Multiphysics Modeling of Potatoes Slices By Warm-air

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Abstract

This work analyzes the hot-air drying of potato (Solonum tuberosum) and the effects of air velocity in the thermal evolution of the material. The work was divided into three parts. In the first one we obtain the experimental drying kinetics. In the second part, drying kinetics was simulated by solving a semi-empirical model (Characteristic Drying Curve). In the third part, we solve a coupled mathematical model for simultaneous heat and mass transfer in potatoes.
The mathematical model considers the contributions of liquid water and the gaseous phase. The mass flux was integrated into the heat transfer equation to consider the heat necessary for evacuation. The variation in moisture content is a function of capillary diffusivity and saturation. When the liquid phase is evacuated, the gaseous phase becomes more important, then pressure gradient become an important driving force. The mobility of the gas phase depends on temperature and pressure, and hygroscopic material balance. The differential equations are nonlinear. The system of equations was solved using the UMFPACK factorization method in COMSOL Multiphysics 3.4.
The model provides important details to understand the physics of drying. However, the results showed some deviations which are attributed to the variation of thermophysical properties since potatoes are a biological material.

Reference

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