Accepted Manuscript

A moving boundary model for food isothermal drying and shrinkage: General setting

A. Adrover, A. Brasiello, G. Ponso

PII: S0260-8774(18)30406-0

DOI: 10.1016/j.jfoodeng.2018.09.018

Reference: JFOE 9405

To appear in: *Journal of Food Engineering*

Received Date: 19 April 2018

Revised Date: 23 July 2018

Accepted Date: 13 September 2018

Please cite this article as: Adrover, A., Brasiello, A., Ponso, G., A moving boundary model for food isothermal drying and shrinkage: General setting, *Journal of Food Engineering* (2018), doi: https://doi.org/10.1016/j.jfoodeng.2018.09.018.

A moving boundary model for food isothermal drying and shrinkage : General setting.

A. Adrover[a,*], A. Brasiello[b], G. Ponso[a]

[a] *Dipartimento di Ingegneria Chimica, Materiali e Ambiente, Università degli Studi di Roma "La Sapienza", via Eudossiana 18, 00184, Roma, Italy*

[b] *Dipartimento di Ingegneria Industriale, Università degli Studi di Salerno, via Giovanni Paolo II, 132 84084, Fisciano (SA), Italy*

Abstract

A moving-boundary model is proposed for describing food isothermal drying. The model takes into account volume reduction of food materials and it is capable to predict sample shrinkage and surface deformation during the drying process. It can be applied to any sample geometry (discoid, cylindrical, cubic, parallelepiped) and to any food material since it can take into account that sample volume can decrease of a quantity that can be smaller, equal or larger than the corresponding volume of removed water.

The core of the present model is the adoption of a pointwise shrinkage velocity equal (and opposite in sign) to the water diffusive flux times a shrinkage factor $\alpha(\phi)$ depending on the pointwise water volume fraction $\phi(\mathbf{x})$. The shrinkage factor $\alpha(\phi)$ can be assumed a priori or directly derived from experimental data of the rescaled volume V/V_0 vs the rescaled moisture content X/X_0. For ideal shrinkage $\alpha(\phi) = 1$.

The model provides good results in terms of prediction of volume reduction, surface deformation and effective water diffusivity for potato strips air-drying.

Keywords: Dehydration, Shrinkage, Moving boundary model, Diffusion

1. Introduction

Drying is one of the most widespread processes for food preservation and storage (Arvanitoyannis et al., 2005; Albanese et al., 2006). Process conditions

*to whom correspondence should be addressed

Email address: alessandra.adrover@uniroma1.it (A. Adrover)