<p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: -www.journalijar.com</p> <h2 style="text-align: center;">INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</h2> <p style="text-align: center;">Article DOI:10.21474/IJAR01/12600 DOI URL: http://dx.doi.org/10.21474/IJAR01/12600</p>	<p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR) ISSN 2320-5407 Journal Homepage: http://www.journalijar.com Article DOI:10.21474/IJAR01/12600</p>
---	---	---

RESEARCH ARTICLE

EFFECTS OF VARIETIES AND BLANCHING TEMPERATURES ON THE FUNCTIONAL AND NUTRITIONAL QUALITIES OF PLANTAIN FLOUR

Patience T.K.¹, Nwachukwu V.C.¹, Inchikida B.M.¹, Sharinya J.T.¹ and Fatima F.K.²

1. Nigeria Natural Medicine Development Agency.
2. Department of Agriculture Engineering and Biomolecular Study Federal University of Technology, Minna.

Manuscript Info

Manuscript History

Received: 20 January 2021

Final Accepted: 24 February 2021

Published: March 2021

Key words:-

Blanching Temperature, Functional and Nutritional Qualities, Plantain Flour

Abstract

A study was carried out on effects of varieties and blanching temperatures on the functional and nutritional qualities of plantain flour. Seven (7) bunches of plantain labelled O35, O48.2, O61.6, O75, P35, P55 and P75 were collected within Minna metropolis. After washing, peeling, slicing, Blanching, Drying and Milling, for nutritional qualities, O75 has the highest moisture content of 16.3, followed by O35 that has 10.6 while P75 has the least of 3.1. For ash content O61.6 has the highest of 3.2, followed by O48.2 and O75 that has 2.0 and P55 has the least of 0.5. For crude fat O35 has the highest of 47.0 followed by O75 that has 37.5 while O61.6 and P75 has the least of 34.5. For crude protein, P55 has the highest of 10.68, followed by O48.2 and O75 with 8.58 respectively while P75 has the least of 5.08. For crude fibre O48.2 has the highest of 28.5, followed by O75 that has 14.5 while O61.6 has the least of 3.0. For carbohydrate, P75 has the highest of 48.32, followed by O61.6 that has 43.05 while O48.2 has the least of 17.62. For functional qualities, P75 has the highest bulk density of 0.8 g/ml followed by P35 that has 0.77 g/ml while O75 has the least of 0.51g/ml. For WAC P75 has the highest of 28%, followed by P55 that has 22% while O35 has the least of 10%. For OAC, P75 has the highest of 24%, followed by P35 with 20% while O35 and O61.6 with the lowest of 16% each. For foam capacity, O35 has the highest of 16.6%, followed by O75 with 12% while P55 has the least of 1.8%. For Emulsion capacity, O75 has the highest of 38.6% followed by P35 with 31.6% while O48.2 has the least of 25.73%. The ogeda flour had higher moisture content, ash content, fat, fiber. While the panbolabola flour had a higher protein, carbohydrate for the nutritional properties.

Copy Right, IJAR, 2021., All rights reserved.

Introduction:-

Plantains (*Musa* spp., AAB genome) are plants producing fruits that remainstarchy at maturity (Marriot and Lancaster, 1983; Robinson, 1996) and need processingbefore consumption. Plantain production in Africa is estimated at more than 50% ofworldwide production (FAO, 1990). The majority (82%) of plantains in Africa areproduced in the area stretching from the lowlands of Guinea and Liberia to the centralbasin of the Democratic Republic of Congo. West and Central Africa contribute 61 and21%, respectively (FAO, 1986). It is estimated that about 70 million people in West andCentral Africa derive more than 25% of their carbohydrates from plantains,

making them one of the most important sources of food energy throughout the African lowland humid forest zone (Swennen, 1990).

