THE MINERAL AND ANTI-NUTRIENT VALUES OF INSTANT PLANTAIN BREADFRUIT FLOUR BLENDS

Ilelaboye N.O. and *Jesusina T.I.
Department of Science Laboratory Technology,
The Federal Polytechnic, Ilaro, Ogun State.
Corresponding email: titilayo.jesusina@federalpolyilaro.edu.ng

ABSTRACT

The research was carried out to study the mineral and anti-nutrient contents of flour blends produced from plantain(P) and breadfruit(B).The study evaluated the mineral contents(calcium, potassium, sodium, magnesium, iron and zinc), and anti-nutrient (tannin, phytate and oxalate) of the flours using standard methods. The flour blends were formulated in the following proportions: (100P:0B, 75P:25B, 50P:50B, 25P:75B, 0P:100B). The mineral content of the flour blends have calcium content ranged from 5.03 to 24.38mg/g, magnesium 55.72 to 66.00mg/g, potassium 826.09 to 1010.58mg/g, sodium 89.15 to 105.06mg/g, iron 6.17 to 8.47mg/g and zinc0.92 to1.09mg/g. Anti-nutrient value of the blends contain tannin ranging from0.41 to 1.81%, phytate 0.52 to 1.21% and oxalate 0.71 to 2.62%. The results showed that sample E (100B:0P) has the highest value of calcium, sodium and potassium while sample A (100P:0B) has magnesium, iron and zinc. The anti-nutritional factors (Tannin and Phytate) of all the samples were found to be lower than the threshold limit (Tannin 60 mg/100g, Phytate 22.1 mg/100g), hence, will pose no danger to consumer's health.

Keywords: Antinutrient; breadfruit; composite flour; mineral; plantain

INTRODUCTION

Plantain (*Musa paradisciaca*) has its origin from India and Southern Asia, and serves as one of the major source of carbohydrate food in the tropical zones of the world, including Nigeria. This fruit contains high carbohydrates and fibre, but low amount of fat and protein. It is also good source of mineral elements (potassium, magnesium and phosphate) and some vitamins (vitamin A, B6 and C) which helps maintain vision, good skin and builds immunity against diseases (Ogazi, 1996). It is consumed either raw (ripe), boiled, roasted or fried, and when processed intoflour, can be utilized as raw material in food industries (Aderounmu, 2006).

Breadfruit (*Artocarpusaltilis*) is a versatile crop which originated from New Guinea Indonesia and the Philippines, and later spread widely throughout the tropical regions of the world (Deivanai and Bhore, 2007). It compares well with other starchy staple crops (yam, plantain, cassava, and sweet potato) frequently consumed in the tropics. The fruit is observed as alternative to yam for the poor man in Nigeria because it is inexpensive and can be processed into various forms for use in several conventional food recipes, and flour production, which serve as raw material in several food industries (Amusa & Kehinde, 2002; Mayaki, Akingbala, Gail, and Baccus –Taylor, 2003).Breadfruits are in various sizes, shapes, texture and colors, its flesh is soft creamy with a nice fragrant, containing sucrose, fatty acids and ellagic

acid, calcium, iron and sodium. (Huie, 2002).Breadfruit has very rapid post-harvest physiological deterioration, hence limiting its availability. Processing breadfruit into flour has helped to minimize post-harvest losses and increase the utilization of breadfruit (Englberger, Alfred, Lorens, and Iuta, 2007; Jones and Ragone, 2010; Ragone and Cavaletto 2006).

Blend of wheat flour with some flours of roots, tubers, cereals and legumes or mixture of these flours alone is known as composite flour (Adeleke and Odedeji, 2010; Julianti, Rusmarilin, and Yusraini, 2015; Awolu, Osemeke, and Ifesan, 2015). Blend of flours without wheat, is beneficial due to its improved nutritional quality and reduction in the cost of importation of wheat flour, and also serve as an opportunity to use underutilized crops (Chandra, Singh, and Kumari, 2015; Aluge, Akinola, and Osundahunsi, 2016; Arise, Dauda, Awolola, and Akinlolu-Ojo, 2017). The use of unusual agricultural product like breadfruit in making of instant flour can enlarge the usage of non-wheat flour, hence increasing farmer's income and will also enhances the industrial utilization of both plantain and breadfruit. Although, breadfruit and plantain are cheap, nutritious and highly available in the tropics, they have limited applications in the food industries (Omobuwajo, 2007). Plantain and breadfruit flours usage are becoming common among Nigerian citizens, thereby plantain - breadfruit composite flour may likely supply low-cost nutrients for the inhabitants of the country. The aim of this study is to determine the minerals and the anti- nutrients of the instant composite flour of plantain – breadfruit.

