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CONFERENCE ABSTRACTS

Role of the human gut microbiome in digestive health and beyond

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The gastrointestinal microbiome influence both health and disease in numerous ways and most certainly, there are significant opportunities to improve health by encouraging the development of a healthy gut microbiome. Over the years, there have been many attempts to modify the composition of the gut microbiome through modifying diets or by including probiotics into the diet by way of food or dietary supplements.
In the past decade, we have seen a growing interest in using probiotics to improve digestive and immune health, as the results of numerous clinical studies suggest that probiotics have a role in reducing the severity of common digestive symptoms including constipation, as well as the prevalence and severity of certain communicable diseases such as respiratory infections.
Most recently, published studies on a few probiotic strains, including *Bifidobacterium lactis* 420™ and *Lactobacillus rhamnosus* HN001™, suggest that these strains may have a role in management of non-communicable diseases. This presentation will review the results of several recent clinical studies, which suggest that probiotics may help in reducing the prevalence of diabetes and other conditions of the metabolic syndrome, all rising concerns globally and especially in ASEAN.

Probiotics and health: Personalising nutrition approaches

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The last decade has witnessed the growth of evidence that probiotics may exert beneficial effects for extra-intestinal infectious and non-infectious conditions, including respiratory and uro-genital symptoms, allergy and eczema and potentially mental health. With the advent of sequencing technology, our understanding of the microbiome promises to revolutionise the use of probiotics. While microbiome diversity has long been associated with health outcomes, the ability to identify the presence (or absence) at the strain level means that the promise of personalising probiotic supplementation may soon be a reality. This talk will examine current evidence for the use of probiotics, what we understand of the microbiota and current work being undertaken as part of Aussie Gut™ to personalise probiotic supplements in athletic populations and in obesity and allergy.

Next generation prebiotics to enhance functional food efficacy

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Molecular constituents of food are transformed and/or sequestered during the digestive process. A fraction of these molecules interact with microbes that assemble into communities along the length of the human gastrointestinal tract. These interactions often guide the function of microbial communities, referred to as microbiomes, to the benefit of their human host. As a consequence, indigestible prebiotic fibers have been developed to direct microbiome structure and function through nutrition. Microbiome-active prebiotics potentiate interconnected host-microbial physiological networks to promote metabolic homeostasis among other benefits. The Sela Lab investigates human milk oligosaccharides (HMOs) and their interactions with microbiota that colonize the infant gut. This research line represents an effort to best understand infant nutrition in context of their microbial commensals. Therefore, nutritional innovations could leverage this co-evolved relationship between mother, infant, and the milk that feeds both the infant and its microbiome. In addition, understanding the molecular linkages between human milk and microbiota of the infant may explicate fundamental nutritional features present at other stages of development. The latest research on understanding HMO interactions at the bacterial population level will be presented. Moreover, non-milk oligosaccharides are currently investigated to identify molecular species that mimic HMO prebiotic properties. This includes cranberry cell wall xyloglucans that could provide an additional option to modulate the gut microbiome to enhance human health.

Dietary intake of oxidized lipids exacerbates colon inflammation and colon cancer through activation of Toll-like receptor 4 (TLR4)

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In the last century, there has been a dramatic increase of dietary consumption of unsaturated lipids in United States, mainly in the form of linoleic acid (LA, 18:2ω-6)-rich vegetable oils. Unsaturated lipids are known to be chemically unstable and highly prone to lipid peroxidation during food processing, storage, and consumption. However, to date, the effects of oxidized lipids on human health are not well understood. Our recent studies showed that compared with un-oxidized lipids, dietary intake of oxidized lipids, even at relatively low oxidaitve status, promoted progression of colon inflammation and associated colon cancer in mouse models. The pro-coitis and pro-colon cancer effects of oxidized lipids were abolished in Toll-like receptor 4 (TLR4)-knockout mice, suggesting that oxidized lipids promote colon inflammation and colon cancer through TLR4-dependent mechanisms. We futher found that the formation of 4-hydroxynonenal (4-HNE) and similar lipid peroxidation products contributed to the adverse effects of oxidized lipids. Since the oxidized lipids are commonly found in our daily life, our results suggest that the individuals with or prone to colon inflammation (e.g. inflammatory bowel disease) and colon cancer may need to reduce the dietary intake of oxidized lipids.

