Thesis projects

BSc and MSc

Food Quality and Design

2026 – 2027, Period 1 – 2

WAGENINGEN
UNIVERSITY & RESEARCH

Introduction to Food Quality and Design

Welcome to our thesis booklet and thank you for your interest in doing a thesis at our chair group! At Food Quality and Design, our work is focused on both food quality as well as food design. This hopefully makes sense when looking at the name of our chair group, but what does this mean for our research and, more importantly, your thesis?

As a student with an interest in food technology, you have already learned a lot about the chemical, physical, microbial, and technological properties of foods. This knowledge is essential to go into the design of new foods and ingredients, and to determine or even predict the quality of foods. Therefore, when doing a thesis at our group, you will be able to integrate and connect your knowledge from various disciplines in one project. If you are interested in complete food science immersion, FQD is the right place for you!

At Food Quality and Design, we have a strong interest in these five themes:

- Food Design
- Food Digestion and Health
- Quality in the Chain
- Consumer Science
- Dairy Science and Technology

Further on in this booklet, you will find all the available topics in each research theme. Within all these topics there is room to discuss your personal preference and design a tailored thesis assignment, often together with the staff member(s) or PhD student(s) working on these topics.

Our multidisciplinary studies help WUR to succeed in its grand mission: To explore the potential of nature to improve the quality of life. Will you join us on this journey?

We hope to see you soon at Food Quality and Design.

Sincerely,

Vincenzo Fogliano & Kasper Hettinga

Contents

Requirements for you as a student

Please read this section carefully, as it explains the requirements (including study programs, courses, and credits) for doing a thesis at Food Quality and Design.

General information
Each topic's page mentions the topic title, supervisor(s), whether it's a topic suitable for BSc and/or MSc students, and if there are any specific prerequisites. Most thesis topics are part of ongoing research projects, so they will be adapted and defined in detail when you start writing your research proposal.

Most topics are only available to one student, but some may accept two or more students. Generally, the number of student places per thesis topic is flexible and depends on the number of student applications and supervisor availability.

The type of supervision differs between supervisors. However, there is one general rule: a topic supervised by a PhD candidate will have closer daily supervision than a topic that is supervised by staff members. Working on a PhD topic means that you have less freedom to decide the direction of your thesis. If you prefer to work more independently, do not be afraid to choose a topic supervised by a member of staff.

BSc: Specific requirements that apply to any topic
To start with a BSc thesis at Food Quality and Design, you should meet these requirements:

- You should have passed all 1st year courses.
- You should have passed at least 102 credits of the BFT program.

In addition, it is highly recommended that you have passed FQD21306 – Food Packaging and Design.

MSc: Specific requirements that apply to any topic
To start with an MSc thesis at FQD, you must have a study progress of at least 30 credits of your individual study program. In addition, you must meet the minimum mandatory knowledge:

- For students of MFT and MFQ, completion of 12 credits is compulsory to start an MSc thesis project at FQD. The 12 credits should be from advanced courses (advanced meaning a course code starting with the digit 3 or 4). Within those 12 credits, at least 6 credits should be from one of the following courses: Predicting Food Quality (FQD40306), Product Properties and Consumer Wishes (FQD31806), Dairy Chemistry and Physics (FQD33306), Food Quality Management Research Principles II (FQD35906), Qualitative Consumer Research in Food Design (FQD24806), or Food Flavour Design (FQD37806).

For students in other study programs (e.g. MDS), other requirements may apply. Please contact the thesis coordinator (Nora van Os, nora.vanos@wur.nl) for more information.

Topic-specific requirements
Some topics may also have specific course requirements. If this is the case, this mandatory knowledge will be listed on the topic information page.

Theme 1: Food Design

At Food Quality and Design, food and ingredient design are approached holistically, integrating nutritional, technological, and consumer perspectives. This theme explores a wide range of topics centered on developing innovative food products and ingredients.

The ingredients and foods investigated in this research theme are designed to improve sustainability, biodiversity, and public health. Some topics even target specific categories, such as people affected by celiac disease, diabetes, or obesity.

Addressing malnutrition is another key aspect. Many people in developing and transitioning countries have limited access to high quality foods. This prevents them from meeting their daily requirements of macro-and micronutrients, such as vitamins, minerals, and essential amino acids. As a solution, we work on alternative, non-conventional protein sources that can improve food quality and accessibility. Local sourcing should also be prioritized, particularly in transition countries, to enhance sustainability.

Plants, insects, and microbial biomass can be good alternatives to traditional animal-based proteins like meat and dairy. Beyond diversifying protein sources, the entire food system (from raw materials and production to storage and transportation) must be optimized. For this, these novel food sources are investigated by checking their structuring properties (such as gelling or fiber formation) or specific quality parameters (such as micro- and macronutrient concentrations and accessibility) after the processing or changing of ingredients.

Together, this research theme drives innovation toward a more sustainable and nutritious food system. By exploring novel ingredients, improving food production, and addressing global dietary challenges, it paves the way for healthier populations and a more resilient planet.

1.1 Healthy plant food design and potential health effects

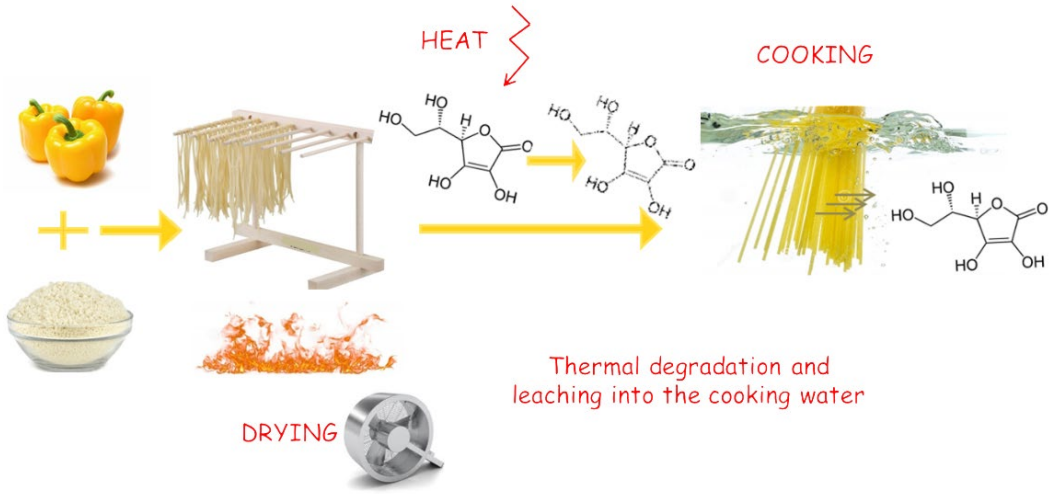
FOOD DESIGN | BFT, MFT

Supervisors
Teresa Oliviero

MSc: Specific prerequisite course
-

Topic overview
Raising consumer awareness that a diet rich in plant-based food is health-beneficial, urges companies to develop plant-based foods (e.g., soups) and food products enriched with plant-based ingredients (e.g., pasta enriched with vegetables, veggie-burgers etc.).

The production of those products often implies processing that can negatively or positively affect the content of healthy–beneficial bioactive compounds (such as vitamins, carotenoids, polyphenols, etc.), reducing or improving the potential beneficial effect of the consumption of those products.



Objectives & approach
The aim of this topic is to study the changing concentration of health-beneficial bioactive compounds during the production of products made with plant-based food ingredients (vegetable, legumes, etc.) and to investigate strategies to retain or to promote the formation of health promoting bioactive compounds to design healthier food products. In some cases, the effect on the bioactivity of those compounds will be part of the aim.

First, you will select a vegetable, fruit or legume, target bioactive compounds, and a product to be investigated. Then, you will investigate which steps of the production process can affect the concentration of these bioactive compounds and which strategies can be used (based on scientific hypothesis) to prevent losses or to promote the formation of those compounds (see the example in the figure). You will make the product, and depending on the target compounds, different analytical and instrumental technics can be used to analyze or to test the bioactivity of such compounds.

1.2 Replacing animal ingredients with plant-based alternatives

FOOD DESIGN | BFT, MFT

Supervisors
Ruud Verkerk, Pien Schouten

MSc: Specific prerequisite course
-

Topic overview
The trend of replacing animal ingredients (meats, eggs, gelatin) is becoming increasingly popular. Reasons for this can be found in sustainability, animal welfare, and human health arguments. The field is very broad, and although a lot of research has been done already, the field is still relatively young.

In many cases, the replacement of animal ingredients with those coming from a plant-based source results in the loss of important technological properties related to physical (e.g., texture, water holding capacity) and chemical (e.g., flavor profile, browning formation) properties. This will in turn influence also microbiological stability. The changes in technological properties and microbiological stability affect the product characteristics and quality. We can expect that consumers are not so compliant in accepting these potential changes. It is therefore important to maintain product characteristics and quality during the redesign of products.

Proposed approach
You will be working on the design of one specific product by testing ingredients of plant-based origin for their potential to replace the actual animal-based standards available on the market. Product characteristics and quality parameters will be identified and monitored in the different stages of product redesign. Key areas of interest for the student should be quality design and physicochemical analysis.

Topics
1. Alternative gelling agents.
2. Vegan cheese.
3. Bakery products (cake/cookies).
4. Create your own topic (student needs to independently come up with his/her own project).

1.3 From cell to ingredient: processing strategies for microbial biomass

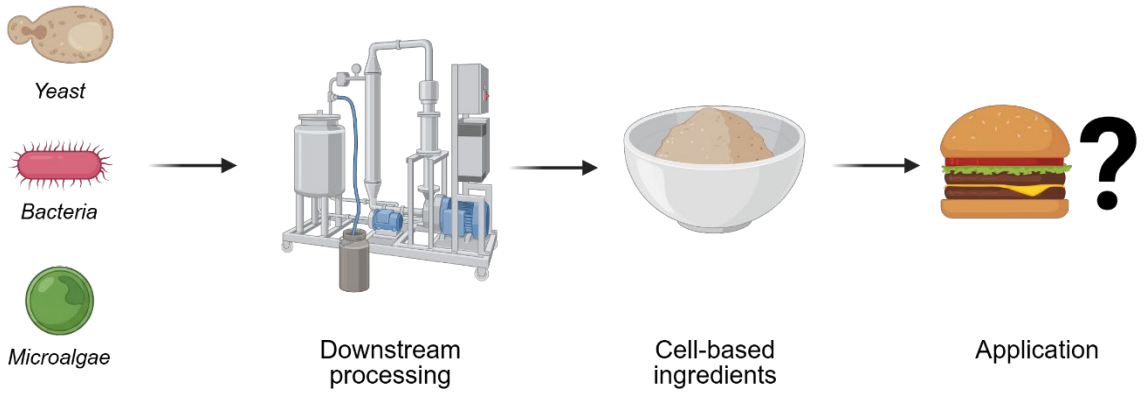
FOOD DESIGN | MFT

Supervisors
Lucas Bozzo (PhD), Maryia Mishyna

MSc: Specific prerequisite course
FPH30306 Advanced Food Physics or
FPH31306 Advanced Molecular Gastronomy

Topic overview
Sustainable diets are a key part of the puzzle in tackling climate change and improving global health. One promising direction is microbial biomass (often called single-cell protein), which can be produced in bioreactors virtually anywhere in the world, with minimal land use. Despite this potential, our understanding of how to extract and apply food ingredients from microbial cells remains limited and tends to be highly organism specific.

In this project, we've developed a generic processing approach to convert microbial cells from microalgae, yeast, and bacteria into distinct food ingredient fractions. The next phase now zooms in on how processing and purification steps shape the physical functionality of these ingredients. A central question is: what is the minimum level of purification needed to make an ingredient fit for a given application? Beyond that, we might also explore whether techniques like extrusion and fermentation could offer alternative routes to valorize microbial biomass.



Concretely, this thesis will map out the relationship between processing intensity and the techno-functional performance of protein-rich fractions from microbial biomass. You'll do this by connecting the dots between mechanical cell disruption, fractionation, ingredient composition, and their functionality, think of gelling, emulsifying, and foaming, and potentially digestibility too.

1.4 Next generation methods in food ingredient functionality

FOOD DESIGN | BFT, MFT

Supervisors
Maryia Mishyna, Jack Yang (FPH), Julia Keppler (FPE)

MSc: Specific prerequisite course
-

Topic overview
Nowadays there is an extensive search for plant-based food ingredients with techno-functional properties, such as foaming, emulsifying, and gelation. However, an important challenge which slows down this development is the inconsistency in existing methodology. There are many already existing methods for measuring the same property, but different approaches (sample preparation, test conditions etc.) are used. Thus, the results are often difficult to compare and draw a comprehensive understanding of the functional potential of different food ingredients. This project will contribute to solving this problem.

The project aims to evaluate different methodologies used to study foaming, gelling, and emulsifying properties and determine the advantages and limitations of each method. By applying a well-thought-out and stepwise approach, the project aims to find the most optimal methodology and thus develop the next generation of analysis methods.

The developed methods can be used to write standardized guidelines that will be used worldwide in food academia and industry.

1.5 Is this palm oil alternative the future for food?

FOOD DESIGN | MFT

Supervisors
Xuan Yang (PhD), Maryia Mishyna,
Rosan van der Glas (NoPalm Ingredients)

MSc: Specific prerequisite course
-

Topic overview
NoPalm Ingredients is a start-up company that makes an alternative for tropical oils such as palm oil through fermentation of food waste streams. The carbon footprint of this yeast-derived oil is significantly lower than that of conventional palm oil. Moreover, the oil can be produced locally, that is, also in non-palm oil producing countries.

By tailoring composition, yeast-derived oil can mimic, complement or even surpass the functionality of some tropical oils, such as palm oil or cocoa butter in different applications.

Your goal is to analyze and determine how NoPalm oil(s) performs across relevant uses and how they differ from those tropical oils. You will investigate various relevant applications and a wide variety of analytical methods. The primary focus will be on physical parameters such as rheology, fat crystal structure, and potentially sensory performance in applications. Ultimately, you need to create an understanding of where and why the ingredient behaves similarly/differently from tropical oils such as palm oil and how these differences can be turned into benefits.

1.6 Design of food matrix with oleaginous microorganisms

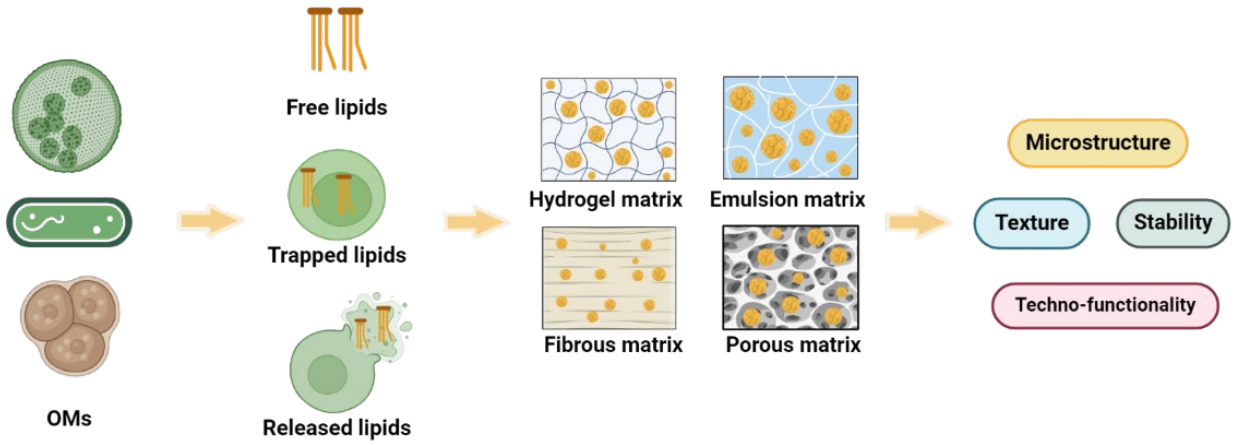
FOOD DESIGN | MFT

Supervisors
Xuan Yang (PhD), Maryia Mishyna

MSc: Specific prerequisite course
-

Topic overview
Numerous studies currently focus on alternatives to traditional food sources to achieve more sustainable diets. Oleaginous microorganisms (OMs) as a kind of novel food source are highly nutritious, easy to cultivate, and produced with limited land. Their applications focus on lipids extraction. However, the application of whole biomass is promising, which will not only simplify the processing but also introduce various intracellular nutrients. However, there is still limited knowledge on how to incorporate OMs into different food matrices. Therefore, the aim of this project is to develop a generalized methodology for the conversion of OMs into food ingredients with various techno-functionalities.

Objectives and activities
The thesis project will focus on investigating physical-chemical and techno-functional properties of OMs-based food matrix, establishing links between OMs and functionality, and designing food matrix with OMs.



1.7 The strength of the tiniest: Using fermentation for novel food sources

FOOD DESIGN | MFT

Supervisors
Maryia Mishyna, Arnau Vilas Franquesa (Universitat Autònoma de Barcelona, Spain), Sultan Arslan Tontul (Selcuk University, Türkiye)

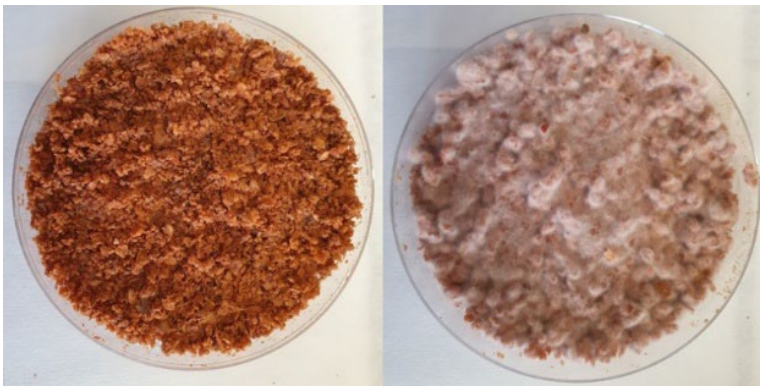
MSc: Specific prerequisite course
-

Topic overview
Fermentation is a versatile and complex process driven by the enzymatic activity of bacteria, yeast, or molds, triggering various biochemical reactions. It can be applied to a diverse range of products to enhance both shelf life and nutritional value. The latter makes fermentation a valuable strategy for improving food security and combating malnutrition.

Several fermentation processes, such as those used in beer and yogurt production, are well known, but our understanding remains limited. There is still much to explore regarding different microorganisms and substrates. Among the most interesting applications are novel foods, including edible insects and microalgae, which hold great potential as they are expected to play a key role in the future of food.

Fermentation is still little studied for novel food sources. The existing studies demonstrated the potential, for example, in solubilization of proteins from insect fractions which have low solubility. Along with an effect on techno-functional properties, fermentation can be used as an approach to tailor sensory properties, for instance, by modifying specific volatile compounds or umami flavor. Also, fermentation could release and generate prebiotics and bioactive compounds which can be used for the fortification of traditional food products.