MATERIALS AND METHODS

Samples collections

Matured unripe breadfruit and plantain were purchased from a local market in Oja-odan, Ogun State, Nigeria.

Preparation of instant plantain flour

The thoroughly washed plantain was peeled and sliced (2 mm thickness) using clean stainless steel knife water to avoid browning, and subsequently blanched at 100^{o}C for 5 min. The blanched plantain was sun dried for 72 hrs, milled and sieved to obtain the instant plantain flour, and then stored in an airtight plastic container pending further use.

Production of instant breadfruit flour

A sharp steel knife was used to peel the matured green breadfruits and sliced into water. The sliced pulp was blanched at 100^{0}C for five minutes, dried and milled to obtain precooked breadfruit flour, which was subsequently packed in an airtight polyethylene bag awaiting further use (Giami, Amasisi and Ekiyor 2004).

Preparation of composite flour

Different proportions of the milled plantain and breadfruit flours (Table 1) were blended together and separately stored in a tightly sealed container pending future use.

Table 1: Plantain to breadfruit ratio

Sample	Plantain flour %	Breadfruit flour %
A	100	0
B	75	25
C	50	50
D	25	75
E	0	100

Mineral and Anti-nutritional Factors Analysis

The flour samples were digested using a tri-acid mixture (4.0 concentrated nitric, 5.0 perchloric and 0.5 sulphuric acids) prior to mineral analysis. The samples' potassium and sodium content were determined using Flame photometry technique, and other minerals (calcium, magnesium, iron and zinc) were analysed with Atomic Absorption Spectrophotometry (Buck 210, Norwalk, United Kingdom),according to the procedures described in AOAC (2000). The flours'anti-nutritional factors, tannin and oxalate determined in accordance to methods of AOAC (2000) while phytate content was estimated by the solvent extraction, gravimetric method of (Onwuka, 2005).

Statistical analysis

All data were analyzed using analysis of variance (ANOVA) and significant treatment of means were separated by Duncan's multiple range test according to procedure stated in SPSS package (SPSS, 2001)

.

RESULTS AND DISCUSSION

The composite flours' mineral compositions are shown in Table 4. The calcium content varied significantly ($p<0.05$) with lowest value observed in sole plantain flour (5.03 mg/100g), and the 100 % breadfruit flour has the highest value (24.38 mg/100g). The breadfruit calcium content obtained in this study tallies with the value recorded by Appiah et al., (2011). Calcium plays a vital role in strengthening body tissues and bones (Vormann, 2003), but it is highly inadequate to meet the recommended daily allowance (RDA) of calcium (1100 mg/day) for adult (FAO/WHO, 2001) because 100 g of composite flours will only supply approximately 0.46 % to 2.27 % of calcium (RDA).

There is significant reduction in magnesium with increase in the amount of breadfruit in the flour blends as depicted in Table 2.Magnesium is very important in human diet because it is crucial for the maintenance of normal function of nerves and muscles, sustains healthy immune system.

Potassium content increased significantly ($P< 0.05$) from A (826.09 mg/100g) to E (1010.58 mg/100g) as a result of increase in proportion of breadfruit in the plantain - breadfruit flour blends. Okoronkwo and Ubani (2012) reported a lower potassium value (582.76 mg/100g) for breadfruit than the value obtained in this study. Sodium concentration in the composite flours differs significantly ($p<0.05$) from each other, ranging from sample A (89.15mg/100g) to sample E (105.06 mg/100g). Sodium and Potassium are needed to maintain the osmotic balance of the body fluids, regulate muscles and nerves irritability. They control glucose absorption and enhance normal retention of

protein during growth (National Academy of Sciences, 2004).

