Abstracts catalogue

Department of Food and Biotechnology
School of Chemistry, UNAM

13 & 14 May 2024

RAGE against the AGEs: unmasking the expression profile of RAGE and its functionality in the context of inflammation

Glycation of human serum albumin impairs its scavenging properties against amyloid-β

It takes guts to BBB: using sustainable omega-3 rich oils to improve gut-brain health

An innovative iron source for human consumption

Improving plant-based meat analogues by evaluating their effect on human health

The adsorption, encapsulation, and release of Rhodamine B in protein microgels

Sporopollenin exine capsules in multiphase systems

Unraveling the drivers of protein-flavour interaction

Muscle proteomics towards molecular understanding of texture, colour, water-holding biochemistry in broiler meat

Electrostatic spray drying of whey protein isolate (WPI) lactose dispersion and its comparison with conventional spray drying

Heating affects protein digestion of skimmed goat milk proteins with different casein: whey ratios under simulated infant conditions

Effect of thermal and non-thermal treatments and in vitro digestion on the loss of immunologically active proteins and allergy-protective capacity of milk

Variation in composition and functionality of goat milk casein

Monitoring black beans (*Phaseolus vulgaris*) in-vitro digestion and colonic fermentation by non-invasive, continuous VOCs monitoring

Double-coated nanoliposomes improve the bioavailability of flavanone hesperetin

The fate of alkylresorcinols in human gastrointestinal tract: bioavailability, microbial metabolism and bioactivity

Animal-free milk protein: development of a secretory system for bovine casein

Cell-based materials for future food

Maillard reaction for enhancing flavour of future food products

How dynamic juiciness perception of plant-based meat analogues and beef patties relates to food and bolus properties

The effect of the eating rate on food and energy intake

The influence of serum release and juiciness on in vivo aroma release and perception of plant-based meat analogues

Influence of oral food breakdown on gut metabolites of carbohydrate dietary fiber

Kocuria rhizophila: an unexpected high protease-producer from Cotija cheese production

Enterococci, phylogenetics and biotechnological applications

Development of a plant-based probiotic beverage designed for cancer-stricken patients

Effect of Alache broth (*Anoda cristata*) in a murine model with obesity

A new molecular strategy for the identification of honey plants from the Northwest of Yucatán, Mexico

Prenatal exposure to Bisphenol A as a risk factor for infant neurodevelopment

Effect of foodborne Emerging Contaminants on neuron cells

Use of extrusion in the preparation of meat analogues based on plant proteins

Valorization of tomato peel and seeds as sources of polyphenols: Evaluation of the performance of different extraction strategies

The art of synthesizing microbial levans: physicochemical examination

1H-NMR metabolomics with chemometrics for detection of Mexican *Apis Mellifera* honey adulterations

1-H NMR-based metabolomics, an emerging field in wine research

Unveiling the neurochemical basis of taste preferences: glutamatergic and catecholaminergic signaling within the insular cortex

Cluster: Food Science and Health

RAGE against the AGEs: unmasking the expression profile of RAGE and its functionality in the context of inflammation

Fleur Jansen

Advanced Glycation end products (AGEs) is the umbrella term for a heterogeneous group of compounds being formed when free amino groups of proteins react with reducing sugars in the presence of heat. The formation of these compounds is irreversible and mainly occurs on the side chains of lysine and arginine. Endogenous formation of AGEs throughout life has been linked to many age-related diseases, such as neurodegenerative and cardiovascular diseases. One of the hypothesized underlying mechanisms for this relationship is AGEs promoting inflammation through the receptor for advanced glycation end products (RAGE). This hypothesis is however highly debated and in vitro studies investigating the pro-inflammatory effects of AGEs hardly consider to show functionality of this receptor in their model system. We characterized the expression of RAGE in multiple immortalized human cell lines and concluded that the receptor is mainly expressed intracellularly. Accordingly, we developed a model based on the differentiation of primary human monocytes to translocate RAGE to the cell surface and used this model to show its function related to inflammation using recombinant HMGB1, a well-known RAGE agonist.

Cluster: Food Science and Health

Glycation of human serum albumin impairs its scavenging properties against amyloid-β

Marialena Chrysanthou

Protein glycation is a posttranslational modification occurring when amino acids of proteins or peptides react with sugars. Such modifications can affect the structure and function of the protein. Human serum albumin (HSA) is a ubiquitous protein within the body that is prone to glycation. One of the roles of HSA is to scavenge amyloid-β, preventing it from forming amyloid-β aggregates. Accumulation of amyloid-β aggregates in the brain is a condition observed in Alzheimer's disease patients. Amyloid-β aggregates can be toxic to the surrounding tissue, creating a pro-inflammatory environment in the brain. In addition, a higher ratio of glycated/non-glycated albumin has been found in patients with Alzheimer's disease. Therefore, our study aimed to understand how glycation of HSA modifies its preventive effects against amyloid-β aggregation and subsequent induced inflammation in human microglial cells. Compared to native protein, glycated HSA inhibited amyloid-β aggregation less effectively. In addition, when microglial cells were exposed to a mixture of amyloid-β with native albumin, cytokine secretion was reduced, as opposed to a mixture of amyloid-β with glycated albumin. In conclusion, glycation modifies the structural and biochemical properties of albumin, and these alterations may contribute to the progression of Alzheimer's disease.

Cluster: Food Science and Health

It takes guts to BBB: using sustainable omega-3 rich oils to improve gut-brain health

Daniëlle Wessels

The goal of the PhD research is to improve the market perspective of sustainable microalgae-derived omega-3 rich oils, by demonstrating their health benefits. Omega-3 from fish oil, especially DHA, has previously been described to have health benefits on several aspects, such as the brain and immune system, mainly due to its anti-inflammatory properties. Recently, algae-oil rich in omega-3 has been proposed as a possible sustainable alternative for fish oil, but differs in its chemical properties. Moreover, research is currently lacking on its uptake as well as on its health benefits. For this reason, we are investigating the bioavailability and health benefits of omega-3 rich algae oils from different companies. We started chemically characterizing the oils to investigate their composition. Also, we use an in vitro digestion model to study the absorbability of the oils. Later in the PhD, the oils will be investigated within in vitro and in vivo gut, immune, and brain models to confirm their health benefits as seen in omega-3 rich fish oil and to link bioavailability to bioactivity properties.