This project aims to understand how integrated quality characteristics of novel food sources can be enhanced (e.g. volatiles, nutritional quality, techno-functional properties) by fermentation processes (using e.g. bacteria, filamentous fungi, yeast). The goal will be to create food ingredients (or products) to incorporate in food formulations.



The project will be done in collaboration with Universitat Autònoma de Barcelona (Spain) and Selcuk University (Türkiye).

1.8 Kitchen heroes: Barista and air-fryer

FOOD DESIGN | BFT, MFT

Supervisors
Vincenzo Fogliano, Ruud Verkerk, Nora van Os, Menno Lemmers, Versuni staff

MSc: Specific prerequisite course
FQD37806 Food Flavor Design or
FQD40306 Predicting Food Quality

Topic overview
Preparation of food at home using fancy devices is gaining popularity. Machines for home brewing of coffee and coffee-related beverages are becoming very sophisticated and require accurate studies by the machine producers. The same applies to air fryers that are gaining popularity in consumer's kitchens. These new applications can be used to fulfil modern needs in food preparation.

Objectives
In this thesis, a possible aim is to find out how brew parameters of an automatic espresso device can be optimized for different types of coffee. Another aim of this study could be to investigate the foaming ability and foam properties of plant-based milk and understand which key properties and ingredients help create quality foam. For the air-fryer, a different gas instead of simple air could be used.

Proposed approach
For this project, you will investigate literature and investigate how different preparation conditions influence the taste and quality of the final product. The volatile fractions as well as key quality parameters can be investigated as well as the decay in product quality after the preparation. Experiments will be performed with Versuni (Philips) devices, which could include modified machines for improved performance.

1.9 Incorporation of cell-based protein ingredients in extruded products: Can we make it or break it?

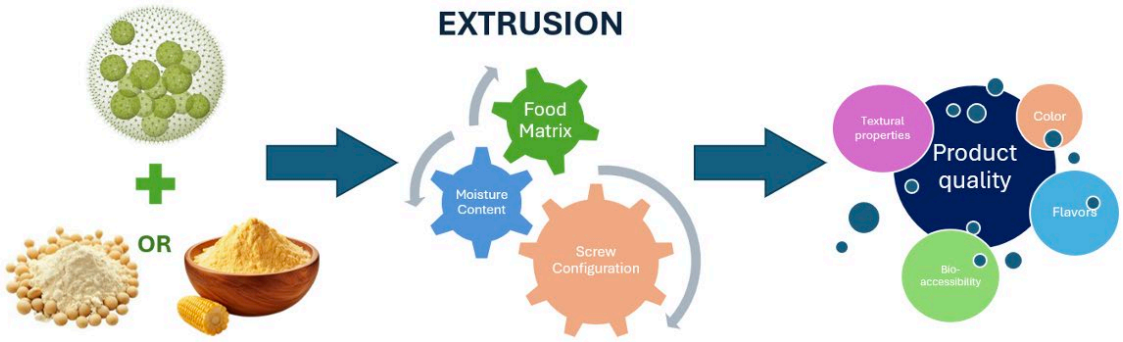
FOOD DESIGN | MFT

Supervisors
Marjanne Verhoeven

MSc: Specific prerequisite course
-

Topic overview
Alternative protein ingredients, including cell materials such as micro-algae, yeast, bacteria, fungi, are studied widely in terms of composition, sustainability and production. Studies on techno functionality, however, are lacking, especially focusing on the applicability of including these ingredients into a food matrix.

In this thesis topic, you will focus on either low-moisture extrusion (often starch-based) or high-moisture extrusion (often protein-based) of cell-based materials when incorporated into a food matrix. We want to see what happens to the cell walls during extrusion; can we break/disrupt those during the process? Does this affect the physical properties of the final product, and do we see any changes in in vitro digestibility (and thus bio-accessibility) before and after extrusion?



During your thesis, you will work with alternative protein ingredients and gain hands-on experience with various techniques in the laboratory, including lab-scale extrusion.

Objectives and approach
The aim of this topic is to study the effect(s) of different extrusion conditions and/or matrices on the final quality of extrudates containing alternative protein ingredients. Examples of quality parameters can be the intactness of algal materials after extrusion, the in-vitro digestibility of the samples, textural parameters, or color.

1.10 Effect of pre-processing on the techno-functional properties and extrusion behavior of novel protein sources

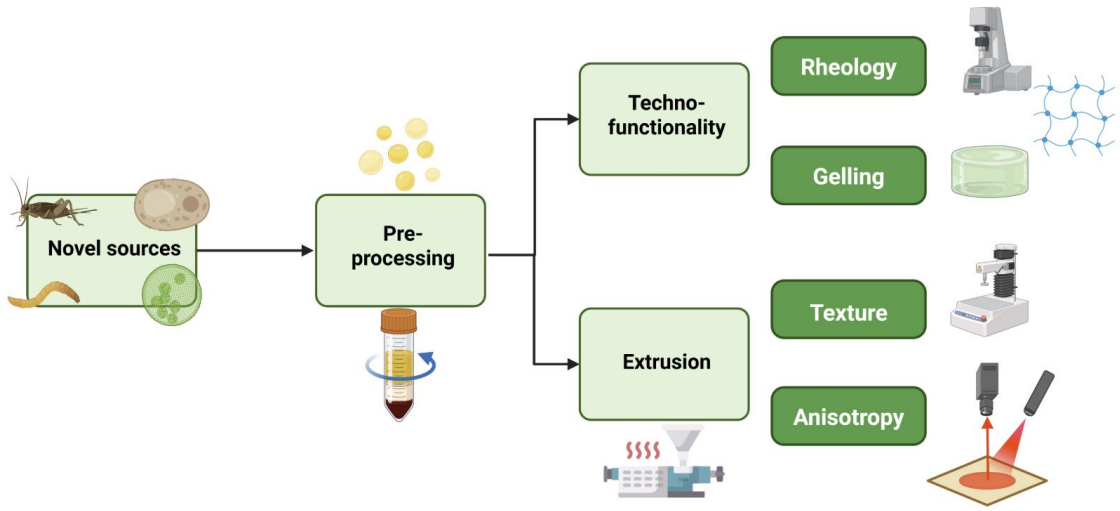
FOOD DESIGN | BFT, MFT

Supervisors
Rajeev Ramesh (PhD), Maryia Mishyna

MSc: Specific prerequisite course
-

Topic overview
The environmental and ethical implications of conventional meat production have prompted a growing shift toward reducing meat consumption and adopting alternative protein sources. Novel protein sources, such as those sourced from microalgae, yeast, and insects show considerable promise, due to requiring far less land and water to cultivate, reduced greenhouse emissions, and concerns over presence of allergens in traditional plant sources such as soy. High Moisture Extrusion (HME) is a prominent industrial technique for producing meat analogues which uses a combination of shear and high temperatures to induce protein texturization and fiber formation, thereby replicating the structural and sensory attributes of meat.

However, the behavior of novel protein sources in extrusion is still poorly understood, due to their markedly different intrinsic properties and composition as compared to traditional plant-based proteins. Furthermore, these proteins often undergo diverse pre-processing treatments during extraction and purification, which can markedly influence their techno-functional properties and introduce further uncertainty in predicting protein behavior during extrusion. Therefore, the aim of this project is to understand the effect of different pre-processing methods on the techno-functionality of novel protein sources and link them to their behavior in extrusion.



The research will involve applying selected pre-processing techniques to various novel protein materials; characterizing their rheological, gelling, and protein properties; performing extrusion trials using different protein formulations, using a lab scale extruder; and assessing the resulting extrudates in terms of texture and structural anisotropy.

1.11 Novel fat sources in meat alternative products

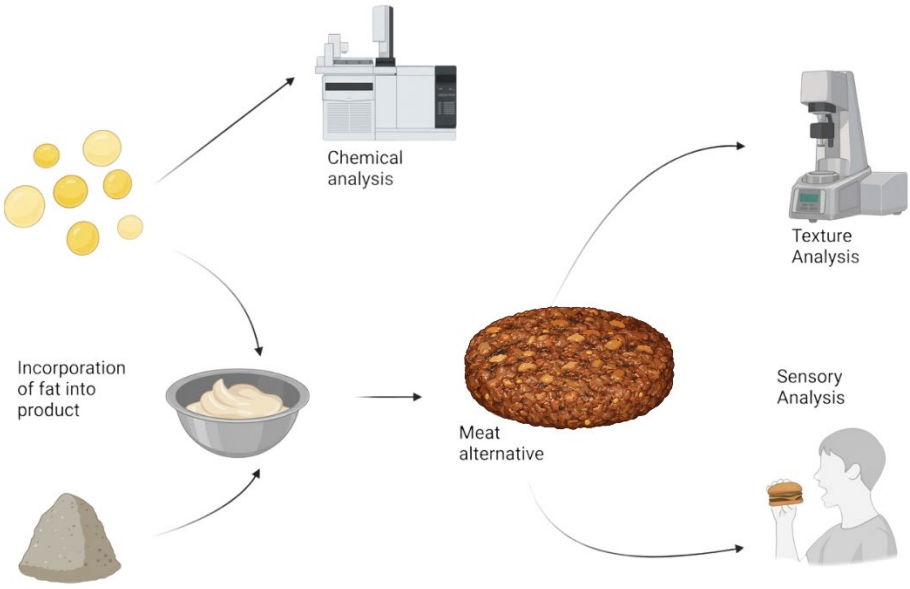
FOOD DESIGN | BFT, MFT

Supervisors
Maryia Mishyna, Ivor Spector

MSc: Specific prerequisite course
-

Topic overview
Fat plays a central role in defining the flavour, texture, and mouthfeel of conventional meat products. As the demand for sustainable food ingredients grows, there is a need to study the potential of novel fat sources and their performance in meat alternative products.

The performance of fats of different origins is largely affected by their degree of saturation and carbon chain length. These characteristics influence melting behaviour, flavour release, and stability, which ultimately determine consumer acceptance. Understanding both the nature of the fat used and its performance in foods is important for the reformulation of traditional foods using novel fats to ensure product quality that satisfy consumers.



In this project, you will work with novel fats originating from cultured fat cells, yeast, and microalgae. Each source offers a distinct fatty acid profile and form, and consequently, different functional potential when incorporated into meat alternative food models.

Objectives
Characterize the techno-functional and sensory properties of novel fat sources and their use in meat alternative products.

Approach
Composition, aroma profile, and thermal behaviour of novel fats will be assessed. The behaviour of novel fats in food formulations will be studied, including rheological, textural, and sensory properties.

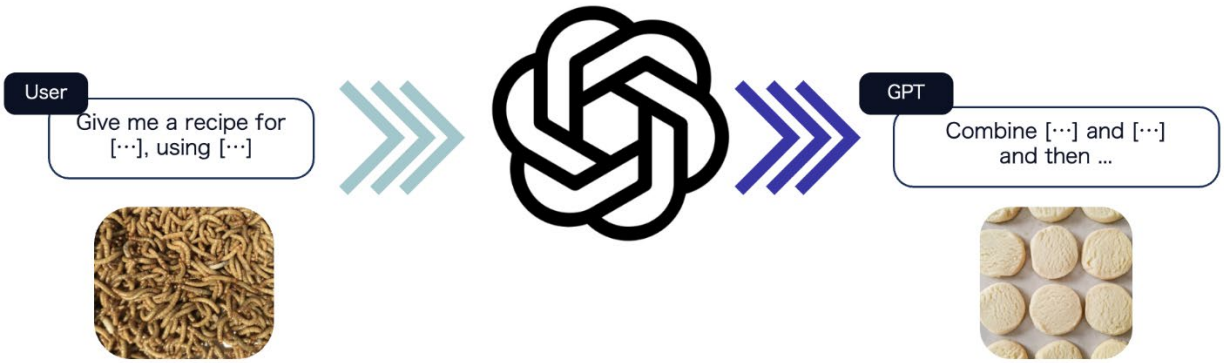
1.12 Cooking with AI: Designing new insect-based foods with Large Language Models

FOOD DESIGN | BFT, MFT

Supervisors
Ezra Kool (PhD), Maryia Mishyna

MSc: Specific prerequisite course
-

Topic overview
Insects are regarded as a potential sustainable food source for their lower environmental impact and nutritional value. Despite these positive features, meeting consumers' acceptance criteria is difficult. Western consumers tend to be reluctant to consume whole insects, which stems from unfamiliarity with the product and its association with feelings of disgust. These concerns have directed research into incorporating insect-derived ingredients into food products familiar to Western consumers. However, developing these is challenging, as the inclusion of insect-derived ingredients affects sensory properties, including texture and flavour, among others. Although there is a growing number of studies on insect-incorporated foods, research remains limited. Thus, more research is needed to understand how the inclusion of insect ingredients affects food properties.



In the past few years, Large Language Models (LLMs) have become prominent tools applied to various scientific domains. In the food domain, the use of LLMs typically pertains to addressing nutritional and culinary tasks. Considering the limited amount of available data on insect-incorporated foods, the question is whether these LLMs are also good at generating insect-based recipes.

This research project aims to explore the predictive recipe creation capabilities of LLMs in the context of data-limited tasks.

Possible tasks:

- Perform data annotation of literature to extract information to train LLMs
- Perform experiments to evaluate the recipe generation capabilities of LLMs.

1.13 Predict to redesign or redesign to predict? Protein drinks with novel food ingredients

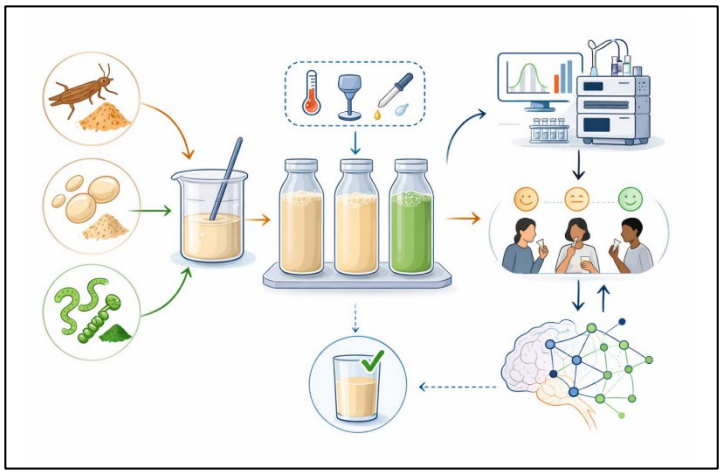
FOOD DESIGN | BFT, MFT

Supervisors
Maryia Mishyna, Miodrag Glumac (The Origin Institute, the Netherlands)

MSc: Specific prerequisite course
-

Topic overview
The growing global population and increasing environmental pressures accelerates the search for sustainable and nutrient-dense alternative protein sources. The most promising candidates are insect, yeast, and microalgae. These novel protein sources offer high protein yields and have lower environmental footprints compared to traditional dairy and meat-based proteins. However, their incorporation into traditional food products remains limited largely due to challenges related to techno-functional and sensory properties. Protein drinks represent a relatively simple food matrix for studying these novel food ingredients, and they are among the fastest-growing functional food categories. In such food models, effects of protein source, concentration, and processing conditions on product quality can be systematically evaluated.

The aim of this research is to generate sensory and instrumental datasets for protein beverages reformulated with novel food ingredients (insects, yeast, microalgae), and to validate predictive models, using beverages as a food model system. This project will be conducted in collaboration with The Origin Institute (TOI, the Netherlands), which brings expertise in developing and refining predictive models that link instrumental analytical data to sensory outcomes.



The objectives of the study:
1. To review and compare the nutritional composition, functional properties, and processing characteristics of insect, yeast, and microalgae proteins relevant to beverage formulation.
2. To formulate protein beverage prototypes incorporating each novel protein source at varying concentrations and processing conditions.
3. To evaluate quality of reformulated beverages using instrumental and sensory techniques.
4. To validate the predictive models by assessing their accuracy in forecasting sensory outcomes from instrumental data.

1.14 Unlocking cocoa flavor: Navigating the Maillard reaction pathways for sustainable alternatives

FOOD DESIGN | BFT, MFT

Supervisors
Riccardo Bottiroli, Vincenzo Fogliano

MSc: Specific prerequisite course
FQD37806 Food Flavor Design

Topic overview
The surging global demand for cocoa has led to deforestation as cocoa plantations expand rapidly. To address this environmental issue and reduce cocoa consumption, offering consumers a non-tropical, cocoa-flavored substitute is a promising strategy. However, replicating the natural and premium cocoa flavors presents a significant challenge due to the complex nature of cocoa's aroma profile. The central reaction responsible for creating the cocoa aroma profile is the Maillard reaction. Thus, replicating the cocoa flavor profile requires designing specific Maillard reaction pathways.

Aim
The main objective of this study is to develop a cocoa-based beverage alternative composed of non-tropical ingredients that can provide a sensory experience akin to traditional cocoa products.

Approach
To achieve this goal, the initial step involves creating a model Maillard reaction system using basic ingredients. These ingredients will provide both the body of the beverage and serve as precursors for the Maillard reaction, which is crucial for flavor development. The process begins with a small number of precursors and gradually increases the system's complexity by adding more reactants to produce targeted volatile compounds. Various pH levels and roasting conditions will be applied to replicate the distinct cocoa volatile profile. The most effective formulations will be used to create the final cocoa alternatives.

Major skills/techniques
- Model Maillard reactions
- Spectral analysis (Fluorescence spectral and UV scanning)
- Analysis of volatiles (GC-MS or PTR-MS)
- Statistical modelling (e.g. PCA).

In summary, this research project aims to create a cocoa-based alternative using non-tropical ingredients while focusing on understanding and controlling the Maillard reaction, the fundamental process for cocoa flavor development.

1.15 The Maillard reaction in food: Balancing flavor and safety in alternative food production

FOOD DESIGN | MFT

Supervisors
Vincenzo Fogliano, Burçe Ataç Mogol (Hacettepe University Ankara)

MSc: Specific prerequisite course
FQD37806 Food Flavor Design

Topic overview
The experimental part and data collection will be performed at Hacettepe University Ankara, Turkey therefore select this topic only if you are interested in doing the thesis abroad

Do you enjoy consuming biscuits, breads, coffee, potato chips, French fries, or chocolate? Then, this is your topic! Many of us love these foods due to their nice color, taste, and aroma. The nice characteristics of these foods come from the Maillard reaction. However, this reaction could also be responsible for the formation of some hazardous compounds, such as acrylamide. Many researchers and producers are changing the formulations of foods or processes to prevent acrylamide formation. But if we interfere with the standard food production or formulation, the Maillard reaction and, eventually, the nice aroma of the food could be affected. So it would become a challenge for both the scientists and the producers to keep the food as nice as it is.