The least iron content was observed in the sole breadfruit flour (6.17 mg/100g), while 100% plantain flour possesses the highest value (8.47 mg/100g). The quantities of Iron in the composite flours will supply the recommended daily allowance for iron (5 mg/day) for adult and insufficient females' daily iron requirement (18 mg/day) (Brink, 2014)Iron is required by pregnant woman, nursing mothers, infants and elderly people and also prevent anemia (Oluyemi, Akinlua, Adenuga, and Adebayo, 2006). The quantities of zinc in the flour blend ranged from 0.92 mg/100g to 1.09 mg/100g, Zinc content of composite flours was improved by addition of breadfruit which contained the higher zinc content. Zinc is required for the body's immune system to function properly.

Table 2: Mineral compositions of plantain and breadfruit flour blends

Sample ID	Calcium	Magnesium	Potassium	Sodium	Iron	Zinc
A	5.03±.04^{a}	66.00±.00^{e}	826.09±.04^{a}	89.15±.25^{a}	8.47±.06^{e}	1.09±.01^{d}
B	10.37±.37^{b}	63.10±.38^{d}	899.11±.34^{b}	92.23±.13^{b}	8.02±.00^{d}	1.02±.02^{e}
C	17.67±.48^{c}	60.58±.37^{c}	901.99±.21^{b}	97.02±.11^{c}	7.49±.06^{c}	1.00±.00^{c}
D	20.96±.30^{d}	59.42±.33^{b}	976.41±2.21^{c}	100.64±.52^{d}	7.02±.08^{b}	0.96±.01^{b}
E	24.38±.21^{e}	55.72±.35^{a}	1010.58±6.41^{d}	105.06±.23^{e}	6.17±.08^{a}	0.92±.00^{a}

Values are means± standard deviations of triplicate determinations. Mean values with different superscript in a column are significantly (p<0.05) different

A-(100P:0B), 100 % plantain flour without breadfruit flour
B-(75P:25B), 75% plantain flour with 25% breadfruit flour
C-(50P:50B), 50% plantain flour with 50% breadfruit flour
D-(25P:75B), 25% plantain flour with 75% breadfruit flour
E-(0P:100B). 100% breadfruit flour without plantain flour

Anti-nutrient value of the composite flour

The values for tannin, phytate, and oxalate content in the flour blends as shown in Table 3 revealed that sample E contained the highest amount of tannin (1.81%) and oxalate (2.62%), while highest phytate content was observed in sample A (1.21%). The contents of tannin, phytate, and oxalate varied significantly (p<0.05) in the flour blends. These anti-nutritional factors (Tannin, and Phytate) in the blends were lower than the estimated threshold limit (Tannin 60mg/100g, Phytate 22.1 mg/100g) of these anti-nutrients, hence will pose no danger to the consumers' health (Nouman, Shahzad Basra, and Siddique, 2004). Tannins are water soluble polyphenolic compounds and if it is in large quantity can cause stomach irritation, nausea and vomiting. Phytate have been connected to the decrease of availability of food mineral elements (calcium, magnesium, iron, and zinc) in the body, because it forms complexes with dietary minerals, thereby causing mineral related deficiency in humans (Audu, 2011). Researchers have proven that high level of oxalates intensifies calcium absorption in the kidney (Chai, Liu, and Chai, 2013), because high oxalate level in food has been implicated as the cause of kidney stones. Therefore, consumers of the fortified flours should have

low risk of adverse health effect due to oxalate toxicity.

