplify the analysis. Therefore, there is a gap between the psychology/physiology approach and texture/rheology approach, and it is necessary to activate more interacting discussion between these research

groups. Since saliva plays important roles in the appreciation of chemical senses but also to make masticated foods into cohesive bolus for deglutition, multi-angle-approach is necessary to comprehensively understand the oral processing in relation with brain science. In the present talk, the fundamentals and application for foods including thickened fluids and semi-solids are presented and discussed in the hope to activate more discussion between different disciplines.

Shingo Matsukawa, Tokyo University of Marine Science and Technology, Japan	**Physical properties and micro phase separation in food gels of mixed biopolymers**

Mixing of biopolymers with different physical properties is used to control those in food gels. Biopolymers with similar chemical structures frequently show transparency in mixed gels suggesting compatibility of each solution, however, the mixed gels occasionally exhibit phase separation at the microscopic level which affects the physical properties. Therefore, it is important to understand the phase-separated structure and the mechanism to induce the structure to control macroscopic physical properties.

We investigated the microphase separation in the mixed gels of kappa/iota carrageenans and mammal/fish gelatins to understand and control their physical properties. Viscoelastic measurements on cooling showed two-step gelation behavior where the individual formation of aggregates for each carrageenan has been clarified by NMR and micro DSC measurements. Furthermore, tracking for nano-size particles revealed inhomogeneity in microrheology owing to the phase separation. On the other hand, viscoelastic measurements for the mixed gelatins showed the gelation at the intermediate temperature of Tg (gelation temperature) for each gelatin, suggesting the cooperative aggregation of the gelatins. The result of micro DSC showed a broad peak at Tg for the mixture and a small peak at Tg for fish gelatin, giving information about the gelation mechanism at the molecular level.

Chaiwut Gamonpilas, National Metal and Materials Technology Center, Thailand	**The importance of shear and extensional rheology and tribology in the design of thickeners for dysphagia management**

Thickening powders are regularly used in various drinks for the effective management of dysphagia and for the improved quality of life of these patients. It has been hypothesised that not only the shear deformation, but also extensional deformation and tribological properties of food bolus are important factors contributing to safe swallowing.

Studies on shear rheological properties of thickened liquids have been extensively conducted to relate to oral and swallowing processes. In contrast, results on their extensional and tribological characteristics are relatively limited. This talk will provide new insights into the importance of shear and extensional rheological and tribological properties of thickened liquids that can be used for better product formulation design and to assist in treating individual patients with dysphagia. Experimental results of thickened liquids prepared from various gum-based, i.e., xanthan vs guar gum, and modified starch-based thickening powders will be presented and discussed. It will be shown that the xanthan-gum based thickened liquid exhibits superior characteristics with higher cohesive property compared to the others. These results provide useful information that paves the way to seeking for novel natural materials to be formulated as new thickening powder.

Aaron Goh, National Metal and Materials Technology Center, Thailand	**Processing aspects of 'healthier' and 'alternative' foods**

The sensorial properties of a product depend on many variables including formulation, processing and storage methods. Indeed, innovation in 'healthier' and 'alternative' foods are often intertwined with process improvement. Examples are presented to demonstrate the challenges in managing calorie reductions in two products. The first example refers to a spray dried herbal powder. Such spray dried herbal extracts usually suffer from issues related to powder stickiness and hygroscopicity. The effects of a small amount of low-calorie gums and proteins on the physicochemical properties of spray-dried roselle extract will be shared. The second example refers to a premix of a local aerated baked product which has a slightly brittle crust combined with a soft and tender internal crumb. Sensorial properties of formulations containing sugar replacers will be shared.

Oni Yuliarti, School of Chemical & Life Sciences, Singapore Polytechnic, Singapore	**Role of low methoxyl pectin in starch-based pudding-like gels**

Tapioca starch is used in food industry as texture modifiers in many food products such as puddings, fruit fillings and thickeners, due to its paste clarity properties and inability to contribute to food flavour. The effect of adding low methoxyl pectin (LMP) and calcium ions on tapioca starch pudding-like gels was investigated, focusing on physical properties such as rheological profiles, gel microstructure, occurrence of syneresis as well as the starch pasting profiles. Incorporation of LMP improved the gelation strength and syneresis reduction of starch-based gels. The addition of calcium ions to the formulation appear to suppress the peak viscosity of starch and govern a denser LMP-starch gel networks, thereby increasing the starch gel strength. Furthermore, when the strain percentage was increased, the starch-LMP gels exhibited a loss in elasticity due to the disruption of starch gel alignment by pectin gel. This study provide insights for manufacturers to improve the quality of pudding-like gel structure, taking into account the gel viscoelasticity and pasting properties.

BR 6 - IAFoST – Global Initiatives (Academy)

Nutritional Strategies for Post-Acute Sequelae of COVID-19 (PASC) Management

Session Chair: Roger Clemens, University of Southern California, USA

A. Satyanarayan Naidu, N-terminus Research Laboratory, USA	**Evidence-based Nutritional Strategies for PASC Management – an overview**

The SARS-CoV-2 infection triggers a complex human host-pathogen interaction(s) resulting in 'host metabolic reprogramming' (HMR), iron (Fe)-redox dysregulation (FeRD) and altered mitochondrial function that cumulatively disrupt several metabolic pathways involved in cellular energy and antioxidant enzyme function; thereby, compromise the innate host defense. The circulatory/RAAS axis contributes to FeRD and any alteration or imbalance in the Fe-redox homeostasis (Fe-R-H) may lead to 'new onset' metabolic disorders. Such inherent body damage and its long-term health

consequences of post-acute sequelae of COVID-19 (PASC) require effective nutritional intervention strategies. The Fe-R-H regulators, such as lactoferrin (LF), heme-oxygenase-1 (HO-1), erythropoietin (EPO), and hepcidin modulators could play a vital role in reducing cellular oxidative stress and inflammation during acute COVID-19 as well as in chronic PASC. The long-term sequelae of PASC indicate an accelerated rate of immune exhaustion in COVID-19 patients, due to prolonged antigen stimuli (including vaccine exposure). Our presentation elucidates the intricate impairments and sequelae associated with pulmonary, neuro-cognitive, cardiovascular, renal, GI/hepato-biliary, endocrinal, skeleton-muscular, and reproductive systems in COVID-19 survivors. The supportive role of specific host system-targeted, evidence-based, nutritional interventions such as plant-based anti-inflammatories, immune-modulators, antioxidants, and macro-/micronutrient metabolic optimizers to manage PASC, the globally emerged metabolic disorder, will be discussed.

Barry Halliwell, National University of Singapore, Singapore	**Dietary Antioxidants: Will the Real Antioxidant Please Stand Up?**

The human diet contains multiple compounds with antioxidant properties in vitro, including vitamins E and C, carotenoids and polyphenols such as the flavonoids. These may all perform important roles in the human body but the evidence that polyphenols, carotenoids and even vitamin C exert major antioxidant activities in vivo is generally unconvincing. Much attention is being given to a unique diet-derived thiol/thione with antioxidant properties, namely ergothioneine (ET). Low blood levels of ET appear to be a risk factor for the development of neurodegenerative and cardiovascular diseases, frailty and possibly COVID-19. Based on studies in a range of in vitro and in vivo (animal) models, ET has exhibited the ability to modulate inflammation, scavenge free radicals, protect against acute respiratory distress syndrome, prevent endothelial dysfunction, protect against ischemia and reperfusion injury, protect against neuronal damage, counteract iron dysregulation, hinder lung and liver fibrosis, and mitigate damage to the lungs, kidneys, liver, gastrointestinal tract, and testis. When compiled, this evidence suggests that ET has a potential application to alleviate the pathology of COVID-19. Ergothioneine could be useful as a supplement to reduce the severity and mortality of COVID-19, especially in the elderly and those with underlying health conditions, although this needs to be confirmed by rigorous human studies.

Fereidoon Shahidi, Memorial University, Canada	**Dietary Polyphenols & Omega-3 Fatty Acids for PASC Management**

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is the virus that causes COVID-19 and is responsible for inflammatory pneumonia. The virus uses the host cells to nourish, multiply and cause damage to various organs. This occurs first by binding the virus spike glycoprotein with the host cell angiotensin-converting enzyme 2 (ACE-2) receptor. Phenolic and polyphenolic compounds may exert their effects via direct antioxidant activity and by modulating intracellular signaling. They also strengthen antioxidant defenses, decrease viral entry and inhibit binding of the virus to ACE-2 receptor and reduce COVID-19 cytokine storm. Dietary polyphenols and plant extracts may serve as unique intervention targets for COVID-19. Therefore, polyphenol-rich formulations are likely to interact with viral proteins or host cell receptors in order to interfere with the entry of the virus and/or its replication in the host cells. In this connection, natural health

products and their extracts may participate in ameliorating the body's immune system post-COVID. Here, it is important to note that polyphenols not only function to scavenge free radicals and serve as reductants and chelators of prooxidant iron, but also act by other mechanisms unrelated to their antioxidant potential. Thus, structural features of polyphenols dictate their efficacy in this regard. Furthermore, omega-3 polyunsaturated fatty acids (PUFA) possess anti-inflammatory activity by themselves or through their metabolites and mediators. Thus, omega-3 PUFA may provide some relief for COVID-19 patients or in the management and reprogramming of host metabolism post-COVID.

Kenji Sato, Kyoto University, Japan	**Nutritional Regulations of ACE3/RAS: Implications in PASC Recovery**

SARS-CoV-2 binds angiotensin-converting enzyme 2 (ACE-2) on the surface of lung cells with the viral spike protein to enter cells. Thus, SARS-CoV-2 from aerosol preferentially infects lung cells. ACE-2 is a member of the renin-angiotensin system (RASS). Angiotensin I (Ang I), an inactive decapeptide, is converted to Ang II, an octapeptide, by ACE. Ang II is further metabolized to Ang 1-7 by ACE-2. Ang II binds to angiotensin II receptor (ATR1) and increases blood pressure. In addition, Ang II-ATR1 system induces inflammation, while Ang 1-7 does not induce inflammation. Therefore, ACE2 suppresses Ang II-ATR1-induced inflammation. Blocking ACE 2 by viral spike protein could exacerbate inflammation, which is also induced by viral ssRNA via TLRs. Therefore, ACE-induced Ang II-ATR1 system, rather than ACE2, may be good targets for the mitigation of COVID-19. Bioactive peptides have been demonstrated to inhibit ACE activity and moderate hypertension. These facts suggest that some bioactive peptides have potential to suppress COVID 19-induced inflammation via Ang II-ATR1 system. However, the bioavailability of the ACE-inhibitory peptides is very low. Thus, the bioactive peptides might suppress Ang II-ATR1 signaling by other mechanisms, such as antagonistic activity against ATR1 and inhibition of intracellular signaling rather than direct inhibition of ACE.

Chin-Kun Wang, Chung Shan Medical University, Taiwan	**Phytonutrients and Metabolic Syndromes (MeS): Roles in PASC Recovery**

COVID-19 has greatly influenced the world for two more years. Vaccination, sanitary behavior, social distance and wearing masks, improved metabolic syndromes, and intervention of some phytonutrients play important role in PASC recovery. In this study, influenza A, B, and COVID-19 viruses were used as the model to evaluate the prevention, and intervention of cell models and human subjects. Combating obesity, hyperglycemia, and hypertension through balanced nutrition and optimal physical activity reduces the risk of viruses on respiratory tissue receptors. Phytonutrients from purple coneflower and propolis suppressed the infection of all viruses, reducing the risk of the inflammatory storm and quick recovery after infection through modulation of T-cell cytokine response. Phytochemicals in purple coneflower and propolis reduced the adhering of COVID-19 to the ACE-2 receptor. In addition, very specific anti-inflammatory properties and immune regulation, especially increase the ratio of CD4/CD8. The combined use of purple coneflower and propolis shows a synergistic effect.

Roger Clemens, University of Southern California, USA	**Summary: Critical Pathways to the Future of PASC**

Post-Acute Sequelae of COVID-19 (PASC) is a residual or extended disease state reported in about 90% of COVID-19 survivors. Such individuals typically show mild or persistent symptoms of fatigue, cough, breathlessness, and fever. Underlying health conditions, including cardiovascular maladies, obesity, diabetes, and inflammatory disorders could aggravate PASC. The SARS-CoV-2-induced host metabolic reprogramming (HMR), mitochondrial dysfunction, and iron (Fe)-redox dysregulation (FeRD) lead to oxidative stress, hyper-inflammation, and decreased energy synthesis that cumulatively triggers acute COVID-19 or chronic PASC. The ensuing multi-organ sequelae appear to involve respiratory, nervous, gastrointestinal, cardiovascular, renal, skeletomuscular, and reproductive systems. Based on animal and cell culture studies, several bioactives such as iron-regulatory proteins, including lactoferrin, ACE2 regulators, anticoagulants (e.g., heparin, coumarin), dietary compounds (e.g., vitamins, minerals, and macronutrients), natural antioxidants (e.g., ergothioneine, anthocyanins) and anti-inflammatories (e.g., curcumin, resveratrol) have been suggested as potential nutritional interventions for PASC. However, human clinical trials (HCT) on the efficacy of these nutritional interventions have yet to be established. Such HCT assessments should evaluate toxicology (safety/tolerance), the mechanism(s) of action, and ultimately dose(s) to elicit desired physiological and pharmacological outcomes. The apparent enigma of sequelae and the pathophysiology of PASC in the midst of the ongoing COVID-19 pandemic warrant an extensive global collaborative investigation.

BR 7 - Food Processing and Engineering 3

Session Co-Chairs: Ogugua Charles Aworh, IUFoST, Nigeria; Melanie Weingarten, Agency for Science, Technology and Research, Singapore

Traiphop Phahom, Suranaree University of Technology, Thailand	**Influence of pre-frying treatment using combination techniques on oil reduction capacity and quality attributes of banana chips**
Banana chips are normally consumed as a snack in Thailand. However, it contains high amount of oil content that may risk in obesity, high blood pressure, high cholesterol, and coronary heart diseases and it also provides a short shelf-life due to lipid oxidation. In recent years, several techniques of pre-frying treatment have been used to decrease oil absorption such as blanching, freezing, air drying and hydrocolloid coating. However, there is less research focusing on the effect of combination techniques on oil absorption and quality aspects of banana chips. Therefore, this research aimed (1) to investigate the effect of pre-frying treatments (moisture reduction combined with freezing (MCF) and coating combined with freezing (CCF)) on quality aspects of banana chips such as moisture content, water activity, color values, crispness and oil content and (2) to evaluate oil distribution in the chips using laser scanning confocal microscopy (LSCM). The results turned out that MCF was the best pre-frying treatment because it provided less oil content, higher crispness and better appearance compared to CCF. Furthermore, appearance oil content obtained from the LSMC technique gave a good correlation with the oil content from the extraction method with a coefficient of determination (R2) of 0.85.	
Azis Boing Sitanggang, IPB University, Indonesia	**Preparation of bioactive peptides from fermented velvet bean using enzymatic membrane reactor: Design and bioactivity characterization**

Velvet bean has potential as a source of bioactive peptides. This study aimed to produce bioactive peptides from fermented velvet beans with an enzymatic membrane reactor. PES membrane with an MWCO 5 kDa was used in the continuous hydrolysis of fermented velvet bean protein concentrate based on the enzyme rejection during alcalase filtration. Permeate obtained with an enzyme-to-substrate ratio of 10% and residence time of 9 h had the highest functional characteristics. The operational TMP at this optimum hydrolytic condition was lower than 1.0 bar. Forth, separation with a 2-kDa PES membrane could enhance the functionalities of bioactive peptides, having the IC50 values of 7.56 and 0.60 µg/mL for antioxidant- and ACE inhibitory activities, respectively. The analysis of peptide sequences using NanoLC Ultimate 3000 Series System Tandem Q Exactive Plus Orbitrap HRMS ThermoScientific showed EQPRPYPYP, RYDNEEGGRRL, IRGPPGGGVR, and VMVPIDPPPHHH were abundance in the permeate. The bioactive peptides contained in permeate were also potential to exhibit dipeptidyl peptidase III and IV-, and α-glucosidase inhibitory activities based on the bioactivity map obtained from the BIOPEP database.
Conclusively, a combination between fermentation and continuous alcalase-catalyzed hydrolysis can be a potent alternative for producing functional ingredients from velvet beans.

Christina Opaluwa, Karlsruhe Institute of Technology, Germany	**Vegetable oil in meat analogues based on plant proteins: the role of rheological properties in the formation of anisotropic product structures**

For ecological, ethical and health reasons, there is a trend towards a vegetarian and vegan diet. Therefore, meat analogues that resemble meat in terms of appearance, color, and texture are gaining greater interest. High-moisture extrusion with a cooling die is a widely used process to produce such plant protein based meat analogues. During extrusion processing, the proteins form a multiphase system that is deformed along the flow direction in the cooling die. Thereby, the rheological properties of the matrix play a crucial role, as they influence the deforming stresses as well as the morphology formation in the die and thus the formation of anisotropic, fibrous-like product structures. However, protein-based meat analogues are frequently described as dry and poor in mouth-feel. To improve these sensory properties, fats and oils are often added to the matrix. The challenge here is that the direct addition of oil can cause instabilities in the extrusion process and impairs the formation of anisotropic structures due to distinct changes in rheological properties and a resulting reduction of deforming stresses. Therefore, in this contribution, it is addressed how oil affects the rheological properties and how the extrusion process can be tailored to obtain products with well-pronounced anisotropic structures.

Yoha K.S., National Institute of Food Technology, Entrepreneurship and Management – Thanjavur, India	**Comparison of 2 types of 3D printed oleogels as nutraceutical carriers**

3D printing (3DP) of nutraceutical carriers is scarcely reported but has huge scope as they could satisfy personalized nutritional requirements. In this study, synergistic bioactives- curcumin and resveratrol were loaded into structured medium chain triglycerides (MCT) oil, a multi-health promoting oil. Comparison of two different 3D printed oleogels- emulsion-templated (Gelated using gelatin-gellan gum) and direct dispersion (ethylcellulose-EC) were studied for its encapsulation and release properties along with printing parameter optimization using CARK™ 3D food printer. For printing of emulsion-templated-oleogel, 30% O/W emulsion with 10% gelatin and 1.5% w/v gellan
gum were required for stable printing at 800 mm/min while for EC-oleogel, 11% (w/w) EC and 5% (w/w) surfactant were needed for optimum printing at 500 mm/min speed and 45â„ƒ in

hotextrusion printer. For 5% each curcumin and resveratrol loading, 10% and 7% higher encapsulation respectively was found in EC-oleogel. During in-vitro digestion, 15% higher curcumin was released in EC-oleogel while 6% higher resveratrol was released in emulsion-templated-oleogel compared to control (oil). From ex-vivo everted gut sac study around 1.5-fold higher permeation was found for both bioactives compared to control in both oleogel-types. Also, both the 3D printed MCT oleogels exhibited targeted intestinal delivery than MCT oil indicating the significance of 3DP oleogels for nutraceutical delivery.

Joel Zink, ETH Zurich, Switzerland	**High quality, gluten-free bakery without additives by controlled high pressure micro-foaming**

The consumption of gluten-free (GF) baked goods has significantly increased over the last few decades due to the rising awareness and knowledge of celiac disease and gluten intolerance. Such higher demand for GF baked goods brings new opportunities, but also new challenges for baked goods manufacturers due to the lack of the highly viscoelastic network formed by gluten proteins. This results in products of lower baking volume and compromised sensory quality compared to gluten-containing analogs. A novel high-pressure (HP) extrusion micro-foaming and dosing technology has proved to be a game-changer by enabling optimal baking volume and crump structure generation in GF bakery comparable to the gluten containing products and beyond. The new process uses a co-rotating twin-screw extruder serially combining the operation steps of mixing, kneading, and foaming of highly viscous dough-like systems in a continuously operated device. Gas, mostly CO2, is injected under high pressure into the dough system and largely dissolved in the continuous water phase. Upon controlled pressure release, gas bubbles are efficiently nucleated by use of a natural nucleating agent and expanded to a micro-foam that is stabilized in a subsequent, fast, dielectrically supported heating/baking step. This process may also make the leavening process step obsolete.

Atsushi Hashimoto, Mie University, Japan	**Infrared spectral features of kaeshi (Japanese traditional sauce based soy sauce)**

Kaeshi (Japanese traditional sauce based soy sauce) is a kind of seasoning containing soy sauce, mirin (Japanese sweet cooking wine) and sugar, and is used as noodle soup by adding soup stock. Since it is very difficult to stabilize the quality just after preparation, aging is practically needed before the wholesale. This study aimed to grasp the transient behavior of the infrared spectroscopy characteristics of kaeshi during aging. The mixture solution by changing the ratio of soy sauce and sugar contents were prepared and was aged at room temperature. The infrared absorption spectra of the solutions were collected using an FTIR equipped with an ATR accessory. The second derivative spectral patterns of infrared absorbance of the kaeshi solution complicatedly changed during aging, and the influences of the mixing ratio on the spectral features were observed. We
then performed the principal component analysis using the spectral information at the wavenumbers where the absorbance intensities significantly changed during aging and the relations between the spectral information and sensory evaluation values were experimentally presented. Consequently, it was suggested that the quality changes of the kaeshi during aging and the sensory evaluation values could be expressed based on the infrared spectral pattern changes.

BR 8 – IUFoST College of Early Career Scientists (CECS) Session

Emerging Food Science and Technology Leadership in Meeting the Grand Challenges

Session Chair: George Ooko Abong, Presiding Officer, College of Early Career Scientists (CECS)

George Ooko Abong, Presiding Officer, College of Early Career Scientists (CECS)	**Resilience in Food Science and Technology Association Leadership**
Ruth Oniang'o, IUFoST Lifetime Achievement Award Winner, Founder Rural Outreach Africa	**Grand challenges that shape the future of food science and technology**
V Prakash, President IUFoST, India	**The Fusion of Experience and Youth in Capacity Building Culture**
Alexander Mathys, Alexander Mathys, ETH, Zurich, Switzerland	**Building a Global Research Network**
Lilia Ahrne, Past President EFFoST	**Getting Ready for a Leadership Role in the New Normal**
Anadi Nitithamyong, Food Science and Technology Association of Thailand, Thailand	**Moving forward together in a world of change**

BR 9 - European Academy of Food Engineering (EAFE) /International Society of Food Engineering (ISFE)

The Value of Food Processing for Nourishing People in A Healthy, Pleasurable and Sustainable Manner

Session Chair: Yrjö H. Roos, University College Cork

Erich Windhab, ETH Zürich, Switzerland	**Food Processing, the mean to tailor sensory and nutritional food quality, safety and sustainability**

Food as we produce and consume it seems to have become the cause of people's and nature's health problems. From a food engineering perspective, processing enables us to tailor product quality and safety as well as environmental sustainability characteristics. Accordingly, there is no motivation to process more than necessary to reach optimal product properties. Nevertheless so-called "ultra-processed" food is increasingly assumed to be a major cause of obesity and related non-communicable diseases. On one hand "ultra-processed" is not defined in clear processing-related terms and mainly determined by formulation engineering. On the other hand, content-wise it addresses the urgent problem of deteriorated eating habits accompanied by exaggerated intake of calories but insufficient micronutrients. However, it's optimized processing combined with balanced formulation that give access to appropriately tailor calory and micronutrient density without compromising consumer-appreciated conveni-ence and palatability aspects. Multi-factor processing optimization allows to include safety and sustainability target criteria into product and process development. The ultimate goal of appropriate processing is to deliver optimum product properties through minimal, sustainable processing at minimized processing costs to also meet lower income consumers' affordability conditions. Thus, processing is not the cause of an unhealthy diet, but as exemplarily demonstrated can be the appropriate solution.

Lynnette Neufeld, FAO, Rome, Italy	**The NOVA Food Classification System**

The centrality of healthy diets and food systems for human and planetary health are now common themes in research and policy dialogues, and in the popular media. The increased focus on healthy diets in the past years represents a unique opportunity to leverage new and more investment and action to address the persistent challenges of nutrition in all its forms.

Despite this focus, critical gaps in the data on what people eat, the level of processing and preparation, the factors that influence their food choices, and evidence of effective actions to achieve healthy diets while enhancing food systems sustainability constrains evidence-based policy making in many regions of the world. This focus has also highlighted some inconsistencies in the evidence. For example, several publications emphasize slightly different perspectives on what constitutes a healthy diet, including the role of animal source foods and alternatives, and the role of processed foods as part of a healthy diet. This presents particular challenges for policy makers to act and adapt guidance to their unique context, and leaves the door open to ideology surpassing evidence in the popular media. Such evidence gaps may also constrain investment in innovations across the food systems with high potential to contribute to healthy diets and food systems sustainability.

In this presentation we will provide an up-to-date overview of the evidence of what constitutes a healthy diet and discuss the critical role of addressing evidence gaps related to dietary data, including level of food processing to strengthen our ability to design actions that favour better nutrition through healthy diets from sustainable food systems for all.

Adam Drewnowski, University of Washington, WA, USA	**How to assess the healthfulness of processed foods: Nutrient density or NOVA?**

Nutrient profiling (NP) refers to quantitative methods used to assess nutrient density of foods. NP models balance the content of protein, fiber, vitamins, and minerals against nutrients to limit: saturated fat, added sugar and sodium. Initially based on nutrients, NP models can include ingredients and desirable food groups. The NOVA system categorizes foods as unprocessed, processed, ultra-processed, and culinary ingredients. However, NOVA criteria can be subjective and not sufficiently transparent. Recently published NOVA categories for foods in the US Food and Nutrient Database for Dietary Studies 2015-16 reveal that out of 8,032 foods, as many as 6,227 were classified as ultra-processed, including 1,153 vegetables (73%), virtually all grains, including whole grains, most dairy products, and some 50% of seafood. Only 339 foods out 8,032 (4.9%) were classified as unprocessed. Published in Nature Food, these NOVA category assignments raise concerns of misclassification and cast further doubt on multiple studies linking the consumption of “ultra-processed” foods with adverse health outcomes. Finally, the NOVA classification conflicts with many NP models: Multiple foods with A-grade Nutri-Score or 5-star Health Star rating fall in to the “ultra-processed” category. NOVA scheme stands in the way of product reformulation for health.

I. Sam Saguy, The Hebrew University of Jerusalem, Israel	**Panel Discussion**

BR 10 - Food Processing and Engineering 4

Session Co-Chairs: Vish Prakash, IUFoST, India; Dejian Huang, National University of Singapore, Singapore

Filiz Koksel, University of Manitoba, Canada	**The use of low-intensity ultrasonics as an online tool to control the physical and nutritional quality of plant-based meat alternatives**
Plant-based meat alternatives (e.g., extruded meat analogues such as patties and chunks) have gained global interest as healthy and sustainable substitutes of animal meat. The characteristic textural features as well as protein quality of such foods depend on ingredient properties, extrusion process conditions and protein alignment in the extruder die. Accordingly, development of desired textural and nutritional profiles in meat alternatives is a complex process that needs to be fully understood for optimized product properties. To tackle this challenge, low-intensity ultrasonics was utilized to monitor extrudates made from a blend of plant proteins at different moisture contents (50-70%) during manufacturing. The ultrasonic properties (phase velocity and attenuation) of the extrudates were assessed using an air-coupled ultrasonic system (200–600 kHz) placed at the die exit. Texture measurements were performed to acquire information on the level of protein texturization, which is a good signature of the formation of meat-muscle-like fibers in an extrudate. The in-vitro protein digestibility corrected amino acid score of extrudates was measured to determine the protein nutritional quality. The relationships between texture, nutritional profile and ultrasonic properties were modelled. Low-intensity ultrasound showed great potential as a nondestructive tool to monitor the quality of meat analogues in-real-time during processing.	
Xinyu Miao, The University of Melbourne, Australia	**Visual characteristics and nutritional value of blended beef patties formulated with different plant proteins**
Novel blended meat products combine meat and plant-based ingredients to reduce meat content. Consumers' purchasing decision is influenced by products' appearance and nutritional value. This study aimed to investigate the colour and nutritional profile of blended patties. Patty formulas consisted of 100 % beef patty (control) and eight blended formulas comprising 2 protein isolate treatments (4 % of pea protein isolate (PPI) vs. fava bean protein isolate (FPI)) x 4 texturized pea protein levels (TPP; 0, 8.5 %, 21.3 % and 42.5 %)). Colour and proximate analysis were conducted. PPI and FPI increased lightness and hue while reducing redness, yellowness, and chroma. A higher TPP level was associated with higher lightness, yellowness, hue, and lower redness and chroma compared to beef patties. Higher TPP % resulted in increased yellowness, hue, and chroma of cooked blended patties. Blended patties were lower in fat, higher in ash, and had a similar protein content to beef patties. Additionally, the TPP addition did not change the protein content, but it increased the ash and reduced fat. Overall, plant proteins significantly affected the colour and nutritional value of blended patties compared to the control.	
Adrian Tica, ETH Zurich, Switzerland	**Advanced high moisture extrusion process control for increased autonomy and upscaling of plant-based meat analogue production**
Food industry is seeking to develop meat alternatives to meet emerging demands for healthy and sustainable products. Plant-based meat produced by High Moisture Extrusion Cooking (HMEC) is attracting growing interest as it offers customers with a sustainable, nutritious, and healthy alternative to animal meat. Having significant impact on sustainability involves large-scale implementation of this technology in numerous facilities, which is not feasible at the current stage as HMEC is highly empirical, and expert driven. Hence, it is important to increase the reliability of production process and transfer the expert knowledge into automated solutions. A novel process control framework to improve operational stability and reproducibility is proposed in this study. Key technological aspects that unlock the next level of production autonomy are addressed by	

coupling a multilayer advanced control structure with in-line techniques for measuring protein structural changes based on RAMAN/FT-NIR spectroscopy. The developed solution aims at optimizing process parameters while keeping the meat-like fibrillar structure formation and textural sensory characteristics at the desired level. The interplay of various parameters is considered by applying a model-based predictive approach that anticipates process future changes and derives optimal setpoints. Extrusion results prove potential advantages and practical implementation of the approach.

Olufunke O. Ezekiel, University of Ibadan, Nigeria	**Effect of alginate encapsulation on the viability of Lactobacillus rhamnosus GG in watermelon juice under refrigerated (4oC) storage**

Watermelon (Citrullus lanatus) is a fruit that has been established in the literature to have significant health benefits due to its high antioxidant and water content. The suitability of watermelon juice, being a non-dairy option, as a substrate for lactic fermentation and a carrier for probiotic Lactobacillus rhamnosus GG (LGG), and the effect of encapsulation on the viability of LGGwas explored. Watermelon juice was fermented with free or alginate-encapsulated LGG cells for 24h and stored at 4oC for 3 weeks, during which the viability counts of LGG and the physicochemical properties [(oBrix, Total titratable acid, pH and colour (L, a, b attributes)] of the fermented watermelon juice were evaluated against the un-inoculated watermelon juice (control). Analysis of variance was computed using Statistical Package for Social Sciences (SPSS, V. 23.0) and statistical significance was accepted at $p < 0.05$.Free and alginate-encapsulated LGG showed a viability of 8.8 x 109 and 9 x 109 CFU/mL,respectively, in watermelon juice after fermentation, with an observed reduction in viability of 4.3 x105 (free LGG) and 7.5 x 107 CFU/mL (alginate-encapsulated LGG), respectively, in the watermelon juice after 3 weeks of storage at 4oC. Total titratable acidity of LGG-fermented watermelon juice (0.24 - 0.52%) was significantly higher than control (0.11%) while the pH (4.73 -5.06) and oBrix (5 - 5.2) of LGG-fermented watermelon juice were lower than control, which was5.78 and 5.5, respectively. There was no significant difference in the L, a, b colour attribute of LGG fermented watermelon juice in comparison with control. The LGG-fermented watermelon juice did not show significant changes in the physicochemical parameters measured during the 3 weeks storage at 4oC.The results showed that watermelon juice significantly supported the viability of LGG, showing decrease in pH with a concurrent increase in cell viability. This shows that watermelon juice proved to be a suitable substrate for lactic fermentation by LGG, and a suitable carrier for the probiotic.The cell losses observed during storage was less pronounced in the alginate-encapsulated LGG,showing that alginate-encapsulation significantly preserved the viability of LGG cells. Watermelon juice with probiotic Lactobacillus rhamnosus GG can therefore serve as a non-dairy probiotic beverage option to lactose intolerant or vegetarian consumers.

Sherazade Fikri, Laval University Canada	**Candida krusei isolated from the surface of filtration membranes is the main spoilage microorganism affecting the quality of cranberry juice**

Ultrafiltration (UF) and reverse osmosis (RO) are widely used for the industrial clarification and concentration of cranberry juice in Canada. The susceptibility of filtration membranes to biofouling was largely studied for a wide number of fluids, but this phenomenon was never evaluated for cranberry juice. Consequently, this project aimed to isolate and characterize the microbial communities at the surface of commercial UF and RO membranes and to determine their effect on the cranberry juice quality. A variation of the microbial profile was found between UF and RO membranes, and the identified genera seemed to come from the fruit cultivation environment. Biofilm-producing yeast Candida krusei was found to be dominant at membrane surfaces and showed an exponential growth in the juice after 42h of incubation. Proanthocyanin was degraded by C. krusei with a loss of 19% whereas phenolic and anthocyanin

compounds were preserved. Finally, a total of 9 volatile compounds (alcohol, ketone, aldehyde, and ester) were modulated by C. krusei which could impact on sensory attributes of juice. This work allowed to understand the impact of spoilage microorganisms on the quality of cranberry juices for the future development of cleaning strategies against C. krusei in the industry.	
Chiemela Enyinnaya Chinma, Federal University of Technology Minna, Nigeria	**Effect of addition of germinated-fermented pigeon pea (Cajanus cajan) flour on the dough rheology, textural and sensory properties of wheat-based cake**
The demand for baked products containing bioprocessed pulse flour is increasing due to their potential health properties. The effect of addition of germinated-fermented pigeon pea flour on the dough rheology, textural and sensory properties of wheat-based cake was investigated. Hydrated pigeon pea seeds were germinated for 96 h under dark, ambient conditions. Uniformly germinated pigeon pea seeds were oven dried at 40 oC for 24 h and milled to obtain germinated flour. The germinated flour was fermented with lyophilised yoghurt culture at 30 °C for 24 h, oven dried at 40 oC for 24 h, milled and sieved to obtain germinated-fermented pigeon pea flour (GFPPF). Wheat flour and GFPPF was blended (100:0, 90:10, 80:20 and 70:30) for the preparation of cakes. Addition of GFPPF increased dough water absorption capacity and viscosity with 30% GFPPF exhibiting the highest effects. Addition of GFPPF decreased the lightness while redness and yellowness of the crumbs increased significantly. Textural properties of the composite cakes were improved compared to control. Consumer tests suggested that acceptable cakes can be prepared with up to 20% GFPPF substitution. The study demonstrated that addition of GFPPF improved the textural and sensory properties of wheat-based cake.	

