Project 1.2 Anti glycation activity of the rapeseed cake a by-product of rapeseed oil extraction
Target: BLT MFT
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Preferred Target: MSc thesis.

Short Description
Advanced glycation end products (AGEs) are formed by non-enzymatic glycation reaction between the carbonyl group of a reducing sugar and the free amino group of a protein. During this reaction, reactive intermediate products including Methylglyoxal (MGO) can be formed. AGEs are also formed in human body, especially in the case of diabetes, inducing oxidative stress and cell apoptosis (Singh et al, 2001).

Rapeseed cake (RSC) is the by-product obtained after pressing the seeds for the oil extraction. It has a high nutritional value as it contains a variety of bioactive compounds including high amounts of protein, crude fibre, phosphorus, calcium, potassium, magnesium, polyphenols, mono-unsaturated fatty acids (MUFA), poly-unsaturated fatty acids (PUFA) and alpha-linoleic acid.

Research questions
• Question 1: Do fiber, proteins and polyphenols extracted from RSC have an antiglycative effect?
• Question 2: Which is the best way to extract the bioactive compounds from RSC?
• Question 3: Which products can be formed?

Proposed approach
The study will be focused on the characterization of the RSC fraction and their potential use as antiglycative agent:
• Different extraction technique will be used: Ultrasounds, microwave, filtration, precipitation, heat treatment.
• Analysis of the phenolic compounds and the antioxidant activity of all the fraction (TPC, ABTS, FRAP, DPPH)
• Analysis of in vitro glycation of BSA by methylglyoxal and glucose and analysis of fructosamine of the selected fraction from RSC.

References
Reactivity of bovine milk oligosaccharides (BMO) in milk model system
Target: BLT MFT

Supervisors
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Preferred Target: MSc thesis.

Short Description
Bovine milk oligosaccharides (BMO), short polymers made of several monosaccharides, exert some beneficial effects, as decoys for pathogenic bacteria and viruses to prevent infection in the neonate. Their use in functionalized milk should face to the chemical reactions occurring during the production process.¹

BMO are a source of reducing carbonyls that can be involved in the reaction pathways influencing the complex network of the Maillard reaction (MR) and as a consequence amino acids and BMO availability.²

Research questions
- Question 1: What is the development of MR in presence of BMO?
- Question 2: Which is the final concentration of BMO in UHT milk model systems?
- Question 3: Which products can be formed?

Proposed approach
- The study will be focused on the characterization of the BMO fraction at the end of the thermal process.
- Different combinations of oligosaccharides will be tested: FOS, GOS, stachiose, BMO.
- Markers of Maillard reaction development such as Amadori compounds and other Maillard reaction end-products (CML, CEL, HMF and blocked lysine) will be measured in order to highlight the underneath behavior of Maillard reactants in these systems.
- Physical properties of the system which can influence consumer perception (turbidity, color, viscosity, etc.) will be assessed.

References
Bioinformatics of edible insect proteins for bioactive peptide production

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With the increasing global population, there is heightened demand for new sources of food macronutrients for human nutrition. Particularly, proteins are a key nutrients of interest and are mostly derived from animal and plant-based sources. Recently, edible insects have attracted global attention as sustainable protein sources, but incorporation into food is yet to be widely accepted especially in the Western society.

In addition to their use as nutrients, proteins have emerged as precursors of specific amino acid fragments known as peptides, which are now known to be bioactive. A wide range of biological properties have been demonstrated with protein-derived bioactive peptides including antihypertensive, immunomodulatory, antimicrobial, antioxidative and other activities. These effects can be relevant in human and animal health promotion, and can also be applied in food preservation for extended shelf life. Despite the prospects, the production of bioactive peptides has relied heavily on the use of food proteins, which further contributes to the depletion of their primary food sources.

