Application of analytical and numerical tools to describe the drying of umbu seeds *(Spondias tuberosa)*

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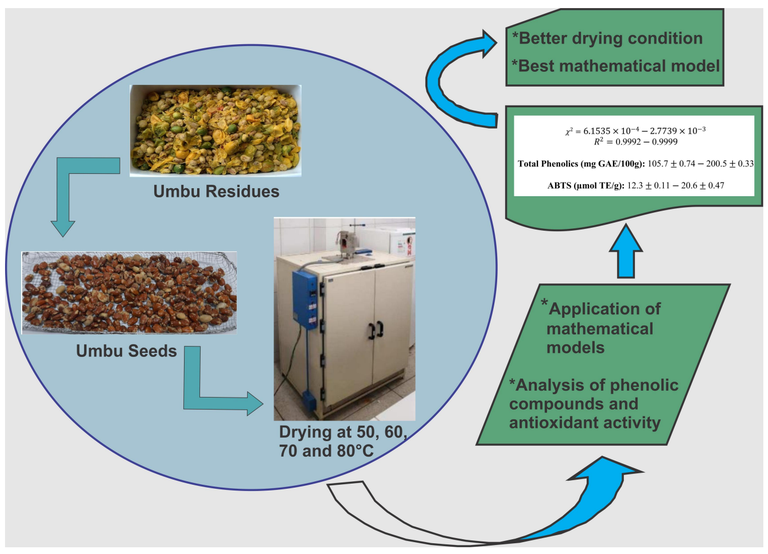
1. INTRODUCTION

The umbu tree (Spondias tuberosa) belongs to the *Anacardiaceae family* and is part of the plant biodiversity of Brazilian biomes, such as the Caatinga (LIMA, 2018). Its fruit is known as umbu, which has great potential for use in human nutrition due to its good nutritional composition.Fruit processing by food industries generates waste that is commonly discarded, but its use for human consumption can generate benefits for health and the environment, as it minimizes environmental impacts with its disposal in nature (GANESH et al., 2022; ANAL, 2017).

2. GRAPHICAL ABSTRACT

Figure 1: Stages of this research.



3. MATHEMATICAL MODELING

To describe the drying process of umbu seeds using a diffusive model, each seed was considered as a finite cylinder. For this, the following two-dimensional case of the Diffusion Equation in cylindrical coordinates , with origin at the center of the cylinder, was considered:

$$\frac{\partial M}{\partial t} = \frac{1}{r}\frac{\partial}{\partial r}\left(rD_w\frac{\partial M}{\partial r}\right) + \frac{\partial}{\partial y}\left(D_w\frac{\partial M}{\partial y}\right) \qquad (1)$$

where M represents the dimensionless moisture content, D_w is the effective water diffusivity, t is the time, and r and y define the position within the finite cylinder.

Two solutions are proposed (analytical and numerical) for the diffusion equation in cylindrical coordinates, with boundary conditions of the third kind.

4. RESULTS AND DISCUSSION

Figure 2: Fitting analytical (50°C-(a) and 60°C-(b)) and numerical (50°C-(c) and 60°C-(d)) solutions to experimental data.

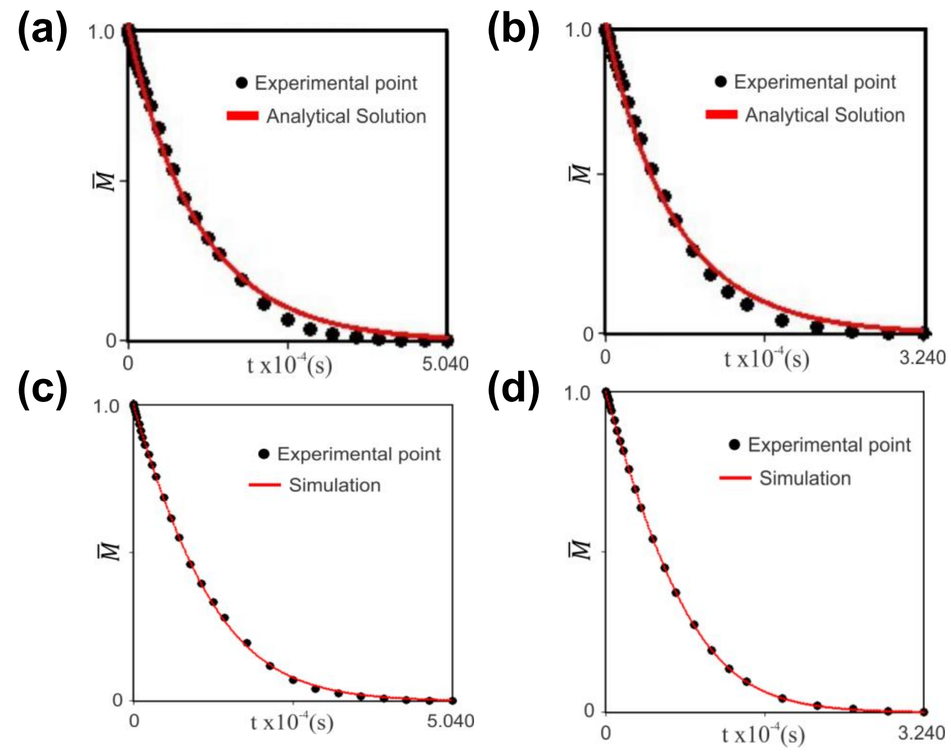
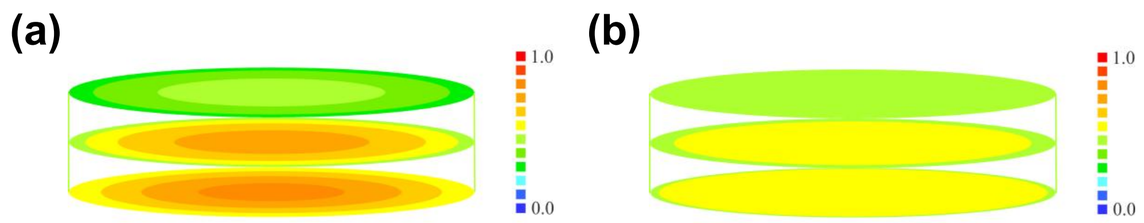


Figure 3: Simulation of moisture distribution using analytical (a) and numerical (b) solutions at times 47.3 min and 59.2 min for a temperature of 70°C, respectively.



5. CONCLUSION

In the present work, analytical and numerical tools were used to describe the drying of umbu seeds. Through the statistical indicators obtained, a good fit of the two models used to the experimental data is verified.

The results obtained may be a first step towards analyzing the viability of using umbu seeds in the food industry, since drying is one of the first processing steps for this type of product.

6. REFERENCES

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