EFFECT OF DRYING PARAMETERS AND GEOMETRY ON PAPAYA QUALITY

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ABSTRACT

Due to the importance of minimizing thermal stresses over drying and maintenance of relevant compounds, selection of proper drying condition is necessary to maintain the quality of the processed fruit. The aim of this project is to study the effect of various drying parameters *i.e.* temperature, air velocity and geometry cut on the quality of papaya based on moisture content. Slices (0.5 x 1.5 x 1.5 cm) and cubes (1.0 cm) of papaya were treated in tray drier (Armfield UOP8) at different levels of temperature (40, 50 and 60 °C) and air velocity (0.5, 1.0 and 1.5 m/s). Temperature was found to be significantly influencing the drying performance for both slices and cubes. However, geometry was the most significant factor played as a controlling effect on moisture content, in which larger surface exposure helps temperature to take action strongly. Slices suffered higher water loss than cubes with regression level (R^2) 0.932.

Keywords: tray drying; papaya; moisture content; geometry; response surface methodology

INTRODUCTION

Papaya (*Carica papaya* L.) has been regarded as one of the most valuable tropical fruits that contains vitamin C, beta carotene and papain enzyme. Dried papaya slices and cubes are expected to be a nutritious tea drink by maintaining the quality *i.e.* moisture content, original taste, color, aroma, nutrient and enzymatic concentration. In recent years, much attention has been given to the quality of dried products. Drying is a process in which water is removed to halt or slow down the growth of spoilage microorganisms, as well as the occurrence of chemical reactions (Vega-Mercado *et al.*, 2001). Tray drying application enhances the drying rate and improves the final product quality. The consumer demand has increased for processed products that keep more of their original characteristics (Torringa *et al.*, 2001). An important factor in the improvement of dried fruits quality is the moisture content. Moisture content determines the water loss in dried products, in which lower moisture content provides higher quality in products preservation. Akanbi *et al.* (2005) reported on drying characteristics of tomato slices, including moisture content at different drying temperature. The aim of this project is to study the effect of various drying parameters *i.e.* temperature, air velocity and geometry cut on the quality of papaya based on moisture content.

MATERIALS AND METHODS

Mature selected papaya fruits (Hawaiian type) were supplied by MARDI, Pontian. The fruits were hand-peeled and cut into slices (0.1 x 1.5 x 1.5 cm) and cubes (1.0cm). The drying procedure followed Park *et al.* (2002) with slight modification. Drying were carried out using tray dryer (Armfield UOP8) at different temperature (40, 50 and 60 C) and air velocity (0.5, 1.0 and 1.5 m/s). The tray dryer consists of horizontal air flow through trays and samples loaded on it. Sample weight was taken with time interval range of 15 – 120 minutes. The drying kinetics was studied by observing the response surface using Statistica 5.0. (Statsoft Inc., USA).

The moisture content was expressed on a dry basis as kg of water per kg of free-moisture solid or kg H_2O/kg dry solid. It was determined by an oven method, slightly modified from Funebo *et al.* (2000). Papaya slices were placed in oven (Memmert) at 100 C for 24 hours to obtain the dry weight. Time-dependent moisture content of the samples were calculated as follows:

$$MoistureContent = \frac{Wet\ weight - dry\ weight}{dry\ weight}$$

RESULTS AND DISCUSSION

Effect of process variables on moisture content

Average initial moisture content of fresh papaya was about 87.56%.From Figure 3.1, it is shown that air velocity had no influence towards drying kinetics for either papaya slices or cubes. However, it can be clearly seen that increased in temperature from 40 C to 60 C caused the reduction of moisture content for both geometry cut. On the other hand, air velocity was only aiding the drying process. At the early stage of drying process, the moisture content was rapidly decrease but showed some convergence at the final drying process as the equilibrium condition was reached. It shows that only at the beginning of drying process, both air velocity and air temperature strongly influenced the drying rate. However getting to the end of the drying process, air temperature effect was stronger than the air velocity. This was due to higher internal resistance of fruits that air velocity insignificantly affecting the drying process. Figure 3.2 shows that papaya slices had rapid drying process and suffered higher water loss compared to cubes. It can be explained that the wider diffusion directions and the lower thickness for slices contributed to the ease of water exits and furthermore affecting by temperature, consequently, less moisture was retained. Model obtained for water loss response through response surface methodology was significant ($R^2 = 0.932$) and predictive, as shown below:

$$Z = 1.2212 \times 10^{-15} + 1.5890X_1 - 0.1619X_2 - 0.00324X_3 \\ + 0.0055X_1X_2 + 0.00378X_2X_3 - 0.0128X_1X_3 + 0.9831$$

