Food-grade aerogels with tailored physico-chemical properties

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Aerogels are lightweight solid materials with low density, high interconnected porosity, and large specific surface area. Due to these properties various applications in foods are interesting. The use of food-grade biopolymers for the aerogel production allows the production of food-grade aerogels. They might be used as carrier for minor ingredients, due to the high specific surface area, source of energy or dietary fiber (depending on the chosen biopolymer), or as mechanical stabilization of the food matrix.

Aerogels are produced in mainly three steps: dissolution of the biopolymer in aqueous media, gelation via different gelation methods (e.g.: \( \text{CO}_2 \) induced, ionicotropic induced, thermal induced), and supercritical \( \text{CO}_2 \) drying of obtained hydrogels to aerogels.

Properties of obtained aerogels strongly depend on solution composition and gelation method. Therefore, aerogels with different properties can be obtained even from one biopolymer. To further adjust the aerogel properties hybrid aerogels are also studied. They are made of two or more different biopolymers and may possess larger specific surface area, higher stability, or liquid uptake behavior.

In collaboration with a major food manufacturer the objective of this project is to explore food-grade aerogels consisting of different biopolymers with properties needed for the application in foods. Therefore, it is necessary to investigate the influence of different production and composition parameters on the aerogel properties.

\( \text{CO}_2 \) induced gelation

One method of the gel preparation is the \( \text{CO}_2 \) induced gelation. This method gives homogeneous and comparably strong gels, which can be then dried to aerogels. The role of \( \text{CO}_2 \) is to reduce pH value of biopolymer solution. This drop of pH value leads to gelation of biopolymer solutions. Nevertheless, the gelation mechanism of \( \text{CO}_2 \) induced gelation is not completely understood for now.
The objective of this project is to shed light on the CO$_2$ induced gelation of different biopolymer solutions. The mechanism will be studied experimentally and theoretically aiming at subsequent modeling of the gelation process for different systems.

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Figure 2: Gelation of a colored pectin solution in pressurized CO$_2$