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Research Article

Effects of Pre-Treatment on Drying Rate and Protein Content of Yam Slices

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Abstract: An experiment to evaluate the drying rate of pretreated yam slices at varying temperatures was conducted at the Federal University of Technology, Akure. The yam slices were subjected to blanching by soaking in hot water at temperatures of 80^0C, 90^0C and 100^0C for 10 minutes and later dried in a cabinet type dryer fitted with an electric heater. The drying process was done at three levels of temperatures (100^0C, 110^0C, 120^0C) and time (4hrs, 5hrs and 6hrs). The experimental results show that the blanching temperature have significant effect on both the drying rate and protein content at 5% level of significance It was also observed from the result of the analysis that samples blanched at 80^0C had the highest rate of water loss and protein content when compared to other treatments. The least values of drying rate was obtained at the 90^0 C blanching temperature.
Keywords: temperature yam slices, water loss, protein content

INTRODUCTION

Yams (*Dioscorea spp*.) are major carbohydrate sources for most people in the West and Central Africa[1]. According to Osunde [2], it is the second most important tropical root crop in West Africa after cassava. Yams can be dried to save part of the harvest that would not be readily consumed providing an extension of shelf life and requiring less storage space. Existing methods of processing, storage and marketing yam crops are poorly developed and to prevent spoilage of harvested tubers, farmers sell them at the low prices offered by middlemen during the season and hence achieve only a poor return. The preservation of vegetables, tubers and fruits, through drying, dates back to many centuries and is based upon sun and solar drying techniques.

The carbohydrates are the tubers most important element. Yam is low in fat and protein and it provides a good source of energy. Unpeeled yam has vitamin C. It is sweet in flavor and may be consumed as boiled yam or fried in oil and then eaten. In most parts of Nigeria, it is often pounded into a thick paste after boiling and consumed with soup.Its use as an industrial starch has also been established as the quality of some of the species are able to provide as much starch as in cereals. It is also used in alternative medicine as a heart stimulant.

The objective of this study is to evaluate the effect of pre-treatment on the drying rate of yam and on the protein content of dried yam.

Drying is a mass transfer process consisting of the removal of water or and solvent by evaporation from a solid, semi-solid or liquid products. Drying is the oldest method of preservation and it is often used as a final production step before selling or packaging products that can add variety to meals and provide delicious nutritious snacks.

Food can be dried several ways; by the sun if air is hot and dry enough, or in an oven or dryer if the climate is humid. A source of heat and an agent to remove the vapour produced by the process is the most important requirement. In most common cases, a gas stream e.g. air, applies the heat by convection and carries away the vapour as humidity. Other possibilities are vacuum drying, where heat is supplied by conduction or radiation, while the vapour thus produced is removed by the vacuum system. An indirect technique is drum drying where a heated surface is used to provide the energy, and aspirator draws the vapour outside the room.

MATERIALS AND METHODS

The yam variety that was used for this study was white yam (*Discorea rotundata spp*). It is the most preferred species for making yam flour. The initial moisture content of yam was determined to be 42.8%.

Procedure for Blanching

The procedure for blanching the specimen is by measuring1500cm^3 of water into a bowl after which it was heated to 80^{0}C and poured into the peeled and sliced yam for 10 minutes. The exercise was repeated for 90^{0}C and 100^{0}C heated temperature levels for the same duration. Water was drained out of the chips with the aid of a plastic sieve. Ten minutes was allowed for full drainage. The samples were weighed before blanching and weighed again after blanching The slices were then spread on the tray and loaded into the dryer.

The dryer was pre-heated to the desired temperature 80^{0}C by the means of temperature regulator while the samples were being prepared to ensure stability of the condition of the drying chamber when the yam chips would be introduced. The sample were removed, weighed at an interval of 1hour and placed back in the dryer with a top loading. The operation continued until the desired moisture content (42.8%) was reached.