From the study, it can be concluded that drying air temperature was the most important factor affecting the drying rate and quality of dried papaya for each geometry cut. However, geometry cut was the most significant factor played as a controlling effect on moisture content, in which larger surface exposure helps temperature to take action strongly. Papaya slices suffered higher water loss than cubes with regression level (R^2) 0.932

ACKNOWLEDGEMENT

The financial support from Research Management Centre, UTM Skudai (vot 75146) and Bioprocess Engineering Department, FKKKSA were gratefully acknowledged.

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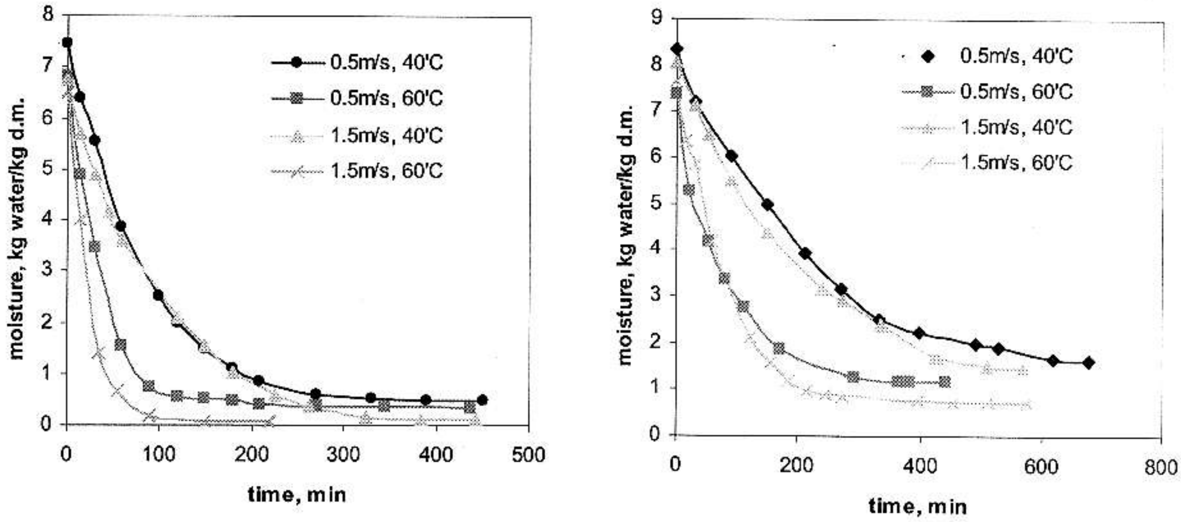
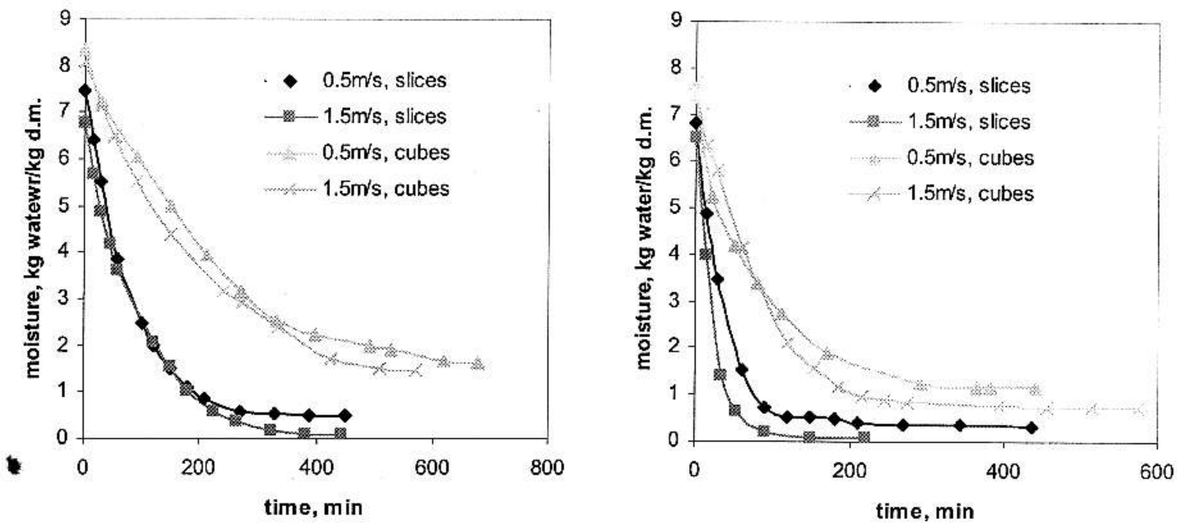
FIGURES



