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# Analysis and Control of Ice Crystal Structure in Frozen Food and Their Application to Food Processing

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The large differences in thermal properties between water and ice cause thermal properties of frozen food to be strongly dependent on ice fraction, which is a function of solute concentration and temperature. Effective thermal conductivity of frozen food is described well by the dispersed model with ice phase dispersed in consideration of ice fraction. Ice crystal structure size in frozen food is determined by the advance rate of ice front reflecting the important role of the molecular diffusion of water in the mechanism of ice crystal growth. Supercooling causes the formation of very fine ice structure through the very high freezing rate at the moment of the cease of supercooling but the similar effect is realized by the pressure-shift freezing as a thermodynamically controllable process. By controlling the ice crystal structure size very large, the progressive freeze-concentration becomes possible. This method is very effective to make the freeze concentration system much simpler as compared with the conventional method of suspension crystallization to reduce the cost of freeze concentration substantially.

**Keywords:** ice fraction, effective thermal conductivity, pressure-shift freezing, progressive freeze-concentration, supercooling