Table 3: Anti-nutrient value of of plantain and breadfruit flour blends

SAMPLE ID	TANNIN	PHYTATE	OXALATE
A	$0.41\pm.02^{a}$	$1.21\pm.02^{e}$	$0.71\pm.06^{a}$
B	$0.73\pm.13^{b}$	$1.06\pm.01^{d}$	$1.12\pm.05^{b}$
C	$1.25\pm.04^{c}$	$0.92\pm.04^{c}$	$1.54\pm.16^{c}$
D	$1.68\pm.19^{d}$	$0.79\pm.02^{b}$	$2.06\pm.08^{d}$
E	$1.81\pm.23^{e}$	$0.52\pm.01^{a}$	$2.62\pm.08^{e}$

Values are means ± standard deviation of triplicate determination. Mean values with different superscript in a column are significantly ($p<0.05$) different

A-(100P:0B), 100 % plantain flour without breadfruit flour
B-(75P:25B), 75% plantain flour with 25% breadfruit flour
C-(50P:50B), 50% plantain flour with 50% breadfruit flour
D-(25P:75B), 25% plantain flour with 75% breadfruit flour
E-(0P:100B). 100% breadfruit flour without plantain flour

CONCLUSION

It can be inferred from the afore mentioned observations that the blending of instant plantain and breadfruit flours gave improved product of considerable mineral compositions and minimal antinutrient, These antinutritional factors in the flour blends were lower than their estimated threshold limit, hence will pose no danger to the consumers' health.Thus, the composite flours could be utilized for product development in different food system, and industries.

REFERENCES

Adegunwa, M. O., Adebowale, A. A., Bakare, H. A., & Ovie, S. G. (2004). International Journal of food research. ISSN 2056-9734. Department of Food Science and Technology, Federal University of Agriculture, Abeokuta, Nigeria .

Aderounmu, E. T. (2006). Effect of Frying, Temperature and Storage Conditions on the quality of Fried Cocoyam chips. A project report: University of Agriculture Abeokuta .

Aluge, O. O., Akinola, S. A., & Osundahunsi, O. F. (2016). Effect of malted sorghum on quality characteristics of wheat sorghum- soybean flour for potential use in confectionaries. Food and Nutrition Sciences, 7,: 1241-1252 .

Amusa, N. A. & Kehinde, I. A. (2002). Bio-deterioration of breadfruit (Artocarpus communis) in storage and the effect on the nutrient composition. Afr. J. Biotechnol . 1(2):57-60.

AOAC (2000). Official Method of Analysis, Association of Official Analytical Chemist .

Appiah, F., Oduro, I.& Ellis,W. O. (2011). Proximate and Mineral Composition of Artocarpus altilis Pulp Flour as Affected by Fermentation. Pakistan Journal of Nutrition, 10:653-657

Arise, A. K., Dauda, A. O., Awolola, G. V.,& Akinlolu-Ojo, T. V. (2017). Physico- chemical, functional and pasting properties of composite Flour made from wheat, plantain and Bambara for biscuit production. Annals. Food Science and Technology, 616-624. Artocarpus spp. and Treculia africana) in Ghana. Acta Hortic. 1128.

Audu , S.S., & Aremu, M.O. (2011). Effect of Processing on Chemical Compostion of Red Kindney Bean(Phaseolus vulgaris.L). Pakistan Journal of Nutrition. Vol: 10 Issue: pg.11 1069-1075 DOI; 10.3923/pjn.2011. 1069.1017

Awolu, O. O., Osemeke, R. O. & Ifesan, B. O. T. (2015). Antioxidant, functional and rheological properties of optimized composite flour, consisting wheat and amaranth seed, brewers' spent grain and apple pomace. J Food Sci Technol., pp1-13. breadfruit(Artocarpus communis) in traditional stiff porridge foods. Journal of food Agriculture and environment 1(2):54-59.

Chai, P.C., Liu, Z., & Chai, Y.(2013).Hedgehog Signaling acts with the temporal cascade to promote neuroblast cell cycle exit.PloS Biol.11(2):e1001494

Chandra, S., Singh, S., & Kumari, D. (2015). Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits. J Food Sci Technol., 52(6): 3681-3688

Chung, M. J.,Woopark, K., Heon, K.K., Kim, C.T., Pill, B.J., Bang, K.H., Choi, Y.M., &Lee, S.J.(2007). composite flour from kernels of roasted and boiled African breadfruit

Deivanai, S., & Bhore, S.J. (2007). Breadfruit (Artocarpus altilis Fosb.)- An Underutilized and Neglected Fruit Plant Species .Species.Middle East Journal of Scientific Research 6:418- 428

Englberger, L., Alfred, T., Lorens, J., & Iuta, T.(2007). "Screening of selected breadfruit cultivars for carotenoids and related health benefits in micronesia."Acta Hortic (ISHS)757:193http://dx.doi.org/10.17660/ActaHortic.2007.757.1.http://dx.doi.org /10.17660/Act aHortic.2007.757.6.

