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# Study drying kinetics of banana slices

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**Abstract**
In the present work, bananas of Dwarf Cavendish dehydrated by hot air drying at 50 ºC, 60 ºC and 70 ºC. The purpose of this work was to fit the kinetic data to different thin layer models found in the literature to describe the drying rates of bananas, in order to find out which model better describes the drying kinetics of these one variety of bananas. The selection of the appropriate drying model was based on their coefficients of determination, which were predicted by non-linear regression analysis using the Sigma Plot program. From the obtained results it was possible to conclude that the drying of banana varieties have a similar kinetic behaviour, regardless of the operating conditions. As to the influence of the drying temperature on the process, it was observed that increasing the drying temperature from 50 ºC to 70 ºC leads to a diminishing of approximately 34% and 49% in the drying time to Dwarf Cavendish, respectively. Furthermore, based on the standard deviation results, as well as on the additional statistical information, the one parameter models such as the Page model was the best to describe the drying kinetics of these one kinds of banana variety.

**Keywords:** Banana, drying, kinetic model

## Introduction

Banana is one of the most commonly consumed fruits in several countries, mainly due to its sensory characteristics. It is a calorific food, rich in carbohydrates, minerals, and vitamin E [1]. However, ripe banana is perishable and deteriorates rapidly after harvesting, due to its relatively high moisture content and degradable enzymes such as those that accelerate non enzymatic browning reactions [2]. Thus, it is of paramount importance to use an appropriate post harvest process to prolong the shelf life of the fruit. The drying process is one of the most popular methods to accomplish such task since it reduces water activity of the material to a level which prevents deterioration. In addition, the banana is dried not only for preservation purposes but also for modification of the taste flavor and texture to meet consumer preferences and to increase the market value of the product [3]. However, the most common technique used to preserve banana is hot air drying [5-7]. Drying has received attention from several years as a technique for production of shelf-stable foods. The demand of healthy, natural, nutritious, and tasty dehydrated food products is continuously increasing. The increasing consumer demand of dehydrated products in national and international market indicates that there is great potential of processing and production of dehydrated banana powder. The on farm production of banana can play an important role in rural development by augmenting rural prosperity and food security. The present work aimed to study drying characteristic of banana slices under air drying process to obtain quality dried product.

## Experimental Procedure

a. **Sampling:** The fresh bananas were obtained from a local supermarket. Prior to the start of the experiments, each banana was peeled and sliced by a knife to disks with a thickness of 5 mm. The initial moisture content of fresh banana was 76.8% (w. b.).
b. **Methods:** The convective drying was made in an tray dryer drying chamber with ventilation (air flow of 0.5 m/s), operated at a constant temperature of 50 ºC, 60 ºC and 70 ºC. The sliced samples were placed on a perforated tray inside the chamber and the samples were dried until reaching a final moisture content lower than 10% (wet basis) in order to assure good preservation characteristics as well as good final physical and chemical properties [11]. The experimental sets of (MR, t) were fitted to different empirical models well-known in the literature [12], namely Newton, Page, modified Page, Henderson & Pabis, Wang & Singh and Vega-Lemus. The layer drying models are summarized in Table I.

**Table 1:** Thin layer drying curves models

| Model name | Equation |
|---|---|
| Newton | $MR = \exp(-kt)$ |
| Page | $MR = \exp(-kt^n)$ |
| Modified Page | $MR = \exp((kt)^n)$ |
| Henderson & Pabis | $MR = a\exp(-kt)$ |
| Wang & Singh | $MR = 1 + at + bt^2$ |
| Vega-Lemus | $MR = (a + kt)^2$ |

## Results and Discussion

Drying curves of Dwarf Cavendish banana slices performed at hot air drying at 50 ºC, 60 ºC and 70 ºC are illustrated in Fig. 1, respectively. Due to differences in the initial moisture content of both varieties, the moisture content is expressed in a dry basis.

