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A Differential Scanning Calorimetric Study of Frozen Liquid Egg Yolk Thawed by Different Thawing Methods

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Abstract : Egg yolk is a popular ingredient in the food industry due to its gelling, emulsifying, colouring, and coagulating properties. Because of the heat sensitivity of proteins, egg yolk can only be heat treated at low temperatures, so its shelf life, even with the addition of a preservative, is only a few weeks. Freezing can increase the shelf life of liquid egg yolk up to 1 year, but it undergoes gelling below -6 ° C, which is an irreversible phenomenon. The degree of gelation depends on the time and temperature of freezing and is influenced by the process of thawing. Therefore, in our experiment, we examined egg yolks thawed in different ways. In this study, unpasteurized, industrially broken, separated, and homogenized liquid egg yolk was used. Freshly produced samples were frozen in plastic containers at -18°C in a laboratory freezer. Frozen storage was performed for 90 days. Samples were analysed at day zero (unfrozen) and after frozen storage for 1, 7, 14, 30, 60 and 90 days. Samples were thawed in two ways (at 5°C for 24 hours and 30°C for 3 hours) before testing. Calorimetric properties were examined by differential scanning calorimetry, where heat flow curves were recorded. Denaturation enthalpy values were calculated by fitting a linear baseline, and denaturation temperature values were evaluated. Besides, dry matter content of samples was measured by the oven method with drying at 105°C to constant weight. For statistical analysis two-way ANOVA ($\alpha = 0.05$) was employed, where thawing mode and freezing time were the fixed factors. Denaturation enthalpy values decreased from 1.1 to 0.47 at the end of the storage experiment, which represents a reduction of about 60%. The effect of freezing time was significant on these values, already the enthalpy of samples stored frozen for 1 day was significantly reduced. However, the mode of thawing did not significantly affect the denaturation enthalpy of the samples, and no interaction was seen between the two factors. The denaturation temperature and dry matter content did not change significantly either during the freezing period or during the defrosting mode. Results of our study show that slow freezing and frozen storage at -18°C greatly reduces the amount of protein that can be denatured in egg yolk, indicating that the proteins have been subjected to aggregation, denaturation or other protein conversions regardless of how they were thawed.

Keywords : denaturation enthalpy, differential scanning calorimetry, liquid egg yolk, slow freezing
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