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Study of Thin Layer Drying Model for Cassava Pulp

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Abstract

This thesis article was purposes to study on the thin layer drying of cassava pulp using the Model BINDER Incubator BD 53 dryer. In experimental the cassava pulp sample with initial moisture content at 80 % w.b. was drying at temperature 50, 60 and 70 °C and collected mass of cassava pulp at interval 20 minute until mass not change. The experimental data was analyzed to evaluate the thin layer drying models and guideline for developed a new empirical drying equation to be suitable for predicting the moisture ratio of cassava pulp. From experimental, the moisture ratio was decreased with increased drying time and drying time was decreased with increased drying temperature. The results analysis of thin layer drying models, the Midilli model was good agreement predicted with experimental data. It had coefficient of determination (R^2) and root mean square error (RMSE) better than another model. The newly developed equation had high accuracy with experimental data and had correlation values R^2 = 0.9938 and RMSE = 0.0264 for drying at temperature 50 °C - 70 °C.

Keywords: Thin layer drying models; Moisture ratio; Cassava pulp

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1. Introduction

The cassava or tapioca which is known biologically as *"Manihot esculenta crantz"*, is one of the important economics crops in Thailand. Thailand is the first major cassava exporter. Even though the major produce cassava of the world are Nigeria, Brazil, Indonesia, Thailand and Congo [1]. Thailand cassava productions during 2013 to 2014 were yields 28.745 million tons of fresh roots with 2.982 million rai of cultivated area [2]. Fresh root from farm would be produce for chip and pellets of 10 to 12 million tons and for starch is around 12 to 15 million tons [3]. However, production of cassava starch results in formation of 15 to 20% of the original processed root dry weight basis as solid waste. This waste is well known as "pulp".

Cassava pulp is retaining a high amount of carbohydrates and fiber. It can be used in biomass, ethanol, animal feeds and paper pulp. On the other hand, cassava pulp is still remains high moisture content (75-80% w/w), it may be causing environmental problems that including a strong and offensive putrefaction odor and local water contamination [4]. If those pulps could be dried that would help to solve exists problem.

Simple dehumidifier of cassava pulps is sun drying but it may have some problem as required large area, relies on the weather condition and poor product quality. However, this study aims to solve this problem by implement the drying technology for dehumidified cassava pulp. More information on properly design and analysis that affected the vital parameters such as: equilibrium moisture content, moisture ratio, drying rate, density, specific heat, etc. is needed for studies. So, the main objective of this article was study the thin layer drying model for predicted the moisture ratio of cassava pulp. This study would not only reduce the environmental problem of cassava pulp from the industry but also add value for cassava crops [5] and drying data could describe the drying characteristic of cassava pulp.

Nomenclature

M	Moisture content (w.b.)
M_0	Initial moisture content (w.b.)
M_e	Equilibrium moisture content (w.b.)
MR	Moisture ratio (decimal)
$MR_{exp,i}$	The *i*th experimentally observed moisture ratio
$MR_{pre,i}$	The *i*th predicted moisture ratio
N	The number of observations
n	The number of constant in thin layer model

2. Thin layer drying model

The moisture ratio of cassava pulp during the thin layer drying experiments was using the following equation:

$$MR = \frac{M - M_e}{M_0 - M_e} \tag{1}$$

For the thin layer drying models in Table 1 were tested to select the best model for describing the drying curve of cassava pulp. The non-linear regression was performed using computer program. The coefficient of determination (R^2) was the primary criterion for selecting the best equation to describe the drying curve [6]. In addition, the root mean square error analysis (RMSE) was used to determine the best fit. This parameter can be calculated as equation 2.

$$RMSE = \left[\frac{1}{N} \sum_{i=1}^{N} \left(MR_{pre,i} - MR_{\exp,i} \right)^2 \right]^{1/2} \tag{2}$$

Where $MR_{exp,i}$ is the *i*th experimentally observed moisture ratio, $MR_{pre,i}$ the *i*th predicted moisture ratio, N the number of observations and n is the number of constant in each thin layer model.