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Chemical and thermal characterization of a Portuguese traditional fermented meat sausage

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Introduction

In the North of Portugal several traditional fermented meat products are produced. One of these is *alheira* (Figure 1) that is a smoked sausage, made from the meat of pig, regional wheat bread and olive oil, seasoned with salt, garlic and paprika. This product must be subjected to a thermal process before consumption in order to guarantee its safety and reducing the occurrence of foodborne diseases.

Figure 1 – *Alheiras*.

Objective

✓ Characterize *alheiras* in relation to the chemical composition and thermal behavior.

Materials and Methods

✓*Alheiras* were bought to local producers.

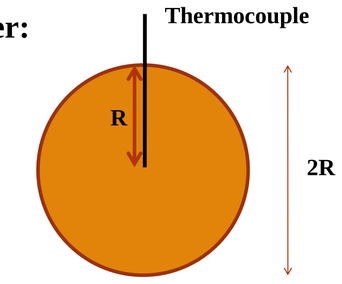
✓pH, water activity, fat and protein contents were determined:

✓In order to obtain the heating curves, *alheiras* were roasted at different temperatures, ranging from 120 to 240 ºC, in a forced convection oven: T_∞ = 119±4 ºC and T_∞ = 243±5 ºC, respectively.

✓The center temperature, as well as the temperature of the surrounding medium, were monitored at 30 s intervals.

Approximating *Alheiras* to an Infinite Cylinder:

$$\frac{\partial T}{\partial t} = \alpha\left[\frac{1}{r}\times\frac{\partial T}{\partial r} + \frac{\partial^2 T}{\partial r^2}\right]$$



$$t = 0, \forall r, T = T_0$$

Boundary conditions

$$t > 0, r = R, T = T_\infty$$

$$t > 0, r = 0, \frac{\partial T}{\partial r} = 0$$

$$\frac{T - T_\infty}{T_0 - T_\infty} = 2\times\sum_{n=1}^{\infty}\frac{J_0\left[R(n)\times r/R\right]}{R(n)\times J_1\left[R(n)\right]}\times e^{-\frac{\alpha t}{R^2}\times R(n)^2}$$

where: $J_0(x)$ – Bessel function of order 0;
$J_1(x)$ – Bessel function of order 1;
R(n) - Positive solutions of the equation $J_0(x) = 0$
α - Thermal diffusivity

After a long period of time ⇒ 1st Term of the Serie + Applying logarithms

$$\ln\left[\frac{T - T_\infty}{T_0 - T_\infty}\right] = \ln\left[2\times\frac{J_0\left[R(1)\times r/R\right]}{R(1)\times J_1\left[R(1)\right]}\right] - \frac{\alpha}{R^2}\times R(1)^2\times t$$

R $_{Alheiras}$ (120 ºC) = 15.63±1.72 mm
R $_{Alheiras}$ (240 ºC) = 16.17±0.84 mm

Results and Discussion

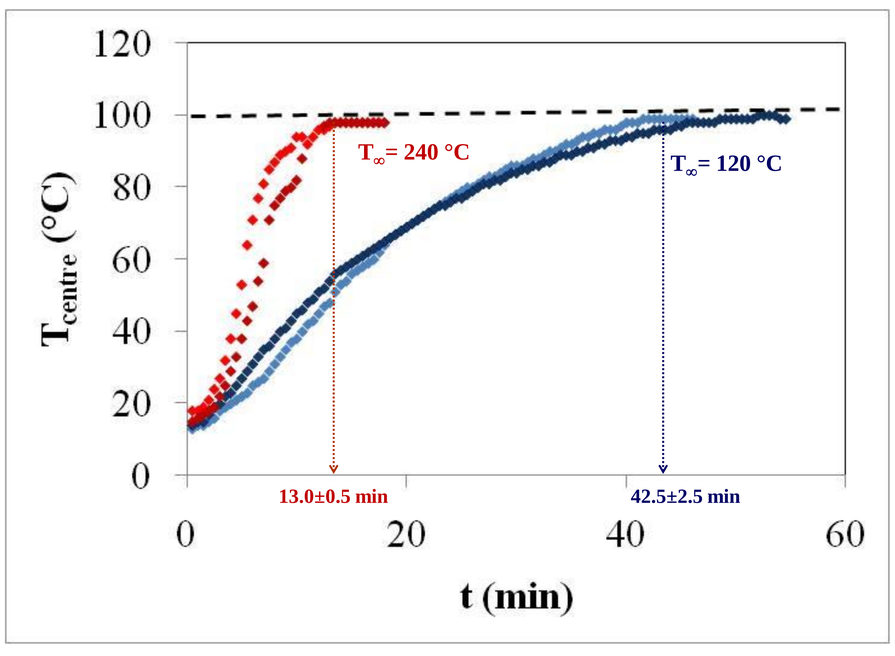
I) *Alheira*'s composition

Table 1: Values of pH, water activity, fat and protein (minimum, maximum, mean and standard deviation) of *Alheiras*.

