Food area

MASTER THESIS

Projects

The Master's degree programme in Department of Food Science
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SHORT PROJECT DESCRIPTION

Phenolic compounds in milk are associated with both health benefits and quality of dairy products. They perform a wide range of metabolic activities: antimicrobial, antioxidant, anti-inflammatory, inhibition of platelet aggregation, and immunological functions, participate in the direct protection of DNA and in the promotion of apoptosis, among other activities.

However, quantitative and qualitative changes in the phenolic compounds in milk and dairy products have not been fully elucidated. Indeed, the potential use of phenolic as functional additives has been embraced by most sectors of the food industry, with the notable exception of the dairy industry.

Therefore, the objective of this project is to establish a method based on liquid chromatography-mass spectrometry to determine the concentration of different phenolic compounds in milk and dairy products to contribute to the understanding of milk composition and potential benefits in dairy products.
Alternative colour agents in muscle-based foods

**SHORT PROJECT DESCRIPTION**

Our food preferences and choices are determined by both conscious and unconscious factors. Appearance is one the first and most important attributes that we use to evaluate foods. Consequently, the color of a food item is decisive for how attractive we find a specific food item. For meat products we have a clear expectation that these should have a red or pinkish color dependent on the specific meat product. Often nitrite is used in meat processing to ensure an attractive red/pinkish color. However, a high intake nitrite may exert harmful effects on human health, and there is therefore an interest in alternative agents for color enhancement of meat products.

This project focuses on elucidating the potential development and use of alternative color agents for muscle-based foods. The project could for example involve extraction and characterization of blood-derived proteins (haemoglobin) as color agents.

Metabolomics to elucidate dietary intake and protein status

**SHORT PROJECT DESCRIPTION**

Aging is associated with a decline in muscle mass and strength, which is known as sarcopenia. Sarcopenia does not only impact mobility but also metabolic health. Elderly may have a low dietary protein intake, which can result in loss of muscle mass in the body and augment sarcopenia. It is therefore important to ensure a sufficient protein intake in elderly to ensure a good protein balance. Commonly 24-h questionnaires are used to assess dietary intake.

However, it is well known that the method is associated with some uncertainties and errors caused by incorrect reporting, either consciously or unconsciously. Thus, there is an interest in developing more objective and quantitative measures of food intake. Metabolomics is an explorative approach that aims at covering multiple metabolites rather than few, selected metabolites and thereby provide a more comprehensive fingerprint of the metabolic state of an individual. The fact that metabolomics has the ability to characterize a wide range of metabolites simultaneously means that it is a useful tool for elucidating metabolic response to food intake.

However, only few studies have elucidated the use of metabolomics for dietary assessment in free-living people. In this project focus will be on elucidating the potential of urine metabolomics for validation of 4-day food intake registration of elderly that are enrolled in an intervention study with dietary protein and exercise.
Flavor compounds in protein stocks

SHORT PROJECT DESCRIPTION

Protein stocks prepared from heat treatment of muscle-based raw materials are used for flavor enhancement in food industry, for example in soups and bouillons.

Amino acids, peptides and nucleotides are some of the major compounds that contribute to a unique flavor of these protein stocks. Glutamic acid is for example known for its contribution to umami taste. Recently another basic taste, kukomi, has started to obtain considerable attention. Kukomi provides an attractive mouthfeel and is ascribed to specific tripeptides including glutathione.

In this project it will be investigated how raw material, enzymatic treatment and processing parameters influence the generation of important flavor compounds and how this may be used strategically to mask undesired taste from bitter compounds. The analyses will be based on a combination of nuclear magnetic resonance (NMR) spectroscopy and liquid chromatography mass spectrometry (LC-MS).

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Prenatal programming studied by metabolomics in a porcine model

SHORT PROJECT DESCRIPTION

We inherit more than genes from our parents. It is well established that decreased growth during fetal development, leading to intrauterine growth restriction (IUGR) and consequently low birth weight, has crucial influence on health later in life.

Thus, poor fetal growth increases the risk of developing metabolic disorder, like type 2 diabetes, coronary heart disease, elevated blood pressure, and obesity, in adult life. Such effects have been shown in animal models of IUGR. The term fetal metabolic programming is generally accepted to describe the phenomenon of the long-term effects of a stimulus or insult during fetal development. Nevertheless, even though the impact of fetal metabolic programming on adult health is well documented, the underlying mechanisms are poorly understood. Metabolomics, which enable to profile numerous metabolites and thereby portray metabolic status, may provide insight into biochemical pathways that are altered during IUGR.

In the present study, metabolomics will be applied on samples collected from a pig-based model of IUGR. The objective is to identify possible mechanisms during fetal development that can couple metabolism during fetal life with later development of the metabolic disorders.
Can the liver taste bitter compounds?

