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## Abstract

A numerical model for non-steady heat and mass transfer during convective drying of cylindrical quince slices, with axis parallel to the air flow, is developed. The model is based on the numerical solution of the coupled one-dimensional heat and mass transport equations, assuming moisture transport due to Fick's diffusion, with an effective moisture diffusion coefficient derived by fitting the analytical solution of the Fick's law to experimentally derived drying curves, on the basis on an Arrhenius-type temperature dependence. The necessary convective heat and mass transfer coefficients are obtained from CFD calculations of the turbulent flow field around the slices using a commercial CFD package. A new correlation of the Nusselt number, as a function of Prandtl and Reynolds numbers is proposed for the specific geometric flow configuration. The model is validated against experimental data for different air stream velocities (1 and 2 m/s) and temperatures (40, 50 and 60$^{o}$C). The model was found to be robust, computationally efficient and able to capture with sufficient accuracy the time evolution of the temperature and the moisture loss, with a minimum need for experimental adjustment, and hence, is considered suitable from an engineering point of view.

**Keywords**: CFD, Heat and mass transfer coefficients, Effective moisture diffusivity, Quince drying.

## Highlights

- *A new correlation for the Nusselt number is proposed for turbulent flow parallel to the axis of the cylindrical slice obtained from CFD calculations.*
- *A one-dimensional heat and mass transport model is used for predicting temperature and moisture content evolution.*
- *Satisfactory accuracy is obtained for the whole range of experimental conditions, by employing a single Arrhenius-type temperature dependent diffusion coefficient and the convective transfer coefficients estimated from the CFD calculations.*