On the other hand, new emerging trends, such as enriching foods with alternative protein sources, e.g. plant-based proteins or insect protein, would again affect the nice aroma of the food due to interfering with the Maillard reaction.

Being a food technologist, some questions arise:

- How will the addition of plant-based materials (pea flour, flaxseed, hemp seed, or sesame seeds etc.) affect the acrylamide formation in bakery products, also considering Maillard aroma compounds?
- How may the green aroma of plant-based proteins be manipulated by the addition of MR-promoting ingredients (amino acids, sugars etc.)?
- How will the addition of insect flours affect the acrylamide formation in bakery products and how to manipulate the formulation or process to keep Maillard key aroma compounds?

So, here we are. Louis Camille Maillard discovered the existence of the reaction in 1912, and since then we have been working and trying to understand it. Do you take this challenge and join us to enhance our understanding of the changes in foods during reformulation and processing?

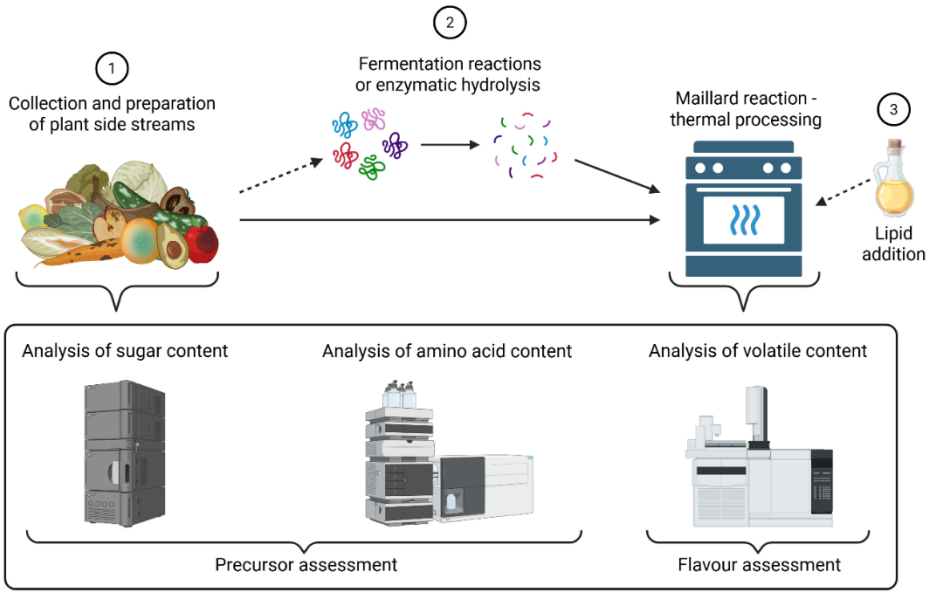
1.16 Use of upcycled materials for flavor enhancement via the Maillard reaction

FOOD DESIGN | BFT, MFT

Supervisors
Emma Khazzam (PhD), Teresa Oliviero

MSc: Specific prerequisite course
FQD37806 Food Flavor Design

Topic overview
Animal-based products, as well as some climate change-sensitive crops such as nuts, coffee, and chocolate, place a negative burden on the environment. As a result, the demand for plant-based alternatives is increasing. However, these alternative products often fall short of their original counterparts, especially in their flavor. There is strong demand for "natural, clean-label" sweet and savory flavorings for plant-based alternatives, and one promising approach is the use of Maillard reaction (MR) precursors. These precursors can derive from countless sources; however, food waste shows promise as a potential flavor source. Upcycling otherwise discarded "inedible" side streams (SS) not only can result in the generation of flavor compounds but also provides environmental and economic benefits.
To investigate this issue, students will aim to create solid flavor model systems with upcycled plant



materials and investigate whether desired sweet or savory flavors can be produced. To achieve this, students will formulate model systems by hand or with extrusion techniques, which they will heat. Treatments such as fermentation, enzymatic hydrolysis, etc., may be applied to increase the flavor precursors. Students will use analytical measurement tools such as HPLC, LC-MS, and GC-MS to investigate the precursors and aroma volatiles. There is potential for the use of sensory studies as well.

1.17 Influence of product breakdown and lubrication on aroma release and perception in model matrices

FOOD DESIGN | MFT

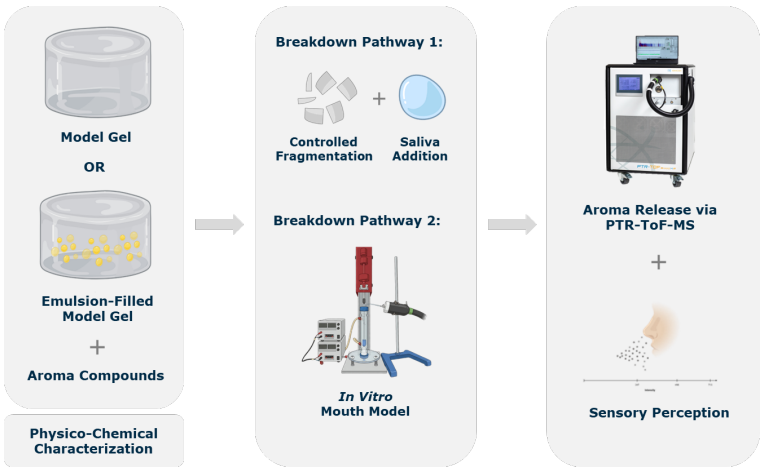
Supervisors
Luka Mtiulishvili (PhD), Arianne van Eck

MSc: Specific prerequisite course
FQD37806 Food Flavor Design or HNH30506 Principles of Sensory Science or MCB33306 Integrated Sensory Science

Topic overview
Food flavor, particularly aroma derived from olfactory sensations, remains a strong determinant of consumer acceptance and repeat purchase. When eating a food product, oral processing, involving mastication, salivation, bolus formation, and swallowing, continuously modifies the mechanical properties of the food, influencing how volatile compounds are released and perceived. Namely, variations in the degree of structure, degree of lubrication, and oro-sensory exposure time directly shape the temporal profile of aroma stimulation according to the classical breakdown model. Nonetheless, the aroma release patterns remain difficult to predict. To reduce complexity, most studies in this field have focused on model gels.

Previous research has observed that a correlation exists between an increase in the exposed surface area of the bolus and an increase in aroma release during mastication. On the contrary, increasing saliva uptake has been predicted to dilute and retain the aroma compounds, reducing their partitioning in the headspace. However, it has not been investigated yet how the effect of surface area evolves temporally along with the saliva uptake.

The aim of this MSc thesis is to systematically study the independent and combined effect of product breakdown (exposed surface area) and lubrication (saliva content and saliva composition) on aroma release in vitro in model gels and/or emulsion-filled gels using dynamic headspace measurements and mouth model simulation coupled with PTR-ToF-MS. Aroma release measurements will be correlated with aroma perception using static sensory descriptive tests. This interdisciplinary approach will advance the fundamental understanding of volatile release and support the design of food products with enhanced consumer liking. A schematic overview of the topic is presented below:



1.18 Food Flavor Dynamics: Flavor release & sensory perception of foods

FOOD DESIGN | MFT

Supervisors
Arianne van Eck

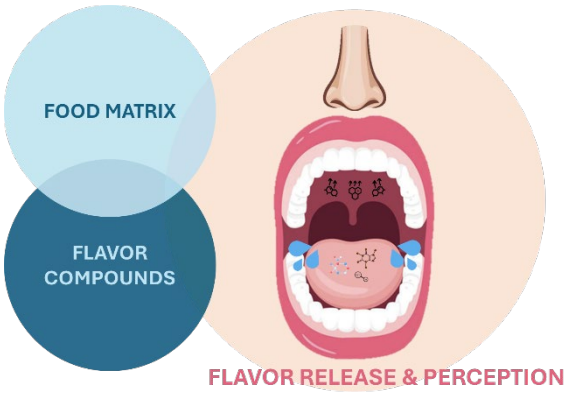
MSc: Specific prerequisite course
FQD37806 Food Flavor Design or
HNH30506 Principles of Sensory Science or
MCB33306 Integrated Sensory Science

Topic overview
Have you ever wondered why your wine smells floral but tastes fruity? Or why products with reduced fat or sugar are generally less liked by consumers? These everyday food experiences are rooted in the science of flavor, a scientific field that explores how we perceive food and enjoy what we eat. In this thesis, we hope to further unravel some of those (delicious) flavor mysteries.

Flavor perception is the sensation perceived during eating/drinking, and it's composed of several sensory modalities: olfactory (smell), gustatory (taste) and trigeminal sensations. Flavor perception is a multisensory and dynamic experience and can change while eating due to food breakdown in mouth and saliva incorporation. Flavor molecules are released progressively from the food in the mouth during consumption. By understanding how flavor compounds are released and how we perceive flavors during consumption, we can create better/healthier/more sustainable food products that are well accepted by consumers worldwide.

Although many studies attempted to understand the complex phenomenon of flavor perception, it is not fully understood yet. Most studies focused on flavor release and/or perception of model foods (emulsions, gels). However, consumers generally consume more complex foods or meals providing a composite blend of physicochemical and sensory properties.

This MSc thesis focuses on understanding how food matrix properties and flavor properties drive flavor release and perception. Using an interdisciplinary design (combining analytical and sensory methods) will help to better understand and manipulate the complex interactions between food matrices, chemical compounds, and human flavor perception. This is key to being able to develop foods that meet the sensory expectations of consumers.



Methodologies
- Flavor release (analytical): headspace or *in vivo* aroma release
- Flavor perception (sensory): dynamic sensory methods (TI, TDS or T-CATA)

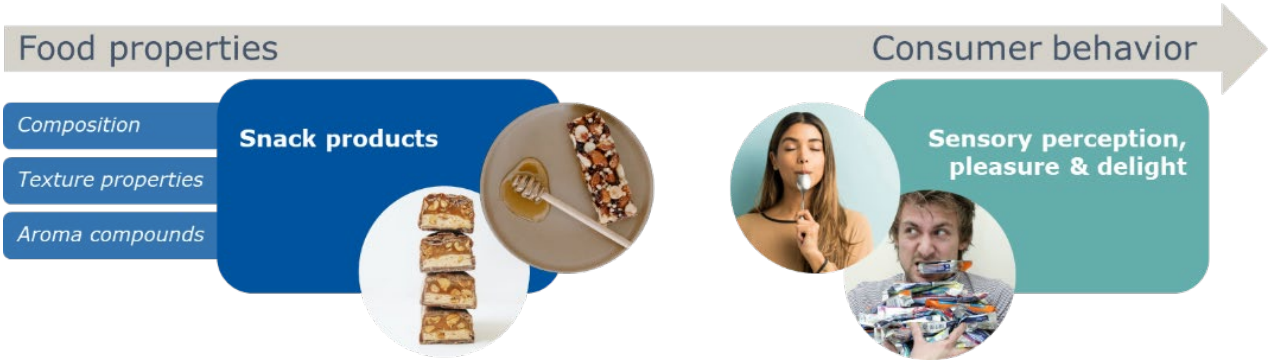
1.19 Texture properties, aroma components and sensory perception of snack products

FOOD DESIGN | MFT

Supervisors
Nienke van Iterson (PhD), Arianne van Eck, Markus Stieger

MSc: Specific prerequisite course
FQD37806 Food Flavor Design or
HNH30506 Principles of Sensory Science or
MCB33306 Integrated Sensory Science

Topic overview
Snack consumption has increased over the years. Snack products are easy to consume and energy-dense; and they thereby contribute substantially to consumers' daily energy intake. Consumers nowadays demand healthier and more sustainable snack products while maintaining sensory pleasure; and the food industry has been launching new snack options by changing the composition and/or other food properties.



This project aims to study product properties (composition, texture, volatiles in headspace) of a broad range of snack products to obtain more insight into which properties drive sensory perception and liking of snacks.

Sensory science is a multidisciplinary research field, and it functions as a bridge between food properties (instrumental analyses) and sensory perception/consumer behavior (sensory analyses). In this project, the instrumental analyses will capture the main composition/texture/aroma differences within the snack category. The sensory analyses will capture the main differences in taste/flavor/texture perception within the snack category.

Methodologies
- Sample composition analyses (water content, fat content, etc.)
- Texture analysis (Texture analyzer)
- Volatiles in headspace (GC-MS)
- Oral processing behavior (video recordings, bolus analysis)
- Sensory evaluation

1.20 Analysis of brewer's grain as a Pickering emulsifier and its behaviour in different food systems

FOOD DESIGN | BFT, MFT

Supervisors
Nora van Os, Ruud Verkerk

MSc: Specific prerequisite course
-

Topic overview
Brewer's grain is the main by-product of the brewing industry. It is rich in dietary fiber and proteins and is currently mainly used as animal feed. Due to its natural composition of proteins and insoluble fiber particles, brewer's grain has strong potential as a particle-based stabilizer in Pickering emulsions. Unlike conventional emulsions stabilized by surfactants, Pickering emulsions are stabilized by solid particles that adsorb at the oil–water interface, creating a physically robust barrier against droplet coalescence. This approach aligns well with clean-label trends and offers enhanced structural stability in complex food systems.

Understanding the Pickering emulsification behavior of BSG can enable the development of clean-label fat systems and promote the use of sustainable ingredients in bakery products, meat products, and plant-based meat alternatives.

Aim
Understand how the properties of brewer's grain as a Pickering emulsifier and its emulsification behavior in different food systems, like bakery, meat, and plant-based meat applications.

Activities
1. Physico-Chemical Characterization of brewer's grain, like particle characterization, surface properties
2. Characterization of Pickering emulsion system, preparation, analysis of microstructure and droplet behavior.
3. Interaction of brewer's grain as a Pickering emulsifier within the food matrix, analysis of techno functional properties and ingredient interactions. Evaluation on volume, texture, sensory properties and stability.

1.21 Upcycling of food by-products and production of vitamin K2 by fermentation approaches

FOOD DESIGN | MFT

Supervisors
Xin Wei (PhD), Melania Casertano,
Oscar van Mastrigt, Vincenzo Fogliano

MSc: Specific prerequisite course
-

Topic overview
The global food industry faces a critical challenge regarding the generation of organic by-products, which are frequently discarded due to their sensory characteristics or lack of direct commercial application. This disposal represents a significant loss of structural carbohydrates and bioactive substrates, needing a shift toward a circular economy where these materials are valorized rather than wasted. Fermentation serves as a transformative technology in this field, offering a sustainable method to upcycle these "waste" streams into high-value functional ingredients. Specifically, the utilization of *Bacillus subtilis* has gained attention due to its robust metabolic capabilities, particularly its ability to synthesize Vitamin K2 (Menaquinone-7 or MK-7) during the fermentation process. By using this bioconversion strategy, underutilized plant-based biomass can be transformed into a nutrient-dense matrix, effectively turning an environmental burden into a source of vital micronutrients associated with health.

However, the functional potential of these fermented ingredients is not limited to the synthesized MK-7. A critical, yet under-explored aspect of these upcycled matrices is the synergy between the fermentation-modified dietary fibers (prebiotics) and the inactivated bacterial biomass, known as paraprobiotics. Unlike live probiotics, paraprobiotics provide distinct functional advantages in terms of stability and safety, while the fermented fibers serve as accessible substrates for the gut ecosystem. Therefore, to validate the health benefits of this strategy, it is essential to determine how this specific combination—bioactive MK-7, prebiotics, and paraprobiotics—modulates the host's intestinal ecology, specifically by influencing the resident microbiota composition and driving the production of Short-Chain Fatty Acids (SCFAs).

Objectives
The main objective of this topic is to evaluate the functional bioactivity and gut-modulating mechanisms of food by-products upcycled through Bacillus subtilis fermentation. This might include:

- Characterizing and investigation of various food by-products suitable for fermentation-based upcycling
- Evaluating the modulation of the gut environment, specifically by analyzing changes in microbiota composition and the metabolic production of SCFAs.

1.22 Sustainable approaches to upcycle food waste streams

FOOD DESIGN | MFT

Supervisors
Melania Casertano, Vincenzo Fogliano

MSc: Specific prerequisite course
-

Topic overview
Wouldn't it be great if food side streams could nourish us instead of being discarded? Driven by population growth and the limits of animal-based foods, the search for alternative high-quality nutrients is accelerating. Agro-industrial side streams are abundant and rich in proteins, fibers and phytochemicals, yet remain overwhelmingly underutilized, with over 1 billion tonnes of food wasted globally each year.

To address this issue, there's a growing interest in upcycling by-products. Green technologies, such as fermentation and enzymatic treatment emerge as key solutions, offering enhanced nutritional profiles and sustainability benefits. Among these technologies, solid state fermentation stands out for its ability to convert entire biomass streams into nutritious ingredients without extensive processing steps.
However, fermentation outcomes are often strongly influenced by the intrinsic characteristics of the substrate, such as fiber composition, protein structure, and phenolic interactions. Understanding how substrate properties drive fermentation transformation is essential for designing targeted upcycling strategies for food side streams.

Aim
Investigate the potential of fermentation-based bioprocessing strategies to convert food by-product into value-added ingredients.

Approach
1. Literature review
    - Identify possible side-streams from food production with high processing volumes
    - Review current state-of-the-art in solid state fermentation applied to plant side stream
2. Characterization of selected food side-streams
    - proximate composition
    - phenolic compounds and antioxidant activity
    - Presence of anti-nutritional factors
3. Design of fermentation strategies
    - Propose realistic fermentation approaches using food-grade microorganisms
    - Monitor fermentation parameters such as pH and enzymatic activity
    - Evaluate biochemical transformation induced by SSF
4. Link substrate composition to fermentation outcome

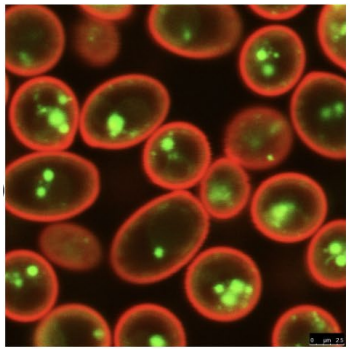
1.23 From side-stream to novel food: Composition and variability of spent biomass

FOOD DESIGN | MFT

Supervisors
Maryia Mishyna, Coen d'Ancona (NoPalm Ingredients)

MSc: Specific prerequisite course
-

Topic overview
NoPalm Ingredients is a start-up company which produces an alternative to palm oil through fermentation technology. During the extraction process of the oil, a side-stream of cell-free fermentation broth is obtained. To make impact, this side stream needs to be understood and valorized, which is important both for sustainable and economic feasibility.




NoPalm Ingredients ferments a variety of side-streams. During fermentation, the composition of this material changes due to consumption and production by the yeast. Finally, a complex mixture is obtained at the end of the fermentation, which contains fibers, proteins and minerals.

