A Molecular View of Lipid Membranes:
Stabilization by disaccharides, mechanical properties and transmembrane protein association

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Abstract: Trehalose, a disaccharide of glucose, is often used in the preservation of biological systems through lyophilization and cryopreservation procedures. The detailed mechanism responsible for the protecting ability of this sugar remains unknown. Using atomistic molecular simulations and quasielastic neutron scattering experiments the dynamics of the hydrophilic and hydrophobic part of the membranes were selectively probed. Elastic scans focusing on lipid tail dynamics display clear evidence of a main melting transition that is significantly lowered in the presence of trehalose, an effect associated with cell preservation. The lipid headgroup mobility is considerably restricted at high temperatures and controlled by the dynamics of the sugar in the mixture.

The lipid lateral organization and the mechanical properties of multicomponent lipid membranes as well as the study of the association of membrane proteins require a view of lipid membranes on considerably larger length scale. Using efficient Monte Carlo simulation techniques and coarse-grained models results by studies on such systems will be presented.