Research Journal of

Medicinal Plant

ISSN 1819-3455

Academic Journals Inc.

www.academicjournals.com

Research Journal of Medicinal Plant 8 (6): 277-282, 2014
ISSN 1819-3455 / DOI: 10.3923/rjmp.2014.277.282

Evaluation of Some Nutritional and Sensory Characteristics of Bread-fruit (*Treculia africana*) Cooked with Various Food-Waste Ash Infusions

[1]Anthony Cemaluk C. Egbuonu and [2]Daniel C. Nzewi
[1]Department of Biochemistry, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
[2]Department of Food Technology, Federal Polytechnic Nekede, Owerri, Imo State, Nigeria

Corresponding Author: Anthony Cemaluk C. Egbuonu, Department of Biochemistry, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

ABSTRACT

The local practice of boiling bread-fruit seeds with food-waste ash infusion, while desirous on environmental ground, may affect the nutritional and sensory characteristics of the porridge, warranting this study. Five bread-fruit seeds samples were separately boiled with ash infusion from palm bunch (PBI), plantain leave (PLI), corncob (CCI), groundnut shell (GSI) and without ash infusion (TW). Compared with the control (TW), the recorded range: 11.98±0.57-13.24±1.15% (moisture), 17.64±0.13-18.24±0.57% (protein), 2.61±0.58-2.75±0.03% (crude fibre), 1.90±0.06-2.04±0.06% (crude fat), 3.19±0.17-3.36±0.02% (ash), 60.56±0.06-62.65±0.11% (carbohydrate), 5.10±0.05-5.32±0.07 mg/100 g (calcium) and 6.94±0.02-6.97±0.05 mg/100 g (potassium) were not significant ($p>0.05$). However, the range 3.58±0.04-4.24±0.08 mg/100 g (iron), 1.8±0.17-4.5±0.12% (texture), 1.3±0.05-4.2±0.06% (aroma), 2.0±0.06-4.0±0.11% (taste), 2.6±0.06-4.6±0.05 (color) and 1.9±0.05-4.2±0.17 (general acceptability) were significant ($p<0.05$). The effect of the various ash infusions on most of the studied nutritional properties of the bread-fruit was not significant, hence, could be negligible. The difference in the iron and sensory characteristics values for PBI sample were significant ($p<0.05$) when compared with the control and those for the other ash infusions, suggesting the overriding effect of boiling with palm bunch infusion on these parameters. The study supports the local use of these ash infusions and their preference for PBI in preparing bread-fruit meal while suggesting a beneficial use of these hitherto food wastes. The potential of these ash infusions (especially PBI) to improve the iron content and sensory properties of the bread-fruit is nutritionally noteworthy hence warrants further study.

Key words: Ash infusions, calcium, potassium, iron, aroma, texture, taste

INTRODUCTION

The African bread-fruit (*Treculia africana*) tree thrives in tropical countries including Nigeria and is probably one of the oldest wild tree species that have came under cultivation and protection in Nigeria. The African bread-fruit (*Treculia africana*) tree is a woody plant. The seeds are edible and are a delicacy known by various tribal names in Nigeria. It is called "Ukwa" by the Igbos, "Afon" (Igala) and "Edikang" (Efik) (Irvine, 1961). The bread-fruit seed is highly nutritious (Oyenuga, 1988; Bassir and Lawal, 1985). African Bread-Fruit (ABF) seeds are rich in amino acids, minerals and fatty acids (Ekpenyong, 1985). The seed contains about 10-11% oil, 14-17% crude protein, 2.5% fibre, 35.3-60.24% carbohydrate and a good distribution of mineral and essential amino acids (Iwe and Ngoddy, 2001).

The preparation of bread-fruit meal is laborious and time consuming. In particular, the processing of bread-fruit requires de-hulling to remove the fibrous colored hulls (seed coats) which usually contain bitter tannin (Iwe and Ngoddy, 2001) and prolonged boiling to soften the seed. De-hulling conditions for the African bread-fruit seed with high efficiency ratio and extraction yield have been proposed (Iwe and Ngoddy, 2001) but are not yet popular. Thus, majority of the people in the rural areas still take to the traditional process involving the addition of alum or plant/food-waste ash infusion into the water used for parboiling the seeds. Rural dwellers claim that this process reduces the cooking time, keeps the cotyledons intact without breaking and enhances the appeal of the resultant porridge. The palm bunch ash infusion is generally added while cooking bread-fruit seeds in Ojoto, a typical locale in Idemili South local government area, South eastern Nigeria. Other ash infusions, including infusion from plantain leave, corncob and groundnut shell are used to a lesser extent. These are agricultural/food wastes with attendant negative environmental implications and the local use of their respective ash infusion may be (at least environmentally) acceptable. However, the effect of such practice on the proximate and sensory characteristics of the bread-fruit which to the knowledge of the authors is lacking, need to be known.