Competition

BR 11 - Undergraduate Students Product Development Competition Session 2 – Sponsored by Cargill

Competition Juries:

- Pavinee Chinachoti, GOIR Working Group, IUFoST
- Jairo Romero, IUFoST, Colombia
- Johanna Tan, Temasek Polytechnic, Singapore
- Sebastiano Poretta, IUFoST, Italy
- Alvin Lee, Institute for Food Safety and Health, Chicago, USA

Team Name	Institution & Country	Title of Project
Wonton Chips	**Nanyang Polytechnic, Singapore**	**Development of plant-based Singapore chilli crab flavoured**
Green Munch	**Singapore Institute of Technology - Massey University, Singapore**	**Corndochi®: plant-based mini mochi corndog**
Tikari	**University of Costa Rica, Costa Rica**	**Tikari, a plant-based snack bar**
Bake it happen	**Kasetsart University, Thailand**	**Take a Bread**
AABB (Video Recording)	**Jiangnan University, China**	**Hi, Peanut!**

18:00 | GMT+8

18:00 – 21:30 GMT+8

Congress Gala Dinner Supported by Unilever – Theme Sustainability with Plant Based Protein

18:00 – Registration
19:00 – VIPs and Guests to be seated, video showcasing Unilever sustainability food solutions
19:15 – Welcome address by SIFST President, Richard Khaw
19:25 – Speech by Ivan Lu, General Manager for Group Asia Unilever Food Solutions on company's initiative in providing sustainable food solutions
19:35 – Dinner is served – Introduction of the menu and ingredients used for all the four courses of dinner by Unilever
20:00 – Performance by Temasek Polytechnic cultural dance group
20:30 – Global Industry Award Presentation Ceremony
21:00 – Showcasing IUFoST Rose Spiess Video Competition award winning videos and award presentation ceremony
21:30 – End of dinner

2 Nov 2022

08:30 | GMT+8
08:30 – 10:00 GMT+8
Main Plenary Room
Plenaries 5, 6 and 7 IAFoST Fellow Induction

IAFoST Fellow Induction Ceremony - Welcome by IAFoST Chair

Plenary 5: IUFoST lifetime achievement awards winner Delia Rodriguez-Amaya

Plenary 6: IUFoST lifetime achievement awards winner Ruth Oniang'o

IAFoST Fellows Induction Ceremony

- 2020 Fellows Induction
- 2022 Fellows Induction

Joachim von Braun, Chair (Scientific Group), UN Food Systems Summit	**Plenary 7: Food Systems in Crisis are Confronted with Hard Choices: The Opportunity for Innovations**

The global and many national food systems are confronted with the hard choice to address the challenge of systems' transformation toward sustainability and resilience, while also managing the acute food crisis with urgency. Food systems actually are impacted by a new set of multi-dimensional problems that have accumulated to a very serious crisis.

The set of problems include, Covid19 disrupting food value chains, wars further add to uncertainty and hinder trade, accelerating prices make healthy diets unaffordable for millions and increase raw material and processing costs, accumulated debts curtail social protection and nutrition programs, climate stress undermining food systems' resilience, destruction of nature and erosion of biodiversity undermine food security in the long run. These problems are interconnected and reinforce each other. A food systems perspective is required to identify the actions needed to achieve transformation toward sustainable food systems, while also managing the crises in the short term. This raises complex questions of trade-offs and synergies of actions. At the center of solutions to the challenges are innovations, that is, policy-, technological-, and organizational innovations. These must be based on science, be context specific, and some must be international.

A set of seven key innovations are presented and elaborated in the lecture. They range from actions to address diet deficiency, to bio-science and processing technology innovations, to de-risking the food system, to natural resource management innovations, and the related investments in all of these. Costing actions and elaborating the true costs of food - including

environmental and health externalities - provide a framework for priority setting of actions and implementation by public- and corporate sectors.

10:00 | GMT+8

10:00 – 10:30 GMT+8

Tea Break with Day 3 Poster Presentation

10:30 | GMT+8

10:30 – 12:00 GMT+8

Concurrent Sessions (Rooms: BR 1 – BR 10)

BR 1 - IUFoST – WG 1.2 Education Session 2

Emerging Issues on Education and Key Focus Areas

Session Chair: Azis Boing Sitanggang, IPB University, Indonesia and Cristina L.M. Silva, Catholic University of Portugal, Portugal

I. Sam Saguy, The Hebrew University of Jerusalem, Israel	**Future challenges facing food science technology & engineering**
Food Science, Technology and Engineering (FST&E) are at the heart of disruptive evolutionary processes, many of which are related to exponential progress in science, innovation and digital transformation. 'Templotion' expresses the time implosion as the speed of change accelerates leading to the 'new-normal.' The 'old normal' pre COVID-19 has been disrupted, while embracing the 'new normal' becomes vital. Facilitating new mindset, promoting hybrid teaching, project-oriented education, multidisciplinary new disciplines and partnerships are critical. Education is relatively a slow evolving process, however coping with Industry 4.0, digital transformation, health & wellness (H&W) and other mounting challenges, it should undergo a paradigm shift including novel curricula. Open innovation, artificial intelligence (AI), machine learning, big data, Internet of Things, 3D printing, robotics, gene editing, microbiome, Enginomics, sustainability, nutrition, bioavailability, consumer expectations and personalization are few typical examples already present in many curricula, but their widespread utilization in food related teaching programs is still slowly emerging. Furthermore, the need to fully integrate nutrition with FST&E is paramount especially with AI-powered and systems biology-based technology and knowledge. IUFoST should provide a significant bridge and a global platform in pursuing these anticipated future changes. Specific steps and recommendations will be highlighted.	
Cristina L.M. Silva, Catholic University of Portugal, Portugal	**Emerging opportunities in reshaping and innovating food science, technology and engineering education addressing research and industry needs**
The global food market generated in 2021 around USD 8.27 trillion in revenue. Yet, current food production is quite inefficient. Food Science, Technology and Engineering (FST&E) has been at the heart of recent scientific, technological and digital transformation and disruptive evolutionary processes, demonstrated in novel manufacturing, products, consumer needs/expectations, and	

health and wellbeing. Consequently, education should embrace constantly and exponentially changing landscape and challenges, driven by progress in science, innovation and disruptive technologies. An online survey designed, conducted and main key identified challenges, opportunities and insights concerning specific recommendations on curricula renovation and unique steps required will be presented.
Main points include:
1. Paradigm shift reforming the curricula and promoting technological innovation by focusing on students' problem-solving and critical thinking. Learning opportunities (e.g., training, research, technology and entrepreneurship|).
2. Partnership with other prestigious domains including most recent digital capabilities, designed to improve curricula development and 4-helix collaboration (academia, industry, government and private sector).
3. Open innovation mindset addressing challenges and novel opportunities prevailing in FoodTech/startups.
4. Integration of FST&E and nutrition. 5. Life (soft) skills, learning/unlearning, and hybrid teaching methods. IUFoST should play a cardinal role leading the implementation on a global/local scale, embracing diversity and turn challenges into opportunities.

Donald G. Mercer, University of Guelph, Canada	**Technology transfer to those outside the formal education system**

"A significant component of the agri-food processing sector is composed of small and medium-sized enterprises (SME's) and entrepreneurs who lack formal training in the areas of Food Science and Technology. Most academic Food Science research is directed toward scholarly pursuits for publication in refereed journals. Formal Food Science courses are geared toward knowledge-based education and training (KBET) with emphasis on theoretical principles and text-book learning. As a result, those outside formal education systems are vastly under-served when it comes to providing relevant training material and general information. In order to bridge this gap in knowledge translation and transfer (KTT), it is critical that a more hands-on competency-based education and training (CBET) approach be emphasized.
We will examine several methods of providing instructional material to small-scale processors and entrepreneurs. Two-day workshops on various aspects of food processing have proven to be highly successful when offered in host countries. Access to this information has been expanded through short videos (20 to 30 minutes) designed to show cause-and effect relationships and provide explanations as to why various processing steps are followed. A recent refinement has been to prepare train-the-trainer videos, which has broadened potential audiences for these workshops.

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Ian Noble, Mondalez, UK	**5-dimensional R&D; food science, technology and engineering in the 21st century**

The challenges facing our global Food System continue to evolve. In the 20th Century the main challenges were availability, affordability and safety. As we move into the 21st Century we additionally need to address nutrition and sustainability. Successfully addressing this combination of challenges requires us to link knowledge and capabilities from across the entirety of our global Food System. This will require our Food Scientists, Technologists and Engineers to understand how to adopt system level thinking as they successfully navigate the complexity of shaping our future Food System and contribute to achieving our Sustainable Development Goals; a captivating transformational opportunity for which we need to prepare both today's students and ourselves.

Ferruh Erdogdu, Ankara University, Turkey; Chelo Gonzalez-Martinez, Spain; and Azis Boing Sitanggang, IPB University, Indonesia	**IUFoST role on food studies education developments – round table discussion**

BR 2 - IUFoSTWG2.1 Food Safety

Food Safety Culture and a Pathway to Improved Food Safety Performance

Session Chair: Carol Wallace, University of Central Lancashire, UK

Carol Wallace, University of Central Lancashire, UK	**Evolution and current perspectives on food safety culture**
Food safety culture is still a relatively new concept industry but has gained traction as understanding how it impacts the success of food safety management systems, procedures and practices has become clearer. The important role of culture in food safety performance has been revealed after several decades of food safety evolution. Starting with control systems based on analytical test results, the industry has progressed through application of hygienic practices and preventative HACCP-based FSMS, and this has led to the current appreciation of the role of human factors and organizational culture. Yet food safety culture can still seem to be a fuzzy concept and it can be difficult to grasp exactly what it is, to know how good yours is and to understand how to improve and benefit from a strong food safety culture. Looking more closely at the evolution of food safety assurance, some of the limitations of previous and current food safety management programmes, and some of the cultural clues from real food safety outbreaks helps to demonstrate why we need to pay attention to food safety culture today. This presentation will explore the evolution of food safety management and the role of culture in food safety performance.	
Rachel Downey, Bulla Dairy, Australia	**Bulla Food safety culture roadmap and impact on performance**
Bulla Dairy Foods is a leading Australian family-owned manufacturer of chilled and frozen dairy products, founded in 1910. With the 6th generation of the founding families now working in the business, Bulla has experienced 112 years of growth and change, enduring two world wars, the Great Depression and COVID 19. Bulla has been working to grow its food safety culture maturity since first being introduced to the concept in 2018. We realised that the cycle of regulatory and third-party audits were not driving sustained improvements in food safety, and that human error was a key root cause of failure. As our business was growing dramatically, we needed to focus on our culture, to ensure that our people had all the knowledge and tools they required to make the right decisions for food safety. This presentation will give participants insight into Bulla's food safety culture maturity process, where we came from and where we plan to go in the future. We will share our experience of what worked well and what challenges we encountered and provide some living examples of how to embed food safety culture into overall business culture and strategic plans.	
Jun Barnes, Neogen, Indonesia	**Making your EMP data meaningful in the context of your organisational culture**
Lone Jespersen, Principal, Cultivate SA, Switzerland	**Improving food safety culture and performance – lessons from businesses across the globe**

The Global Food Safety Initiative published its Food Safety Culture Position Paper in 2018. This initiative, along with moves by private standards owners to include requirements around food safety culture, has increased the already keen interest of food safety practitioners into how to strengthen food safety culture in practice. This presentation will revisit the definition and dimensions of what makes up a culture of food safety and how industry, academia, and regulators can play their part in improving the overall food safety performance through better understanding. Showcasing unique case studies of international food companies who have taken different approaches to building understanding and integrating food safety into their organizational culture, the presentation will discuss ways of working that make a real difference to culture maturity and offer a pathway to stronger food safety performance. These practical solutions will challenge audience participants to think of at least ONE thing they can bring back to their teams 'Monday morning' to impact their own or help others with improving food safety.

BR 3 - International Society of Food Applications of Nanoscale Sciences (ISFANS)

Future of Food Manufacturing

Session Chair: An-I Yeh, National Taiwan University, Taiwan and Harjinder Singh, Riddet Institute, New Zealand

Harjinder Singh, Riddet Institute, New Zealand	**Milk protein complexes for protection and delivery of sensitive nutrients and bioactive compounds**

" Milk proteins have excellent nutritional profile and functional properties that make them suitable for a wide range of food applications. As these proteins contain hydrophilic (and charged) and hydrophobic amino acid side chains, they can bind to other molecules via electrostatic and hydrophobic interactions, resulting in protein-ligand complexes. Caseins have unique structures with strong ability to bind divalent cations. They naturally assemble into spherical nanoparticles that can incorporate hydrophobic compounds.

We will present two specific case studies from our recent work in this area. In the first study, we demonstrated the formation of iron-casein complexes, in the presence of orthophosphate. Under specific conditions, colloidal structures with particle sizes of approximately150 nm were formed; the complexes had improved organoleptic properties and bioavailability of iron. This iron-casein complex has now been commercialised in partnership with Nestle.

The second study developed a novel process for co-precipitation of casein and selected flavonoids, e.g., rutin. This process converted the rutin crystals into an amorphous structure, which resulted in high dispersibility of rutin in water. Subsequently, the gastrointestinal behaviour of a yoghurt enriched with casein–rutin co-precipitate and an unfortified yoghurt combined with powdered rutin was determined. The yoghurt fortified with rutin–casein co-precipitate showed better rutin bioaccessibility than the same yoghurt co-digested with a rutin supplement."

Karin Schroen, Wageningen University and Research, Netherlands	**Micro- and nanotechnology for sustainable food production**

Micro- and nanotechnology both hold great promises to achieve sustainable food production. Due to the very small scale at which they can probe phenomena, this leads to insights that otherwise

could not be achieved. In this presentation, I will give a flavor of the multitude of applications in which micro- and nano technology are used. Examples will be taken from sensing: on the land (tailored nutrient delivery for optimized growth), or in the factory (minimize food waste), or even at the consumers level who could benefit from freshness sensors on food packages. Also, tools to analyze e.g. protein functionality as part of the proteins transition, will be presented in detail. In doing so, it is possible to improve current food production processes greatly. Away from current options, I will address options that are further into the future, such as measurement of digestion on chip, which would allow reversed food design. This can be taken even one step further when analyzed within organs on chip, leading to analysis of health effects. These are futuristic perspectives that may ultimately lead to the design of food that is healthy on a personalized level, based on nano- and micrometre insights.

Hyun Jin Park, Korea University, Korea	**Customized foods system through the insertion of a formulated nano-emulsion using coaxial 3D food Printing**

The technology of 3D food printing is based on an additive manufacturing process. This technology is applied for the production of food tailored for a specific consumer group and generally aims at improving food sensory characteristics, enhancing nutritional values, or modifying food texture. The printability of materials used in extrusion based 3D printing is one of the most important properties especially when fabricating objects with architectural complexities. However, this parameter is influenced by several factors (temperature, components, and additives) which makes thorough evaluation and classification challenging. Orodispersible films (ODFs) have attracted attention as delivery systems for the easy ingestion of functional substances. However, conventional casting-based production limits the potential for personalization and controllable onset of action of functional substances. Although inkjet-type substance impregnation technology has been developed, it remains challenging to control the release characteristics, and the loadable capacity is lacking. In this study, a custom ODF system was developed using a three-dimensional (3D) printer and loaded with curcumin as a model functional substance. Hydroxypropyl methylcellulose (content of 1%&20%) was embedded as an ODF matrix, and the curcumin core was loaded through 3D printing. The embedded curcumin reached defined doses of 34.53–138.13 ppm depending on the infill patterns and nozzle sizes. In addition, the mechanical properties of the ODF were modified according to the direction of 3D printing. The results indicated that 3D printing can provide customized dosages of functional substances as well as control dissolution and improve stability.

An-I Yeh, National Taiwan University, Taiwan	**Enhancing functionalities of food materials by size reduction via media milling**

A media mill, derived from a stirred ball mill, has been utilized to produce nano/submicrometer particles via a top-down in paint and pharmaceutical industries. During media milling, material is comminuted among the stirring media, the grinding chamber wall, and the material itself by friction, impact, compression, and shearing forces.This is to discuss the benefits and applications of size reduction via media milling. The size reduction into nano/submicrometer scale enhances the bioactivity of Lycium barbarum (goji) on gene expression in mouse spleen. Three genes, TNF, Nfkb1, and Bcl-2, are up-regulated and two genes, APAF-1 and caspase-3, are down-regulated by goji. With the help of media milling, the contents of bioactive compounds (diosgenin, stigmasterol, and β-sitosterol) in yam products are significantly increased, which enhances the secretion of hTGF-β and inhibits the formation of MMP-1. In addition, the soluble fiber has been doubled by media milling, compared with blended yam. It is also found that media milling could endow chitin with film-forming property and creates new applications. Size reduction has been found to enhance the bioactivities of phytochemicals and can be an attractive method for utilizing whole edible materials, such as whole food beverages.

Mitsutoshi Nakajima, University of Tsukuba, Japan	Formulation and Characterization of Diluted and Highly Concentrated Monodisperse Oil-in-Water Emulsions by Microchannel Emulsification
Emulsions prepared by mechanical homogenizers are mostly polydisperse and rather unstable. More stable emulsions are needed for actual applications. We have investigated the fabricated microchannel for preparing monodisperse emulsions, and achieved successful emulsification using asymmetrically structured microchannels with slit and microhole. The slit structure caused large distortion of the oil-water interface, and the interfacial tension induced spontaneous droplet formation. Diluted monodisperse emulsions up to 10% oil volume fraction was possible to formulate by microchannel emulsification. Highly concentrated emulsions with higher internal fraction are often concerned about their coalescence stability due to the high droplet concentration. Microchannel emulsification was used to prepare monodisperse oil-in-water highly concentrated emulsions, using refined soybean oil as dispersed phase and emulsifiers such as whey protein isolate Tween 20 and sodium dodecyl sulfate. Monodisperse highly concentrated emulsions were successfully prepared with different emulsifiers with concentration as low as 0.5 wt%.The monodispersity of emulsion droplets showed good stability despite having relatively larger droplet size, which might be due to little difference of Laplace pressure between droplets.Highly concentrated monodisperse emulsions prepared showed better physical and chemical stability than polydisperse ones. It could be potentially applied to food products.	

BR 4 - CAAS

Plant Based Food Processing and Nutritional Improvement

Session Chair: Hongshun Yang, NUS Singapore

Sajid Maqsood, United Arab Emirates University, UAE	Comparative study on health-related bioactive properties of Young and mature soybean upon in-vitro gastrointestinal digestion
In this study, two-stage in-vitro simulated gastrointestinal digestion (SGID: gastric phase followed by intestinal phase) was carried out to generate young (YS) and mature soybean (MS) digesta. The aim was to investigate the influence of simulated gastric and intestinal digestion on the total phenolic compound, in-vitro antioxidant properties, as well as the anti-inflammatory (AI), anti-diabetic [a-amylase (AA) and dipeptidyl peptidase-IV (DPP-IV) inhibition] and anti-obesity [pancreatic lipase (LP) and cholesterol esterase (CE) inhibition] activities of the resulting digests from YS and MS samples generated upon the in-vitro SGID. After gastrointestinal digestion, the total phenolic content remarkably increased from 55.66 µg GAE /mL and 176.05 µg GAE /mL for undigested YS and MS samples, respectively, to 689.27 µg GAE /mL and from to 376.98 µg GAE /mL for the respective resulting digests. The gastric digests of both YS and MS exhibited higher inhibition activity towards AA and DPP-IV digestive enzymes linked to diabetes. Furthermore, the complete SGID of MS displayed significantly higher antioxidant and anti-inflammatory activities compared to YS digests. Change in different metabolites in YS and MS upon SGID was also elucidated. Therefore, YS and MS could be recognized as potential sources of bioactive compounds released in the gastrointestinal tract.	
Victoria Kristina Ananingsih, Soegijapranata Catholic University, Indonesia	Microencapsulation of Andrographis paniculata extract using crystallizer at a different agitation speed

The covid-19 pandemic has made the influence of functional food even stronger. Sambiloto (Andrographis paniculata) is a local herb called “the king of bitters” because of its bitter taste. It has bioactive compounds which function as an immunostimulant. Microencapsulation of Andrographis paniculata extract can extend its shelf life and maintain its bioactive compound. Microencapsulation is conducted by crystallization method with sugar as an encapsulating agent. This study was aimed to determine the effect of agitation speed of crystallizer and concentration of Andrographis paniculata extract on the physicochemical characteristics of microencapsulated powder. Crystallization was conducted at 100 oC. This study used three concentrations of Andrographis paniculata extract (0.5%, 1%, 1.5% w/w) and three agitation speed of crystallizer (60 rpm, 80 rpm,100 rpm). The results showed that increasing agitation speed contributed to increase yield value and to decrease crystallization time, moisture content, ash content, dissolving time, bulk density. Increasing Andrographis paniculata extract affected on the increase of antioxidant activity. The optimum process condition was achieved at 100 rpm with extract concentration of 1,5%, which resulted on crystallization time (110 minutes), moisture content (1.32 %), ash content (1,05 %), dissolving time (70 second), bulk density (0.71 g/ml), antioxidant activity (59.50%).

Walailak Khotchai, Kasetsart University, Thailand	**Effect of heating process on protein in soy milk powder**

Soy milk, the plant-based milk, is becoming popular worldwide due to its nutritional benefits and lower calories, compared to dairy milk. In addition, demand of soy milk, is increased as the alternative milk for dairy allergy. However, soy milk contains higher anti-nutrients, so the protein digestibility is lower than the dairy milk. This project aimed to investigate effect of conventional heating (90ËšC for 20 min) and microwave heating at 2450 MHz (360 W, 600 W and 900 W for 1, 3 and 6min) on quality and quantity of protein. Both heating methods did not affect quantity of protein (p > 0.05). Field emission scanning electron microscopy showed that the conventional heated milk had a smooth surface and porous structure, but the microwave heated milk had protein matrix in clusters with rough surfaces. The molecular weight of protein in the SDS-PAGE profile was reduced to <16 and 19 kDa after microwave and conventional heating, respectively. In addition, both conventional and microwave heating were effective to reduce Trypsin inhibitor in soy milk. Therefore, the microwave heating could be used for reduction of trypsin inhibitors activity and possibly improve the protein digestibility in soy milk.

Musfirah Zulkurnain, University Science Malaysia (USM), Malaysia	**Ultraviolet irradiation assisted autolysis of Stichopus horrens body wall for enhancement of sulfated polysaccharide release**

Traditional processing of local sea cucumber (Stichopus horrens) extracts (SHE) relies on long hours uncontrolled autolysis to release bioactive compound including sulfated polysaccharides (SP) that pose food safety risk. Hence, it is necessary to understand the parameters that activate endogenous proteolytic activities and potential mechanisms of SP release for process control of Stichopus horrens autolysis using UV irradiation technology. Blended sea cucumber body walls were exposed to different UV irradiation dosages (0-327,600 J/m2) prior to pH controlled autolysis up to 8 hours. The findings indicated that high UV dosage (327,600 J/m2) increased endogenous enzyme activities by 4-fold compared to control and low UV dosage after 4 hours autolysis, leading to higher release of soluble proteins, glycosaminoglycan, and soluble polysaccharides by 4, 2, and 4 folds. Addition of buffer at pH 7 increased endogenous protease activities by at 25%, that further increase the release of glycosaminoglycan (GAG) by 22.6% with 18% increase in hydroxyproline.

However, evaluation of the secondary protein structure of insoluble SHBW using FTIR revealed larger reduction of α-helixes content (13%) for sample without buffer that accompanied with increment of β-sheet content (13%) while sample with buffer showed increment of random coil content (8%) with the reduction in α-helixes content (6%) with larger decrease in thermostability compared to control. FTIR results also showed increased in intensity of carbohydrate region and degradation of collagen structure of UV treated samples varied among pH. The formation of 5-hydroxymethylfurfural (HMF) carcinogenic contaminant at 0.09±0.01 mg/kg compared to hot water extraction (0.21±0.02 mg/kg) was within safe limit, consistent with their reducing sugar content. Understanding the molecular mechanism underlying physiochemical changes during autolysis would be essential to achieve better control of the quality and safety of SHE.

Hongshun Yang, NUS Singapore	**Synergistic adsorption of surface-active components at the air-liquid interface improves foaming properties of plant-based egg analogues**

Plant-based proteins are generally inferior in foaming compared to egg proteins. Hence, this study aimed to elucidate the foaming mechanisms in plant-based egg analogues modified by different amount of hydroxypropyl methylcellulose (HPMC) up to 2.5%. The molecular adsorption at the air-liquid interface (ALI) with the mass transfer coefficients (k) was determined by a two-film theory. Group with 1.5% HPMC addition matched the foaming capacity (217% vs. 200%) and foaming stability (70% vs. 72%) of liquid egg, due to the thermodynamic incompatibility between biomacromolecules in the vicinity of the ALI that accelerated the protein and lipid adsorption through depletion mechanism (97 and 149 μm/min for k_{protein} and k_{lipid}, respectively). This led to the highest viscous synergy, consistency, and elasticity in the foams made thereof. Foams contained less HPMC did not have fast molecular adsorption, probably due to less HPMC on inducing synergistic adsorption. Foams contained more HPMC exhibited HPMC-dominated ALI, competing with protein and lipid adsorption and reducing foaming properties. It is concluded that HPMC imparts dose-dependent effect on the molecular adsorption at the ALI, which determines the foaming properties of the plant-based egg analogues. This study provides new insights in optimizing foaming of plant-based egg analogues.

BR 5 - International Life Science Institute (ILSI) - Commonwealth Scientific and Industrial Research Organisation (CSIRO) Scientific Session

Food-omics – Rethinking Analytical Tools for Food Components and Their Health Impact

Session Chair: Geoffry Smith, ILSI SEA Region, Singapore

Michelle Colgrave, CSIRO, Agriculture, Australia	**Proteomics – a versatile tool for revealing protein food value, allergenicity and food pathogens**

A major challenge facing the world is providing protein security in the face of a growing global population. To this end, we have started exploring different crops and food sources from pulses to insects to algae and more. As we pivot towards these under-utilised resources, potential exists for increasing prevalence of allergy or cross-reactivity. Soy is a mainstay of the plant protein ingredient market, but new plant protein sources are emerging. For instance, lupin seeds possess high protein content (35-44%) and many health-promoting benefits (lowering cholesterol and blood pressure, managing glucose levels). But lupin also contains proteins that can trigger life-threatening anaphylaxis. Another complementary, sustainable source of protein to feed the world's growing population is insects. Insects have been consumed by people for millennia, but belong to the arthropod family, like crustaceans. Crustacean (shellfish) allergies are both relatively common and potentially severe; hence, the cross-reactivity of the immune system with insect proteins (e.g., tropomyosin and arginine kinase) is a potential health concern. The development of

insects for food requires technology to explore their allergenic potential. In this presentation, the role of proteomics as a powerful tool to characterise both nutritional and antinutritional proteins in emerging protein sources will be discussed.	
Markus Wenk, NUS, Singapore	**Lipidomics – understanding the complex functions and signalling by fats in foods, and health impacts**
Pregnancy and early child development are characterised by profound changes in physiology and metabolism. Here I will highlight results from our recent biochemical characterization of large Singapore birth cohorts. Mass spectrometry-based lipidomics was used to measure hundreds of circulating lipid metabolites in mothers and their off-spring until early childhood. We have also characterized inter- and intra-individual (morning versus evening) variability of breastmilk. Collectively, these studies are providing valuable information maps to advance our knowledge in the fields of nutritional science, endocrinology and paediatrics.	
Nancy Dewi Yuliana, Fitra Tun Nisa, Dian Rosalina, Endang Prangdimurti, Didah Nur Faridah, IPB University, Indonesia	**Measuring the health effects of food by metabolomics and other omics sciences: An example using volatilomics of several Zingiberaceae spices from Indonesia**
Metabolomics is one of the emerging biomarker discovery tools that has received a lot of interest. It enables systematic investigation of a complex mixture, such as a botanical preparation or food product, which may be linked to the results of biological testing systems to identify active principles without the need for recurrent chromatographic procedures. Metabolomics of the plant or food can be integrated with the metabolomics of the treated patients or experimental animals in order to correlate the compounds with their quantifiable health effects. Thus, how the chemicals normalize the human or experimental animal metabolome at distinct disease phases to achieve homeostasis can be investigated. In addition, metabolomics can be utilized to determine whether a substance is harmful to human health. In our lab, we conducted metabolomics-based research using several analytical platforms, primarily to describe bioactive chemicals in various plant-based foods. We recently focus on the volatile components of numerous Indonesian underutilized Zingiberaceae spices and their in vitro antioxidant, anti-diabetic, and immunomodulatory effects. Several compounds have been successfully identified. More research employing metabolomics method to link the identified chemicals with the altered metabolic pathways is being planned to provide insight on the processes behind their antioxidant, anti-diabetic, and immunomodulatory activities.	

BR 6 - Nutrition and Health 1

Session Co-Chairs: Aman Wirakartakusumah, IUFoST, Indonesia: Kalpana Bhaskaran, Temasek Polytechnic, Singapore

Hanif Naufal Ahmi, National Taiwan Ocean University, Taiwan	**Green Seaweed (Ulva nitidum) Hydrolysate Effect on High-Fat Diet-Induced Obese Rats After Osteoarthritis Caused by Ligamentous/Meniscal Injury**
Osteoarthritis (OA) is a common chronic degenerative joint disease involving articular cartilage, synovium, and subchondral bone degeneration. Obesity is associated with musculoskeletal inflammation. In obese people, the levels of pro-inflammatory cytokines, matrix metalloproteinase	

(MMP), considerably increase in the extracellular matrix (ECM). Ulva nitidum contains a high concentration of bioactive sulfated polysaccharides. Sulfated polysaccharides are predicted to have antiviral, antitumor, immunomodulatory, and anticoagulant effects. Ulva nitidum hydrolysate promotes proliferation and suppresses the expression of OA-related factors in SW-1353 induced with mono-iodoacetate and nitric oxide production in RAW 264.7 cells induced with lipopolysaccharide. In vivo investigations on Sprague Dawley rats; they were domesticated for one week and induced with a high-fat diet. The osteoarthritis was induced via anterior cruciate ligament tear and meniscus meniscectomy surgery. Then, rats were treated with UH. UH decreases adiponectin, leptin, TG, TC, MMP-3, CTX-II, and pro-inflammatory cytokines while increasing antioxidant enzymes. Cartilage lesions in osteoarthritis rats treated with UH had decreased proteoglycan loss. In conclusion, Ulva nitidum may help treat osteoarthritis and alleviate pain in patients in that condition.

Qi Yi Ambrose Wong, National University of Singapore, Singapore	**Associations between dietary habits and allergic rhinitis manifestation in young Chinese adults from Singapore and Malaysia**

Allergic rhinitis (AR) is characterized by at least two symptoms of nasal itching, nasal blockage, runny nose, and sneezing, when not afflicted with a cold or flu, with defined atopic sensitization demonstrated by skin prick test (SPT) or specific IgE responses. Presently, we assess the relationship between AR manifestation and dietary habits.
In total, 12,872 individuals with mean age 22.1 (SD = 4.8) were recruited from universities in Singapore and Malaysia. Each participant provided epidemiological data according to validated ISAAC protocol, while atopy status was determined via skin-prick testing. AR was diagnosed according to ARIA guidelines and a positive SPT result (3797 AR cases, 2133 non-allergic nonrhinitis controls). Frequent consumption of seafood (OR: 1.418, 95% CI: 1.153-1.743), butter (OR:1.594, 95% CI:1.317-1.934), margarine (OR:1.486, 95% CI:1.195-1.856), and fast food (OR: 1.350, 95% CI: 1.061-1.727) were associated with higher risk of AR. Conversely, frequent consumption of meat (OR: 0.680, 95% CI: 0.470-0.972), fruits (OR: 0.752, 95% CI: 0.570-0.985), and vegetables (OR: 0.593, 95% CI: 0.400-0.864) were associated with lowered risk of AR. Lastly, assessment of food
combinations according to glycaemic index (GI) and revealed that lower overall dietary GI was protective against AR (OR: 0.682, 95% CI: 0.578-0.805)

Yoha K.S., National Institute of Food Technology, Entrepreneurship and Management – Thanjavur, India	**Influence of postbiotics on the post-consumption fate of non-heme iron in the gastrointestinal tract**

Iron is an essential mineral in the human diet and its level in the human body can be controlled only by the absorption of dietary iron. The amount of non-heme iron in our daily diet is generally higher than that of heme iron. Besides, non-heme iron can provide more iron nutrition than heme iron, but it is challengeable to make non-heme iron bioavailable. The insoluble form of non-heme iron is the cause of poor absorption. This research was focused to study the influence of postbiotics on the assimilation and bioavailability of non-heme iron in the body. Postbiotics produced by immobilized lactic acid bacteria were screened by spectrophotometric method and GC-MS analysis. Iron-rich plant-based food matrices were selected and the effect of postbiotics on their anti-nutrient contents and the solubility of non-heme iron were assessed. Further, in vitro dialyzability and ex vivo intestinal permeability of dietary iron were estimated. The immobilized lactic acid bacteria showed enhanced production of postbiotics and the presence of microbial metabolites was detected. The iron-rich plant-based foods treated with postbiotics showed a

better reduction in antiâ€'nutrient contents - tannin (52.1-65.23%), phytate (30.24-63.41%), saponin (16.72-21.65%), oxalate (46.43-53%), and alkaloids (34-48.33%) which revealed the ability of postbiotics to make non-heme iron soluble. Also, the influence of postbiotics showed improved dialyzability of iron under simulated gastrointestinal conditions and enhanced permeability of iron across the chicken intestinal epithelium.	
H.P. Vasantha Rupasinghe, Dalhousie University, Canada	**Anthocyanin-rich haskap berry as a cancer-preventive superfood**
Haskap (Lonicera caerulea) berry has been used as a traditional medicine in Russia, Japan, and Northeastern China for centuries. We have found that the antioxidant capacity of haskap was significantly greater compared to that of other commonly consumed fruits. We have demonstrated for the first time that anthocyanin-rich haskap berry extracts could reduce carcinogen-induced DNA damage in cultured lung epithelial cells as well as in carcinogen-induced lung tumorigenesis in A/Jcr mice. Pre-treatment of cultured human lung epithelial BEAS-2B cells with the anthocyanin-rich haskap berry extracts significantly reduced carcinogen-induced DNA damage, DNA fragmentation, and intracellular reactive oxygen species and upregulated the ATM-dependent DNA damage repair cascade compared to non-treated BEAS-2B cells. Dietary supplementation of anthocyanin-rich haskap berry powder (262 mg C3G/kg body weight/day) for 22 weeks significantly reduced the tobacco-specific nitrosamine, 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone, (NNK)-induced lung tumor multiplicity and tumor area. Immunohistochemical analysis showed reduced expression of proliferative cell nuclear antigen (PCNA) and Ki67 in lung tissues. The integrative mechanisms of action of haskap anthocyanin include carcinogen detoxification, anti-inflammatory, and immune modulatory properties. Scientific evidence suggests that this ancient berry of Asia can be established as a cancer-preventive superfood.	
Levente L. Diosady, University of Toronto, Canada	**Scale-up of multiple micronutrient fortification of salt**
Approximately a third of the world's population suffers from micronutrient deficiency and related diseases due to diets deficient of key trace metals and/or vitamins. Micronutrient fortification with combinations of trace elements (minerals) and water-soluble vitamins formulated for prevention of maternal and infant micronutrient deficiency diseases tailored to local conditions could effectively reduce the disease burden. Technology that we have developed for double fortification of salt with iodine and iron in large scale in India tests– with 3.4 million school children and some 50 million adults in three states resulted in a 20% improvement in iron status. The intervention was recently expanded to five Indian states with some 100 million recipients. We have further developed the technology to include up to six micronutrients on salt: iodine, iron, zinc, thiamine, folic acid and Vitamin B12. The extrusion-based process has been tested on pilot scale. Premixes and salt were produced and retained the added micronutrients in accelerated stability tests. Fortified salt was produced for efficacy trials involving several thousand participants in India, Tanzania and Cambodia by partner research groups. The technology is ready for large scale roll-out through commercial and philanthropic channels.	
Tabea Kroeber, Technical University Munich, Germany	**Quinoa malt as a remedy for diabetes**
Diabetes is one of the most common metabolic disorders in modern society. One possible form of treatment is the administration of dipeptidyl peptidase IV (DPP-IV) inhibitors. However, synthetic inhibitors can have adverse effects, which might be reduced by additional administration of	

natural peptides which are able to inhibit DPP-IV and are degraded in the body. These peptides can be produced from a variety of foods, such as cereals and pseudocereals, through hydrolysis. In this study, nine different (pseudo-)cereals have been investigated concerning their DPP-IV inhibitory potential, both before and after hydrolysis. Out of these, the most potent pseudocereal, quinoa, was chosen for a malting study. It was malted at different conditions, following a response surface methodology setup. The malts were hereafter investigated towards their DPP-IV inhibitory potential both before and after simulated gastrointestinal digest. It was found that after long-term germination, the inhibitory potential was increased compared to unmalted quinoa. When the malts were digested, however, the short-term germinated malts showed the highest potential. In a possible application the malts would be digested by patients suffering from diabetes. Thus, this shortly germinated quinoa qualifies for the production of dietary supplements with DPP-IV inhibitory potential.