Nigeria is one of the largest plantain producing countries in the world (FAO, 2006). Despite its prominence, Nigeria does not feature among plantain exporting nations because it produces more for local consumption than for export. National per capita consumption figures show its importance relative to other starch staples (FAO, 1986). However, these figures do not show regional reliance, which is often very important for highly perishable crops that are usually consumed in or near areas of production. The consumption of plantain has risen tremendously in Nigeria in recent years because of the rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations. Besides being the staple for many people in more humid regions, plantain is a delicacy and favored snack for people even in other ecologies. A growing industry, mainly plantain chips, is believed to be responsible for the high demand being experienced now in the country. This study reviews the trend of plantain production, its problems and prospects in Nigeria in the last two decades.

Plantains are good bases of potassium and nutritive fiber. They also comprise of vitamins A (83 micrograms), vitamin C (27mg), vitamin B2, vitamin B6 (0.44mg) and Magnesium (55mg). The juice that oozes from peeling the plant can tinge clothing and hands, and the stain can be very difficult to remove. Banana plantain meal is an important food source that has the following constituents: water (10.62%), fat (1.15%), carbohydrates (81.67%) more than 2/3 starch, fiber (1.15%), phosphates (0.26%), 1.60% sugar, and other salts. The primary sugar is sucrose (Jacquelyn, 2016). Blanching means a short-range heat treatment (70–100 °C) that is applied to vegetables preceding to more processing with the objective of enhancing both safety and quality attributes. Several reactions occur. Enzymes are deactivated (e.g., polyphenol oxidase) to prevent discoloration also destruction of surface micro flora on vegetables and the enhancement of the color, texture and keeping the quality of vegetable products (Lindhauer, 2003). Therefore, this work was aimed at determining the effects of blanching temperatures on varieties of unripe plantain and the Nutritional and Functional properties of the plantain flour.

Materials And Methods:-

Plant Collection:

Seven (7) (O35, O48.2, O61.6, O75, P35, P55 and P75) bunches of Unripened plantains were collected within Minna metropolis and brought to the Crop Processing and Storage Laboratory in the Department of Agricultural and Bioresources Engineering, Federal University of Technology, Minna (Niger state) for further processes.

Material Preparation:

Unit operations are the step by step processes carried out to produce plantain flour.

1. Washing: after harvesting this plantain, it may contain some impurities on it such as mud or sand. Clean water is used to wash these impurities.
2. Peeling: peeling is essential for making high quality plantain flour, the plantain was hand peeled.
3. Slicing: the plantain was manually sliced into pieces of about 2mm thickness.
4. Blanching: the already washed plantain is placed in hot water at 35°C, 48.2°C, 55°C, 61.6°C, 75°C temperatures to destroy the enzymes and bacteria faster, allowing beneficial benefits of plantain product to survive the process of flour production.
5. Drying: the use of a Gallen Kamp (oven 300 plus series) oven dryer is employed at 70°C for 24 hours. This is done to reduce the moisture contained in the plantain to attain a flakes state which could be milled.
6. Milling: milling machine is used to bring the plantain to flour which was then sieved to produce fine powder which is a ready form for the analysis to be carried out. The flour is then stored in polyethylene bags and labelled with codes and stored at room temperature.

Determination of Nutritional Properties:

Determination of Moisture Content:

5.0g of powder was weighed and moved into a formerly weighed crucible. The crucible was then positioned into the electric drying oven at about 105°C for 2 hours. The crucible containing dried sample was removed and placed in a desiccator to cool. The cooled crucible was weighed. The weight loss after drying was then evaluated as percentage moisture content (AOAC, 1990).

$$\% \text{ moisture content} = \frac{w_1 - w_2}{w_3} \times 100$$

Determination of Ash Content:

2g of sample was weighed into a crucible of known weight and placed in a muffled furnace for about 2 hours. The crucibles were cooled and weighed again. The loss in weight was then calculated as percentage ash content of the sample (AOAC, 1990).

$$\% \text{ ashcontent} = \frac{\text{weight of ash}}{\text{weight of sample}} \times 100$$

Determination of Carbohydrate:

The carbohydrate content was determined by calculation using the difference method:

$$\% \text{ carbohydrate} = 100 - (\% \text{ moisture content} - \% \text{ crude protein} - \% \text{ crude fat} - \% \text{ crude fiber} - \% \text{ ash content})$$

Determination of Crude Fibre:

A defatted sample of 2.0g was used. The residue was boiled in acid (H_2SO_4) with concentration of 0.25mol and heated using a hot plate for 30 minutes and then filtered through cheese cloth and washed clean with distilled water, this is done till sample is no longer acidic. The same sample is then boiled with alkaline (NaOH) with concentration of 0.25mol and heated using a hot plate for 30 minutes and washed with distilled water. The sample is then oven dried. The dried sample is then put in a crucible and heated until it turns to ash. The weights are taken and used to compute percentage crude fiber using:

$$\% \text{ crude fiber} = \frac{\text{weight of ash}}{\text{weight of sample}} \times 100$$

Determination of Crude Fat:

2g of sample is put in filter paper which is stapled for proper closure. A round bottom flask to be used was weighed. Petroleum ether was added to the flask and the Soxhlet apparatus was assembled. A condenser was connected to the Soxhlet extractor and reflux for 6 hours on low heat. The flask was removed and evaporated at steam bath. The flask with the fat was heated for approximately 30 mins in an oven. The flask and its contents were cooled to room temperature in a desiccator after which it was weighed and percentage fat was calculated using:

$$\% \text{ crude fat} = \frac{\text{weight of oil (fat)}}{\text{weight of sample}} \times 100\%$$

Determination of Crude Protein:

The nitrogen value of the samples was determined by micro kjeldhal method. The nitrogen value obtained was multiplied by 6.25 to convert it to crude protein.

$$\% \text{ nitrogen} = \frac{\text{titre value} \times \text{molarity of sulphuric acid} \times 0.0014 \times 50}{5} \times 100$$

$$\% \text{ crude protein} = \% \text{ nitrogen} \times 6.25$$

Determination of Functional Properties:**Determination of Water Absorption Capacity:**

One gram of sample and 10ml of distilled water was mixed and emptied into a centrifuge bottle and stirred. This is allowed to stand for 30 minutes and placed into a centrifuge, setting it to 2000rpm for 15 minutes. This is then followed by a time line between 5 minutes for separation. Then decantation was carried out and the amount of water remaining was measured.

Determination of Oil Absorption Capacity:

One gram of sample and olive oil with specific gravity 0.9092 was mixed and poured into a centrifuge bottle and stirred. This is allowed to stir for 30 minutes and placed into a centrifuge, setting it to 2000rpm for 15 minutes. This is then followed by a time line between 5 minutes for separation. Then decantation was carried out and the amount of oil remaining was measured using a measuring cylinder.

Determination of Least Gelation:

The least gelation concentration was calculated using a modified method of Coffman and Garcia (1977). The flour dispersions (2, 4, 6, 8, 10 %) were prepared in 10ml distilled water was heated at 90°C for 1 hour in water bath. The contents were cooled and kept for 22 hours.

Determination of Emulsion Capacity:

2.0g of sample was dispersed in 25ml distilled water and 25ml vegetable oil added. The 50ml mixture was emulsified at high speed for 1 minute. The emulsions were filled into centrifuge tubes and centrifuged for 5 minutes at 1300×6 rpm. Percentage emulsion capacity was calculated using:

$$\%emulsion = \frac{\text{height of emulsifier}}{\text{height of whole solution in centrifuge bottle}} \times 100$$

Determination of Foam Capacity and Stability:

The method of AOAC (1984) was used. One gram of each sample of flour was blended with 50ml of distilled water in a blender and whipped for 5mins. The mixture was poured into a 250ml measuring cylinder and the volume was recorded after approximately 30 seconds. Foaming capacity is calculated using the formula:

$$\text{foam capacity} = \frac{\text{volume after whipping} - \text{volume before whipping}}{\text{volume after whipping}}$$

