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Effects of Pretreatment on the Drying Rates and Drying Time of Potato

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Abstract: The effects that two pretreatments -blanching and freezing- used prior to drying had on the drying rate and drying time of potato were investigated. An untreated sample was used as a control. The initial and overall drying rates were highest for the freezing treatment, which resulted in the shortest drying times. Increase in the freezing time resulted in decrease in the drying time while increase in the blanching temperature and blanching time has no effect on the drying time of potato.

Key words: Blanching, freezing, drying rate, drying time

INTRODUCTION

The control of the activity of water (A_a) in food is very important due to the influence that water has in determining the stability of food against chemical, enzymatic or microbial attacks. Therefore, within the industrialized processes in the preservation of edible food, drying is one of the oldest methods e.g. sun drying which Tatsadjieu *et al.,* [1] used to study the drying kinetics of fermented milk based sorghum flour and it is gaining forces as one of the promising techniques.

In dehydrated foods, due to the presence of a minimum amount of water, microorganisms practically do not grow. Dehydrated foods are therefore immune to many of the chemical or enzymatic reactions that could provoke alterations or spoilage in the food.

Drying is an energy intensive unit operation. The drying rate of food materials generally decreases as drying progresses. Hence energy efficiency and production efficiency would improve if drying rate could be increased. Physical pretreatments such as blanching [2-5],Osmotic pretreatment [6] and freezing[5-7] have been studied in order to improve either product quality or drying kinetics.

Blanching is an important step in the processing of food because of the many advantages that can be derived. One major effect of blanching is to inactivate enzymes. Moreover, blanching has also resulted in increasing the drying rate of products such as apple and peaches [8], red pepper[9] and carrot cubes[10]. However, blanching some food materials such as potato[11] did not increase the rate of drying because of starch gelatinization[12] that resulted in reduced porosity[13].

Freezing foods prior to drying may also increase the drying rate. Freezing before drying has been investigated for avocado[14] and for carrot and beans [7].

Potato is one of the root tuber food crops that provide major part of the caloric needs of people in the tropics. It can be boiled and mashed or baked. It is used in preparing candied yams and pie fillings. It is used industrially as a source of starch, glucose, syrup and alcohol (Ihekowuye and Nguddy, 1995). Therefore, the objective of this study is to investigate the effects of pretreatments on the drying rate and drying time of potato.

MATERIALS AND METHODS

Preparation of raw material: Fresh potatoes (Ipomoea Batata) were purchased from the local market of Ogbomoso, Nigeria. The potatoes were randomly divided into three groups for each treatment. The potatoes were pretreated before drying as follows:

1. Freezing: The potatoes were peeled, placed in a freezer for 24 h after which they were brought out and allowed to thaw at room temperature before drying. This was repeated for 48, 72 and 96 h, respectively.
2. Blanching: The potatoes were peeled, cut into slices of 5 mm diameter. Put in a beaker containing water and placed in a a temperature controlled water bath and heated at a temperature of 60°C for 3 min after which the samples were removed from the water and blotted dry using tissue paper in order to remove the excess water. This procedure was repeated at temperatures 70, 80, 90 and 100°C and time 3, 5, 10 min.

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3. Untreated or Control Sample: Potatoes were peeled, cut into slices of 5 mm diameter, weighed and loaded onto drying trays without any pretreatment.

Drying: Approximately 50 g of the sliced samples from each of the three treatments were dried in a hot air oven dryer (Uniscope SM9053A Laboratory Oven, Surgifriend Medicals, England) at a temperature of 70°C. At an hour interval, samples were withdrawn from the dryer and then weighed until 5% final moisture content was attained. Moisture content at each measurement time was calculated based on initial moisture content and weight loss. This data was plotted against time for each treatment and curves fitted using a two term exponential model [15]. All parameters in the model were estimated [16] as a non-linear regression and the model used to calculate the time for each treatment to reach common moisture content of 5%. Drying rates for each treatment were calculated based on weight of water removed per unit time and per kilogram of dry matter and expressed in units of kg kg^{-1} h^{-1} [5,16].

Moisture determination: Moisture content determination of fresh as well as dried potato samples was done according to the AOAC[17].

RESULTS AND DISCUSSION

Drying rate and drying time: Drying rates of the pretreated potatoes plotted against product moisture content are presented in Fig. 1. Drying rates of all treatments were high initially when the moisture content was highest, then decreased rapidly until all were loosing moisture at a similar rate after some hours of drying. This was due to the unbound moisture near the surface of the product removed early in the process.