(a) (b)

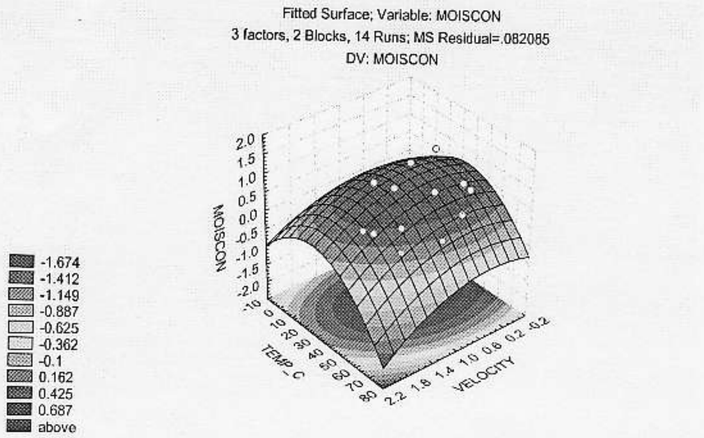
Fig 3.1: Drying kinetics of papaya (a) slices and (b) cubes



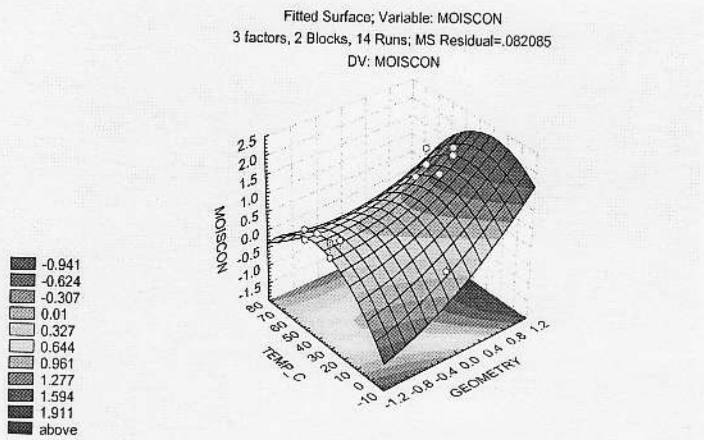
(a) (b)

Fig 3.2: Effect of geometry and air velocity on moisture content at drying temperature

(a) 40 °C and (b) 60 °C



(a)



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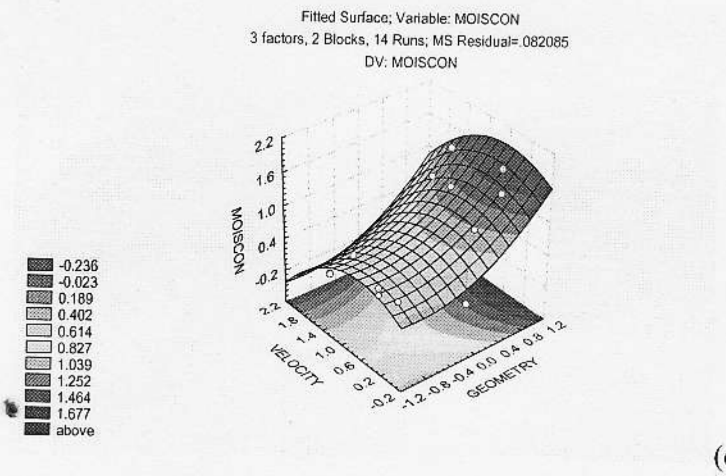

(c)

Figure 3.3 Response surface methodology for moisture content analysis with process variables (a) air velocity and temperature, (b) geometry cut and temperature, and (c) geometry cut and air velocity