

Enhanced Quality of Cheese through Neutron Scattering



Arla Foods



“The new neutron beam techniques give us the opportunity to investigate the microstructure of cheese without having to add chemicals or otherwise disturb or destroy the sample. In other words, we can see the cheese in its natural state, and we also have the opportunity of studying the exact same sample again later as it hasn’t been altered by the neutron investigation.”

Dairy scientist and Industrial PhD at Arla Foods, Hanne Sørensen, can hardly wait for the ESS to open in Lund:

“It will be fantastic. We do have some chances of obtaining beam time at the Paul Scherrer Institute in Switzerland due to an agreement between that institute and Denmark, but the competition for that time is quite fierce. Due to the Danish co-ownership of ESS and the close distance to Lund opportunities will certainly be much higher.”

From milk to cheese

As an Industrial PhD Hanne Sørensen has Arla Foods as her workplace while also being inscribed at Food Science and the Niels Bohr Institute, Copenhagen University. Her field is the study of microstructures in milk and cheese:

“Ultimately we want to be able to predict how a planned change in the way the milk is processed will affect the microstructure of the cheese.”

The microstructure is of importance to a number of cheese quality features. Firstly, the microstructure will determine the experience we feel as we bite the cheese. Secondly, the microstructure controls how aromatic substances are released. And thirdly, the microstructure determines the texture of the cheese.

For example in cream cheese, if the microstructure is not right, there will be an increased risk of a change in texture resulting in cheese serum being expelled from the cheese. The cheese serum will be visible as a thin layer of water on the top when the container is opened.

Mapping the size of fat droplets

A possible tool for studying the microstructure of cheese and milk systems is a type of small angle neutron scattering (SANS). The spin echo SANS technique exploits a quantum mechanical feature of neutrons, namely their ability to be in two different states simultaneously. When passing through the cheese sample, one of the quantum states may go through a fat droplet, thus being delayed slightly, while the other state passes unhindered. As the two states are then refocused they will be out of phase. The more they are out of phase, the bigger the fat droplet must have been. Thus, the data can be used to generate an image showing the fat droplets and other features in the cheese microstructure.



Many still find these techniques a bit far-fetched, but really the applications are quite down to earth. Hopefully, the opening of ESS will change this scene. Through my project we are taking the first little step at Arla Foods. It is important to prepare already now.

Hanne Sørensen, Industrial PhD, Arla Foods

“It has been shown in various studies that spin echo SANS can be applied to cream cheese. These results are highly interesting, but personally I find that SANS will be even more relevant to firm, or yellow, cheese which is my area of interest. This is because cream cheese can be studied by other techniques also, while in the case of yellow cheese, neutrons may provide a whole new level of insight,” says Hanne Sørensen.

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Presently, the studies on yellow cheese are preferably done by traditional methods which are destructive to the samples.

“The possibilities for exploiting neutron scattering techniques have become more visible over the last five-six years, but they have still not been fully appreciated by the dairy industry. Many still find these techniques a bit far-fetched, but really the applications are quite down to earth.

New Horizons Are Opening to the Food Industry

World leading facilities within neutron and X-ray scattering, the ESS and MAX IV, will open in the Oresund region over the next few years. However, there is no need to wait for these facilities to open. Scientists at Technical University of Denmark and University of Copenhagen are already in gear for X-ray and neutron scattering projects. These could either be full research projects in their own right or preliminary projects leading up to projects at existing or the coming large scale facilities. Contact the universities to learn more about what they can offer you.

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