Cluster: Food Science and Health

An innovative iron source for human consumption

Tomer First

Iron deficiency is the most common micronutrient deficiency amongst humans. The prevalence of iron deficiency, alongside the lack of sustainable iron sources calls for alternatives. Recent studies have proposed edible insects as a valuable source of iron, showing high iron concentration and iron bioavailability. It is hypothesized that the high bioavailability of insect-based iron is due to the iron-binding protein complex entoferritin. However, there are currently no studies that examine entoferritin of edible insects. This project aims to add a novel ferritin purification link to the insect for food production chain, leading to a new and sustainable ferritin-based iron supplement for human consumption. This aim will be accomplished by developing and evaluating the steps needed to create a ferritin-based iron supplement derived from edible insects, through up-scalable and sustainable methods. Additionally, the project is aimed to provide fundamental knowledge and insights of edible insect ferritin, contributing to the advancement of edible insects as an iron source.

Cluster: Food Science and Health

Improving plant-based meat analogues by evaluating their effect on human health

Jolien de Boer

Plant-based meat analogues (PBMAs) have found their way into human diets as a result of sustainability and health awareness. However, the impact of PBMAs on human health remains relatively unknown, hindering the provision of dietary recommendations. Health- and environmental-related benefits can be gained by evaluating the PBMA processing conditions and their effect on nutritional parameters. Herewith, this research aims to increase the knowledge of the health benefits of commercial PBMAs and determine the impact of processing on key health aspects of lab-made PBMAs without compromising sustainability. This will be achieved by evaluating the process-induced contaminants (e.g., N-nitrosamines, advanced glycation end-products (AGEs), and protein oxidation products), ingredient digestibility and uptake, and the interaction with the gut microbiota of commercial and lab-made PBMAs, produced by extrusion and high-temperature shear cell (HTSC) technology. Moreover, linear programming will be used to determine how the PBMA nutritional demands can be met within planetary boundaries. Hereby, the trade-off between nutrient profile and environmental impact will be evaluated. Based on the obtained information, health-driven rules (e.g., on protein quality and fibres) for the next generation of PBMAs will be defined without compromising sustainability.

Cluster: Food Design

The adsorption, encapsulation, and release of Rhodamine B in protein microgels

Keqing Hu

A new nanocomposite protein microgel based on high-density lipoprotein was fabricated via crosslinking protein using Au3+ ions as a crosslinker. The microgel shows an acceptable and effective adsorption ability toward Rhodamine B (Rho B). Besides, the microgels are crosslinked entities that can be used as carriers to deliver and release drugs at the point-of-need in the body. The effect of the initial concentration, pH of Rho B solution, and temperature on the adsorption capacity of protein microgels was investigated. Several adsorption isotherms were tested to explore the process of the adsorption of Rho on the microgel particles. The microgels' encapsulation and release of small molecules (Rho B) were investigated as a model for drug encapsulation and release mechanisms. The results showed the dependent of adsorption capacity on the initial concentration, pH of the Rho B solution, and temperature and their optimum values were determined. The adsorption mechanism was based on multilayer adsorption, and an adsorption capacity of 288 mg/g was obtained. The present study presented acceptable adsorbing capability and adsorption capacity. The results for adsorption, encapsulation, and release of Rho B on the protein microgels showed its wide range of applicability, especially potential application in wastewater treatment systems and drug delivery systems.

Cluster: Food Design

Sporopollenin exine capsules in multiphase systems

Diana Sotoaguilar

Plant spores transport the genetic material of plants for reproduction and are composed of an inner cellulose layer (intine) and an outer sporopollenin layer (exine). By a harsh acid extraction protocol, the core components of the spores are removed, leaving just the exine layer, a protein-free hollow intact microcapsule, also known as sporopollenin exine capsule (SpECs). This study explores the potential of utilizing SpECs from Lycopodium clavatum spores in all-aqueous (water-in-water) emulsions and capillary suspensions. SpECs were tested for their ability to stabilize the interface in dextran (Dex) and polyethylene glycol (PEG) all-aqueous emulsions. The stability of the emulsion phase was attributed to a Pickering-type stabilization mechanism, possible formation of SpEC rafts at the interface, and the physical hinderance to droplets coalescence by the SpECs that remained suspended in the continuous PEG phase. Additionally, SpECs are utilized in the study of capillary suspensions, which are ternary systems involving liquid-liquid-solid phases. Results demonstrated that with a gradual increase in the volume of the secondary fluid, SpECs create diverse network structures, ranging from dimers and trimers until the formation of a particle network that spans the entire sample. This leads to significant changes in the rheological properties of the suspension. The research highlights SpECs as valuable natural constituents in the design of novel materials with tailored rheological properties, particularly applicable in biomedical and food industries.

Cluster: Food Design

Unraveling the drivers of protein-flavour interaction

Cristina Barallat Pérez

Food flavorings are added to many food products to enhance their overall flavor experience. Flavor sensory perception is strongly mediated by the flavour-matrix interaction. Multiple ingredients in the food system such as proteins will interact with added aroma molecules. Hydrophobic interactions, hydrogen bonds, van der Waals, ionic/electrostatic forces, and covalent bonds are the primary protein-flavor interactions. Protein-flavor binding delays the release of the aroma compounds into the headspace. This quenches the flavour perception affecting the final quality of food and consumer appreciation. By quantifying the flavor release from different plant protein solutions and aroma substances it is possible to define the main drivers at a molecular level involved in the binding mechanism and comprehend the repercussions of flavor retention on the dynamics of in-vivo aroma release. These interactions are assessed and measured following a multidisciplinary approach combining mathematical tools (mathematical and molecular models), analytical in vitro and in vivo techniques such as GC-MS and PTR-MS, next to sensory evaluation (TI and CATA). Thus, a complete picture of the binding mechanism can be obtained. This information may help food developers expand the use of alternative commercial food plant-based protein isolates in flavored protein-based systems (e.g., meat and dairy alternatives) by tailoring flavor compositions.

