SAXS study of structure and phase behaviour of pig gastric mucin at different temperatures and hydration levels

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One essential function of mucous gel is to protect the mucosa from dehydration. Mucus properties respond quickly to changes in ambient conditions, and when the relative humidity (RH) of the surrounding atmosphere decreases it undergoes a transition from elastic to glassy state. According to our previous calorimetric studies [1], this mucin glass transition occurs at an RH between 60-70%.
Here, hydration and temperature-induced changes in pig gastric mucin (PGM) in a wide concentration range were studied using small angle X-ray scattering (SAXS). This work demonstrates three ranges of the scattering vector q corresponding to different fractal dimensions in PGM solutions. Such scattering can originate from PGM fiber-like structures that adopt random coil conformation in dilute solutions. Starting from about 20 wt% PGM, three peaks are clearly visible in the scattering pattern and they become more pronounced at intermediate concentrations, indicating structuring in the mucin system at lower levels of hydration. In strongly and fully dehydrated mucin, where the system is in a glassy state, these peaks do not appear. The SAXS data show that the structural changes at about 80 wt% of mucin at 25°C correspond to a mucin glass transition, in agreement with our previous calorimetric results [1].
Temperature-induced changes in the phase behavior of mucin were observed at about 60-70°C at intermediate levels of hydration. Here the single main peak becomes double, indicating formation of a different structure at elevated temperatures. These results are in a good agreement with polarized light microscopy and DSC data. Obtained SAXS data are used to complete the PGM phase diagram.

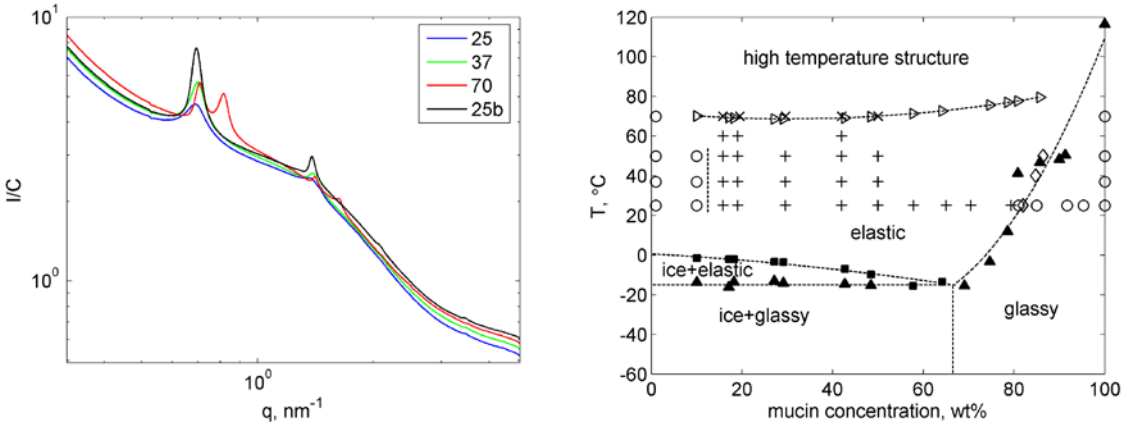

Figure 1 Temperature dependence of concentration normalized intensity I/C versus the scattering vector q for 30 wt% PGM (left image). A phase diagram of PGM constructed using our previously published sorption calorimetry and DSC [1] and present SAXS and DSC data (right image).

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[1] Y. Znamenskaya, J. Sotres, J. Engblom, T. Arnebrant, V. Kocherbitov, *J Phys. Chem. B*, 2012, ***116***, 5047.