

A study on the structural changes of bovine casein micelles in milk using neutron and X-ray scatterings

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Milk is processed in different environments. Importantly, the physical properties and processabilities of milk are strongly influenced by temperature and pH. Milk, an integral dietary component consumed worldwide, undergoes processing in various environments where temperature and pH play crucial roles in shaping its properties and processing capabilities. Additionally, pH is closely tied to the dairy production. Consequently, it is essential to understand how alterations in pH influence the microscopic structure and constituents of milk.

The behavior and physical properties of a casein micelle are strongly dependent on pH. The micelle structure in milk with altered pH has been reported by researchers using the SAXS technique. However, since pH was not changed systematically in these papers, it has not been clarified how the casein micelle structure, specifically the internal structure of a micelle, is influenced by changing pH. The pH dependence of structural changes of a casein micelle based on the pH range of 6.5–7.1 was investigated using SANS.

Skim milk with the pH range of 6.5–7.1 was used as samples. The pH was adjusted to the prescribed pH values by gradual addition of 1 N NaOH or 1 N HCl. All samples were freeze-drying. Reconstructed milk obtained by adding various ratio of D₂O/H₂O mixed water into freeze-dried skim milk were used as samples. It was confirmed that experimentally obtained SANS profile was different from that obtained by SAXS.

Fig. 1 shows the SAXS profiles of skim milk in the pH range of 6.5–7.1 obtained at 30 °C. The SAXS profiles were found to change continuously with varying pH. The scattering intensities around $q = 0.15 \text{ nm}^{-1}$ decreased at pH of less than 7.1. SANS data is currently being analyzed by fitting.

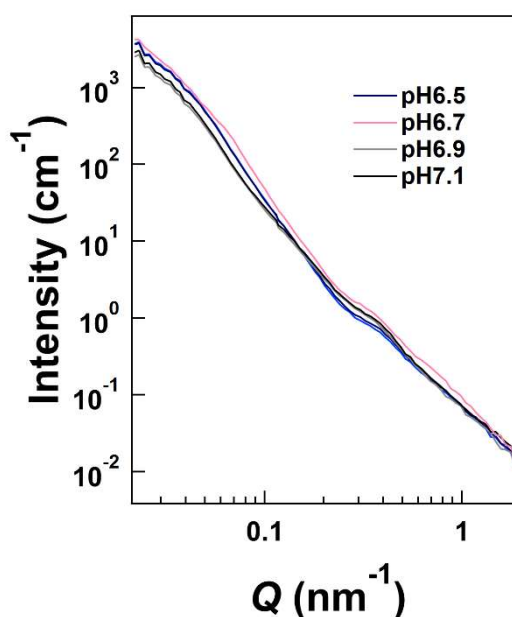


Fig. 1. The SANS profiles of skim milk in the pH range from 6.5 to 7.1.