The goal of this topic is to identify compounds which are likely present in the cell-free fermentation broth (literature/analytics), to separate and purify valuable components, and to discuss the opportunities for bringing this to market.

1.24 Green upcycling: Functional and nutritional ingredients recovery from HORECA, retail and household waste

FOOD DESIGN | BFT, MFT

Supervisors
Vincenzo Fogliano, Melania Casertano, Yannick Schrik, Willie van den Broek

MSc: Specific prerequisite course
-

Topic overview
The project is performed in collaboration with the AMS Institute in Amsterdam. The AMS Institute has developed a device to grind and separate domestic and HORECA (i.e. food service) waste. The samples obtained will be upcycled using biobased strategies: enzymatic treatment and fermentations developed in the past years at FQD.

Objectives
As cities struggle with food waste collection, we are considering grinders and microbes to provide solutions. In this research, a possible aim is to find out the best conditions for sampling and treating the organic municipality waste in Amsterdam.

Proposed approach
For this project you will run field investigation in Amsterdam and process the waste in the pilot plant of the AMS Institute. The obtained material will be analyzed and upcycled at FQD laboratories using different biobased strategies.

Interested? You can find more information on this project via https://www.ams-institute.org/news/bin-there-done-that-a-new-approach-to-food-waste/.

1.25 Edible insects: Creating food of the future

FOOD DESIGN | MFT

Supervisors
Maryia Mishyna, Catriona Lakemond, Vincenzo Fogliano

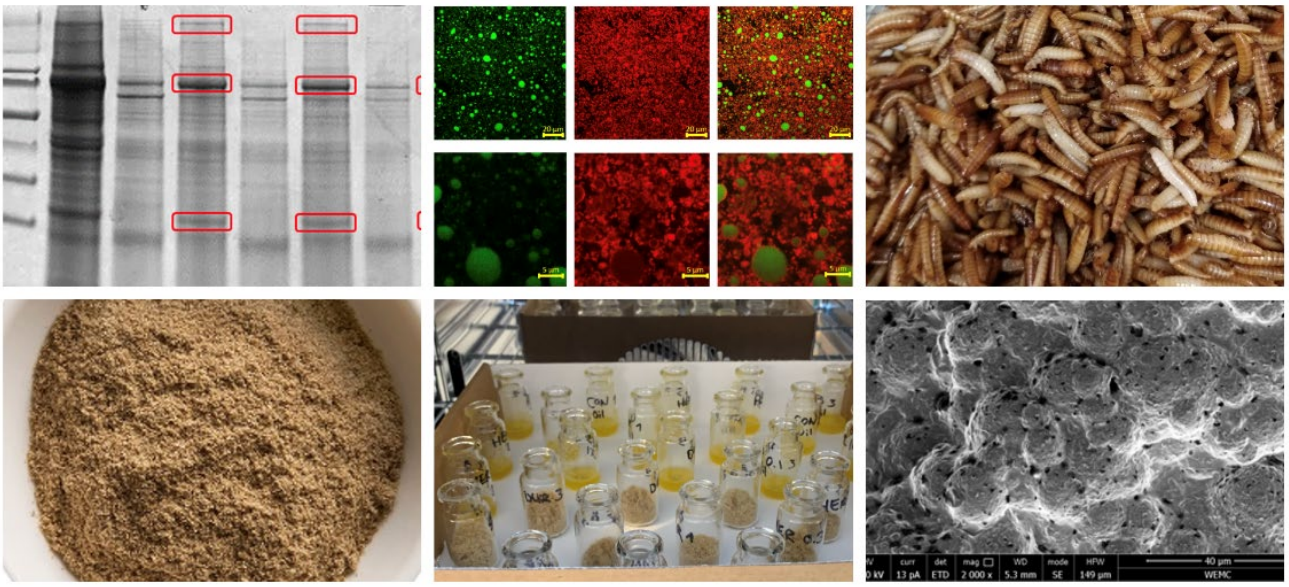
MSc: Specific prerequisite course
-

Topic overview
Edible insects represent a novel food source in Western countries. High protein content, well-balanced amino acid composition, and enough vitamins and minerals make edible insects comparable to traditional plant and animal sources. Moreover, insect farming is more sustainable and has a lower negative environmental impact in comparison to conventional livestock. To increase consumers' acceptance of edible insects, they can be processed into food ingredients and incorporated into familiar food products. The processing comprises various techniques including drying, fractionation, extraction, purification of proteins and fat, application of enzymes, and aims to obtain high-grade insect material or fractions with the enhanced characteristics for use as food ingredients. Although knowledge on insect processing is developing in the last decade, much is still unknown.

The research project covers various aspects of edible insects as a sustainable food source aiming to explore their potential for the food industry.

The students will work on one of the following topics:

- Techno-functional properties of insect proteins for tailored insect applications
- Texturization of insect proteins using extrusion



1.26 Standardization of analytical microplastics detection methods

FOOD DESIGN | MFT

Supervisors
Catriona Lakemond, Nathan Meijer (WFSR)

MSc: Specific prerequisite course
-

Topic overview
Consumers may be exposed to microplastics (MPs) via the food they ingest. A precautionary approach should be employed to reduce any potential exposure. To facilitate this, insights into the levels, types and sizes of MPs in different food and feed products are needed. However, standardized analytical methodologies are currently lacking, preventing evaluation of MP scope, risk and possible mitigation measures. The aim of this project is to develop and standardize analytical measurement methods for microplastics in food and feed. In analytical terms, the project may focus on microscopy and/or spectroscopy, to facilitate assessment of particle size or polymer type identification.

To enable analysis of more complex food and feed products, separation of the matrix and MP contamination is crucial. This should be done by developing digestion methods for relevant product groups, which require a delicate balance: sufficiently aggressive (corrosive) to digest as much as possible of the product matrix, without damaging the integrity of the MPs. Enzymatic digestion methods could also be considered. Additional filtering and/or other techniques (e.g., staining) can be considered, to enhance contrast between remaining organic matter and MPs. Primary aim of this project is to perform iterative analytical method-development by determining quantitative limits of one or several methods and providing recommendations on application of fit-for-purpose methods.

The thesis project will be conducted at FQD group in close collaboration with WFSR (Wageningen Food Safety Research).

1.27 How can genAI tools be used to develop effective educational materials?

FOOD DESIGN | BFT, MFT

Supervisors
Trang Anh Nguyen (PhD), Teresa Oliviero, Vincenzo Fogliano

MSc: Specific prerequisite course
-

Topic overview
In the last years, commercial generative artificial intelligence (genAI) tools such as ChatGPT, Deepseek and LeChat have gained popularity. GenAI tools can generate text, responses, pictures, audio tracks, videos and more. Their use seems promising as they can support students with understanding the material by asking questions back or by providing feedback on their answers.

However, despite them being promising, genAI tools are still not used a lot in education. Many teachers struggle to implement genAI tools, because they do not know how to use them and include these tools in their teachings. Furthermore, it is yet unclear whether these genAI tools can really help students achieve their learning outcomes.

Therefore, the aim of this project is to investigate how commercial genAI tools can be used to design or develop effective educational material.

Potential activities include:

- Investigate promising applications of genAI tools in education.
- Investigate if courses need to be improved and how this can be done using genAI tools.
- Design and develop new educational material that includes the use of genAI tools.
- If time allows, (develop), test and evaluate newly designed educational material in Food Technology courses via surveys and interviews.

Theme 2: Food Digestion & Health

The focus of this research theme is on the fate of food matrices along the entire gastrointestinal tract and the effect that this has on nutrients bioavailability, gastrointestinal health and sensory perception. This theme has two sub-themes.

Nutrient digestibility and bioavailability

The first sub-theme typically investigates food-related factors affecting nutrient digestibility and bioavailability as well as the ability to modulate gut microbiota structure and metabolism. Next to that, the potential beneficial effect of food components on gastrointestinal health (e.g., effect on gut permeability, inflammation, and immunomodulation) is investigated.

This sub-theme typically involves the following research questions:

- What is the effect of food formulation and processing on nutrients/bioactive compounds bioaccessibility and bioavailability?
- What is the effect of food formulation and processing on gut microbiota composition and functionality?
- What is the effect of specific food components on gut permeability, inflammation, and immunomodulation?

The main methodologies used in these topics are the physical and chemical characterization of the food matrix/food components, in vitro gastrointestinal digestion/colonic fermentation, characterization of microbial metabolites/change in microbiota structure, and biological assays on cell lines. By acquiring this knowledge, we can design food with optimized digestibility/bioavailability of nutrients, optimized effect on gut microbiota as well as an optimized biological effect on gut health.

Oral processing

The second sub-theme aims at acquiring scientific knowledge on how food structure is converted into dynamic texture perception by food oral processing. This knowledge is needed by the food industry to develop healthier and tastier foods. This sub-theme addresses the following questions:

- How can we understand fundamental physical and perceptual concepts determining texture?
- How are changes in food structure connected with changes in oral behaviour and sensory perception?

To obtain insights into the perception of complex textural attributes, the research employs traditional, static descriptive, and recently developed, time-resolved sensory methodologies (dynamic).

2.1 Effect of plant cell wall integrity and permeability on nutrient bioaccessibility and digestibility

FOOD DIGESTION & HEALTH | BFT, MFT

Supervisors
Edoardo Capuano

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview
In plant tissues, cells are surrounded by a cell wall that is made up of fiber, i.e., polysaccharides that are not digestible by humans. If cells are intact at the point of swallowing, cell integrity is maintained during digestion, which may have detrimental effects on nutrients bioavailability. By modifying the cell wall before digestion, nutrient release from the cells or the accessibility of macronutrients to digestive enzymes might be controlled and the utilization of nutrients optimized. Such modifications could be physical, thermal, enzymatic, etc.

Aim
Study the effect of cell wall integrity and permeability on macronutrients digestibility in plant-based foods and any other food where cells are surrounded by a fiber-based cell wall

Approach
Nutritionally relevant "cell-walled" foods (plants, fungi, bacteria, etc.) will be selected and processed. Macronutrients digestibility or bioactive compounds bio-accessibility will be studied in relation to cell wall integrity and permeability. A combination of structural (e.g. microscopic analysis, potentially also in combination with image analysis), chemical (e.g. pectin degradation), and physical (e.g. particle size distribution) assays will be used to uncover the cell wall integrity and/or permeability. Specific strategies can be tested to modulate cell integrity and cell wall permeability and thus, nutrients digestibility. This last will be monitored using in vitro models of digestion.

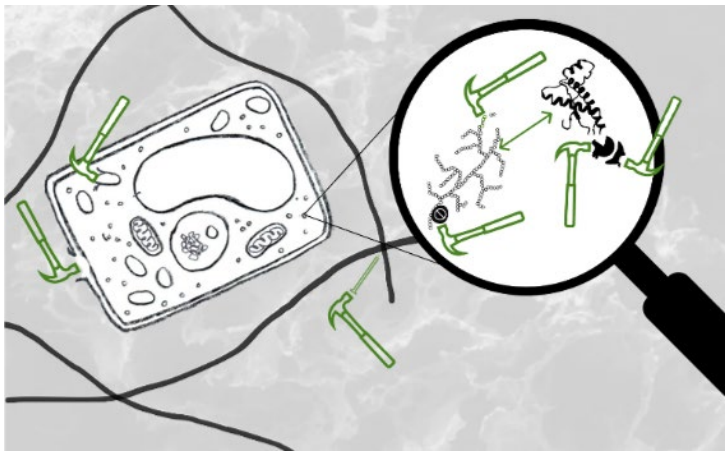
2.2 Tweaking bean macronutrient digestibility through modification of the cell wall integrity

FOOD DIGESTION & HEALTH | MFT

Supervisors
Edoardo Capuano, Gaëlle Boisset (PhD)

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview



Considering the nutritional and environmental benefits of pulses, the EAT-Lancet Commission recommends a minimum daily intake of 75 gram, which is a requirement that is met by only a few countries in the world. Food technology may contribute to a solution by improving the palatability of legume-rich diets through the incorporation of legumes in food products. However, it remains unclear whether the nutritional advantages, such as e.g. the low GI of legumes, are preserved during food processing. A plethora of studies have demonstrated the impact of the so-called food matrix on nutrient accessibility, digestibility and bioavailability through various mechanisms (see figure). This thesis focuses specifically on how the preservation of legume cell walls affect macronutrient digestion. While, several studies have shown that the cell wall delays starch digestion, more research is needed to understand if this effect persists within complex food matrices.

Objective
This study aims to explore the impact of legume cell wall integrity on macronutrient digestion, particularly when legumes are incorporated into food products like bread.

Activities
Select and apply relevant methods to produce flour with intact cell walls, followed by the creation of legume-based food products. Visualize and study the microstructure of these products using microscopy. Assess the effects of cell wall integrity by performing mechanistical research, studying digestion through in vitro models (e.g., the Infogest 2.0 protocol for protein digestion or the Englyst method for starch digestion) or through running a human intervention trial depending on the research progress and new insights in the field.

2.3 The digestive fate of plant pomaces

FOOD DIGESTION & HEALTH | MFT

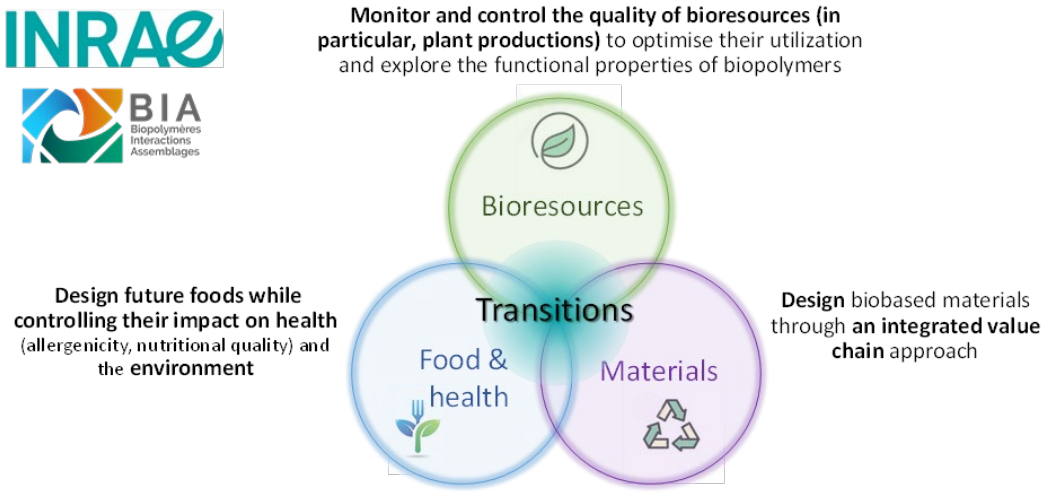
Supervisors
Claire Berton-Carabin, Edoardo Capuano

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview
In sustainable food process engineering, there is a growing interest in the valorization of food by-products (issued from cereal or fruit processing) as new food ingredients. However, the fate of these fiber-rich by-products is still not fully evaluated. From different plant pomaces and model systems, we propose a multidisciplinary approach (structural plant polymer characterization, in vitro digestion, analytical chemistry) to evaluate how different fiber structures influence their sensitivity to digestive enzymes.

Project information
This is an initiative within the framework of our long-standing collaboration with dr. Claire Berton-Carabin (visiting associate professor at FPE and appointed at INRAE's research unit BIA - Biopolymers, Interactions, Assemblies; https://www6.angers-nantes.inrae.fr/bia_eng/) in Nantes, France). To strengthen the bonds between both institutes, the BIA unit offers some thesis students to conduct their MSc thesis in Nantes.

Practical information
The whole thesis project will take place in Nantes from the start. Except for the examination, which will take place at FQD in Wageningen. A dedicated department will help the student with housing, opening a bank account, and other practical arrangements in Nantes. In addition, the student will receive an allowance of 600 euros/month to cover additional costs.



An overview of the research focus and approach of the BIA unit (Nantes, France) of INRAE, the French National Research Institute for Agriculture, Food and Environment.

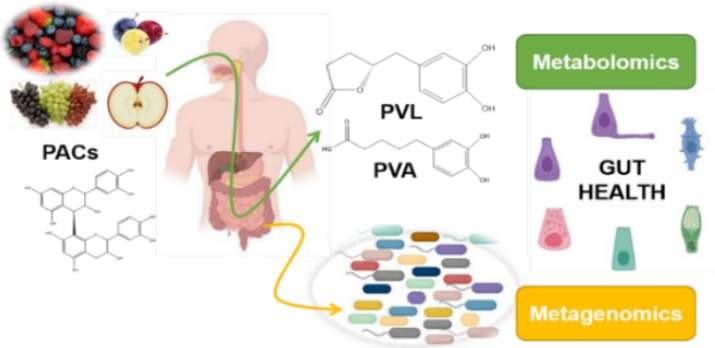
2.4 How do gut microbial metabolites promote gut health?

FOOD DIGESTION & HEALTH | BFT, MFT

Supervisors
Josep Rubert

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview
Dietary patterns, or the food we eat, are the sum of many small molecules foreign to the body. After being ingested and digested, nutrients are altered by the trillions of microorganisms that inhabit our gastrointestinal (GI) tract, shaping the chemical structures of such gut microbial metabolites (GMMs), and thus modifying the lifespan, bioavailability, and biological effects. Indeed, the diet–gut microbiota–host triangle evolves as a promising avenue in preventing GI diseases. If we eat vegetables and fruits rich in PACs, such as apples, pears, stone fruits, cranberries, blueberries, plums, among others, we may have a reduced risk of gastrointestinal diseases. Dietary fiber and PACs reach the colonic region almost intact, undergoing extensive microbial bioconversion, and producing phenyl-γ-valerolactones (PVLs), their derived hydroxy-phenylvaleric acids (PVAs), small phenolic acids, and short-chain fatty acids (SCFAs). These GMMs may play a pivotal role in promoting gut health. However, the type, quantity, and biological activity of GMMs in humans depend on the composition of gut microbiota. For this reason, it is becoming more and more essential to study the gut microbiota function



Aim
This topic aims at studying GMMs, such as PVLs, PVAs, and phenolic acids, and the gut microbiota composition. The interaction between gut microbiota and diet-related compounds (PACs and fiber) will be investigated by combining omics approaches. First, metabolomics will reveal the differences at the GMM level, and sequencing techniques will explore taxonomy and microbial function. This concept will generate and validate microbiome metabolic networks linking GMMs and microorganisms.

Approach
In this research, we will investigate the triangle diet-gut microbiota-host in vitro. Faecal fermentations will be carried out using faecal inoculums. Faecal Batch cultures or SHIME® (Simulator of Human Intestinal Microbial Ecosystem) will be used to mirror the colonic region and investigate biotransformation processes in homeostasis and GI disease. In the slurries, GMMs will be characterized by MS-based methods, and the composition of the gut microbiota will be revealed by metagenomics.