FAO/WHO/UNU.(2007). Expert consultation on protein and Amino Acid Requirements in Human Nutrition (2002: Geneva, Switzerland), Food and Agriculture Organization of the united Nations, World Health Organization and United Nations University.

Giami SY, Amasisi T, Ekiyor T (2004). Comparison of bread making properties of composite flour from kernels of roasted and boiled African breadfruit (Treculia africana decne) seeds. J. Material Res. 1(1): 16-25.

Huie C.W. (2002). A review of Modern sample –preparation techniques for the extraction and analysis of medicinal plants. Anal Bioanal Chem.373(1-2(23-30. Doi:10.1007/s00216-002-1265-3. ISNS2016.DOI10.17660/Acta Hortic.2016.1128.3

Julianti, E., Rusmarilin, H., & Yusraini, E. (2015). Functional and rheological properties of composite flour from sweet potato, maize, soybean and xanthan gum. Journal of the Saudi Society of Agricultural Sciences, 16: 171-177.

Mayaki, O., Akingbala, J.O., Gail, S.H., & Baccus –Taylor, S.T. (2003).Evaluation of
National Academy of Sciences. (2004). Dietary Reference Intakes (Washington, DC, USA: National Academy of Sciences).

Nouman, W., Shahzad M.A., Basra, M.T., & Siddique, M.T.(2014).Potential of Moringa oleifera L. as livestock fodder crop: a review. Tuurk J Agric for 38:1-14 DOI:10.3906/tar-1211-66

Ogazi, P. O. (1996). Plantain: Production, processing and utilization. Paman and Associates Ltd, (1996).Development and sensory evaluation of Soyamusa: A soybean-plantain baby food. ISHS Acta Hortic., p.540: International Conference on Banana and Plantain for Africa. (Treculiaafricana) seeds. J. Mater. Res. 1(1):16-25.

Okigwe; pp 307. hydroxy-3-methyl-glutaryl-co-enzyme A reductase expression in vitro and in vivo and show hypocholesterolanemic properties in mice. British Journal of Nutrition,15: 1-9.

Okonkwo, E.U., & Ubani, O.N.(2012). Application of HACCP to Post – harvest processing of African breadfruit(Treculia Africana decne). African Journal of Agricultural Research; 7(32): 4536-4542.

Oluyemi, E.A., Akinlua, A.A., Adenuga, A.A., & Adebayo, M.B. (2006); Mineral Content of some commonly consumed Nigeria foods. Science Focus 11(1) :153- 157.

Omobuwajo, T.O. (2003). Compositional characteristics and sensory quality of biscuit, prawn- crackers and fried chips produced from breadfruit. Journal of Innovative Food Science and Emerging Technologies.4 (2): 219-22.

Omobuwajo, T.O. (2007). Overview of the status of breadfruit in Africa. Acta Hortic . 757, 60–63

Onwuka, G. I. (2005). Food Analysis and Instrumentation: Theory and Practice. Naphthali Priints. Lagos, Nigeria, : 22-30.

Pallant, J.(2001).SPSS survival manuel: A step by step guide to data analysis using SPSS for windows version 10.Buckingham:Open University Press.

Ragone, D. (2007). Breadfruit: diversity, conservation and potential. Acta Hortic. 757, 19–30

Ragone, D., & Cavaletto, C.G. (2006). Sensory Evaluation of Fruit Quality and Nutritoinal Composite of 20 Breadfruit (Artocarpus, Moraceae) Cultivars. Economic Botany 60(4):335-346.

Ragone, D., & Jones, A. M.P. (2011). Beyond the botany: Breadfruit (Artocarpusaltilis) for food security and novel foods in the 21stcentury. A journal of plants, people and Applied Research. Ethnobotany Research and Applications 9:129-149.

Vormann, .J.(2003). Magnesium; Nutrition and Metabolism. Molecular Aspect of Medicine .vol 23,.27.