Food Based Approach to Prevent Gut Inflammation

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Inflammatory bowel diseases (IBD) are on the rise and it is well documented that patients with IBD have a significantly higher risk of colorectal cancer. However, there are currently limited treatment options and it is of great importance to develop strategy to prevent and/or treat IBD. The purpose of this study was to determine the effects of cranberry products on the development of colitis. Cranberries (*Vaccinum macrocarpon*) are rich in bioactive compounds, such as antioxidants and fiber, and cranberry bioactives were previously reported to alleviate inflammatory and immune responses, however, knowledge how cranberries elicit its effect on IBD is rather limited. Thus, to determine the effects of cranberry on IBD we tested cranberry products, extracts and dried whole cranberries in a dextran sulphate sodium (DSS)-induced colitis mice model. Both cranberry extract and dried whole cranberries-fed groups had a reduced disease activity index, where as dried whole cranberries were more effective in preventing colitis than cranberry extract. Other markers of IBD, such as the shortening of colon length, colonic myeloperoxidase activity, and the production of pro-inflammatory cytokines, were decreased in animals fed dried whole cranberries compared to the control. The current results suggest that cranberries, particularly cranberry fiber components, effectively prevented the development of IBD, further suggesting the potential use of cranberries for the prevention of IBD.

Characteristics of Soluble Polysaccharides from Seaweeds and Their Influence to Gut Health

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Seaweeds are categorized in three major groups based on their dominant pigmentation: red, brown, and green. They are utilized mainly in two ways; direct intake after boiling (e.g. as soup or salad) or polysaccharide extraction (soluble dietary fibers). Red seaweeds are the main source for the extraction of gelling agents such as agar, carrageenan and alginate. Based on FAO-FISH STAT, 1,000-1,300 million tons wet weight of seaweeds are harvested worldwide per year. Among that, the world seaweed production from aquaculture increased more than twice within the last ten years, especially red seaweeds cultivation. Polysaccharides from seaweeds have different characteristics in comparison to land plant polysaccharides, such as e.g. pectin. Seaweed polysaccharides, such as fucan, fucoidan, galactan sulfate, carrageenan , xylomannan sulfate, alginate, fucoxanthin, or porphyrin, frequently are including acidic sugars. These water soluble polysaccharides are known to have various effects on intestinal health. In the 1980's, the content and composition of polysaccharides and their differences by species, location, and season were reported. Some of these polysaccharides were further reported to clean up the gut by increasing the fecal volume. In the 1990's, polysaccharides were reported to bind intestinal bile acids and to disturb their reabsorption in the liver, reducing cholesterol levels both in liver and blood, demonstrating that the lipid metabolism is affected by soluble polysaccharides in the gut.
Already in the late 1980's some researchers discussed gradual changes of the intestinal microflora by continuous intake of soluble polysaccharides, but different animal models showed diverse degrees of adaptation to these nutritional components. This variability always needs to be kept in mind when

discussing health-promoting effects of soluble polysaccharides in the human intestine. In addition, solubilized polysaccharide amounts differ between whole and refined seaweed, and it is evident that digestion of polysaccharide derived from whole seaweed or refined ones cause clearly different effects on gut condition. In case of whole seaweed as food, seaweed includes not only soluble polysaccharides, but also color pigments (polyphenols) and other health-promoting compounds. The extraction ration of soluble polysaccharides during the intestinal passage is in this case usually lower than taking extracted/refined soluble polysaccharides directly. Current research showed positive effects of half-digested or lower molecular weight soluble polysaccharides for intestinal health, e.g. lower incidence of colon cancer or inflammations, and an improved microflora. Recent reports further revealed that fermentation of seaweeds changed the characteristics of soluble polysaccharides.
Combination studies with resistant starch and fermentation trials of seaweeds are currently a fertile research area, especially experiments with in vitro simulation and animal models.