2.5 Digestive behavior of fiber-based aerogels in the gastrointestinal tract

FOOD DIGESTION & HEALTH | BFT, MFT

Supervisors
Ziqi Zhuang (PhD), Edoardo Capuano

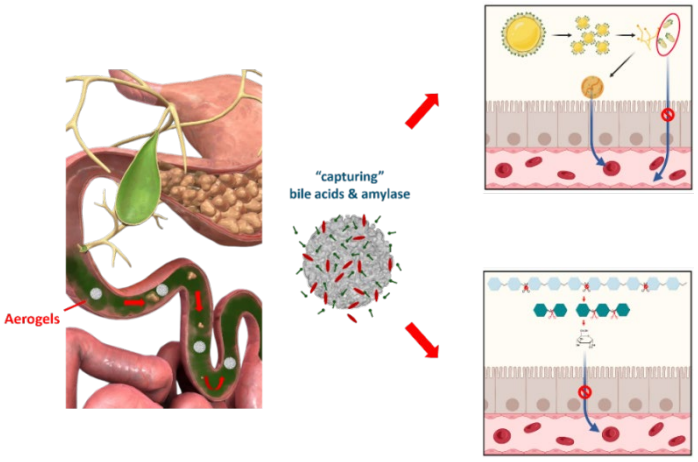
MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption or FCH32306 Fermentation and Gut Health or HNH30506 Principles of Sensory Science or MCB33306 Integrated Sensory Science

Topic overview
Aerogel is a novel material with broad applications. Aerogels have several interesting properties for example, low density, high surface area, high porosity, and excellent mechanical properties. They have been extensively used in biological engineering, food science, pharmacies, medicine, aerospace engineering, and textile, etc. In the meantime, different preparation methods have been developed with compatible technological breakthroughs. For example, freeze-drying, supercritical CO_2 drying, micro-emulsification method, spray freeze-drying, droplets jetting, and micro-fluidic method, etc.

In recent years, aerogels have been increasingly utilized in human-related applications, including wound healing, bone regeneration, and the encapsulation of bioactive compounds or pharmaceuticals. Their potential use in specific food applications, such as texture modulation, represents an emerging and innovative avenue. Furthermore, given their unique microstructural properties such as high porosity and surface area. It can be hypothesized that aerogels may interact with digestive fluids, thereby influencing digestion physiology. However, research on the behavior of aerogels within the human gastrointestinal tract remains highly limited.

Aim
The goal of this project is to characterize the behavior of aerogels in the human gastrointestinal tract and investigate how they can modulate digestive physiology, e.g. slowing down starch or lipid digestion and how this modulation is related to aerogels properties.

Approach
In this project you will produce fiber-based aerogels and characterize them in terms of microstructural and mechanical properties. After that you will characterize their digestive behavior during digestion using in-vitro models of digestion. This will include the stability of aerogels, the change in their structural and mechanical properties and the ability of aerogels to bind/entrap digestive enzymes (e.g., amylase) and bile salts during digestion. This may modulate starch and lipids digestion in a beneficial way for health.



2.6 Exploring the role of the gut microbiome as an auxiliary liver to deal with food contaminants

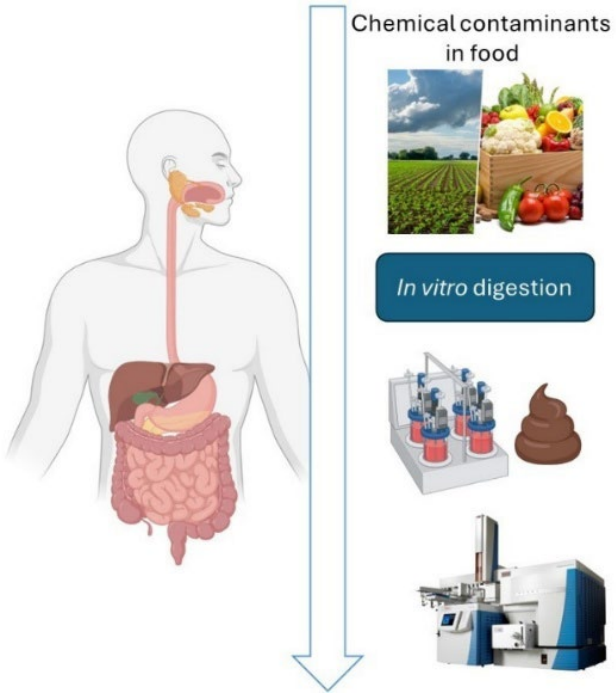
FOOD DIGESTION & HEALTH | BFT, MFT

Supervisors
Josep Rubert, Laura Righetti

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview
Emerging experimental evidence indicates that toxicant-induced alterations in gut microbiota composition and activity may affect host homeostasis. However, data from human studies are scarce, and we do not know whether these compounds affect the gut microbiome or whether the microbiome has the capacity to detoxify. The relationship between food contaminants and the gut microbiome is an area of increasing scientific interest, as it highlights the complex interactions that impact human health. Contaminants, such as mycotoxins, may affect the composition and function of the gut microbiome, leading to a variety of health implications.

To tackle this challenge, we will first explore the digestion of these compounds using different food matrices. As soon as we understand the biological fate of these residues and contaminants in the gastrointestinal tract, we will then expose the gut microbiome to them. We will study the capacity of these microbial communities to detoxify these compounds by exploring the metabolites released and markers of microbial stress. The activities to be performed range from *in vitro* digestion to the use of bioreactors and quantification of microbial-related metabolites.



2.7 Un-Brie-lievable: exploring the antibiotic effects of brie bloomy rind on the gut microbiome

FOOD DIGESTION & HEALTH | MFT

Supervisors
Josep Rubert, Guido Camps

MSc: Specific prerequisite course
FCH32306 Fermentation and Gut Health

Topic overview
Microbiome research poses significant challenges due to numerous confounding factors and unclear causal relations. Untangling the intricate web of interactions within microbial communities is a complex task. This research aims to shed light on the impactful role of relatively minor dietary behaviors on the microbiome, operating under the as-of-yet untested hypothesis that Brie cultures, such as *Candidum Penicillium*, may exert a substantial influence on the bacterial composition of the microbiome.

The exploration of these subtle dietary influences is crucial for understanding how seemingly minor components in our food, such as those found in Brie cultures, can have profound effects on microbial ecosystems. By focusing on the antibacterial properties of these cultures, particularly within the context of the bloomy rind, we endeavor to uncover previously unexplored dimensions of microbiome dynamics. This investigation not only contributes to the broader field of microbiome research but also provides a nuanced perspective on the potential impact of cheese cultures on microbial communities.

Aim
The main objective of this MSc thesis project is to investigate the antibacterial effect of Brie cheese cultures on the gut microbiome.

Approach
This project is in its early stages, providing the student with the opportunity to shape the research direction. Key thesis activities include conducting a thorough literature review, designing and implementing a small trial, and analyzing the data generated.

We are excited to welcome an independent and motivated MSc thesis student to join us in uncovering the microbial mysteries of cheese. If you are passionate about food science, microbiology, and conducting hands-on research, this project offers a unique opportunity to contribute to the field and gain valuable experience.

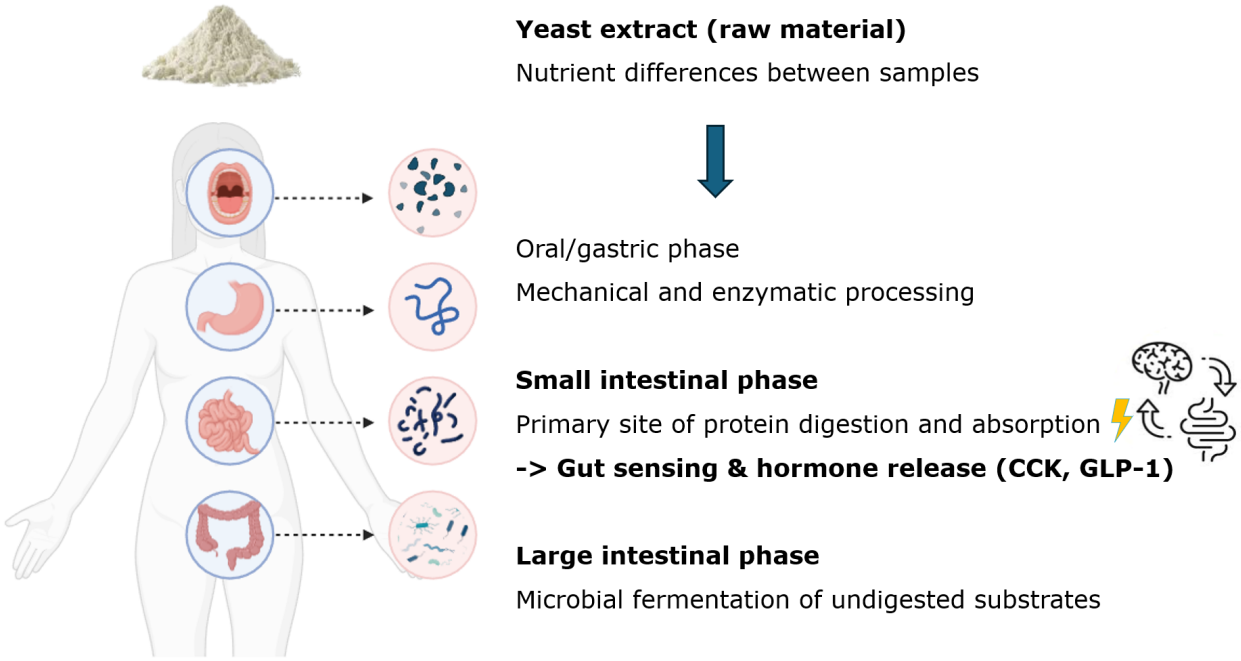
2.8 Protein Transition: Evaluating the nutritional value of yeast protein extracts

FOOD DIGESTION & HEALTH | MFT

Supervisors
Edoardo Capuano, Chuyu Ding (PhD)

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview
Yeast protein represents a promising alternative in the protein transition due to its lower resource requirements and favourable nutritional and gastronomical properties. Beyond serving as a protein-rich ingredient, yeast-derived protein may deliver health-promoting effects through its composition and interaction with the human digestive system. The origin (strains) of the yeast and the downstream processing (DSP) steps can influence the structural and compositional features of the extracts, thus influencing their digestibility and potential nutritional benefits. This project aims to understand the effect of yeast strains and DSP on nutritional quality, bioavailability, and physiological properties of yeast protein extracts.



The project aims to characterize yeast-derived protein extracts from different strains and processing methods in terms of nutritional quality and to assess their behaviour during digestion, intestinal interaction, and colonic fermentation.

In this research, we will investigate the entire journey of yeast extracts from raw materials through digestion, fermentation, and interaction with intestinal cells. Activities include proximate analysis (fibers, proteins, lipids, and other relevant components), in vitro digestion (INFOGEST Quant), in vitro colonic fermentation (SHIME), and selected cell-based assays, etc.

2.9 Protein digestibility of plant protein source combinations

FOOD DIGESTION & HEALTH | MFT

Supervisors
Els van Uffelen (PhD), Vincenzo Fogliano, Feike van der Leij (Inholland)

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption or FCH32306 Fermentation and Gut Health

Topic overview
Protein transition is crucial for constructing a more sustainable and resilient food system. Alternative protein sources need to be considered to develop comparable replacements for animal proteins. Plant sources with a high protein content that can be produced locally are especially of interest. Interesting plant sources include faba beans (Vicia faba spp. minor), water lentils (Lemna minor), and rapeseed (Brassica napus), which can all be grown in the Netherlands. The digestibility and essential amino acid (EAA) composition of many single plant proteins are less favourable compared to animal proteins. Therefore, it would be compelling to look into opportunities to combine plant protein sources.



Aim
This project aims to evaluate the effect of combining different plant protein sources, such as faba bean, water lentils, and rapeseed, on protein digestibility.

Approach
The protein digestibility of combinations of plant protein sources will be investigated using the standardized INFOGEST in vitro digestion model mimicking adult gastrointestinal conditions. During the in vitro digestion, samples will be collected at different time points during the gastric and intestinal phases and will be subjected to different analyses. The digestibility of plant protein source combinations will be compared to that of the single protein sources and animal protein sources.

Practical information
This thesis project, including writing and experimental work, will be conducted in the Inholland Amsterdam building. The student will receive a reimbursement of 400 euros per month to cover the extra expenses.

2.10 Understanding the role of fatty acid profile in the kinetics of lipid digestion in the presence of absorptive cells

FOOD DIGESTION & HEALTH | MFT

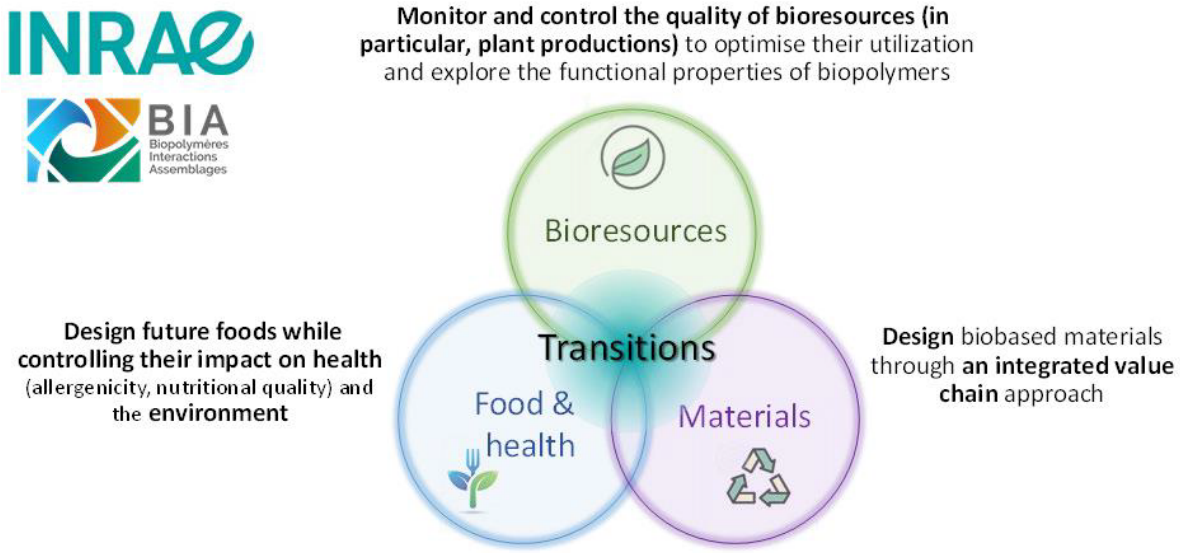
Supervisors
Sébastien Marze, Wieneke Dijk, Edoardo Capuano

MSc: Specific prerequisite course
HNH30706 Nutrient Breakdown and Absorption
or FCH32306 Fermentation and Gut Health

Topic overview
Dietary oils that differ in fatty acid composition are known to display contrasted lipolysis kinetics. Yet, the kinetics of the subsequent solubilization of lipolysis products in bile mixed micelles (bioaccessibility) and the kinetics of lipid enterocyte transport have not been systematically studied.

In this project, we plan to monitor lipolysis kinetics using a system combining digestion and a Caco-2 cellular monolayer, for emulsions made of different vegetable oils.

Experimental approach
To quantify transport kinetics, free fatty acids in both the apical and basolateral compartments will be measured as a function of digestion time. These data will provide new insights into the kinetic relation between lipid digestion and absorption.



An overview of the research focus and approach of the BIA unit (Nantes, France) of INRAE, the French National Research Institute for Agriculture, Food and Environment.

Practical information
The whole thesis project will take place in Nantes from the start. Except for the examination, which will take place at FQD in Wageningen. A dedicated department will help the student with housing, opening a bank account, and other practical arrangements in Nantes. In addition, the student will receive an allowance of 600 euros/month to cover additional costs.

2.11 Oleosin purification in a context of oilseed allergenicity

FOOD DIGESTION & HEALTH | MFT

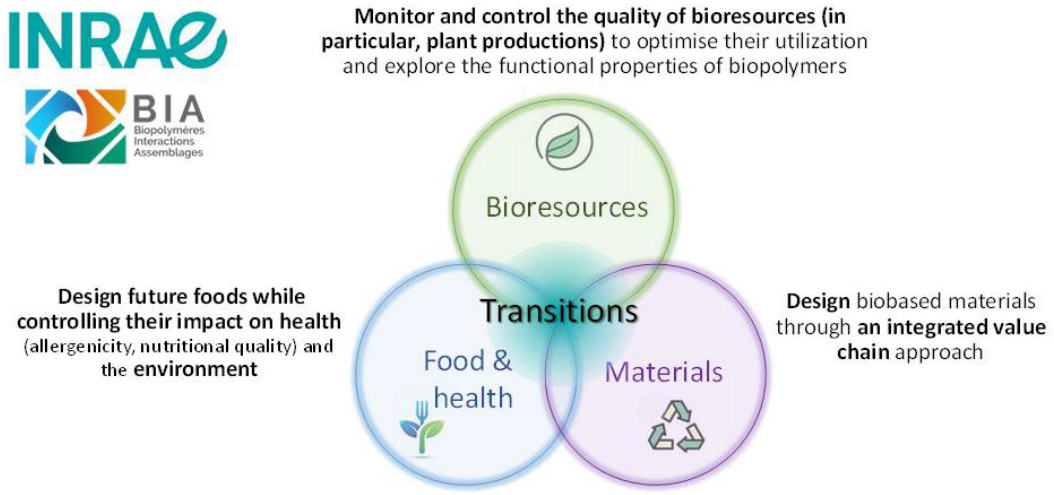
Supervisors
Tamara Hoppenbrouwers

MSc: Specific prerequisite course
-

Topic overview
This project explores the allergenicity of oilseeds. Oil body–associated allergens, including oleosins, are poorly represented in diagnostic extracts but they can provoke severe allergic reactions, especially in sesame-allergic patients.

Aim of the project
This study aims to compare different methods to extract oleosins from sesame seeds, including an innovative mild method aimed to preserving the native structure of oleosins.

Experimental approach
Upon extraction, protein composition and conformation will be assessed to verify their structural integrity. The reactivity of patients' sera allergic to the extracted oleosins will be evaluated using immunochemical methods (ELISA, dot blot, Western blot). As oilseed consumption continues to increase, the most valid method to extract oleosins will also be applied to other oil seeds, such as hemp seeds. This work will help to better understand the importance of oleosins in oilseed allergenicity, and might provide a method to improve oleosin-related allergy diagnosis.



An overview of the research focus and approach of the BIA unit (Nantes, France) of INRAE, the French National Research Institute for Agriculture, Food and Environment.

