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## **Freeze-Drying of Soybean Protein Solution Containing Oil Effects of Freezing Conditions on Drying Rate**

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Solutions of soybean protein with and without added oil were freeze-dried. The measured drying-rate was analyzed using the uniformly retreating method to obtain the coefficient of vapor permeability,  $K$ . The drying-rate was proportional to the cooling rate. The solution was frozen without supercooling, and the vapor permeability was proportional to the cooling rate. An uncontrollable supercooling occurred during the cooling rate resulting in a texture for the frozen sample along with a low drying rate. The addition of oil induced a relatively uniform ice structure through the drying process. The drying rate was low but almost remained constant until about 90% of the sample was freeze-dried. The relationship between the supercooling and the

confirmed by the temperature distribution in the drying sample and of the dried sample.

**Keywords:** [freeze-drying](#), [supercooling](#), [drying rate](#), [vapor permeability](#), [ice structure](#)

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