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Effect of Some Processing Variables on Some Selected Funtional Properties of Plantain Flour

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ABSTRACT

The functional properties of plantain flour are very important in the design of handling and processing equipments for the production of the flour. They also help in deciding the blend of different flours for various products and have direct influence on its usability and quality of derived product from it. The study was aimed at investigating the influence of some production methods viz: drying methods (sun drying and oven drying), blanching temperature (45^0 and 85^0 C), soaking concentration (0.1% and 0.2% matalsulphate), size reduction (transverse and longitudinal) on some selected functional properties of the plantain flour. The effect of these factors was investigated on bulk density, water retention ratio, wettability and porosity using 2^4 factorial experiments. Drying method was found to be the only processing variables that affect all the functional properties investigated in this study. The drying temperature was observed to be significant ($p < 0.01$) on all the parameters investigated. The moisture content decreased from 12.38 to 9.9 % when the drying method changes from solar to mechanical. Also, the change of drying method from mechanical to solar increased bulk density from 0.522 to 0.674 g/ml. The porosity decrease from 0.85 to 0.78 as the sodium metabisulphate concentration used in soaking plantain before drying increased from 0.1 to 0.2. It was observed that water retention ratio (WRR) was affected by all the processing parameters. The highest wetting time (231seconds) was observed when solar drying was used while the least wetting time (59seconds) was observed when mechanical drying method was used. The effect of size reduction was also found to be significant ($p<0.01$) on porosity, final moisture content and bulk density of the flour.

It is of opinion that the results of this experiment will guide flour miller where they want to use plantain flour as composite flour or in the production of confectionaries.

Key words: Drying methods, Final moisture content, wetting time, porosity, blanching, size reduction, water retention, soaking concentration

INTRODUCTION

Plantain is one of the most important staple food crops for millions of people both in developed and developing countries. It is an important staple crop that contributes to the calories and subsistence economics in West Africa. They are good source of carbohydrate [2], rich in dietary

fibre and help to reduce the blood sugar level thereby a good source of food for obesity and diabetics patient [10,8]. Plantains are highly perishable crop that cannot be stored for a long time therefore to increase the shelf life of plantain there is need to process it to another product such as plantain flour. Due to increase interest in the consumption of functional foods and the cost of wheat flour, non-wheat composite flour has being experimental (Okpala and Okoli, 2011 blend flour from pigeon pea, cocoyam and sorghum; Agripa and Iwe, 2009 blend from cassava, groundnut and corn starch; and Chinna and Gernah, 2007 blend from cassava, soyabean and mango). Since the usability and mixability of any flour depend on its physic-viable properties among other properties, therefore there are needs to study the effect of varying processing methods on these properties.

MATERIAL AND METHOD

Sample collection and preparation

Bunches of matured unripe plantain fruit were obtained from Arada market in Ogbomoso, Ogbomoso South local government, Oyo State, Nigeria. Mature green unripe plantain fruits were washed in clean water and manually peeled and then processed as samples.

Experimental Design

A 2^4 factorial experiment were performed to investigate the influence of size reduction, soaking concentration, blanching temperature and drying method on the physical properties of plantain flour. Each factor was investigated at two level yielding sixteen treatment combinations.