The foam was recorded at an interval of (15, 30, 60 and 120 seconds) after whipping to determine the foam stability using the formula:

$$\text{foam stability} = \frac{\text{foam volume after time}}{\text{initial foam volume}} \times 100$$

Determination of Bulk Density:

The method of Onwuka (2005) which is a modification of AOAC (1984) was used. A 100ml capacity graduated measuring cylinder was weighed and recorded. The flour sample was gently placed in the measuring cylinder to the 10ml graduation. The cylinder is gently tapped on the table several times until there is no further diminution of sample level. The bulk density is then calculated using:

$$\text{bulk density} = \frac{\text{weight of sample}}{\text{final volume of sample after tapping}}$$

Statistical Analysis:

The data obtained was subjected to analysis of variance (ANOVA) and significance difference were reported at 95% confidence level using factorial (characterization).

Results and Discussions:-

The nutritional and functional properties were determined to investigate the effect of blanching temperatures on the value and characteristics of the plantain flour. The results of the nutritional properties of the varieties of plantain is presented in table 1

Table 1:- Nutritional properties of plantain flour.

Samples	Moisture content (%)	Ash content (%)	Crude fat (%)	Crude protein (%)	Crude fiber (%)	Carbohydrate (%)
O35	10.6	1.99	47	7	4	29.41
O48.2	7.3	2	36	8.58	28.5	17.62
O61.6	8.2	3.2	34.5	8.05	3	43.05
O75	16.3	2	37.5	8.58	14.5	21.12
P35	4.8	1.49	35	7.18	9.5	42.03
P55	7.5	0.5	35	10.68	4	42.32
P75	3.1	2	34.5	5.08	7	48.32

KEY: O35- ogeda blanched at 35⁰c, O48.2- ogeda blanched at 48.2⁰c, O61.6- ogeda blanched at 61.6⁰c, O75- ogeda blanched at 75⁰c, P35- panbolabola blanched at 35⁰c, P55- panbolabola blanched at 55⁰c, P75- panbolabola blanched at 75⁰c. The results of the functional properties are presented in table 2

Table 2:- Functional Properties of Plantain flour.

Sample	Bulk density (g/ml)	WAC (%)	OAC (%)	Foam capacity (%)	Emulsion capacity (%)	Least gelation
O35	0.63	10	16	16.6	30.2	6
O48.2	0.59	14	18	8.4	25.73	-
O61.6	0.61	13	16	8.8	28.8	4
O75	0.51	14	18	12	38.6	8
P35	0.77	16	20	8	31.6	-
P55	0.74	22	18	1.8	28.8	-
P75	0.8	28	24	2	33	4

Discussion of Results:-

The low moisture content of the variety panbolabola would enhance its storage ability by avoiding the growth of mould and some biochemical reactions, the moisture content of panbolabola was within acceptable limit of within 10% for long storage of flour (Singh *et al.*, 2005) making the panbolabola flour have a better storage shelf life than the ogeda flour. According to (Haard and Chism 1996), low moisture content of flour will in the end extend the shelf life of the product produce from the flour because moisture content and water activity have been reported to have effects on the keeping ability and storage of foods (Eke-Ejiofor and Owuno, 2012). Ogeda plantain flour had its lowest value when blanched at 35°C and its highest value at 61.6°C while the panbolabola had its lowest value at 0.5% and its highest value at 2%. This is contrary to the report of Oluwalana (2011) who stated that an increase in blanching temperature leads to a decrease in ash content of flour. Table 4.1 shows that the crude protein for ogeda flour ranges from 7% to 8.58% and panbolabola flour ranges from 5.08% 10.68%. Generally, plantain has been reported to contain between 3.15 and 4.61% protein (Adenijet *al.*, 2007 and Eleazuet *al.*, 2010). Emulsifying capacity which is the ability of protein to emulsify oil, it indicates the maximum amount of oil that can be emulsified by protein dispersion (Enujuighaet *al.*, 2003).