BR 7 - New Zealand Special Session: Unleashing Sustainable Nutrition

Session Co-Chairs: Don Otter, Auckland University of Technology, New Zealand and Yi-Chern Lee, New Zealand

Anu Gnanavinthan, The Pure Food Co, New Zealand	**Novel 3D printing on Texture Modified Foods (TMF) to feed vulnerable population**
PFC has developed nutritious fortified purees using novel process and technologies. These products have been very popular with hospitals/Aged Care across the country. One thing that becomes clear is that many kitchen staff struggle to make the time to present pureed foods for those residents that require TMF in an appetising way. Research has shown that food presentation has a significant impact on the eating experience and on food intake that is especially important for older people with eating difficulties & low appetites. As a next step to an automated processing technology of shaped foods at PFC, we have explored the possibilities of 3D food printing as a future dietetic tool for preparing personalised nutritious meals for people in hospitals and aged care facilities. The PFC along with UOA present an exciting new way to offer highly nutritious pureed foods in a visually pleasing way using 3D printing. The nutritionally fortified purees 3D printed in realistic-looking shapes, visually pleasing full of protein, fibre and other important nutrients. We expect the fine control over personalised portion control to reduce plate waste and allow better management of nutritional intake. 3D food printing may also permit remote plating of food for some people.	
Sze Ying Leong, University of Otago, New Zealand	**Designing food structure and its texture using pulsed electric fields (PEF) technology to improve human masticatory performance and digestibility of macronutrients**
PEF technology induces subtle to major structural modifications in solid foods to achieve desirable food manufacturing outcomes (e.g. time, water and energy saving, reduce food waste). Changes in food structures can affect how they breakdown during human mastication, and how macronutrients are released and assimilated upon digestion. This study applied PEF technology on foods with distinct structural and chemical characteristics (simple: carrot, multi-layered: legume with seed coat, fat-containing: fried potato). Furthermore, combined effect of PEF and human mastication on the in vitro digestion kinetics of macronutrients (i.e. hydrolysis rate of starch,	

protein) from the resulting bolus was quantitatively described using either a first-order fractional conversion or zeroorder kinetic model. High-resolution images of disintegrated bolus were used to evaluate the
mastication performance of human subjects. Using mathematical modelling meaningful information (e.g. particle size, colour and shape) was extracted from the images and converted into numerical data. Results showed that PEF exerted subtle impact on the way human disintegrated and shifted the digestion kinetics of each food sample although masticatory performance differed greatly between individuals. The ability of PEF technology in modifying the structure of plant tissues may aid better design of plant-based foods for controlling the release of macronutrients during digestion.

Biniam Kebede, University of Otago, New Zealand	Tackling today's and future food science and nutritional challenges: A foodomics approach

It is becoming increasingly recognized that metabolomic fingerprinting combined with chemometric data mining has a considerable potential to tackle food science and nutritional challenges. Metabolomics focuses on the high-throughput characterization of small molecule metabolites in biological systems. It is ideally positioned to be used in many food and nutritional research areas, such as (1) component analysis; (2) quality/authenticity/safety assessment; (3) consumption monitoring and nutritional and health biomarker selection. In this talk, a summary of findings of ongoing research activities at the University of Otago will be presented. Case studies on the potential of metabolomics to aid NZ hop breeding; study origin traceability of high-value foods;
investigate the impact of (non)thermal processing on quality; understanding the role of diet on gut microbiota will be presented. Challenges and opportunities of these advanced omics approaches will also be discussed. Overall, our research has successfully demonstrated that foodomics (metabolomics) have a huge potential to increase our understanding of complex food quality/safety changes to tackle food science and nutritional challenges from farm to fork and beyond.

Manasweeta Angane, University of Auckland, New Zealand	Synergistic combinations of plant essential oils and peel extracts with potent antibacterial activity for food preservation.

In this study we investigated the chemical composition, antibacterial activity, and possible synergism of plant essential oils (EOs; peppermint, thyme, lavender, feijoa peel) and an ethanol extract (EE, feijoa peel). The minimum inhibitory concentration was determined for individual EO/EE, and synergistic combinations, against five food-borne pathogens (Escherichia coli, Salmonella enterica Typhimurium, Staphylococcus aureus, Bacillus cereus and Listeria monocytogenes). The phenolic compounds in EOs and EEs were analysed using GC-MS and LC-MS, respectively. The major compounds were menthol (950 µg/mL, peppermint), thymol (660 µg/mL, thyme), linalool (505 µg/mL, lavender), caryophyllene (210 µg/mL, feijoa peel EO) and flavone (3300 µg/mL, feijoa peel extract). Amongst all the combinations tested peppermint/thyme, peppermint/lavender and peppermint/feijoa peel extract exhibited the strongest synergistic bactericidal activities against E. coli and L. monocytogenes. The combination of feijoa peel extract and peppermint EO was superior to the other combinations for the inhibition of all 5 selected foodborne pathogens, reducing the minimum bactericidal concentration of EOs and extract by 6-10 fold. The synergistic combinations were further investigated by performing time-to-kill kinetics and studying the mechanism of action. This work highlights the potential of combinations of EOs as natural alternatives in food preservation.

Debashree Roy, Riddet Institute, Massey University, New Zealand	Curd formation in cow and non-cow milks during in vivo gastric digestion

The traditional dairy industry is becoming increasingly diversified, with strong emergence of goat and sheep milk, mainly because of consumer perception that these milks have better digestive properties than cow milk. However, there is little scientific information on their digestion behaviour.

Curd formation (coagulation) of milk in the stomach is the first crucial step in determining its digestion behaviour. We investigated the curd formation in cow, goat, and sheep milk during gastric digestion, using suckling piglet as a model.

The study revealed that cow and non-cow milks formed curd (aggregated caseins) and liquid (soluble whey) phases in the piglet's stomach. During digestion, the liquid phase emptied faster, while the curds digested slowly and remained longer in the stomach. Compared to cow milk curd, the curds formed by non-cow milks in piglet's stomach had relatively open microstructure and lower rates of strengthening leading to their faster gastric emptying. Such differences in curd structure of cow and non-cow milks were due to differences in their protein composition and physicochemical properties.

The study provided new and enhanced understanding on digestion behaviour of milk from different species, which can be used for designing advanced dairy products to meet the special nutritional needs of consumers.

BR 8 - Food Safety and Regulatory Science 1

Session Co-Chairs: Chin-Kun Wang, IUFoST, Taiwan; Benjamin Smith, Agency for Science, Technology and Research, Singapore

I-Ning Chen, School of Food Safety, Taipei Medical University, Taiwan	Effect of food processing on the allergenic proteins of mealworm

Edible insect is a novel and sustainable food for solving the increase of food consumption. However, edible insect is allergic to sensitized individuals, especially the people with crustacean allergy. Tropomyosin and arginine kinase have been identified as allergenic proteins among edible insects. The thermal-stability is a critical characteristic for understanding the biochemical change of allergenic protein during food processing. Mealworm (Tenebrio molitor) is the first European Union (EU) approved edible insect species and has reached commercial production scale. The objective of the study is, therefore, to study the effect of food processing on the allergenic proteins of mealworm. The fresh mealworms were subjected to different food processing including steaming, boiling, baking and frying. The protein extracts of processed samples were analyzed by ELISA, SDSPAGE and immunoblot. The results show that tropomyosin is the major thermal-stable protein and able to resist common food processing. In contrast, arginine kinase is not able to resist food processing. The results indicate that tropomyosin is the highly thermal-stable and dominant allergenic protein in edible insect, mealworm.

Young-Chang Kim, Korea University, South Korea	**Development of visual detection method for biogenic amines in foods**

Biogenic amines are causative agents in toxic reaction at fermented food. Although either chromatography-based quantification methods are highly sensitive and enable simultaneous analysis of various biogenic amines in foods, the request of expensive equipment and skilled operators are drawback for on-site monitoring. Here, a enzymatic visual detection method for monobiogenic amines including histamine and tyramine has been developed. In the visual detection process, an amine oxidase produce H2O2 as much as the monobiogenic amines in the sample. Upon employing an electron donor at a concentration which is the safety guideline for the biogenic amines, the samples containing the monobiogenic amines higher than the the safety guideline can be selected by color development by the coupled reaction catalyzed by horseradish peroxidase. As electron donors, ascorbic acid and isoascorbic acid were selected, and 3,3′,5,5′-tetramethylbenzidine as peroxide substrates exhibited the highest sensitivity. The detection limit by bare eye was 2 μM of the biogenic amine extract solution. Therefore, the visual detection method could be applied to a on-site and instrument-free quality control method for foods contaminated biogenic amines.

Yang Yie Sio, National University of Singapore, Singapore	**Sensitization to seafood allergens associates with poorer clinical outcome in paediatric asthma**

Background: Increasing trends of food allergy and allergic asthma prevalence were observed in Asia, however, the role of seafood allergens on the clinical outcome of pediatric asthma remains to be investigated.

Objective: To investigate the association between seafood sensitization and clinical characteristics of pediatric asthma.

Methods: We recruited 277 asthmatic patients from KK Hospital, Singapore (age = 10.9 ± 2.9, 61% male). All patients had positive allergic sensitization to house dust mite allergens. Spirometry measurements were performed during the patients' multiple hospital visits within a year. The serological assessment was performed against a panel of 23 common seafood allergens using the immune-dot-blot approach.

Results: We observed high sensitization rates of fishes (ranging from 9.4% to 44.4%), mollusks (32.9% to 54.5%), and crustaceans (10.8 to 20.9%) allergens among pediatric asthmatic patients. Sensitizations to multiple fishes and mollusks allergens were associated with a significant decrease ($p < 0.05$) in average readings of lung function parameters across patients' multiple visits to the hospital, as well as a significant increase ($p < 0.05$) in fluctuations of these lung function parameters, which indicated poor asthma control.

Conclusion: Seafood sensitization represents an important marker for the identification of poor clinical outcomes among pediatric asthma patients.

Shazia Shareef, Indian Institute of Technology Delhi, India	**Generation of Label-free DNA aptamer against Aflatoxin B1 through gold nanoparticles-based SELEX**

Contaminations of food commodities by aflatoxins is a severe problem spread worldwide posing threat to human and animal health. Hence the priority is to develop various specific and sensitive methods for aflatoxin detection. The present study aims to develop highly sensitive and specific aptamers for aflatoxin B1 (AFB1) detection through SELEX (Systemic Evolution of Ligands by Exponential Enrichment) using ssDNA aptamer N40 library. To enhance the possibilities of generating highly specific and sensitive aptamers, tag-free target method was followed, where free AFB1 was allowed to interact with aptamer library and unbound aptamers were removed by

adding excess gold nanoparticles followed by centrifugation at 13500 rpm. The supernatant containing aptamer-AFB1 complex was subjected to asymmetric PCR to amplify the enriched aptamers. After 12 rounds of SELEX, the detection limit of AFB1 compared with available AFB1 standard aptamer. The detection limit of standard aptamer and 12th round pool was 4-8 nM and 2-4 nM, respectively. After confirming the enrichment, the selected pool was amplified and cloned using a Blunt end mighty cloning Kit, Takara. Sequencing AFB1 specific aptamers are in progress. This study provides a reliable and straightforward method to generate highly specific and sensitive aptamers against selected low molecular weight targets.

Gary He, Thermo Fisher Scientific, USA	**How discrete wet chemical analysis is bringing flexible, cost-effective multiparameter testing to support growing testing requirements in the food and beverage industry**

Achieving product consistency and meeting regulatory requirements for dairy, beverage, wine, and beer requires the analysis of multiple parameters. It can be challenging for manufacturers to keep up with the increasing test requirements.

One example is dairy laboratories facing the challenges of increasing productivity, maximizing testing comprehensiveness of dairy samples, and introducing galactose into sugar profiling mix, in compliance with regulations specifying ‘sugar-free’ or ‘lactose-free’ samples.

The traditional test workflow involves several instrumentation and bench-top chemistry procedures. They require long analysis time, multiple well-trained technicians for routine operations, and offer limited automation or high throughput options. Traditional flow injection analysis (FIA) or segmented flow analysis (SFA), as an example, require high reagent volume usage. The modules coming with the systems are customized for specific chemistries, meaning if one buys an instrument with four specific chemistries it can’t do anything else without the need to purchase additional modules.

In contrast, to support manufacturer’s growing testing needs, integrated discrete analyzers can help laboratories consolidate multiparameter tests onto one automation platform. Participants will learn how discrete analyzers, with ease of use and expansion, help to monitor multiple in-process and finished product parameters while enabling productivity improvement, and cost reduction per analysis.

Thilini Kananke, Sabaragamuwa University of Sri Lanka	**Occurrence and in vitro bioaccessibility of heavy metals in raw and cooked forms of green leafy vegetables**

This research aimed at investigating the heavy metal contaminations (Ni, Cd, Cr, Pb and Cu) in four popular green leafy vegetables (GLV) [Ipomoea aquatica, Alternanthera sessilis, Basella alba and Lasia spinosa] cultivated in Colombo District, Sri Lanka. The study also focused on analysis of heavy metal concentrations (by ICP-OES) in soil and irrigation water, distribution patterns of metals in different plant parts and an in vitro gastrointestinal extraction to find the bioaccessibility of heavy metals in raw, cooked and stir-fried GLV. The average concentrations of Cd, Cu, Ni and Cr in tested soils exceeded the acceptable limits. The heavy metal levels in irrigation water samples complied with the recommended guidelines, except for Ni. The mean concentrations of elements tested in all GLV exceeded WHO/FAO safe limits, except Cu. Among the GLV analyzed, L. spinosa showed the highest tendency to accumulate metals. All analyzed GLV showed the distribution pattern for heavy metals as: roots>stems>leaves. In almost all cases, cooking and stir-frying of GLV have reduced the bioaccessibility of heavy metals than in raw samples. The average bioaccessibility (%)

of trace metals in all the analyzed GLV were significantly higher (at P<0.05) in the gastric phase than in the intestinal phase.

The covid-19 pandemic has made the influence of functional food even stronger. Sambiloto (Andrographis paniculata) is a local herb called “the king of bitters” because of its bitter taste. It has bioactive compounds which function as an immunostimulant. Microencapsulation of Andrographis paniculata extract can extend its shelf life and maintain its bioactive compound. Microencapsulation is conducted by crystallization method with sugar as an encapsulating agent. This study was aimed to determine the effect of agitation speed of crystallizer and concentration of Andrographis paniculata extract on the physicochemical characteristics of microencapsulated powder. Crystallization was conducted at 100 oC. This study used three concentrations of Andrographis paniculata extract (0.5%, 1%, 1.5% w/w) and three agitation speed of crystallizer (60 rpm, 80 rpm,100 rpm). The results showed that increasing agitation speed contributed to increase yield value and to decrease crystallization time, moisture content, ash content, dissolving time, bulk density. Increasing Andrographis paniculata extract affected on the increase of antioxidant activity. The optimum process condition was achieved at 100 rpm with extract concentration of 1,5%, which resulted on crystallization time (110 minutes), moisture content (1.32 %), ash content (1,05 %), dissolving time (70 second), bulk density (0.71 g/ml), antioxidant activity (59.50%).

BR 9 - Tanzania Association of Food Scientists and Technologists (TAFST)

Tanzania: A Country with Great Potential for Food Production and Processing

Session Chair: Anne D Perera, Food & Nutrition Consultant, Auckland, New Zealand

Anne D Perera, Food & Nutrition Consultant, Auckland, New Zealand	**Capacity building and empowerment through volunteering in Tanzania**
Most people are keen to learn new skills and apply new technology to gain personal and economic benefits for themselves, their families and the nation. There are several organisations in Tanzania that are geared to help individuals with entrepreneurial inclinations to start small scale industries to become self-sufficient and to contribute to building economically empowered communities. One such entity is the Small Industries Development Organisation (SIDO) of Tanzania, which operates under the Ministry of Trade, Industry and Investment. Some of their best-known activities are the Industrial Estates, Technology Development Centres, Training cum Production Centres, hire purchase schemes for equipment, technology development, technology transfer through exchanges with other countries. At the request of SIDO, the Volunteer Service Abroad (VSA) of New Zealand provided a Food and Nutrition Advisor who initially spent two years engaged in capacity building and full utilisation of the crops and waste reduction through application of appropriate technology. In addition, the volunteer also helped in the revitalisation of the Tanzania Association of Food Scientists and Technologists (TAFST). This presentation will highlight some of the key activities carried out by the VSA (NZ) Volunteer in capacity building and empowerment through Training of Trainers in Tanzania.	
Jacqueline Mkindi, Tanzania Horticulture Association, Tanzania	**An overview of horticulture industry in Tanzania**

The Tanzania Horticultural Association (TAHA) is committed to the growth, promotion, and continued development of the horticulture industry in Tanzania, which includes flowers, fruits, vegetables, spices, herbs and horticultural seeds. TAHA is a catalyst promoting Public-Private-Partnership thereby providing a platform for industry networking, and partnership at both the local and international levels. As a member-based apex organization, TAHA represents the needs of the industry and drives change through its advocacy initiatives. Our documented success (link to achievements) in lobbying on behalf of our members and the industry at large is complimented by other services offered by the Association, such as market and information, technical support, and industry analysis. Together with our members and partners we are working to address the challenges affecting horticultural businesses in Tanzania, thereby creating the enabling environment necessary to promote industry growth and sustainability. For 17 years TAHA has joined hands with the Government of the United Republic of Tanzania, development partners, and the private sector in the efforts towards Horticulture transformation in Tanzania. This presentation will cover how TAHA plans to ensure access to information and knowledge including the adoption of appropriate technologies and market access to achieve highest potential of earning through Horticulture Industry.

Conrad O. Perera, The University of Auckland, New Zealand	**Ethnomedicinal plants of interest to horticulture industry in Tanzania**

Many developing regions are rich in endemic horticultural diversity, and there is a growing demand for indigenous and traditional crops in the local, and export markets. One such crop is Moringa oleifera. It is native to India, but it also grows well in in Tanzania. The leaves, flowers, seeds, and roots of this plant have been used in folk medicine for centuries. It has traditionally been used as a remedy for such conditions as, diabetes, inflammation, bacterial, viral, and fungal infections, joint pain, heart health and cancer. In Tanzania there is a flourishing young industry based on growing and processing moringa products for export. Another is Centella asiatica, which grows well in Tanzania. It has many uses including wound healing burns, ulcers, skin diseases, eye diseases, fever, rheumatism, and mental illness. It has a history of use for centuries in Ayurveda and Chinese Traditional Medicine. Aspalathus linearis is an endemic African species, and is cultivated to produce the well-known herbal tea, Rooibos. It is a rich source of the antioxidant aspalathin, which helps to balance blood sugar levels and reduce insulin resistance. This presentation will focus on the potential of some of the endemic plant species for commercialization in Tanzania.

Hosahalli Ramaswamy, McGill University, Canada	**Potential / future opportunities for food processing in Tanzania**

Food security is a country's global responsibility throughout the world. Global food security means providing adequate amounts of safe and nutritious food for the global population. It not only implies adequate production or procurement of sufficient food to meet the needs but also to use appropriate processing and handling technologies to preserve them. Government policies and priorities often focus on farm level technologies for increasing food production and necessary importation to fill the gap. Most agricultural production are seasonal, and generally the output is large at the time of harvesting or procurement. It therefore becomes necessary to empower the food processing industries with appropriate tools and facilities to preserve this high-volume input into safe and nutritious products.

Many food processing technologies have been developed and practiced in developing countries to achieve this goal, and several exist for adaptation of some of them in developing countries. This presentation provides an overview of the food processing technologies highlighting ones that are appropriate to development in Tanzania and similar African countries.

Bertha Mjawa/Mercy Mmari, Post-Harvest Consult & Capacity Building Company, Tanzania	**Extension of postharvest technologies for small scale food processing in Tanzania**

Since 2010 our work in Tanzania has been focused on identifying training needs, designing extension programs and providing training for postharvest trainers and women's associations involved in small scale food processing enterprises. We initially worked with the USAID Horticulture Collaborative Research Project (Hort CRSP) during 2010-14, where we trained 44 young professionals as postharvest trainers and provided training support for two training centers in Arusha and Njiro. The Marketing Infrastructure, Value Addition and Rural Finance Programme (MIVARF) Project, funded by IFAD, the African Development Bank and the Tanzanian Prime Minister's office, then expanded this work to 17 sites in Tanzania, where training and services focused on value addition for fruit and vegetable crops, herbs and staple crops for local cooperatives, young entrepreneurs, and women's marketing associations. This work continues today as part of the mission of The Postharvest Education Foundation. Key food processing technologies included solar drying of fruits, vegetables and herbs, and the manufacture of jams and jellies from indigenous fruits, along with training on postharvest handling practices, food safety, appropriate packaging methods and marketing options.

BR 10 - Food Processing and Engineering 5

Session Co-Chairs: Vish Prakash, IUFoST, India; Mei Yin Wang, Singapore Institute of Technology, Singapore

Olufunke O. Ezekiel, University of Ibadan, Nigeria	**Peptide content and functional properties of Baobab seeds fermented with Bacillus subtilis singly or co-cultured with a lactic acid bacteria**

Bioactive peptides (BPs) have health-promoting properties such as anti-oxidative, antihypertensive, anti-obesity or anti-inflammatory properties, and can be derived from protein-rich legumes through enzymatic or microbial hydrolysis. Baobab (Adansonia digitata L.) seed is an under-utilised, protein-rich legume with significant nutritional properties. There is a necessity to explore BPs obtained from the controlled fermentation of baobab seeds for the development of commercial nutraceutical and functional foods. Baobab seeds were fermented spontaneously or under controlled fermentation with Bacillus subtilis singly or co-cultured with a lactic acid bacteria (Lactobacillus brevis, Lactobacillus delbrueckii, Lactobacillus rhamnosus GG or Lactobacillus fermentum) for 72 h, during which the changes in pH and peptide content were monitored. The functional properties of the fermented baobab seed flour (BSF) were also evaluated, using the unfermented BSF as control.

The pH increased as fermentation progressed, from 5.89 to 7.23 for all the controlled fermented sample, and comparable to spontaneously fermented samples, which increased from 6.17 to 7.20.

The peptide content of baobab seeds significantly ($p < 0.05$) increased with controlled fermentation, with the highest value observed in B. subtilis only group which increased from an initial 27.34 mg/mL at 0 h, to 136.5 mg/mL after 72 h of fermentation. These values were significantly higher than spontaneously fermented baobab seeds, which increased from 13.92 at 0 h to 51.2 mg/mL after 72 h, respectively. The functional properties of BSF showed a decrease in bulk density, which shows improved digestibility, and water absorption capacity in all the fermented samples compared to the control. Controlled fermented baobab seed samples were significantly higher than the spontaneously fermented samples in total phenolic and total flavonoid contents, with the highest 2.87 mg GAE/g and 2.75 mg QE/100g, respectively, observed in L. fermentum + B. subtilis, comparable with B. subtilis fermented baobab seed, which showed the highest Ferric Reducing AP (2.56). Spontaneously fermented samples showed the highest (49.67%) level of antioxidant activity as measured by DPPH, but was not significantly higher than L. rhamnosus + B. subtilis (48.43) and L. delbrueckii + B. subtilis (48.67) fermented baobab seed.

The result of this study showed that controlled fermentation significantly enhanced the peptide, phytochemical and antioxidant properties of Baobab seed, with improved flour quality. Thus, Baobab seeds may be harnessed to produce bioactive peptides or protein-rich flour, both of which will be of significant positive health and nutritional impact for consumers

Nidhi Bansal, The University of Queensland, Australia	**Biochemical and proteomic characterisation of Australian camel milk and its powder**

Camel milk is an increasingly popular alternative to bovine milk around the world due to its nutritional properties and its potentially therapeutic benefits. In this study, major nutritional components and whey protein profile of Australian camel milk samples collected over four seasons were initially analysed, and camel milk powders were produced by different dehydration techniques. The milk composition varied with season, milking frequency and yield. A proteomic study showed that, in general, summer camel milk contained higher amounts of functional whey proteins, such as lactotransferrin, peptidoglycan recognition protein 1, osteopontin and lactoperoxidase. To increase the potential availability of camel milk, camel milk powders were produced by freeze drying or spray drying with/without pre-concentration by reverse osmosis. Smaller magnitude changes in protein profile were observed in directly freeze-dried or spray-dried camel milk powder, with the freeze-dried sample showing the closest protein profile to that of unprocessed milk, while reverse osmosis had the greatest impact in changing the milk protein profile. The reverse osmosis concentrated and freeze-dried camel milk powder exhibited the highest anti-Listeria activity among all the powders produced. The results suggest that the dehydration method should be carefully selected depending on the use and desired characteristics of the camel milk powder.

Daisuke Hamanaka, Kagoshima University, Japan	**Application of high hydrostatic pressure processing under 100MPa for bacterial inactivation and shelf-life extension of food products**

Non-thermal technologies have been attractive as the effective process for inactivation microorganisms and extending shelf life of food products. In this study, we investigated the combined effect of high hydrostatic pressure processing (HPP) with heat, electrolyzed water and emulsifier on the inactivation and heat resistance reduction of bacterial spores of Bacillus and Clostridium for the purpose of reduction of pressure level during treatment. Heat resistance of bacterial spores were significantly reduced by the combination of <100MPa of HPP with the pretreatment of electrolyzed water and emulsifier, and effective spore inactivation were obtained by the following heat treatment at 80â„ƒ in vitro. This process was also effective for the inactivation of bacterial spores inoculated to various foods (mashed potato, Hamburg steak, bean

paste and fish Surimi product), and their shelf life were extended considerably without quality deterioration. These results are expected to contribute to ensuring food safety, lowering the cost of HPP equipment, reducing the use amount of food additives, and producing high-quality food product.

Hartono Tanambell, Aarhus University, Denmark	**Use of Membrane Filtration in Fractionating and Concentrating Alfalfa Proteins**

Environmental concerns, population growth, and animal welfare, among various other global issues, have resulted in an increasing demand for alternative protein sources. Alfalfa, a perennial legume, is an alternative protein source that has been approved for human consumption by the European Food Safety Authority (EFSA). However, the approval granted in 2009 has a very low recommended daily dose of 10 g concentrate/day, due to possible inclusion of anti-nutrients in the alfalfa concentrates, including saponins1. In addition, the plant contains compounds with undesirable sensory characteristics, namely chlorophyll and off-flavor compounds.

Membrane technology is a gentle technology for selectively fractionating and concentrating proteins. Here, the challenges and advantages in using membrane technology for purifying proteins, particularly ribulose-1,5-biphosphate carboxylase/oxygenase (RuBisCO) from alfalfa protein extracts will be discussed. Experimental data emphasizing the importance in overcoming the technological barriers will be presented. Furthermore, the potential of membrane technology in concentrating proteins and selectively separating the saponins from the proteins will be evaluated. This is particularly important as we have found evidence that saponins, including those not previously reported from alfalfa aerial parts, are concentrated in the protein fraction when processed with acid precipitation.

1 The EFSA Journal (2009) 997, 1-19

Zhenzhao Li, The University of Melbourne, Australia	**Rinse and Chill®, frozen storage and retail packaging influence the quality of lamb loins**

This study evaluated the effects of Rinse & Chill® (RC), a novel technology for carcass processing, vs. control, storage condition (fresh vs. frozen-thawed) and retail packaging (high oxygen modified atmosphere packaging vs. vacuum skin packaging) on the quality of lamb loins. Thirty-two lambs were slaughtered, and the carcasses were allocated to RC or control (n=16). Longissimus muscles from both sides were boned at 24 hours post mortem and aged for 7 days (fresh) in vacuum. After ageing, half of the muscles from both RC and control groups were frozen for three months followed by thawing at 0.5â°C for 24 hours (frozen-thawed). Fresh (non-frozen) and frozen-thawed loins were stored in either high oxygen modified atmosphere packaging (80% O2, 20% CO2) or vacuum skin packaging for eight days under the simulated retail display. RC samples had a significantly lower heme protein concentration and lipid oxidation (TBARS). In the frozen-thawed lamb samples, vacuum skin packaging led to lower lipid oxidation, better instrumental colour, and more tender meat compared to those in high oxygen modified atmosphere packaging. This study showed that RC can be used with vacuum skin packaging to deliver a better eating quality of lamb at the retail point.

Eric C Peterson, SIFBI, A*STAR, Singapore	**Valorization of lignocellulosic sidestreams into microbial protein and lipids with an aerotolerant cellulolytic consortium**

Lignocellulosic biomass is globally abundant, and can be found in food manufacturing side streams and post-harvest residues, representing a promising feedstock for microbial bioconversion to food and feed ingredients, and this is of particular interest for the growing Singapore aquaculture

industry. However, the recalcitrance of these materials has historically limited their application, and pretreatment, sterilization, and enzymatic hydrolysis are bottlenecks to economic feasibility. Through consolidated bioprocessing, aerotolerant thermophilic cellulolytic consortia can be applied to overcome these challenges, achieving rapid and complete cellulose conversion into short-chain fatty acids (SCFAs) in less than 48 hours. These SCFA cocktails have now been confirmed to be an excellent substrate for the growth of food grade strains such as *Candida utilis*, *Yarrowia lipolytica*, and *Corynebacterium glutamicum*. *C. utilis* has been shown to produce up to 30 g/L cell dry weight when cultivated on SCFAs in bioreactors, with 43% protein and 18% lipids containing up to 50% polyunsaturated fatty acids. Importantly, the selective thermophilic and anaerobic conditions of this mixed culture process can be performed without sterilization, which could significantly reduce cost. The cellulose-derived microbial biomass demonstrated represents a previously untapped food and feed source, increased food security and a step towards a circular bioeconomy.

12:00 | GMT+8

12:00 – 13:30 GMT+8

Networking Lunch Symposium Sponsored by U.S. Soybean Export Council (USSEC)

Mrs Yeong Boon Yee, Senior Technical Consultant USSEC SE Asia, Singapore	**Welcome and Introduction**
Suresh Itapu, Technical Consultant, USSE South Asia, India	**Soy Protein Advantage in Food Uses- Functionality, Technology & Versatility**
Hemang Dholakia, Tetra Pak SE Asia, Singapore	**Soy in Plant Based Beverages – Innovation & Evolving Trends for Asian Palate**
Yeong Boon Yee, Technical Consultant, USSEC SE Asia, Singapore	**Soy Transformation – From Traditional Fermented Soy to New Functional food**
<u>Moderator:</u> Ong Mei Horng, National University of Singapore, Singapore **<u>Panelists:</u>** **Anadi Nitithamyong, Food Science and Technology Association of Thailand, Thailand** **Purwiyatno Hariyadi, IPB University, Indonesia and**	**Panel Session: Soy Innovation and Education towards Sustainable Development Goals (SDGs)**

Kwan Lui, At-Sunrice GlobalChef Academy, Singapore	

Day 3 Poster Presentation

13:30 | GMT+8

13:30 – 15:00 GMT+8

Concurrent Sessions (Rooms: BR 1 – BR 10)

BR 1 - International Symposium on the Properties of Water (ISOPOW)

Innovation and Advances in Structuring Water in Foods

Session Chair: Yrjö H. Roos, University College Cork, Ireland

Yrjö H. Roos, University College Cork, Ireland	**Critical notes for integration of water sorption modelling, glass transition and dynamics**

Water sorption dictates properties and time-dependent characteristics of food materials while relationships of water content and water activity are described using sorption models, such as the BET or GAB model. Such models assume equilibrium and include monolayer and multilayer concepts, besides being "dummy" as structural changes are ignored. Conversely, both static and dynamic water sorption data reflect dramatic changes resulting from glass transition, deliquescence and crystallization. Furthermore, biological materials are multicomponent "blends" in which water distribution occurs at an individual molecular level. A metastable glassy state of a dominant component at a low water content may show pseudo-equilibrium, but a steady state in a "rubbery flow" region above a critical water content may never exist. Indeed, water plasticization causes poor performance of the BET model above 0.4 a_w, but the GAB model provides more flexibility in fitting to water sorption data. That is, water-induced changes are hidden, as sorption theories neglect plasticization and disappearance of surfaces. Such phenomena cannot be avoided and water sorption theories must be extended to cover dynamic changes in materials. Although present isotherm models may provide acceptable fitting, their uses in water sorption studies is problematic and many common concepts such as water monolayer become unrealistic.

Zusana Sediva/Erich Windhad, ETH Zürich, Switzerland	Gas hydrates used as a physical blowing agent for highly viscous food-based media

A 2019 patented novel ETH-FPE technology of using gas hydrates for foaming of viscous matrices was optimized, up-scaled and tested. Gas hydrates are crystalline inclusion compounds consisting of hydrogen-bonded, three-dimensional cages from water molecules, entrapping gas molecules. The upgraded technology consists of (i) an in-house gas hydrate formation reactor designed for up to 450 bar operational pressure and (ii) a high-pressure mixing homogenizing unit such as an extruder (200bar) or surface-scraped heat exchanger (80 bar). These pressure ranges cover the stability region of most gas hydrate formers. This study was focused on the formation of single-gas CO_2(formation pressure 15-55 bar), mixed gas CO_2/N_2 (formation pressure 15-450 bar) and single gas N_2 (formation pressure 130-450 bar) hydrate crystalline slurries. The formed gas hydrate slurries were dosed into a high-pressure un-foamed product streamline using a pressure-controlled transfer unit. Foam formation was induced by expanding the gas hydrate slurry/product mix. The new technology is expected to offer great potential in facilitating micro-foam formation, in highly viscous matrix fluid systems since the gas hydrate crystals can be used as a "foaming ingredient" (propellant) which can be well dispersed before their gas load release is activated by pressure and/or temperature adaptation.

Kim Mishra, ETH Zürich, Switzerland	Water incorporation into novel cocoa fibre-enhanced chocolate confectionery systems

A new development entitled “Holistic Chocolate” is addressing the current socio-economic, environmental sustainability, and human health impact deficiencies of the cocoa value chain. Therefore, a novel chocolate processing technology was developed at ETH Zurich (Food Process Engineering Laboratory) in collaboration with the two enterprises KOA Switzerland GmbH and Max Felchlin AG. The novel process uses (1) part of the cocoa pulp juice (CPJ) being rich in natural sugars as well as (2) part of the endo- and mesocarp of the cocoa pod husk rich in high methoxy pectin, cellulose, hemicellulose and lignin. The CPJ is subjected to vacuum concentration resulting in a cocoa pulp juice concentrate (CPJC). From the endocarp of the cocoa pod husk, a fine powder (ECP) is obtained by advanced milling technology. Mixing ECP and CPJC leads to the formation of a watery gel. This gel is incorporated into cocoa mass, thereby forming a chocolate reduced in sugars and enriched with fibres. To achieve smooth fat-continuous chocolate structure and desirable rheological behaviour water migration from the CPJC to the cocoa starch contained in the cocoa mass under acting mixing conditions had to be controlled since exceeding a critical shear stress leads to lump formation and phase inversion.

Lilia Ahrné, University of Copenhagen, Denmark	Structuring future dairy products – the role of water distribution on product properties

Structuring dairy products towards target properties, such as non-melting behavior or fiber formation, requires an understanding of food structure at different length scales from macro to molecular structure. In this context water, consisting of 50 to 90% of the product composition, plays and important role on product stability and functionality. This role has not been fully elucidated, especially in fat containing dairy products. In this presentation, the dominating mechanisms responsible for water and fat retention in a structured dairy protein network will be reviewed by comparing dairy, meat and model food systems.