Food-grade Delivery System to Improve the Bioavailability of Hydrophobic Nutraceuticals

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There is a growing interest for consumers to obtain health benefits from nutraceuticals instead of medicine. However, many bioactive compounds such as curcumin, polyunsaturated fatty acids, β-carotene and some vitamins have low water solubility, hence low bioavailability. Delivery systems such as nanoemulsion, nanoparticles, liposomes are therefore applied to encapsulate these hydrophobic nutraceuticals to improve solubility and increase the amount that reach small intestine. After reaching the small intestine, nutraceuticals along with delivery system will be transported into the enterocyte by different pathways. The nutraceuticals will be incorporated into chylomicron by disassembly/re-assembly and then be transported to other parts of the body through lymph circulation. Fluorescent probes for these nutraceuticals are usually developed to track the distribution inside biological tissue and better understand the transport mechanism. The fluorescent probes can be formed by chemical synthesis or direct reaction depending on the type of the nutraceutical. For example, a fluorescent probe for detecting polymethoxyflonve (PMF) in cell culture and mouse tissue was developed by suing 2-Aminoethoxydiphenly borate. The uptake of PMF nanoparticle inside Caco-2 cell was visualized with a fluorescent microscope. In conclusion, food-grade delivery system can be used to improve the bioavailability of hydrophobic nutraceuticals. In addition, with the application of fluorescent detection method, the underlying mechanism associated with nutraceutical uptake and transport can be further elucidated.

Gut microbiota-mediated biotransformation of food components: The key for their health-promoting effects

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There are several important barrier mechanisms in human body that limit the bioavailability and bioactivity of orally ingested xenobiotics including bioactive food components (also know as nutraceuticals), therefore minimize their potential adverse effects. Among these mechanisms, first-pass metabolism (biotransformation) plays a critical role in dictating the metabolic fate of ingested nutraceuticals in the human body. In general, biotransformation can effectively decrease bioavailability and bioactivities of nutraceuticals. However, in certain cases, nutraceuticals can be activated by biotransformation and become more bioavailable and bioactive. In this talk, the latest findings on the role of gut microbiota in the biotransformation of important nutraceuticals such as curcumin, resveratrol, and pterostilbene will be summarized, and its important impact on the beneficial effects of these nutraceuticals will also be presented.

Gastrointestinal fate of polymethoxyflavones and its role in cancer chemoprevention

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Polymethoxyflavones (PMFs) are a unique class of flavonoids specially found in citrus fruits. Studies have shown that PMFs exhibit numerous biological activities including anti-carcinogenic and anti-inflammatory effects. Gastrointestinal fate of dietary components played critical roles in their biological functions. We have investigated the gastrointestinal fate of representative citrus PMFs in both rats and mice. Our results showed that orally administered PMFs underwent extensive demethylation reaction by phase I metabolism followed by conjugation reactions (mainly sulfation and glucuronidation) during phase II metabolism in the stomach and small intestine. The conjugated metabolites were then deconjugated to produce various phase I metabolite via the action of gut microbiota in the colon. We have identified more than 20 novel colonic metabolites of PMFs, and their biological effects were characterized both *in vitro* and *in vivo*. Our results demonstrated that the colonic metabolites of PMFs contributed significantly to the in vivo anti-inflammatory and anti-cancer effects of orally administered PMFs in both mice and rats.