Practical information
The whole thesis project will take place in Nantes from the start. Except for the examination, which will take place at FQD in Wageningen. A dedicated department will help the student with housing, opening a bank account, and other practical arrangements in Nantes. In addition, the student will receive an allowance of 600 euros/month to cover additional costs.

Theme 3: Quality Along the Chain

In this research theme, you can find topics that investigate food quality along the supply chain. We investigate various food quality aspects from farm to fork, such as how farming/production practices can influence food quality, how to measure and/or predict and/or monitor these changes using statistical (e.g., advanced modelling and intelligence) and/or analytical tools (e.g., non-destructive sensors, handheld devices, advanced analyses, etc.).

There is increasing pressure on the food industry to become more environmentally friendly and sustainable. This means that changes need to occur at various levels in the supply chain. For example, farming practices can be changed/modified; changes can be made towards more efficient production/processing/storage/transport systems. Packaging design is a crucial component, aiming to create safe and environmentally friendly packaging that extends shelf life and reduces food waste. The goal is to strike a balance between high-quality food preservation and minimal environmental impact. However, there are various challenges that need to be addressed to be able to make these changes. Furthermore, it is of scientific value that we also seek to gain a deeper understanding of how the food product is being influenced. In the bigger picture, the data generated along the chain can also be effectively used to help us address these challenges.

This research theme includes topics that are focused on food and (specifically meat and postharvest) quality and supply chain integrity. We explore how intrinsic quality is influenced by various extrinsic factors such as farming practices, processing, storage, etc. This requires that we characterize the product's quality traits. These quality traits can then also act as a way of ensuring the authenticity and traceability of a product, especially in cases where the final product has an added value, i.e., organic, free-range, etc. In the past, a series of food fraud incidents have occurred (i.e., melamine, horse meat, organic eggs, cardboard stuffed dumplings) that demonstrate the vulnerability of the food systems. Hence, together with understanding the quality traits, we investigate ways to develop and validate methodologies to ascertain food authenticity. Mathematical modelling plays a significant role in this research theme, aiming to describe and predict the physical and chemical processes occurring throughout the food production and consumption chain. This provides valuable insights into the underlying mechanisms governing these processes, from production to home processing and consumption.

Quality Along the Chain is a comprehensive exploration of food quality and supply chain integrity, addressing the complexities of sustainability, packaging, authenticity, and the physical and chemical phenomena driving food processes. It aims to contribute to a more sustainable and transparent food supply chain while enhancing food quality and safety.

3.1 Food packaging – Sustainable package design

QUALITY ALONG THE CHAIN | MFT

Supervisors
Deniz Turan-Kunter, Maarten Smulders

MSc: Specific prerequisite course
FQD31306 Predicting Food Quality

Topic overview
Packaging is essential to preserve food quality and safety during storage, improve shelf-life and decrease food waste. However, because optimal protection is still attained using plastic materials, food packaging contributes in a significant way to environmentally persistent plastic waste and microplastic pollution. Sustainable, recyclable biodegradable packaging materials are seen as the solution in agendas such as the EU Circular Economy strategy. However, these materials do not provide sufficient barrier properties against gases such as water vapor and oxygen, which prevents their broad application in food packaging.

Tailoring the chemical structure of biopolymers aiming to achieve oxygen/water vapor barrier-mechanical balance without sacrificing the biodegradability is very challenging. Therefore, this thesis study aims towards a new class of recyclable and/or biodegradable barrier material and testing the package performance for preserving the food quality. This research will produce a new generation of barrier coatings, presenting a solution to the problem of sustainable food packaging, and generate new designs for further research in the field of bio-polymer synthesis.

Activities
You will perform a combination of literature research, laboratory research (including polymer synthesis) and data analysis.

3.2 Development of sustainable smart packaging solutions for fresh fruits and vegetables using nanocellulose-based materials

QUALITY ALONG THE CHAIN | MFT

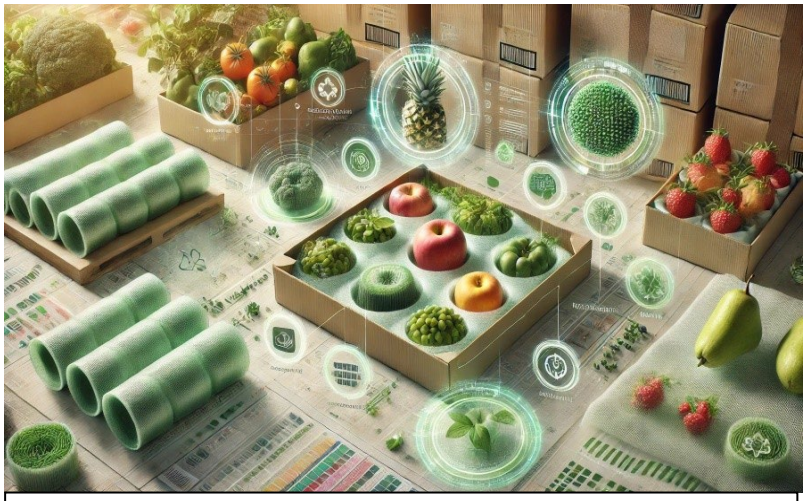
Supervisors
Deniz Turan-Kunter, Joice Kaschuk

MSc: Specific prerequisite course
-

Topic overview
Transportation-induced damage and moisture-related deterioration are major issues in the logistics of fresh produce, leading to significant postharvest losses. Traditional packaging materials, such as expanded polyethylene and polystyrene, are effective but pose environmental challenges due to their non-biodegradable nature. This project proposes to address these challenges by developing bio-based, biodegradable smart packaging solutions that combine mechanical durability with advanced sensing capabilities.

This thesis will explore the development of sustainable smart packaging solutions for fresh fruits and vegetables, focusing on optimizing packaging performance, reducing postharvest losses, and promoting environmental sustainability.

Activities
You will perform a combination of literature research, laboratory research (including polymer synthesis) and data analysis.



Conceptual representation of innovative sustainable food packaging for fresh fruits and vegetables, highlighting bio-based materials with smart sensor integration.

The design emphasizes eco-friendly materials, recyclable packaging, and the monitoring of transportation conditions to reduce food waste.

3.3 Active edible coatings from food by-products for food packaging

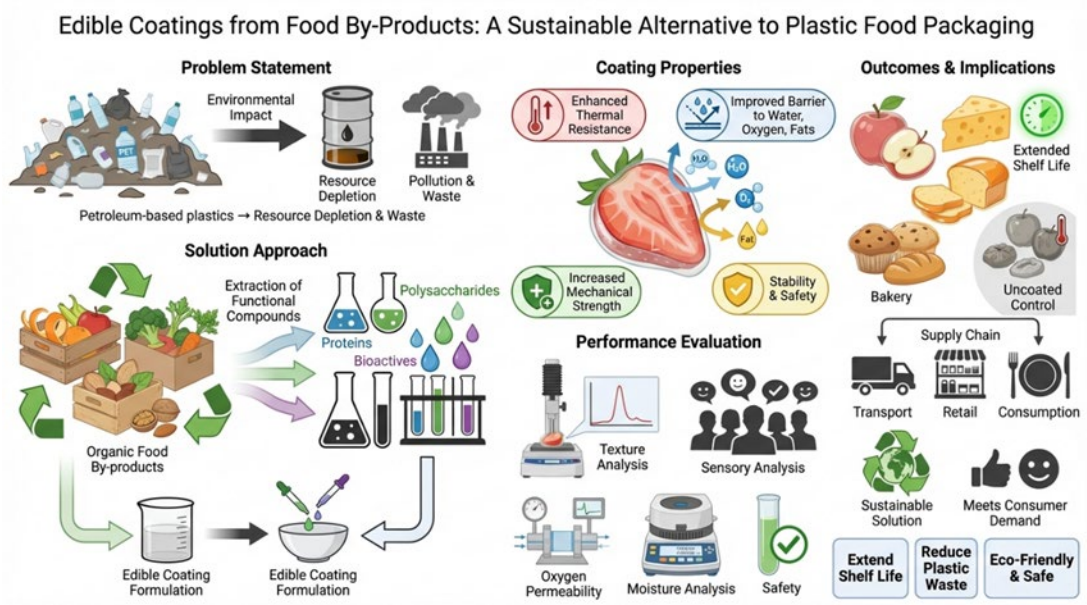
QUALITY ALONG THE CHAIN | MFT

Supervisors
Niloufar Sharif, Deniz Turan-Kunter

MSc: Specific prerequisite course
FQD40306 Predicting Food Quality

Topic overview
As natural resources diminish and global environmental waste increases due to the extensive use of petroleum-based plastic packaging, there is an urgent need to explore eco-friendly alternatives for traditional food packaging. In this context, food by-products and waste are potential sources that can be transformed into biodegradable and functional coatings.

This research focuses on developing edible coatings with enhanced heat resistance, barrier properties, and stability to improve the shelf life and quality of food products. These coatings can act as effective barriers against water, oxygen, and fat migration, helping to preserve food integrity and freshness throughout the supply chain. By improving mechanical strength and thermal resistance, these coatings support product stability from production to consumption.



The study involves extracting functional compounds from the food industry by-products and waste, formulating edible coatings with targeted functional properties, and evaluating their potential for various food applications in terms of barrier performance, mechanical characteristics, safety, and sensory properties. The findings aim to contribute to the development of sustainable food packaging solutions that align with environmental goals and meet consumer demand for safe, high-quality products.

Activities
You will perform a combination of literature review, laboratory research, and data analysis.

3.4 Liquid crystal-based optical sensors for intelligent food packaging systems

QUALITY ALONG THE CHAIN | MFT

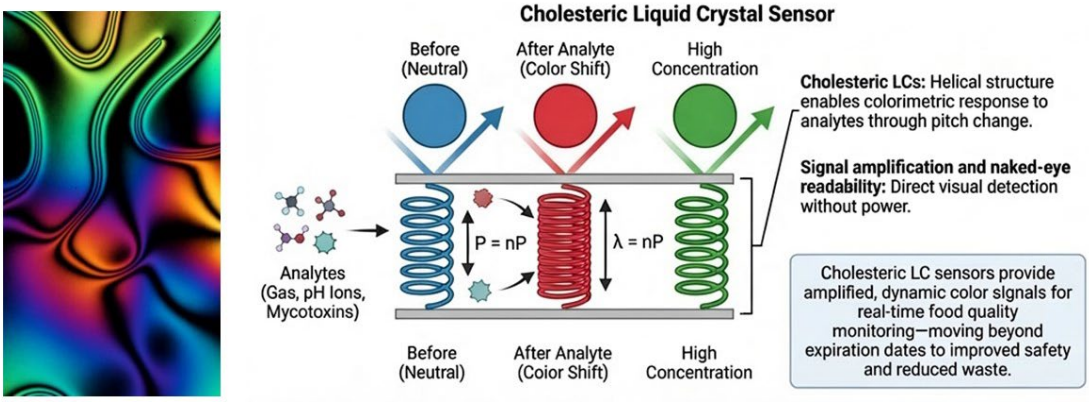
Supervisors
Niloufar Sharif, Deniz Turan Kunter, Siddharth Deshpande (Physical Chemistry and Soft Matter)

MSc: Specific prerequisite course
FQD40306 Predicting Food Quality

Topic overview
This is a topic in collaboration with Prof. Siddharth Deshpande from Physical Chemistry and Soft Matter (PCC)) and the main lab work will be carried out there.

Ensuring food quality and safety across complex supply chains requires real-time monitoring technologies that go beyond conventional expiration dates. Intelligent packaging integrates sensors, indicators, and data carriers into packages to track physicochemical and microbiological changes such as gas composition, pH, temperature, and microbial metabolites, thereby reducing food waste and food-borne risk. Within this context, liquid crystals have emerged as highly sensitive, optically readable, and low-power sensing materials whose orientational state changes in response to interfacial interactions with target analytes, producing easily interpreted dark/bright or color responses.

Liquid crystals are a fourth state of matter; they have greater ordering than more normal liquids but less ordering than crystalline solids. Specifically, cholesteric liquid crystals, with their helical mesogen arrangement, produce vivid, tunable structural colors that shift with analyte type and concentration, providing amplified, visually accessible signals. Such systems align well with dominant trends in intelligent packaging, where colorimetric and optical indicators are favored for their simplicity, low cost, and compatibility with consumer use. However, key challenges remain in integrating these sensors into real packaging formats (e.g., films, labels, or compartments), ensuring long term stability, safety of sensing materials, and scalability under industrial conditions.



This thesis proposes developing and characterizing cholesteric liquid crystal-based sensors for visual, real-time monitoring of quality indicators (e.g., gases, pH, specific contaminants), capable of providing more accurate information on food freshness and safety throughout storage and distribution.

3.5 Removal of food residues and printing ink from food packaging to facilitate recycling

QUALITY ALONG THE CHAIN | MFT

Supervisors
Deniz Turan Kunter

MSc: Specific prerequisite course
-

Topic overview
Recycling of post-consumer food packaging is often limited by contamination from residual food components and printing inks adhered to packaging surfaces. These contaminants can negatively affect polymer quality, recycling efficiency, and the safety of recycled materials. Conventional cleaning processes rely on chemical detergents and high temperatures, which may be energy-intensive and not always effective for complex residues such as fats, oils, proteins, or starch-based foods. Enzymes offer a promising alternative due to their ability to selectively degrade organic compounds under mild conditions. Understanding the interaction between enzymes, food residues, and packaging materials is essential to evaluate whether enzymatic cleaning can support more efficient recycling processes.

The aim of this thesis is to investigate the potential of enzyme-based treatments to remove food residues and printing ink components from commonly used food packaging materials and to evaluate their relevance for improved recycling performance.

The student will select representative packaging materials (e.g., PET, PE, PP); apply model food residues (e.g. fat/oil) and printed surfaces to simulate realistic contamination; perform cleaning experiments using selected enzymes; investigate the effect of process parameters such as temperature, pH, and treatment time; quantify residue removal and assess surface cleanliness using analytical and visual methods and interpret results in the context of packaging recyclability

3.6 Digital, physical, and emulated-twin modelling tools to optimize fresh fruit cold chains from tree to table

QUALITY ALONG THE CHAIN | MFT

Supervisors
Deniz Turan-Kunter, Taylor Person

MSc: Specific prerequisite course
FQD40306 Predicting Food Quality

Topic overview
Optimizing cold chains of fruits across all unit operations is of crucial importance to maintain fresh food quality and reduce food losses. Temperature and the gas composition in the air affect decay and fruit quality, so they need to be controlled during precooling, refrigerated transport, and cold storage. By optimizing these environmental parameters, shelf life can be maximized. Currently, extensive monitoring of the environmental conditions in food supply chains (air temperature and humidity) is performed. However, this information is not yet optimally used to quantify how the fruit feels and how its quality evolves throughout the cold chain.

Aim
In this project, we look to use sensor data to better predict how the life of each fruit and vegetable in a refrigerated container, truck or cold storage room. For that purpose, we develop different types of cargo twins:

- Digital twins (Figure – middle) that rely on measured air temperature and humidity data in fruit cold chains by commercial sensors. These data are fed into physics-based models to provide theoretical estimates of key performance indicators such as average cargo temperature, mass loss, and remaining fruit quality at the end of the chain. We upcycle the temperature-time data to obtain quality decay data as a function of temperature. These digital twin models entail computational fluid dynamics (CFD) simulations of airflow and heat transport in these cooling units.
- Physical twin sensor systems (Figure - right) that measure all relevant metrics that affect fruit quality evolution, such as pulp temperature, surface temperature, surface condensation and humidity, and acceleration. These sensor systems are integrated into a biomimetically engineered artificial fruit to have the same response as a real fruit.
- Emulated twin setup in the lab, where the measured physical twin environmental conditions in a real supply chain are mimicked in a lab environment, enabling experiments evaluating fruit quality over time in a controlled environment.

The choice between the type of twin that is focused on depends on the available supply chain contacts at hand.

3.7 Constructing the largest food structure-functionality database

QUALITY ALONG THE CHAIN | BFT, MFT

Supervisors
Yizhou Ma, Ziyun Zhong (PhD)

MSc: Specific prerequisite course
FQD40306 Predicting Food Quality

Topic overview
Food scientists spend a lot of effort characterizing food structures at various length scales. From measuring the size of a cookie to scanning an X-ray image of the same cookie to understand air bubble distributions, we measure a lot of food structures. Food structures are also indirectly measured through techno-functionalities - how ingredients interact with bulking media such as water, air, and oil. You may have done/heard of some of these tests before, such as water holding capacity, solubility, foaming/emulsifying capacity, etc.

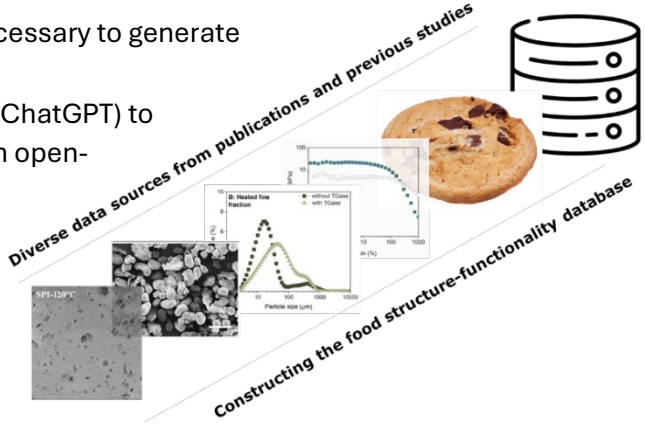
These measurements (i.e. data) normally end up in thesis reports, presentation slides, and research articles. A cold hard truth is that this data is almost never reused. Data are not reused because they are spread around, missing annotations (metadata), and exist in multiple formats (images, videos, curves, single number measurements, etc.).

It may sound like a mess, but it also presents a great opportunity. If we can reuse food structure data, we can enable cross-lab comparisons, systematic review of impacts of processing on food structures, and even build predictive models to understand the structure-functionality relationship – a constant pursuit in the field of food science and technology.

Aim:
This project combines literature research, web scrapping, and database configuration to construct (possibly) the largest food structure-functionality dataset.

Join this project if you would like:

- Develop systematic knowledge about food structure measurement techniques and their data structures
- Perform limited laboratory experiments if necessary to generate additional data for the database
- Program with large language model (such as ChatGPT) to scrape hundreds of food microstructure from open-source platforms
- Perform data analysis to reveal trends and draw patterns about food structure-functionality data



3.8 Predicting food quality changes based on neural networks

QUALITY ALONG THE CHAIN | BFT, MFT

Supervisors
Yizhou Ma

MSc: Specific prerequisite course
-

Topic overview
Food product quality evolves based on kinetic changes during processing (e.g., baking, frying, drying) and storage (e.g., color change, lipid oxidation, creaming, softening). Understanding these transformations is crucial for optimizing processing parameters and product quality.