Cluster: Food Design

Muscle proteomics towards molecular understanding of texture, colour, water-holding biochemistry in broiler meat

Seren Yigitturk

Poultry meat is projected to constitute 47% of the protein consumed globally from meat sources and is the primary driver of growth in animal protein production. The physiological and metabolic functions of the animals are influenced by many factors such as extensive husbandry practices, with consequent impact on the animal welfare and intrinsic quality of the broiler meat. However, to what extent the extensiveness of animal husbandry affects intrinsic meat quality and animal welfare still needs to be confirmed. This study, which is part of the EU-funded H2020- FNR-05 mEATquality project, aims to elucidate texture, colour and water-holding biochemistry in chicken meat and clarify the function of proteomics biomarkers in the complex molecular pathways of muscle-to-meat conversion. We hypothesize that animal welfare linked to extensification factors such as genetics, diet, space availability and environmental enrichment changes the proteome of Pectoralis major, leading to differences in broiler meat quality. Meat texture, colour and water holding capacity were measured as related to the intrinsic quality traits: pH, drip loss, cooking loss and thaw loss. For Pectoralis major muscle proteomics, the method of Protein Aggregation Capture (PAC) on magnetic microparticles was used. Protein quantification was performed using the label-free quantification (LFQ) method. Feather corticosterone levels were measured as indicators of the animal's stress/welfare. We propose that changes in animal welfare would change the dynamics of the protein interactions in muscle, leading to differences in light scattering, water-holding capacity and texture on broiler breast meat.

Cluster: Food Design

Electrostatic spray drying of whey protein isolate (WPI) lactose dispersion and its comparison with conventional spray drying

Doll Chutani

This study explored the effect of electrostatic spray drying on whey protein isolate (WPI) lactose dispersions manufactured at lower drying temperatures than conventional spray drying and its effect on protein stability. A dispersion of WPI and lactose was dried by either conventional spray drying or electrostatic spray drying with charge (ESD). The powders were then characterized using differential scanning calorimetry (DSC), X-ray photoelectron spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR) and scanning electron microscopy (SEM). Conventional spray drying of the WPI lactose dispersion at an inlet temperature of 90°C failed to generate dry powders due to poor drying efficiency; electrostatic spray drying at the same temperature with charge enabled the formation of powder with satisfactory moisture contents. In the conventional process, much higher inlet conditions (170 °C) were required to produce powders with similar moisture contents. Protein denaturation from the DSC shows that ESD led to better protein stability during drying as compared to the samples spray dried with conventional method. Secondary structural analysis by FTIR also shows promising results in terms of better physical stability of whey proteins. Surface protein coverage of ESD powders was higher than conventional powders, either because of attraction between charged proteins and the electrode, or, differences in protein conformation altering the diffusion of protein to the surface during drying. Overall, ESD shows promise as a low temperature drying method for the preservation of heat sensitive components. Further work is planned to determine if this can be applied to premium human nutrition products.

Cluster: Dairy Science and Technology

Heating affects protein digestion of skimmed goat milk proteins with different casein: whey ratios under simulated infant conditions

Qing Ren

Goat milk is increasingly used for infant formula (IF) production. To more closely mimic the composition of human milk, the goat IF products with 40% casein and 60% whey protein are developed. This research aims to compare effects of heating on the digestion of goat milk proteins in skimmed goat milk model systems with different casein-to-whey protein ratios. Whey protein concentrates were added to skimmed goat milk (80% casein, C80 sample) to make a 40% casein sample (C40 sample). Digestion were compared in both supernatant and clot parts. Heating at 65°C showed limited influence on digestibility of proteins in both model systems. Based on the soluble protein level in the supernatant, the C80 sample was more stable during 85°C heating compared to the C40 sample. After heating at 85°C for 30 minutes, the digestibility of proteins in the supernatant of C40 and C80 samples was increased. This heating also increased the digestibility of the gastric clot of C80 sample, but resulted in more undigested whey protein aggregates in C40 sample. Heated samples showed higher number of small peptides than unheated samples, especially for C80 samples. Comparing the C80 and C40 sample, the proteins in the supernatant of C80 samples showed a higher digestibility than those in the supernatant of C40 samples, both in non-heated and in 85°C heated samples. C40 samples always showed higher number of small peptides than C80 samples, which may indicate proteolysis of C40 samples proceeded further. More information about bioactive peptides will be shared during the presentation. The clots of C40 samples showed a relatively higher digestion rate of casein than C80 samples clots, which may be due to their higher water content and looser microstructure. Overall, this study showed that heating induced different digestion kinetics of goat milk preparations with different casein-to-whey ratios.

Cluster: Dairy Science and Technology

Effect of thermal and non-thermal treatments and in vitro digestion on the loss of immunologically active proteins and allergy-protective capacity of milk

Siwei Li

Consumption of raw cow's milk and untreated mother's own milk has been reported to protect children from developing asthma, allergies, and respiratory infections because of the presence of immunologically active proteins, like IgG and lactoferrin. Thermal treatments induce a loss of protection because most immunologically active proteins are heat-sensitive. Non-thermal treatments (e.g., Ultraviolet-C (UV-C) and nano-PEF) play an important role in protecting immunologically active proteins and may therefore possibly decrease the loss of allergy-protective capacity of human and bovine milk, while the mechanism of this remains unclear. Our study aims to compare the loss of immunologically active whey proteins in human and bovine milk after non-thermal treatments, exploring the digestibility of these immunologically active whey proteins with an infant in vitro digestion model, and evaluating the loss of allergy-protective capacity of these milk by in vivo experiments in an OVA-sensitized mouse model. This research would help improve milk production processes to retain immunological benefits in processing human and bovine milk.

Variation in composition and functionality of goat milk casein

Swantje Breunig

In both, cow and goat milk, 80% of proteins are caseins which are assembled in a micelle. These casein micelles are very important in dairy processes. Structural and compositional variations of these caseins can influence the micelle structure and thus also techno-functional as well as product properties of milk. Even though goat and cow's milk are quite similar on a macronutrient level, they exhibit differences in their casein fraction. Furthermore, the caseins can exhibit a large variation between individual goats due to a genetic polymorphism. Additional heterogeneity arises from posttranslational modifications (PTMs) of casein, such as the phosphorylation level and the degree of glycosylation. All these differences can affect the techno-functional properties of goat milk. However, compared to bovine milk a clear understanding of the differences in casein composition and how this affects casein micelles and techno-functional properties of goat milk is missing. This knowledge is necessary to better predict and design the processing of goat milk products. In the first part of the study the aims is to investigate variation in casein composition (genetic variations, PTMs, casein ration) and salt composition, and how this links to differences in micelles size and in 234 Dutch goats. In the second part, this research is focusing on the investigation of selected functional properties (e.g. coagulation behavior) and linking this to differences in casein composition and micelle structure between goats, or in comparison to caseins from cow milk.

