Molecular structure and Equilibrium forces of bovine submaxillary mucin adsorbed at a solid-liquid interface - DTU Orbit (08/01/2019)

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By combining dynamic light scattering, circular dichroism spectroscopy, atomic force microscopy, and surface force apparatus, the conformation of bovine submaxillary mucin in dilute solution and nanomechanical properties of mucin layers adsorbed on mica have been investigated. The samples were prepared by additional chromatographic purification of commercially available products. The mucin molecule was found to have a z-average hydrodynamic diameter of ca. 35 nm in phosphate buffered solution, without any particular secondary or tertiary structure. The contour length of the mucin is larger than, yet of the same order of magnitude as the diameter, indicating that the molecule can be modeled as a relatively rigid polymeric chain due to the large persistence length of the central glycosylated domain. Mucin molecules adsorbed abundantly onto mica from saline buffer, generating polymer-like, long-ranged, repulsive, and nonhysteretic forces upon compression of the adsorbed layers. Detailed analysis of such forces suggests that adsorbed mucins had an elongated conformation favored by the stiffness of the central domain. Acidification of aqueous media was chosen as means to reduce mucin–mucin and mucin–substrate electrostatic interactions. The hydrodynamic diameter in solution did not significantly change when the pH was lowered, showing that the large persistence length of the mucin molecule is due to steric hindrance between sugar chains, rather than electrostatic interactions. Remarkably, the force generated by an adsorbed layer with a fixed surface coverage also remained unaltered upon acidification. This observation can be linked to the surface-protective, pH-resistant role of bovine submaxillary mucin in the variable environmental conditions of the oral cavity.