

**DEVELOPMENT OF THREE-DIMENSIONAL MEASUREMENT METHOD FOR
ICE CRYSTALS IN FROZEN LIQUID FOODS**

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A Micro-Slicer Image Processing System (MSIPS) has been applied to observe the ice crystals structure formed in frozen dilute solutions. Several characteristic parameters were also proposed to investigate three-dimensional (3-D) morphology and distribution of ice crystals, based on reconstructed images obtained by multi-slicing a frozen sample with the thickness of 5 μm . The values of characteristic parameters were determined for a sample image having the dimension of 530 \times 700 \times 1000 μm . The 3-D morphology of ice crystal was found to be a bundle of continuous columns at any freezing temperature under the usual freezing conditions except supercooling. The equivalent diameter of ice crystals were in the range of 73 μm up to 169 μm , and then decreased exponentially in increasing freezing rate at the freezing temperature of -20°C to -80°C . At the freezing temperature of -40°C , the volume of ice crystals were in the range of $4.6 \times 10^4 \mu\text{m}^3$ up to $3.3 \times 10^7 \mu\text{m}^3$ and 36 ice columns were counted in a 3-D image.

Keywords: Freezing, Ice Crystal, 3-Dimensional, Morphology, Micro-Slicer, Image Processing