**SHORT PROJECT DESCRIPTION**

Hepatic detoxification is conducted by a series of enzymatic reactions and results in the elimination of drugs and toxic compounds from the body. The rate-limiting step in this process is the reaction carried out by the cytochrome p450 enzymes (CYP). The expression of the CYPs is highly adaptive and controlled by a network of transcription factors. Central in this network is the aryl hydrocarbon receptor (AhR) controlling the expression of the major CYP sub-family CYP1A.

Taste is divided into five basic categories, sensed by taste-specific receptors. Bitter taste is perceived by the TAS2 receptor family and is considered a warning signal of toxic compounds. Interestingly, TAS2 receptors are expressed in extraoral tissue, including the liver and intestine. The function here is only vaguely elucidated and it could be speculated that the perception of bitter tastes here is linked to the detoxification process.

Preliminary data from our lab shows that activation of the AhR by TCDD upregulates the mRNA expression of TAS2R in porcine primary hepatocytes.

This project will investigate at the molecular level, the tissue distribution of TAS2R in pigs and the impact of AhR activation on TAS2R regulation in hepatocytes. The project includes culturing of primary liver cells, analysis of gene (qPCR) and protein expression (e.g. western blotting).

Effects of phytoestrogens on cytochrome p450 in skeletal muscle

**SHORT PROJECT DESCRIPTION**

The female sex hormone, estradiol, is found naturally in the body, while ethinyl estradiol is the synthetic counterpart found in oral contraceptives. Estradiol has been shown to have anabolic effects on skeletal muscles. Estradiol is synthesized from testosterone by the p450 enzyme system in the liver, which also plays an important part in metabolizing both estradiol and ethinyl estradiol into inactive metabolites. Muscle specific p450 enzymes exist, which suggest that skeletal muscle can metabolize the female hormones and may also support the notion of a direct effect of estradiol in skeletal muscle.

Preliminary results from our lab suggest that both estradiol and ethinyl estradiol can regulate cytochrome p450 expression in muscle cells, which may cause its own metabolism to be accelerated. At present, it is unknown if this is also the case for phytoestrogens.

Using an existing skeletal muscle stem cell model growing satellite cells in culture, this project will investigate regulation of p450 in skeletal muscle in the presence of phytoestrogens. The project will include experimental techniques like RT-PCR and western blotting, as well as cell culturing.
Understanding sources of variability of the texture of the yoghurts produced as a function of milk source

**SHORT PROJECT DESCRIPTION**

The research questions of the project is around whether day to day variability of yoghurt texture be correlated to the milk source in terms of cow related primary factors, it could be genotype, cow feed, season, somatic cells or lactation stage. What is minimum (i.e. unavoidable) day to day variability in yoghurt texture? Can the identified relevant parameters be measured routinely, and can the yoghurt texture be predicted (if the identified relevant parameters are known)? The objectives are to identify sources of variability and their relative importance, to provide leads on possible markers and to evaluate the maximum tolerable day to day variability in yoghurt texture if milk quality is held under control (for Chr. Hansen ATC yoghurt productions).

The approach involves:
1. Review literature, processes and raw materials and compile an extensive list of factors influencing the final variability of the yoghurt texture.
2. Use a yoghurt model study set up initially to test effect of selected variability in milk on yoghurt properties.
3. Set up a model yoghurt production (raw materials, model culture, process, etc) and estimate (“measure”) day to day variability using milk powders to reduce variation stemming from raw materials.
4. Produce a number of yoghurt samples from selected experimental milks originating from selected raw milk variabilities. Analyze the results to identify the relevant parameters.
5. Test the hypothesis / validate the model on an unknown sample.

**SHORT PROJECT DESCRIPTION**

The wooden breast phenomenon is an abnormality of the large breast muscle affecting meat quality. The development of wooden breast has been registered already 2 weeks prior to slaughter.

The aim of this project is to follow the development of wooden breast from the chickens are small until the time of slaughter and try to identify biomarkers which at an early stage can indicate if wooden breast is developing. Chickens are reared in houses where the CO2 level is followed in order to investigate a possible impact of the environment on wooden breast development.

The project include gene and protein regulation analysis (real time PCR and western blotting, respectively).
**SHORT PROJECT DESCRIPTION**

Use of natural compounds for washing of carrots to prolong shelf-life

High consumer awareness has led to search for technologies that do not involve chemicals and can be considered natural. Use of natural active compounds from plants and herbs gained recently a lot of attention, due to their antimicrobial, antifungal and antioxidant properties. The aim of the study is to test natural active compounds (e.g., essential oil from thyme or oregano) as sanitizers during washing process and their impact on produce quality and sensory. The quality of carrots is mainly determined by presence of the fungus Thieiavaliopsis basicola and the bacteria Erwinia caratovora. The research project involves development of the washing protocol and evaluation of the impact of different treatments on product quality determined by physical analyses (microscopy, electrolyte leakage), chemical analyses (volatiles, polyacetylenes, sugars), and sensory analysis by expert evaluation. The project also involves artificial inoculation of carrots before HWT to study treatment efficiency. The MSc project is part of the research project ‘KvaliRod’ funded by the Green Development and Demonstration Program. ‘KvaliRod’ is carried out in collaboration with several Danish companies. You will be part of our project group and will interact with our partners. The MSc project can be developed in different directions depending on the interest and background of the student.

