Evaluation of functional and sensory properties of Plantain flours produced from three different varieties of *Musa acuminata*

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ABSTRACT

Flour samples were produced from three different varieties of Plantain; the samples were tPlantain, False and French horns. The functional and sensory properties of the flour samples were evaluated using standard procedures. The mean results showed the ranges of water absorption capacity, oil absorption capacity, foaming capacity, bulk density and swelling capacity as 1.7-2.0%, 0.2-0.2%, 6.1-15.8%, 0.6-0.8g/cm^3 *and 49.3-67.0% respectively. Comparatively, oil absorption capacity and swelling capacity values were significantly low and high respectively at p>0.05 in all the samples. There were no significant differences (p>0.05) in was and bulk density mean values of False horn and tPlantain. However, all the samples significantly differed in swelling capacity. Low swelling capacity and foaming capacity values were observed in tPlantain sample. The False horn was score 'indifferent' in all the quality attributes while tPlantain sample was favourably scored 'like' in texture, odour and general acceptability except the colour which was disliked by the panellists. From the work carried out, the common plantain sample (tPlantain) was concluded to possess both functional and sensory attributes compared to other samples such as false and fresh horns. Incorporation of tplantain flour in foods of people of all ages as a food thickener and upgrade to viable commercial standard were recommended.*

Keywords: functional property, flour, plantain, thickener.

INTRODUCTION

Plantain (*Musa acuminata*) is a major source of carbohydrate in diets of people from Latin America, through most of Africa and from countries of South-east Asia (Marriott and Lancaster, 2007). It is estimated that 60 million people in West Africa derive more than 25% of their carbohydrate intake from plantain (Akubor, 2008). In Ghana, plantains have higher contribution to the Agricultural Gross Domestic Product (AGPD) than cereals; its per capita annual consumption is higher than maize and yam (Foluso, 2014; MOFA, 2006).

Thus, one of the primary requirements in using hot-air drying is to understand the phenomena involved in the drying process, to be able to predict drying times, establish the distribution of moisture throughout the solid pieces during drying and the influence of the processing variables such as air temperature and velocity, pre-treatment and the size of the pieces on drying behaviour. Pre-treatments have been used commercially to accelerate the drying of fruits, dipping fruits for several seconds in pre-treatment solutions greatly reduces the drying time. Pre-treatments also lead to the bleaching of the plantain to prevent browning of its flour. (Oluwatomiwa *et al*., 2000; Zakpaa, 2010). They are applied to the surface of the fruit by dipping; resulting in a coating which apparently breaks down the cuticular fruit surface, resulting in a reduced resistance to moisture loss and this increases the drying rate (Gareth, 2009).

Plantains and other cooking bananas are staple foods grown throughout the tropics, they constitute major source of carbohydrates for millions of people in Africa, the Caribbean, Latin America, Asia and the Pacific. Due to the perishable nature of the fruits, the rate of plantain postharvest losses varies from one country to another according to the organization of market chains and modes of consumption (Akubor, 2008). Acccording to N'da Adopo (2011), postharvest losses of plantains are caused by some factors resulting in depreciation in quality. Far distance between farms and markets, unavailability of buyers among others reported such as poor transportation, distribution facilities in the production areas, and harvest at maturity close to fruit ripening and poor storage conditions.

The downswing in the production of plantains due to localised cultivation thus brings loss of research interest to relevant authorities, soil and plant scientists.

Therefore, the objective of this study was to evaluate the functional and sensory properties of flours produced from different varieties of Plantain.

MATERIALS AND METHODS

Plant materials

Matured three varieties of Plantain were obtained from a local market, in Masaka town, Karu Local Government Area, Nasarawa State – Nigeria. These varieties included common Plantain, False and Fresh Horns.

Methods

Preparation of sample

The method described by Ngalani (2002) was used to prepare the samples. The three varieties (Plantain, French and False Horns) were prepared by hand peeling the fruits, followed by chopping the peeled fruits into small pieces, and then air dried for 5 days. The dried samples were grinded using attrition mill (SK-30-SS, Munson, NY). An improved traditional method was used to blanch the plantain samples at 80°C for about 3 minutes in a sodium metabisulphite solution (4 g/1) containing 3g citric acid, followed by draining and drying in an oven (DHG – 9023A, Nanjing- China) at 65°C for 20 minutes resulted in the production of whitish flours, these flour samples were labelled tPlantain, Fresh and False horns.

Determination of Functional Properties

The procedures described by the following authorities were used to determine the functional properties of the three samples of Plantain obtained from the three different varieties (tplantain, French and False horns):

Bulk density (Makhuvha, *et al.*, 2014); swelling index (Awolu, 2017); foam capacity stability; water absorption capacity (WAC) and oil absorption capacity (OAC) (Beuchat, 1977) were all determined.