Furthermore, Low field Nuclear Resonance Magnetic (LF-NMR) results of water distribution in heat and acid induced milk gels and extruded cheese curds, under various processing and cooking conditions, will be compared. The relaxation times in the extruded curds were well described by two proton populations, while four proton populations (serum water, junction zone water, entrapped water and water associated with fat) better described the heat and acid induced gels. The relaxation times and water distribution in the protein network was compared with information about the molecular structure of the protein network, obtained by imaging and chemical bonds determination, to better understand the interplay between water and fat retention.

BR 2- International Association of Engineering and Food (IAEF)

Nonthermal Processing

Session Chair: Hosahalli Ramaswamy, McGill University, Canada

Roman Buckow, The University of Sydney, Australia	**Texturizing meat with pulsed electric fields and hydrodynamic shockwaves**
Meat texture is a highly valuable attribute to consumers and tender meat-eating quality demands a premium price in the market. This drives the meat industry to search for technologies which can consistently meet such expectations. Pulsed electrified field (PEF) and hydrodynamic shockwave processing have shown good potential for meat tenderisation. PEF is the application of short, high voltage pulses to a food resulting in the perforation of biological cell membranes. Hydrodynamic shockwaves, on the other hand, are generated by a controlled electrical discharge underwater resulting in a high-pressure shockwave which causes physical tearing and disruption of food material.	
Keshavan Niranjan, University of Reading, UK	**Ultrahigh pressure processing for targeted biochemical transformations in food systems**
Ultrahigh pressure related research has predominantly focused on improving food safety and intensifying processing operations such as dehydration, leaching/extraction etc. Research on bringing about targeted biochemical transformation in food systems is relatively scarce. This presentation will consider the use of high pressures to: 1) improve the yield and selectivity during oligosaccharide synthesis, 2) enhance the formation of methylglyoxal in honey, and 3) intensify the formation of resistant starches, in order to illustrate the potential of ultrahigh pressure application in biochemical transformation.	
Alexander Mathys, ETH Zurich, Switzerland	**Low energy electron beam (LEEB) as alternative non-thermal decontamination technology for dry food surfaces**
Dry food products are often highly contaminated, and dry stress-resistant microorganisms, such as certain types of Salmonella and bacterial spores, can be still viable and multiply if the product is incorporated into high moisture food products or rehydrated. Traditional technologies for the decontamination of these products have certain limitations and drawbacks, such as alterations of product quality, environmental impacts, carcinogenic potential and/or lower consumer acceptance. Nonthermal low energy electron beam (LEEB) is a promising innovative technology for microbial inactivation on dry food surfaces, which has shown potential to solve these certain limitations. High spore inactivation efficiency supports the application of LEEB. Due to the limited penetration depth of LEEB (≤ 300 keV), product-process interactions can be minimized by maintaining product quality. A first demonstrator for LEEB with a capacity of one ton per hour has already been introduced into the food industry for the decontamination of herbs and spices.	

Proposed inactivation mechanisms, product-process interactions, current limitations and upscaling potential, as well as future trends and research needs of this emerging technology will be critically summarized.

Anubhav Pratap-Singh, The University of British Columbia and Ronit, Mandal, University of British Columbia, Canada	**Use of pulsed UV light for processing liquid food products**

This work focuses on Pulsed Light processing, modeling and computational simulation of different liquids for the process of PL process optimization. A PL system consisting of two different quartz reactors (annular [AT] and coiled tube [CT]) with a cylindrical lamp at the axis were designed. 3-D light energy distribution was modeled water, model liquid foods (water + red/green dye) and skim milk around the lamp to predict lamp energy at any point in space the reactors. Liquids were treated in the reactors at various flow rates (14-75 L/h) and pulse frequency (1-5 Hz) after inoculation with Escherichia coli ATCC 29055, Clostridium sporogenes ATCC 7955 and Listeria innocua ATCC 33090. Batch collimation experiment was done to ascertain UV dosage for microbial inactivation in the liquids. The inactivation was in the order: water > water + red dye > water + green dye > milk. Then, milk samples (0%, 1%, 2% and 3.25%) were treated under above conditions and analyzed for microbial inactivation, pH, colour, vitamin B2 and C content, lipid, and protein oxidation. Up to 4 logs reduction of microorganisms were obtained for milk. The pH of the treated samples was similar to than control. The colour parameter b* decreased as treatment intensified, while vitamin B2 and C decreased significantly. There was significant lipid oxidation and protein oxidation. Red grape and watermelon juice were treated at above conditions and analyzed for microbial inactivation, pH, colour, total phenolics, antioxidant capacity and anthocyanin contents. While there was complete inactivation (>7 logs) of microbes in juices, there was minimal effects on color and pH; but the phenolics, antioxidants and anthocyanins were affected. The results of this study will inform the food industry on how to effectively use this technology

Hosahalli Ramaswamy, McGill University, Canada	**Minimal thermal alternatives for food surface microbial decontamination using steam and ultrasound**

Microbial contamination of food surfaces is a serious problem in handling and transportation of fresh foods. Chemical methods are currently used for surface decontamination have residue concerns. Some physical methods including steam has been tried with limited success.Steam is the most effective medium used for conventional thermal processing of foods. However, the presence of air interferes with the heat transfer mechanism and slows down the effective heating of the surface. In conventional thermal processing, this may not pose a problem because the air is vented out prior to and during the process. However, for rapid and short duration heating of food products, presence of air in the medium and internal tissues of the food products poses a serious problem. Adding an ultrasound combination to steam helps to remove this surface barrier and promote better heat transfer. Application of ultrasound-steam combination process and assessing the influence of air on the effectiveness of microbial decontamination is the focus of this presentation.

BR 3 - Federation of Institute of Food Science & Technology in ASEAN (FIFSTA) Leaders Session
Food Safety and Sustainability in ASEAN: Where the Future Lies
Session Co-Chairs: Koh Yew Ming, Malaysia Institute of Food Technologists, Inc., Malaysia, Richard Khaw, IUFoST & SIFST, Singapore

Maria Leonora dL. Francisco, Philippine Association of Food Technologists, Inc., Philippine	**Enhancing professional development through regulating the practice of food technology in the Philippines**
For more than 45 years, the Philippine Association of Food Technologists, Inc. had for its goal, the acceptance of the practice of food technology by the food industry. And finally, in 2018, food technology was elevated to a high standard of professionalism, ethics and competence. Food technologists have been finally recognized through Republic Act No. 11052, the Philippine Food Technology Act. As stated in the statement of policy, the State shall develop and nurture competent, virtuous, productive, and well-rounded professional food technologists, whose standards of practice and service shall be excellent, world-class and globally competitive through inviolable, honest, effective and credible licensure examinations and through regulatory programs, measures, and activities that foster their professional growth, social responsibility and development. The Act mandates the creation of the Professional Regulatory Board of Food Technology, code of professional conduct, and the conduct of the licensure examination. An important feature of the Act is the integration of all food technologists in the Philippines into one national organization and the provision for continuing professional development through science-based programs, courses of actions and strategies that foster professional growth.	
Koh Yew Ming, Malaysia Institute of Food Technologists, Inc., Malaysia	**Malaysia journey to moving towards higher food safety standards through empowerment**
The food industry, regulatory and other related agencies depends on analytical data as the scientific basis for their decision making. The risks of not having proper and correct analysis carried out by professionally qualified food analysts to support these day-to-day decisions can be considerable and far-reaching. The Food Analysts Act 2011 and Food Analysts Regulations 2013 have been enforced on March 15, 2014. This meant that only registered food analysts with a valid annual practicing certificate would be allowed to issue or certify food analysis reports. All food analysts in the public and private sector are obliged to apply for registration with the Malaysian Food Analysts Council from the enforcement date and as soon as possible. This Act will ensure that qualified, competent and registered food analysts issued quality food analysis reports. Indirectly, it will empower the food analyst profession in Malaysia.	
Anadi Nitithamyong, FoSTAT, Thailand	**Modernization and value addition of traditional foods: A case study from Thailand**
Traditional food products have always been an integral part of the ASEAN society including Thailand. Often times these products are faced with declined interest among current generation due to lack of product improvement and modernization as well as value addition. More importantly appropriate food science and technology knowledge required for processing and production can be a challenge. A variety of research and development activities has been carried out to assist traditional food manufacturers in upgrading their products. Value addition is also introduced to create new products and generate more income. The	

presentation describes product improvement or development revolving around traditional foods. Case examples of value added traditional food products and certain successful commercially available products will be shared.

Winiati P Rahayu, IAFT, Indonesia	**Strategy to improve food safety of indigenous food through risk analysis principle in Indonesia**

WHO as the world's health organization has endorsed three food safety strategies for 2013-2022. The strategies are: 1) science-based decision making, 2) cross-sectoral collaboration and communication, and 3) leadership and technical assistance. The discussion on this paper is based on Indonesia experiences in developing food safety especially for indigenous food. As an example, we will discuss about tempe. Tempe is known as Indonesian original food which is known as a functional and safe food. In the application of the concept of risk analysis, the risk assessment shows that tempe has nutritional content and antibacterial properties. To dignity its functional properties, the 3rd generation (isoflavone aglycone) was produced. In management side, the government is willing to develop tempe industry, from small scale to high tech industry. In many provinces we have hygienic tempe house as a role model. The application of risk communication on tempe is promoting tempe outside country, so tempe is well known internationally and now we proposed tempe to UNESCO as one of an intangible cultural heritage of humanity. Application of risk analysis principle could be applied to indigenous food like tempe to make it more useful and popular.

Keywords: Indonesia, indigenous food, food safety, tempe, risk analysis

Ly Nguyen Binh, VAFoST, Vietnam	**The strategy for Vietnam sustainable agriculture development for 2021-2030, vision to 2050 and the re-shape of food sector**

Vietnam is an agricultural country with main agricultural products including rice, fruit, and seafood produced for domestic and international markets. In 2021, its export turnover reached USD 48.6 billion. However, due to climate changes, the deltas of the country are facing many problems such as sea-level rise, saltwater intrusion, weather changes, temperature increase, etc. These impacts have strongly affected agricultural production patterns and the likelihood of local people. It is therefore essential to reform the agricultural production structure of the country from rice-fruit-seafood to seafood-fruit-rice. In this context, the food sector has to change definitely to cope with the new production structure. This paper reviewed the re-shape of the food sector of the country accordingly.

BR 4 - Global Outreach/Industry Relation Working Group

Nutrition and Functional Food Health Claims in ASEAN: how possible to harmonize the regulation?

Session Chair: Pavinee Chinachoti, GOIR Working Group, IUFoST

Tee E. Siong, President, Nutrition Society of Malaysia	**Calibration on health claim in ASEAN: how possible?**

Functional foods are in highly competitive business sector with lucrative roadmaps. For years, the food industry and university researchers have put in extra efforts to deliver safety and health claim substantiation evidence with some diffficulty in obtaining successful approval. Clusters of small countries such as Southeast Asia are interested but face with some local challenges. With no clear harmonizing guideline established, companies face daunting tasks of approaching local individual regulations that differ in guidelines and procedural practices. In 2004, Codex Alimentarius defined health related food claim statements in categories namely nutrient-function, other function and

disease risk reduction claims. As several countries developed guidelines accordingly, evidence-based health claim substantiation guidelines and document requirements remain difficult to many. This presentation will layout regulatory and category background information and discuss ways regulatory bodies may take beginning steps towards food health claim harmonization in ASEAN and hopefully lesson learned can be useful globally.

Pauline Chan, ILSI SEA Region	**Functional food: from concept to scientific evidence for health claims**
Functional foods and functional ingredients have gained more attention due to their benefits over and above basic nutritional properties. Global Functional Food Market size is expected to reach $259.7 billion by 2027. However, there is no unanimously accepted global definition of functional foods. This presentation will provide an overview regarding essential attributes or characteristics of functional foods and functional ingredients. In addition, examples of guidelines for evaluation of safety of functional foods and ingredients that have been established in some countries will be discussed.	
Pavinee Chinachoti, GOIR Working Group, IUFoST	**Foods with functional claims (FFC)**
Food Innovation and Regulation Network (FIRN) has been established to encourage the ecosystem for business development of high-value functional foods. One of FIRN missions is to help narrow down the gap both in scientific knowledge and in project roadmap towards functional food health claims. With abundant agriculture and food raw materials, Thailand research development and innovation policy focuses on functional ingredients and functional foods due to necessity to raise economic growth and sustainability outcome. Thailand has reported economic opportunities to raise food and agriculture sector as well as expansion of potential health markets of local rural producers. Food with Functional Claims (FFC) platform (similarly to Japan) has been proposed and approved by Thailand's National Food Committee early this year as a means to deliver more functional ingredients and functional foods to the market place. This presentation will outline FFC Thailand platform and its importance in bio-resource and agriculture utilization in support of BCG (Bio-Circular-Green economy) context. The premise of FFC Thailand is to drive this sector where about one half of the population engage in food and agriculture business; it could become a crucial link between agricultural farmers, small medium and large enterprises. The unique role of FIRN on bridging knowledge and management gaps among food industries, regulatory bodies as well as academia to reach the National goal will be discussed.	
Pavinee Chinachoti, Pauline Chan and Tee E. Siong, President, Nutrition Society of Malaysia	**Panel Discussion**

BR 5 - Food Safety and Regulatory Science 2

Session Co-Chairs: Aman Wirakartakusumah, IUFoST, Singapore; Benjamin Smith, Agency for Science, Technology and Research, Singapore

Karl R. Matthews, Rutgers University, USA	**Colistin resistant and ESBL producing Enterobacteriaceae associated with retail lettuce and seed sprouts**
The WHO suggests antibiotic resistance is one of the top ten threats to public health worldwide. Colistin is a last line therapeutic option in treatment of infections caused by extended-spectrum beta-lactamase producing Enterobacteriaceae. Commensal Gram-negative bacteria associated	

with fresh vegetables were screened for colistin and β-lactam resistance and associated genes contributing to resistance. Isolates were recovered from head lettuce (n=26) and seed sprouts (n=6) purchased from local food markets. The APC for lettuce and seed sprouts ranged from 3.88 to 8.47 log CFU/g and the population of colistin resistant bacteria ranged from 1.55 to 5.76 log CFU/g. Colistin resistant isolates (CLR, n=99) were selected from MacConkey agar supplemented with 2 µg/mL colistin sulfate. Isolates were identified by biochemical testing and 16s rRNA sequencing and included Pseudomonas putida, Escherichia coli and Stenotrophomonas maltophilia. Susceptibility to 12 antibiotics was determined using disk diffusion assay. Extensively drug resistant bacteria were recovered, 8% of isolates were resistant to >5 antibiotics. The colistin resistance genes, mcr-1 to mcr-4, were not detected, however, blaSHV and blaTEM, that encode for beta-lactamase were detected in several CLR. The potential spread of ARB through the global food supply from non-food animal derived products (fresh produce) must be addressed.

Shabarinath Srikumar, United Arab Emirates University, UAE	**Acidic environment promotes chloramphenicol sensitivity and gentamycin resistance in Multi Drug Resistant DT104 *Salmonella Typhimurium***

The development of antimicrobial resistance (AMR) in bacterial pathogens represents a serious threat to human, animal, and environmental health. AMR imperils the worthy use of antibiotics, and without intervention, humanity is heading for a pre-antibiotic era where even minor infections can be fatal. One line of thought to circumvent the danger of AMR is to identify/characterize bioactive molecules from food matrices that can act as antimicrobial agents. We found that, in agreement with previous observations, date seed extracts were antimicrobial to our model organism Salmonella Typhimurium. However, our search for antimicrobial compounds from date seed extracts gave us a serendipitous observation – the NADES-based citric acid extract promoted chloramphenicol sensitivity in a multidrug-resistant Salmonella Typhimurium strain DT104. Upon deeper characterization, we found that the acidic environment, independent of the date seed extract, promoted this phenotype. DT104, though multi-drug resistant, is originally gentamycin sensitive. Very surprisingly, treatment with citric acid NADES promoted gentamycin resistance in DT104. These surprising observations have long-lasting implications for food safety - since Salmonella is a foodborne pathogen and citric acid is generally applied in food as a food-grade preservative.

Rethinasamy Velazhahan, Sultan Qaboos University, Oman	**Aflatoxin B1 detoxification potential of medicinal plant extracts and essential oils**

Aflatoxins are toxic secondary metabolites produced predominantly by Aspergillus flavus and A. parasiticus and are common contaminants of several food commodities including peanut, corn, chilli and tree nuts. Among the different types of aflatoxins, aflatoxin B1 (AFB1) is highly toxic and most frequently detected in foods. AFB1 is highly stable and exhibits carcinogenic, mutagenic, teratogenic and immunosuppressive effects in human and animals. A variety of pre- and postharvest treatments have been employed in order to minimize the levels of AFB1 in food commodities. Detoxification has been considered as a promising strategy to reduce the risk of aflatoxin contamination of foods. In the course of screening of medicinal plants for detoxification of AFB1 we observed that the aqueous extracts and essential oils of a few traditional medicinal plants including Heliotropium bacciferum, Ocimum dhofarense and Zataria multiflora were able to degrade AFB1. The degradation of AFB1 by these herbal extracts was confirmed by liquid chromatography-mass spectrometry analysis and the biological toxicity of the degraded products of AFB1 was determined by using brine shrimp bioassay. These botanicals may be highly useful for the development of functional foods or biologically safe herbal feed additives to reduce the toxic effects of AFB1.

Tan Hui Ru, Integrative Sciences and Engineering Programme, NUS Graduate School, Singapore	**Using near infra-red spectroscopy (NIR) to rapidly authenticate the harvest seasons of Tieguanyin oolong teas**

Anxi Tieguanyin is a semi-fermented oolong tea produced in Anxi, Fujian, China, and is under the register of products with protected geographical indication by the European United. Tieguanyin is harvested and produced throughout the year, except in the winter period. The climatic condition of the season influences the chemical composition of the tea leaves, which consequently contributes to the differences in the taste and aroma of Tieguanyin teas produced in different harvest seasons. Tieguanyin teas from the autumn season are favoured and priced higher as compared to those produced during the spring or summer seasons. Thus, mislabelling of the harvest season of Tieguanyin teas is a concern and it is crucial to authenticate their harvest seasons. In this study, the feasibility of using near-infrared (NIR) spectroscopy as a rapid and non-destructive technique to
differentiate Tieguanyin produced in Spring and Autumn was investigated. A total of 49 teas from Autumn and 46 teas from Spring were analysed using a benchtop NIR spectrometer. Combined with the linear discriminant analysis model, a good classification accuracy of up to 78.6% was achieved. This finding highlights the potential of NIR as a rapid tool to accurately authenticate the harvest season of Tieguanyin teas.

Yingfen Jiang, National University of Singapore, Singapore	**Designing fractionation technique to maximize bioactive compounds and reduce toxic elements in purple wheat flours**

Purple wheat has been well recognized for its high nutrition value, such as anthocyanins, phenolic acids, and dietary fiber. However, it may contain trace toxic elements which can accumulate in human body through daily intake. Therefore, this work aimed to identify its nutritive fractions while removing harmful ones during fractionation processing, as examined by confocal microscopy, total anthocyanins content (TAC), essential and toxic mineral analysis of different fractions from three purple wheat varieties. Four layers were fractionated, which were bran, coarse middlings, fine middlings and flour. Results from confocal analysis showed distinct dominant components between various layers, indicating the effectiveness in separating different fractions of purple wheats. Comparing TAC revealed that the bran layers had highest anthocyanins contents while the flour layers had the least, and their difference could be up to 4 times. Most of elements (Ni, Sr, Cr, Mn)
showed progressively decreased amount from the outer layers to the inner layers, while Pb was concentrated in the inner layers, and Se was distributed evenly among different fractions. These findings indicate that fractionation technique is an efficacious processing method to provide flours that are rich in bioactive compounds and safe in terms of significantly reduced amount of trace contaminants.

Hongfei Zhang, National University of Singapore, Singapore	**Antibacterial mechanism of low-energy X-ray irradiation on *Escherichia coli* O157:H7 and *Listeria monocytogenes***

As a non-thermal inactivation technology, low-energy X-ray has attracted growing interest in food preservation field, due to possessing high linear energy transfer effect. This study evaluated the inactivation efficacy and mechanism of low-energy X-ray against Escherichia coli O157:H7 and Listeria monocytogenes. The results indicated that low-energy X-ray irradiation at 400 Gy yielded 4.81 and 4.21 log-reductions for E. coli O157:H7 and L. monocytogenes, respectively. The irradiation caused outer membrane damage, cytoplasmic membrane depolarization, cellular pump and glucose uptake systems damage, and DNA oxidation. However, irradiated E. coli O157:H7 and L. monocytogenes still preserved active intracellular esterase and intact cytoplasmic membrane,

despite losing the ability to form colony. Low-energy X-ray irradiation generated viable-but-nonculturable state E. coli O157:H7 and L. monocytogenes. These results provided new insights into the antibacterial action of low-energy X-ray and its further utilization in the food industry.

Albert Ching, Chief Technology Officer, i-Sprint Innovations, Singapore	**Implementing Food Safety Measures for Brand Owners**

Brands must ensure food safety in their supply chain when delivering products from their factories to their end customers. Consumers expect real-time product information from product companies for them to make informed choices for their purchases. Thus, Brands can substantiate their supply chain transparency and food safety claims to consumers who progressively choose products that reflect their own environmental and social values. Companies must integrate the necessary technology to ensure product safety and provide relevant information to their consumers.

The speaker will discuss technologies companies need to support their supply chain transparency and food safety initiatives for this presentation.

BR 6 - Nutrition and Health 2

Session Co-Chairs: Stephane Guilbert, IUFoST, France; Conor Delahunty, Symrise, Singapore

Abiodun Adebayo-Oyetoro, Cape Peninsula University of Technology, South Africa	**Nutritional benefit of yoghurt from blends of skimmed cow milk and blanched coconut milk**

Food consumption should be centered on having nutritious, safe and durable products at minimum cost. Studies have shown that the number of obese people in the world today has risen to 2.1 billion which is about 30% of the global population. A person is said to be obese when his Body Mass Index is above 30. Yoghurt is a complete and nutritious food taken by everyone due to its health-promoting factor. Coconut is low in protein and carbohydrate but rich in heart-friendly oil. Blanching helps to inactivate enzyme lipase thereby preventing hydrolytic rancidity. This study was carried out to assess the quality and acceptability of yoghurt from skimmed cow milk blended with blanched coconut milk, in various proportions. Results obtained showed that fat, protein and carbohydrate content of the samples were low and vary from 0.54-1.90%, 4.0-6.10% and 9.90-15.82% respectively. The samples recorded good consumer acceptability in the sensory parameters measured. This product has low calorie (hence, good for lactose intolerant, diabetic patients and the obese) and has good shelf life because of its low acidity. Blanched coconut milk in yoghurt will introduce diversification and make it a functional food.

Janusz Kapusniak, Jan Dlugosz University in Czestochowa, Poland	**Vegetable and fruit mousses enriched with soluble dextrin fiber from potato starch with prebiotic properties for children and youth**

The study with acronym PreSTFibre4kids is aimed at examining vegetable and fruit mousses with the addition of soluble dextrin fiber (SDexF) from potato starch with prebiotic properties, in terms of the prevention of overweight and obesity in children and the reduction of metabolic disorders secondary to obesity. In the first stage, an innovative method of obtaining SDexF on a semi-industrial scale was developed. Then, SDexF was subjected to comprehensive

physico-chemical characterization and nutritional labeling. Based on analysis, including assessment of the composition and nutritional value, as well as safety assessment, National Institute of Public Health issued a positive recommendation recognizing SDexF as a food ingredient. In the next stage, industrial partner developed recipes of 6 flavors of vegetable and fruit mousses with and without addition of SDexF. The organoleptic characteristics of mousses were assessed using acceptance and preference methods according to the criteria developed in The Children's Memorial Health Institute. The most accepted and preferred: apple-carrot-quince, apple-peach-parsnip-lemon, apple-cherrycarrot-banana mousses were selected for further clinical trials. The study was performed in a group of 80 to 100 children aged 6 to 10 years, using a double-blind procedure. Evaluation points were anthropometric, metabolic, immunological parameters and changes in intestinal microbiota and metagenome.

Elias Manuel Amadeu Militao, Mid Sweden University, Sweden	**A qualitative study on coping strategies among food insecure households in Greater Maputo, Mozambique**

Food insecurity (FI) is a living reality for many households in low- and middle-income countries, especially among the most vulnerable groups. In Mozambique, the burden of household FI and how various coping strategies might be associated with negative health outcomes is unknown. This study aimed to investigate the experiences and coping strategies used by food insecure households and their perceived health outcomes. Accordingly, 16 in-depth interviews were performed and audio-recorded and transcribed verbatim. Thematic analysis was employed and 5 themes were generated. A wide-range in experiences and coping strategies was reported with focus on skipping meals, eating unsafe and low quality foods, having less nutritious monotonous diet, reducing and re-allocating food intake, reducing meal preparation costs, sending children to relatives and selling household appliances and furniture. Furthermore, the respondents experienced emotional distress, poor academic performance, anxiety and depression, substance use, hypertension, type 2 diabetes, increased risk for HIV/AIDS acquisition and other perceived health outcomes. These findings suggest the need for employment creation and women empowerment as well as implementation of appropriate policies and health programs designed to alleviate household food insecurity.

Key words: Food insecurity, in-depth interviews, coping strategies, perceived health outcomes, Mozambique

Jerrell Felim, National Taiwan Ocean University, Taiwan	**The protective effect of chicken liver hydrolysate on reproductive function of STZ induced diabetic male rats**

Obesity has become a major global health issue in the last century. As obesity is the primary risk factor for various non-communicable diseases, most notably type 2 diabetes. Diabetes can cause significant male reproductive system disruption. Male infertility can be caused by diabetes mellitus in three ways: pre-testicular, testicular, or post-testicular. The chicken liver hydrolysate from chicken liver leftover from slaughtering chickens was hydrolyzed, freeze-dried, and ground into powder. It has antioxidant, anti-obesity, anti-liver fibrosis, and anti-heart damage properties. This study aimed to determine the protective effects of chicken liver hydrolysate on male diabetes rats' reproductive function. In an in vitro experiment, H2O2 was used to induce LC540. It demonstrates that chicken liver hydrolysate can alleviate oxidative stress. In vivo, a high-fat diet and low-dose Streptozotocin (35 mg/kg) induced obesity and diabetes in male Sprague Dawley rats. After six weeks of treatment, chicken liver hydrolysate significantly improved hyperglycemia and insulin resistance. Additionally, the effects on diabetes-related morphology of testicular seminiferous tubules, sperm morphology, motility, and ROS production were ameliorated by chicken liver hydrolysate, and antioxidant enzymes were increased, while pro-inflammatory cytokines were

decreased. Chicken liver hydrolysate significantly improved the reproductive function of diabetic male rats in the current study.

Eunice Ngozi Ezembu, Nnamdi Azikiwe University Awka, Nigeria	**Comparative evaluation of glycemic index of breakfast flakes from OFSP-Cocoyam composite flour sweetened with date fruits and market cornflake sample**

Comparative evaluation of glycemic index(GI) of breakfast flakes from OFSP(Orange flesh Sweet Potato)-Cocoyam composite flour sweetened with date fruits was studied. Six flakes sample ratio (50:50, 60:40, 70:30, 80:20, 90:10 and 100:0 (OFSP:Cocoyam) were randomly generated, produced and subjected to GI determination using a standard methods. GI results ranged from 55 to 100 for all the breakfast flaked and standard glucose. Generally, based on the GI classification, all the breakfast flake samples produced had lower values of GI when compared with that of corn flakes but all falls within the ranked range for medium GI foods except sample 70:30. Interestingly, breakfast flake sample 70:30% competed favorably to the cornflake (65) with a low GI of 55 when compared. This implies that the breakfast flake from OFSP-Cocoyam would raise blood glucose level slowly than that of cornflake, thus reducing the high risk of development of insulin resistance and inadequate or lack of insulin production due to over laboring of pancreas. OFSP-Cocoyam flake with ratio 70:30 could serve as a replacement to conventional cornflake consumption especially with those with hyperglycemic challenge.

Keywords:comparativestudy, OFSP-Cocoyam and corn breakfast flakes, GI, blood glucose

Sumanto Haldar, SIFBI, A*STAR, Singapore	**Effect of consuming cooking oils high in oleic acid or alpha-linolenic acid on fatty acid profile and cardiovascular disease risk: evidence from a randomized controlled trial**

Consumption of oleic acid (OO) and alpha-linolenic acid (ALA) have been independently associated with anti-inflammatory effects and improve cardiovascular health; although their direct comparison using randomized controlled trial with cooking oils, high in either of these two fatty acids, have not been investigated. In this secondary analysis of an 8-week, parallel design, dietary intervention study, we examined the effects of consuming refined olive oil or two blends of cooking oil made from rice bran, flaxseed and sesame seed oils, with distinct concentrations of OO and ALA on ex vivo red blood cell fatty acid profile, markers of inflammation and cardiovascular disease risk in 128 Chinese volunteers with borderline hypercholesterolemia. Compared with baseline, there were significant increase at the end of the intervention in the red blood cell OO and ALA concentrations for the refined olive oil and two oil blend groups respectively. Serum IL-1b, VLDL and MID C lipoprotein fractions decreased with all 3 treatments, indicating comparable effects with either OO or ALA intake on these parameters. Specially formulated cooking oils, through blending different vegetable oils that are sourced in Asia, have the potential to improve cardiovascular health biomarkers to a similar extent as refined olive oil.

BR 7 - Nutrition and Health 3

Session Co-Chairs: Adewale Obadina, IUFoST, Nigeria; Yusuf Ali, Nanyang Technological University, Singapore

Akanksha Singh, CFTRI, India	**Therapeutic effect of arabinoxylan oligosaccharide from pearl millet bran in high-fat diet-induced type-2 diabetic mice model**

The current study aimed to prepare the arabinoxylan oligosaccharides (AXOS) from the pearl millet bran (PMB) using alkaline pretreatment followed by xylanase digestion (Trichoderma viride) for the first time and study their anti-diabetic potential in diet-induced type-2 diabetic mice model. The structure of AXOS was confirmed by different spectroscopic methods. Type-2 diabetes was developed in C57BL/6 mice by feeding high-fat diet, and they were orally gavaged with AXOS at 300 and 600 mg/kg BW for 8 weeks. Body weights of the AXOS treated mice were reduced to 35±1.49 and 31±1.11 g compared to diabetic mice (41± 1.49 g). Elevated fasting blood glucose levels in the diabetic group (205±3.8 mg/dL) were controlled in the AXOS treated group (176±11 and 161±9.6 mg/dL). OGTT-AUC also confirmed the ameliorating effect of AXOS. A significant increase in antioxidant enzymes (SOD, LPO, and CAT) and a decrease in liver function enzymes (AST, ALT, and ALP) in plasma and liver were observed in AXOS treated groups. A decrease in the triglycerides (26.3 and 49.5%) and cholesterol (31 and 58%) in the plasma of the AXOS treated group showed the potent hypolipidemic effect. It was further supported by the decrease in the fatty liver and white adipose tissue weights in the treated groups. AXOS also inhibited the accumulation of advanced glycation products (AGEs) in the liver (34 and 60%) and plasma (18 and 30 %) significantly. These findings indicate the promising therapeutic effect of AXOS from PMB on type-2 diabetes.

Yujing Xu, National University of Singapore, Singapore	**Co-consumption of plant sterols-enriched soy milk with a healthy eating pattern diet lowers blood pressure in adults with metabolic syndrome: A randomized controlled trial**

Plant sterols (PS) supplementation has been shown to be a potential dietary strategy for cardiovascular disease (CVD) risk management, however, limited studies examined this in adults with metabolic syndrome (MetS). The aim of this study was to evaluate the effects of co-consuming PS as part of a healthy eating pattern (HEP) diet on blood pressure and endothelial function in Singaporean adults with MetS. This was a 12-week, crossover, randomized controlled trial with a 4- week washout period where 14 subjects were instructed to consume a HEP diet either with normal soymilk (control group) or with PS (2 g/day)-enriched soymilk (PS group) for 4 weeks. Blood pressure and endothelial function-related outcomes were assessed before/after the intervention.

Systolic blood pressure (PS group: -4.0 ± 12.9 mmHg; control group: 5.9 ± 8.6 mmHg, PInteraction=0.01) and long-term CVD risk (PS group: -0.2 ± 3.6 %; control group: 2.7 ± 4.5 %, PInteraction=0.03) were decreased after PS consumption. Additionally, 33% of subjects in the PS group were no longer diagnosed with MetS. No changes were observed in other endothelial function-related outcomes. In conclusion, co-consumption of a PS-enriched food with HEP diet may lower blood pressure and long-term CVD risk in adults with MetS.

Yi-Chun Han, Fooyin University, Taiwan	**Modulation of plasma lipid levels by light-roasted high chlorogenic acid coffee in obese adults**

Chlorogenic acid (CGA) is one of the most abundant phenolics which can be found in green coffee extracts. CGA has shown antioxidant activity, anti-inflammatory, and anti-obesity. However, the covalent bond of CGA is unstable during roasting, and potentially affects the functional properties of CGA. The aim of this study was to investigate the effect of lightly roasted, high CGA coffee brews on decreasing blood lipids levels and body fat in obese adults. Forty obese people were randomly separated into two groups, the experimental group (CGA 340 mg/day) and the control group (CGA 12.4 mg/day), and a 12-week study was conducted. Our results showed a significantly decreased in body weight, BMI and body fat ratio, plasma total cholesterol, and low-density lipoprotein (LDL) in the experimental group. 5' adenosine monophosphate-activated protein kinase (AMPK), and peroxisome proliferator-activated receptor alpha (PPAR-α) were significantly increased, and

peroxisome proliferator-activated receptor gamma (PPAR-γ) was significantly decreased after 12 weeks of intervention. Also, the adipocyte-related hormone adiponectin in the experimental group was increased, while leptin decreased. In our study, it has shown that lightly roasted, high CGA brewed coffee plays important role in lipid and glucose metabolism, and inhibition body fat accumulation in obese individuals.

Bo Kai Chen, Chung Shan Medical University, Taiwan	**Antiviral effect of natural herbal extracts against respiratory viruses**

COVID-19 has spread globally since 2019. Respiratory viral infectious diseases such as influenza and respiratory syncytial virus (RSV) infection are also prevalent at the same time. While vaccines and antiviral drugs are available for the prevention and treatment of the diseases, herbal extracts would be an alternative choice. Traditionally used to control the symptoms of colds, flu and other diseases and immunomodulatory effects. Literatures have shown different herbs possessed antiviral effect via immunomodulation or alteration of viral replication. This study investigated the inhibitory effects of Echinacea spp. and G. lucidum extracts on RSV and influenza A/B viruses. To determine whether Echinacea spp. and G. lucidum extracts affects the infection or consequence of immunity of RSV and influenza virus, we used cell survival assay and plaque reduction assay to observe the ability of Echinacea spp. and G. lucidum extracts to inhibit virus and increase cell survival rate.

Preliminary results showed that Echinacea spp. and G. lucidum extracts could effectively inhibit the activity of RSV at non-cytotoxic concentrations, indicates that both have antiviral potential. Following experiments will be carried out to supplement the complete results.