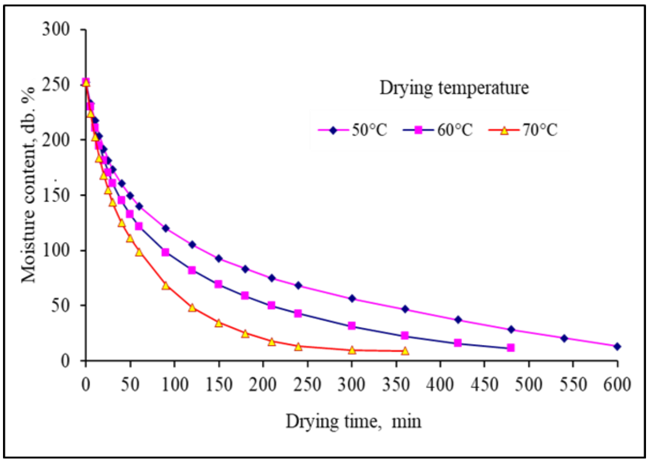


**Fig 1:** Variation in moisture content with drying time

The typical curves showing variation in moisture content with drying time for banana slices dried with air temperature of 50, 60 and 70ºC are shown in Fig. 1 for air velocities of 0.5 m/s, respectively. The average initial moisture content of the banana slices was 252.59 per cent (db), the final moisture content was found in the range of 9.27 to 13.15 (db) (Fig .1). It can also be observed from these curves that final moisture content of banana slices 13.15 (db) decreased exponentially with drying time under all drying conditions.

It can be observed from the Fig 2 that as the drying proceeds, the moisture content of the sample decreased and the rate of drying also decreased. It can also be seen from the figure that the rate of drying was higher for high temperature of drying air. This is expected also because high temperature of drying can remove moisture quickly from the sample which resulted in high drying rate. Further, it can be seen from the figures that no constant rate period was found during air drying of banana slices and entire drying has taken place in falling rate period. The drying rate curves presented in Fig. 2 were statistically analyzed and regression equation of second order in following form was fitted.

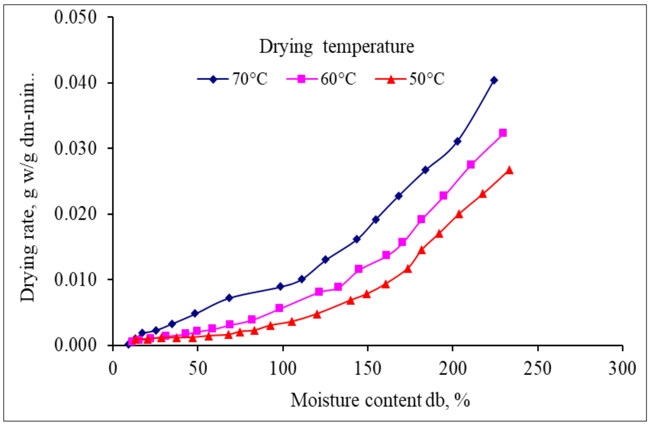


**Fig 2:** Variation in drying time with moisture content

The moisture loss data from air drying were analyzed and moisture ratios at various time intervals were determined. The moisture ratio (MR) was plotted with drying time on in order to find out moisture diffusivity for banana slices Fig. (3). The variation in ln (MR) with drying time of the banana slices have been presented in Fig. 3.

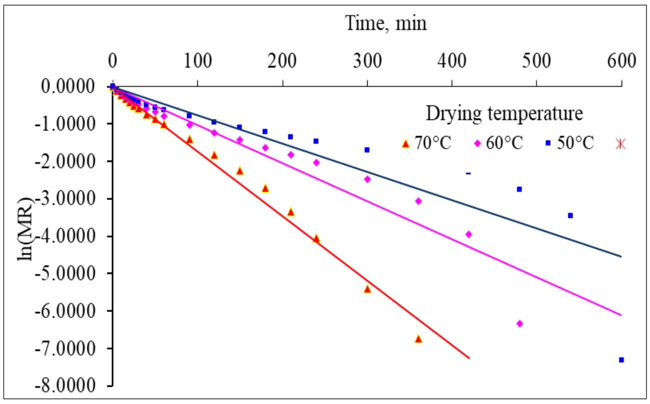


**Fig 3:** Variation in ln (MR) versus time for air drying of banana slices

The selected page model for hot air drying studies was validated by comparing the predicted and observed values of moisture ratio in all drying experiment. The predicted and observed values of moisture ratio were plotted as shown in Fig. 4. for