This study, therefore, evaluated the effect of ashes from palm bunch, plantain leave, corncob and groundnut shell (that are usually used by the rural dwellers in parboiling the bread-fruit seed) on some nutrient, mineral and sensory characteristics of the resultant bread-fruit porridge.

MATERIALS AND METHODS

Ashes from palm bunch, groundnut shells, dry corncobs and dry plantain leaves were obtained by burning these materials separately. Bread-fruit seeds were cleaned, boiled for 10 min, duhulled and winnowed to obtain clean cotyledons. Two hundred grams of the de-shelled bread-fruit seeds were weighed into five different cooking pots and 1.5 L of water was added to each. Each of the ashes (2 g) was dissolved in 10 mL of water in separate glass beaker. The respective bread-fruit seed samples were allowed to boil for 20 min, using electric cooking stove (Everest brand). Then, the different ash infusions were separately decanted into the boiling bread-fruit seed samples and boiling continued until the seeds softened. The electric stoves (for the different samples) were switched off at the same time. The bread-fruit seeds were sieved, cooled and the panelists served the respective samples for sensory evaluation. The remaining respective samples were separately stored in labeled glassware with a stopper cork prior to analysis. The experiment was carried out with ash infusion from four food waste sources (palm bunch, corncob, plantain leave and groundnut shell) at three replicates ($4\times3 = 12$ replicates).

Chemical analysis: Proximate composition-moisture, crude protein, fat, ash, crude fibre and carbohydrate were determined using the AOAC (1984) method. The mineral contents were determined using the spectrophotometric method described by James (1995).

Sensory evaluation: Sensory evaluation was carried out on the bread-fruit samples boiled with different ash infusions, using a nine point Hedonic Scale as outlined by Ihekoronye and Ngoddy (1985). A fifteen member semi-trained panelist comprising staff and students of Federal Polytechnic

Nekede was used. The panelist was served the samples of the boiled bread-fruit in coded plates to assess on a nine point scale for the texture, aroma, taste and general acceptability. Nine represents like extremely, 8: like very much, 7: Like moderately, 6: like slightly, 5: Neither like nor dislike, 4: dislike slightly, 3: Dislike moderately, 2: Dislike very much and 1: Dislike extremely.

Statistical analysis: The data obtained was statistically analysed using Analysis of Variance (ANOVA) as reported earlier (Iwe, 2002; Egbuonu *et al*., 2009, 2014a; Egbuonu and Ezeanyika, 2013; Egbuonu and Nzewi, 2014) but applying Sidak *post hoc* test to identify the mean that differ at significant level of $p<0.05$. The descriptive statistics was presented as Mean±Standard Error of Mean (SEM) of triplicate determinations.

RESULTS

The change for the proximate compositions was not significant ($p>0.05$) and ranged from 11.98±0.57-13.24±1.15% (moisture), 17.64±0.13-18.24±0.57% (protein), 2.61±0.58-2.75±0.03% (crude fibre), 1.90±0.06-2.04±0.06% (crude fat), 3.19±0.17-3.36±0.02% (ash), 60.56±0.06-62.65±0.11% (carbohydrate) (Table 1).

Results for mineral compositions ranged from 5.10±0.05-5.32±0.07 mg/100 g (calcium) and 6.94±0.02-6.97±0.05 mg/100 g (potassium) and 3.58±0.04-4.24±0.08 mg/100 g (iron). The change when compared with the control was not significant ($p>0.05$) except that obtained for iron ($p<0.05$). The iron content in sample cooked with PBI was significant when compared with that obtained by cooking with the other ash infusions (Table 2).