Preparation of plantain flour

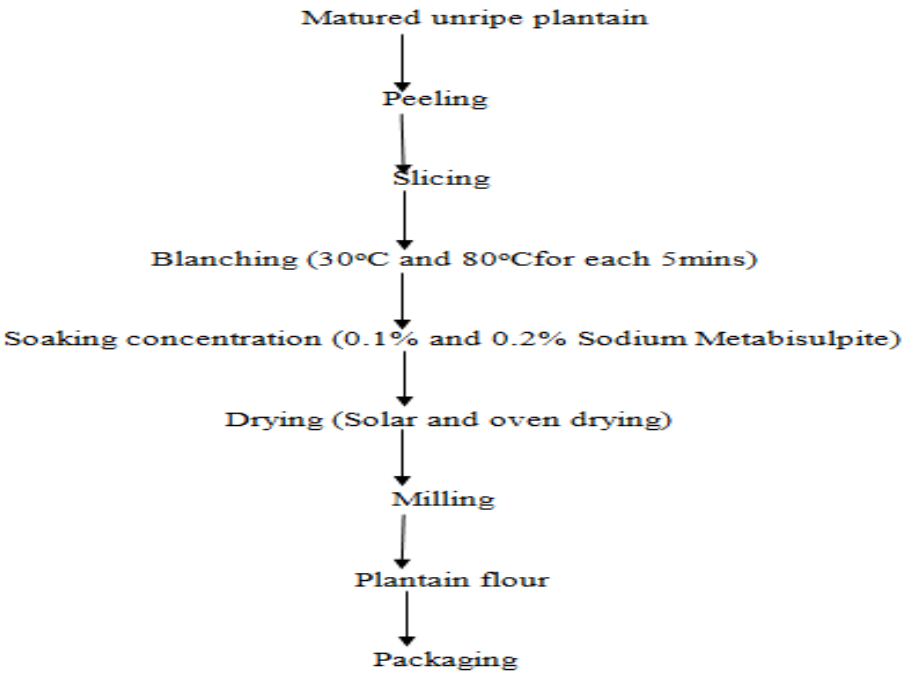

Figure 3.1: Flowchart showing the preparation of plantain flour

Determination of bulk density

The bulk density of material were determine by measuring the volume by weighing of 2g sample into 10 ml graduated cylinders and tapped ten (10) times against the palm hand. The bulk density of the powder was measured. The experiment was replicated (5) five times and the average of it were recorded.

$$Bulk\ density = \frac{Mass\ (g)}{Bulk\ volume\ (ml)} \quad (1)$$

Evaluation of porosity ratio

Porosity ratio, is define as the ratio of density to the bulk density. Density is the ratio of mass sample to the volume of the sample. The results of measurement of density and bulk density were then used in determine the porosity ratio.

$$Porosity\ ratio = \frac{Density}{Bulk\ Density} \quad (2)$$

Wettabillity (WET)

Wettability of the flour was estimated by measuring the wetting time in second(s) of 10g of sample powder dropped from a height of 15 mm on the surface of 200 cm^3 distilled water contain in 250 cm^3 cylinder at room temperature (°C). The wetting time regarded as the time required for all the powder to become wet and penetrate the surface of distilled water. This method has been reported by Idowu [9] for cassava flour,

Water retention ratio (WRR)

The water retention ratio was determined using George Tiky (1997) and Idowu (2008). The plantain flour sample (10g) was added to 10mm distilled water in a glass beaker and stirred. The sample was removed and drained off on a filter paper for 30minutes. The water retention ratio of the flour was expressed as weight of soaked flour per weight of dried flour.

$$WRR = \frac{Weight\ of\ soaked\ \ flour}{weight\ of\ drted\ flour}$$

RESULT AND DISCUSSION

The physical properties of flour determine the application and its uses in various food products either as sole or composite flour. The results of the selected physical properties of plantain flour are presented in Table 1.

The moisture content of the flour was found to be between 12.38 and 9.9 % db. It was observed that only the drying method was significant on the final moisture content. A change in the drying method from solar to mechanical dying reduces the moisture content by about 20 %. The moisture content was within the range found in literature [1,2].

The result of the experiment on wettability shows that drying temperature is significant ($P < 0.01$). As it can be observed in Fig. 2, the effect of drying method is more pronounced on the wetterbility of the flour. Bulk density is a measure of heaviness of flour [3] and an important parameter that determines the suitability of flours for the ease of packaging and transportation of particulate foods [14] as well as in composite flour formulations. From Table 1, it was observed that the bulk density increased when the drying method was changed from solar to mechanical (0.522g/ml to 0.674g/ml). The bulk density was in the range found in literature for altilis pulp flour which is between 0.57 g/cm^3 and 0.46 g/cm^3 [5]). The result of the experiment was statistically analysed using Yates Algorithm. The statistical result showed that the drying method was significant on bulk density ($P< 0.01$).

The porosity ratio of the plantain flour decreased from 0.85 - 0.78 ; when the concentration of sodium metabisulphite used for soaking the plantain was changed from 0.1% to 0.2%, when the drying method was changed from solar to mechanical the porosity ratio increased from 0.851-0.899. The statistical result showed that the interaction of soaking concentration and drying method were significant at ($P< 0.01$) while other variables are insignificant. It was observed that the water retention ratio decreased from 2.530 - 1.630 when the blanching temperature was changed from 27°C (ambient temperature) to 80°C. The water retention ratio also increased from 2.20 - 2.39; when the soaking concentration was changed from 0.1% t to 0.2% and decreased by 0.09 (2.530 -2.521) as the drying method was changed from solar to mechanical. The wetting time decreased from 231secs - 58secs when the drying method was changed from solar to mechanical. It was also

observed that the interaction of the variables together were insignificant.

CONCLUSION

The effect of processing variables on the physical properties of plantain flour shows that the drying method is significant on all the functional properties of the flour except water retention ratio.

