Effective thermal conductivity of a porous model food at above and sub-freezing temperatures

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Abstract

Good knowledge of thermal conductivity of foodstuffs has a major importance for the accurate prediction of their unsteady–state temperature distribution, the process design and the quality of product in cooling and freezing. Nevertheless, few studies about thermal conductivity at subfreezing temperature were carried out. In this research, a number of the predictive models of effective thermal conductivity are studied. Two improved general thermal conductivity prediction models (Maxwell and Krischer models) have been developed for the porous food as a function of water content, porosity and temperature. These models included the effect of latent heat transport by water vapor transfer because of evaporation-condensation within the pores in addition to heat conduction. To valid the models, the effective thermal conductivities of several samples (porosity =0.70-0.94 and water content 30-60% wet weight basis) at –35°C-30°C were measured and compared with the predicted values. The predicted values by using the improved Maxwell model were only in good agreement with the measured values in high porosities. But, the predicted values by using the improved Krischer model showed the good agreement with the measured values in all measured porosity ranges.

Keywords: Evaporation-condensation effect; Porous media; Conductivity; Thermal properties

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