Description of the Dryer

The dryer used for the experiment is a cabinet type dryer which consists of heating chamber having one electrical heaving coil of 1.8kW power rating, connected directly to a centrifugal fan of 0.37 kW, and drying chamber. The heater was connected to the temperature regulator which controls the temperature of the dryer by switching the heater on and off. The dryer consist of three trays. The drying chamber is double walled with 3cm thick fibre glass insulation. The drying trays were made from 25mm pipe with expanded metal having an aperture wide enough to allow free flow of heated air. The heating chamber is rectangular in shape. To ensure that the hot air touches all the products uniformly, the heating chamber links directly into the drying chamber. The dryer has vent which helps to prevent moisture condensation at the top of the drying chamber.

Experiment Design

The experimental design is a3 x 3 x 3 factorial design. The input parameters were drying temperature, blanching temperature and drying time while the effects of the input parameters on the samples were measured by determining the drying rates, and the quality of the yam slices.

Three levels of drying temperature,3 levels of blanching temperature and 3 levels of drying time were considered. Data obtained were analysed for significant effects of the blanching temperature on the drying rates and protein content.

Measurement of Drying Rate

Reduction in moisture was monitored during drying by measuring the weight of the samples at regular interval of 1 hour until the desired moisture content was reached. The drying rate was calculated as follows:

$$R = \frac{(Dm)}{dt} = \frac{(m_i - m_f)}{t}$$

Where:

R = drying rate in g/h (from Ro, R_1 ..... R_6)

Dm = change in mass (g)

dt = change in time (h)

t = total time (h)

m_i and m_f are the initial and final mass of the slice respectively in g.

Evaluation of Product Quality

The effects of input parameters on the nutritive quality of the dried product were evaluated by subjecting the processed product to proximate analysis following the methods outlined in Opara [3] to assess the percentage of crude protein in the dried yam slices

RESULTS AND DISCUSSION

Table 1 shows the average mass (grams)of dried yam slices at different drying time (h) at different levels of pre-treatment and drying temperature while Table 2 shows the hourly drying rates. It indicates that samples experienced reduction in mass due to water loss progressively on hourly basis.

Table1: Average mass(grams)of driedyam slices at different drying time (h)

Drying Temp (◦C)	Drying Time (h)	Blanching Temp (◦C)	W_0	W_1	W_2	W_3	W_4	W_5	W_6
100	4	80	430.2	387.2	345.2	282.1	264.1		
		90	433.5	401.2	372.1	311.1	283.0		
		100	433.8	400.5	381.3	314.5	287.4		
110	5	80	432.2	387.2	325.2	282.1	264.8	231.4	
		90	433.5	395.5	353.4	314.1	290.8	236.2	
		100	433.8	388.8	326.7	302.7	279.8	237.1	
120	6	80	432.8	385.1	343.2	278.7	256.1	226.8	215.2
		90	435.1	412.1	392.3	301.8	268.1	231.0	215.2
		100	435.7	414.2	401.1	312.1	271.8	35.7	215.2

Blanching do not have any significant effect on the drying time but the drying time was affected by the drying temperature considered as samples attained the required moisture content in 4 hrs, 5hrs and 6 hrs according to drying temperature. Similarly, It was found that yam slices dried at high temperature for a higher time than at lower temperature.

Value of drying rate for the three levels of blanching temperature in figure one did not show a clear trend. Water loss was higher in the pre-treated sample at 80 degrees with 28.34 g/h. This was followed by samples blanched at 100◦C (25.79g/h) and then 25.57 for 90◦C blanching temperature.

Table 2: Drying rates of yam slices at different times

Drying Temp(◦C)	Drying Time (h)	Blanching Temp (◦C)	R_1	R_2	R_3	R_4	R_5	R_6	Mean
100	4	80	43	42	63.1	18			27.68
		90	32.3	29.1	61	28.1			25.08
		100	33.3	19.2	66.8	27.1			24.40
110	5	80	45	62	43.1	17.3	33.4		27.90
		90	38	42.1	39.3	23.3	54.6		23.78
		100	45	62.1	24	22.9	42.7		25.67
120	6	80	47.7	41.9	64.5	22.6	29.3	11.6	29.45
		90	23	19.8	90.5	33.7	37.1	15.8	29.45
		100	21.5	13.1	89	40.3	36.1	20.5	27.32