Sensory Property

The prepared samples were evaluated for some sensory properties i.e. colour, texture, odour and overall acceptability on a 5-hedonic scale of Larmond (1977). On the 5-hedonic scale, 1= like extremely; 3= Indifferent and 5- like extremely by a team of 25 untrained panellists.

Statistical Analysis

One-way ANOVA and Duncan multiple range test of SPSS version 20 were used to analyse the data obtained and test for significant difference at 5% confidence level. Results were presented in Mean±SEM.

Results

Functional Properties

The mean values of the functional properties of the three varieties of plantain samples were presented in Table 1. The results showed the ranges of water absorption capacity, oil absorption capacity, foaming capacity, bulk density and swelling capacity as 1.7-2.0%, 0.2-0.2%, 6.1-15.8%, 0.6-0.8g/cm^3 and 49.3-67.0% respectively.

Comparatively, oil absorption capacity and swelling capacity values were significantly low and high respectively at p>0.05 in all the samples. There were no significant differences (p>0.05) in was and bulk density mean values of False horn and tPlantain. However, all the samples significantly differed in swelling capacity. Low swelling capacity and foaming capacity values were observed in tPlantain sample.

Sensory Evaluation

The sensory evaluation results are presented in Table 2. The French horn was scored dislike, like, like, and indifferent for colour, texture, odour and general acceptability respectively. The False horn was score 'indifferent' in all the quality attributes while tPlantain sample was favourably scored 'like' in texture, odour and general acceptability except the colour which was disliked by the panellists.

Table 1: Functional Properties of Plantain samples

SAMPLE	Water Absorption Capacity	Oil Absorption Capacity	Forming Capacity	Bulk density	Swelling Capacity
French Horn	$2.0^a \pm 0.0$	$0.2^a \pm 0.0$	$16.0^a \pm 0.2$	$0.8^a \pm 0.0$	$67.0^a \pm 0.0$
False Horn	$1.7^b \pm 0.1$	$0.2^a \pm 0.0$	$16.0^a \pm 0.2$	$0.6^b \pm 0.0$	$56.0^b \pm 0.4$
tPlantain	$1.7^b \pm 0.0$	$0.2^a \pm 0.0$	$6.1^b \pm 0.2$	$0.6^b \pm 0.0$	$49.3^c \pm 0.6$

The mean values of the sample group with different superscripts are significantly different (P≤0.05)

Table 2: Sensory Properties of Plantain samples

SAMPLE	Colour	Texture	Odour	General Acceptability
French Horn	$4.0^c \pm 0.11$	$2.2^b \pm 0.3$	$4.1^b \pm 0.0$	$3.5^b \pm 0.6$
False Horn	$3.5^b \pm 0.31$	$3.0^c \pm 0.5$	$3.3^a \pm 0.0$	$3.6^b \pm 0.3$
tPlantain	$2.1^a \pm 0.20$	$1.9^a \pm 0.1$	$4.3^b \pm 0.0$	$2.4^a \pm 1.0$

The mean values of the sample group with different superscripts are significantly different (P≤0.05).

DISCUSSION

Drying is the major cause of the low bulk density as observed in the plantain samples, the range of values of bulk density obtained in this study agrees with the report of Makhuvha, *et al.*, (2014) on similar study. According to Arshad *et al.*, (1996), bulk density shows the ability to perform structural, support, water and solute movement and soil aeration. Bulk densities above threshold indicate impaired functions.

The swelling capacity of flours depends on size of particles, types of variety and processing methods or unit operations (Beuchat, 1977). This suggests that the high swelling capacity observed in the present study may be attributed to the high carbohydrates content of the samples.

Low water absorption capacity has been implicated in low amount of polar amino acids and increased amylase leaching, solubility and loss of starch crystalline structure (Beuchat, 1977).

The insignificant difference among the values of the oil absorption capacity in this study agrees with the report of Beuchat (1977) in a similar study. According to Aremu *et al.*, (2007), the flours in the present study may be said to lack flavour retention, structural interaction, enhancement of palatability and extension of shelf life particularly in bakery or meet products where fat absorption is required. Thus, the plantain flours may not be appropriate for baking and flavour enhancement. The sample with low foaming capacity is more stable and flexible.

CONCLUSION

The functional properties and acceptability of the common plantain sample (tPlantain) as observed in the present work were concluded to be high when compared to other samples such as false and fresh horns.

RECOMMENDATIONS

In view of the findings, the following recommendations are hereby made:

1. tPlantain flour should be incorporated as a food thickener in foods for people of all ages.
2. tPlantain flour should be improved into viable commercial standard.

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