H.P. Vasantha Rupasinghe, Dalhousie University, Canada	**Traditional haskap berry of Asia as a future food for cancer prevention**

Globally, the emergence of various cancers is a predominant challenge to human health, society, and the economy. One of the interests in designing future foods is to identify and incorporate disease preventive and health-promoting phytochemical bioactives in our diet. We have assessed the nutritional and nutraceutical quality of commercially grown haskap berry (Lonicera caerulea). Haskap berry has been used as a traditional medicine in Russia, Japan, and Northeastern China for centuries. We have found that the antioxidant capacity of haskap was significantly greater compared to that of other commonly consumed fruits. Polyphenols extracted from haskap berry exerted suppression of the release of pro-inflammatory cytokines by lipopolysaccharide-induced macrophages in vitro, suggesting the anti-inflammatory properties. Independent of cultivars, cyanidin-3-O-glucoside is the predominant bioactive presence in haskap berries. We have demonstrated for the first time that anthocyanin-rich haskap berry extracts could reduce carcinogen-induced DNA damage in cultured lung epithelial cells as well as in carcinogen-induced lung tumorigenesis in A/Jcr mice. Haskap berry is now developed in functional foods and dietary supplements. Validating the efficacy of haskap berry using human clinical trials is in progress, and this ancient berry of Asia can be established in promoting the optimal aging of humanity worldwide.

Cesarettin Alasalvar, TÜBİTAK Marmara Research Center, Turkey	**Development of phytosterol-enriched functional ice tea and dietary supplement from black tea**

Diet-related chronic diseases have been on the rise, representing 60% of all deaths in the world. Tea is one of the most popular beverages consumed worldwide. Therefore, it is important to develop some value-added products from tea. This study was aimed to develop phytosterol-

enriched functional ice tea (P-EFIT) and anti-diabetic dietary supplement from black tea. Two different experiments were carried out. Firstly, cardio-protective effects of P-EFIT was assessed using a clinical trial. Compared with baseline, consumption of P-EFIT significantly decreased the concentrations of total cholesterol by 5.6% ($P < 0.001$) and low-density lipoprotein cholesterol by 8.7% ($P < 0.001$). The data indicate that consumption of P-EFIT is an excellent beverage for delivering phytosterols and has several beneficial cardio-protective effects in subjects with mild hypercholesterolemia. Secondly, streptozotocin and high-fat diet induced T2D in vivo model was developed in male mice for anti-diabetic effect from black tea polysaccharides (BTP). The results showed that the water-soluble BTP significantly decreased the blood glucose level ($P < 0.05$) in diabetic mice even fed with high-fat diet and improved the insulin resistance compared to the control diet. Water-soluble BTP can be used as anti-diabetic dietary supplement. This presentation will cover details of these two original studies.

BR 8 - Food Processing and Engineering 6

Session Co-Chairs: Sebastiano Poretta, IUFoST, Italy; Amy Lin, Agency for Science, Technology and Research, Singapore

Karol Banaś, Wrocław University of Economics and Business, Poland	**Oil manufacturing method impacts on physicochemical characteristic of rapeseed oil oleogels**

In recent years, there has been a significant increase in interest in the oleogelation process due to its potential use in the food, pharmaceutical and biotechnological industries. At the same time, studies show that physicochemical parameters (e.g.texture profile/colour) of oleogels are strongly affected by the method of manufacturing the plant oil. The method of obtaining oil determines its subsequent physicochemical properties in the oleogel structure, which in turn affects its physicochemical parameters and thus, the quality of the resulting product.

The study showed the difference between oleogels made using cold-pressed (CP), cold-pressed and bleached (CPB); and refined (R) rapeseed oil. Oleogels made with 3% of agar and CPB or R oils show very similar hardness. For 1% agar and R oil oleogels were slightly harder than CPB oil oleogels. Significant differences were observed for oleogel from cold-pressed oil, where it was less hard than refined oil by 35%, 33% and 35%, respectively, for the tests measured after 2h, 24h and 48h.

The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

Joanna Harasym, Wrocław University of Economics and Business, Poland	**Ultrasonication of buckwheat grains impacts the resulting flour characteristic**

The exploitation of the potential of ultrasounds as a form of energy transfer in food processing techniques is still insufficient. The study investigated if ultrasounds change the functional characteristics of buckwheat flour obtained from sonication of intact buckwheat grains. The solid:liquid (grains:water = 1,2.5, 1:5, 1:10) ratio during ultrasonication seemed to have an essential impact on damaged starch content and granulometry distribution. Both parameters affected the rheology and fermentation characteristics, modifying the pasting properties of buckwheat flour gels (RVA 4500), basic rheology parameters (MCR-102) and gas retention ratio

(Rheofermentometre F3) in buckwheat flour dough. The breakdown viscosity during pasting was 3, 4 and almost 5 times increased in 1:10; 1:2,5; 1:5 solid: liquid ratio, respectively. Moreover, the relocation of pigments during ultrasound treatment darkened the endosperm layer resulting in ΔE> 2,0, which is notable for an inexperienced user. Ultrasound seems to be a physical treatment which has excellent potential as a rheology modifier while being clean and green technology. The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

Ran Feng, University of Copenhagen, Denmark	**High shear cooking extrusion to create fibrous mozzarella cheese from renneted curd**

Although cooker-stretcher is the most used device for mozzarella manufacture, extruders are of increasing interest to produce structured cheese products, as they have the advantages of being more flexible, minimizing loss, allowing extensive variation in energy inputs and efficient mixing. A lab co-rotating twin-screw extruder was used and four controllable parameters were selected: heating temperature (Th), screw speed (SP), barrel length (L) and cooling temperature (Tc), to understand the shearing process. Extruded curds with a variety of properties were obtained. Th and Tc determine critical phase transitions, important for the creation of fibrous structure, but the final structure was defined in the cooling die. A higher Th enhances curd elasticity and reduces melt strength while a higher Tc induces lower water content and melt strength. Based on statistical analysis, measured and calculated parameters (specific mechanical energy SME, exit temperature Texit and residence time RT), are more promising indicators to understand the extrudate properties compared to controllable parameters. Easily separated, longer and finer fibers were formed at relatively lower SME (23-27 kJ·kg−1), higher Texit (50-54 °C) and shorter RT 55-60 s. This study provided new insights that can be further explored to produce structured mozzarella products with customized behavior.

Gipsy Tabilo-Munizaga, Universidad del Bío-Bío, Chile	**Impact of starch-protein interactions on the digestibility of a 3D printed food matrix based on a salmon by-product protein isolate**

Designing personalized starch-protein-rich foods has become relevant in food science. Given the nutritional implications of starch-protein interactions, this study evaluated the effect of starch-protein interactions on the digestibility of a 3D printed gel based on a salmon by-product protein isolate (SPI). Gels containing 15% corn starch and 4-12% SPI were prepared and 3D printed. The protein secondary structure of the printed gel was analyzed by Fourier transform infrared spectroscopy (FTIR), and thermal analysis was performed by differential scanning calorimetry. In vitro digestibility of the printed gels was evaluated as a function of the degree of hydrolysis (DH) and glycemic index (GI) under gastrointestinal conditions. Thermal analysis showed that as the SPI concentration increased the denaturation temperature was higher, while the intensity of the secondary protein structure bands decreased with increasing digestion time. Adding starch to the gel improved the in vitro gastrointestinal digestion of SPI reaching 52% DH. Moreover, SPI-starch interactions increased slowly digestible starch and resistant starch by 12% and 21.2%, respectively. The printed gel with 15% starch and 12% protein showed the lowest GI values and decreased free glucose. This study provides crucial information to design 3D printed nutritional systems rich in starch and protein with low GI.

Denis Baranenko, ITMO University, Russia	**Combination of terahertz and hyperspectral analysis for meat products safety and quality control**

The control for the most xenobiotics in meat products is carried out using an expensive, time-consuming techniques and quality control is mainly carried out using organoleptic analysis, which requires high qualifications of employees and, most importantly, is poorly documented. The use of

hyperspectral and terahertz radiation for the quality and safety control of meat products can reduce the cost and duration of testing, and at the same time give fully traceable and documented data of an objective instrumental study. The analysis was carried out for meat phantoms, sausages, chilled and minced beef. The following quality parameters were obtained: color and related quality characteristics in the visible (470-840 nm) and near-IR (950-1650 nm) spectral ranges, compliance with the declared content of protein, fat and water in the frequency range 0.2-0 .6 THz. The spectral characteristics of antibiotics of the chemical groups of aminoglycosides, beta-lactams, macrolides, quinolones, tetracyclines, cephalosporins in the spectral range of 0.2-2.0 THz have been established. The limit of direct detection of antibiotics in model mixtures was 0.01%, the error of the method was 5.0-10.0%. To increase the sensitivity and specificity of the method, it is necessary to develop a self-learning algorithm for processing and interpreting of obtained data.

Joncer Naibaho, Wroclaw University of Environmental and Life Sciences, Poland	**Structural formation and microstructural evaluation of soy-based yogurt alternatives substituted with brewersâ€™ spent grain derivatives and the evaluation of its physico-chemical properties during the storage**

In this study, we evaluated the influence of brewer's spent grain (BSG) derivatives, i.e., BSG flour and three different protease-treated protein extracts, during the production of soybean-based yogurt alternatives (SYA). The aim of the study was to explore the influence of BSG derivatives on the formation of SYA microstructure during the fermentation process, as well as its influence on rheological behavior, consistency, and lactic acid production over 14 days of refrigerated storage. The study results revealed that BSG derivatives modified the fermentation process, microstructural characteristics, and structural formation depending on the protein availability of the BSG derivatives. Confocal laser scanning microscopy showed that protease-treated protein extracts from BSG generated a softer, more uniformly distributed dense network, while BSG flour generated an irregular and less fat particle distribution. The rheological properties showed that BSG derivatives strengthened the formed network of SYA and also preserved the flow behavior and consistency during refrigerated storage. BSG derivatives enhanced the production of lactic acid and, therefore, improved the survival of lactic acid bacteria. In conclusion, BSG derivatives modified the microstructural characteristics of SYA, improved rheological behavior, and supported the survival of lactic acid bacteria during the refrigerated storage.

Lida Rahimi Araghi	**Continuous flow high-pressure homogenization extends shelf-life and maintain microbial safety and quality of cantaloupe juice**

The effects of untreated, high-temperature short-time (HTST), and continuous flow high-pressure homogenization (CFHPH) techniques on quality of cantaloupe juice were investigated during 45 days of cold storage (4ºC). Cantaloupe (*Cucumis melo*) juice was extracted, and pH was adjusted to 4.6. The juice was treated with combinations of three pressures (200, 250, 300 MPa), two inlet temperatures (10 or 22ºC), three flow rates (0.75, 1.125, 1.5 L/min) using a pilot-scale dual-intensifier continuous high-pressure homogenizing unit. The HTST treatment was done in a pilot-scale pasteurizer at 75, and 85ºC for 15 seconds. The untreated, HTST and CFHPH samples were analyzed at 0, 15, 30 and 45 days, for physicochemical measures (ºBrix, pH, titratable acidity, viscosity, and particle size distribution), and microbial levels (total plate count, coliforms, yeast, and mold). There were no significant differences in pH, ºBrix, titratable acidity, and viscosity among untreated, CFHPH, and HTST samples, while total aerobic bacteria, coliforms, and yeast counts showed a significant reduction (P≤0.05) in CFHPH treatments and HTST treatments. The results indicate that CFHPH conditions of 250 and 300 MPa can induce

the same level of microbial safety as HTST at 85ºC while preserving the quality and extending the shelf-life of cantaloupe juice.

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Consumption of oleic acid (OO) and alpha-linolenic acid (ALA) have been independently associated with anti-inflammatory effects and improve cardiovascular health; although their direct comparison using randomized controlled trial with cooking oils, high in either of these two fatty acids, have not been investigated. In this secondary analysis of an 8-week, parallel design, dietary intervention study, we examined the effects of consuming refined olive oil or two blends of cooking oil made from rice bran, flaxseed and sesame seed oils, with distinct concentrations of OO and ALA on *ex vivo* red blood cell fatty acid profile, markers of inflammation and cardiovascular disease risk in 128 Chinese volunteers with borderline hypercholesterolemia. Compared with baseline, there were significant increase at the end of the intervention in the red blood cell OO and ALA concentrations for the refined olive oil and two oil blend groups respectively. Serum IL-1b, VLDL and MID C lipoprotein fractions decreased with all 3 treatments, indicating comparable effects with either OO or ALA intake on these parameters. Specially formulated cooking oils, through blending different vegetable oils that are sourced in Asia, have the potential to improve cardiovascular health biomarkers to a similar extent as refined olive oil.

BR 9 - Food Industry Asia

Understanding the Role of Processed Foods in Healthy and Sustainable Diets

Jeyakumar Henry, SIFBI, A*STAR, Singapore	**Processed Foods and the Impact on Consumers – Assessing the Impact on Consumers**

Humans acquired their food and nutritional needs by hunting and gathering for millennia, before the advent of farming and the domestication of plants, that occurred approximately 10,000 years ago. As hunter-gatherers, humans consumed over 200 plant and animal species for their food requirements. With the domestication of plants and the introduction of modern food technology

in the 19th century, we are now down to as little as 30 to 40 plants and animals species to produce over 25,000 foods that stock our supermarkets. Take for example how the 3 main grains i.e. wheat, rice and corn are capable of being transformed into over 2000 varieties of food. The consequence of the reduction in the number of plant species that we use, and the expansion of food variety has led to nutritional and public health challenges. These along with the contemporary concerns about "ultra-processed foods" and how it influences consumers will be discussed in this presentation.

Kalpana Bhaskran, Centre of Applied Nutrition Services, Glycemic Index Research Unit (TP), Singapore	**Perceptions, Definitions and Policy issues linked to processed foods**

Despite great strides made in the recent years in scientific research in the field of food processing on food structure and health, there has been very little attention paid to consumer perceptions as well as translating the policies linked to processed foods into actionable messages. There is still a lack of universally accepted definition of food classification by processing level and this harmonisation is necessary to effectively communicate the link between processing and healthfulness to the various target groups. The misalignment between consumer perceptions of processing and researcher classifications undoubtedly influences how information about processed foods is communicated and how that drives purchasing behaviour of consumers. This directly translates to what type of foods go into meal planning and their impact on the health and well-being at large. The goal of this presentation is to look into the exisiting literature on the perceptions of food processing, including interpretations of processing related terms; how consumer perceptions of food processing classifications align with that being used in research. The policy and regulatory issues linked to processed foods will be addressed too.

Jasmine Pavlic, Unilever, Food Solutions South East Asia	**The Role of Plant-Based Food in Healthy Sustainable Food Systems**

The current global food system is unsustainable and food insecurity is increasing as well as the double burden of malnutrition. Food production is one of the main single contributors to environmental impacts. Intensive Animal agriculture is responsible for almost half of greenhouse gas emissions. Urgent changes are needed to be able to feed the world in a more sustainable and healthy way. Dietary shifts towards more plant-based foods with fewer animal source foods confers improved health, and environmental benefits. Plant-based diets can be as or even healthier than traditional diets and products like meat replacers and fortified products can be part of the solution and help diversify diets. Researchers are showing that meat replacers that have texture, flavor and appearance similar to meat are easier to be incorporated by consumers in the diet than the advice to eat more vegetables. Therefore, meat replacers are considered to be a great addition to a healthy plant-based diet. These products are, in general, healthier, and more sustainable than animal products, and its technological development is inevitably leading to further quality improvement. Despite these benefits, plant-based meat alternative products are still sometimes seen as unhealthy, ultra-processed foods.

BR 10 - TEAGASC (The Agriculture and Food Development Authority) Session

Teagasc Food Programme

Declan J Troy, Teagasc, Ireland	Emerging technologies for sustainable meat industry

"The responsibility to produce high quality, sustainable and cost effective meat products rests with producers, manufacturers, distributors and retailers to ensure that consumer demands are met. New and emerging robust technologies can play an important role in ensuring a more resilient meat value chain and satisfying consumer demands and needs.

New and emerging robust technologies can offer several benefits, including increased process efficiency, improved product safety, enhanced quality attributes and extended shelf-life stability of products.

The commercial uptake and consumer acceptance of novel technologies in meat processing have been subjects of great interest over the past decade. Consumer focus group studies have shown that consumer expectations and liking for novel technologies, applicable to meat processing applications, vary significantly. New processing and meat quality assessment techniques have shown potential benefits to various stakeholders involved in meat production and supply chain. These technologies have demonstrated the potential in achieving various consumer demands associated with the meat product. Nonetheless, the path from the introduction of a new technology on the production line to consumer acceptance is not straight forward. The necessity for meat processors to address consumer risk-benefit perceptions, knowledge and trust in order to be commercially successful in the application of novel technologies within the meat sector."

Mark Fenelon, Teagasc, Ireland	Extraction of protein with valorisation of residual biomass from plant and marine resources

"Teagasc, the Irish Agriculture and Food Development Authority, are diversifying plant and marine research activities (https://u-protein.ie) to complement Ireland's current agri-food system for protein resources. Researchers are collaborating with universities to investigate terrestrial and marine crops including grassland, cereals, legumes and niche crops like duckweed, and seaweeds as viable protein alternatives. A bio-refinery approach is used to generate co-products from non-protein residual biomass. These co-products add value to novel extraction processes. The work leverages established expertise on nutritional and processing parameters associated with meat, dairy, cereal and marine produce and evaluates sustainability, land use, economics, food use, biodiversity and circularity within the supply chain. A multidisciplinary approach spans agronomics to processing, generating ingredients with targeted functionality for use in nutritional formulations. Different combinations of cell disruption techniques, including ultrasound, pulse electric field, hydrodynamic cavitation and drying technologies where evaluated as energy efficient processes to produce protein ingredients.

Value-add streams produced via enzymatic and microbial biotransformation have potential to increase sustainability and circularity in food systems. The programme demonstrates that valorisation of plant and marine crops can create opportunities to develop novel protein blends and ingredients with a broad range of functionalities and health benefits for human use."

Kaye Burgess, Teagasc Food Research Centre	Antimicrobial resistance in changing food production scenarios

Antimicrobial resistance (AMR) is a global health threat which needs to be addressed through a coordinated One Health approach. The food production chain is a central aspect of this but to date the role of the natural environment and food production in the selection and transmission of AMR has received much less attention than that between animals and humans. There is now increased focus on addressing this and understanding the factors which can drive and influence the transmission of AMR within the food chain. As well as this however, the way we produce,

distribute and consume food needs to change to address the challenges of feeding a growing global population and the influences of climate change, all whilst delivering on the UN Sustainable Development Goals. These changes will have an impact on the role food production plays on the emergence and transmission of AMR and will need to be considered carefully in the development of future AMR risk management strategies. This talk will provide an overview of AMR in food production as part of the One Health paradigm, and examine how various factors along the food chain can influence AMR. Knowledge gaps which need to be addressed will also be identified.

Eoin Murphy, Teagasc, Ireland	**Advances in drying technologies for protein powders**

Dehydration is a key transformative step in food production, allowing processors to extend shelf life and reduce volume for storage and export. Teagasc is heavily engaged in this area, providing applied research and support to benefit food processors. Historically, a large focus was placed on spray drying, particularly of dairy products, due to their importance to the Irish agri-food sector. However, in recent years the Teagasc Food Programme has expanded its scope to explore novel technologies as a means of addressing current and/or future industry challenges. In 2017, a novel drying platform was established, focusing on three strategic goals; 1) reduction of operational cost in production of low value streams; 2) improved bioactive stabilisation and enhanced functionality for nutritional products and; 3) wholefood dehydration for high protein consumer products. With respect to low operation cost technologies, a 100 kg/hr plant based on superconcentration and reverse-wet granulation has been installed at Teagasc Moorepark. Preliminary work estimates energy requirements for whey/permeate manufacture are approx. 30% lower than spray drying. For higher value nutritional products, electrostatic spray drying has been shown to be an effective, low temperature process for stabilisation of heat-sensitive bioactives. Lastly, research is underway to investigate the effect of vacuum assisted microwave drying on high protein matrices such as cheese. Overall, the novel drying platform has identified and increased scientific understanding of a number of exciting technologies and this will be expanded upon in the coming years.

Norah O'Shea, Teagasc, Ireland	**Digital Solutions for the Food Industry driven by Converging Technologies**

Additive manufacturing (3D Food Printing), inline process analytical technologies (PAT) and robotics are examples of technologies that underpin Industry 4.0 (I4.0). These technologies are currently being researched in Teagasc and lend themselves to support digital transformation in the dairy industry. The adoption of PAT in dairy processing offers benefits such as non-destructive, real-time and rapid measurements, it also allows efficient monitoring and control of major processes while ensuring a consistent final product. This research highlights novel and cost-effective PAT solutions with applications in dairy concentrate monitoring i.e. acoustics, and Near Infrared (NIR), and powder moisture monitoring i.e. multi-frequency. Microwave analysis. 3DFP has the potential to develop products with complex structures, personalised nutrition, and customised textures. The success of this technology is dependent on foods with suitable physicochemical or rheological properties to ensure a self-supporting structure is printed. Milk proteins can form structured objects (i.e., cheese, yoghurt), so are potential ingredients for 3DFP. This study will discuss how the principles of rennet gelation from the curdling process of cheese-making can be used to produce 3D printed dairy snacks using milk protein isolate fortified milk. Finally, a methodology was developed using collaborative robotics to simulate different human biomechanical movements used during the preparation of infant formula (IF). This is an important technology as a key quality characteristic of an infant formula (IF) powder is the reconstitution quality of the mixture post preparation as well as to ensure targeted nutrient delivery during feeding of the infant. The digital technologies discussed (3DFP, PAT and collaborative robotics) illustrate the importance of the current and future role of I4.0 in dairy processing.

Competition

BR 11 - Food Sustainability Idea/Concept Development Competition (Supported by Singapore Food Agency)

Competition Juries:

- Poh Bee Ling, Singapore Food Agency, Singapore
- Hongda Chen, IUFoST, USA
- Anne D Perera, Food & Nutrition Consultant, Auckland, New Zealand
- Paruchuri Gangadhar Rao, CSIR, India
- Mitsutoshi Nakajima, University of Tsukuba, Japan

Leck Yuan Ling Alicia (Singapore)	**Future VITA-ME**
Anuruddika Hetti Hewage (Canada)	**Development of instant pumpkin string hopper flour as a vitamin A carrier vehicle in Sri Lankan traditional food market**
Anet Rezek Jambrak (Croatia)	**Additive manufacturing in capsules development filled with by-product plant material extracts obtained by energy efficient low carbon emission technique**
Jay Kant Yadav (India)	**Integration of dairy-based protein nanostructures for the management of Alzheimer disease (AD)**
Qurrata Ayuni (Thailand)	**Coconut based Indonesian archipelago: an overview sustainability organic crystal coconut sugar through modify of innovations and supply chain**
Alexandra Obenewaa Kwakye (Japan)	**Refrigerator and pantry mobile application for food waste reduction**

15:00 | GMT+8
15:00 – 15:30 GMT+8 (30 Mins)
Tea Break with Day 3 Poster Presentation

15:30 | GMT+8
15:30 – 17:00 GMT+8
Concurrent Sessions (Rooms: BR 1 – BR 10)

BR 1 - IUFoST WG 3.2 Food and Nutrition Security
Empowerment of Sustainable Food Systems Through Food and Nutrition Security
Session Chair: Cheikh Ndiaye, IUFoST Working Group on Food and Nutrition Security, Senegal and Paruchuri Gangadhar Rao, CSIR, India

Cheikh Ndiaye, IUFoST Working Group on Food and Nutrition Security, Director, Senegal	**Welcome & Introductory Remarks**
Anne D Perera, Food & Nutrition Consultant, Auckland, New Zealand	**Educational interventions for achieving Sustainable Development Goals**

The Sustainable Development Goals (SDGs) of the United Nations aim to bring peace and prosperity to all people by 2030. Education enables upward socioeconomic mobility and is a key to escaping poverty and promoting wellbeing. Over the past decade, progress has been made towards increasing access to education at all levels, particularly for girls. Of the seventeen SDGs, although only number four refers directly to "quality education", all the other goals need educational intervention to achieve them. This presentation will focus on science based educational interventions that would help in achieving the SDGs by 2030. Special reference will be made to the SDG based master's degree programme offered at Massey University in New Zealand. This is aimed at preparing next generation qualified personnel to handle areas covered by SDG's. The approach followed by Massey University works across disciplines and reaches out to other organizations such as R&D institutions, industry, government entities in a more practical way to suit the future needs of the world. It is a good initiative and a model for both developed and developing countries to take advantage of the momentum developed at the UN Food Systems Summit.

Lara Hanna-Wakim, Holy Spirit University of Kasalik, Lebanon	**Designing Food quality and safety policies for Inclusive Sustainable Development Goals**

The evolution of the global food system, which includes new technology and the increase of food trade, has piqued public interest in many countries since the turn of the millennium. Despite this enthusiasm, many countries still lack the adequate tools to safeguard their food systems and public health to meet the sustainable development goals. These issues pose a wide range of challenges to assure the quality and safety of food supplies, as well as their availability at any time and in any location around the world.

In fact, the majority of developing countries have a limited ability to implement rules and regulations concerning food safety. Moreover, there is a lack of inspection systems regarding food safety, in addition to a lack of effective surveillance and monitoring systems of foodborne illnesses and education programs about awareness of food hygiene. The question is: How can policymakers design coherent policies to address these challenges?

When it comes to policy design and decision-making, it's crucial to remember that turning policy decisions into results isn't easy, and it necessitates rigorous policy implementation, evaluation, and adjustment processes. Consequently, finding relevant facts and correctly interpreting the policy implications of available evidence are critical for policy design.

Mitsutoshi Nakajima, University of Tsukuba, Japan	**Development of 3D chef machine system for sustainable food and QoL improvement**

Presently we have faced with many world-wide difficulties, such as aging and declining population, extreme natural disasters, and global climate change. Against this background, Council for Science, Technology and Innovation of Japan has started the new “Moonshot Research and Development Program” aiming to create disruptive innovations and promoting challenging R&D based on revolutionary concepts with 9 Moonshot Goals. Moonshot Agriculture, Forestry and Fisheries Research and Development Program has started to realize the research and development concept, which was set forth by the Ministry of Agriculture, Forestry and Fisheries, Japan to achieve the Moonshot Goal #5 "Creation of the industry that enables sustainable global food supply by exploiting unused biological resources by 2050". We have investigated “Development of Innovative Food Solution for Simultaneous Food Loss Reduction and QoL Improvement” as one of Moonshot projects. Our project is expected to build an innovative solution (AI Chef Machine) system that provides tasty/healthy personal foods suitable for each individual using AI-driven 3D printing system to reduce food loss and improve food QoL at the same time, in which we will produce long-term preservable food cartridges for 3D printers from food loss. Acknowledgment: The research is supported by Bio-oriented Technology Research Advancement Institution.

Paruchuri Gangadhar Rao, CSIR, India	**Innovations in Food Engineering for Food and Nutrition Security**

The challenges in managing Food to meet the increasing demands of the global population for the food requirement, and specifically nutritious food, the traditional methods of food processing and preservation would not be adequate and sustainable. There is a greater need for New innovations in this sector keeping in mind the limited resources. As there is high consumer demand for safe and nutritious food especially during the pandemic and in some regions post pandemic, the food sectors are trying to seek innovative technologies to produce premium quality food loaded with nutrition, ensuring safety and affordability and perception for the buyer. To meet the large demands, up scaling of the process and methods is an essential step. This requirement demands more innovations in food engineering at different steps in the food chain. The traditional thermal treatments of food preservation are slowly being replaced by high pressure processing, freezing technologies vacuum frying to name a few. these also alters functional properties and nutritional accessibility and the shelf life of foods. The paper addresses different aspects of technological innovations in food engineering in the context of its contribution to the food and nutrition security.

Cheikh Ndiaye, IUFoST Working Group on Food and Nutrition Security, and Executive Director, Senegal and PG Rao, CSIR, India	**Open discussion on “Food & nutrition security with respect to sustainable food systems”**

BR 2 - The European Federation of Food Science & Technology (EEFoST)

The Role of Processing to Nourish People

Session Chair: Lilia Ahrné, University of Copenhagen, Denmark

Erich Windhab, ETH Zurich, Switzerland	**Controlling the textural characteristics of plant protein-based meat analogue**

In processing of plant protein-based meat analogues by High Moisture Extrusion Cooking (HMEC) a highly viscoelastic watery protein melt is subjected to a converging die entrance velocity field coupling high shear and elongation flow at temperatures between 120 to 170°C. Under such conditions fibrillar structuring of the proteins is triggered by viscous shear and elongational stresses as well as by elastic extra normal stresses. The latter being expressed by the Normal Stress Differences and, can dominate the flow in the extrusion cooling die down to the die exit by generally unwanted flow phenomena like (i) die swell and (ii) melt fracture if a critical ratio, particularly of in a converging die section is exceeded. However, as demonstrated, based on rheological in-line measurement and process control, such normal stress-induced flow characteristics can also be used to tailor the fibrillar structure and related textural properties of the meat analogues to meet consumer expectations of tenderness and natural meat structure appearance. Such sensory quality adjustment is shown to be further enhanced by our patented high-pressure protein melt micro-foaming processing technology (HMEC-AEREX) which complements sensory and nutritional/health-supporting to convenience and sustainability benefits being demonstrated.	
Ian Noble, Mondalez, UK	**Food Processing – benefits and opportunities**
Advances in food processing have played a pivotal role in assuring the safety, availability and affordability of our food today. Going forwards we need to expand our processing technology capabilities to deliver the benefits required by our future food system.	
Harjinder Singh, Riddet Institute, New Zealand	**Effects of processing on milk digestibility**
Milk is an important source of nutrients in the human diet. For reasons of health and safety, milk is always processed in different ways, mostly involving heat treatment, to destroy pathogenic bacteria. Heat processing also extends its shelf life. Recent studies have shown that heat processing affects the digestion behaviour of milk in the stomach, which may further impact on the rate of delivery and absorption of nutrients. In this presentation, we discuss our recent work on the dynamic in vitro digestion of proteins and fat from milk subjected to different processing treatments, e.g. heating at 90°C, pasteurization, UHT, high pressure and homogenization using a human gastric simulator (HGS). When milk is ingested into stomach and mixed with gastric fluid, milk forms a clot at about pH 6.2. Unheated milk formed a clot with closely knitted network with numerous small pores interspersed throughout the matrix. However, heated, and homogenized milk formed a clot with larger voids and open network structure, which became more open when the milk was heated at greater intensity. With increasing digestion time, as the pH decreased, the structures of the clots tightened and became less permeable to serum and solutes. These changes apparently affected the hydrolysis of protein by pepsin in the gastric system. Consequently, hydrolysis of casein was much slower in the unheated milk than that in the heated milk. Whey proteins remained largely intact during the digestion in unheated milk but in heated milk whey proteins were involved in the formation of casein clot and readily hydrolysed by pepsin and released to intestine. The structure of the clot also influenced the rate of lipid release and digestion. This was due to the entrapment of fat globules within the clot structure, and their release was dependent on the rate of curd breakdown and protein hydrolysis. This new understanding could be applied to manipulate the macronutrient delivery and digestion of dairy products in both gastric phase and intestinal phases.	
Guglielmo Bonora, Nestle Singapore	**The role of food processing in unlocking the power of food**

The presentation will be about “The role of food processing in unlocking the power of food. Through real life example from our experience at Nestlé, we will showcase and elaborate on how food processing can help unlocking the nutrition present in raw ingredients: from bioavailability of nutrients, like lycopene in tomatoes, to decreasing negative components, like lectins in beans or phytates in grains.”

BR 3 - International Union of Nutritional Sciences (IUNS)

Advancing Nutrition Science Globally

Session Chair: Vish Prakash, Vice-president of IUNS; President of IUFoST and J. Alfredo Martinez President, IUNS

Lynnette M Neufeld, Food and Nutrition Division (ESN), FAO	**Healthy diets concepts and controversies**
"The centrality of diets for the prevention of all forms of malnutrition and many health outcomes is now well accepted. Up-to-date evidence of the healthfulness of diets should be used to inform policy and programmatic actions to prevent malnutrition and advance such health outcomes. However, while guidance outlining the components of a healthy diet have received some level of acceptance, there is no agreed definition of a healthy diet or the most appropriate metrics to measure the healthfulness of diets. This lack of consensus stems at least in part from the highly diverse diet-related issues that exist across varying contexts. Definitions and related metrics have tended to focus on issues of nutrient inadequacy, or factors related to non-communicable disease risk; rarely are both issues considered simultaneously. In this presentation we will review the various components of a healthy diet, explore some of the challenges that exist in its measurement and discuss a new initiative underway to foster consensus building.”	
J. Alfredo Martinez, The University of Navarra	**Nutrient and gene interactions for precision management of obesity**
"Obesity is not only strongly associated to unhealthy lifestyles and unbalanced diets, but also to individualized genotypes and phenotypes. Personalized nutrition advances against obesity are pursuing a metabolic counting on gene-nutrient interactions. Precision nutrition in obesity permits the delineation of unique nutritional subgroups or obesotypes, based on the assessment of personalized indicators such as medical records, age, gender, physical activity, psycho-emotional mood, and social position, as well as food preferences and metabolic and physiopathological conditions. Genetic and metagenomic studies confirm that inter-individual genotypic differences partially explain the heterogeneity in the response to dietary patterns. Evolving “omics” instruments targets the analysis of genes (genomics/epigenomics), of mRNA (transcriptomics), of metabolites (metabolomics) and the microbiota (metagenomics), which can be conjointly used in obesity prevention and management. Thus, obesity nutrigenetics researches the genotype/SNPs role in the differential response to nutritional and metabolic factors concerning fuel homeostasis influencing the unique calorie requirements for each person, while obesity nutrigenomics investigates the role of nutrition on gene functions and expression related to energy metabolism. An updated personalized precision nutrition concerning obesity needs to implement the previous omics tools integrating all endogenous and environmental factors involved in the nutrition and health axis affecting adiposity and obesity outcomes.”	

Vish Prakash, IUFoST, India	Nutritional sciences enriching India school noon meals of 140 million a day with healthy diet
"The huge Nutrition gap in populous countries with large economic disparity, challenges any system with many financial and management issues as well as logistics when one is faced with the sensitive Child Nutrition Intervention programme spreading to adoloscent nutrition. The success story in India of the school going children nutrition is because of governments long drawn strategy and empowering the system to the last mile. Barring COVID pandemic time, this scheme of midday meal programme where the children get hot cooked food catered with the traditional food of the region with a clear focus on Food safety and sustainable approach. This has made India as one of the largest country reaching nearly 120 million Children across the country everyday in 1.3 million schools with one supplementary meal.The future looks at the fortification of these with a focus on micronutrient and protein undernutrition.This success story unique to India in principle can be replicated in many countries including developed countries. This is an example of local solution to global problems using innovative Food Science and Technologies with hygiene embedded into the sustainable programme of freshly cooked food at an affordable cost funded by the government."	

Hisanori Kato, The University of Tokyo, Japan	Communication of nutrition science in the 21st century
"The Japanese public is highly interested in health and food and has a relatively high level of knowledge about nutrition and food preparation. This is due in part to the extensive nutrition education, especially through school lunches and the activities of nutrition teachers, where correct knowledge is cultivated from an early age. Under such circumstances, the Tokyo Nutrition for Growth Summit 2021 was held In Japan last year. The results were compiled into the Tokyo Compact on Global Nutrition for Growth. In addition, the 22nd IUNS-International Congress of Nutrition (ICN) will be held in Tokyo this December. With about 2,500 abstracts already submitted, it is expected to be a productive meeting, with lively discussions during the six days of the conference, which is expected to provide a valuable forum for exchange among more than 4,000 researchers. In the second half of my talk, I would like to touch upon a few of our group's research activities aiming at showing how detailed molecular analyses such as genomics, epigenomics, and multi-omics can lead to practical knowledge for nutritional science."	