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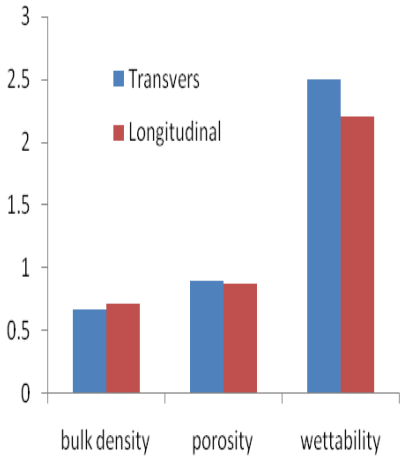

Fig.2: Effect of size reduction on some selected physico-viables properties of plantain flour

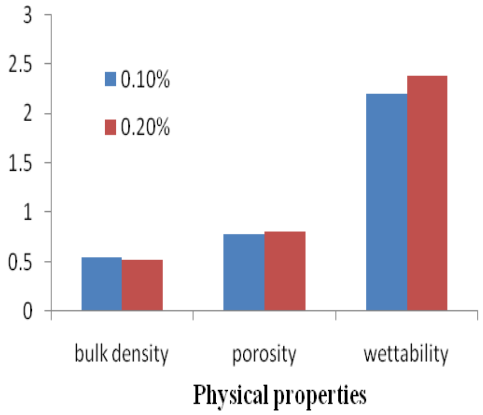

Fig.3: Effect of soaking concentration of sodium metabisulphite on some selected physico-viables properties of plantain flour

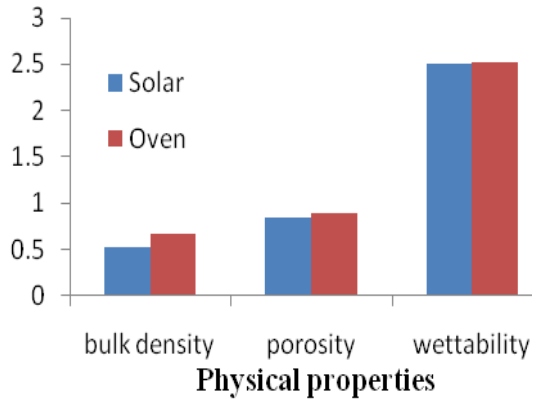

Fig.5: Effect of drying methods on some selected physico-viables properties of plantain flour

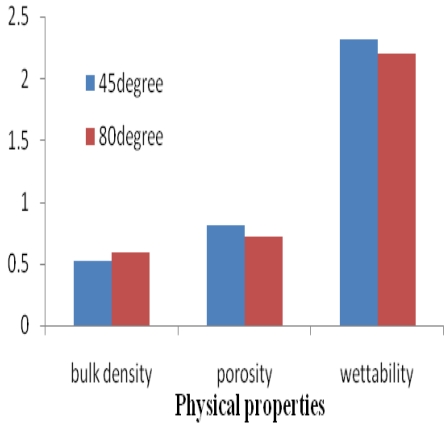

Fig.4: Effect of blanching teperature on some selected physico-viables properties of plantain flour

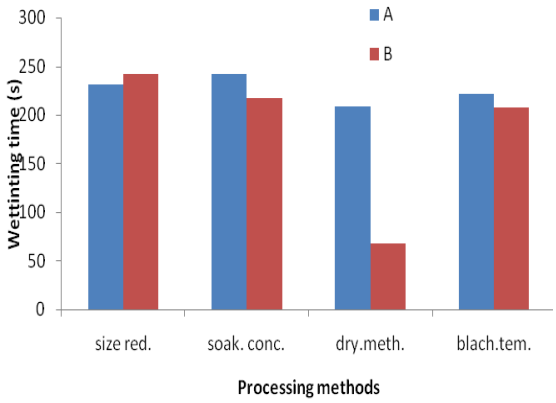

Fig.6: Effect of processing variables on the wettint time of plantain flour (where size reduction (A=Logitudinal, B=Transvers); Soaking concentration (A=0.1% and B=0.2% sodium metabisulphate); Drying methods (A=sun drying and B= oven drying); Blanching

Table 2: Result of processing variables on some physical properties of the flour

Run	Size reduction	Soaking	Blanching temp	Drying meth	Bulk density(g/ml)	Porosity ratio	WRR	WET(sec)
1	T	0.1	27	Solar	0.522	0.851	2.530	231
2	L	0.1	27	Solar	0.545	0.782	2.200	242
3	T	0.2	27	Solar	0.526	0.781	2.320	217
4	L	0.2	27	Solar	0.522	0.805	2.390	222

5	T	0.1	80	Solar	0.619	0.724	1.630	208
6	L	0.1	80	Solar	0.588	0.719	2.100	202
7	T	0.2	80	Solar	0.545	0.787	1.890	258
8	L	0.2	80	Solar	0.594	0.717	2.24	209
9	T	0.1	27	Oven	0.674	0.899	2.521	58
10	L	0.1	27	Oven	0.714	0.875	2.010	61
11	T	0.2	27	Oven	0.682	0.880	2.200	68
12	L	0.2	27	Oven	0.682	0.889	2.368	59
13	T	0.1	80	Oven	0.674	0.674	2.411	57
14	L	0.1	80	Oven	0.566	0.566	2.220	110
15	T	0.2	80	Oven	0.625	0.625	2.210	72
16	L	0.2	80	Oven	0.645	0.894	2.410	62