The change in the sensory evaluation characteristics was significant ($p<0.05$) and ranged from 1.8±0.17-4.5±0.12% (texture), 1.3±0.05-4.2±0.06% (aroma), 2.0±0.06-4.0±0.11% (taste),

Table 1: Effect of different ash infusions on the proximate composition of boiled bread-fruit

Parameters (%)	PBI	PLI	CCI	GSI	TW
Moisture	11.98±0.57[a]	13.24±1.15[a]	12.70±1.73[a]	12.98±0.58[a]	13.14±1.15[a]
Crude protein	17.64±0.13[a]	17.64±0.08[a]	18.01±0.58[a]	18.04±0.55[a]	18.24±0.57[a]
Crude fat	1.94±0.02[a]	1.90±0.06[a]	2.01±0.05[a]	2.04±0.02[a]	2.04±0.06[a]
Crude fibre	2.69±0.57[a]	2.61±0.58[a]	2.72±0.24[a]	2.70±0.57[a]	2.75±0.03[a]
Ash	3.30±0.17[a]	3.19±0.06[a]	3.32±0.15[a]	3.34±0.08[a]	3.36±0.02[a]
Carbohydrate	62.65±0.11[a]	61.22±0.12[a]	60.98±3.10[a]	60.85±3.01[a]	60.56±0.06[a]

Mean±Standard error of mean (SEM) of triplicate determinations. Mean with different superscripts on the same row are significantly different ($p<0.05$). PBI: Bread-fruit cooked with palm bunch ash infusion, PLI: Bread-fruit cooked with plantain leaves ash infusion, CCI: Bread-fruit cooked with corn cob ash infusion, GSI: Bread-fruit cooked with groundnut shell ash infusion, TW: Bread-fruit cooked without ash infusion

Table 2: Effect of different ash infusions on the mineral composition of boiled bread-fruit

Parameters (mg/100 g)	PBI	PLI	CCI	GSI	TW
Calcium	5.32±0.07[a]	5.27±0.09[a]	5.22±0.06[a]	5.10±0.05[a]	5.18±0.06[a]
Potassium	6.97±0.05[a]	6.95±0.08[a]	6.94±0.06[a]	6.95±0.05[a]	6.94±0.02[a]
Iron	4.24±0.08[b]	3.76±0.03[c]	3.70±0.05[c]	3.75[c]±0.02	3.58±0.04[a]

Mean±Standard error of mean (SEM) of triplicate determinations. Mean with different superscripts on the same row are significantly different ($p<0.05$). PBI: Bread-fruit cooked with palm bunch ash infusion, PLI: Bread-fruit cooked with plantain leaves ash infusion, CCI: Bread-fruit cooked with corn cob ash infusion, GSI: Bread-fruit cooked with groundnut shell ash infusion, TW: Bread-fruit cooked without ash infusion

Table 3: Effect of the different ash infusions on the sensory parameters of boiled bread-fruit

Parameters (%)	PBI	PLI	CCI	GSI	TW
Texture	4.5±0.12[a]	3.4±0.06[b]	3.4±0.08[b]	3.1±0.05[b]	1.8±0.17[c]
Aroma	4.0±0.02[a]	3.2±0.05[c]	4.2±0.06[b]	3.5±0.11[bc]	1.3±0.05[d]
Colour	3.2±0.06[a]	2.8±0.05[b]	3.0±0.12[b]	2.6±0.06[b]	4.6±0.05[c]
Taste	4.0±0.11[a]	3.4±0.05[b]	3.2±0.12[b]	3.1±0.05[b]	2.0±0.06[c]
General acceptability	4.2±0.17[a]	3.2±0.17[b]	3.3±0.12[b]	3.3±0.06[b]	1.9±0.05[c]

Mean±Standard error of mean (SEM) of triplicate determinations. Mean with different superscripts on the same row are significantly different ($p<0.05$). PBI: Bread-fruit cooked with palm bunch ash infusion, PLI: Bread-fruit cooked with plantain leaves ash infusion, CCI: Bread-fruit cooked with corn cob ash infusion, GSI: Bread-fruit cooked with groundnut shell ash infusion, TW: Bread-fruit cooked without ash infusion

2.6±0.06-4.6±0.05 (color) and 1.9±0.05-4.2±0.17 (general acceptability). The value for the respective sensory parameter obtained for PBI was significant when compared with that for the other ash infusions (Table 3).

DISCUSSION

The local practice of boiling bread-fruit seeds with ash infusion to prevent the breaking of the cotyledons and reduce the cooking time may affect the nutritional and sensory characteristics of the bread-fruit seeds, warranting this study. Moisture content of food determines its keeping quality (Ejikeme *et al.*, 2010; Nzewi and Egbuonu, 2011). The moisture content of the samples ranged from 11.98[a]±0.57-13.24±1.15% with bread-fruit boiled with palm bunch ash infusion and plantain leaves ash infusion ranking lowest and highest, respectively. Carbohydrate content indicates the amount of useful energy in a food (Ukoha *et al.*, 2011). The carbohydrate content ranged from 60.56±0.06-62.65±0.11% for TW and PBI, respectively. The result on carbohydrate compares with the values reported for de-hauled and dried bread-fruit seeds (77.44±8.46%) (Ijeh *et al.*, 2010) and breadfruit composited with wheat (67.61±0.116%) (Ojinnaka *et al.*, 2013). The observations may indicate better moisture reduction and carbohydrate preserving potentials of the palm bunch ash infusion that could enhance the energy and stability qualities of the bread-fruit porridge.