BR 4 - Education Session by ISEKI

Training New Skills of Agri-Food Professionals For 2030

Session Chair: Ferruh Erdogdu, Ankara University, Turkey

Remigio Berruto University of Turin, Italy	Sustainability, bioeconomy and digitalisation skill needs in Agribusiness education with a multidisciplinary approach: Erasmus+ FIELDS project
There are new opportunities and open doors for agriculture today, determined by the environmental change, the greening of the items and cycles, the reuse of side-stream items, the raised complexity of the food chain and the expanded accessibility of data. To effectively address and respond to these drivers, agribusiness and farms service needs new plans of action and skills. The distinguishing proof of existing and arising skills needs in bio-economy, sustainability and digital innovation is of foremost significance to foster an essential way to deal with keep the European rural area secure and economically competitive in the long term. The FIELDS project	

approach, beginning from the current and future patterns and skills needs, will prompt a sustainable European procedure to address these expertise gaps. Since agriculture issues and potential open doors contrasts a change a lot from one country to another, the EU strategy will be modified to have the national road maps. It will address country-explicit activities, work related profiles and preparing material to mirror the nation needs while keeping EU quality norms (ESCO, EQAVET, and ECVET) to address the portability of learners through Europe solidly.	
Rui Costa, Polytechnic of Coimbra, Portugal	**Tackling the skills gap in the food industry with innovative training**
Particularly the last decade has brought the food industry to face several challenges related to sustainability, health, and skills gap in the job market. The fast-changing job market, with introduction of IT, AI, automatization and robotization, leads to the disappearance of some jobs moving to unemployment workers which skills are not needed in the same share and lack skills for the new occupations. A challenge particular of the food industry, is the changing diets toward plant-based. A considerable share of consumers is becoming vegan due to sustainability, animal welfare and diet concerns, putting pressure on the food industry and hospitality to supply vegan alternatives. The vegan consumer also affects the habits of their close social ties at home, with friends or at work. However, the biggest contribution to this change is due to flexitarian consumers that are reducing the meat consumption, though not avoiding it completely, but represent a big share of the population. The EQVEGAN projects proposes to tackle the skills gap created by the two pre-mentioned trends by reskilling and upskilling by training in soft skills, green skills, digital and automatization skills, and new plant-base processing technologies, and additionally with certification of job profiles and of work-based learning.	
Ferruh Erdogdu, Ankara University, Turkey	**Training the food technologist on digital and automation skills for I4.0**
"A major current interest in the food industry is the sustainable food processing while the innovative approaches have also gained significance. This brings certain challenges due to the digitalization and automation trends through the introduction of I4.0. Considering that the food industry in Europe, as a largest manufacturing section comprised by SMEs (99.1%), these challenges are difficult to fulfil. The introduction of automation, sensors for intime quality control, robots, additive manufacturing, artificial intelligence, among others, brings more productivity to the food industry with lower costs but needs the human interaction to programme it, and recognise and correct its faults during operation. For the adaptation to these challenges, the food industry professionals need to be reskilled. Therefore, the EQVEGAN (European Qualifications & Competences for the Vegan Food Industry) project has proposed to design and to offer innovative trainings to the food operators, food technicians and food technologists/engineers on digitalization and automation . This presentation will introduce the activities on the digitalization – automation module for a sustainable processing with innovative approaches (innovative processing, process design - control, robotic applications, etc.). This project is expected to result in an effective approach for the training of food professionals for quality assurance and sustainability of the processing. "	
Anet Režek Jambrak, University of Zagreb, Croatia	**Green skills for the food industry professionals**

With the growth of population and climate changes, there is a need and urge to act towards sustainable and smart food supply chain and smart factories. The idea is also to move toward flexitarian diets, that is known as more intake of vegan food products. The GREEN SKILLS module covers important topics in line with sustainable development goals (Agenda 2030, issued by United Nations). The GREEN SKILLS training includes main topics and training about sustainability, general facts about vegan food processing in terms of reducing of energy consumption, ecological footprint, as well impact to the economy and society, as sustainability pillars. Other important skills of future are economy, marketing, and entrepreneurship skills. The food professional also needs to be in line with legislation in vegan food processing, environmental standards, and future legislation alignment. Finally, tackling consumers in their sustainable living, sustainable diets and acting as responsible consumer towards reducing waste, water and energy consumption is highly needed. EQVEGAN, by its action, is in line with SDGs, especially, in target 4.7 Education for sustainable development and global citizenship. Sustainable Development Goal 4 aims to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”.

Line Friis Lindner ISEKI-Food Association, Austria	**Action-learning in education for sustainable agrifood systems**

Sustainability challenges in the agrifood sector are of complex nature calling for new knowledge, skills, values and attitudes. Education plays a central role in responding to such challenges. In the transition to more sustainable agrifood and forestry systems, NextFOOD (2018-2022) is employing action-learning and action research in twelve educational cases transitioning to experiential education where learning environments fostering participatory interactions between students, teachers and stakeholders form the starting point for learning. The educational cases represent a wide range of agrifood and forestry systems in different geographical locations (Europe, Africa and Asia). One of the twelve educational cases is FoodFactory-4-Us, an extracurricular international student competition run by ISEKI-Food Association, aims at developing the competencies needed to drive the transition towards more sustainable agrifood and forestry systems. The competition is organized in a cyclical manner in which action-research is conducted on students’ self-assessment of their competences, experiences and contributions. The data shows that students improve their competences in building and maintaining networks; collaboration; and problem-solving through participation in the competition and that students’ values and attitudes contribute the most to the learning community. Such findings give notion to the importance of cultivating learning environments in which a multitude of values and attitudes are given room and space to flourish thereby shaping the current and future agrifood system.

BR 5 - bioMerieux Scientific Session

Predictive and Preventive Diagnostics: What It Means to Food Safety and Quality

Vikrant Dutta, bioMerieux, USA	**Path to create predictive diagnostics**
Katleen Varnckx, bioMerieux, Belgium	**Predictive diagnostics approach: using knowledge to eradicate pathogens in food processing**
Gaulthier Pesneau bioMerieux, France	**How diagnostics help with the dairy market expansion in Asia**

BR 6 - Future of Food Manufacturing

Session Co-Chairs: Ogugua Charles Aworh, IUFoST, Nigeria; Shao Quan Liu, National University of Singapore, Singapore

Maximilian Kannapinn, Technical University of Darmstadt, Germany	**3D conjugate physics-based data-driven Digital Twins enable food processing autonomy**

Smart food processing devices decrease production losses and energy consumption on an industrial scale and help us reduce the value chain's carbon footprint. In community catering and on a private level, they help to improve food safety and quality.

Like the global self-driving mobility trend, we can expect a development towards the autonomy of food processing methods during the 2020 decade. **This work demonstrates how the Digital Twin can help develop self-cooking machines.**

Autonomous processes require real-time status information for decision-making. Not all data might be possible to measure during operation. Digital Twins are gaining increased attention, as the concept's fundamental idea is a virtual doppelgänger that reenacts the real-world process contemporaneously. As a consequence, it can provide status information via virtual probes.

Multi-physical CFD simulations form a central prerequisite for high fidelity results. This talk advocates the coupled simulation of foodstuff and processing plants, as food-only simulations often lack proper thermodynamic interaction with their surroundings.
These CPU intense simulations remain far away from solving in real-time. We utilize a Machine Learning based methodology to reduce the CPU time to less than one second for 3D one-hour-ahead predictions.

Some illustrative examples of thermal processing autonomy conclude this talk.

Alexander Mathys, ETH Zurich, Switzerland	**Novel food production and processing for more sustainable food systems**

Food systems are at the heart of the 17 Sustainable Development Goals (SDGs). The wide scope of the SDGs calls for holistic approaches that integrate 'siloed' food sustainability assessments in order to develop solutions able to change complex food systems. Here we present a global-scale analysis quantifying the status of national food system performance of 156 countries, employing 25 sustainability indicators across 7 domains. The alliance of novel production technologies with integrated sustainability assessment in real time and further data integration into national food systems through nutritional, environmental and social indicators could be a basis for the holistic development of more sustainable food systems.

Based on this system understanding, focus of innovations is laid on alternative protein rich foods and food waste reduction by considering more sustainable food processing and production. Advanced approaches relying on innovative raw materials from single cells or insects and their connected biorefinery concepts are the basis of these actions. By using novel proteins from these emerging sources food security and sustainability of the protein supplies could be significantly improved. Selected implementation initiatives of these science-driven innovations with relevant industry partners and start-ups demonstrate the impact and relevance for the food sector.

Paulomi (Polly) Burey, University of Southern Queensland, Australia	**From food chain to food loop: preventing food waste**

Current food supply chains have many points where food waste occurs, usually from Food Excess and By-Products (FE&Bs) that could have been utilised before the point of no return. This waste can be prevented if there is an enabling preservation and process pathway for the food, before it can no longer be used as a nutrition source. For horticultural food production and processing in Australia, there are several contributors to this issue, which include:

The significant distances between where food is produced and where it has to go for either fresh retail or market sales or processing

1. Industry standards relegating 'imperfect' product to remain on-farm
2. A lack of financial return for imperfect product that cannot be sold as fresh produce, and is a financial loss if harvested and sent on to food processors.
3. Waste levels can be erratic, some years have lower rates than others making a fixed factory not as feasible.

One approach that could assist in tackling this issue is to take suitable processing activities to the source of food production through mobile Food Modular Processing Systems (Food MoPS). This approach could be deployed to absorb any food excess remaining on farm and assist in extending the production part of the food supply chain into different circular economy 'loops'. Here we present our integrated Food MoPS valorisation system and mathematical model that integrates several core process modules for deployment to food production and processing sites. There are 4 key elements which are: 1. The Capture and Preserve (CaP) module to extend shelf life of produce and enable it to extend further into the food supply 'loops', 2. The Extract and Refine (EaR) module that separates valuable nutritional compounds and structural polymers, 3. The Symbiotic Algal/Fermentation Energy and Residues (SAFER) module, and 4. The Clean and Feed (CaFe) module. Each of these modules have a part to play in zero food waste processing, ensuring that the entire food resource has a use and is not lost. To determine the most practical and economically viable pathways through the modules, we developed a simulation approach that employs the principles of technoeconomic and life cycle analysis. The simulation tested a range of horticultural produce streams and included matching processed product yield to market demand. From this approach, we determined the best division of the entire FE&B resource that and has the best economic return.

Mohammed A Bareen, University of Queensland, Australia	**Insights into relationship between process parameters and print accuracy of 3D-printable heat acid coagulated milk semisolids and polyol matrix: Implications towards testing methods**

The aim is to establish a correlation between print accuracy and critical 3D printing process variables in order to develop a test method for expediting the selection of materials and printing settings for high-precision 3D food printing. Herein, heat acid coagulated milk semisolids and polyol matrix are examined to adopt multiscale milk-based formulation as a candidate to achieve advanced control of 3D food printing precision. Experimental design and clustering are used to study the correlation and the effects of processing conditions (80 °C for 15, 20, 25, 30, 35 minutes) and printing parameters (flow rate, nozzle diameter, layer height) on the formulation material properties (microstructure, rheology, simulated flow field characteristics) and properties-variables interactions on 3D printing precision. The formulations are a 3D network formed with agglomerated casein particles containing coalesced fat globules ranging from >100 µm to <1000 µm (depending on processing condition) in diameter interlinked with thick protein bridges and numerous void spaces interspersed throughout. The numerical analytical simulation was used to examine the effects of processing conditions and print settings on the formulation flow characteristics. Higher flow rates, while allowing for quicker printing, necessitate higher extrusion

pressure, whereas lower flow rates affect extrudate quality by causing nozzle obstructions due to low print velocities. From a mathematical model defining the interaction between flow field characteristics and process parameters, the effective range of printing process parameters corresponding to chosen barrel geometry and printer stipulations is retrieved. The results were used to confirm 3D printing studies; we then evaluated the printed construct's images using image processing technologies to determine the print's dimensional accuracy. Finally, multi-objective optimization was carried out by means of the desirability function method. The optimization process workflow proposed in this study provides a framework for quantitatively assessing and predicting print accuracy for 3D printing of complex food products.

Keywords: Complex food matrix, Microstructure, Image analysis, Finite element method, Multi objective optimization

Lee Kah Yin, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**Fibrous scaffolds for cultivated meat**

Cultivated, or cell-based meat holds much promise as a solution to the down sides of animal agriculture, which include greenhouse gas emissions and the unsustainable use of natural resources. While the initial products from this endeavour are expected to be in the form of comminuted, or ground meat, consumers will eventually expect the availability of cell-based whole meat cuts. One approach to realise the latter would be to employ scaffolds that act as the template for the proliferation of relevant cultivated meat cell types to form meat tissue. In our laboratory, we are employing the method of encapsulating muscle cells into polyelectrolyte complex fibres, which provide a 3D hydrogel matrix for cell proliferation and differentiation. The fibres are then assembled to obtain thicker scaffold structures. In the present work, we describe the optimization of biomaterial and tissue culture conditions for cell viability in the fibrous scaffolds and discuss how the anisotropic nature of the fibres may promote cell differentiation. Rapid progress in the development of such scaffolds will see its adoption as an important component of the burgeoning cultivated meat industry.

Kim Mishra, ETH Zurich, Switzerland	**Synchronous multi-scale 3D-printing of solid foods with functional structure at elevated production rate**

Introducing additive manufacturing (AM) techniques into the food value chain is challenging due to low margins typically associated with food products compared to medical or mechanical engineering products. Furthermore, the complex rheology of food requires careful design of dispensing units posing additional hurdles for AM applications. Consequently, we present a novel AM approach capable of producing complex 3D food structures at elevated production rates. As a model food, we chose the production of multiphase chocolate confectionery products. The complex 3D structure is broken down into three main scales, the macro-, meso- and micro scale. The macro scale is manufactured by a twin-screw extrusion macro-scale die and acts as scaffold for the meso-scale. Two six-axis robots equipped with a single screw extrusion system and an electromagnetically triggered jetting nozzle dose the meso- and micro- scale synchronously into and onto the macro scale printed shape. We demonstrate how to rapidly manufacture a multiphase food product composed of different phases with non-Newtonian and highly temperature dependent flow behavior. The spatially resolved texture and aroma/flavour functionality of the presented food product offers new organoleptic properties and sustainability benefits generating added value across the whole food value chain using the newly developed additive manufacturing technique.

BR 7 - Food Chemistry and Ingredients 6

Session Co-Chairs: Roger Clemens, IUFoST, USA; Dejian Huang, National University of Singapore, Singapore

Gow-Chin Yen, National Chung Hsing University, Taiwan	**Ameliorative effect of buckwheat polysaccharides on colitis via regulating the gut microbiota**
The plant polysaccharides act as prebiotics through modulating gut microbiota. However, the functional characteristics of buckwheat Fagopyrum tataricum polysaccharides (FTP) and F. esculentum polysaccharides (FEP) on colitis prevention are still unclear. This study aimed to evaluate the ameliorative effects of FTP and FEP against TNBS-induced colitis via gut microbiota modulation in rats. The characterizations of FTP and FEP were analyzed, including TGA, DSC, XRD, SEM, and monosaccharide composition. In addition, the pathological features of colon length and symptoms in TNBS-induced colitis were improved by intragastric preadministration of FTP and FEP for four weeks. The results showed that pre-feeding with FTP and FEP decreased inflammatory cytokines (IL-6, IL-1b, and TNF-a) and increased superoxide dismutase, catalase, and glutathione peroxidase levels in TNBS-induced rats. The decreasing inflammatory signaling associated proteins (NF-κB p-p65, COX-2, and iNOS) improved TNBS-induced colitis by buckwheat polysaccharides treatment. Moreover, pre-feeding with buckwheat polysaccharides raised the ratio of Firmicutes/Bacteroidetes, the relative abundance of Peptostreptococcaceae, and the short-chain fatty acid (SCFA)-producing bacteria (Erysipelotrichaceae). In conclusion, both FTP and FEP strongly improved TNBS-induced colitis through anti-inflammatory, antioxidant, and gut microbiota modulation properties. Buckwheat polysaccharides have potential to be developed as functional ingredients or foods to promote health.	
Aileen Pua, National University of Singapore, Singapore	**Combining microextraction modes and soft electron ionisation techniques for coffee aroma analysis**
Coffee aroma analysis remains challenging due to its physicochemically-diverse volatile compounds and high matrix effect. To improve sensitivity and specificity for the rapid testing of a multiclass range of coffee volatile compounds, solid-phase micro-extraction (SPME) and low energy electron ionisation (LE-EI) were investigated. From a pre-evaluation of devices and modes, the combined use of direct immersion-stir bar sorptive extraction and headspace-thin-film SPME (SBSE-TFSPME) was selected to increase the recoveries of 36 model coffee compounds. This was optimised for extraction time (88 °C) and temperature (110 min) as a 'single-shot' method. Furthermore, to complement sample preparation by improving method specificity, a LE-EI method was developed by evaluating the effect of ionisation energy (15 eV), source temperature (150°C), and emission current (0.3 µA) on the preservation of the multiclass diagnostic molecular ions. This complete workflow was validated in coffee matrices and possessed good repeatability (1.6-7.3%), intermediate precision (4.1-12.2%), and linearity (R2>0.98). Even for complex coffee samples, the method detection limit reached the pg/mL range. In conclusion, this study demonstrated the potential of SPME and LE-EI in improving analytical sensitivity and specificity for a wide range of volatile compounds from coffee and other complex food matrices.	
Yang Xin, National University of Singapore, Singapore	**Catalyst-free oxidative couplings of flavones**
Catalyzed oxidative coupling reactions play an important role in the chemical synthesis of complex natural products. However, the poor functional group tolerance renders these reactions unfit for the synthesis of naturally occurring polyphenolic flavones. We have found that molecular oxygen	

in alkaline water acts as a hydrogen atom acceptor and oxidant in catalyst-free oxidative coupling of luteolin and other flavones. By this facile method, we achieved the synthesis of a small library (42) of flavone dimers and trimers including naturally occurring dicranolomin, philonotisflavone, dehydrohegoflavone, distichumtriluteolin, and cyclodistichumtriluteolin. Mechanistic studies using both experimental and computational chemistry uncovered the underlying reasons for optimal pH, oxygen availability, and counter-cations that define the success of the reaction. These flavones have potential as anti-microbial and anti-starch hydrolase agents that can be exploited for human health promotion.

Ningping Zhan, National University of Singapore, Singapore	**Green extraction methods of poly phenolics from tropical fruit by-products**

While we enjoy diverse type of tropical fruits, such as durian, mangosteen, and jackfruit, for their flavour and nutrition, we discard large amount (as many as 50% or more of the total weight of the fruits) of peels and seeds, which typically contain high amount of polyphenolic compounds and soluble fiber that are highly valuable for functional food ingredients. Yet, the current industrial extraction process of polyphenolic compounds utilizes large amount of organic solvents and depend on column chromatography and thus are not cost effective and environmentally benign. We report here in a novel extraction method of phytochemicals from mangosteen pericarp (MP) with alkaline solution (2% w/v Na2CO3) at room temperature. The alkaline water solubilizes polyphenolics compounds, which precipitated from the aqueous solution after acidification achieving the separation from the other components. The precipitate chemical composition analysis by 1H NMR and HPLC the extract revealed that it mainly contains mangostin with 52.71% purity. Comparing the extract from AEW (Acetone:Ethanol:Water=2:2:1, MP-AEW our extract has higher TPC (total phenolic content), anti-oxidant activity (DPPH assay and ORAC), alpha-amylase inhibition activity and anti-inflammatory activity (RAW 264.7 cell model). Our green extraction methods may be extended to extract other fruit by-products.

Andrea Gomez-Maqueo, Singapore Institute of Food and Biotechnology Innovation, A*STAR, Singapore	**The application of modified slowly digestible potatoes in preparing asian cuisines**

Developing staple carbohydrate foods with slow digestion is a promising approach to address the increasing prevalence of type 2 diabetes. We previously developed slowly digestible potatoes by toggling control the accessibility of α-amylase and mucosal α-glucosidase to starch in potato tubers. This study aims to examine the effect of Asian culinary preparations (i.e., steaming, stir-frying, pan-frying, mashing, and deep-frying) on the slow digestibility of modified potatoes. Starch digestibility was assessed by in vitro simulated gastrointestinal digestion and texture profile analysis was assessed via the double bite test. Shearing and temperature conditions from culinary preparations significantly ($p \leq 0.05$) affected the efficacy of our pretreatment for toggling α-amylase and α-glucosidase in vitro. Culinary preparations retained and promoted a high resistant starch content of 18-26% in our modified potatoes, which could promote gut fermentation. Steaming retained the highest amount of slowly digestible starch (35%) obtained from the modification, showing promising potential for glycemia management. Modified potatoes could lead to consumer-preference due to their superior properties such as firmness (compared to unmodified controls). We hope to contribute to the development of healthy potato meals which can be made available to the public (i.e., household dining, hawker centers) for promoting health.

Vusi Mshayisa, Cape Peninsula University of Technology, South Africa	***Hermetia illucens* protein conjugated with glucose via maillard reaction: antioxidant and techno-functional properties**
The food industry is considering novel sources of proteins with enhanced functionalities to meet the increasing demand and population growth. Edible insect proteins have emerged as an alternative that is environmentally friendly and economically viable and thus could make a significant contribution to global food security. This study was aimed to establish the effect of conjugation via the Maillard reaction on the antioxidant and techno-functional properties of black soldier fly larvae protein concentrate. Reaction mixtures containing black soldier fly larvae protein concentrate and glucose (2 : 1 weight ratio) were wet- heated at 50, 70, and 90°C for 2, 4, 6, 8, and 10 h, respectively, with an initial pH of 9. The results showed that the browning indices of the black soldier fly larvae-glucose (BSFL-Glu) model system increased with an increase in reaction time and temperature, with conjugates formed at 90°C exhibiting the highest browning intensity at 420 nm. At 50°C, the DPPH-RS of the conjugates ranged from 15.47 to 32.37%. The ABTS+ radical scavenging activity of BSFL-Glu conjugates produced at 90°C exhibited significantly (p <0:05) higher scavenging activity as a function of reaction time. The foaming capacity of BSFL-Glu conjugates produced at 70°C showed a significant increase (p <0:05) as a function of reaction time. Principal component analysis was applied to browning and antioxidant indices. Component 1 of the score plot accounted for 89%, while component 2 accounted for 8% of the observed variability and allowed discrimination/differentiation of the samples based on the heating temperature. These findings provide a practical means to improve the functionality of novel edible insect proteins for food application.	

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Session Co-Chairs: Jairo Romero, IUFoST, Colombia; Mark Richards, Nanyang Polytechnic, Singapore

Azadeh Vatandoust, University of Toronto, Canada	**Characterization of zinc and iron microcapsules to be used for salt fortification**
Diets poor in essential micronutrients are widespread worldwide, resulting in micronutrient deficiencies that profoundly affect individuals' health. Since iron and zinc deficiencies usually coincide, supplying both in a single-vehicle will maximize the impact of fortification. Salt is an ideal carrier as it is universally consumed, and incorporating these two micronutrients into current salt iodization processes is an affordable and promising approach. For salt fortification with iron and zinc, ZnSO4 and FeSO4 or Ferrous fumarate microparticles were produced by spray drying. Particles were either coated with chitosan (1% w/v) or a combination of Eudraguard® and HPMC at 6%w/v and HPMC 2%w/v, respectively. The goal of the program was to produce uniform encapsulated microparticles where the coating acts as an effective barrier between iodate and the metal compounds to prevent iodine loss. To evaluate the bioaccessibility of the active ingredients in the particles, the release kinetics of iron and zinc were assessed at pH values representative of the stomach and small intestine conditions for 2 hours. More than 80% of zinc and iron were released at pH 1 for all the samples except chitosan-coated ones containing FeSO4. Furthermore, the surface composition and morphology of encapsulated particles were compared by XPS and SEM.	

Tay Jingxin Uma, National University of Singapore, Singapore	**Texturization of pulse protein-based salmon fillet mimic by dual-nozzle 3D printing approach**

To reduce reliance on salmon aquaculture, plant-based alternatives capable of effectively diverting demand are urgently needed. Such alternatives would need to match macronutrient content and organoleptic profile of salmon fillet. To investigate the potential of achieving this via 3D-printing pulse proteins, one nozzle was applied to print the myosepta simulant - a high-pressure homogenized yellow pea protein-stabilized emulsion. Whereas the other nozzle was used to print the myomere simulant - a red-lentil protein emulsion with astaxanthin to supplement redness. Transglutaminase was then applied in protein cross-linking.
The 3D-printed salmon mimic developed had both the internal structure and macronutrient content of salmon fillet. Post-printing incubation at 55â„ƒ to activate transglutaminase transformed inks from pastes into firm solids. Through this approach, the myomere simulant achieved anisotropy up to the myofiber scale where fibrous structures were observed under scanning electron microscopy. Confocal imaging revealed that widths of these protein microfibers were not significantly different from salmon myofibers. Additionally, the myosepta simulant could potentially have similar fat release given resemblance in oil droplet size under confocal imaging (below 2.54 µm relative to 0.41 µm).
Overall, our results illustrate that 3D printing plus post-printing processing can cost-effectively convert plant-based ingredients into customizable nutritious seafood mimics.

Andrea Koo, Integrative Sciences and Engineering Programme, NUS Graduate School, National University of Singapore, Singapore	**Effect of High Pressure Processing on the volatile profile of bok choy juice**

High Pressure Processing (HPP) is a non-thermal technique commonly used to pasteurise juices. While HPP has generally been demonstrated to retain the original “fresh” flavour of most juices, off- flavours have also been detected in specific products. This study investigates the effect of HPP on the volatile profile of juice from bok choy, a leafy vegetable commonly consumed in Asia. Bok choy juice treated at 600 MPa, 5ËšC for 3 min was compared against an untreated control using headspace-solid phase microextraction coupled to gas chromatography-mass spectrometry (HS-SPME-GC-MS). A commercial HPP machine was used, and pressurization took approximately 3.7 min. HPP resulted in significant changes ($p < 0.05$) in the volatile profile of bok choy juice – compounds associated with green flavours (e.g. 2-hexenal, hexanal, 3-hexen-1-ol) increased, while limonene and isothiocyanates (e.g. 4-isothiocyanato-1-butene, isothiocyanatocyclopropane) decreased. Comparison against juice immediately depressurized once 600 MPa was reached revealed that all observed changes were independent of holding time, except for hexanal and 2-ethylfuran which increased during the isobaric hold. While the build-up time is often neglected in HPP research, these results highlight that changes occurring during this period may contribute significantly to the final volatile profile.

Xin Yi See, A*STAR, SIngapore	**Creating plant-based muscle meat products from Asian plant proteins using high moisture extrusion**

Consumer demand for meatless foods produced from sustainable, regional crops has been increasing in response to the global climate crisis. To date, plant proteins from Asian crops like rice, mung bean and lentil tend to be underutilised in plant-based meat production due to a lack of reliable data on how these ingredients behave during extrusion.

In this study, we aim to gain insights into the rheology and extrusion behaviour of a range of Asian plant proteins to meet consumers' demand for increased variety in extruded ingredients. Using a closed-cavity rheometer and a phase transition analyser, the ingredients' viscosity, glass transition and melting temperatures were measured under conditions that mimic extrusion (e.g., temperature, pressure, and humidity). The plant proteins were then processed using high moisture extrusion at different moisture contents and cooking temperatures. Finally, the extrudates' texture and sensory characteristics were studied and correlated to the plant proteins' composition, physical properties, and processing conditions.

Findings from this study are used to develop a new generation of plant-based products that mimic muscle meat. This would expand the repertoire of plant protein ingredients that producers can use when formulating plant-based meat products, supporting crop diversity and food resilience.

Kai Yi, National University of Singapore, Singapore	**Rheological investigation of wakame flour addition in noodle and the underlying mechanism of dietary fiber fortified alternative flour**

Wakame is edible seaweed rich in dietary fiber and minerals, which is rarely found in ordinary noodles. In order to investigate the mechanism and microstructure of wakame noodles with different addition (5–20.0%), the texture analyses, rheological measurements, SEM and FTIR, etc were used to explore how extruded wakame flours can modify the texture and viscoelasticity of noodle qualities. Besides, a Burgers model was applied to fit compliance J (t) data, which showed the addition significantly increased instantaneous compliance J0 (1.27 vs. 1.52 10-4 Pa -1), and higher concentration would evoke high strain values as already seen for doughs at 20% wakame flour. Compared to others, 10% wakame addition best matched the physiochemical properties of noodle, in terms of chewiness (99.10 vs. 122.66 g.mm), gumminess (281.98 vs. 323.44 g), and gel strength (132.65 vs 173.95 kPa•s-1). This formulation contributed to a continuous gluten network and even starch/protein distribution of noodles, with better cooking and eating properties. Extruded wakame flour with dynamic viscosity functioned as adhesives, which can hold starch granules and other components within flours together, as indicated from several mathematic models and FTIR images. Microstructure studies revealed the enhanced interaction between starch granules and fiber molecular. This study provided an in-depth understanding of seaweed industry, which would offer Singapore a sustainable, high-tech and high-value opportunity.

Ahmad Ni'matullah Al-Baarri	**Water release of chili paste in aluminium packaging by hypoiodous acid utilization as preservatives**

Chili paste in Indonesia is made of second grade of chili after the premium is utilized for first grade consumer, as consequence, the quality of chili paste is hard to retain resulting in its short of shelf-life. This research was objected to utilize hypoiodous acid from peroxidase system in chili paste stored in the aluminum package. The preservation for 30 days was done to analyse water release from chilli paste since this phenomenon reduces the consumer preferences. Chili paste was prepared from fresh chili with 3 days storage in room temperature as model of second grade of chili. Hypoiodous acid was obtained from chemical reaction between kalium iodide and hydrogen peroxide with peroxidase as catalist. As much as 0,1% hypoiodous was used to preserve each package containing 10 gram chili paste. Hypoiodous treatment was done using spray to whole chili after dipping in free chlorine water at 3 days fresh chili storage. Data were calculated as descritive analysis in every 3 days. Water release was calculated using the weight of water that might release from chili naturaly. As results, the release was detected in 18 days of preservation while non hypoiodous acid treatment only could be detected on 9 days of no water relase indicating the action of hypoiodous was amazing. The water release was then calculated for total dissolve solid

indicating the satisfactory result after hypoiodous acid treatment. In addition, no change in pH was also showed in the chili paste with hypoiodous acid. As conclusion, the hypoiodous acid might extend the chili paste shelf-life and had strong potent as chili paste preservatives.

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Session Co-Chairs: Chin-Kun Wang, IUFoST, Taiwan; Melanie Weingarten, Agency for Science, Technology and Research, Singapore

Zamantha Escobedo-Avellaneda, Tecnologico de Monterrey, Maxico	**High hydrostatic pressure for the assisted curing of vanilla beans (Vanilla planifolia)**
Vanilla is a highly profitable crop native to Mexico. Once harvested, it is subjected to a curing process which is carried out in a very traditional way in which the activity of hydrolytic enzymes is key for flavor developing. Traditional curing includes the application of thermal treatments that decrease the enzyme activity required for flavor formation. High hydrostatic pressures (HHP), a nonthermal technology, has demonstrated to improve enzymatic activity at certain processing conditions. So, in this work the effect of HHP at 50-600 MPa to improve ß-D-glucosidase activity and phenolic compounds formation in vanilla beans was evaluated. Vanillin was the main phenolic and it was formed by ß-D-glucovanillin hydrolysis and vanillyl alcohol oxidation. HHP improved vanillin content and influenced ß-D Glucosidase activity. At the beginning of the curing up to 15% of increment in vanillin content was observed, while at the end up to 138%. Maximum increment of up to 400% in ß-D-glucosidase activity was obtained attributed to tissue decompartmentalization and conformational changes induced by pressure. HHP could be used during vanilla curing to improve vanillin content and ß-D-glucosidase activity.	
Ofir Benjamin, Tel Hai College¸Israel	**High pressure homogenization influences emulsion stability and flavor release at various pH and saliva addition**
High pressure homogenization (HPH) possesses a novel non-thermal preservation technology to form nano-emulsion with higher stability and longer shelf life. To our knowledge, there are barely any studies dealing with the relationship between nano-emulsion structure and flavor release. We studied these parameters in both conventional and nano-emulsion systems at pH values of 3.5 and 7.0 and saliva to simulate wide food emulsion applications under oral conditions. Nano-emulsions were structurally more stable than conventional emulsions, with and without saliva. At pH 3.5, saliva addition decreased the emulsion stability by reducing particle charges closer to the emulsifier isoelectric point. Flavour release from emulsions was measured at equilibrium to determine partition coefficients and dynamically using an electronic nose. For most conditions, partition coefficients of the flavor compounds were two to four times lower in emulsions prepared at pH 7.0 than at pH 3.5 and in emulsions without saliva. Dynamic analysis revealed more apparent differences in VOC release between conventional and nano-emulsions depending on VOC physiochemical properties and emulsion stability. High-pressure homogenized nano-emulsions can be used in food applications for beverages with higher stability and different flavor release perception than conventional emulsions.	
Byron Perez Simba, ETH Zurich, Switzerland	**Nanosecond pulsed electric fields-based process optimization for leveraging heterotrophic microalgae bioconversion efficiency**
Improving resource efficiency is a key driver steering cellular agriculture. Emerging nanosecond pulsed electric field (nsPEF) processing has efficiently stimulated single-cell growth; however,	

process optimization remains limited to phototrophic microalgae. Heterotrophic microalgae are gaining momentum owing improved consumer perception (e.g. bright color) and the sustainable notion of their associated value-chains.

This research highlights nsPEF-related advances on process parameter optimization of heterotrophic microalgae (Auxenochlorella protothecoides and Chlorella vulgaris) leveraging biomass and protein yields. Advanced statistical modeling using Definitive Screening design was established to identify optimal process parameter combinations (pulse width, -repetition frequency, -number, electric field strength). Bioprocess parameters, i.e., repetitive process application, inter-treatment intervals, and refeeding schemes were evaluated regarding their effect on biomass, protein, and lipid yields.
Underlying cellular mechanisms were investigated by transcriptomics. Central composite design analyzed by surface response methodology then determined optimal process parameter combinations maximizing biomass and protein yield [Preliminary results show 12.54 ± 3.46 % higher biomass yield].

This work provides a basis to increase microalgae productivity and, therefore, affordability of this more sustainable food alternative. Combining statistical modeling with a characterization of intracellular treatment effects allows leveraging process control and transferability to multiple organism groups highlighting the impact of this research on fostering cellular agriculture.

Yung-Kai Lin, National Taiwan Ocean University, Taiwan	**Artificial steak: A 3D printable hydrogel composed of egg albumen, pea protein, gellan gum, sodium alginate and rice mill by-products**

Food security and sustainability are the most urgent problems worldwide. In the present study, the combinations of egg albumen, pea protein, and gellan gum were optimized to fabricate an artificial steak for specific populations. The relationships among the different components on the texture profile analysis, sensory evaluation, viscoelastic properties, and thermal behavior were conducted. 3D printing food was an emerging issue, this study also investigated how to assemble an artificial steak and mitigate the impacts of meat production. Gellan gum was found to compensate for the proportion of proteins and regulate the instrumental hardness ranged from 453.82±39.75 g to 2515.62±144.55 g, the instrumental chewiness ranged from 156.29±22.77 to 1054.66±85.70 being feasible to regulated by different formulations, and extend to the customized platform and the applications of elderly' foods. In sustainability orientation, 8.0% egg albumen /9.5% pea protein /0.7% gellan gel was computed as the optimal formulation, 9.5% egg albumen /5.5% pea protein /0.7% gellan gel which was conducted as the optimal solution in marketing orientation. The "Artificial steak" has the potential to improve food security and human well-being, reduce animal suffering, and mitigate most of the environmental impacts associated with meat production.