Cluster: Food Digestion and Health

Monitoring black beans (*Phaseolus vulgaris*) in-vitro digestion and colonic fermentation by non-invasive, continuous VOCs monitoring

Andrea Dell'Olio

In Western countries, the increased prevalence of gastrointestinal illnesses such as inflammatory bowel disease, colon cancer, obesity, and diabetes are posing a significant health burden. To address this issue, a full understanding of the gut microbiota is required. This knowledge is critical for developing effective ways for manipulating the microbiota and reducing the likelihood of metabolic disorders. The microbial volatile organic compounds (mVOCs) generated during intestinal fermentation play an important role in host-microbe interactions. There is current evidence that frequent consumption of certain sub-classes of highly fermentable dietary fibers results in microflora and gut-associated immune system modulation due to the production of certain gut microbiota metabolites (GMMs), such as short-chain fatty acids (SCFAs). Due to the enormous throughput of molecules produced by the gut microbiota, in recent times, the research has been focused on findings new key molecules such as SCFAs that can play a pleiotropic role. In this study, the mVOCs produced during the fermentation of black beans, a high-fiber high-protein model food, was investigated. An automated, non-invasive, solid-phase micro-extraction (SPME) sampling coupled with gas chromatography-mass spectrometry (GC-MS) was applied to increase the analytical throughput of the experiment. The anaerobic in vitro fermentation was monitored every 4 hours for 24 hours. The digested material was fermented by three healthy fecal donors to measure inter-individual variability. Furthermore, simulations of ascending and descending colonic conditions were investigated to understand the influence of the colonic regions. To identify and select the most relevant mVOCs, longitudinal multivariate time series analysis, such as empirical Bayes statistics (MEBA) and repeated measures ASCA+ were used. We detected 156 VOCs, with unique clustering patterns between substrates, donors, and colon segments. Interestingly we assessed an increased prevalence of sulphur-containing compounds in samples from the descending compartment. Furthermore, unique patterns were observed between fermentation substrates and individual donors. Overall, the results highlight how the same dietary substrate can provide diverse metabolic profiles based on the starting microbial populations, potentially leading to distinct impacts on the host.

Cluster: Food Digestion and Health

Double-coated nanoliposomes improve the bioavailability of flavanone hesperetin

Xiangnan Meng

Nanoliposomes (NL) are a promising delivery systems. However, NL are quickly broken down under physiological conditions and this leads to the leakage of encapsulated compounds. Hesperetin (HST) is a flavanone with antioxidant, anti-inflammation, and anticancer potential, but its bioavailability and stability is poor. The objective of the current study was to increase the bioavailability of HST using different delivery systems such as maltodextrin (MD), β-cyclodextrin (CD), and nanoliposomes coated with different biopolymers chitosan and carrageenan. These capsules underwent in vitro digestion and Caco-2 Transwell models were used to investigate cellular absorption. The chitosan and carrageenan conjugated-nanoliposomes retained 76 % of the administered HST, whereas delivery systems such as MD and CD retained 30% and 66%, respectively. The capsule with chitosan and carrageenan showed the highest HST transfer rate through the intestinal epithelium transporting 9 ng after 6 hours, exhibiting a threefold increase compared to free HST. The strategy of designing polysaccharide coated nanoliposomes can be an interesting tool for the delivery of drugs to the small intestine and can improve their transepithelial transport.

Cluster: Food Digestion and Health

The fate of alkylresorcinols in human gastrointestinal tract: bioavailability, microbial metabolism and bioactivity

Obaid Ul Hassan

Alkylresorcinols (ARs) are present in the outer portion of cereals. They may contribute to the health effects of wheat or rye bran diet as they have been reported to have antioxidant, anti-neoplastic and cholesterol lowering effects in the human body. However, the mechanism of ARs absorption through intestine and microbial metabolism in human body is not known. So, the main aim of this research is to clarify some of the aspects relative to the fate of ARs in the human body including bioaccessibility, absorption mechanism, microbial metabolism in the small and large intestine and anti-inflammatory activity. Rye bran will be used as a starting material and processed in several ways to check the effect on bioaccessibility and behaviour during digestion by using the in vitro harmonized INFOGEST protocol. Intestinal organoids (IOs) will be developed to assess ARs absorption and the exact mechanism of absorption. In vitro batch fermentation will be employed to study the microbial metabolism of ARs in the small and the large intestine, using ileum effluents and faecal sample as inoculum respectively. ARs microbial metabolites will be identified by HPLC-QTOF-MS. An acute intervention study will be carried out with human volunteers to further validate the findings of the in vitro studies and to characterize the pharmacokinetics of ARs in the human body. Lastly, ARs anti-inflammatory effect will be investigated using IOs combined with immune cells. Inflammation will be induced by using cytokines and then pro-inflammatory markers (IL-1β & IL-6) will be quantified using ELIZA kits.

Cluster: Future Food

Animal-free milk protein: development of a secretory system for bovine casein

Laura Iaria

Dairy production has a large impact on the environment: cheese has one of the highest amounts of greenhouse gas emission and land use among protein rich food products. Consequently, the demand for animal-free alternatives to dairy products is raising. Precision fermentation of milk protein is a promising way to address this issue. Four types of casein, that in milk form colloidal casein micelles, represent approximately the 80% of protein fraction in bovine milk: αs1-casein, αs2-casein, βcasein and κ-casein. These proteins have post-translational modifications (PTMs) like phosphorylation and glycosylation (this latter just for κ-casein), which are a critical factor in micelle formation and stability. The aim of this project is to express and secrete the four casein in a suitable microorganism (Pichia pastoris), in order to obtain proteins that have an identical primary structure and similar PTMs as bovine casein. Therefore, the project comprises the genetic engineering of Pichia pastoris to express and secrete recombinant casein, its optimization to increase the product yield, and the purification and characterization of the produced protein.