Key words: Fresh fruit and vegetables, Process technology, Product quality, Secondary metabolites, Microbiology, Postharvest physiology and biology.

**SHORT PROJECT DESCRIPTION**

Hot water treatment to prolong shelf-life of fresh carrots

Hot water treatment (HWT) has recently gained attention as an eco-friendly technology to reduce food waste; however, there are few studies on the technology. The objective of the research project is to develop a method for HWT of carrots to reduce spoilage of packaged fresh produce in the supply chain caused by the fungus Thieiavaliopsis basicola and the bacteria Erwinia caratovora. The research project involves development of the HWT technology (temperature and time) and studies of the impact of different treatments on product quality determined by physical analyses (microscopy, electrolyte leakage), chemical analyses (volatiles, polyacetylenes, sugars), and sensory analysis by expert evaluation. The project also involves artificial inoculation of carrots before HWT to study treatment efficiency. The MSc project is part of the research project ‘KvaliRod’ funded by the Green Development and Demonstration Program. ‘KvaliRod’ is carried out in collaboration with several Danish companies. You will be part of our project group and will interact with our partners. The MSc project can be developed in different directions depending of the interest and background of the student.

Key words: Fresh fruit and vegetables, Process technology, Product quality, Secondary metabolites, Microbiology, Postharvest physiology and biology.
New process technologies in milk powder production - hydrodynamic and acoustic cavitation

SHORT PROJECT DESCRIPTION

The project will cover the application of cavitation-based technologies in relation to powder production. Cavitation is the sudden formation and collapse of low-pressure bubbles in liquid with the release of an energy wave. Uncontrolled, cavitation can be very destructive to process, but using high intensity ultrasound or hydrodynamic cavitation the destructive force can be controlled and used. There is a potential for use of such technologies as pre-treatment in milk powder production as cavitation events can reduce the viscosity of concentrated milk.

During milk powder production, water is removed by evaporation prior to spray drying. Spray drying at higher solids concentration improves drying efficiency, and reduces the overall energy cost. As the performance of the evaporator prior to spray is limited by viscosity, it is beneficial to reduce feed viscosity. Thus, cavitation-based technology could potential be used as a pre-treatment in milk powder productions. A master thesis project could cover areas such as evaluating the reduction in viscosity, powder quality or microstructure/functionally of yoghurt produced from cavitation treated powders. It is possible to discuss master project ideas in relation to these areas and eventually formulate a specific project within this area based on interest. There are opportunities for participating in pilot plant experiments at the SPX Flow Technology innovation center.

Formation of ice crystals in cheese samples

SHORT PROJECT DESCRIPTION

In order to extend shelf life dairy products, we aim at transporting products as cold as possible. In a specific project we are looking at transporting products at a supercooling temperature, meaning temperatures below 0°C without freezing the products. The benefit of storing products below 0°C is that microbial growth, microbial spoilage and enzymatic degradation is reduced significantly, thereby prolonging the shelf life of the products. However, cooling below 0°C is a major challenge from a microstructural and quality point of view. Formation of ice crystals is detrimental for product microstructure and integrity, thus causing product quality to be compromised. We aim to find the lowest supercooling temperature at which no ice crystals are formed. In other words, we aim at finding the freezing point of specific products. Currently, focus is on different kind of cheeses and we have already looked into several ways of analyzing products to find the freezing point. Techniques include differential scanning calorimetry (DSC) and analyzing freezing curves for products stored at different temperatures. Furthermore, macro- and microstructural changes have been investigated using different imaging techniques. We can have an investigation if other methods (e.g. NMR) might be applicable as well. In this current project we aim to find the effect of both the freezing rate as well as the water distribution in the food matrix on the ice crystal formation. The products that are incorporated in the research are: yellow cheeses, cream cheeses, white cheeses, white mould cheeses and cream.
Milk fat quality and functionality

SHORT PROJECT DESCRIPTION

Already in the feeding and management of the dairy cow the quality of the milk fat is affected. Increasing the milk frequency to 3 times per day increase the milk yield, however several studies have also showed that the concentration of free fatty acids in milk increase. Elevated levels of FFA can result in rancid flavours in dairy products. The mechanism behind the effect of milking frequency is rather unknown. From a farm study, we have collected milk from individual cows, which has been milked both 2x and 3x. In the project, the composition of the milk fat and milk fat globule membrane can be analysed.

Feeding the dairy cow with only grass-based feedstuff provide economically and environmental benefits and additionally create a “healthier” milk composition. The research project “Grass milk” receive milk from herds using such a grass concept. In the project, the composition of the milk fat and milk fat globule membrane can be analysed.

It is possible to discuss master project ideas in relation to these research projects and formulate a specific project within this area based on interest.