Stability and changes of phytochemical nutrients under oxidative stress

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The stability of phytochemical nutrients in foods changes differently under diverse oxidative stress. In this presentation, effects of singlet oxygen oxidation and thermal oxidation on the changes of phytochemicals were discussed. Foods under light irradiation can undergo photosensitized oxidation, which accelerates the detrimental effects on the sensory quality and nutritional values of foods. Riboflavin (RF) and chlorophylls, which are well known photosensitizers in foods, can generate singlet oxygen from triplet oxygen. Photosensitization induces volatile formation in milk, changes of isoflavone in soybean products, and changes of phenolic compounds. Also ways to protect antioxidative compounds using core/shell collagen structure in deep-fat frying were introduced.
Riboflavin photosensitization significantly affects the stability of isoflavones in model and soymilk. 3'-Hydroxyldaidzein and 2 dimers of daidzein were formed from RF photosensitized daidzein. *p*-Coumaric acid and vanillic acid under RF photosensitization showed increases in ferric ion reducing ability and radical scavenging activity of DPPH whereas other phenolic compounds including caffeic acid, chlorogenic acid, trolox, quercetin, curcumin, and resveratrol did not. Hydroxy coumaric acid and conjugated hydroxyl coumaric and coumaric acids were tentatively identified compounds from *p*-coumaric acid under RF photosensitization. Oxidative stability in bulk oil was significantly enhanced by added collagen mesh structure or collagen core/shell complex with α-tocopherol compared to that in control bulk oils ($p<0.05$). Enhancing stability of antioxidative compounds against oxidative stress is an important and practical strategy to increase shelf-life and beneficial functionality in foods.

Measurement and application of antioxidants for shelf-life extension of foods

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To extend the shelf-life of foods, synthetic and natural antioxidants are added to prevent lipid, protein and flavor oxidative deterioration. There have been reports of screening for potential antioxidants for food applications. Unfortunately, the information obtained from conventional antioxidant assays are usually not relevant to what is observed in real food matrices. This talk will cover the performance of several currently developed antioxidant assays and their extended application to understand how localization of radicals and antioxidants in food matrices influences global lipid oxidation. In addition, the current status of antioxidant application in Thailand's market, and future trends in developing commercial natural antioxidants will be discussed.

Biopolymer Microgels: Design, Fabrication and Utilization as Delivery Systems in Foods

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Biopolymer microgels have considerable potential for their ability to encapsulate, protect, and release bioactive components, such as vitamins, nutraceuticals, enzymes, and antimicrobials. Biopolymer microgels consists of small particles (typically 100 nm to 1000 μm) whose interior consists of a three-dimensional network of cross-linked biopolymer molecules that traps a considerable amount of solvent. Biopolymer microgels are typically prepared using a two-step process involving particle formation and particle gelation. This presentation reviews the design, fabrication and utilization of biopolymer microgels as delivery systems in foods. The major constituents and fabrication methods that can be used to prepare microgels are discussed. The most important characteristics of microgel particles that can be designed to alter their functional attributes are reviewed (such as size, shape, structure, composition, and electrical properties). Finally, recent examples of the utilization of biopolymer microgels to encapsulate, protect, or release bioactive agents is given.

Fabrication and Application of Biopolymer Particles for Delivery of Bioactive Components