Conclusion:-

This study has characterized the nutritional and functional properties of ogeda and panbolabola flours. The ogeda flour had higher moisture content, ash content, fat, fiber. While the panbolabola flour had a higher protein, carbohydrate for the nutritional properties. The blanching temperature provided a better flour from the panbolabola variety with a better shelf life due to its low moisture content compared to the ogeda flour. The ash content of ogeda flour is higher than that of the panbolabola thereby making it a better source of mineral content of food.

References:-

1. Adeniji, A.A.A, Usman, J.M., Abiola, I.O and Akinyemi, S.O.S. (2007). Problems and prospects of plantain marketing in Ibadan. Proc. 22nd Annual Conference of Horticultural Society of Nigeria. Ibanda, Nigeria 3–6, September. p.142–145.
2. AOAC International, (1990). Official methods of analyses of the association of official analytical chemists. 15th ed. AOAC International, Arlington, Virginia, USA
3. AOAC International, (1984). Official methods of analyses of the association of official analytical chemists.
4. Coffman, C.V and Garcia, V.V (1977). Functional properties and amino acid content of a protein isolate from mung bean flour. *Journal of Food Technology*. (3) 19- 22.
5. Eke- Ejiofor, J., and Owuno, F. (2012). Functional and pasting properties of wheat/three-leaved yam (*Dioscorea dumentorum*) composite flour blend. *Global Research Journal of Agricultural and Biological Sciences*, 3, 330-335.
6. Eleazu, A. M., Bayeri, K.P. and Nwachukwu, I. 2003. Storage methods influenced occurrence and severity of crown rot and anthracnose diseases on plantain (*Musa* spp. ABB) fruits during storage and post storage. p.201–204. In: A.S. Fasina, A.O. Olufolaji and V.C.Umeh (eds.), Proceeding of the 21st Annual Conference of the Horticultural Society of Nigeria. Ess-Jay Business and Publishing Centre, Lagos.

7. Enujuigha V. N., Badejo A. A., Iyiola S. O., Oluwamukomi M. O. (2003). Effect of germination on the nutritional and functional properties of African oil bean seed flour. *J. Food, Agricultural Environment*, 1 (3and 4): 72-75.
8. F.A.O. (1986). Roots, tubers, plantains and bananas in animal feeding (D. Machin and S. Nyvold, editors).
9. F. A. O. (1990). Production Yearbook 1990. FAO, Rome.
10. F. A. O. (2006). Production Yearbook 2004. FAO, Rome.
11. Haard, N.F. and G. W. Chism. (1996). Characteristics of edible plant tissues, Food Chemistry. New York: Marcel Dekker, Inc. pp. 943-1001.
12. Jacquelyn C. (2016). Plantains: Nutrition Facts and Health Benefits; medically reviewed by Peggy Pletcher, MS, RD, LD, CDE, october7, 2016
13. Lindhauer, M.G. (2003). In Encyclopedia of Food Sciences and Nutrition (Second Edition).
14. Marriot, J. And Lancaster, S.K. (1983). Starch and sugar transformations during ripening of plantains and bananas. *J. Sci. Food Agric.*, 32, 1021-1026.
15. Oluwalana, I.B., Oluwamukomi, M.O., Fagbemi, T.N., and Oluwafemi, G.I. (2011). Effects of temperature and period of blanching on the pasting and functional properties of plantain (*Musa parasidiaca*) flour. *Journal of Stored Products and Postharvest Research*, 2, 164-169.
16. Onwuka, G. I. (2005). Food Analysis and Instrumentation: Theory and Practice. Lagos, Nigeria: Naphtali Prints.
17. Singh, N., Sandhu, K. S., and Kaur, M. (2005). Physicochemical properties including granular morphology, amylose content, swelling and solubility, thermal and pasting properties of starch from normal, waxy, high amylose and sugary corn. *Progress in Food Biopolymer Research*, 1, 43-54.
18. Robinson, J.C. (1996). Bananas and Plantains. CAB International, Wallington.
19. Swennen, R. (1990). Plantain Cultivation under West African Conditions. A Reference Manual. Amarin Printing Group Co., Bangkok.