Testing a future vegetable

SHORT PROJECT DESCRIPTION

Through traditional breeding, crossing of rapini (Brassica rapa) and a rapeseed (Brassica napus) with white flowers has resulted in the new vegetable colzácoli. The student work will contribute to the testing of the vegetable leading to the final product.

We expect the vegetable to have a distinct taste and a unique profile of secondary metabolites, which is linked to human health.

In the project, you will have the possibility to analyze for plant content of glucosinolates, carotenoids or polyphenols. Depending on when the project starts, an evaluation of the sensory properties (taste) or a shelf life experiment can be carried out as well.

Furthermore, the project gives you the possibility to get insight into a small breeding company and its’ work.
Investigating healthy compounds in green leafy vegetables of white-flower- ing rapeseed

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SHORT PROJECT DESCRIPTION

All Brassica crops such as cabbages contain the potential health-beneficial secondary metabolite glucosinolate, which is furthermore related to the taste of the plant. They also contain other secondary metabolites of relevance to human health such as carotenoids and polyphenols.

The content of secondary metabolites can be modified through growing conditions of the crop e.g. fertilization levels, plant developmental stage at harvest, and temperature, thereby resulting in potentially healthier vegetables.

With this starting point, you have the possibility of collecting data defined by your interests, from a field experiment running in the project. You will learn the basic principles of setting up an experiment, analyze the plant content of a secondary metabolite besides data analysis.

Furthermore, the project gives you the possibility to get insight into a small breeding company and its work.

The master project will be linked to an industrial postdoc project working on new products of green leafy vegetables (salad) developed from white-flowering rapeseeded (Brassica napus) together with the breeding company Knold & Top ApS (www.colza.dk). The company uses the scientific results in their business selling seeds.

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Effect of different UHT technologies on aggregate formation, whey protein denaturation and fat globule modification

SHORT PROJECT DESCRIPTION

The two major UHT technologies used in the dairy industry, indirect and direct heat transfer, differ regarding heating rates and mechanical forces. The fast heating rates in direct UHT processes result in a different whey protein denaturation and aggregation behavior compared to indirect processes which could have functional implications for certain dairy products. On the other side, introducing steam into a liquid product and the vacuum cooling step lead to mechanical stress of the product resulting in increased protein aggregation. The aim of this project is to characterize the aggregate formation of both whey proteins and caseins and to investigate the impact of mechanical stress on protein and fat stability.

Milk will be heat treated at Arla’s pilot UHT plant using steam infusion, steam injection and indirect heating technologies. The heat treatment will be matched to achieve the same heat load on the milk. Optionally pre heat treatment can be varied to achieve different levels of whey protein denaturation and aggregates.

Aggregates will be characterized by particle size measurement and size exclusion chromatography. The nature and composition of the aggregates will be analysed by LC-MS. Fat globule damage and modification will be assessed by particle size measurement and can be supplemented by confocal microscopy.
Influence of different product and sensory profiling methodology factors on the perceived bitterness of beer

**SHORT PROJECT DESCRIPTION**

Beer is an intriguing product, because it is complex and has a wide range of controllable and very specific sensory characteristics depending on its source and brewing basis. Furthermore, some of the flavour and taste components in beer, especially bitterness, are still not identified.

The MSc project will study how different product factors (type of beer; barley, yeast, hops) and sensory profiling methodology factors (type and length of scale, sample presentation and training of panel) influence the perceived bitterness of beers.

The MSc project will be part of a larger project called DNA-shapes (full title: Analysis of Complex Biological Mixtures by A Novel Method: “DNA-Shapes” – A Model for Artificial Taste).

The aim of the project is to endeavour to mimic and potentially gain a more comprehensive understanding of human taste perception by linking DNA-segmentation profiles to ultra-sensitive sensory profiles of complex food mixtures. This requires very sensitive sensory profiling methods in able to measure perception on a molecular level. Therefore, a part of the DNA-shapes project investigates how to optimize key factors in two areas (product and methodology) involved in sensory profiling.

**SHORT PROJECT DESCRIPTION**

The sugar intake especially from beverages is too high among specific segments, e.g. adolescents. The beverage industry has mainly focused on reducing sugar content per se with limited success due to drastic alteration in the sensory profile that are disliked by many.

The goal of the project Innosweet is to apply an integrated scientific-based sensory perceptional-, psychological-, and physiological (PPP) approach to sugar-reduced or -replaced (SRR) beverages enabling lowering the sugar content whilst maintaining unaltered sweetness perception.

You will as a master thesis student in the Innosweet project work on product development of beverages with lower sugar contents but unaltered sweetness perception from a sensory and consumer science perspective. This is going to be done and tested using taste-taste interaction and crossmodal interactions such as flavor-taste and texture-taste interactions. The thesis will include sensory descriptive analysis and consumer studies and you will be part of planning, executing and analyzing data from the studies.

