Modelling of the drying curves of a fibre enriched meat-based product (Sobrassada)

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ABSTRACT

The objective of this investigation was to evaluate the influence of the incorporation of Dietary Fibre (DF) in the formulation of Sobrassada on the drying curves of the product, and to propose a mathematical model to simulate these drying curves.

The change of formulation modified both the initial composition of samples and the drying rate, being the effective diffusivity affected by the quantity of DF added. The proposed diffusional model, where the effect of the external resistance was taken into account, provided a satisfactory simulation of these drying curves for all the samples evaluated.

INTRODUCTION

Sobrassada is a ripened meat-based product traditionally made in Mallorca (Illes Balears).

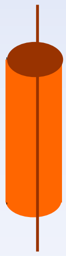
Mathematical model

Non-steady mass transfer equation for moisture diffusion within a homogeneous and isotropic cylinder:

$$\frac{\partial W(r,t)}{\partial t} = D_{eff}\left[\frac{\partial^2 W(r,t)}{\partial r^2} + \frac{1}{r}\frac{\partial W(r,t)}{\partial r}\right]$$

Admitted hypotheses

- Isotherm process
- Constant solid shape



Initial condition

$$W(x,0) = W_o$$

Boundary conditions

$$\frac{\partial W(0,t)}{\partial t} = 0 \quad \Big| \quad -D_{eff}\,\rho_{dm}\frac{\partial W(R,t)}{\partial r} = k_G(\varphi_s - \varphi_\infty)$$

Separation of variables method [2]:

$$\Psi(r,t) = \frac{W(r,t) - W_e}{W_o - W_e} = 2\sum \frac{2J_1(\gamma_v)}{\gamma_v\left[J_0^2(\gamma_v) + J_1^2(\gamma_v)\right]} \times \exp\left[-\gamma_v^2 \frac{D_{eff}}{R^2} t\right] \times J_0\left(\gamma_v \frac{r}{R}\right)$$

MATERIALS AND METHODS

Dietary fibre source: carrot

Carrots were dehydrated until 6.8 g/100 g d.m. and grinded to a particle size of 0.355 mm.

Sobrassada manufacture

Mixture of lean pork meat (27.8%), white fat (64.8%), Dietary fibre (3-12%) and a mix of paprika, salt, glucose and pepper (7.4%).

Drying process

Ripened controlled conditions: 75±5% of relative humidity and 12±2ºC of temperature water losses during drying were measured by weighing.

RESULTS AND DISCUSSION

The drying curves at different DF concentration have been evaluated and a diffusional model has been proposed to simulate the drying kinetics (figure 1). The equilibrium moisture content was obtained using the moisture isotherm at 14ºC proposed by Simal et al. [1].

The figure used for the mass transfer coefficient was 3.99×10^{-3} m/s, proposed by Simal et al [1] for a similar system.

The identified figure for the effective water diffusivity (D_{eff}) obtained for the different samples of Sobrassada are shown in figure 2.

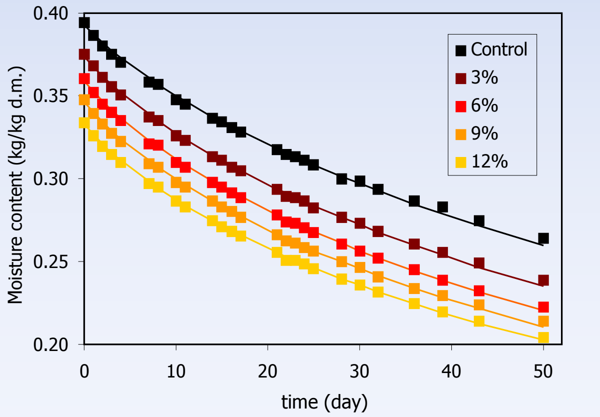


Figure 1. Drying curves of Sobrassada with different DF content.

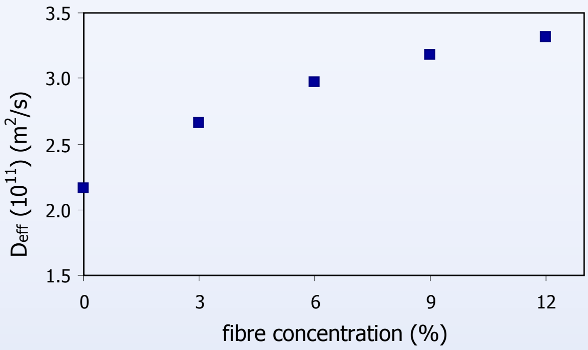


Figure 2. Variation of the effective diffusivity coefficient with the DF content

In all cases, the simulation was very accurate being the average percentage of error (%E) of 0.3±0.1%.

The figures obtained for D_{eff} in the present work are very similar to that proposed by Simal et al. [1] for samples of Sobrassada without DF enrichment and ripened at 14ºC under different air relative humidity (2.86×10^{-11} m^2/s).

The simulation of the drying curves of samples with different DF content have been also represented in figure 1.

REFERENCES

[1] Simal S., Femenia A., Garcia-Pascual P, Rosselló, C. *2003. Simulation of the drying curves of a meat-based product: effect of the external resistance to mass transfer.* Journal of Food Engineering 58 (2003) 193-199

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