The result of one way classification for the three blanching temperature indicated that there is significant difference at $\alpha = 0.05$ with the values of 370.57 and 5.31 for calculated and critical F respectively

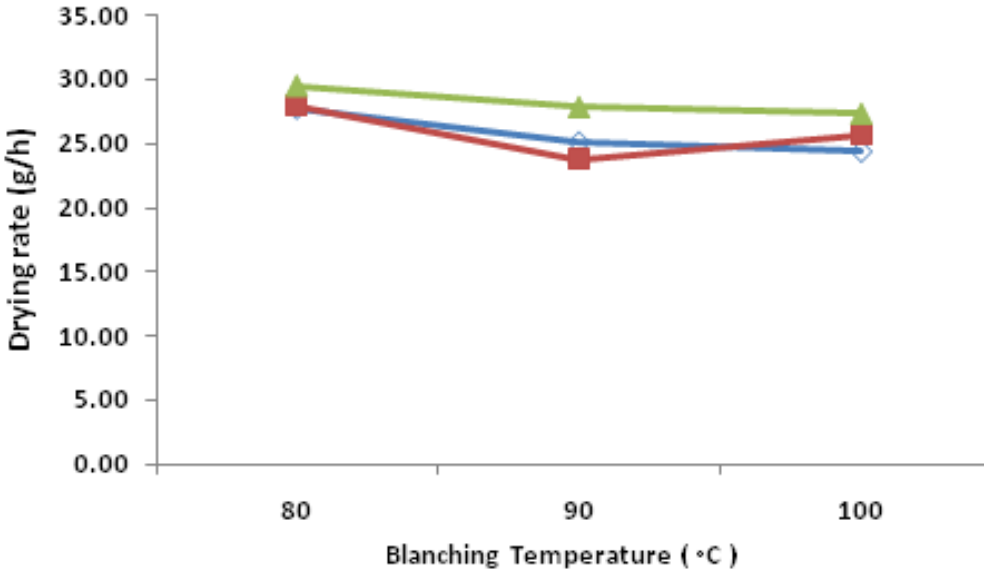

Fig 1: Effects of blanching temperature on drying rate of yam slices

Table 3 shows the effects of the respective treatments on the protein content of dried yam slices. The highest protein percentage of 5.8% was recorded by sample blanched at 80^0C while the least protein content value of 4.3% was recorded in samples blanched at 100^0C. Generally, in conformity with the discovery of Kilic [4]) and Omodara *et al* [5] increase in drying temperature has been shown to be responsible for decrease protein content. The effects of the blanching temperature did not follow this trend; mean values are 4.99, 4.98 and 4.97 for blanching temperature 80◦C,100◦C and 90◦C respectively. This is possibly indicating that both extremes of blanching temperature are good for protein content although a reason for this is so far unclear. However, there is a possibility that this results may be due to differences in the micro dimensions of the thickness of yam which had been found by Etoamaihe [6] to be significant in similar studies on cocoyam.

Table 3:Results of the analysis of protein content and Blanching Parameters

Drying Temperature (◦C)	Blanching Temperature (◦C)	Protein Content (%)
100	80	5.814
	90	5.81
	100	5.809
110	80	4.831
	90	4.763
	100	4.823
120	80	4.33
	90	4.326
	100	4.317

CONCLUSION

The experimental results show that the blanching temperature have significant effect on both the drying rate and protein content at 5% level of significance. It was also observed from the result of the analysis that samples blanched at 80^0C had the highest rate of water loss and protein content when compared to other treatments. The least value of drying rate was obtained at the 90^0 C blanching temperature. It can be concluded that pretreatment of yam slices under similar lukewarm condition may be beneficial to food processors,

It is recommended that this study be carried out on other yam varieties as well as using some other pre-treatment methods to determine the ability of yam to dry faster and maintain the nutritional qualities of such processed samples of yam products

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