What is crossmodal perception? How information from the different sensory modalities such as sight, sound, touch, smell, and taste, may be integrated by the nervous system and perceived by us. Of importance in this thesis is how different sensory modalities interact with one another and alter each other’s processing.
Sweet product development – sensory perception and acceptance of beverages sweetened with alternative sweeteners

SHORT PROJECT DESCRIPTION

The sugar intake especially from beverages is too high among specific segments, e.g. adolescents. The beverage industry has mainly focused on reducing sugar content per se with limited success due to drastic alteration in the sensory profile that are disliked by many.

One of the goals of the project Innosweet is to test the sensory perception and acceptance of beverages where alternative sweeteners have replaced sugar.

You will as a master thesis student in the Innosweet project work on product development of beverages with alternative sweeteners but unaltered sweetness perception from a sensory and consumer science perspective.

The thesis will include sensory descriptive analysis and consumer studies and you will be part of planning, executing and analyzing data from the studies.

PHYSICAL LOCATION OF THE PROJECT
AU-Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev

PROJECT START
Any time

EXTENT AND TYPE OF PROJECT
45 or 60 ECTS master thesis project

MAIN SUBJECT AREA
Sensory analysis in product development of foods

ADDITIONAL INFORMATION
Co-supervisor Post Doc Line Holler Mielby, LineH.Mielby@agrsci.dk
Ph.D.student Anne Sjørup Bertelsen, Annesbertelsen@food.au.dk

Acceptance of organic, bitter and healthy vegetables in the public food service sector and among consumers

SHORT PROJECT DESCRIPTION

The goal of many public kitchens is to increase the ratio of organic food in their production of meals.

Vegetables, including cabbage and root vegetables, are important ingredients in organic meals.

The student will focus on bitter-tasting vegetables, their applicability and preparation of these vegetables as well as acceptance of these vegetables in a hospital kitchen and vegetable delivery to Årstiderne’s consumers, respectively.

PHYSICAL LOCATION OF THE PROJECT
AU-Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev

PROJECT START
Any time

EXTENT AND TYPE OF PROJECT
45 or 60 ECTS master thesis project

MAIN SUBJECT AREA
Sensory and consumer analysis

ADDITIONAL INFORMATION
Co-supervisor Post Doc Line Holler Mielby, LineH.Mielby@agrsci.dk

Optimizing the method for measuring the satiating capacity of foods

SHORT PROJECT DESCRIPTION
Designing food and beverages that make consumers feel full faster and for longer are one of the top priorities in Danish food industry R&D. Despite the high relevance of optimizing the method to measure the satiating capacity of foods, little work is done in this field.

In this MSc project you will be connected to the OmniSaM project (Omnibus Satiety Metric) which explores satiety from a behavioural, fMRI and endocrine and perspective.

You will work with the method to measure the satiating capacity of foods and its optimization, more specifically; you will test the effectiveness of the method when changing the context of study conductance; natural setting compared to laboratory setting compared to clinical setting.

Ingredients to create beverages with different satiating capacity will be delivered by Arla Foods Ingredients and Arla Foods Armba.

How does a product make you feel? – Sensations experienced after eating

SHORT PROJECT DESCRIPTION
There is an increased focus on healthy products in the food industry and food cultural trends. Researchers and product developers are used to asking consumers why a product is liked, and how much it can contain regarding nutritional content etc. In recent years, this has been supplemented with questions regarding how a product makes you feel, with a shift from a biological perspective to a more holistic and wellbeing perspective.

An area that needs to be addressed more extensively is the sensations experienced as a consequence of eating. In this MSc you will study dynamics in mental- (e.g. desires, motivations and satisfaction) and physical (e.g. stomach rumbling, energy) sensations experienced after intake of meals and products, e.g. with different protein content or other model foods. These sensations are especially relevant for the overall appreciation of the food, for food choice, and for repeated purchase.
**SHORT PROJECT DESCRIPTION**

Food and meals in schools and day cares are not only about securing availability of healthy foods but requires that the context in which the food is eaten supports that children can eat and enjoy their food. At this point, information about the meal setting in schools is limited. In this project the focus is at how the setting can be optimized to facilitate and support healthy eating.

The student will explore factors of importance for facilitating healthy and joyful eating and investigate the effect of changing meal settings on intake, preferences and the eating experience.

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**PHYSICAL LOCATION OF THE PROJECT**

AU-Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev

**PROJECT START**

Any time

**EXTENT AND TYPE OF PROJECT**

45 or 60 ECTS master thesis project

**MAIN SUBJECT AREA**

Sensory and consumer analysis

**ADDITIONAL INFORMATION**

Co-supervisor Post doc Barbara Vad Andersen, barbarav.andersen@food.au.dk

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**SHORT PROJECT DESCRIPTION**

Background:

A variety of different whey protein products are produced by Arla Foods Ingredients (AFI). Our ingredients are sold for pediatric, sport nutrition, medical nutrition, health foods, dairy and bakery. Our mission is “We are here to discover and deliver all the wonders whey can bring to people’s lives”. AFI assisting the food industry to develop and efficiently process more natural, functional and sustainable foods. To achieve this, it would be interesting for AFI to gain more knowledge about the surface properties of whey proteins. Especially foam ability, but emulsifying ability could also be interesting. To replace other emulsifier and stabilizer to achieve more natural foods.