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Different types of colloidal delivery systems such as polysaccharide-based hydrogel beads, nanoemulsions, nanoparticles and liposomes have been utilized to encapsulate and protect bioactive components. Among these delivery systems, the micro/nanoparticles exhibited better performance in enhancing the functional properties (water solubility, stability to environmental stresses and oral bioavailability) of bioactive compounds due to the unique particle size and surface characteristics. The micro/nanoparticles are mainly fabricated from food-grade biopolymers, such as proteins and polysaccharides. And Individual biopolymer micro/nanoparticles have been applied as ideal delivery vehicles for many bioactive compounds such as polyphenols and flavone in food industry. Although individual biopolymer micro/nanoparticles have many advantages, their applications are limited due to poor physical stability during storage and lower encapsulation efficiency. Therefore, a variety of fabrication methods are involved in the formation of composite micro/nanoparticles. For water-soluble biopolymers (proteins and polysaccharides), there exist two types of covalent and non-covalent composite micro/nanoparticles. Covalent composite micro/nanoparticles are usually generated through free radical grafting, phenolic oxidation, Maillard reactions, or enzyme-catalyzed reactions, while non-covalent composite micro/nanoparticles are mainly formed by the self-assemblying methods according to the mechanism of non-covalent interactions including hydrophobic effects and electrostatic attraction. For ethanol-soluble biopolymers, anti-solvent precipitation method (ASP) is utilized to prepare prolamin-based micro/nanoparticles with a core-shell structure. Prolamin-based composite micro/nanoparticles are fabricated through the method of anti-solvent co-precipitation (ASCP), which is different from ASP. Therefore, we mainly introduce fabrication methods of biopolymer micro/nanoparticles, highlight their applications and describe the challenges for future research.

Harnessing Optical Luminescent Techniques to Enhance Food Quality, Stability and Safety

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The use of luminescent compounds and optical luminescent techniques in food science and engineering applications has been mostly limited to: 1) assessing food composition (e.g., quantification of vitamins), 2) detecting specific contaminants (e.g., aflatoxins) or, more recently, 3) authenticating specific foods (e.g., luminescence fingerprinting of olive oil). However, recent systematic study of the environmental sensitivities of lumiphores relevant to foods and their basic photophysical properties has significantly expanded the use and applicability of specific luminescent compounds and optical techniques in food research and development. Optical lumiphores can be operationalized as intrinsic and safe luminescent probes of important properties in foods. The effective characterization and interpretation of the luminescent signals from GRAS chromophores can be used to relate the complex spectral parameters of optical emission from a probe to specific molecular properties of the food and, thus, can expand the repertoire of analytical techniques available to monitor quality, stability, bioavailability and safety. This presentation will cover recent advances in optical luminescence techniques including the development and applicability of optical sensors of food quality and safety, the utilization of intrinsic and extrinsic luminescent probes to follow important technological processes such as formation and stability of delivery systems.

Structural changes of potentially harmful substances in meat products during *in vitro* human digestion

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The objective of this study was to determine the structural changes in such potential mutagenic and carcinogenic substances in meat and meat products during *in vitro* human digestion in the presence of enterobacteria. The levels of heterocyclic amines (HCAs), nitrite, and *N*-nitrosodiethylamine (NDEA) in cooked pork patties decreased gradually during *in vitro* human digestion. These compounds were reduced dramatically after large intestine digestion with *E. coli* and *L. sakei*. Cooked pork patties containing HCAs showed higher mutagenicity compared with that in the other pork patties. However, the mutagenicity of all cooked patties decreased during *in vitro* human digestion. The amount of residual sodium nitrite was influenced by starter cultures in fermented sausage before *in vitro* human digestion. Among six different treatments, T1 containing *P. acidilactici* and T2 containing *P. pentosaceus* & *S. carnosus* starter cultures resulted in the lowest residual nitrite concentrations in fermented sausage. The concentrations of residual sodium nitrite in fermented sausage were significantly decreased during stomach digestion. Enterobacteria *E. coli* and/or *L. casei* then dramatically reduced the concentrations of residual sodium nitrite during large intestine digestion. Some microbial strains can reduce the amount of residual sodium nitrite, especially *Pediococcus* strains and *S. carnosus* which showed the highest ability in reducing the amount of residual sodium nitrite when they were used as starter cultures for fermenting sausages. The tyramine (biogenic amine) concentration in fermented sausage was not significantly changed until small intestinal digestion, and was increased after large intestine digestion. The presence of *E. coli* and *L. casei* in large intestine

digestion dramatically increased the tyramine concentration. This may be due to decarboxylation of amino acids by *E. coli* and *L. casei* growth during *in vitro* human digestion. The results of these studies indicate that the amount of potentially harmful substances in meat and meat products, and their toxicity can be decreased during human digestion but not biogenic amine.