Cluster: Future Food

Cell-based materials for future food

Lucas Bozzo

Sustainable diets are a crucial element in addressing ongoing climate change and achieving global health and sustainability. Microbial cells grown in bioreactors can serve as an alternative ingredient source. Their cultivation requires less land than conventional crops and possible in any geographical location. However, to make use of microbial biomass as food ingredients economically feasible, we need to adopt a biorefinery approach that valorizes all fractions of the microorganisms. Also, fundamental knowledge on the techno-functional properties of said fractions is essential to use this ingredients effectively in food systems. The project aims to develop a generic approach to convert microbial biomass into techno-functional ingredients. To achieve this goal, we will develop a process to recover functional fractions from disrupted microbial cells obtained from microalgae, bacteria, yeast, and filamentous fungi. By precisely controlling the disruption of various microbial cells using bead milling, it will be possible to establish relationships between cell ultrastructure, its disruption and the consequent composition and techno-functional properties of the recovered material. Furthermore, the techno-functionality of (fractionated) biomass fractions from different organisms will be studied individually and in systems representing food products. This will enable us to define a set of principles for the application of disrupted cells as structuring ingredients in food systems. Ultimately, the generated knowledge will contribute towards the expansion and implementation of microbial cells as alternative sustainable sources of ingredients in food products.

Cluster: Future Food

Maillard reaction for enhancing flavour of future food products

Bei Wang

Producing food from sustainable alternatives to the current production has been identified as a promising solution of feeding an increasingly world population. However, food technologists face significant challenges in achieving products with flavour characteristics comparable to their conventional counterparts. The Maillard reaction is a promising avenue in the sustainable food industry, offering opportunities for enhanced flavour and sustainable improvements in food production. However, due to the complexity of real food products, there is a need to develop a model system that can accurately capture the complex interactions between the Maillard reaction and food matrices and extrusion technology will be employed to establish the system. This research will investigate the potential of the Maillard reaction to prepare target volatile compounds in a complex food systems. The current project aims at (1) producing the flavour in situ by using common ingredients and processing conditions to reduce or eliminate the use of exogenous flavours to simulate flavour; and (2) contributing to the enhancement of flavour in sustainable products.

Cluster: Food Quality and Consumer Study

How dynamic juiciness perception of plant-based meat analogues and beef patties relates to food and bolus properties

Yifan Zhang

The sensory quality of plant-based meat analogues (PBMAs), particularly their lack of juiciness, limits wider consumer acceptance. This study aimed to determine the food and bolus properties that drive juiciness and texture perception of PBMAs and beef patties. PBMAs and beef patties were cooked to three core temperatures (60, 70, and 80°C) to obtain samples differing in juiciness from the same raw materials. Dynamic sensory perception was quantified using Temporal Check-All-That-Apply (TCATA) (n = 65). PBMAs and beef patties were characterized for cooking loss, composition, texture properties, serum release under compression, and serum composition. Expectorated boli (n = 10) were collected at 33, 66, and 100% of mastication time, and characterized for composition, saliva uptake, serum properties, texture properties and bolus particle size and number. For PBMAs and beef patties, juiciness intensity increased significantly with decreasing core temperature. Juiciness was perceived during the initial stages of the mastication process, with citation proportions typically peaking after 17-26% mastication time and then decreasing strongly until swallowing. Over 75% of serum was released from the PBMAs and beef patties into the oral cavity during the initial stages of mastication (< 33% mastication time). Further mastication until swallowing led to an additional breakdown of the patties into significantly more and smaller bolus particles. Saliva uptake and bolus texture properties were significantly influenced by mastication time but not by patty juiciness. With increasing juiciness, beef patties were perceived as fattier, softer and less chewy, whereas juiciness of PBMAs did not significantly impact these texture sensations. Juiciness intensity was strongly correlated with food properties, with juicier PBMAs and beef patties being associated with lower cooking loss, mor e serum released during compression, and higher water content in released serum. We conclude that (a) juiciness perception of plant-based meat analogues and beef patties is driven by the serum release during very early stages of mastication, and (b) juiciness perception is linked more strongly to food properties than bolus and oral breakdown properties.

Cluster: Food Quality and Consumer Study

The effect of the eating rate on food and energy intake

Lise A.J. Heuven

Consumption of industrially processed foods has been associated with obesity and related adverse health outcomes. Yet it is unknown what properties of industrially processed foods drive this association. Extensive research has shown that foods that can be consumed more quickly, lead to higher food intakes and this has been suggested as one of the ways in which processed foods promote excess in calorie intakes. The primary objective of this study is to determine the effect of eating rate (ER) of ultra-processed food diets (UPF fast ER vs UPF slow ER) on ad libitum energy intake across a two week period. The secondary objectives are to determine intake on the level of the meal, day, week and study period and to compare body composition and metabolic changes. We will conduct a randomized controlled cross-over trial to examine the effects of a 14-day ad libitum ultra-processed slow eating rate (UPFslow) diet versus a 14-days ad libitum ultra-processed fast eating rate diet (UPFfast) on ad libitum energy intake. Eating rate of the diets will be manipulated through food texture. The study will have a run-in period to determine habitual dietary habits (baseline) and a washout period in between the two treatments to prevent carry-over effects. All participants will receive both treatments and are their own control (within participant design). 39 healthy, non-smoking, Dutch adults between 25-50 years old and with a BMI between 21-27 kg/m2 will be included.

Cluster: Food Quality and Consumer Study

The influence of serum release and juiciness on in vivo aroma release and perception of plant-based meat analogues

Rutger Brouwer

A better understanding of the influence of structure, composition, and physicochemical properties of plant-based meat analogues (PBMAs) on the eating process and the oral structural breakdown during consumption can be used to enhance sensory perception and consumer acceptance. In vivo aroma release and perception during food oral processing of plant-based meat analogues has not been explored yet. The objective of this study was to determine how serum release and juiciness of PBMAs affect in vivo aroma release and perception. Burger patties were made from PBMA mince and spiked with menthone (0.01 w/w%, Mw = 154 g/mol, log P = 2.7). Internal cooking temperature (60, 70, and 90°C) of the PBMAs was varied during preparation. A naive consumer panel (n=99) evaluated all PBMAs using Rate-All-That-Apply methodology. As internal cooking temperature decreased from 90 to 60°C, the serum release under compression and juiciness intensity of PBMAs significantly ($p<0.05$) increased. With increasing juiciness of PBMAs, fattiness increased, while dryness decreased significantly ($p<0.05$).