**Aim:**

The aim is to achieve more knowledge about the surface properties of whey proteins. The ability of the whey proteins to lower surface tension and form film / interface (interface rheology). Knowledge of how whey proteins effect foam structure and foam stability, and effect of salts /minerals, lactose, pH and ionic strength on the foam ability of the whey proteins. Additionally, it might be interesting to initiate new analyzes in this area.

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**PHYSICAL LOCATION OF THE PROJECT**

Arla Foods Ingredients, Research & Development, Sønderupvej 26, Nr. Vium, DK-6920 Videbæk og AU-Foulum Biichers Allé 20, DK-8830 Tjele

**PROJECT START**

Any time

**EXTENT AND TYPE OF PROJECT**

60 ECTS master thesis project

**MAIN SUBJECT AREA**

Whey proteins, surface properties, foam/emulsion, structure, stability, protein interactions, implement new analysis

**ADDITIONAL INFORMATION**

Tanja Jæger, Tanjr@arlafoods.com. Tlf. +45 72177732
SHORT PROJECT DESCRIPTION

The project will focus on extraction of protein from alternative sources e.g. seaweed, lucerne or clover (it can be discussed which species to focus on).

Different extraction, precipitation and pretreatments will be investigated in relation to protein yield and quality. In plants and seaweed, the redox enzyme polyphenol oxidase can disturb both yield and quality of protein and therefore inhibition of this particular enzyme will be investigated.

The polyphenol oxidase oxidizes the secondary metabolites called polyphenols resulting in crosslinkages between them and the protein may affect the bioavailability of the extracted protein. Polyphenol are therefore considered as antinutritional factors (ANFs) and the investigation of these can be a focus as well.

Thus, protein chemistry and evaluation of secondary metabolites are investigated in the project.

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PHYSICAL LOCATION OF THE PROJECT
AU-Foulum Blichers Allé 20, DK-8830 Tjele

PROJECT START
August or September 2018

EXTENT AND TYPE OF PROJECT
60 ECTS master thesis project

MAIN SUBJECT AREA
Protein from alternative sources

ADDITIONAL INFORMATION
The project will be aligned with an ongoing project.

SHORT PROJECT DESCRIPTION

The project will cover application of proteomics and/or peptidomics based methods for the characterisation of protein and/or peptide profiles, respectively, in raw or processed foods by combinations of protein chemistry-based techniques. Possibility to link to technological properties and content and distribution of eg minerals.

Currently, I supervise master and PhD projects in the areas of UHT milk, milk from native breeds, digestability of food proteins eg after heat treatments, milk oligosaccharides, fractionation and functional properties of proteins from potato and in quality aspects of different dairy products. This includes quality of UHT products, of lactose-reduced UHT milk and overall characterisation of protein composition of different fractions or dairy products prepared from bovine milk, including raw bovine milk.

Furthermore, we look at milk quality, protein composition, proteolysis and technological properties in relation to cow genetics, genetic variants of milk proteins, somatic cell count and at prolonged lactation. We also look at e.g. calcium content and how different production parameters, treatments and fractionations influence the distribution of calcium in milk and dairy products. It will be possible to discuss master project ideas broadly in relation to these areas and eventually formulate a specific project within these themes and techniques.

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Food compounds and intestinal integrity - a cell model for the small intestine

**SHORT PROJECT DESCRIPTION**

Caco-2 is a human colon epithelial cancer cell line. By growing a monolayer of Caco-2 cells on permeable membranes, the model can be used to mimic the epithelial cell-layer lining the wall of the small intestine. Intervention studies can be made by adding a component of interest on the apical side of the Caco-2 cell monolayer. This could be done in relation to investigate the effect of food compounds on inflammation. An effect of the intervention can be seen by analyzing the Caco-2 monolayer integrity and the cell media on the apical and basolateral sides. At the end of the experiment, the Caco-2 cells can be harvested and protein and gene expression investigated (using e.g. western blotting and RT-PCR).

Different food compounds will be tested in the caco-2 cell model to study cell permeability and integrity. To gain further mechanistic insight, OMICS-techniques can be used on the metabolic and proteomic levels.

The project aim is to:
1) optimize the caco-2 cell monolayer model for obtaining samples for metabolomics and proteomics investigations
2) study the effect of food compounds on monolayer integrity using transepithelial resistance (TEER), trans-epithelia transport of fluorescence dye and RT-PCR to evaluate gene expression.

**Background:**

There is a strong and growing need for proteins for feed and food, which we can culture with low impact on climate - and seaweed may be a future alternative source of protein to fulfill this need. Recently, there has been an increased focus on seaweed, e.g. due to its high content of bioactive components and its climate friendly farming. During spring 2018 we have started off a new project focusing on extraction and characterization of protein from different seaweed species farmed in Denmark. There are two main types of protein in seaweed; the soluble proteins, whereof photosynthesis proteins are the main protein, which is high during summer, and the less soluble storage proteins, which is high during winter, where light exposure is low, due to limited hours of sunlight. To obtain high yield of extracted protein during the whole season we need to extract both the soluble and insoluble fraction of proteins and from this purpose we will introduce the use of different enzymes.

