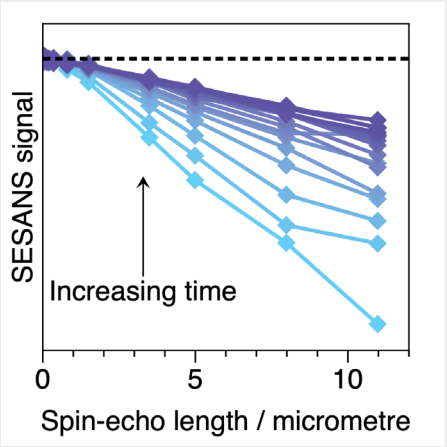
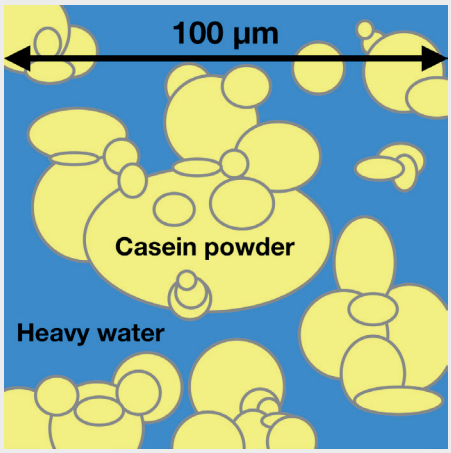
Watching milk go from powder to liquid

In this project, researchers from the Niels Bohr Institute and the Department of Food Science at University of Copenhagen studied the rehydration of milk powders with spin-echo small-angle neutron scattering (SESANS). This special variety of neutron scattering enabled characterisation of the micrometre-scale structures in the casein powder particles and provided a way of seeing the rehydration process as it happens.

Milk powders are useful as ingredients in food products. However, their use as ingredients is hampered by their slow dissolution and poor rehydration kinetics in typical food processing procedures. Understanding both the drying and the rehydration processes will provide important information for optimising industrial processes.

SESANS provided a way to monitor the rehydration process directly by adding the powders to heavy water (D_2O, to gain contrast for neutron measurements) to study the colloidal structure of the dissolving powders while they were tumbled over 24 hours. From this, the amount of D_2O that hydrated the casein powder could be determined, and this was related to the progress of the rehydration process.





The measured SESANS signal (left) changed with time as the large, irregularly shaped casein powder particles (right) were rehydrated by heavy water (D_2O). The change in the signal is related to the amount that the powders had been rehydrated.

What we did

- Solutions of micellar casein isolate (MCI) powders were prepared in heavy water (D_2O) and mixed in a rotation cell.
- Spin-echo small-angle neutron scattering (SESANS) measurements were performed at the Technical University of Delft (TU Delft) in The Netherlands.
- The data showed that the powders changed structure as they were rehydrated over the 24 hours of the experiment.
- Modelling the data showed how the air in the powder was replaced with heavy water as they were rehydrated.

What's next?

The next steps will be to prepare sample environments that are more similar to industrial processing equipment for *in situ* SESANS measurements of real processes.

"The potential of SESANS to follow in situ the dynamics of rehydration of complex powders at micrometre-scale can provide unique knowledge to understand the structure changes caused by water uptake. This knowledge provides a unique base to design powders with improved functionality. This multidisciplinary work would have not been possible without the collaboration of experts in scattering techniques and food science that was provided through LINX."

- Professor Lilia Ahrné, Department of Food Science, University of Copenhagen

In the LINX project, researchers at leading Danish universities collaborate with scientists in industry to solve industry relevant problems using advanced neutron and X-ray techniques. The Arleth group at University of Copenhagen contributes with their expertise in small-angle scattering techniques.

Read more
linxassociation.dk

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