The crude protein values ranged from 17.64-18.24% for PBI and TW, respectively while that of the crude fat ranged from 1.90±0.06-2.04±0.06% for PLI and TW, respectively. The results compare with the values 18.32±0.54% (crude protein) and 1.31±0.02% (crude fat) obtained by Ijeh *et al.* (2010) but in raw (de-hauled and dried) sample. The GSI values 18.04±0.55% (crude protein) and 2.04[a]±0.02% (crude fat) suggest that groundnut ash infusion (GSI) may preserve the protein and fat contents of the boiled bread-fruit seeds more than the other ash infusions. Dietary fiber protects against cardiovascular diseases, hypercholesterolemia, obesity and glucose intolerance (Iwai, 2008; Monago and Uwakwe, 2009). The crude fibre content varied from 2.61±0.57-2.75[a]±0.03% for PLI and TW, respectively. The result compares with that of Ojinnaka *et al.* (2013) for breadfruit composited with wheat (3.39±0.03%). The CCI value (2.72±0.24%) suggests its better preservation of the crude fibre content of the bread-fruit seeds. Ash content was associated with the amount of mineral in a food sample (Egbuonu *et al.*, 2014b). Variation in the ash values of the bread-fruit samples boiled with different ash infusions (3.19±0.06-3.36[a]±0.02% for PLI and TW, respectively) suggests poor mineral preservation capacity of the PLI. However, the GSI ash value (3.34±0.08%) suggests that its infusion may preserve the ash (mineral) content of the bread-fruit more than the other ash infusions.

Generally, calcium, iron and potassium are required for cellular functions with recommended allowance for adolescents and adults up to 2 μg day^{-1} (iron) and 1300 mg day^{-1} (calcium) (FAO/WHO, 2001). For instance, calcium deficiency was implicated in the development of type I and type II diabetes (Pittas *et al*., 2007). Calcium content ranged from 5.10±0.05-5.32±0.07 mg/100 g for GSI and PBI samples, respectively. The results compare with that of Ijeh *et al*. (2010) for calcium (5.34±1.15 mg/100 g). The values obtained for potassium ranged from 6.94±0.02-6.97±0.05 mg/100 g for TW and PBI, respectively. These suggest that palm bunch ash infusion may improve the calcium and potassium contents of the bread-fruit porridge. The values obtained for iron ranged from 3.58±0.04-4.24±0.08 mg/100 g for TW and PBI, respectively. The results did not compare with that of Ijeh *et al*. (2010) for iron (8.00±0.00 mg/100 g) which could be attributed to difference in the processing methods.

The various ash infusions significantly ($p<0.05$) altered the iron content and the sensory characteristics (texture, aroma, colour, taste and general acceptability) but not the other studied nutritional properties of the bread-fruit. This is a pointer that the ash infusion from these plant/food wastes could improve the iron content and overall appeal of the resultant bread-fruit porridge with a negligible effect on the other nutrient contents. The difference in the iron and sensory characteristics values for PBI sample were significant ($p<0.05$) when compared with those for the other ash infusions, suggesting the overriding effect of boiling with palm bunch infusion on these parameters.

Thus, the study supports the local use of these ash infusions and their preference for PBI in preparing bread-fruit meal while suggesting a beneficial use of these hitherto food wastes. The potential of these ash infusions (especially PBI) to improve the iron content and sensory properties of the bread-fruit is nutritionally noteworthy hence warrants further study.

ACKNOWLEDGMENT

The authors sincerely acknowledge M.O. Agoha, of the Department of Food Technology, Federal Polytechnic Nekede, Owerri, Imo State for assisting the experiments.

REFERENCES

AOAC, 1984. Official Methods of Analysis. 14th Edn., Association of Official Analytical Chemists, Washington, DC., USA.

Bassir, O. and R.O. Lawal, 1985. Changes in the major nutrients of the seeds of *Treculia Africana* during preparation. J. Plant Foods, 6: 247-251.