**Aim:**

The aim of the project is to follow the two fractions (soluble and storage protein) over the season and investigate the effect of enzymatic treatment on i) protein yield, ii) solubility, and iii) composition of proteins. You will learn how to extract proteins, how to choose and use enzymes within the enzyme class hydrolases, and to characterize the extracted protein by separation techniques e.g. SDS-PAGE, reverse phase separation and mass spectrometry.

**MAIN SUPERVISOR**

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**ADDITIONAL INFORMATION**

Co-supervisor: Assistant Professor Martin Krøyer Rasmussen
http://pure.au.dk/portal/da/persons/id(c5259478-eeef-4bbd-8dff-462bdefc04e3).html
This project will partner DuPont Nutrition & Health

**EXTRACTION OF SEAWEED PROTEIN - EFFECT OF ENZYMATIC TREATMENT**
# Enzymatic Catalyzed Modification of Natural Yellow Colourant

**SHORT PROJECT DESCRIPTION**

**Background:**
The annatto plant produces a secondary metabolite bixin, which is a natural yellow/orange colorant, in very high quantities compared to other crops producing similar colours. The annatto crop (Bixa orellana L.) is endogenous to South America and can contain above 5% carotenoids in the seeds. This is 100-1000 times the concentration normally found in orange carrots, making *Bixa orellana* a promising production system for such pigments. The major pigments in the annatto plant are cis-bixin (70-80%) and minor constituents are trans-bixin and cis- and trans forms of norbixin. These pigments are used as natural colours in e.g. cheddar cheese and beverage. The problem with these pigments is the high degree of lipophilicity that make them more oil soluble than water-soluble. To be able to use bixin in aqueous food items we recently found that bixin could be enzymatic modified using a commercial available lipase (Jahangiri, submitted manuscript), yielding a novel product with novel properties concerning stability and solubility. We will like to introduce an antioxidant in such a reaction and investigate the stability.

**Aim:**
The project will focus on improving the solubility of natural colours bixin from the Annatto plant by enzymatic treatment using an antioxidant as substrate. Stability of the final product will be tested in heat and light-induced reactions.

## Interaction between Plant and Milk Proteins in Co-Precipitates

**SHORT PROJECT DESCRIPTION**

**Background:**
Co-precipitation of plant proteins with animal protein is a novel technology to improve functional properties of plant protein. Recently, we have seen that interactions between proteins from plant and milk interact and changes functionality and in vitro digestibility. However, the interactions between plant and milk protein, which are responsible for the changes, are not understood at all.

**Aim:**
The aim of the project is to produce co-precipitates of purified plant and milk proteins, investigate the protein-protein interaction and relate it to changes in functional properties. You will learn to: purify proteins from whey (globular milk proteins) and pea or other plant proteins and you will learn to: investigate the interaction between the purified proteins.

**Methods**
For the purification and characterization you will learn to use i) size exclusion chromatography ii) ion exchange chromatography, and SDS-PAGE. For the interaction studies you will use i) fluorescence spectroscopy for studying protein structure (Trp-excitation) and hydrophobic studies using probes like ANS, ii) dynamic light scattering for particle sizes, iii) NEM-blocking of the Cys, iv) mass spectrometry (MALDI-TOF-TOF MS).
Transport and absorption of enzyme hydrolysates in advanced animal cell culture models

SHORT PROJECT DESCRIPTION

A collaboration between Aarhus University and Novozymes
Aarhus University department of Food Science and Novozymes Animal Health & Nutrition is looking for a motivated student to study on transport and absorption of nutrients derived from enzyme hydrolysates of food/feed components.

The project will use static and dynamic organ-on-a-chip cell culture models to investigate nutrient uptake.

Part of the project can also be optimization and stress testing of existing cell culture models. The exact project proposal can be adjusted to the background and interest of the student.

We offer the right person the following competencies upon completion of a project: Cell culturing techniques in advanced micro-physiological in vitro models, statistical data analysis, enzyme assay, simulated digestion models and development of in vitro models for industrial product development testing.

A shorter or longer stay at Novozymes headquarter in Bagsværd can be arranged but is not obligatory.

Karakterisering af hydrocolloider til fødevaresystemer

SHORT PROJECT DESCRIPTION

Karakterisering af hydrocolloider til fødevaresystemer

Hydrocolloider omfatter en række polysaccharider, som anvendes i et stort antal af fødevareapplikationer, til at give den rette tekstur og stabiliserings. Hydrocolloider findes i naturen, hvor de ekstraheres fra bl.a. tang, frø og frugtskaller.