In vivo nose space Proton Transfer Reaction Mass Spectrometry was used to monitor the release of menthone over time while simultaneously perceived aroma intensity was quantified using Time-Intensity (n=13, triplicate). In vivo menthone release and peppermint perception during mastication was affected by serum release and juiciness suggesting that increased serum release increased aroma release and perception. We conclude that serum release and juiciness of plant-based meat analogues impact in vivo aroma release and perception.

Cluster: Food Quality and Consumer Study

Influence of oral food breakdown on gut metabolites of carbohydrate dietary fiber

Zhen Liu

Food oral processing is the initial stage of the digestion process, during which food structures are broken down and lubricated with saliva to form a bolus that is subsequently swallowed and then digested in the gastrointestinal tract. An expanding body of literature indicated that oral processing significantly influences the digestion of food products and therefore plays an important role in determining the nutritional benefits of food. However, its further influence on the gut microbiome and metabolites has not been studied. The aim of this study is to explore the relationship between oral food breakdown with gastrointestinal digestion and gut fermentation. Possible health effects of different chewing behaviors will be discussed through gut microbiome metabolites during fecal batch fermentation. The results of this study will contribute to the development of dietary recommendations and interventions aimed at optimizing gut fermentation for improved gut health and disease prevention.

Department of Food and Biotechnology, School of Chemistry, UNAM

Kocuria rhizophila: an unexpected high protease-producer from Cotija cheese production

Marco André Navarrete T.,
Maricarmen Quirasco Baruch

K. rhizophila is a Gram-positive coccus that is catalase- and coagulase-negative. It is found in various environments, including the rhizosphere, fermented meat, and dairy products, and rarely in drug-resistant infections. Our team isolated *K. rhizophila* from milk used to make Cotija cheese in the mountains of Michoacan and Jalisco. Surprisingly, it was found to be a fast-growing and highly proteolytic strain. Although classified as non-predominant during cheese ripening, it remained unclear whether any of its traits might be of biotechnological interest. The results demonstrate its susceptibility to antibiotics of varying degrees of concern and its lack of apparent antagonistic effects on food-borne pathogens. However, the proteolytic activity of this strain remains the most interesting due to its slight study and potential applications in various industries, particularly in food processing. The enzyme has been identified as a single alkaline serine protease with an unusually high molecular weight. It is calcium-dependent and thermally stable up to 42 °C. Proteases like these have the potential to shorten the maturation time of fermented dairy and soy-based foods, as well as prevent chill haze, and ensure colour and head stability in winemaking and brewing.

Department of Food and Biotechnology, School of Chemistry, UNAM

Enterococci, phylogenetics and biotechnological applications

Daniel Alejandro Acero Pimentel,
Maricarmen Quirasco Baruch

The genus *Enterococcus* is present ubiquitously in many habitats, including the gastrointestinal tract microbiota, water, soil, and many naturally fermented foods produced worldwide, such as cheese, sausages, and fermented vegetables, where they play a significant role in the development of odours and flavours. However, they can also be found in hospital settings, and may harbour multiple virulence and resistance elements, such as vancomycin resistance, which is of high epidemiologic relevance. Therefore, they are classified as opportunistic pathogens, and are not classified as GRAS (Generally Recognized As Safe). This situation has hindered the potential biotechnological applications of the genus regarding their role as probiotics and their capability of proteolysis, lipolysis, and production of antimicrobial agents. In the present research project, we aimed to establish the genomic similarities and differences between five pathogenic and five food *Enterococcus faecium* strains by comparative genomics. We found that the former share more epidemiologically relevant elements between themselves than with food strains, and vice versa, and as such, are phylogenetically distant from one another. Additionally, the strain QD-2, isolated from a Mexican ripened cheese, produces two novel class II bacteriocins with activity against *Listeria monocytogenes*, which could be helpful in food safety.

Department of Food and Biotechnology, School of Chemistry, UNAM

Development of a plant-based probiotic beverage designed for cancer-stricken patients

Yalith Arancibia, Gerardo Portillo, Amelia Farrés

Cancer is one of the leading causes of death, even if novel therapies have made it almost a chronic disease. Some of these treatments can have serious side effects and provoke malnutrition and a debilitating condition for patients. In some cases, especially in breast cancer, milk or milk-based supplements are not recommended because of inflammatory effects and hormonal content. Therefore, this work aims to develop a nutritional supplement high in protein and low glycemic index, containing probiotic strains we previously showed had an antiproliferative effect on breast cancer and prostate cell lines (Sierra, 2021), probably due to polysaccharides (Di et al., 2017; Wang et al., 2022). These are *Lacticaseibacillus casei*, *L. rhamnosus* and *Lactobacillus helveticus*. All the strains tolerated high levels of common antineoplastics (Ruiz Amelco, 2013). Amaranth was selected as the primary protein ingredient, but pea protein was used to achieve the required protein level. Inoculum size was determined to achieve the recommended dose, and amylase was used to achieve the desired viscosity.

Di, W., Zhang, L., Wang, S., Yi, H., Han, X., Fan, R., & Zhang, Y. (2017). P Carbohydrate Polymers 171,307-315. https://doi.org/10.1016/j.carbpol.2017.03.018
Ruiz Amelco, M., 2013. Food Chemistry Thesis
Sierra, E. 2021. M. Sc. Thesis, UNAM
Wang, X., Xu, M., Xu, D., Ma, K., Zhang, C., Wang, G., Dong, M., & Li, W. (2022). Carbohydrate Polymers, 296, 119971. https://doi.org/10.1016/j.carbpol.2022.119971

Department of Food and Biotechnology, School of Chemistry, UNAM

Effect of Alache broth (*Anoda cristata*) in a murine model with obesity

Aurea Raquel González Macías, Marisol Rivera Hernández, Isabel Gracia Mora, María Amanda Gálvez Mariscal

Neglected Underutilized Species (NUS) are plants not in the list of main crops, being wild or semiwild species that feed small communities. Their use includes the traditional knowledge transmitted over generations. These species represent a remedy for overexploited lands and protection for the world´s biodiversity. *Anoda cristata*, known as Alache in some regions, is a native Mexican plant, used as vegetable when their leaves are tender; alaches show a mucilage, extracted when the leaves are boiled in a broth soup, recommended as a nutritive dish, especially for those with specific disorders such as diabetes. Currently, Mexican population faces obesity as an important health issue with concomitant complications such as cardiovascular disease, type 2 diabetes and others.