Egbuonu, A.C.C. and D.C. Nzewi, 2014. Effect of blanching prior to oven-drying on some functional compositions of bitter yam (*Dioscorea dumetorum*). Res. J. Med. Plant, 8: 231-238.

Egbuonu, A.C.C. and L.U.S. Ezeanyika, 2013. L-arginine exposure improves renal function markers of metabolic syndrome in female rats. Am. J. Biochem. Mol. Biol., 3: 50-60.

Egbuonu, A.C.C., D.C. Nzewi and O.N.C. Egbuonu, 2014a. Functional properties of bitter yam (*Dioscorea dumetorum*) as influenced by soaking prior to oven-drying. Am. J. Food Technol., 9: 97-103.

Egbuonu, A.C.C., D.C. Nzewi and O.N.C. Egbuonu, 2014b. Effect of soaking prior to oven-drying on some nutrient and anti-nutrient properties of bitter yam (*Dioscorea dumetorum*). J. Nutr. Food Sci., Vol. 4.

Egbuonu, A.C.C., O. Obidoa, C.A. Ezeokonkwo, L.U.S. Ezeanyika and P.M. Ejikeme, 2009. Low dose oral administration of monosodium glutamate in male albino rats may be nephroprotective. Bio-Research, 7: 470-473.

Ejikeme, P.M., N.L. Obasi and A.C.C. Egbuonu, 2010. Physico-chemical and toxicological studies on *Afzelia Africana* seed and oil. Afr. J. Biotechnol., 9: 1959-1963.

Ekpenyong, T.E., 1985. Chemical composition and amino acid content of African breadfruit (*Treculia africana* Decne). Food Chem., 17: 59-64.

FAO/WHO, 2001. Human vitamin and mineral requirements: Report of a joint FAO/WHO expert consultation Bangkok, Thailand. World Health Organization/Food and Agriculture Organization of the United Nations, Rome, Italy, pp: 161-162.

Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. Macmillan Publishers Ltd., London, ISBN: 9780333388839, pp: 109.

Ijeh, I., C.E. Ejike, O.M. Nkwonta and B.C. Njoku, 2010. Effect of traditional processing techniques on the nutritional and phytochemical composition of African bread-fruit (*Treculia africana*) Seeds. J. Applied Sci. Environ. Manage., 14: 169-173.

Irvine, F.R., 1961. Woody Plants of Ghana: With Special Reference to their Uses. Oxford University Press, Oxford, pp: 54-62.

Iwai, K., 2008. Antidiabetic and antioxidant effects of polyphenols in brown alga *Ecklonia stolonifera* in genetically diabetic KK-A mice. Plant Food Hum. Nutr., 63: 163-169.

Iwe, M.O. and P.O. Ngoddy, 2001. Development of a mechanical dehulling process for the African breadfruit (*Treculia africana*). Niger. Food J., 19: 8-16.

Iwe, M.O., 2002. Handbook of Sensory Methods and Analysis. Rojoint Communication Services Ltd., Enugu, Nigeria, pp: 7-12.

James, C.S., 1995. Analytical Chemistry of Foods. 1st Edn., Chapman and Hall, New York.

Monago, C. and A. Uwakwe, 2009. Proximate composition and *in vitro* anti-sickling property of Nigeria *Cyperus esculentus* (tiger nut sedge). Trees Life J., 4: 1-6.

Nzewi, D. and A.C. Egbuonu, 2011. Effect of boiling and roasting on the proximate properties of asparagus bean (*Vigna sesquipedalis*). Afr. J. Biotechnol., 10: 11239-11244.

Ojinnaka, M.C., F.A. Anyanwu and A. Ihemeje, 2013. Nutritional evaluation of cookies produced from African breadfruit (*Treculia Africana*) starch and wheat flour. Int. J. Agric. Food Sci., 3: 95-99.

Oyenuga, V.A., 1988. Nigerian Foods and Feeding Stuff: Their Chemistry and Nutritive Value. 3rd Edn., Ibadan University Press, Ibadan, Nigeria.

Pittas, A.G., J. Lau, F.B. Hu and B. Dawson-Hughes, 2007. The role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. J. Clin. Endocrinol. Metab., 92: 2017-2029.

Ukoha, P.O., E.A.C. Cemaluk, O.L. Nnamdi and E.P. Madus, 2011. Tannins and other phytochemical of the *Samanaea saman* pods and their antimicrobial activities. Afr. J. Pure Applied Chem., 5: 237-244.