Nandika Bandara, University of Manitoba, Canada	**Deep eutectic solvent based extraction technology for improving sustainability in plant protein ingredient processing**

Pulses are excellent, sustainable, and economically viable protein sources. However, current protein ingredient processing technologies have major concerns about their environmental sustainability and poor protein functionality due to denaturation during protein extraction. This study aims to extract protein from pulse crops such as fava bean using eco-friendly deep eutectic solvents (DES). We hypothesized that the DES system selected would increase the protein purity (PP), yield (PY), and recovery (PR) compared to the conventional alkaline extraction method. Response surface methodology (RSM) was used to optimize the extraction conditions. Extracted proteins were characterized for chemical and structural properties. At the optimum extraction conditions, DES extraction resulted in 92.33±2.28% of PP, 65.42±6.53% of PY, and 23.15±2.31% PR.

Compared to DES extracted proteins, alkaline-extracted proteins had a similar protein content (92.50±1.36%), but showed significantly lower (P<0.05) PY (60.76±1.16%) and PR rate (21.74±0.19%). Notably, it was evident that the higher hydrophobic AA/uncharged polar AA (45.19%) in ALK-FBPI compared to the DES counterpart (40.59%). In addition, DES extraction increased α-helix content (21.37%) while ALK-FBPI showed intermolecular β sheets as protein aggregates (7.61%) along with increased β turns (19.71%). Moreover, the Molecular weight (MW) distribution pattern of proteins extracted from both methods showed similarities. Our findings suggest that DES protein extraction could be an alternative to the conventional alkaline extraction method.

Pedro Maldonado-Alvarado, Escuela Politécnica Nacional, Ecuador	**Evaluation of the physicochemical, functional and texture properties of parboiled amaranth (*Amaranthus caudatus L.*)**
The parboiling is a steam cooking process used in kernels for improving certain properties. Nevertheless, there is no in-depth investigation about the effect of parboiled on the properties of amaranth. The aim of this contribution was to evaluate physicochemical, functional, and texture properties of parboiled amaranth (Amaranthus caudatus L.) from Ecuador. The effect of time (6-34 min) and temperature for steam cooking (55-84 °C) of the parboiling process in the amaranth kernel was evaluated. The optimized parboiling treatment (OPT) was obtained at 84 °C for 20 min. The content of moisture, ash, lipids, protein, carbohydrates, crude fiber, starch, and caloric value of the OPT were: 15.67, 2.41, 0.98, 13.31, 67.63, 6.76 and 62.67 %, and 332.56 Kcal, and for the not treated amaranth (NTA): 19.56, 2.37, 0.20, 12.94, 64.95, 6.55 and 59.09 %, and 313.28 Kcal, respectively. There were no differences in ash content between the OPT and NTA. Differences in hardness, granule size D [4,3] and IAA, PH, and ISA with values of 3.76 N, 1.59 µm and, 5.64, 6.67 and 15.57 g/g, and respectively, 30.83 N, 0.73 µm, 4.20, 4.62 and 9.10 g/g were found between OPT and NTA.	

Competition

BR 10 - Undergraduate Quiz Bowl Championship (Sponsored by IFIS)

Competition Juries:

- Siti Noorbaiyah Abdul Malek, Singapore Institute of Technology, Singapore
- Roger Clemens, University of Southern California, USA
- George Ooko Abong, Presiding Officer, College of Early Career Scientists

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18:00 | GMT+8

18:00 – 22:00 GMT+8

IAFoST Academy and Fellows Dinner

3 Nov 2022

08:30 | GMT+8

08:30 – 10:00 GMT+8

Concurrent Sessions (Rooms: BR 1 – BR 11 and Plenary Room)

BR 1 - International Society of Food Applications of Nanoscale Sciences (ISFANS)

Nanotechnology for Food and Agriculture

Session Co-Chairs: Cristina M Sabliov, Louisiana State University and LSU AgCenter, USA and Hongda Chen, USDA, USA

Geoffry Smith, ILSI SEA Region, Singapore	**Nanotechnology in food and agriculture - new applications, toxicology and regulatory issues**
Nanotechnology is rapidly being utilized in many fields but the use in food and agriculture has lagged, despite the discovey of many potential applications utilizing this technology. An overview of the current and latest applications will be shared, along with a toxicological update on the most recent findings and approaches. The regulatory framework will be presented and evaluated, and new approaches advanced. Human health as well as potential environmental impacts and updated approaches for evaluation will be presented. A risk assessment of nanoparticles in food contact packaging will be expored, along with the latest finding's from the EU nanotechnology toxicology projects PATROLS and GRACIOUS. Finally, paradigms for future human exposure and envionmental risk assessment will be presented.	
Jason C. White, The Connecticut Agricultural Experiment Station, USA	**Nanotechnology-enabled agriculture: A path to global food security?**
Low use and delivery efficiency of conventional agrichemicals is a significant impediment to maintaining global food security, particularly given the 60-70% increase in food production is needed by 2050. Further confounding these efforts is a changing climate, which may force increased cultivation of crops under more marginal conditions. Novel and sustainable strategies for enhancing food production are needed all along the “farm-to-fork” continuum. We have focused on using nanotechnology to increase the delivery efficiency and efficacy of nutrients. In a number of studies, foliar amendment of nanoscale materials such as CuO, CuS, S, and SiO2 have been shown to significantly promote crop health and alleviate damage caused by the fungal pathogens, resulting in enhanced yield. Importantly, disease suppression is a function of modulated plant nutrition and disease resistance and not direct toxicity against the pathogen. Separately, we are also looking at novel biopolymer-based nanocomposites as a means to enhance the precision of nutrient delivery. Other studies are focused on the use of nanoscale metal oxides to enhance photosynthetic efficiency under stressed and non-stressed conditions. Results will be presented from several studies where manipulation of nanoparticle synthesis resulted in tunable and sustainable materials that yielded greater plant health and crop yield.	
Benjamin Smith, Future Ready Food Safety Hub (FRESH), Singapore	**All disease begins in the gut: 3D Reconstituted Human Intestinal Models for food additive safety testing**
Scientific and regulatory support for non-animal methods continues to grow, however, uptake by the food additive industry remains low. A major factor is the development and validation of in vitro	

methods that can assess the broad chemicophysical diversity of food additives under realistic physiological conditions. This is particularly the case for nanoingredients whose properties differ significantly from conventional food chemical additives. In order to help address the gap in testing methods, we have developed a 3D-reconstituted human intestinal model for genotoxicity testing of food ingredients, including nanogredients. This presentation will focus on the development of the model and provide examples of nanomaterials tested using our protocol, as well as briefly discuss ongoing efforts to validate and promote regulatory acceptance of NAMs for food safety assessment.

Cristina M Sabliov, Louisiana State University and LSU AgCenter, USA	**Agrochemical nanodelivery systems for a sustainable agriculture**

Most applied agrochemicals are lost to the environment or go unused due to leaching, mineralization, and bioconversion. Alternative and sustainable methods of delivery are needed to minimize adverse environmental effects by reducing numbers of applications and amount of active ingredient. Recent research in Sabliov’s laboratory has centered on engineering pesticide nanoformulations with the goal of increasing efficacy while minimizing applications. Natural polymers such as zein and lignin have been effectively constructed in the form of nanoparticles for delivery of insecticides (methoxyfenozide) and fungicides (azoxystrobin). These particles enhanced the water dispersibility of the agrochemicals and provided a more efficient controlled release, thereby improving their translocation in the soybean plant and effectiveness against pests. These bio-degradable, non-persistent nanoparticles did not detrimentally affect plant growth or yield and performed equally to commercial formulations. Azoxystrobin loaded nanoparticles used as an antifungal seed treatment, aided in an increase in the yield of field-grown, fungus inoculated soybeans. Zein and lignin nanoparticles proved to be suitable materials for an efficient delivery of agrochemicals designed to prevent waste of active ingredients and achieved a goal of sustainable agriculture.

Lennie K.Y. Cheung, University of British Columbia, Canada	**Identifying key residues of potato plant-specific insert membrane activity using in silico mutagenesis**

As virulent plant pathogens pose increasing threat to global agriculture production, the need to better understand innate plant defenses has become urgent. Plant aspartic proteases are involved in plant immunity, the autonomous domain (i.e., the plant specific insert, or PSI) of which exhibits antimicrobial activity. PSIs of different crops display remarkably specific membrane activity in vitro, despite sharing highly conserved primary sequences. A greater understanding of PSI sequence-structure-function relationships is therefore critical for developing effective strategies against plant pathogens. In this study, site-directed mutagenesis was conducted in silico on wildtype potato PSI at locations of key tryptophan and lysine residues to further understand their influence on protein stability and membrane activity. The introduced mutations were predicted to alter both the location and number of charged groups in the PSI at active pH and induce structural changes using all-atom molecular dynamics. Coarse-grained simulations with a lipid bilayer consisting of equimolar phosphatidylcholine, phosphatidylethanolamine, and phosphatidylserine suggest the importance of selected residues on the initial contact and subsequent anchoring of the PSI to the membrane. In silico insights thus far underscore the importance of distinct residue types and their location within the PSI during different stages of membrane interaction and, presumably, antimicrobial activity.

Session Co-Chairs: Fereidoon Shahidi, IUFoST, Canada; Jeroen Schmitt, Agency for Science, Technology and Research, Singapore

Wang Xiang, National University of Singapore, Singapore	**Structure-activity relationship (SAR) of flavones on their anti-inflammatory activity**
Flavones, found in various fruits and vegetables, benefit human health by their anti-inflammatory activity, yet their structure-activity relationship is not clear. Herein, we selected 15 flavones with the same backbone but different substituent patterns, and systematically assessed their anti-inflammatory activities on RAW 264.7 cell model in regard to cellular-Src kinase (c-Src) affinity, suppression activity of IκBα phosphorylation, inhibition of nitric oxide (NO) production, inducible nitric oxidase (iNOS) biosynthesis, and downregulation of genes related to pro-inflammatory cytokines interleukin-6 (IL-6), interleukin-1 beta (IL-1β), and tumor necrosis factor-α (TNF-α). Our results indicated that the double bonds between C2-C3, hydroxyl substituents on C3′ and C4′ promoted while hydroxyl group on C5′ and methoxy group on C4′attenuated the overall anti-inflammatory and antioxidant activities. Hydroxyl groups at other backbone carbon positions showed more complicated functions on different key nodes in inflammation cascade on top of their radical scavenging activity. Our work established the relationship between flavones' structure and their anti-inflammatory activity in vitro and provide important scientific support for the potential application of flavonoid aglycones as active constituents in fruits, vegetables, and herbal teas.	
Tan Hui Ru, Integrative Sciences and Engineering Programme, NUS Graduate School, Singapore	**Using atmospheric solids analysis probe-mass spectrometry (ASAP-MS) to rapidly differentiate the harvest seasons of Tieguanyin oolong teas**
Atmospheric solids analysis probe-mass spectrometry (ASAP-MS), an ambient mass spectrometry technique, is an emerging technique in the area of food authentication. It is gaining traction due to the low cost of operation, short analysis time, and minimal sample preparation required. This study aimed to explore the potential of ASAP-MS as a high-throughput, non-targeted fingerprinting tool to differentiate Anxi Tieguanyin produced during the spring and autumn seasons. Differentiating the harvest seasons of Tieguanyin is crucial as autumn teas are favoured because they have a better aroma profile and are priced higher than spring teas. Spring Tieguanyin may be purposefully mislabelled as autumn ones to maximise profits. In this study, 20 Tieguanyin samples - 10 produced in spring and 10 produced in autumn - were analysed using RADIAN™ ASAP, an ASAP system coupled to a single quadrupole mass spectrometer. Clear separation of tea samples according to their harvest seasons was achieved using orthogonal projection to latent structures discriminant analysis (OPLS-DA) with high R2 and Q2 values of 0.87 and 0.64, respectively. Findings from this study are proof-of-concept that ASAP-MS is a viable tool that can be used to rapidly differentiate the two harvest seasons of Tieguanyin teas.	
Sergey Gorelik, Singapore Institute of Food and Biotechnology	**Development of micro-assay to test gelation properties of food ingredients based on viscosity-sensitive fluorescence methods.**

Innovation, A*STAR, Singapore	
Functional properties of food ingredients, in particular gelation, play important role in achieving desirable textural and sensory properties of food products. Standard methods to test gelation, e.g. rheology, are time consuming and require large sample volumes. Discovery of alternative proteins requires novel technologies for functional screening of proteins in micro quantities. Fluorescence detection has a superb sensitivity hence it has great potential for miniaturizing the screening assays. Here, we employ several viscosity-sensitive fluorescence methods to study their applicability for assessment of gelation of food proteins such as (1) fluorescent dyes - molecular rotors, (2) fluorescence polarization anisotropy, (3) fluorescence recovery after photo-bleaching, and benchmark the results against standard methods, such as rheology. Feasibility of applying the methods for microlitre volume samples is examined. Relation of micro viscosity, which is fluorophore micro-environment viscosity, to macro viscosity in gels is discussed.	
Amy Lin, School of Pharmacy, China Medical University, Taiwan	**The novel butyrate-starch-complex inhibits potential in inhibiting osteoclast formation and promoting osteoblast mineralization**
Osteoporosis is a metabolic bone disorder resulting in an imbalance of bone remodeling. Butyrate, one of short-chain fatty acids, has been reported its bone protection activity, however, the half-life of butyrate is less than 5 min which is challenging in applying butyrate to promote bone health. We developed a non-conventional complex of butyric acids with non-high-amylose starch (25-38%, w/w) through high-pressure processing at 5 °C, which departed from traditional heating-based gelatinization and high-amylose-starch-lipid based complexation. In this study, novel butyrate-starches (BSs) made with potato, pea, and corn starch and their control starch were used for evaluating the effects on osteoclast formation and osteoblast differentiation. In vitro studies used murine macrophage cell line (RAW264.7) stimulated with the RANKL for inducing osteoclasts formation and used murine preosteoblastic cell line (MC3T3-E1) for osteoblast differentiation. The results showed that all BS treatment significantly inhibited osteoclast differentiation and downregulated the expression of osteoclast-specific markers such as NFATc1 and TRAF6. In addition, BSs also could increase osteoblasts activity in stimulating alkaline P and OCN production and promoting osteoblasts mineralization. These results suggest that BSs regulated bone cells in both osteoclasts formation and osteoblasts mineralization. Therefore, BSs might develop to be a potential agent for enhancing bone health.	
Nthabeleng, Cape Peninsula University of Technology, South Africa	**Evaluation of proximate, techno-functional, physicochemical, and antioxidant properties of edible insect flours from South Africa**
With the increasing global population and consumer demand for protein, the provision of this essential nutrient is expected to double by 2050. thus, leading to concerns regarding food security and sustainability. As a result, there is a need to develop novel, alternative strategies to ensure that food is available to all people at all times. Insects are currently being investigated as a viable future solution to help meet the growing protein demand. The present study was undertaken to assess the proximate, techno-functional, physicochemical and antioxidant properties of three edible insect flour species of Gonimbrasia belina (G. belina), Hermetia illucens (H. illucens) and Macrotermes subhylanus (M. subhylanus). The crude fat of the edible insect flours varied from	

6.36 to 27.93%. there was a notable significant difference in the protein content of the edible insect flours ($p < 0.05$) with M. subhylanus obtaining the highest protein content (52.74%). No significant difference ($p > 0.05$) was observed in the water activity of all three edible insect flours. Water binding capacity (WBC) and oil binding capacity (OBC) were retained most efficiently by M. subhylanus. (1.46g/g) and (1.48g/g) respectively. While H. illucens retained the highest emulsion stability and capacity (67.33%) and (42.45%) respectively. the antioxidant activity against the DPPH radical was low for H. illucens (3.63%), with M. subhylanus (55.37%) exhibiting the highest DPPH radical. Moreover, the reducing power activity of edible insect flours was significantly different ($p < 0.05$). The findings of this study indicated that edible insect flours can be used as a sustainable source of food or ingredient to combat future food shortages.

Anne Gellie Pablo	**Factors selection and the development of fruit juice loaded Calcium-alginate microbeads**

Calcium-alginate is an efficient encapsulation material for bioactive extracts. Many factors need to be considered for an effective encapsulation process. The objective of this study is to select the appropriate factors for Calcium-alginate encapsulation of fruit extracts through the Box, Hunter & Hunter (BHH) fractional factorial design. Six factors, including fruit juice type, fruit juice concentration, alginate concentration, $CaCl_2$ concentration, nozzle temperature, and gelation time, were screened in eight experimental runs as per design. The corresponding maximum and minimum levels were Indian gooseberry/melon juice, 25/10%v/v fruit juice, 1.0/0.5%w/v alginate, 1.0/5.0%w/v $CaCl_2$, 40/25^{o}C temperature, and 20/120 mins of gelation time, respectively. Microbeads were formed using the ionic gelation method through the dripping extrusion technique. The data analysis confirmed that all factors are critical to Ca-alginate microbead formation. %fruit juice and hardening time have a significant effect (p-value≤0.05) on bead size, while all other factors are highly significant (p-value≤0.005). For sphericity and firmness, all factors were highly significant at a p-value≤0.005. The results of this work will be a guide for future researches related to microencapsulation of fruit juices/extracts with the Calcium-alginate system.

BR 3 - Food Safety and Regulatory Science 3

Session Co-Chairs: Oni Yuliati, Singapore Polytechnic, Singapore

Chan Siew Herng, Singapore Food Agency, Singapore	**Beyond the conventional: Exploring a real-time PCR approach for accelerated detection and serotyping of *Salmonella Enteritidis* in shell eggs**

Salmonella enteritidis (SE) is an enteric bacterial pathogen that is the leading cause of human salmonellosis worldwide, with contaminated hen's eggs being a significant vehicle of the infections Hence, early and speedy detection of SE pathogens in the shell eggs will enable effective intervention to stem the release of contaminated eggs into the market and achieve a continual supply of safe products. This study aimed to develop faster methodologies for the detection of viable SE for early alerts to circumvent the conventional workflow for SE detection in the shell eggs which typically requires at least 6 working days with a culture isolate. In this study, performance of several commercial RT-PCR assays for detecting viable SE in artificially spiked eggs experiments was investigated in term of their sensitivity and specificity. Our results showed that the selected assay was able to detect SE fragments in egg samples collected at 16h post-inoculation for spiked dosage of < 10 CFU/25g, 10 CFU/25g and 102 CFU/25g, while no positive signals were observed for heat-treated, non-viable SE at spiked concentrations of 103 CFU/25g and 106 CFU/25g. This RT-PCR assay also correctly showed 100% specificity for 12 SE isolates and presented no

cross-reactivity towards the other 61 non-SE isolates of various Salmonella serogroups. Here, we demonstrated that this multiplex RT-PCR assay is a sensitive and specific assay for SE detection in eggs and serotyping of SE isolates. Most importantly, this assay can be adapted into the current conventional SE workflow in the shell eggs testing for early alerts (Day 2), thus providing accurate serotype confirmation to reduce the current testing time (Day 4).	
Geraldine Lim, Singapore Food Agency, Singapore	**Singapore's initiatives for total diet study**
A total diet study (TDS) examines the patterns of chemical exposure across the diet of a population. In a TDS, foods are prepared to a state as consumed to allow a more accurate assessment of the level of chemicals, which could be lost or gained through the process of food preparation. The TDS is a robust, internationally recognised exposure assessment tool to realistically estimate a population's background dietary exposure to chemical hazards. When used with health-based guidance values (HBGV), it provides the fundamental scientific evidence needed to support the development of regulatory and non-regulatory measures to ensure food safety. This presentation gives an overview of the first TDS in Singapore that has begun in 2021.	
Alex Ng Yu Zhe, Singapore Food Agency, Singapore	**Leveraging data science towards smarter food safety system in Singapore**
In an ever-changing and increasingly complex food safety landscape, SFA uses data science to make sense of the vast amount of data available in-house and on the Internet for the surveillance of food safety risks. Food consumed in Singapore is largely imported and hence it is important to monitor the risks associated with these imported foods. SFA does this through the Horizon Scanning Programme which adopts a data analytics approach to monitor food recalls globally for informed risk assessment and subsequent triggering of risk management measures if required. Additionally, SFA is expanding its Syndromic Surveillance initiative on foodborne diseases in Singapore. Text analytics is used on web-scraped online consumer data to anticipate emerging foodborne disease outbreaks. These data science initiatives has empowered SFA to pre-emptively manage food safety risks both externally and internally so as to ensure a supply of safe food for Singapore.	
Khor Wei Ching, Singapore Food Agency, Singapore	**Antimicrobial resistance in the food chain in Singapore**
AMR is a One Health challenge. Microorganisms carrying resistance can be transmitted between humans, animals and the environment. Like other ecological sectors, antimicrobial resistant microorganisms are monitored and found in food chain globally as well as in Singapore. This presentation aims to share SFA's current efforts and future outlook for monitoring AMR in the food chain, to better understand the dynamics of AMR across sectors. The presentation will also aim to promote continued food safety vigilance and joint responsibility to further reduce the global public health risks of AMR.	
Tan Yong Quan, Singapore Food Agency, Singapore	**Developing an agile food safety regulatory framework for cultured meat**
Advances in foods derived from modern biotechnology are shifting existing food safety regulatory paradigms. The safe introduction of cultured meat onto the market requires an in-depth risk analysis of the inputs and critical control points that are specific to the cultured meat production process. Here, we provide an overview of a food safety regulatory framework for cultured meat at	

the Singapore Food Agency (SFA) that encapsulates current and future developments in cultured meat. We highlight challenges in safety evaluation of cultured meat, and present scientific resources and communication strategies that address these challenges. We believe that SFA's agile food safety regulatory framework for cultured meat ensures food safety for consumers while providing a transparent approval process that promotes innovation for cultured meat developers.

Joseph Merillyn Vonnie, Universiti Malaysia Sabah, Malaysia	**Physicochemical properties of orange peel and eggshell activated carbon for removal of heavy metal**

The contamination of heavy metals has spread throughout the world, particularly in developing countries. In this study, eggshell and orange-peel waste was used as natural adsorbent for removal of heavy metals. The purpose of this study was to characterize the physicochemical properties and investigate the absorption efficiency of orange peel and eggshell activated carbon (OPESAC). The morphology of the activated carbon was characterized using Scanning Electron Spectroscopy (SEM) that showed a highly porous and rough surface with more open channels and a non-uniform honeycomb. The diffraction peaks for this film were found to be at 13.74°, 17.45°, 18.4°, and 23.6° by using X-ray diffraction (XRD), indicating a typical crystalline A-type packing arrangement within the starch granules. The surface chemical properties of activated carbons were determined by the Fourier transform infrared spectroscopy (FTIR). The effect of the initial concentration of cadmium (II) ions was determined through UV-vis spectrophotometer and atomic absorption spectroscopy. This activated carbon showed higher removal efficiency with 100 % and 99.7 % in 0.5 mg/L and 1.0 mg/L of heavy metal solution, respectively. Thus, orange peel and eggshell activated carbon has a high potential to adsorb heavy metals in food and water samples.

BR 4 - West African Association of Food Science and Technology (WAAFoST)

Towards Establishing Nigeria's Research and Development Foundation

Session Chair: Lateef Oladimeji Sanni, FAS, FNiFST, Nigeria

Lateef Oladimeji Sanni FAS, FNiFST, Nigeria	**Challenges and opportunities facing food processing practices in Nigeria: The role of food technologists**

Food Science allows us to make the best use of our food resources and minimize waste from harvesting, processing, distribution, storage and preparation of agricultural commodities. Various opportunities such as changes in food consumption patterns, human population, income growth, increase in the demand for variety of products (like low calorie foods, fortified foods, nutraceuticals etc), and increasing interest by the funding agencies and private donors. Donor driven interventions in transforming agricultural commodities is expected to enhance the growth of food science and technology. For instance, African Development Bank hosted experts to accelerate food transformation in West Africa through technology whilst the U.S. Government's Global Food Security Strategy (GFSS) seeks to reduce global hunger, malnutrition and poverty by empowering West Africa in agriculture and food security. One World – No Hunger Initiative of GIZ West Africa. The commencement of The African Continental Free Trade Area (AfCFTA) in accelerating intra-African trade and boosting Africa's trading position in the global market by strengthening Africa's common voice and policy space in global trade negotiations is another opportunity. The need for an integrated approach and plausible entry points for food professionals are discussed. Apart from Nigeria, very few universities are offering food science and technology with low institutional innovations in ensuring effective and safe food processing practices. This paper conclude on best strategies to train, mentor, recruit and sustain best talents in the food science and technology profession in the region.

O. Charles Aworh FIAFoST, FNiFST, Nigeria	Zonal/regional food pilot plants for scaling up food research in west Africa

Most of the advances made in food research in West African universities and research institutes remain largely at the bench scale with little commercialization of research findings. Industry-academia partnership is very weak and food research have, by and large, not made the desired impact on the society. Lack of modern food pilot plants, needed to move from bench scale to commercial production, is one of the most important factors constraining commercialization of food research findings in West Africa. Food pilot plants enable the scaling up of production capacity from a few kg/day (bench scale) to a few tons/day, facilitating detailed technical and economic feasibility studies that are required before adoption by the industry. Given the high cost of modern food pilot plant facilities, the establishment of zonal/regional food pilot plants in West African universities and research institutes by governments in partnership with the private sector will promote the commercialization of research findings in upgrading African traditional foods, food product development and value-added food processing with huge benefits for food and nutrition security, food safety and wellness.

Arc. Sonny S. G. Echono, FNIA, Nigeria	Supporting research for development: the targeted interventions of Nigeria's tertiary education trust fund

Nigeria's Tertiary Education Trust Fund (TETFund) was established in 2011 for the rehabilitation, restoration and consolidation of tertiary education in Nigeria, specifically for the provision or maintenance of essential physical infrastructure for teaching and learning; instructional materials and equipment; research and publication; academic staff training and development; and any other need which, in the opinion of the Board of Trustees, is critical and essential for the improvement of quality and maintenance of standards in higher educational institutions in Nigeria. Some of the research related TETFund interventions include the National Research Funds (NRF), the Institution Based Research (IBR) grants, the Centres of Excellence, Academic Research Journals (ARJ) support and the Academic Staff Training and Development. Other TETFund interventions under the Book Development Project are book production to promote indigenous authorship and address the paucity of reading and learning materials in Nigeria's higher educational institutions, the revitalization of academic publishing through the establishment of Academic Publishing Centres (APCs) and support for Professional Association Journals (PAJs).

Suleiman Elias Bogoro FAS, Nigeria	Towards establishing Nigeria's research and development foundation

The capacity to educate, innovate and build sustainable long-term national investments in basic and applied research and development is critical for Nigeria's economic growth and development and the promotion of knowledge and market-based innovations for Nigeria to be able to compete in sophisticated knowledge economies. The formation of a well-managed National Research and Development Foundation (NRDF) is the surest way of achieving this objective as many countries that have set up similar foundations have achieved rapid economic growth and development. The proposed NRDF will be the national focal point for the development of sustainable knowledge-based economy that is grounded in excellence in Science, Technology and Innovations (STI) which is crucial for industrialization. The mandate of the proposed NRDF shall include, among others, the promotion of basic and applied research through provision of adequate funding; support for indigenous capacity building and human resource development particularly in STEM (Science, Technology, Engineering and Mathematics); provision of necessary infrastructure to promote the culture of research excellence; and strengthening industry-academia partnership including providing opportunities for the development of industry incubators and start-up companies.

BR 5 - Food Packaging and Material Science

Session Co-Chairs: Pingfan Rao, IUFoST, China; Joo Won Lee, Singapore Polytechnic, Singapore

Phanwipa Wongphan, Faculty of Agro-Industry, Kasetsart University, Thailand	**Incorporations of food preservatives into biodegradable blown films for active meat packaging**
Functional packaging preserves quality and safety of packaged foods, while avoiding direct addition of food preservatives into products. This research aims to develop biodegradable films from thermoplastic starch (TPS) blended with polybutylene adipate-co-terephthalate (PBAT) containing food preservatives namely sodium erythorbate and sodium hexametaphosphate. The active films were produced via blown-film extrusion for biodegradable active meat packaging. The functional packaging was determined for morphology, phase transition behavior, mechanical strength and barrier properties. Results showed that hexametaphosphate gave tighter film structure than erythorbate due to better melting and granule disruption of starch. Both food preservatives decreased mechanical relaxation temperature. Topographic images indicated surface roughness of the films, while erythorbate gave smoother surface than hexametaphosphate probably due to smaller molecular size. Interaction between TPS/PBAT and food preservatives modified mechanical strength, involving H-bonding and carbonyl group and modified barrier properties. The active films were applied for beef packaging. Film containing food preservatives effectively retained quality, while preserved redness, reduced metmyoglobin formation and maintained lipid oxidation during storage. Accordingly, incorporation of food preservative has potential to modify compatibility between biodegradable polymer blend, enhanced functional properties to maintain quality of meat products which effectively produced sustainable packaging.	
Mapitsi S. Thantsha, University of Pretoria, Pretoria	**Cell free supernatants of lactic acid bacteria disrupts biofilms of Listeria monocytogenes strains from avocados and cucumbers, and causes downregulation of their prfA gene expression**
Listeria monocytogenes forms biofilms on food contact surfaces, a niche from where it dislodges to contaminate food products, including fresh produce. This study aimed to screen biofilm formation capabilities of L. monocytogenes isolates from the avocado and cucumber fruits, and an avocado processing plant, and to evaluate the anti-biofilm effects of cell free supernatants (CFS) of lactic acid bacteria (LAB) against their biofilms formed on polyvinyl chloride (PVC) and stainless steel. L. monocytogenes strains 243, Avo and Cuc were screened for biofilm formation capabilities. CFS of Lactobacillus acidophilus, Lactiplantibacillus plantarum and Lacticaseibacillus rhamnosus were then separately evaluated for inhibition and dispersion of biofilms. Quantitative RT-PCR was used to quantify the expression of prfA gene by sessile L. monocytogenes in the presence and absence of CFS. L. monocytogenes strains formed biofilms on PVC and stainless steel, being classified as either moderate or strong biofilm-formers. All CFS reduced the biofilm formation capabilities of these strains and disrupted the integrity of their pre-formed biofilms. The expression of prfA gene was significantly reduced in the presence of CFS ($p < 0.05$). Thus, these CFS have potential for use as food grade sanitizers in the avocado and cucumber processing facilities for L. monocytogenes' biofilm control.	
Monjurul Hoque, School of Food and Nutritional Sciences, University College Cork, Ireland	**Development and characterisation of pectin/sodium alginate based active packaging films**

The present study was carried out to develop a bio-based, water-insoluble, and active packaging film. For film formation, a solution of high methoxyl pectin/sodium alginate (HMP/SA) (3 wt.% at 1:1) composite was mixed with microcrystalline cellulose (MCC) (10 wt.% of HMP/SA) and geraniol (GER) (at 2.5%, 5%, 7.5% and 10% wt. of HMP/SA). Crosslinking of film components was achieved by immersing the air-dried film in a CaCl2 solution. The films were characterised for physical, mechanical, barrier, thermal, chemical, and antimicrobial properties. The tensile strength of the control sample reduced from 54.25 MPa to 35.15 MPa as GER concentration increased. GER addition lowered water solubility (100% to 21.55%), reduced water contact angle (42.22 to 22.18â °), lowered OTR (9.30 to 7.42 cc/(m²·day)) and WVTR (115.32 to 112.421 g/ (m²·day)) of the films. TGA demonstrated GER addition reduced the thermal degradation (44.92% to 27.63%) of the films. FTIR spectra revealed the formation of new hydrogen bonds between the film components in GER-loaded films. XRD analysis demonstrated that the films developed were predominantly amorphous. GER-loaded films also exhibited a 100% reduction of Gram-negative Escherichia coli (NCTC 9001) in 24 hours. It was concluded that the composite film exhibited desirable physical and active properties to be considered for food packaging applications.

Wong Chun Hong, National University of Singapore, Singapore	**Enhancement of quality and safety of fresh shell eggs with zein/clay/chitosan composite coating**

Eggs are highly nutritious food but are susceptible to spoilage due to the pores on egg shells that allows gaseous exchange to occur with the atmosphere and lowering egg quality. Water-based biodegradable coatings are favourable for food packaging applications due to its non-hazardous nature and sustainable properties. In this study, a novel composite coating consisting of zein, silica-modified clay, and chitosan was explored and applied on fresh eggs. A ratio of 20:80 of zein and silica-modified clay formed a homogenous layer and have the best oxygen barrier when coated on polyethylene terephthalate (105.14 cc/m2/24h) and was further improved when 2.5% chitosan was added (0.24 cc/m2/24h). Eggs coated with this coating were able to be maintain a grade AA quality (Haugh unit ≥ 72) after 30 days of storage at room temperature. Furthermore, the coating was able to form a homogenous layer on egg shells and plug the pores on the egg shells as observed under Scanning Electron Microscopy. Lastly, artificially inoculated Salmonella enteritidis on coated egg shells was inhibited after 24 h at room temperature. Therefore, this new composite coating may provide a sustainable solution enhance the quality and safety of fresh shell eggs.

Lakshmishri Roy, Techno Main Salt Lake, India	**Nanoemulsion pigment formulation from agrowaste for smart packaging application**

Incessantly evolving food market requires the design and development of various new packaging technologies to maintain food quality, overall food safety, and organoleptic characteristics and calls for the ability to monitor the quality of packaged foods easily. Intelligent or smart packaging methods are typically used to attach or incorporate labels or tags to indicate or identify changes in packaged food quality. Intelligent packaging based on visual color change indicator materials, can play an essential role in solving a lot many packaging related problems. Development and production of pH-responsive color-changing indicators have gradually expanded. These pH-responsive color-changing indicators are non-invasive and non-destructive and offer the advantage of inexpensive ingredients and fast reaction.

The present research involves fabrication of biopolymer-based pH-responsive color indicators integrated with natural colorants for real-time monitoring of packaged food quality. Natural colour from plant sources which is gaining popularity for multifarious ecofriendly sustainable food applications has been extracted from agrowaste using green solvents in the present study. The enzyme assisted green extraction was carried out using Deep Eutectic Solvents

using magnesium chloride hexahydrate [MgCl2, 6H2O] and urea [U] proportions (1:1) and (2:1) for their use as extracting and stabilizing agents for red and violet betalains from beetroots. Obtained natural Betalain pigment extracts was thoroughly characterised and assessed for stability at various conditions like light ,pH, temperature etc. Nanoemulsions with the pigment extracts were formulated using high energy ultrasonnication and low energy method for improving the stability and effectivity for application in packaging films. Resultant nanoemulsions were conferred with kinetic stability and better applicability.The films with these nano formulations can be extensively applied in packaging films.

Umesh Rajapakse, Wayamba University of Sri Lanka	**Geographical variation of polyphenols and haze level present in instant tea powder produced using economical raw materials**

Broken Mixed Fannings (BMF) is the most economical grade of black tea that can be used to manufacture instant black tea powder (IBT). The commercial interest lies in determining the ideal geographical regions to source BMF to produce IBT with the desired quality. This study aimed to determine the effect of tea growing elevation and rainfall on quality parameters of BMF and IBT produced from BMF.

IBT was prepared from BMF obtained from eight tea estates from the three growing elevation categories in Sri Lanka i.e., high grown (HG), mid grown (MG) and low grown (LG). Total polyphenol content (TPC) in both IBT and BMF in HG regions were significantly higher ($p<0.05$) than MG and LG regions. TPC of IBT was approximately 1.5 times greater than that of BMF. Haze value of IBT from HG region was also significantly higher than that of MG and LG regions. Polyphenols are precursors that produce haze in black tea and a significant positive correlation ($p<0.05$, $r= 0.77$) was found between TPC and haze in IBT. Therefore, HG region was determined to be the best for producing instant tea for therapeutic applications. LG and MG regions were determined to be ideal for ready-to-drink applications.