In order to circumvent the challenge, this project explores the use of edible insects as sustainable sources of proteins for bioactive peptide production. The project will involve a comprehensive profiling of the major proteins in insects (meal worm *Tenebrio molitor*, or black soldier fly *Hermetia illucens*) with theoretical calculations of the linear structure, conformation and biological significance of peptide motifs released by specific proteases used in industrial and physiological food processing. Bioinformatics will be conducted with open-access web-based tools and will be followed up with wet lab experiments to confirm the structural, surface and biological properties of the insect peptides.

The discovery of competitive edible insect-derived bioactive peptides from this project will offer new ingredients for use in formulating functional food products for health promotion.
Health cooking for healthier vegetables

Target: MFT

Supervisors
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Background
Fruit and vegetable based food products are often characterized in terms of nutritional content. However, it was emphasized that it is (even more) relevant to investigate to what extent the bioactive nutrients present in the food products can be digested and effectively assimilated by the human body in order to eventually reach the target tissues where they can carry out their function. Microstructure of foods or the food matrix plays an important role in the release and absorption of the nutrients and phytochemicals. Grinding, blending and/or heat treatments break the cellular structure of the plants affecting the bioaccessibility of these compounds. Moreover, food matrix that is formed during processing and other components that are taken together with the food affects the kinetics of absorption and kinetics in the digestive system. The degradation of the nutrient matrix complex or transformation to a more active molecular structure may increase the bioaccessibility and, in turn, the bioavailability. Food structure may hinder the bioaccessibility because nutrients are usually either inside the cell or connected to cellular structure. For instance the release of carotenoids from vegetable tissue is due to cell structure disruption by food processing, it does not happen in the digestive system. Therefore, understanding the role of heat processing on food matrix and matrix structuring to increase the nutrient availability is an important area to investigate. Besides that, processing can also affect the vegetable satiating and sensory characteristics since it affects the structure, the texture and the content of water and gas.

Research questions
1) How the processing (cooking) influence the food matrix of vegetables also in mixed meals and the release of nutrients and phytochemicals during an in vitro digestion.
2) Which are the performance of differently processed vegetables in the satiety and acceptability assessed by a human study?

Methodology
As a case-study, carrots will be studied.

Question 1) Carrots will be i. differently cooked (steaming, boiling) ii. differently processed (e.g., blending, extrusion) iii. added with other ingredients such as oil and spice to simulate a mixed meal. The microstructure and the release of carotenoids will be evaluated after a simulated human digestion and compared to raw carrot.

Question 2) Satiety study will be performed comparing sliced steamed carrots dressed with oil will to baked carrot chips prepared with oil in a short-term study using a preload study design.
Macroscopic food structure heterogeneities: bolus properties, oral processing behaviour, sensory perception and liking of composite foods

Target: MFT

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Background
Texture perception is a dynamic process, depending on food properties and oral processing behaviour. The physical properties, bolus properties, oral processing behaviour and sensory perception were studied for many foods, i.e. mayonnaise, bread and biscuits. However, most meals are often combinations of different foods (composite foods) rather than only one food product on its own.

Many foods composed of multiple components have considerably different mechanical properties. This might lead to texture contrast, both within a single bite and within a meal, which is considered to increase liking. However, little is known about the bolus properties, oral processing behaviour and sensory perception of foods displaying mechanical contrast on macroscopic length scales.

Objective
This research aims to study the effect of texture contrast on a macroscopic scale, using composite foods. The effect of composite food properties on bolus properties, oral processing behaviour, dynamic sensory perception and liking will be studied.

Approach
A first approach will be to combine solid/crispy foods with soft foods to form different categories of composite foods, for example French fries with mayonnaise or crackers with cheese spread. The properties of the composite foods will be varied, e.g. the crispness of the solid foods, and the viscosity and fat content of the soft foods. Subjects are asked to process the composite foods in the mouth. The influence of the composite food properties on bolus properties, oral processing behaviour (video recording and/or EMG), sensory perception (TDS or CATA) and liking throughout mastication will be studied.