

Time-Dependent Structural Evolution of Casein Micelles in Reconstituted Milk Probed by SANS and SAXS

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Small angle neutron scattering (SANS) provides unique sensitivity to hierarchical organization in complex soft-matter systems and is particularly well suited for probing the internal structure of the casein micelle in milk. In this contribution, we present newly obtained SANS data on reconstituted milk samples, focusing on how the internal organization of the casein micelle evolves as a function of reconstitution time and concentration.

First, we investigated the structural development of the casein micelle following reconstitution from milk powder. The SANS data reveal clear and systematic changes in the internal micellar structure over time, with measurable differences persisting for up to 24 hours after reconstitution. These results indicate that the casein micelle does not instantaneously recover its equilibrium internal organization upon rehydration, but instead undergoes a gradual structural reorganization.

Second, we examine the effect of concentration, and concomitantly mineral concentration, on the micellar structure. Variations in concentration lead to pronounced changes in the scattering profiles, highlighting the strong coupling between casein organization and mineral-mediated interactions within the micelle.

Initial modelling of the SANS data is presented, capturing the main structural features and trends observed experimentally. Ongoing work aims to apply our comprehensive structural model, previously developed for small angle X-ray scattering (SAXS) data on casein micelles, to the SANS measurements. This modelling approach is expected to provide a holistic and quantitative description of the internal organization of the casein micelle, bridging neutron and X-ray scattering insights and advancing our understanding of milk as a dynamic, multiscale colloidal system.

Keywords:

Casein micelle

Milk

Small angle X-ray scattering

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structure

milk powder reconstitution