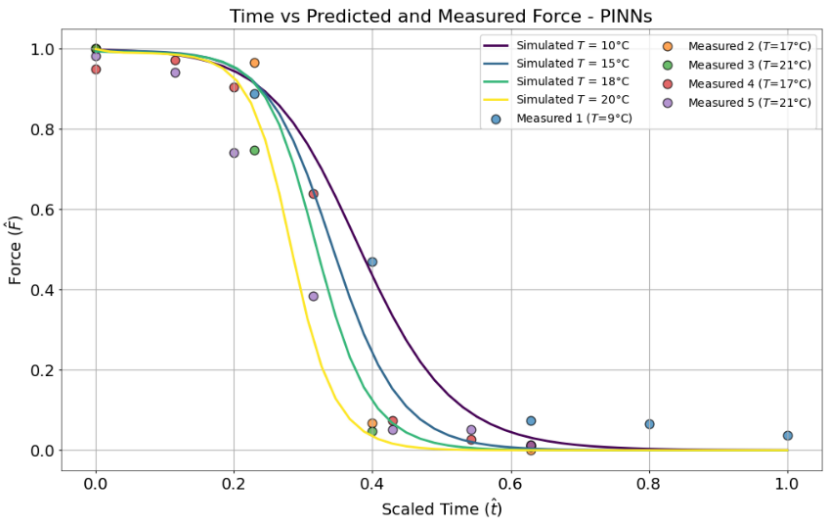
Traditional kinetic models rely on reaction kinetics and transport phenomena, which describe fundamental physical and chemical changes in food. However, these models often require extensive parameter estimations and experimental data. Neural networks offer a more flexible, data-driven approach to predicting quality changes. Long Short-Term Memory (LSTM) networks effectively model time-series data, capturing complex dependencies in food kinetics. Additionally, Physics-Informed Neural Networks (PINNs) incorporate scientific principles into neural architectures, enabling accurate predictions with limited data.

This thesis project explores LSTMs and PINNs for modeling food quality changes, aiming to unify data-driven and physics-based approaches. By reviewing existing methods and datasets, we seek to outline a computational framework that enhances predictive accuracy while improving data efficiency.

Join this thesis if you want to:

- Model complex food systems with data-driven approaches.
- Write modelling scripts in Python with the help of artificial intelligence.
- Making meaningful prediction models that the food industry can benefit from.

This is a desk research topic, but students must be comfortable with using programming languages (with the help of AI, of course).



3.9 Developing a database to unlock food packaging-quality interactions in foods

QUALITY ALONG THE CHAIN | BFT, MFT

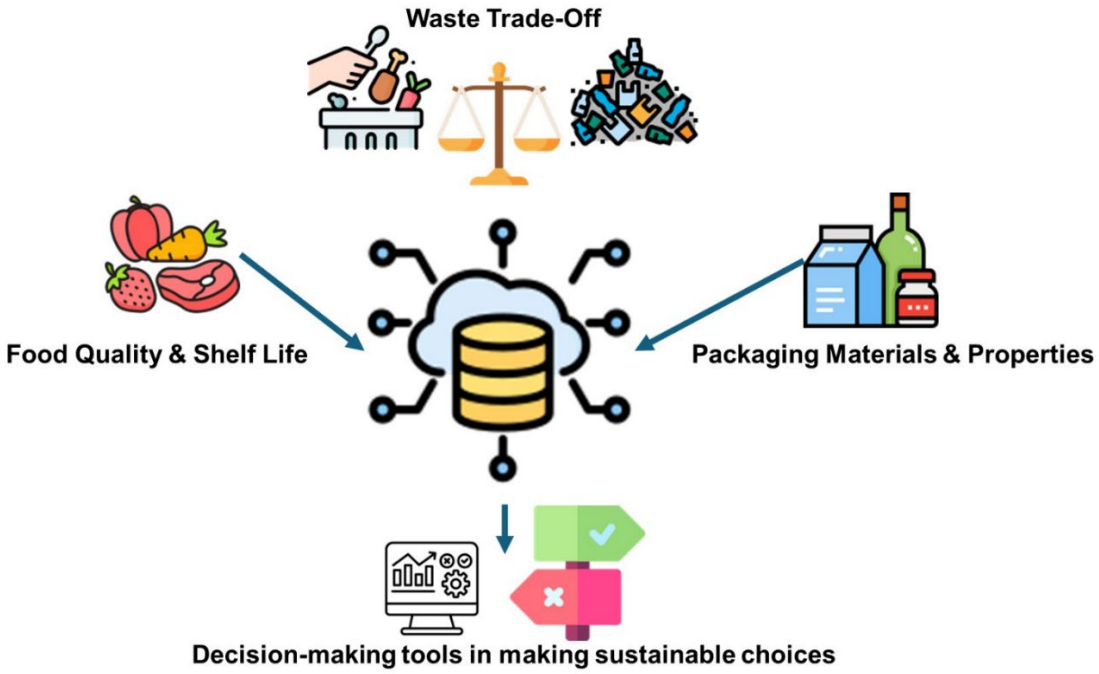
Supervisors
Deniz Turan-Kunter

MSc: Specific prerequisite course
FQD40306 Predicting Food Quality

Topic overview
Food packaging plays a critical role in preserving food quality and extending shelf life. However, there is an ongoing trade-off between reducing plastic waste and preventing food spoilage. While sustainable packaging alternatives are being explored, their impact on food quality and shelf life is not always well understood. A structured database linking food packaging materials with quality indicators can support data-driven decision-making to optimize both sustainability and food preservation.

The aim of this thesis is to develop a comprehensive database that consolidates information on food packaging materials, their barrier properties, and their impact on food quality attributes. The database will serve as a tool to support sustainable packaging decisions while minimizing food waste.

You will conduct a systematic literature review, collect and organize existing experimental data on packaging-performance relationships, develop a structured database framework to categorize food types, packaging properties, and quality outcomes, analyze trends to identify optimal packaging solutions for different food products and validate the database through case studies.



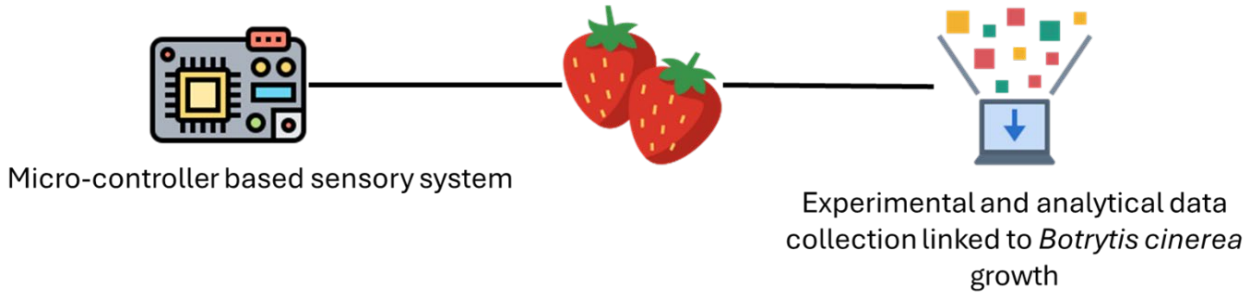
3.10 Sensor-based monitoring for early detection of Botrytis cinerea in strawberries

QUALITY ALONG THE CHAIN | MFT

Supervisors
Eda Coşkun, Deniz Turan-Kunter

MSc: Specific prerequisite course
FQD40306 Predicting Food Quality

Topic overview
Strawberries are among the most perishable fruits due to their high transpiration rates and delicate tissue, making them highly susceptible to post-harvest decay. One of the greatest threats to strawberry quality is Botrytis cinerea (gray mold), a fungal pathogen that significantly reduces shelf life. Intelligent packaging equipped with sensors offers a promising solution for real-time monitoring of environmental and biochemical changes associated with fungal growth.



This study aims to correlate sensor responses with strawberry quality deterioration to enable early detection of Botrytis cinerea before visible spoilage occurs. Various sensors, including gas sensors (for detecting VOCs released during fungal metabolism), and pH sensors (for acidity shifts caused by microbial activity) will be evaluated for their sensitivity and accuracy in predicting mold development.

Strawberry samples will be stored under controlled conditions, with mold development continuously tracked. Changes in pH, VOC profiles, and other key indicators will be analyzed using instrumental techniques. The data will be used to define sensor detection limits for Botrytis cinerea and assess the effectiveness of different sensors in providing early-warning signals for fungal spoilage. Ultimately, the findings will support the development of smart packaging solutions that help reduce food waste and improve supply chain management.

3.11 Does a happy animal equal quality meat?

QUALITY ALONG THE CHAIN | BFT, MFT

Supervisors
Sara Erasmus

MSc: Specific prerequisite course
-

Topic overview
Meat is one of the food sources with a high nutritional value, serving as a valuable protein source. As for any food product, high quality is important for consumers. The major components determining meat quality are yield and composition, appearance, technological characteristics, palatability, wholesomeness and ethical quality.

These properties are referred to as 'intrinsic quality', associated with extrinsic factors that define the way meat is produced. Some of these factors, like animal husbandry (e.g., breeding, feeding, management), are well known to affect the intrinsic quality of meat, whereas the influence of others like ecological sustainability of production systems is less known. This is largely since the latter has only recently started to gain more momentum with the need to switch to more sustainable systems.

Although the intrinsic quality of meat is important, there is increasingly more attention being placed on the extrinsic factors and how they link to the demands of society, and how they offer the prospect to develop consumer-led meat products and more market segmentation. With the demand for more sustainable animal husbandry practices, there is great pressure to produce meat that is still of high quality. Extensification is seen as a more 'sustainable' system with increased animal welfare. Hence, it is vital to explore the effect of 'extensification' on meat quality.

Aim
Your task would be to distinguish the importance of factors determining fresh meat quality. The aim of the topic is to assess the intrinsic quality of meat obtained from animals (e.g., chicken, pork, beef , etc.) produced under varying husbandry conditions. The main task will be to assess the intrinsic quality of meat in relation to extensive husbandry factors.

Approach
Perform a literature review and patent search to gather state-of-the-art information on the relationships between husbandry practices (i.e., extrinsic factors), intrinsic product quality (i.e., nutritional value, organoleptic quality, fat/lean ratios and sensorial features) and/or meat authenticity for pork and broiler meat. At the start of the thesis, together with the supervisor, a decision will be made about the approach (intrinsic quality) and type of analyses to focus on. Based on literature and standard practice, a standardised protocol to assess the intrinsic quality of the meat samples will be developed and used for the intrinsic quality testing.

3.12 Ensuring the integrity of the food supply chain: Authenticity and traceability challenges

QUALITY ALONG THE CHAIN | BFT, MFT

Supervisors
Sara Erasmus

MSc: Specific prerequisite course
FQD36306 Food Fraud and Mitigation

Topic overview

In the efforts to make food systems fair, healthy and environmentally friendly, it is vital that the food supply chain is free of food fraud. This means that every supply chain actor should be able to demonstrate the quality aspects of food, but also the traceability of their products.

Food fraud is a global issue that disrupts the normal market environment. It is a major concern for various supply chain actors and stakeholders. Food fraud incidents have a significant impact, generating considerable global monetary losses, eroding consumer confidence and trust in food products. Due to globalisation, food ingredients are sourced globally, while food supply chain networks have become more complex and adaptive in response to current world-wide incidents. There is also extra pressure to ensure that products from nature-positive food systems that enhance biodiversity and have lower environmental impacts do not fall victim to food fraud. The opportunities and motivations to commit food fraud prevail, while the adequacy of technical and managerial controls is not always sufficient to deter fraud. Although authentication techniques perform well in detecting fraudulent vulnerable food quality traits, the defence is passive, while an approach to actively prevent the fraud crimes happening in the early stage needs to be investigated. To improve food supply chain integrity, it is required to elucidate risk factors contributing to food fraud vulnerability and study advances that can help in the fight against food fraud.

Objectives

The main objectives are to elucidate economic/criminological risk factors contributing to food fraud vulnerability, discern markers which substantiate the identity of food products and to study advances that can help in the fight against food fraud. Such information on vulnerability and detection options and/or advances will help to set up food fraud management systems.

In this thesis, your tasks are:

- To explore food fraud risk factors from product and business perspectives
- To develop novel methodologies (analytical- and sensor-based techniques and/or digital technologies) to ascertain the authenticity and/or traceability of food product constituents
- To advance detection techniques to substantiate the history of food products, i.e. the production system (e.g. organic, halal), provenance (geographical origin), and processing.

3.13 Exploring the potential of spectral imaging to address food quality and or authenticity challenges

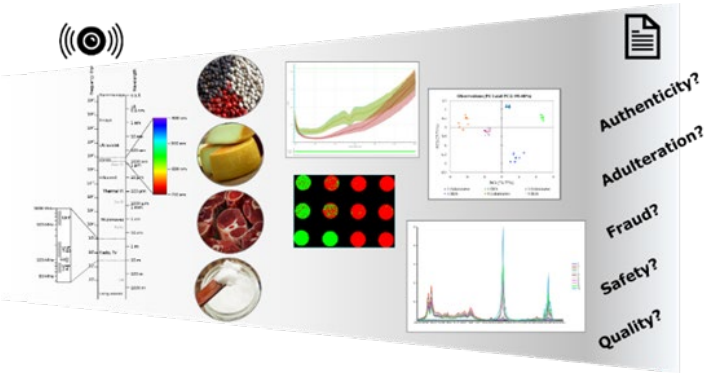
QUALITY ALONG THE CHAIN | BFT, MFT

Supervisors
Sara Erasmus, Joseph Peller (WPR)

MSc: Specific prerequisite course
FQD36306 Food Fraud and Mitigation

Topic overview
The advancement of technology enables scientists to actively address food quality and authenticity challenges through the development of innovative analytical techniques. The food industry is implementing these advances and techniques into their production systems to stay up to date and improve product quality, authenticity, safety and nutrition. In addition, if a technique could replace or reduce the usage of traditional methods it is always advantageous to explore. Spectral devices (spectral imaging) are increasingly used as rapid, objective and non-destructive analytical tools instead of expensive, invasive, time-consuming and destructive traditional laboratory techniques. Various applications still require research into these techniques to be used successfully in the industry. Hence, it is important to explore the use of spectral imaging in the food industry to address food quality and authenticity challenges.

Aim
The aim of the study is to explore the use of spectral imaging (i.e., near-infrared spectroscopy, (hyper)spectral imaging, Raman spectroscopy, etc.) to study the quality (including safety and nutritional aspects) and/or authenticity of food products.



Approach
Use spectral imaging (or sensor technology) to solve quality-related issues for various food products, for example:

- Meats: to examine different animal muscle cuts and meat products.
- Oils and fats: for detection of virgin coconut oil adulterated with palm oil/lard.
- Dairy products: to examine and monitor quality issues regarding cheese, infant formula or yogurt.
- Spices: detection of the foreign biological material (adulterants) in spices.

The food products can vary and will be decided when the student starts with the topic.

Theme 4: Consumer Science

The consumer science team of the chair group Food Quality and Design (FQD) aims to generate consumer insights that can be used to optimize product development, use and quality. Therefore, FQD focuses on the interaction between consumers and products with which the consumer gets in touch in a certain context. Interviews, focus groups, or observations are often used methods to study consumers, sometimes supplemented by questionnaires.

The consumer science team of FQD is engaged in:

- Studying consumer needs and wishes
- Understanding the daily life context of the consumer to solve complex consumer issues
- Analysing the interrelationship between consumers and products/services to gain insight into consumption patterns and behaviours
- Translating consumer insights into guidelines for other stakeholders to enable optimisation of the consumer context and experience

4.1 Consumer behaviour and food quality

CONSUMER SCIENCE | BFT, MFT

Supervisors
Pieter Groen (PhD)

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
Hardly any research is done on consumer handling and practices at home with food products. How are products stored and prepared and how do these practices influence the final product quality? To gain more insight into these behaviors, consumer research in daily life situations is needed to understand practices and motives behind these practices. The research methods used will be in home observations and interviewing consumers. Students can also focus on consumer perception, understanding and/or acceptance of new products and/or ingredients and assess best ways to inform consumers about this. When these final steps in the food production-consumption chain are considered during product design, possible quality loss can be prevented by anticipating the behavior of the consumer.

This type of research needs to be done with all food products, according to the students' own preferences: e.g. vegetables (including 'new' products like sea weeds), dairy, meat, meat replacers (incl. insects), convenience products etc. Examples of products recently studied are broccoli and carrots as part of a hot meal. Also, the influence of in-home behavior on the quality of ready-to-eat meals has been studied.

The aim of the project will be to generate knowledge that can be used to improve product design and/or to inform consumers about more appropriate food handling.

Students are also invited to define a topic of their own interest in which food products/ ingredients and food quality is studied from the consumer perspective.

4.2 Children's perception of plant-based food alternatives

CONSUMER SCIENCE | MFT

Supervisors
Lotte Pater (PhD), Bea Steenbekkers

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
The shift of consumption from animal- to plant-based food alternatives is one of the major food-related challenges in the coming decades, considering the negative impact of animal-based food production and consumption on the environment, animal welfare and human health. Plant-based alternatives have the potential for mainstream acceptance and consumption but will only become part of consumer's habitual everyday diet when they provide a rewarding product experience and are accepted.

Families could play an important role in the mainstream acceptance and consumption of plant-based alternatives. Food perceptions and preferences of children are of great influence on parents' food choice and children can have a promising influence on the consumption of plant-based alternatives of the whole family. Attempts to understand consumer acceptance and to direct consumers towards plant-based alternatives have limited potential unless children are convinced to eat those alternatives. As children have a pivotal role as actors of environmental change, starting at the dinner table, a deep understanding of children's perception of plant-based alternatives is needed to effectively transit from an animal- to a plant-based diet.

Aim
The aims of this project are:

- to understand children's perception of plant-based food alternatives and the influence of product-related and context-related factors on this perception.
- to understand children's influence on plant-based food perception and choices within the household
- to develop an innovative qualitative mixed method design for investigating children's perception in a more accurate and valid way.

Different traditional and novel qualitative research methods can be used, applied and evaluated to enhance the effectiveness of qualitative research in understanding children as a target group. Creating a deep understanding of children's perception of plant-based food alternatives enables the development of plant-based alternatives that better fit children's needs and wishes, for current and future plant-based food innovations.

4.3 Acceptance of edible insects by school children: A cross-country study

CONSUMER SCIENCE | MFT

Supervisors
Lotte Pater, Maryia Mishyna

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
Tactile stimuli with food have been demonstrated to be an alternative strategy to reduce children's natural neophobic reactions. In light of the growing demand for alternative protein sources, edible insects have been promoted as a nutritious and sustainable source of protein. However, many consumers are still unwilling to eat insects due to the perceived disgust of insects and neophobia regarding insects.

The present project aims to evaluate the effect of information provision on children on their willingness to taste and on their hedonic response to foods containing insects. The study can be done as a comparison between two countries: the Netherlands and Italy.

