Title Diffusive Drying Kinetics in Wheat, Part 1: Potential for a Simplified Analytical Solution
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Citation Journal of Agricultural Engineering Research, Volume 80, Issue 4 , December 2001, Pages 351-364
Keywords wheat; drying

Abstract

Mathematical models for kernel drying predict grain–air mass and heat transfer rates, and the faster and more accurately they can do this the better, especially in simulation-based design and control. Few publications used the simplified analytical solution of the diffusion equation for 'short times' based on semi-infinite medium concepts, which is simpler and as accurate as the exact infinite series though it still awaits its place in determining diffusion coefficients. The drying background of wheat and similarly sized grains was reanalysed because assumptions that could not apply to larger grains may be valid for smaller ones to justify analytical solutions. Reliable Biot numbers were calculated to be some 0·5 for heat transfer and 50–3000 (internal control) for mass transfer. Despite heat transfer which individually may or may not be considered to be controlled externally, the grain thermal-to-moisture diffusivity ratio was about 6000, making heat transfer instantaneous compared with mass transfer. To corroborate these indicators, the complete heat conduction–moisture diffusion problem was numerically solved, and the predictions showed, precisely, that analytical solutions may be used to estimate diffusion coefficients in wheat. Then, the steps leading to this overlooked simplified diffusive equation were revised in the light of current knowledge to show how computing time can be saved without loss of accuracy.