Research theme 8 - Food Packaging

Within the research area of food packaging, as food technologists, we are focusing mainly on the interactions between the package, the environment and the food and we study the effects on the quality of foods. Food packaging is very important for the quality of foods, since a good package can help to improve or maintain the quality of foods and increase the shelf life of foods. The selection of suitable packaging materials for existing or projected target foods is primarily determined by the properties and type of food being packaged. In addition, market image, costs, and environmental issues must also be considered. Therefore, it is very critical to understand not only the food itself but also the general characteristics of various packaging materials and the conditions in the supply chain.

A food package has several functions, the basic functions being containment, protection, convenience and communication. Two important trends in the field of food packaging are the development of active and intelligent packaging. Active packaging can be used to increase the protection function of the package and intelligent packaging extends the communication function of a package. Intelligent and active packaging can help to maintain food quality, increase food safety, extend the shelf life of foods, and/or reduce food waste. Another important trend in the field of food packaging is the development of biobased and biodegradable packages. This trend is driven by trends as sustainability and the desire to reduce the waste from packaging materials.

Figure: Example of an intelligent packaging that monitors the freshness of meat (left) and an active packaging with an oxygen scavenger to extend the shelf life of these packed nuts (right). Within FQD, we are studying different disciplines of food packaging. We aim to develop new, or improve existing packages, to improve the functions of the package in order to optimize food quality. Currently we have projects within the areas of intelligent packaging, active packaging and biobased packaging.
Project 8.1 Modelling TMA in packed fish

Target: BLT MFT

Supervisor
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Freshness is the most important quality attribute of chilled stored cod fillets and the remaining shelf life can be estimated from the quality attribute TMA. TMA (trimethylamine) is a volatile compound that is produced by micro-organisms that grow on the fish and TMA is strongly correlated to the sensory rejection of fish. When the TMA is measured by a sensor on a package, one can make predictions of the remaining shelf life of this fish package.

Mathematical models have been developed for the formation of TMA. A dynamic model can be used to predict the TMA formation, but the model needs to be validated by measurements at dynamic temperatures, simulating a supply chain in which temperature fluctuations can occur.

At the same time we would like to monitor the changes in the aqueous phase in which electrodes are placed to see whether accurate predictions can be made from the sensor signal when the sensor is compared to freshness measurements in the fish.
Project 8.2 Develop an antimicrobial packaging using isothiocyanates

Target: BLT, MFT

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Topic description
Antimicrobial packaging belong to the category of active packaging and currently many developments are taken place in this research field. Active packaging interacts with the product or the headspace in the food package. The aim of this interaction is to obtain desired conditions for a specific function or to optimize the quality of foods. Likewise, antimicrobial food packaging acts to reduce, inhibit or retard the growth of microorganisms that may be present in the packed food or packaging material itself.

Antimicrobial packaging can take several forms including:
1. Addition of sachets/pads containing volatile antimicrobial agents into packages.
2. Incorporation of volatile and non-volatile antimicrobial agents directly into polymers.
3. Coating or adsorbing antimicrobials onto polymer surfaces.
4. Immobilization of antimicrobials to polymers by ion or covalent linkages.
5. Use of polymers that are inherently antimicrobial.

In this research we will study the antimicrobial effects of isothiocyanates (ITCs) from glucosinolates. ITCs are breakdown products from glucosinolates, phytochemicals that are naturally present in brassica vegetables. In research it has been shown that glucosinolates and their breakdown products have antimicrobial effects. Therefore we would like to use these compounds to develop an antimicrobial package. We need to study the application of the ITCs on the package, so which form will give the best effects. Furthermore we need to study the release of the ITCs from to the headspace of the package and develop mathematical models for this.

Research aim
The research aim is to study the antimicrobial effects of ITCs from glucosinolates and to develop models for the release of the antimicrobial compound from the package.

Research activities
The research activities in this topic consist of experimental work in the laboratory and mathematical modelling on the computer.
Project 8.3 Characterisation of a biobased and biodegradable package with graphene nano-particles

**Target:** BLT MFT

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**Topic description**
The increased use of synthetic polymers has led to several ecological problems. In the past years more and more attention is given to the environmental aspects of food packages. The development of biobased and biodegradable polymers for food packaging applications is therefore a popular trend in the research area of food packaging. Poly lactic acid (PLA) is a promising biobased and biodegradable polymer as food packaging material. In order to be a suitable packaging material, the package material needs to fulfil all important functions for a food package. Among other functions, the food package needs to protect the food from light, moisture, oxygen, microorganisms and other influences to prolong the shelf life of the packed food. Important packaging properties to consider in the development of a food package are the gas permeability and the moisture transmission rate of the material. But sometimes PLA can only be used for short shelf-life products because it provides a medium barrier to gasses and water vapour and it is too brittle.

![Figure: Possible interactions between foods, their package materials, and the environment, together with the adverse consequences from these interactions (Nielsen and Jägerstad, 1994).](image)

In this research we are developing a PLA package that can be applied on foods. We are studying possibilities to improve the barrier functions of the PLA material. One approach is to apply novel graphene oxide (GO)-nanoparticles in the PLA film to improve the oxygen permeability. GO can improve the mechanical strength of the PLA film and reduce the oxygen permeability of GO. We study different ways to incorporate GO on the PLA film and study the effect on the quality of the foods. Furthermore we are looking to possibilities to use GO components to make an active packaging with antimicrobial properties.
**Research aim**
This research is in collaboration with NTU-Singapore that will provide us some PLA films with different graphene nanotech particle layers. Compare the properties (permeability, effect on shelf life) of some PLA films with different graphene nanoparticles and evaluate the results for the development of a suitable food package.

**Research activities**
The research activities in this topic consist of experimental work in the laboratory and mathematical modelling on the computer.