Information about two types of insects (grasshopper and mealworm) will be gathered and incorporated into the activities, where children will evaluate their hedonic responses to insect-based snacks. Children aged 9 to 11 years old will be recruited from local schools in Turin and if possible/desired from schools in the Netherlands.

Activities to be performed by the student will comprise:

1. Collect and prepare an interactive presentation for children about the benefits of insects and their use as foods information (lecture/workshop).
2. Assistance during the lectures/workshops, and hedonic test which will be provided at the beginning and end of the workshop.
3. Collecting and analyzing data.

The project will involve interaction with children in their mother tongues, therefore it is mandatory to have proficiency in Dutch and/or Italian languages. Also, the project can allow a student to apply for Erasmus Grant and stay for some time in Turin, Italy.

4.4 Consumer perception of hybrid meat

CONSUMER SCIENCE | BFT, MFT

Supervisors
Pieter Groen (PhD)

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
The production of meat is negatively linked to environmental problems like pollution, animal welfare, deforestation, depletion of natural resources, etc., while on the other hand the overconsumption of meat is related to public health issues like cardiovascular diseases, diabetes and colorectal cancer. To move consumers to a more plant-based diet, many meat substitutes are launched on the market, especially meat analogues that mimic the appearance, taste and texture of animal meat. Although consumers show a general interest in consuming alternative protein sources, research shows that the actual meat consumption per capita (NL) is still growing. Actual consumption of meat substitutes/analogues remains low, which suggests that the products that enter the market do not (yet) meet consumers' expectations.

A growing trend in both research and society is that of hybrid meat**:** a product consisting of both 'real' meat and more sustainable plant-based ingredients. With hybrid meat products one could aim to decrease consumers' meat consumption without cutting it completely from their meals. Such products might convince regular meat eaters to consume less meat.

Research on consumers' perception of hybrid meat products is still very limited. There are several aspects within this topic that could be interesting to study. For example, regarding perceptions of different 'type of consumers' (e.g. omnivores, flexitarians, etc.). Or more related to the composition of the product: what type of meat and plant-based ingredients, and in what ratio? It might also be interesting to study how such products should fit in a consumer's diet, how it has to be named or categorized, etc. The exact research question can be decided upon in collaboration with your supervisor.

4.5 Consumer perception & co-creation of authentic vegetarian meals

CONSUMER SCIENCE | BFT, MFT

Supervisors
Pieter Groen (PhD)

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
One of the main societal challenges nowadays is to shift the production and consumption from animal proteins to plant-based proteins, since the production and (over) consumption of meat is negatively linked to environmental problems and public health issues. Various strategies are used to direct consumers towards a more plant-based diet, with a main strategy being the development of substitute products that mimic the appearance, taste and texture of animal meat. However, the actual consumption of these products remains low, resulting in an actual meat consumption that remains (too) high.

In scientific literature much attention is being paid to the consumer's perception and acceptance towards single meat substitute products, while it is just as important to study the meals in which these substitute products are used. Recent qualitative research amongst flexitarian consumers even suggested that those consumers who successfully lowered their meat consumption in the main meal mainly did so by reformulating their entire meal composition instead of substituting meat. These consumers talked about "authentic vegetarian meals" without the use of meat substitutes. They expressed a desire for a completely different culinary experience and to explore unique meatless dishes that deviated from traditional meat-centric recipes.

This thesis focuses on how these so-called "authentic vegetarian meals" should be constructed according to consumers wishes and perceptions, and if and how these can further foster the shift towards the consumption of more plant-based meals. The exact research question can be decided upon in collaboration with your supervisor, but might go in the direction of:

- What are consumers' wishes/perceptions regarding "authentic vegetarian meals"?

Possible research methodologies are interviews, focus groups, consumer co-creation. A combination with sensory research is also possible.

4.6 Information on food labels and consumer research

CONSUMER SCIENCE | BFT, MFT

Supervisors
Esther Oldenhuis, Ruud Verkerk

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
Are you interested in exploring how food labels influence consumer perceptions and behavior? When deciding what to eat or drink, consumers often must rely on the product's packaging and label as their first source of information. While part of the information on food labels is legally required, much of what appears on the front of the package is voluntary information, which the company uses to communicate to the consumers.

What specific information do companies choose to share on the labels, how does this relate to the expected and perceived food quality and how does this shape consumer perceptions and behavior? Is the information clear and transparent to consumers, what type of information does consumers want and need, what claims are being made on the label and how can this influence consumers?

To explore these questions further, consumer research is needed. BSc and MSc students are invited to define a topic of their own interest that examines food labelling from the consumer's perspective. Potential areas of research include, but are not limited to Nutri-Score, nutrition or health claims, sustainability information, logo's, country-of-origin information, allergen information, usage instructions, disposal guidelines, QR codes, accessibility of the information etc. This research will contribute to a better understanding of how label information affects consumers' perceptions and behavior.

4.7 Consumers' perception of upcycled food

CONSUMER SCIENCE | BFT, MFT

Supervisors
Lotte Pater

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
Upcycled food (i.e. products made from ingredients that would otherwise go to waste) has emerged as a sustainable solution to global food loss and waste. While its environmental and economic benefits are widely discussed, consumer acceptance remains a crucial factor in its success.

This topic aims to explore how consumers perceive upcycled food in terms of quality, safety, sustainability, value, etc. It will examine the role of awareness, labeling, and trust in shaping perceptions, as well as potential barriers such as skepticism or negative associations. The findings will provide insights into strategies for improving consumer acceptance and promoting upcycled food as part of a sustainable food system.

4.8 Consumer perception on the use of real-time quality indicator labels in the food sector

CONSUMER SCIENCE | MFT

Supervisors
Deniz Turan Kunter, Lotte Pater

Specific prerequisite course
FQD24806 Qualitative Consumer Research in Food Design

Topic overview
Smart labels that provide real-time information about food freshness and quality have the potential to reduce food waste and support better purchasing and consumption decisions. However, the success of such technologies depends strongly on how consumers understand, trust, and use the information provided by these labels. Despite increasing technological development of real-time quality indicators, there is limited empirical evidence on how consumers interact with these labels and how they influence decision-making during purchasing, storage, and consumption.

The objective of this MSc thesis is to evaluate consumer perception, understanding, and acceptance of real-time quality indicator labels in the food sector. The student will conduct comprehensive consumer behavior studies to assess how end-users interpret and respond to smart label information. Activities include designing and distributing questionnaires, analyzing consumer attitudes, trust, willingness to use such labels, and perceived benefits related to food safety and waste reduction. The research will also explore differences across consumer segments and product categories.

Based on the collected insights, the student will contribute to the development of a demonstrator smart label concept that reflects consumer needs and expectations. The outcomes will provide practical recommendations for improving the design and communication of smart labels, ensuring that the technology aligns with market needs and supports broader adoption in the food system.

Theme 5: Dairy Science & Technology

The dairy industry is an important player within the food industry, not only by making dairy products, but also through the production of a broad range of dairy-based ingredients. The dairy science & technology research focuses on understanding the physical & chemical properties of milk components, as well as the impact of dairy processes on these properties. This understanding can contribute to product and process innovations, e.g., infant formula that better resembles the composition of human milk or improved texture and flavour of cheese. This knowledge is not only useful within the dairy industry, but also within the food industry, because dairy-based ingredients are used in a wide range of food products.

Dairy research is not limited to the traditional dairy chain. We also perform research related to the protein transition, such as the production of animal-free milk as an alternative for animal-based milk, using proteins that have been recombinantly produced, e.g. by micro-organisms. As such, a thorough understanding of the physical-chemical properties of milk components is required.

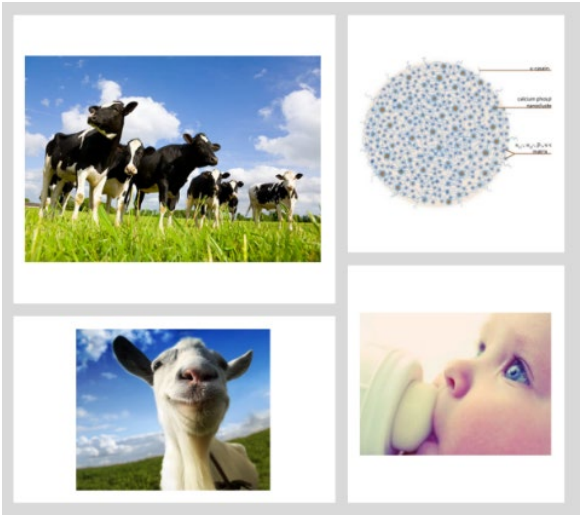
5.1 Exploring variation in milk protein composition within and between species and its potential for dairy product innovation

DAIRY SCIENCE & TECHNOLOGY | BFT, MFT

Supervisors
Etske Bijl

MSc: Specific prerequisite course
FQD33306 Dairy Chemistry and Physics or
FQD32306 Dairy Science and Technology

Topic overview
Large variation exists in milk composition between species such as cows, goats and humans. While the major milk components for all these species are proteins (serum and casein fraction), fats and carbohydrates, the amount of these components in milk varies considerably as well as their chemical composition and structure (e.g. casein micelles and milk fat globules). To illustrate this; if we look at the protein fraction the extent of variation between species is remarkable; fast-growing animals such as rabbits can have milk with 9 % casein, while human milk only contains 0.6 % casein. Also, the composition of the casein fraction varies: While the bovine milk protein fraction consists of four caseins; αs1-casein, β-casein, αs2-casein and κ-casein, milk of humans and mares contains no or little αs2-casein, and elephant milk contains only β-casein and κ-casein. Also, within species, e.g. different breeds of cows and goats, large variation exists in composition and structures.



Knowledge on variation between species and within species is highly relevant to understanding how techno-functional properties such as renneting behavior or heat stability are affected. Moreover, human breast milk composition is considered the gold standard for providing optimal nutrition for infants. Therefore, a clear understanding of differences between and within species is necessary to design products with an optimal nutritional profile.

Aim
In this project we want to further explore natural variation in milk composition, structure, and effect on dairy product properties to create opportunities for future dairy product innovations.
The objective of your thesis project will be defined together with the supervisors based on your interest and ongoing research. Some examples of past and ongoing projects:

- Natural variation in composition and functionality of goat milk caseins
- Spotting new opportunities to determine breast milk composition
- Understanding the structural differences between casein micelles in human milk and bovine milk
- The variation in milk composition between different cattle breeds from the Netherlands, compared to breeds from other countries in Europa and Africa

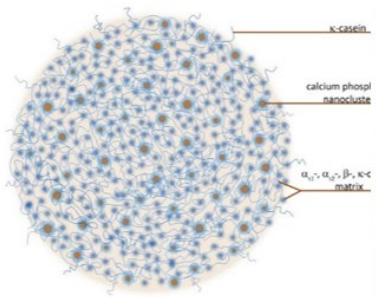
5.2 Towards animal-free dairy products

DAIRY SCIENCE & TECHNOLOGY | BFT, MFT

Supervisors
Etske Bijl, Kasper Hettinga, Zekun Fan,
Renske Bouma (PhD), Stefan ten Voorde (PhD)

MSc: Specific prerequisite course
FQD33306 Dairy Chemistry and Physics or
FQD32306 Dairy Science and Technology

Topic overview
Milk from cows is an essential source of protein in the Western diet. The major protein fraction in milk are the caseins, which are mostly organized into supramolecular structures called casein micelles. These colloidal structures are essential in obtaining the characteristic structure of dairy products such as cheese and yogurt. Next to that, milk contains whey proteins that are important functional agents in the food industry. Unfortunately, dairy production has a large impact on the environment, and the available alternatives (often plant-based) generally fail to reach nutritional and sensory parity.



Aim
In this project we aim to develop sustainable alternatives for milk proteins by researching a new animal-free source: recombinant proteins produced by microorganisms (e.g. bacteria, yeast or fungi). We compare their composition, structure and functionality to the ones found in cow's milk and think about how we can produce them into new dairy analogues.

Approach
Many aspects of these new proteins need to be studied and compared to traditional sources and ways of processing (e.g. composition, purity, structure, renneting behavior, texture and flavor formation, etc.). As availability of recombinant proteins is still limited, in some of the projects we will still use caseinate and individual casein/whey fractions from cow's milk as models to study how the new source would behave. The objective of your thesis project will be defined together with the supervisors based on your interest and ongoing research.

5.3 Immune-active proteins and peptides in bovine and human milk

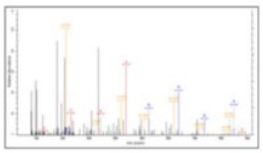
DAIRY SCIENCE & TECHNOLOGY | BFT, MFT

Supervisors
Kasper Hettinga, Siwei Li (PhD),
Corinna Szedlak (PhD)

MSc: Specific prerequisite course
FQD33306 Dairy Chemistry and Physics or
FQD32306 Dairy Science and Technology

Topic overview






Heating of human, bovine and goat milk has all been shown to influence the healthy immune development of newborn infants. Therefore, heat-labile components are expected to cause this difference between breastfeeding and infant formula. Proteins are generally the most heat-labile milk component, so the immune effects of milk may be caused by this class of heat-labile protein components. The mechanisms that underline the decrease in native milk proteins are not well understood. Denaturation and aggregation kinetics of single proteins have been studied in model systems. However, in the case of milk, these processes will be more complex. It has for example been shown that denatured proteins may aggregate with other whey proteins and/or casein micelles. However, the extent of these reactions is often unclear. To solve this, non-thermal processing methods can be used (e.g. UV-C, thermo-ultrasonication, or high-pressure processing), as these may limit the damage to the immune-active milk proteins. In addition, to better understand the role of immune-active proteins, studying human milk, as the gold standard for infant formula, can lead to novel insights in the role these human milk proteins play in the health of the newborn infant.

This topic consists of multiple subprojects, of which the overall aim is to study the effect of thermal and non-thermal processing on milk proteins in general and immune-active proteins in particular.

Objectives

1. Characterize the heat damage to immune proteins in milk from different mammals during heat processing.
2. Determine the effect of non-thermal processes on immune-active proteins in comparison to regular thermal processes.
3. Understand the effect of human milk composition on infant health outcomes.

Methods

1. For the first two research objectives, after processing native proteins will be separated from aggregated proteins, and both classes of proteins will be quantified using proteomics methods.
2. For the third research objective, this project is related to a large cohort study in which huma milk samples and infant health data are collected, aiming to understand functionality of immune active milk protein.

5.4 Exploring dairy processing and ingredient changes to determine its effect on a final product's attributes

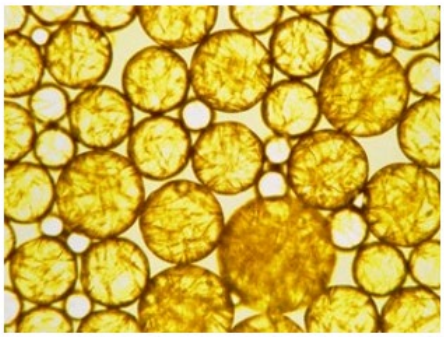
DAIRY SCIENCE & TECHNOLOGY | BFT, MFT

Supervisors
Kasper Hettinga, Etske Bijl, Qing Ren, Yuqing Zhong (PhD), Ruiwen Sun (PhD)

MSc: Specific prerequisite course
FQD33306 Dairy Chemistry and Physics or
FQD32306 Dairy Science and Technology

Topic overview

Dairy products play a key role in the human diet and nutrition throughout the world. In the coming years, industry will have to find sustainable methods to provide nutritious products to the growing population. This may involve optimizing the way dairy products are processed, exploring the use of new ingredients or determining the impact of processing on nutrient availability.



Understanding the structure of a dairy product is critical as this dictates the final characteristics such as physical stability, texture, structure, etc. The structure is greatly impacted by two factors: processing and ingredient formulation. In this project, different processing techniques and different dairy components will be tested for their potential use in the dairy industry. This type of research would include using e.g. texture analysis, detailed composition analysis to determine fat, protein, moisture, ash, and lactose content, structural analysis and analysis of product properties like digestion.

Objectives

This thesis topic includes multiple different projects, that can include studying various dairy products such as cheese, infant formula, etc. with the main objectives being:

1. To elucidate the relationship between different processing techniques on the final quality of the chosen product (such as physical stability, cheese making, digestion).
2. What compositional differences (protein composition, milk fat globule membrane) affect product properties.
3. To study the effect of various ingredient substitutions in dairy product formulations to understand their impact on the final consumer good.

5.5 Effect of processing-induced changes on digestion and functionality of dairy components

Dairy Science & Technology | BFT, MFT

Supervisors
Kasper Hettinga, Qing Ren, Marit Navis, Marialena Chrysanthou, Yifan Liang (PhD)

MSc: Specific prerequisite course
FQD33306 Dairy Chemistry and Physics or
FQD32306 Dairy Science and Technology

Topic overview
Milk proteins play a major role in nutrition and development of the immune system in infants. During the first months of life, milk proteins are the only source of protein that infants receive. Infants that do not receive breastfeeding rely on infant formula as a replacement. In the industrial processing of this category of products, heat processing plays a central role. These heat processes may lead to heat-induced denaturation/aggregation of the proteins, as well as glycation, which is the reaction between a reducing sugar and the protein. These changes can affect the digestibility, nutritional value and immunogenicity of proteins. For example, reduced access of digestive enzymes to the protein can lower its digestibility, whereas protein modifications may cause an unwanted pro-inflammatory immune response, such as sensitization and allergic responses. However, the link between process-induced protein modifications and digestibility remains largely unknown, especially in infants.
Next to bovine milk proteins, nowadays plant proteins are also receiving attention as a potential alternative to milk proteins in infant formula. However, compared to milk proteins, even less information is available on the effect of heat processing on the digestibility of these proteins.

Aim
This project description relates to several different PhD and postdoc projects. The aims of these projects are:

1. To investigate the effect of processing on digestibility of dairy components.
2. Difference in processing-induced changes between a dairy matrix and one based on plant-based components, especially proteins.
3. Obtain detailed insight in the effect of heat processing on the in vitro digestion and immunological consequences, especially in relation to infant nutrition.

Project description
Components used in e.g. infant formula (that can e.g. come from bovine or goat milk, or from plant sources) can be processed at different conditions which will lead to different protein modifications (e.g. denaturation, aggregation). The effect of these process-induced protein modifications might alter the digestibility of heated proteins. In this project, protein modifications caused by processing and how these modifications affect digestibility will be investigated. Different biochemical techniques (such as SDS-page, HPLC, ANS, OPA, and in vitro digestion models) will be used to characterize the process-induced protein modifications and the digestibility of these proteins. Finally, the immunological impact of the digests resulting from differently heated proteins will be studied. Based on the above studies, the relationships regarding the proteins between heating—protein modification—digestion—immunogenicity will be revealed.