

Cocoa Fermenter Models

Propose and analyze of different cocoa fermenter models that could enhance the efficiency and quality of the production.

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Abstract

In the southern region of Bahia, the cocoa culture has been a source of income and moved the economy for a long time, but the emergence of the witch's broom caused the decline of this productive sector. To be able to be used in the manufacture of chocolate and derivatives, cocoa needs to go through processing. Fermentation is one of the most important stages of processing since it is through fermentation that cocoa develops most of its characteristics, such as color, flavor, and aroma [1].

Thus, the idea arose to create a cocoa fermenter model that could increase the efficiency of the fermentation cycle, and boost its scale and quality. Nowadays the process is done manually, requiring monitoring and stirring the cocoa mass at short intervals, in hours. This work compares four fermentation equipment through the analysis of heat diffusion. The method is theoretical with the help of computer modeling, where the propagation of heat from a source throughout the system filled with a mass of cocoa is evaluated.



FIGURE 1. 2D models of fermentation trough, dynamic/static cylindrical fermenter and fermenter with propeller.

Methodology

The method is theoretical with the help of computer modeling, where the propagation of heat from a source throughout the system filled with a mass of cocoa is evaluated, once the fermentation is exothermic.

Table 1: Physical Properties of cocoa

Density (ρ)	1106,4 (Kg/m ³)
Thermal conductivity (k)	0,535 (W/m °C)
Especific heat (C_p)	3600 (J/Kg °C)

Source: Sales, 2022 [2].

Results

The (a) fermentation trough and (b) static cylindrical fermenter shows, through computer simulation, which a single heat source (50 °C), propagates symmetrically to its isotherms, without further spreading. Conversely (c) the dynamic cylindrical fermenter and (d) the cylindrical fermenter with propeller showed most dispersion in isotherms within the cocoa mass. The spinning favors the propagation of heat to other regions of the cocoa mass. Consequently, activating fermentation at other points within the spinning drum. Resulting in more uniform fermentation throughout the system, where (c) showed a better dispersion, so the dynamic cylindrical fermenter is the most efficient one.

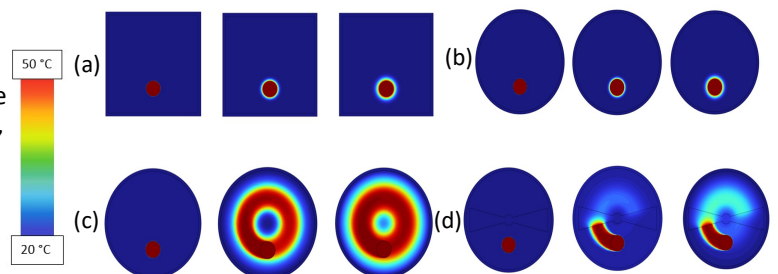


FIGURE 2. Fermentation models at instants 0, 60 and 600 seconds (10 min).

REFERENCES

1. A. Ferreira, "Beneficiamento de cacau de qualidade superior", Editora: PTCSB, 2017.
2. J. Sales et al, "Modelagem Computacional Contribuindo para Desenvolvimento da Agricultura Cacauera", Vektor-Revista de Ciências Exatas e Engenharias, vol. 32, pp. 37-54, 2022.

