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A WORKED EXAMPLE USING A NEW METHOD FOR PREDICTING THE EFFECTIVE THERMAL CONDUCTIVITY OF A POROUS FOOD

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Abstract

The literature contains numerous effective thermal conductivity models, however, the discrepancy between predictions from different models for a given porous food can be 50% or greater. Previous studies have indicated that no single model can be expected to provide accurate effective thermal conductivity predictions for a range of porous materials without requiring the values of certain parameters to be determined empirically. However, experimental determination of a parameter is often impractical.

This paper outlines a worked example of how to predict the thermal conductivity of porous foods based on porosity, water content and a visual assessment of the food's structure, but without the need for any experimental measurement. The prediction method makes use of thermal conductivity bounds, proposed previously, that confine the range of possible thermal conductivity values for a given type of porous food and a given a composition. The basic structure of the food (i.e. whether it is a granular/particulate material, or contains internal pores) determines which particular set of bounds the effective thermal conductivity data of the product would be expected to lie between. Once the product has been classified according to these thermal conductivity bounds, an effective thermal conductivity model is selected according to certain guidelines.

The method is applied to a real food (sponge cake) and the results show that the predictions agree with experimental measurements to within ±10%.