Title Mathematical modelling of wheat kernel drying with input from moisture movement studies using magnetic resonance imaging (MRI), Part I: Model development and comparison with MRI observations

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Abstract

A three-dimensional (3D) simultaneous heat and moisture transfer drying model for a single wheat kernel was developed. The model was based on the information obtained from magnetic resonance imaging (MRI) of wheat drying. The model assumed a non-uniform initial moisture distribution and two different values of water diffusion coefficients in the germ and endosperm of a wheat kernel. The model was theoretically developed using finite element method and then solved using COMSOL® Multiphysics™, a commercial finite element software package. Model simulations were performed on the actual shaped 3D geometric objects obtained from the MR images of wheat kernels using image processing algorithms. Model-predicted moisture data were compared with the results obtained from MR images under similar drying conditions. Activation energies of the water removal process in the endosperm and germ were calculated to be 26.5 and 13.8 kJ mol^{-1}, respectively, based on the range of drying temperatures under study.