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Thermal Hysteresis Activity of Ice Binding Proteins during Ice Crystal Growth in Sucrose Solution

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Abstract : Ice recrystallization (IR) which occurs especially during frozen storage is an undesired process due to the possible influence on the quality of products. As a result of recrystallization, the total volume of ice remains constant, but the size, number, and shape of ice crystals change. For instance, as indicated in the literature, the size of ice crystals in ice cream increases due to recrystallization. This results in texture deterioration. Therefore, the inhibition of ice recrystallization is of great importance, not only for food industry but also for several other areas where sensitive products are stored frozen, like pharmaceutical products or organs and blood in medicine. Ice-binding proteins (IBPs) have the unique ability to inhibit ice growth and in consequence inhibit recrystallization. This effect is based on their ice binding affinity. In the presence of IBP in a solution, ice crystal growth is inhibited during temperature decrease until a certain temperature is reached. The melting during temperature increase is not influenced. The gap between melting and freezing points is known as thermal hysteresis (TH). In literature, the TH activity is usually investigated under laboratory conditions in IBP buffer solutions. In product applications (e.g., food) there are many other solutes present which may influence the TH activity. In this study, a subset of IBPs, so-called antifreeze proteins (AFPs), is used for the investigation of the influence of sucrose solution concentration on the TH activity. For the investigation, a polarization microscope (Nikon Eclipse LV100ND) equipped with a digital camera (Nikon DS-Ri1) and a cold stage (Linkam LTS420) was used. In a first step, the equipment was established and validated concerning the accuracy of TH measurements based on literature data.

Keywords : ice binding proteins, ice crystals, sucrose solution, thermal hysteresis
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