	Min.	Max	Mean	SD
pH	5,29	6,32	6.07	0.26
Water activity	0.90	0.93	0.92	0.01
Fat (%)	5.44	7.37	6.60	0.68
Protein (%)	8.94	12.06	9.78	0.9

pH and a_w ↑ ⇒ It is important to subject *alheiras* to a correct thermal treatment

II) *Alheira*'s heating - Temperature profiles

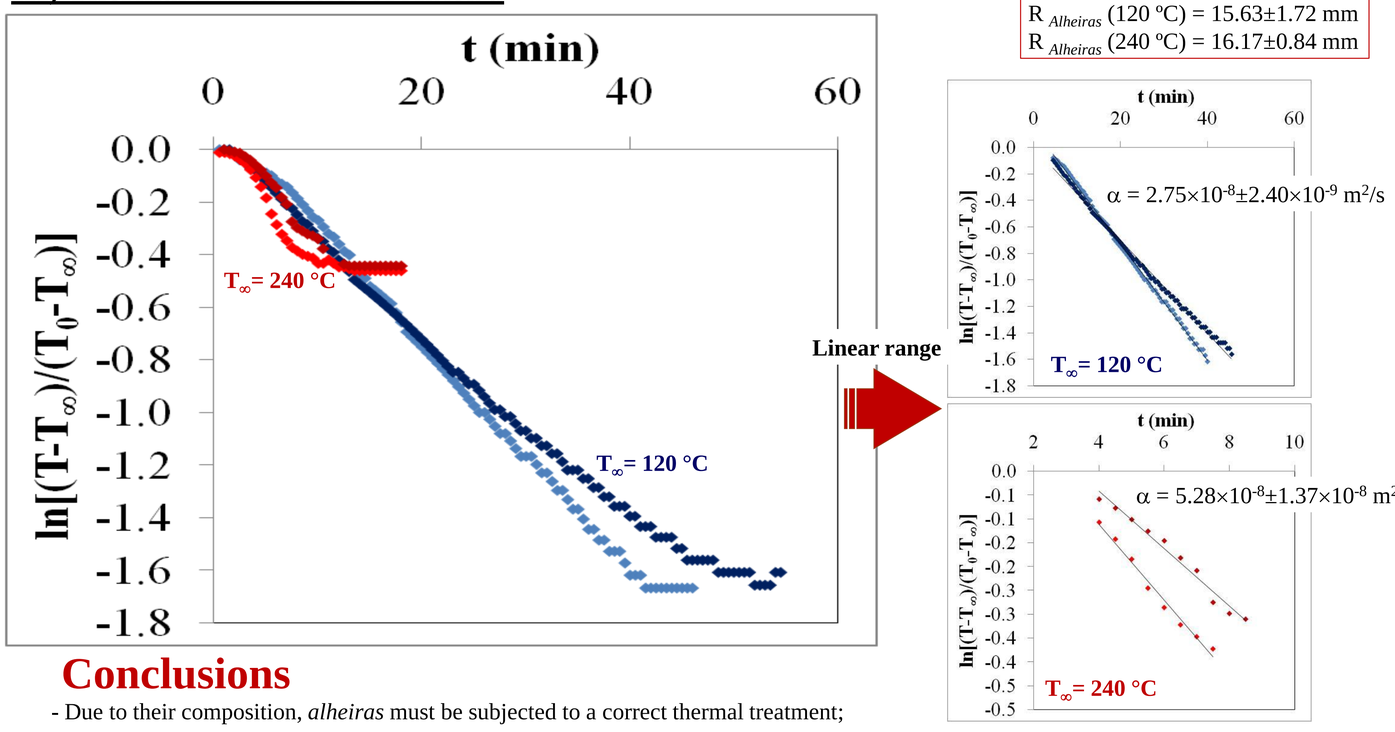


✓ After a certain period of time, the temperature at the center of the product remained almost constant, around 100 ºC, eventhough higher heating temperatures were used;

✓ At 240ºC the heating process was around three times faster than at 120 ºC;

✓ For reaching 100 ºC, 13.0±0.5 min were necessary at 240 ºC instead 42.5±2.5 min at 120 ºC.

III) Thermal Diffusivities of *Alheira*



Conclusions

- Due to their composition, *alheiras* must be subjected to a correct thermal treatment;

- A two-fold increase of temperature, decreases the time of heating in 1/3.

-Thermal diffusivities of *alheiras* at 120-240 ºC are around 10^{-8} m²/s.