The initial drying rate of potatoes from the blanched treatment was similar to that of the untreated potatoes as shown in Fig. 1a. This indicates that blanching has no effect on the drying rate of potatoes. A similar observation was made by Alzamora and Chirife, 1980. This could be due to the effect of starch gelatinization during blanching[7]. Therefore, blanching treatment did not result in reduced drying time when compared with the untreated or control samples.

The initial drying rate of potatoes from freezed treatment was higher than that of the untreated and blanched potatoes but quickly decreased after some hours to become of a similar rate with those of blanched and untreated samples. Hence, the overall drying rates due to freezing treatment was faster than those of treatments

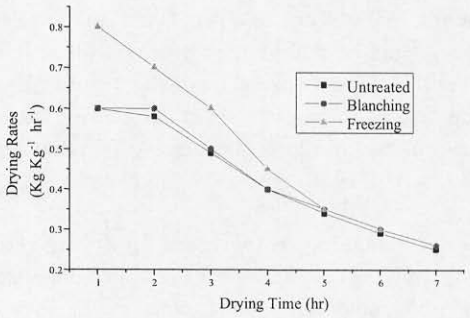

Fig. 1a: Drying rate against drying time for potato dried at 70°C

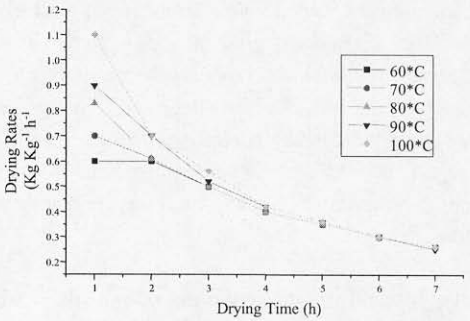

Fig. 1b: Drying rate against drying time for potato blanched at different temperatures and dried at 70°C

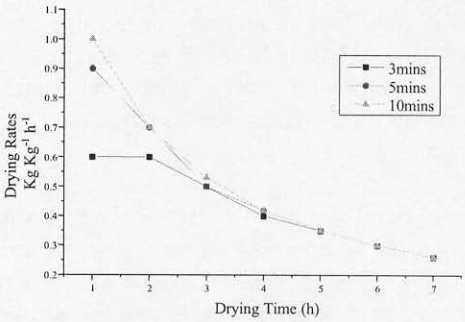

Fig. 1c: Drying rate against drying time for potato blanched at 60°C and at different times and dried at 70°C

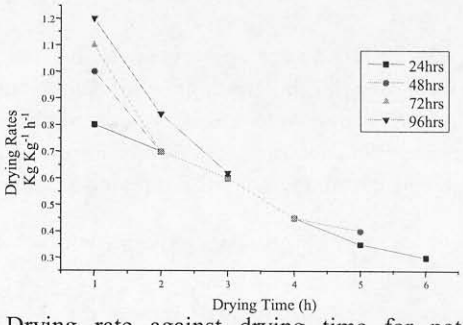

Fig. 1d: Drying rate against drying time for potato freezed at different times and dried at 70°C

where freezing was not involved. Dandamrongrak *et al.*,[5] in the pretreatment drying of cassava, made a similar observation. Thus freezing treatment resulted in a faster drying time of samples[16,17] because freezing causes cell disruption, which allows moisture to be removed more easily [7].

Effect of blanching temperature on drying rates and drying time: The effect of blanching temperature on drying rates and drying time is shown in Fig. 1b. It can be seen that as blanching temperature increased, the initial drying rates increased and then began to decrease rapidly until all samples were loosing moisture at a similar rate. The differences in the drying rates of potatoes as a result of increases in blanching temperature are marginal, hence the general trend indicates that the overall drying rates are similar under increased blanching temperature and this did not result in reduced drying time. Thus, increasing blanching temperature does not reduce the drying time of potatoes.

Effect of blanching time on drying rates and drying time: The effect of blanching time on drying rates and drying time is shown in Fig. 1c. It can be seen that as the blanching time increased, the initial drying rate increased marginally and then started to reduce rapidly until all samples were loosing moisture at the rate after some hours. Thus, the overall drying rate due to increase in blanching time did not increase and therefore no reduction in the drying time when compared to the control samples.

Effect of freezing time on drying rates and drying time: The effect of freezing time on the drying rate and drying time is shown in Fig. 1d. It can be seen that as the freezing time increased, the overall drying rate also increased and thus drying time decreased.

CONCLUSION

The results of this study demonstrate that freezing and increasing freezing time can significantly increase the drying ate and therefore decrease the drying time of potatoes. This could provide a major means of reducing processing cost through increased drying efficiency.

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