BR 6 – Global Harmonization Initiative (GHI)

Global Food Safety and Security

Session Co-Chairs: Huub Lelieveld, President of GHI and Diana Bogueva, University of Sydney, Australia

Rui Costa, Polytechnic Institute of Coimbra	**The Status Of Whistleblowing Legislation In The Food Sector**

In recent years, the importance of whistleblowing as an essential element of risk management and as a mechanism for combating corruption and fraud has been increasingly recognized. As such, it is also critical to the food sector, which entails both risky operations and food fraud.
Whether a worker, scientist, manager, or executive, anyone in the food sector may encounter irregularities and need to report them internally to their management or externally to regulators. However, according to a GHI survey, laws on whistleblowing are not always adequate to protect whistleblowers who risk retaliation or address the raised food safety concerns. According to the experience of some whistleblowers, all along the chain of events, from reporting, following up and correcting the food safety issue, to protecting the whistleblower or their redemption, the various legislations contain loopholes and discrepancies. Therefore, the food sector will benefit from a harmonized model legislation, specifically adapted to food sector and reflecting best practices and optimal conditions for whistleblowing,

The lecture will present the result of the GHI survey on 27 countries from all continents on the various legislations in the world and the way forward to enhance food safety management.

Michael Murkovic Graz University of Technology, Austria	**Chemical food safety in an increasingly complex world**

Toxicologically relevant food constituents can have an impact on our health. Although the food laws around the world try to minimize the health risk that is associated with the exposure to these compounds it is not possible to eliminate all these risks. Some of the compounds that contaminate our foods are naturally occurring like the toxic elements (As, Pb, Cd) or plant toxins that have not been eliminated completely through e.g. breeding (e.g. solanin, oxalic acid, lectins, cyanogenic glycosides) or they are formed by microorganisms that live on the food organisms (bacterial toxins, mycotoxins, algal toxins).
Other toxic compounds are formed during heating processes or storage. One group of toxic compounds arises from oil oxidation that is occurring either by heating or sunlight in presence of oxygen. Although the health effects of oxidation products of unsaturated fatty acids have not been attributed to specific compounds yet it is known from epidemiology that exposure to alimentary oxidized oil increases the risk of colon cancer. Recently, a mouse model was developed that proved that oxidized oil can lead to non-alcohol induced liver inflammation. In these experiments it was not possible to identify the specific compounds that are responsible for this disease. However, a series of highly reactive compounds which have been characterized in detail ranging from hydroperoxides, to epoxides, epidioxides, and carbonyl compounds are occurring in high concentrations in oxidized oils – and all of these might induce such effects.
The only possibility to reduce the uptake of these oxidation products is to protect the oils. This can be achieved by storage of the highly unsaturated oils in the dark and avoid the presence of oxygen. Oleic acid is not as sensitive and saturated fatty acids are not prone to oxidation anyway.

Hamid Ezzatpanah, Pakropart Company, Iran	**The importance of harmonization of law and regulations: viral decontamination of food, food contact surfaces, and water**

International guidelines and some national regulations have addressed the contamination and transmission routs of some viruses, particularly human norovirus (HuNoV) and hepatitis A virus (HAV) to water, food, and food contact surfaces. They also have provided advices and decontamination measures especially for bivalve molluscs and fresh produce. The objective of present study is to discuss the importance of harmonization of the regulations on viruses in the food chain. The Codex Alimentarius Commission (CAC) has published the CAC/GL 79-2012 to give guidance on how to prevent or minimize viral contamination from primary production to consumption, following the format of CAC/RCP 1-1969 (General Principal of Food Hygiene), which has been adapted globally. A National Outbreak Reporting System (NORS) accompanied by the U.S. Centers for Disease Control and Prevention (CDC) report waterborne, foodborne, and human enteric illnesses in the United States. The EPA/100/J-12/001 &USDA/FSIS/2012-001 guideline “Microbial risk assessment–pathogenic microorganisms with focus on food and water” has published by EPA/USDA-FSIS to address the risk assessment of food borne pathogens including viruses across the food chain. Food and Drug Act of Canada covers all registered hard surfaces disinfectants and disinfectant-sanitizers claiming virucidal effect in Canada. Additionally, Health Canada has published three new guidelines including Disinfectant drugs, Safety and efficacy requirements for surface disinfectant drugs, and Management of disinfectants drug applications, to facilitate registration process of disinfectant drugs and disinfectant-sanitizers. According to the Zoonoses Directive 2003/99/EC, all member states of European Union should collect data on zoonoses, zoonotic agents, antimicrobial resistance, and foodborne outbreaks. The List B of Annex I of this Directive includes calicivirus, HAV, influenza virus, and rabies virus. Generally, the

development of EU food law is based on international standards such as CAC publications (e.g. the CAC/GL 79-2012). Although in other parts of the world such as Australia and New Zealand, India and China, and Africa, it is common to adhere to Food Code publications of the CAC, the harmonization of food law and regulations on viral contamination of water, food, and surfaces seems to be critical.

Diana Bogueva University of Sydney, Australia	**Consumer perceptions of alternative proteins**

Consumers' dietary patterns impact on planetary and personal health. To address these challenges, one of the many possible solutions is to substitute meat consumption with alternative protein sources. Consumer interest in non-meat-based protein options is increasing globally, and a protein transition towards plant-rich diets appears to be happening. Plant-based, insects and algae choices, fermentation and cell culture products are being developed to substitute conventional meat and dairy products.

The presentation focusses on the key drivers for the adoption of alternative protein products by consumers. It covers the major challenges that need to be overcome to satisfy consumers' perceptions about these products. It analyses attitudes related to benefits and doubts related to alternative protein production and consumption. It also touches on understanding consumer concerns in the evolving market dynamics and the opportunities for food industry players.

Chin-Kun Wang, Chung Shan Medical University, Taiwan	**Nutrition and precision health**

Nutrition and physical activity are both critical for human health. Nutritional deficiency happened before owing to the poor food supply in the past. But unbalanced nutrition becomes a challenge of health. Daily recommend allowance has been established for the suggestion of people of different life spans. However, different geography, lifestyle and culture could greatly influence the so called balanced nutrition. The same nutrient is not equally contributed to the individuals, phenotype and microbiota could influence its bioavailability and bioaccessibility. The primary focus of public health recommendations related to the prevention of food-related chronic disease has been on the adoption of healthy dietary patterns. However, the implementation has been challenging. There has been increasing recognition that an individual's diet and environment may impact disease susceptibility by affecting the expression of genes involved in critical metabolic pathways. Precision nutrition (PN) has emerged to translate discoveries about diversity in nutrient metabolism between subgroups and the inter-individual variability in the responses to dietary interventions. The overarching goals of PN are to deliver individualized, actionable dietary therapy based on an individual's nutritional phenotype, created from the integration of genetics, metabolic profile, and environmental factors in order to prevent and treat chronic disease.

Dora Marinova, Curtin University, Australia	**Food and sustainability transition**

Among the transition theories, the ones that relate directly to development and food are demographic, nutrition/protein, food and lately sustainability transition. These theories explain changes in population behaviour and related population health, well-being and environmental consequences.

The paper analyses the four transition frameworks and the transformations which have occurred globally and particularly in the West. It argues that changes in the way we produce food and in our eating preferences need to be part and a main driver in a sustainability transition towards reducing

the human impact on the natural environment allowing it to regenerate. The analysis examines specifically the role of new plant-based alternatives to animal-sourced products as part of the current stage of the nutrition/protein and food transition. Against the trends in new developments in this burgeoning field of new alternatives to livestock products, it is important for people to shift their eating habits as well as change the current methods of food production to respond to the present environment and climate emergency resulting from persistent problems in human activities. Alternative proteins can be part of such conscientious behavioural change together with resurrection of the importance of vegetables, fruits, legumes, whole grains, tubers and nuts.

Marco Dalla Rosa, University of Bologna, Italy	**Anonymous whistleblowing in the food chain**

Food safety is one of the most prominent goals within the Global Harmonization Initiative (GHI) objectives and food professionals working inside a food company could discover a potentially serious food safety hazard during the production of foods or beverages. Thus GHI has been working on the establishment and launch of a Whistleblower Food Safety Incident Report Site now available in over 30 languages since there has never been a global reporting system for food safety concerns really anonymous as well as that launched by GHI. a specific working Group on Global Incident Alert Networks (GIAN) was created and now anyone who chooses to report an incident can be assured that their report is anonymous – in fact even GHI does not know who has submitted a report in order to protect the identity of whistleblowers (WB). A protocol to systematically evaluate the WB's submission has been developed and experts from industry and academia have been involved to a GHI Advisory Experts (GAE) panel to determine if in their judgment the WB's report is authentic and represents a significant risk to consumers. If the majority of the experts answer in this direction the GIAN chairs will send a message to the GHI president asking to formally inform the local food safety authority (FSA)

BR 7 - Food Safety and Regulatory Science 4

Session Co-Chairs: Sebastiano Poretta, IUFoST, Italy; Joanne Chan, Singapore Food Agency, Singapore

Yohanes Tandoro, Chung Shan Medical University, Taiwan	**Suppression of *H. pylori* infection with black raspberry supplementation**

Helicobacter pylori (H. pylori) is a gram-negative bacterium that colonized human gastric. Adherence of H. pylori into the epithelial cells can induce injection of cytotoxin-associated gene A (CagA) and secretion of pro-inflammatory cytokines. Black raspberry (Rubus occidentalis) was found to possess antibacterial activities due to high phenolic and anthocyanin contents but the effect in suppressing H. pylori is still unknown. The aim of this study is to examine anti-H. pylori effect of black raspberry on AGS cell model and asymptomatic H. pylori-infected subjects with UBT C13 value>10‰. The sample used for the study was crude extract, different isolated fractions, and powdered black raspberry. Parameters assessed in the cell model were cytotoxicity, anti-adhesion activity, intracellular CagA expression, VacA, and IL-8 levels and for the human clinical trial was the reduction of infection, blood inflammatory markers, and oxidative indexes. Crude extract and isolated flavonoids fraction of black raspberry significantly ($p< 0.05$) suppressed the adhesion of H. pylori to AGS cells, expression of intracellular CagA, VacA, and IL-8 levels. Results from human clinical trials clearly showed that black raspberry supplementation can reduce the infection of H. pylori. In conclusion, black raspberry, especially isolated flavonoids fraction showed anti-H. pylori activity.

Patrick Gan, Singapore Food Agency, Singapore	**Exposure science and food consumption research: strategies and approaches to inform food safety measures**

Food consumption is an essential element for the determination of dietary exposure. This presentation provides an overview of the food consumption assessment programme in Singapore to support exposure assessment. A combination of individual-based surveys provides the basis for understanding the food consumption patterns among various resident populations in Singapore. The collected food consumption data are processed through coding based on international food classification system as well as using a recipe compendium to disaggregate mixed dishes into individual foods. Combined with the occurrence data of contaminants in foods, food consumption data will be used to identify potential dietary exposure concerns through risk ranking of foodborne hazards.

Zejia Lin, National University of Singapore, Singapore	**Influence of mixed-species biofilms of Escherichia coli and Salmonella on chlorine resistance and cross-contamination in sponge cake**

Reported outbreaks of pathogenic Escherichia coli and Salmonella in cakes might be associated with cross-contamination of biofilms on food-contact surfaces. This study aims to prevent biofilms cross- contamination between sponge cake and contact surface.

Single- and dual-species biofilms of E. coli (O45:H2, O121:H19), and S. Typhimurium formed on stainless steel were treated by 1-min 100 mg/L NaClO treatment. Biovolume and metabolites upon chlorine were studied via confocal laser scanning microscopy and nuclear magnetic resonance (NMR) spectrometer. Analysis of variance was performed for mean comparisons.

Mixed-species biofilms (total biovolume: 148,000-167,000 μm3) stimulated the biomass 2-6 times growth of single-species biofilms. Upon chlorine treatment, E. coli O45 and S. Typhimurium achieved less reduction when coexisting in mixed biofilms (0.70 and 1.17 log CFU/coupon reductions); compared to their corresponding single biofilms (1.97 and 2.01 log CFU/coupon reductions). For O121, the reduction in single biofilms were 0.59, while 1.37 log CFU/coupon in mixed biofilms. The increase of putrescine (antioxidation regulator), and the decrease of glucose (enhanced glycolysis for energy replenishment) were found in mixed biofilms.

In conclusion, dual-species biofilms promoted the biofilms growth and their chlorine resistance. The results provide insights to alleviate biofilms formation and food cross-contamination.

Wang Yue, National University of Singapore, Singapore	**Membrane phospholipids and nucleotide derivatives in *Escherichia coli* are targets of chlorine-based sanitisers during lettuce decontamination**

To reduce the prevalence of outbreaks linked to fresh produce consumption, effective sanitisers targeting the most concerned pathogens are highly demanded. Therefore, using lettuce as the food matrix, the sanitising efficacy and the antimicrobial mechanisms of two chlorine-based sanitisers, sodium hypochlorite (NaClO) and electrolysed water (EW), both containing 4 mg/L of free available chlorine (FAC), against six Escherichia coli strains from O26, O45, O103, O111, O121 and O145 serotypes (“big six”), were investigated in this study via UPLC-MS-based metabolomics.

In each strain, the two sanitisers led to comparable cell reductions after 10 min’ treatment, which indicated the decisive role of FAC in their antimicrobial power. Among the strains, mortalities varied from approximately 0.68 log CFU/g in O111 under both treatments to 1.48±0.04 log CFU/g in EW- treated O26 and 1.23±0.04 log CFU/g in NaClO-treated O45. O111’s high resistance was confirmed by its almost undisturbed metabolome whereas membrane phospholipid loss was the main change underlay the high lethality of O26 and O45. Additionally, inadequate cell growth and

energy deficiency as implied by a vast depletion of nucleotide derivatives also challenged O45's survival.
Overall, by altering phospholipid and nucleotide derivative metabolism, the chlorine-based sanitisers reduced "big six" contamination to enhance fresh produce safety.

Jaeick Lee, Department of Food and Biotechnology, Korea University, South Korea	**Application of pH indicator assay to screen inhibitors against bacterial tyrosine decarboxylases**

Biogenic amines (BAs) are produced through decarboxylation of amino acids by decarboxylases in bacteria. Inhibition of bacterial amino acid decarboxylases (AADCs) is mainly considered to reduce BAs in fermented foods, and discovery of effective inhibitors is highly important. In this study, a pH indicator assay in a 96-well plate platform was developed to detect increase of pH during decarboxylation by tyrosine decarboxylase from Enterococcus faecium (EfmTDC), known as major bacteria producing tyramine (TyrN), and applied to inhibitor screening against bacterial TDC. 2.5 mM 2-(N-morpholino)ethanesulfonic acid (MES) pH 5.5 and 50 µM bromocresol purple (BCP) were determined as the optimal condition for the pH indicator assay for EfmTDC. The pH indicator assay for EfmTDC in the presence of four tyrosine derivatives as inhibitors against EfmTDC allowed not only to select the best inhibitor but also to determine their inhibition mode rapidly compared to the traditional TDC assay using high-performance liquid chromatography. Therefore, the pH indicator assay would enable to perform high throughput screening of inhibitors TDCs and other AADCs.

Xiaohong Sun	**Identification of peptides from defatted wheat germ proteins with dual functionality: Emulsifying activity and anti-adhesive activity against Helicobacter pylori**

Peptides (n = 267) were identified in wheat germ protein hydrolysates with anti-adhesive potential against H. pylori. In addition to biological activities, peptides also exert functional properties on food product formulations. Therefore, the objective of this study was to identify peptides with both emulsifying property and anti-adhesive activity against H. pylori. The emulsifying property of the peptides was predicted by calculating the amphiphilic scores and secondary structures in silico. Six top-ranking peptides were synthesized for validation of their emulsifying and anti-adhesive activities. Three peptides (HLNLDFQLQEGGR, VNQAIYLLTTGAR, and ESLLNALTEHVK) showed high emulsifying activity by forming smaller oil droplet sizes of 1.396±0.015 µm, 1.163±0.010 µm, and 1.159±0.257 µm, respectively. Compared to Tween 80, only VNQAIYLLTTGAR maintained good emulsifying stability at different pHs, ionic strengths, and heating. Anti-adhesive activity was determined using GES-1 cell line. Anti-adhesive activity of the peptides ranged from 36.3±2.0% (VNQAIYLLTTGAR) to 5.5±7.0% (AINDIRDQLER) at 10 mg/mL, which is attributable to binding of peptides and H. pylori adhesins through hydrogen bonding and hydrophobic interactions. In conclusion, VNQAIYLLTTGAR showed both biological and techno-functional properties, thus making it a strong candidate for further development as a dual functional food ingredient.

BR 8 - ALACCTA Scientific Session

Old Ways and New Ways, Strategies Generated by the Food Scientists and Food Industry to Protect the Environment

Session Chair: Sara Esther Valdés Martínez, Universidad Nacional Autónoma de México

Sara Esther Valdés Martínez, Universidad Nacional Autónoma de México	**Introduction**
Susana Socolovsky, IAFoST, Argentina	**Turning 'trash' into 'treasure': Food Technology Innovations in LATAM to reduce food waste.**

"Latin America is a diverse region where primary production is paramount. Feeding this expanded population nutritiously and sustainably will require substantial improvements to the regional food system, while providing economic opportunities in both rural and urban communities. Food systems are inefficient, leading to significant waste even as chronic hunger affects millions in Latin America.

While food waste varies from one category to another, innovation which focuses on previously discarded but nutritionally valuable products will provide a boost to sustainability efforts. Manufacturing in the areas of frozen vegetables, jams, pasta sauces and wine, among others, discard peels and seeds that are rich in fiber, phytonutrients and nutrients.

By better utilizing the full potential of raw materials, food and beverage companies can turn waste into valuable ingredients. Practical examples of companies utilizing waste in the region will emphasize the dominant importance of food science and technology in pursuing of reduction of food waste.

On the other hand, the spread concept of "ultra-processed foods", wrongly defined and strongly pushed forward by PAHO is misleading consumers in Latin America, and promoting public policies that greatly risk to induce consumers to annul their consumption of processed foods. Unjustified exclusion of culinary ingredients of the need to exhibit the warning labels in several FOP systems currently mandatory in South American countries makes consumers believe home-made food are intrinsically healthier no matter what their chemical composition is.

Counterbalancing these issues will be necessary to allow the food companies to utilize primary production waste, and turn it into valuable enriched food products that are accepted and appreciated by the Latin American consumer."

Roberto Castelo Baéz, Advisor to the Directorate of Industry, Quality and Sales of the Business Group of the Fishing Industry, Cuba	**The fishing industry in Cuba, past, present and future, steps towards food sustainability**

"The round table intends to provide an overview of fishing (capture and industrialization) from before 1959 to the present in Cuba. To obtain this objective, the main strengths, weaknesses, opportunities and threats that the fishing sector currently has and faces were identified. Offensive, defensive, reorientation and survival strategies were defined to be applied in principle that allow proposing the steps to follow to increase the production of the sector in order to achieve its vision that is aimed at responsible fishing, with high social recognition, high economic impact and with safe steps to provide a broad contribution to the food sustainability of the country. The current trend must be intentional to generalize the consumption of fishery products that do not exceed the current capacity of our aquatic ecosystems and convert them into sustainable habits or practices. The value chain will be managed, with certified industries and with the knowledge, preparation and accumulated experience of managers and workers. Added to this is the high recognition of exportable productions, to attract foreign investment. Priority attention is proposed to aquaculture with more science and the application of genomics, the use of biological modifiers

to improve the growth, productive performance and resistance to diseases of the species. This will make it possible to develop key processes in the value chain, with better preparation of workers and specialists, in addition to establishing mutually advantageous links between the state and non-state sectors.”	
Sara Esther Valdés Martínez, Universidad Nacional Autónoma de México	**Handling food packaging waste, helping the environment and making money.**
"Food packaging generates a huge waste, which can be reduced, recycling containers, therefore reducing the adverse impact food waste packaging has on the environment. There are several programs in Mexico aimed at the separation of garbage. As a country, the fight for environmental protection, separating waste, was late, however the efforts of the public and private sector have begun to generate positive results. There are countless products that can be obtained from recycled containers, such as bags, pots, fibers, urban and household furniture, lining of jackets, T-shirts, recycled paper, books, etc., many of which, when marketed, already show in its label, made with recycled materials. The separation of waste in Mexico is carried out by private companies, civil organizations and government. In the former who delivers a recyclable container, receives a payment for it, as an example of the latter, is ECOCE, founded in 2002, has among its partners to the large and medium food industry in Mexico and in the third, the government, which has a growing number of collection machines, in which stimuli are provided in the form of free public transport and that it has. The new classification of waste from mid-2019, in Mexico, will facilitate the separation and reprocessing of garbage by the authorities. Mexico City generates 13,000 tons of garbage daily at a rate of 1.5kg of garbage per capita. When the garbage separation programs began more than 15 years ago, the recovery of plastic waste was only 2% of the plastic generated by the city, nowadays 58% recovery is achieved, which places Mexico as the country with the highest plastic waste recoveries in Latin America. Throughout the talk will be given data on the impact of these efforts to support the environment by the food industry in Mexico, strategies to educate and raise consumer awareness of the philosophy of recycling and the impact that has been achieved at the time. Key words: food packaging, waste, recycling, strategies, impact”	

BR 9 - Global Food Regulatory Science Society (GFORSS)

Introduction of the Global Food Regulatory Science Society: Current Focus and Areas of Priority for Investments in Food Regulatory Science Capacity

Session Co-Chairs: Samuel Godefroy and Charles Aworth

Samuel Godefroy/ Pamela Byrne	**Introduction of the Global Food Regulatory Science Society: Current focus and areas of priority for investments in food regulatory science capacity**
Samuel Godefroy, Co-chair Charles Aworth, Co-chair Pamela Byrne Nik Naud Amine Kassouf	**Members of the IUFoST Codex Committee – Panel discussion Review of the re-engagement approach of IUFoST in Codex Proceedings and discussions of priority of interventions and contributions of means to maximize the impacts and contributions of the food science and**

Lara Hanna Wakim Jairo Romero Kazutaka Yamamoto Judith Meech, Secretary General - IUFoST	**technology sector in international standard setting efforts under the auspices of the Codex Alimentarius Commission**

BR 10 - International Life Science Institute (ILSI)

Food Packaging – Safety and Sustainability in the Food System

Session Chair: Stéphane Vidry, ILSI, USA

Cristina Nerin, University of Zaragoza, Spain	**Novel bioactive packaging: Shelf-life extension, sustainability, and safety assessment**
The huge amount of plastic waste around the world has caused serious environmental problems, as the plastics used so far are not biodegradable. Efforts have been made in the last years to develop and produce biodegradable polymers able to be in contact with food. However, most of these new polymers do not have the required barrier properties for most of the food in the market. Thus, the limited barrier to gases prevents the packaged food to reach the market under the same conditions as the conventional plastics do. One good approach is to get bioactive materials, what means that these new materials will contain some additional agents which will extend the shelf-life of packaged food. These new materials are called “active packaging” and can act to prevent oxidation and/or microbial growth in the packaged food. As active agents, both essential oils, food additives and nanoparticles can be used, providing their efficiency and safety. But not only the shelf-life extension and sustainability are important, as the food packaging requires as well to guaranty the safety in use of all packaging materials. The presentation will show the main points of the topics and illustrate them with selected examples, dealing with biomaterials, active packaging and their safety in use.	
Terrynz Tan, Tetra Pak Malaysia, Singapore, Philippines & Indonesia	**Towards circular economy with sustainable packaging innovation: Industry perspectives**
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Sumalee Tangpitayakul, Thai Packaging Association, Thailand	**Thailand’s sustainable packaging roadmap and the regulatory development**
In Thailand, the Thai Food and Drug Administration (FDA), Ministry of Public Health (MOH) is the national authority for the safety of food packaging, while the Thai Industrial Standard Institute (TISI,) Ministry of Industry is responsible to develop various standards including food contact materials standard. Food contact materials standard covers both technical quality and safety of the product. Moreover, the Department of pollution control has set up the management of plastic waste road map for 2018-2030. The roadmap targets 1) to reduce and stop using single-use plastic, as well as 2) recycling plastic waste to create circular economy. This presentation will share the revision of Notification No. 295 of Food Act (1979) which prohibit the use of recycled plastic for food packaging to the new Notification No. 435 effective since June 2022 which allows the use of recycled polyethylene terephthalate (PET), and the changes of two voluntary compostable plastics standards to mandatory standards.	

BR 11 – New Zealand Session – Innovative Technologies of the Future

Session Co-Chairs: Richard Archer, Massey University, New Zealand, Matthew Zhao, Massey University, New Zealand

Cai Ling Ang, Massey University, New Zealand	**Clean-label" starch for tomorrow: a potential solution for structuring sustainable foods**

Starch serves as an important additive to enhance the physico-chemical properties of many food products. With the increased pursuit of natural products, there is an increasing demand for "clean-label" starches. In our study, we have physically-modified waxy potato starch at 120–150 °C for 30 min at a stirring speed of 300 rpm, in a pressurised reactor. The modified starch samples exhibited a wide range of rheological properties including Newtonian, shear-thinning, shear-thickening and anti-thixotropy behaviours. In particular, 120 °C-treated starch showed interesting shear-induced gelation. Such shear-induced properties can potentially be exploited in food applications where improved structure upon shearing is desired, e.g. in enhancing the stability of whipping cream. In addition, a synergistic increase in gel hardness was noted in whey protein isolate (WPI) gels made with 140 °C-treated starch, such behaviour was absent in the control sample. The effect of salt was also studied. At NaCl concentrations ≥ 0.25 M, unique soft and creamy gels were obtained for WPI gels containing 140 °C-treated starch. These findings indicate that structuring a wide spectrum of textural attributes can be achieved by applying the modified starch in various foods systems, including high-protein soft foods suitable for dysphagia.

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Hien Truong, Massey University, New Zealand	**Quality assessment of New Zealand manuka honey using anticipated imaging technique**

Honey is a valuable but limited resource. Mono-floral honeys are often more valuable than those from multi-floral sources. New Zealand mÄ nuka honey comes mainly from *Leptospermum scoparium*. Its potent antibacterial activity derives principally from methylglyoxal (MGO) formed from dihydroxyacetone (DHA) uniquely accumulated in *L. scoparium* nectar. MÄ nuka honey also has an idiosyncratic

phenolic profile useful as a chemical maker. Once diluted by other nectars, mÄ nuka honey irrevocably loses value, as does any honey which derives value from being monofloral. We aimed to apply non-invasive spectral methods directly to honey frames before bulk extraction to ensure minimal dilution of genuine mÄ nuka by other honeys, and to ensure authenticity at source. Combining fluorescence & NIR provides both the high capacity and spectral resolution needed to assess honey potency and purity in formats applicable to an industrial setting. Predictions of potency gave 70-83% accuracy. Mono-floral mÄ nuka honey can be classified with above 90% accuracy, successfully distinguished from multi-floral mÄ nuka and from non-mÄ nuka honeys while still in the frame. The technique, proven with non-imaging instruments is being applied to hyperspectral imaging.

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Joy Sim, University of Otago, New Zealand	**Rapid and non-destructive traceability of coffee origin using vibrational spectroscopy and machine learning**

Accompanying the rise in coffee consumption around the world is the increasing number of fraud cases, such as mislabelling and adulteration of coffee as single origin coffee. These issues have been exacerbated by the covid-19 pandemic, leading to economical and health consequences. To protect coffee producers and consumers of these high-value products, efficient analytical methods are needed to trace the origin and evaluate the authenticity of coffee. Traditional geochemical methods, stable isotope and trace element analysis are well established and accurate methods to detemine coffee origin but they involve a lot of time, destructive sample preparation steps and chemicals. Vibrational spectroscopy has been suggested as a sustainable, non-destructive, and rapid tool to perform routine analysis on coffee. However, there has been no attempt to predict geochemical data from vibrational spectroscopy, nor to validate results across laboratories. In this study, green coffee beans from four countries and three regions were investigated to (i) predict geochemical data from vibrational spectroscopy, and (ii) to validate results across laboratories using near-infrared and Raman spectroscopy. Machine learning and data fusion techniques were employed to produce predictive models. The models successfully classified and predicted the origins of the coffee samples, demonstrating inter-laboratory agreement of results.

Dominic Agyei, University of Otago, New Zealand	**Bioprocessing and food applications of two hydrolytic enzymes from *Lactobacillus leichmanii* 313: narrative of a 10-year research endeavor**
Lactobacillus leichmanii 313 (LL313, ATCC7830) is an important microorganism with an emerging food technology application (e.g., in cheese and sourdough) due to the presence of certain unique enzymes produced by this microbial species. Cell-envelope proteinases (CEP) and β-galactosidase (b-Gal) are two important enzymes expressed by LL3131 that are used in the production of peptides and galactooligosaccharides, respectively. The peptides and oligosaccharide products of these enzymes are high-value bioactive compounds used as ingredients in several food products. Moreover, these enzymes have shown promise to valorize dairy by-products such as whey. This talk is a narrative of a 10-year research endeavor involving the production of these important enzymes from LL313. I will discuss the bioprocessing of these enzymes, i.e., beginning from the bacterial growth parameters and conditions necessary for optimum expression of these enzymes through to the immobilization, purification, and biochemical characteristics assessment (i.e., kinetic parameters, pH/temperature optima, inhibitors, and activators), and thermal inactivation kinetics. The ability of the enzymes to convert substrates into products will also be presented, together with an assessment of the unique structural properties and linkages in the oligosaccharide and peptide products.	

Roman Karki, University of Otago, New Zealand	**Pulsed Electric Fields (PEF) processing tenderises tough meat and reduces the sous vide processing time**
The aim of this research was to investigate the effect of pulsed electric field (PEF) and sous vide (SV) processing on the meat quality parameters of bovine short ribs. Cooking loss (%), Texture parameters such as Warner Bratzler Shear Force (WBSF), Texture Profile Analysis (TPA), and International Commission on Illumination (CIE) colour parameters were assessed. The result showed that cooking loss (%) significantly (p<0.05) increased with elevating SV temperature and prolonging SV time in contrast to WBSF and TPA hardness. The latter parameters became significantly lower while insignificant effect on CIE colour parameters was observed. When PEF processing was applied prior to SV, the meat tenderness was enhanced and this combined process resulted in lower cooking loss percentage. The optimum SV time after PEF- SV application was found at 60 °C for 24 h which is 12 h less than SV processing without PEF. It implies that PEF prior to SV provides a substantial reduction of SV processing time that will improve the cost effectiveness of SV processing and improve the quality of SV processed short ribs.	

10:00 | GMT+8

10:00 – 10:15 GMT+8

Tea Break

10:15 | GMT+8

10:15 – 13:00 GMT+8

Plenary 8, Young Scientist Award Presentation, Keynote Address and Closing Ceremony

Session Co-Chairs: Aman Wirakartakusumah, IUFoST, Indonesia Weibiao Zhou, National University of Singapore, Singapore

Young Scientist Awards Session 4 (Sponsored by Elsevier)

10:15 – 10:30 GMT+8

Haizhou Wu (Sweden)	**Examining the mechanisms of lipid oxidation in muscle food systems and development of new cost-effective stabilization technologies**
Lipid oxidation is one of the most critical factors that affect muscle food quality. It is therefore somewhat surprising that this reaction is not better controlled throughout the muscle food production system. To change this, it is however necessary to elucidate the pro-oxidative mechanism(s) dominating in different muscle sources. This presentation will discuss lipid oxidation mechanisms in selected meat, poultry and fish sources, and different ways to control it. The importance of muscle microstructure, content of heme proteins (hemoglobin, Hb, and myoglobin, Mb) and accessibility of phospholipids to heme proteins will be outlined together with the lower impact of the degree of phospholipid unsaturation and total lipid content. The antioxidative role of lipid hydrolysis and free fatty acids will also be discussed. Finally, results from the development of new antioxidant strategies for highly challenging muscle raw materials -fish filleting co-products- are to be outlined. These are based on dipping the raw materials in rosemary extract-containing solutions prior to further storage or value adding processes, such as pH-shift based protein isolation. The possibility to recycle the antioxidant solutions up to 10 times without losing its efficacy render the dipping strategy cost-effective, which is needed for low-value materials as co-products.	

10:30 – 10:45 GMT+8

Xiaonan Sui (China)	**Emerging trends of protein-based meat alternatives in China**

Owing to the rapid growth of the world's population and the consequent effects on the consumption of natural resources, we are facing increasing shortages in availability of proteins with high biological value. Additionally, considerations relating to animal welfare and human health have promoted the development of plant protein meat alternatives. The market for plant-based meat alternatives is expanding rapidly to cater to growing consumer demand. Soy protein has been successfully utilized in the preparation of meat alternatives, due to its excellent gelation properties and potential to form fibrous structures, and has become the most widely known alternative to animal protein. High moisture extrusion is a relatively mature technology and is widely used for manufacturing soy protein meat alternatives with a similar fiber texture to meat. Further research needs to focus on optimizing technical parameters, improving nutrition and safety, and enriching product taste to meet consumer demands for product quality.

10:45 – 11:15 GMT+8

Mathys BOEREN (Nurasa)	**Keynote: How to Accelerate the Commercialisation of Sustainable Food Products across Asia**
The Asia Food Challenge: By 2030, Asia will have an additional 250 million mouths to feed and will be home to approximately 65% of the world's middle-class population. And yet Asia struggles to feed itself. Asia today has some of the lowest levels of arable land per capita in the world, and according to the UN's Food and Agriculture Organisation, this is expected to fall by five percent over the next decade due to climate change and environmental degradation. Instead, Asia is relying on importing food, which stand at about 220 million tonnes a year. These food supply chains are often riddled with inefficiency, food waste and safety issues. What are some of the specific ways and examples in which science and technology is being harnessed to address the Asia Food Challenge and establish a sustainable food system in the region? Where are the pain points in Asia's sustainable food system value chain and can science and technology alone alleviate these barriers? How can the commercialisation and adoption of sustainable food be accelerated in Asia?	

11:15 – 11:45 GMT+8

Ludovica VERZEGNASSI (Nestle)	**Plenary 7: Food Processing to Ensure Food Security: A Regulatory Perspective**
The global world population currently stands at 8 bio and is foreseen to rise to 9 bio in 2050. As a consequence, the demand for nutritious and safe food will continue to rise. Today, food security* is conditioned by political unrest in key geographies, as well as by climate change and its impact on water availability, on pest occurrence, and on the capability of plants to produce food and feed under unforeseen/growing stress. In addition, the need to reduce greenhouse gas emissions and reach zero carbon by the second half of the century will impact the farming practices currently in use, and potentially their qualitative and quantitative outputs. Research on new food processing technologies (e.g., aquaponics, cultivated meat, nutrient recovery from side streams) is crucial to ensure access to safe and nutritious food for a fast-growing world population. Reduction of food losses throughout the supply chain, enabled by food processing, can also play a crucial role in terms of food security. Given the scale of the challenge, new governmental policies should consider agile regulatory frames authorizing safe and nutritious novel food offerings, prepared through novel processing technologies. An agile regulatory approval process would support food business operators in shifting towards new technologies that could help solving increasing food security challenges.	

11:45 – 12:30 GMT+8

Panel Discussion: Collaborating to build a more an innovative and sustainable world to Feed 9 Billion (the future)

Moderator: John CHENG, Founder & Managing Director, Innovate 360

Panel Speakers:

- Eugene Toh, Director of the Agri-tech Division, Enterprise Singapore
- Hazel Khoo, Executive Director, Singapore Institute of Food and Biotechnology Innovation (SIFBI), A*STAR
- Deborah Koh, Director, Industry Development & Community Partnership, Singapore Food Agency
- Ed Alejandrino, CEO Kalsangi Pte. Ltd
- Gautam Godhwani, Managing Partner, Good Startup
- Sandhya Sriram, Group CEO and Co-founder, Shiok Meats

12:30 – 13:30 GMT+8

IUFoST World Congress Day 4 - 3 Nov 2022 (Thu)

Closing Ceremony – Competition Award Presentation and Handing Over Ceremony to 22nd IUFoST World Congress of Food Science & Technology Host Country - ITALY

13:30 – 15:30 GMT+8

IUFoST General Assembly

14:00 – 17:00 GMT+8 Technical Tours