The aim of this work was to test the mucilage on a murine model fed on a high-fat diet, drinking sugared water, with high blood sugar, compared with a group treated with metformin. Blood biochemistry, histology and urine analyses were performed. The conclusion was that the viscous broth of the traditional alaches soup was able to control glucose levels in animals fed on a high-fat diet plus sugared water, similar to the group treated with metformin, and was able to keep other biochemical parameters in normal levels.

Department of Food and Biotechnology, School of Chemistry, UNAM

A new molecular strategy for the identification of honey plants from the Northwest of Yucatán, Mexico

Catalina Villagómez Garfias, Julia Aidé Pineda Hernández, Cindy Estrada Hernández, Amanda Gálvez Mariscal

Yucatan Peninsula is the main beekeeping region of Mexico. The endemic flora provides nectar and pollen for European and native bees. Yucatan honey is valued for its aroma, flavor and medicinal properties. Melissopalynological analysis requires specialized taxonomic knowledge and involves long time. Molecular techniques such as barcoding, based on amplification, sequencing and analysis of conserved genetic regions, are relevant as auxiliary methods for the characterization of the local pollen found in honey samples, although it is necessary to enrich the databases. Therefore, the goal of this research was to generate molecular barcodes of the Yucatan honey flora where *Melipona beecheii* forages.

Molecular barcodes were generated from herbarium and field specimens. Four molecular markers were tested. Taxonomic identification was confirmed by phylogenetic reconstruction. Molecular barcodes were generated for 17 plant species: *Bursera simaruba, Viguiera dentata, Piscidia piscipula, Turbina corymbosa, Gymnopodium floribundum, Erythroxylum areolatum, Croton reflexifolius, Lysiloma latisiliquum, Caesalpinia yucatanensis, Caesalpinia gaumeri, Lonchocarpus longistylus, Lonchocarpus yucatanensis, Alseis yucatanensis, Metopium brownei, Thouinia paucidentata, Cordia dodecandra* and *Thrinax radiata*. The barcodes showed different levels of resolution: *rbc*L and *trn*H-psbA identified family or genera, *ITS*2 and *mat*K resolved up to genera or species.

We contributed 70 sequences uploaded to BOLD SYSTEM, the international database safeguarding barcode sequences, and identified which markers exhibit better resolution for each plant species.

Department of Food and Biotechnology, School of Chemistry, UNAM

Prenatal exposure to Bisphenol A as a risk factor for infant neurodevelopment

Ivan Hazel Bello Cortés

In this study we review the epidemiological data to quantitatively characterize the risk for neurodevelopmental disorders among children associated with BPA exposure of pregnant mothers. The odds ratios based on a comprehensive analysis of clinical studies indicate an association between BPA exposure in pregnant mothers and behavioral problems in their children. In male infants an increased risk was associated with BPA exposure during the third trimester of pregnancy. Estimated daily BPA intake values in pregnant mothers were below the safety limits. Therefore, we discuss the need of potential new health regulations to protect the fetal environment and mitigate the risk for neurological disorders among children.

Department of Food and Biotechnology, School of Chemistry, UNAM

Effect of foodborne Emerging Contaminants on neuron cells

Gabriela García Cerón

Autism Spectrum Disorder (ASD) is a neurocognitive disorder characterized by atypical social interaction due to unknown etiology. ASD has been proposed to be associated to redox imbalance in neurons caused by involuntary fetal exposure to Endocrine Disrupting Compounds (EDCs) during pregnancy or early life-stages. EDCs can be found in food. Their origin is diverse (e.g. packaging, irrigation water, etc.) and although they are found in low concentrations (ppm or ppb) they are capable of altering endocrine functions, leading to the production of oxidative stress and causing changes in the ratio of metabolites related to methionine synthase (MS) activity. In the present work, the viability of neuronal cell cultures was evaluated in vitro with the most common EDCs reported in food: phthalates at different concentrations. Cultures were exposed to EDCs in 24 h treatments in order to identify the specific MS activity. As a result, enzymatic activity of MS was significant variation in the increase or decrease of MS activity in comparison to cultures that were not exposed to EDCs or redox regulatory molecules. Our results demonstrate that some endocrine disrupting compounds in food alter significantly the enzymatic activity of MS in neurons, leading to possible changes associated with autism.

Department of Food and Biotechnology, School of Chemistry, UNAM

Use of extrusion in the preparation of meat analogues based on plant proteins

Darianna Ur Mora

The annual per capita meat consumption in 2018 in the Latin American and European regions was 75 kg, while in regions such as North America and Oceania this value exceeds 100 kg, Taking into account that the World Health Organization recommends not exceeding 500 g of meat per week, which is equivalent to 26 kg per year for an adult, it can be seen how the actual consumption of meat far exceeds what is necessary to cover the needs of a healthy person. An alternative way to reduce meat production and consumption numbers consists of the production of meat analogues based on vegetable proteins. This research project aims to develop these analogues. The procedure is based on the texturing of preselected vegetable protein using High Moisture Extrusion Cooking (HMEC) technology, which allows obtaining fibrous protein foods with sensory characteristics comparable to that of meat muscle. Proximal chemical analysis was carried out on the extruded samples using various methodologies to determine the percentage amount of moisture, proteins, fibers, ashes and lipids present in the extrudate, as well as analyzed by Fourier Transform Infrared Spectroscopy and Scanning Electron Microscopy.

