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## Importance and Problems of Water in Food and Food Related Materials

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Most food contains relatively large amounts of water and this water is generally of central importance for the taste and other properties of the food. However, in the case of long-time storage this water can be problematic and cause a lot of detrimental aging effects. One way to overcome such aging effects is to reduce the temperature and thereby slow down the aging, but this gives often rise to ice formation, which generates other problems of damaged cellular structures in the food materials. To overcome this problem it is generally required to dry the food material before it is long-time stored at a low temperature, so called freeze-drying. Nevertheless, water in food materials, as well as in living biological materials, is both essential and sometimes problematic. In this presentation these important and detrimental roles of water in carbohydrate rich food will be discussed. For example, we have elucidated the nature of ice crystals in frozen dough and bread [1], and how these ice crystals grow with increasing storage-time [2,3]. We also discuss attempts to reduce the detrimental ice formation. Furthermore, we have investigated how the dynamics of the water in carbohydrate rich food is affected by the structure and/or dynamics of the food material. It was found that the water dynamics becomes slower in food materials with slow dynamics, which implies that the dynamics of the water and the pure food material are interrelated [4]. It was also evident that the water dynamics speeds up dramatically with increasing water content [4]. Finally, the anomalous dynamical properties of deeply supercooled water will be discussed, and how this affects the freeze-storage of biological materials.

[1] G. Chen, H. Jansson, K. F. Lustrup and J. Swenson. Formation and distribution of ice upon freezing of different formulations of wheat bread. *J. Cereal Sci.* 55, 279 (2012).

[2] G. Chen et al. Long-term frozen storage on the dynamics of water and ice in wheat bread. *J. Cereal Sci.* 57, 120 (2013).

[3] J. Eckardt et al. Long term frozen storage of wheat bread and dough – Effect of time, temperature and fibre on sensory quality, microstructure and state of water. *J. Cereal Sci.* 57, 125 (2013).

[4] H. Jansson, W. S. Howells and J. Swenson. Dynamics of fresh and freeze-dried strawberry and red onion by quasielastic neutron scattering. *J. Phys. Chem. B* 110, 13786 (2006).

**Primary author(s)** : SWENSON, Jan (Chalmers University of Technology)

**Presenter(s)** : SWENSON, Jan (Chalmers University of Technology)

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