Improving the Sustainability of Food Proteins: Novel Sources and Combinatorial Approaches

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The global population is slated to reach the 10 billion mark by 2050, which will put a substantial pressure on the global food supply system. Hence, food research must focus on the discovery and use of new raw materials, and a more efficient use of existing supplies to ensure food security. In particular, there is a need to fractionate and structure plant or microbial-derived food proteins to supplement the available supply of highly functional animal-derived proteins. In this talk, we will present research results that illustrate issues and potential solutions to fractionating proteins from e.g. microalgae species or plants. Recent work on forming colloidal protein – polysaccharide and protein – protein aggregates to serve as a structural basis for further downstream processes will be shown, offering opportunities to overcome existing functionality deficits of alternative proteins. Finally, a chemical approach to improve technofunctionality of alternative proteins, namely a glycoprotein conjugate formation via electrospinning, will be discussed.

Antimicrobial delivery systems

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Delivery systems for natural and potent antimicrobials allow for stabilization and reduction of off-flavors and potential astringency/bitterness. My lab group has been working in collaboration with Dr. McClements and Weiss on the development of delivery systems based upon emulsions, nanoemulsions and micelles have been evaluated for antimicrobial effectiveness in a variety of systems. While different antimicrobials vary in effectiveness, the composition of the delivery system greatly influences antimicrobial efficiency. The level of antimicrobial efficiency can vary greatly depending upon surfactant type, droplet charge essential oil concentration in relation to carrier oil, carrier oil composition, and pH of the system. It is essential to optimize delivery system to each food system to assure maximum antimicrobial activity.

Surface-enhanced Raman spectroscopy for food safety applications

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Our food system can be contaminated intentionally and unintentionally by many agents, such as bacteria, pesticides, and engineered nanomaterials as emerging food contaminates. Early-on detection of these contaminants in food system is critically important to keep our food safe. Currently, all three types of contaminants use different detection methods, which all have limitations in terms of speed and cost-effectiveness. Surface enhanced Raman spectroscopy (SERS) is perhaps the only technique that has been explored for detecting all classes of contaminants. SERS combined Raman spectroscopy and nanotechnology. The uses of certain nanostructure can enhance the inherently weak Raman signal tremendously, which advances the technique from characterization to detection. Various SERS based methods, especially the imaging based methods, have been developed for rapid detection of bacteria, pesticides, and silver and titanium dioxide nanoparticles in complex food matrices. The capability of ultra-sensitive, in situ, real time, and on-site fingerprint acquisition is a highlight for this technique.

Emerging Foodborne Pathogens: Topics and Techniques

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Prior to 1999, foodborne viruses received relatively little focus. Since then, foodborne viruses, including human norovirus, have been recognized as the leading cause of foodborne illness globally—inflicting a considerable public health and economic burden. Despite recent focus and breakthroughs, multiple challenges in understanding, detecting, and controlling foodborne viruses still exist. The inability to efficiently and cheaply concentrate viruses; lack of robust, rapid, and portable detection methods; and lack of broadly effective antivirals are a few of these extant challenges. This presentation will discuss work that has been performed and will be performed to address these complicated issues. Methods for efficient, cheap bacterial capture of viruses from complex samples will be discussed. Efforts in development of a method that allows for lab-in-a-suitcase detection of viruses in under 30 minutes without an electrical grid will be presented. Additionally, a project focused on portable whole genome sequencing of virus to allow real-time outbreak tracing and attribution will be discussed; which has potential to allow for mobile response to outbreaks in restaurant/production facility settings. Finally, development of novel alternative therapeutic reagents targeting an under-investigated viral protein crucial for replication will be discussed.