Department of Analytical Chemistry, School of Chemistry, UNAM

Valorization of tomato peel and seeds as sources of polyphenols: Evaluation of the performance of different extraction strategies

Jared Mauricio López-Téllez,
María del Pilar Cañizares-Macías

The antioxidant potential of tomato waste, given by polyphenols, is underexploited. Although several extraction processes have been reported, variability in phenolic composition makes necessary to evaluate the performance of the methods. In this work, polyphenol-rich extracts from tomato peel and seeds were obtained by two drying – oven and dehydrator – and four extraction – Soxhlet (SOX), stirring (SE), ultrasounds (US), and microwaves (MW) – processes. The phenolic composition was estimated in terms of total polyphenol and antioxidant capacity indices and concentration of gallic, caffeic, chlorogenic acids, quercetin, and kaempferol. Data were then subjected to principal component analysis to find patterns. Oven-dried extracts increased from 4.16% to 49.05% antioxidant index, gallic and chlorogenic acid, and quercetin than dehydrator-dried ones. Moreover, SE (1 h) showed the highest total antioxidant polyphenols, but individual concentrations were not statistically different in the US (5 min). MW was also fast (20 min) but reduced all phenols by around 30%. SOX (4 h) showed the poorest results with a long extraction time. To sum up, the present study evidences the importance of the extraction method on the quality/quantity of polyphenols in tomato by-product extracts, proposing new routes for valorization of these wastes through their phenolic composition.

Institute of Biotechnology, UNAM

The art of synthesizing microbial levans: physicochemical examination

Sol Castrejón Carrillo, Agustín López Munguía

Levan, a fascinating homopolymer, is composed by fructose units intricately joined by β-2,6 glycosidic bonds with branching through β-2,1 linkages. It's found in plants, but predominantly in diverse microorganisms, mainly bacteria. It is synthesized by levansucrases (LS), enzymes belonging to the CAZY glycosyl hydrolase family GH68. The source of LS and most importantly, the reaction conditions define the polymer's degree of polymerization, influencing properties like its ability to form biofilms. Levan's biocompatibility, biodegradability, and low toxicity make it a prized asset in biotechnological realms. In the food industry, levan is valued as a soluble fiber, while fructo-oligosaccharides have been shown to function as prebiotics, nurturing *Bifidobacterium* growth among other beneficial species, aiding nutrient absorption, and presenting an array of functional properties ideal for a wide range of food formulations. Some traditional fermented foods such as *Natto* and *Kimchi* in Asia, and *pulque* in Mexico are examples of these claims. *Bs*-SacB, the LS from *Bacillus subtilis*, yields levans of varying molecular weights. We have demonstrated how *Bs*-SacB synthesize high molecular weight polymers in a processive manner, forming microgel-like structures, or low molecular weight nanoparticles through a non-processive mechanism. Our research aims to unravel how this enzyme modulates the molecular weight of synthesized levan, possibly through protein-protein interactions.

Institute of Chemistry, UNAM

1H-NMR metabolomics with chemometrics for detection of Mexican *Apis Mellifera* honey adulterations

Andrea Mier y Teran

Honey is a natural product produced by bees from plant nectar or honeydew. It comprises mainly carbohydrates, proteins, amino acids, organic acids, vitamins, flavonoids, and minerals. Honey has a complex composition due to its botanical and geographical origin. Nowadays Mexico is the ninth greatest producer of honey in the world; unfortunately, the production is not enough to satisfy the high demand for this product leading to a growing occurrence of adulterated honey. To increase the production of honey, adulterations can be directly or indirectly with cheap sweeteners such as corn syrup, high fructose corn syrup, cane sugar syrup and inverted sugar syrup. In certain cases, honey is combined with water or apple cider vinegar to create a sour taste and odor of honey produced by Trigona and Melipona bees. The aim of this project is to develop a methodology using ^{1}H-NMR metabolomics with chemometrics to establish the metabolic profile differences of directly and indirectly adulterated *Apis Mellifera* honey with the most common adulterants used in Mexico. In addition to developing a protocol for the assessment of honey adulterations.

Institute of Chemistry, UNAM

1-H NMR-based metabolomics, an emerging field in wine research

Circe C. Hernández-Espino.
Nuria Esturau Escofet

Nuclear magnetic resonance (NMR) spectroscopy is a technique that allows the analysis of multiple compounds, such as organic acids, amino acids, sugars, etc, in the same sample without extensive preparation steps, making it a key tool in metabolomic studies. The NMR spectra of any mixture are complex, with numerous signals, providing qualitative information to compare patterns (fingerprints) or quantitative profiles, involved in metabolic changes. Applications of NMR metabolomic of agri-food products studies include geographical discrimination, among others. The elevated number of samples requires the use of automatic software to reduce analysis time. In quantitative NMR, the goal remains to correctly identify and quantify the metabolites in the spectrum, despite signal overlap. Metabolomic applied into the study of foods, also known as foodomics, is increasing year by year, and the trend will continue to grow in the short and large term. One of the products whose quality is primarily determined by its uniqueness and recognisability is wine, based on grape varieties, origin, and technology, but any food can be analysed.

Cognitive neuroscience, Institute of Cellular Physiology, UNAM

Unveiling the neurochemical basis of taste preferences: glutamatergic and catecholaminergic signaling within the insular cortex

Karla Gabriela Medina-Medina,
F. Bermúdez-Rattoni, D. Osorio-Gómez

Metabolic diseases represent a public health concern, marked by a rising incidence. Despite their broad etiology, the consumption of sugar-rich foods exacerbates their prevalence, so understanding the mechanisms underlying the preference for sweet foods is a strategy for addressing contemporary health challenges. In this regard, we assessed the neurochemical mechanisms within the insular cortex (IC) that underlie the processing of gustatory stimuli and the subsequent positive postingestive effects. Initially, a dose-response curve was conducted in male Wistar rats to establish the glucose dose required to elicit a conditioned taste preference (CTP). Our results indicate that the intraperitoneal (i.p.) administration of glucose at 350 mg/kg induces a long-term CTP. Subsequently, monitoring neurotransmitter release during saccharin intake and i.p. glucose administration revealed that saccharin consumption elicits an elevation of catecholamines, whereas glucose administration leads to an elevation in catecholamines and glutamate levels. Finally, to assess the functional role of these changes in neurotransmitters release during CTP establishment, we administered glutamate, norepinephrine, and dopamine antagonists into the IC either immediately before or 30 minutes after glucose administration. Our results demonstrate that glutamatergic and catecholaminergic signaling within the IC plays an important role in CTP acquisition, while glutamate- and dopamine- receptor activity is related to CTP consolidation.