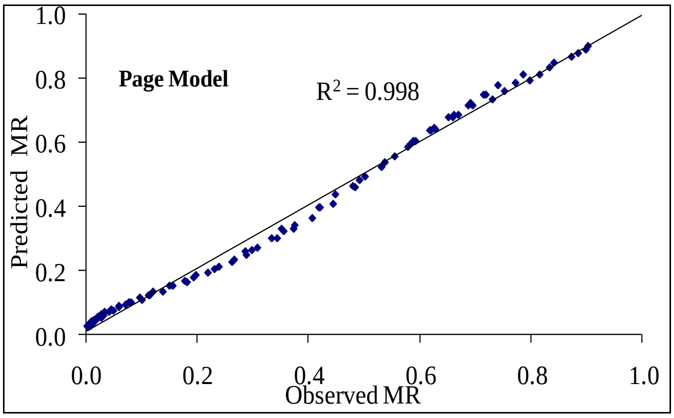


**Fig 4:** Experimental and predicted values of moisture ratio by Page model for 0.5 m/s air velocity and at various temperatures.

## Conclusion

The results showed that moisture curves for the drying of banana at 50 ºC, 60 ºC and 70 ºC followed a shape characteristic of the drying processes, and gave evidence of a reduction in drying time with the increase in temperature. The drying kinetics data expressed in the form of moisture ratio versus time, was fitted to different models available in the literature and a good agreement was observed between the experimental and predicted values of the models under study. However, according to the statistical indicators, Page model was found to be the most satisfactory to represent the thin-layer drying of banana slices.

## References

1. Wall MM. Ascorbic acid, vitamin A, and mineral composition of banana (*Musa* sp.) and papaya (*Carica papaya*) cultivars grown in Hawaii, J Food Compos. Anal. 2006;19:434-445.
2. Fernandes FAN, Rodrigues S, Gaspareto OCP, Oliveira EL. Optimization of osmotic dehydration of bananas followed by airdrying, J Food Eng. 2006;77:188-193.
3. Guiné RPF, Barroca MJ. Dried Banana, *in* Hui YH, Chandan RC, Clark S, Cross N, Dobbs J, Hurst WJ, Nollet LML, Shimori E, Sinha N, Smith EB, Surapat S, Titchenal A, Toldrá F (Eds), Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits and Functional Foods. Chapter John Wiley & Sons, Inc., New Jersey, USA. 2007;38:867-878.
4. Demirel D, Turhan M. Air-drying behavior of Dwarf Cavendish and Gros Michel banana slices, Journal of Food Engineering. 2003;59:1-11.
5. Karim MA, Hawlader MNA. Drying characteristics of banana: theoretical modeling and experimental validation, Journal of Food Engineering. 2005;70:35-45.
6. Nguyen MN, Price WE. Air-drying of banana: influence of experimental parameters, slab thickness, banana maturity and harvesting season, Journal of Food Engineering. 2007;79:200-207.
7. Togrul IT, Pehlivan D. Modelling of thin layer drying kinetics of some fruits under open-air sun drying process, Journal of Food Engineering. 2004;65:413-425.
8. Barroca MJ, Guiné RPF, Pinto A, Golçalves FM, Ferreira DMS. Chemical and microbiological characterization of Portuguese varieties of pears, Food Bioprod. Process. 2006;84:109-113.
9. Akpinar EK. Determination of suitable thin layer drying curve model for some vegetables and fruits, Journal of Food Engineering. 2006;73:75-84.