Yderligere vil effekten af ændringer i pH eller ionstyrken undersøges nærmere ved brug af avancerede analysemøder som mikroskopi eller kalorimetri. Mindre model-systemer kan anvendes til at afprøve forskel i hydrocolloid-funktionalitet i fødevareelignende systemer, inden sammenhænge mellem struktur og funktion vil blive brugt til at forstå egenskaber i fødevaresystemer.

Yderligere information kontakte Kenneth Bøtkjær (Kenneth.Boetkjaer@dupont.com) eller Lise Stouby (Lise.Stouby@dupont.com)
Vitamin D fortified juices - Stabilizing effect of different constituents

**SHORT PROJECT DESCRIPTION**

Background:
Most Danes are lacking vitamin D3 during wintertime and it has been shown difficult to cover the natural need. Therefore novel functional food may be a solution and vitamin D fortified juices might be an excellent choice.

Most recently, we found that vitamin D3 was stabilized to a high extent in juice. We will like to investigate, which compounds in juice that is responsible for the observed stabilizing effect. In collaboration with Rynkeby we will produced juices with different level fruit pulp and pectin and investigate the stability of vitamin D3 during storage. Furthermore, an in-depth understanding of the effect of other compounds will be of interest.

The aim of the project is to investigate the stability of vitamin D3 in juices and understand the mechanism behind the stabilization.

**Aim:**
The aim of the project is to investigate the stability of vitamin D3 in juices and understand the mechanism behind the stabilization.

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Sonic seasoning: Behavioural measurements of crossmodal interactions on sweetness perception

**SHORT PROJECT DESCRIPTION**

The sugar intake especially from beverages is too high among specific segments, e.g. adolescents. The beverage industry has mainly focused on reducing sugar content per se with limited success due to drastic alteration in the sensory profile that are disliked by many.

You will as a master thesis student linked to the InnoSweet project (www.innosweet.com) working on the development and validation of environmental cues linked to food and eating, particularly background sound/music, that can help reduce people’s sugar intake. This thesis calls for a degree of creativity when it comes to designing new ways to measure empirical influences of background sound on food perception and eating behaviour. The thesis will include sensory descriptive analysis and consumer studies and you will be part of planning, executing, and analysing data from the studies.

The thesis may include questions like, how is information from the different sensory modalities such as sight, sound, touch, smell, and taste, integrated in the brain to form a coherent perception of flavour? How does environmental factors influence eating behaviour? Of importance to the thesis is how the understanding of multisensory flavour perception can support healthy eating behaviours.
What does this wine taste like? Measuring the temporal evolution of complex flavours

**SHORT PROJECT DESCRIPTION**

The sensory identity of food and beverages has an important temporal component. In other words, flavours don’t stay the same, but change over time in the mouth. This is especially relevant for complex products such as wine. Recently, new temporal sensory methods have been proposed to describe the evolution of in-mouth sensations over time (e.g., Temporal Dominance of Sensations (TDS), Temporal Choose All That Apply (TCATA)).

The project focuses on linking temporal sensory data with reported wine liking as well as expert evaluations of wine complexity and quality. The thesis will include sensory descriptive analysis, temporal sensory methods, and consumer studies. You will be part of planning, executing, and analysing data from the studies.

The thesis addresses fundamental questions in flavour perception and cognition, such as, what makes a wine complex? How do people of different expertise levels evaluate wine complexity and quality? From a practical standpoint, an understanding of wine complexity is of crucial importance to wine producers, marketers, and retailers.

**PHYSICAL LOCATION OF THE PROJECT**

AU-Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev

**PROJECT START**

Any time

**EXTENT AND TYPE OF PROJECT**

45 or 60 ECTS master thesis project

**MAIN SUBJECT AREA**

Sensory and consumer analysis

**ADDITIONAL INFORMATION**

Co-supervisor: Post Doc Line Ahm Mielby, lineh.mielby@food.au.dk

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Changing tastes: How does sound change taste perception in real time?

**SHORT PROJECT DESCRIPTION**

Crossmodal perception deals with how information from different sensory modalities may be integrated as a whole in the brain. Several recent studies have demonstrated the impact of background music on the taste/flavour evaluation of food and beverages. Since both music and flavour are time-varying in nature, it makes sense to take temporality into account when studying the impact of sound on the eating/drinking experience.

The student will measure the influence of sound on flavour perception over time, using especially designed soundtracks. The thesis will include sensory descriptive analysis, temporal sensory methods, and consumer studies. You will be part of planning, executing, and analysing data from the studies.

The thesis may include questions like, how does the brain process temporal information from different sensory modalities? What is the role of attention in flavour perception? Of importance in this thesis is how different sensory modalities interact with one another when it comes to flavour perception, and how this understanding can be utilised to support healthy eating behaviours.

**PHYSICAL LOCATION OF THE PROJECT**

AU-Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev

**PROJECT START**

Any time

**EXTENT AND TYPE OF PROJECT**

45 or 60 ECTS master thesis project

**MAIN SUBJECT AREA**

Sensory and consumer analysis

**ADDITIONAL INFORMATION**

Co-supervisor: Post Doc Line Ahm Mielby, lineh.mielby@food.au.dk