

Effects of freeze–thaw treatment on the mechanical and structural properties of konjac glucomannan gels

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The mechanical, structural, and water-holding properties of freeze-thawed konjac glucomannan (KGM) gels prepared using sodium carbonate as a solidifying agent were examined. For GM gels prepared at pH = 11, the freeze-thaw (FT) treatment significantly enhanced the compressive stress because the treatment promotes the crystallization and aggregation of GM. Additionally, we examined the effect of additives, such as curdlan (CUD), antifreeze glycoprotein (AFGP), and tremella fuciformis polysaccharide (TFP), on the various properties of freeze-thawed GM gels prepared at pH = 8.5. Synchrotron simultaneous small-angle X-ray scattering and wide-angle X-ray scattering experiments revealed that the GM gels containing additives formed a network with a fractal dimension of 2.4–2.5 that was constructed by the aggregates with partly crystallized GM [1].

1 Introduction

Freezing is a convenient and effective way of storing food for a long period. However, the freeze-thaw (FT) treatment significantly affects the mechanical and structural properties of many foods. Below the freezing point, ice crystals form and then grow, which damages the cells and gel network in foods and consequently causes an unfavorable change in the texture.

Konjac glucomannan (KGM), which is the major component of refined konjac flour, comprises glucose and mannose units. Elasticity of konjac or GM gels is caused by adding alkali to an aqueous GM solution and then heating [2], which promotes the aggregation and crystallization of KGM molecules [3].

In this study, we examined the structure of KGM gels containing additives by synchrotron simultaneous small-angle X-ray scattering (SAXS) and wide-angle X-ray scattering (WAXS) measurements. Additionally, we explored the structural change of GM gels during the FT process.

2 Experiment

We used konjac GM (RHEOLEX RS), kindly supplied by Shimizu Chemical Corp. Synchrotron simultaneous SAXS/WAXS measurements were performed at beamline 6A.

3 Results and Discussion

Fig. 1 shows a SAXS curve of KGM gel containing CUD. Herein, we analyzed the SAXS data using the double Beaucage equation. The dashed and dotted curves shown in the figure represent each component of the two-level Beaucage equation. The fitting analysis also supports that the GM/CUD gel is composed of two structures in

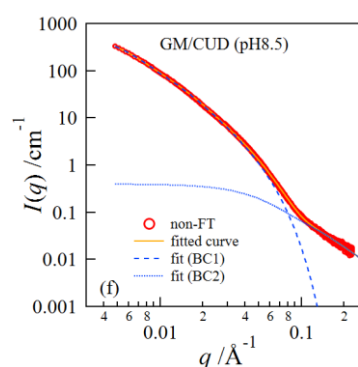


Fig. 1 A SAXS curve of KGM/CUD gel.

the regions of $q < 0.1 \text{ Å}^{-1}$ and $q > 0.1 \text{ Å}^{-1}$. The analysis showed that the aggregated structures of the GM/additive gel have a fractal dimension of 2.4–2.5.

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References

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