Prediction of the glass transition temperature of sugar rich mixtures

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Abstract

The prediction of the glass transition temperature (Tg) of sugar rich foods is of high interest in food science to prevent stability issues. The main solids of fruit juices are sugars and organic acids. The low Tg values of these components are responsible for the occurring stability issues during drying. In order to gain a better understanding of the Tg in low molecular weight component mixtures, six commercial fruit juice concentrates and artificial juices on basis of the sugar and organic acid profile were transformed into powders and equilibrated over various saturated salt solutions. The powders were analysed for their Tg values and compared to the estimated Tg values using a newly developed prediction method for multicomponent systems. The comparison of the predicted Tg values and the experimental were in good agreement (± 3C), especially for the artificial juices. Additionally, the effect of high molecular weight components on Tg of low molecular weight mixtures were studied. For this purpose, the polysaccharides inulin DP > 23 and maltodextrin DE 10-13 were mixed with blackcurrant juice concentrate at various ratios (3/7, 1/1, 7/3) and converted into a powder. Identical to the fruit juice study, the Tg values of the powders were determined at various water activities and correlated against the predicted values, which also corresponded well (± 5C). The Tg values indicate a strong deviation from ideal mixing and slow increase of Tg with inclusion of polysaccharides. This is accompanied with a broader DSC signal for the Tg of these mixtures and could be an indicator for unequal distribution of local environments.

Keywords: Glass transition temperature, DSC, prediction model, multicomponent systems

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