CPP 57: Physics of Food

Time: Friday 10:45–12:15 Location: ZEU 260

Invited Talk CPP 57.1 Fri 10:45 ZEU 260

Crystallization in Food — •Hans Jörg Limbach[1], Konstantin Koschke[2], and Davide Donadio[2] — [1]Nestlé Research Center, Lausanne, Switzerland — [2]MPI for Polymer Research, Mainz, Germany

The paper will start with a short introduction covering various aspects of the role of crystallization in food products like ice cream, frozen meals, chocolate and beverage powders.

The main part will focus on recent work on the thermodynamics of freezing point depression in solutions that has been carried out in collaboration with the Max-Planck-Institute for Polymer Research. We will show how the freezing point depression changes as a function of the similarity between the solvent and the solute molecules. The influence of the solute molecules on the liquid structure of the solvent will be discussed. In addition a suitable thermostat to study the kinetic limit of crystal growth rates in a model system will be presented. The work is based on molecular dynamic simulations using binary Lennard-Jones model systems.

As the last part of the contribution a small number of open problems related to crystallization in food will be put forward for further discussion.

CPP 57.2 Fri 11:15 ZEU 260

Molecular migration in multicomponent food products — •Svenja Reinke[1], Stephan V. Roth[2], Gonzalo Santoro[2], John Rasburn[3], Stefan Palzer[4], and Stefan Heinrich[1] — [1]Hamburg University of Technology, Hamburg, Germany — [2]HASYLAB/DESY, Hamburg, Germany — [3]Nestlé PTC, York, United Kingdom — [4]Nestlé SA, Vevey, Switzerland

Controlling the molecular migration of molecules through complex food products is of high interest in food technology: This process is leading to major quality issues such as fat blooming of chocolate resulting in large sales losses for the food industry.

In general, the complex, multicomponent food products investigated consist of particles surrounded by a continuous lipid matrix. The molecules could migrate through the continuous matrix phase, through the phase composed by the embedded particles or via the interface of matrix and particles. However, this mechanism of migration through multicomponent materials is still not well understood. Therefore, the microstructure of the multicomponent material is analyzed and visualization of the migration path within the matrix is intended. Using microbeam small-angle X-ray scattering (μSAXS) at the MiNaXS/P03 beamline at DESY we investigated oil migration through multicomponent products. Thereby, the effect of different oils and their possible influence on structural changes was analyzed. To get further insight into possible pathways, the wetting properties of the hydrophobic and hydrophilic components are analyzed. We present a model to describe the migration on a molecular level based on molecular simulations.

CPP 57.3 Fri 11:30 ZEU 260

Understanding protein denaturation, water loss and texture during sous-vide cooking of pork filet — •Birgitta Zielbauer[1], Benjamin Viezens[1,2], Johannes Franz[1], and Thomas Vilgis[1] — [1]Max-Planck-Institut für Polymerforschung, Mainz, Germany — [2]Beuth Hochschule für Technik, Berlin, Germany

Meat is a highly complex natural product, comprising a wide range of different proteins assembled into complex structures, which form the muscle fibers as well as connective tissue. Besides taste, the main factor influencing the sensory perception of a cooked piece of meat is its texture. This depends - besides of intrinsic factors such as animal type and age or muscle type, which determine the properties of the raw product - crucially on protein denaturation stages and related water content of the final product. Sous-vide cooking offers the possibility to precisely control those factors by choosing appropriate time-temperature combinations and thus selectively denature specific proteins while keeping others intact.

The denaturation kinetics of the meat proteins (such as myosin, collagen, actin, and sarcoplasmatic globular proteins) can be followed by differential scanning calorimetry (DSC). For longer times, proteins denature below their denaturation temperature obtained from DSC measurements, which can be roughly explained by a statistical and kinetic model. These results are related to water content and textural characteristics of the samples.

Invited Talk CPP 57.4 Fri 11:45 ZEU 260

Soft Matter Multi-Scale Food Physics - Texture, Taste and Aroma — •Thomas Vilgis — Max-Planck-Institut für Polymerforschung

The common point of the large variety of raw, cooked, and processed foods is that they are multi-component materials which consist at least of proteins, carbohydrates, fat and water. Their concentration ratios define most of the structural and textural properties of the foods. Given the different solubility of these components in the basic solvents water and fat, it becomes clear that many physical properties, such as structure and texture are determined by a large number of competing interactions between these different components. The conformation and dynamics of water soluble long carbohydrates and partially water soluble native or denatured proteins determine together with the water content the textural properties of foods. In addition, local short range interactions of these macromolecules with comparatively small ions (salts), polar molecules (water, low molecular weight sugars) and amphiphilic molecules (emulsifiers) have a strong influence on macroscopic properties, such as texture and mouth feel as it is demonstrated with simple model systems such as multi-component gels with special rheological properties and resulting physics based sensory qualities.