International Journal of Theoretical & Applied Sciences, 13(1): 26-31(2021)

ISSN No. (Print): 0975-1718
ISSN No. (Online): 2249-3247

Quality Assessment of Azama – A Toasted African Yam Bean (*Sphenostylis stenocarpa*) Seed Snack in Abia State, Nigeria

***Dorothy. C. Arukwe*[*1] *and Juliet. A. Arukwe*[2]**
Department of Home Science/Hospitality Management and Tourism,
College of Applied Food Science and Tourism, Michael Okpara University of Agriculture Umudike, Nigeria.
[2]Department of Optometry, Faculty of Health Sciences, Imo State University Owerri, Nigeria.

(Corresponding author: Dorothy. C. Arukwe)
(Received 17 January, 2021, accepted 18 April, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A snack is a meal that is consumed in a hurry to quench hunger. This study aimed at assessing some quality attributes of *azama* – a toasted African yam bean seed snack in Abia State, South Eastern Nigeria. The samples of azama were procured from sellers in seven local government areas of Abia State and assessed for proximate composition, mineral content, anti-nutritional factors content, microbial qualities and sensory attributes using standard methods. The result of the proximate indicated significant differences ($p<0.05$) in the moisture, protein, crude fibre, fat, ash and carbohydrate content of some of the samples with values ranging from 5.88-6.15%, 20.86–21.06%, 7.00–7.10%, 3.80–3.85, 4.00–4.15% and 58.01–58.20% respectively. There were significant differences ($p<0.05$) in mineral content of some of the samples. The anti-nutritional factors analyzed recorded low values in all the samples. The microbial analysis showed that no coliforms were detected in the samples and the bacterial and fungal counts had low values. The sensory analysis showed significant differences ($p<0.05$) in the parameters of colour, aroma, taste and texture, although all the samples were accepted. Azama snack is from African yam Bean which is an under-utilized legume and there exists a lot of apathy towards its consumption. This study will go a long way in educating the people on the nutritional benefits thereby increasing its consumption and utilization.

Keywords: African yam bean, snack, sellers, azama, quality attributes, toasted

I. INTRODUCTION

A snack is a food traditionally consumed as a light meal or taken between meals. Traditional foods and snacks such as *azama* play a significant role in the nutrition of the people. The main functions of snacks is supply of micronutrients, for restoring strength and for reception at homes and parties, and their preparation is a means of subsistence and occupation particularly for women in developing countries such as Nigeria [26]. The popular snack foods in Nigeria include bread, cake, biscuit, chin chin, gala, puff, plantain chips, potato chips, roasted groundnut, roasted maize, Toasted breadfruit, etc. [1, 16, 31].

Azama is a legume snack that provides nourishment to the people and serves as source of employment and income to the women who prepare and sell them. The snack *azama*, is less popular in Nigeria and is produced from African yam bean by roasting and dehulling the seed. It is a common snack found in Abia State of Nigeria which is consumed by the people familiar with the taste, and is eaten with cracked palm kernel or coconut meat. The intake of this local snack dates back several decades in the affected communities particularly among the low income people. Aletor and Ojelabi [2] noted that consumption of local snacks adds to the overall nutrient ingestion of Nigerians.

African yam bean (*Sphenostylis stenocarpa*) is a perennial herbaceous plant whose seed and tubers are edible, but in Nigeria it is cultivated mainly for the seed [21]. It is an underutilized crop and therefore classified as a minor grain legume [20, 33]. It is commonly called okopo dudu or odudu in Igbo, Sheshe in Yoruba, Azeba in Obanliku, Bitei in Obudu and girigiri in Hausa [25; 18]. African yam bean is abundant in protein, carbohydrate, vitamins and minerals [13] and its protein is composed of equal or higher levels of lysine and methionine than those of soybeans [23]. According to Onwuka [29], African yam bean contains over 32% essential amino acids with lysine and leucine being prevalent. Uguru and Madukaife [36] reported that the seeds of african yam bean is properly balanced in essential amino acids and has greater amino acid levels than pigeon pea, cowpea and Bambara groundnut.

African yam Bean being an under-utilized legume, people have so much apathy towards its consumption. Efforts are being made to increase its utilization due to its immense nutritional benefits. Its consumption as a

snack (azama) will increase its use. There is no published work on the quality assessment of this local snack till date hence this study. The objective of this study is to assess some quality attributes of azama, a snack consumed in Abia State, Nigeria.

II. MATERIALS AND METHODS

A. Collection of samples

The *azama* samples were procured from sellers spread across seven local government areas of Abia State namely, Aba South, Aba North, Bende, Ohafia, Umuahia South, Umuahia North and Ikwuano. From each of the local government, samples were collected from sellers in two different communities. From each community, samples were collected from at least two sellers. The samples were separated into batches on the basis of local government areas and from each batch, three samples were randomly selected for analysis.

B. Proximate determination

The AOAC [4] methods were used to determine the protein, moisture, crude fibre, fat, ash and carbohydrate content of the samples and their analysis was done in triplicates.

C. Minerals determination

The method described by Onwuka [29] was used. The samples were ashed and digested and the digests were used for mineral element determination. Calcium and Magnesium were analyzed by EDTA complexiometric titration method as described by Udoh and Ogunwale [35] and Potassium and Sodium were measured using flame photometric method of AOAC [4]. The Zinc and Iron were analyzed by atomic absorption spectrophotometer, model AAS, Hitachi 26100, Tokyo Japan, while Phosphorus was determined using vonadomolybdate spectrometric method as described by James [14].

D. Anti-nutritional factors determination

The AOAC [3] method was employed to determine oxalate and saponin, trypsin inhibitor was by the spectrophotometric method described by Nwosu [22], tannin was by method of Folin Denis spectrophotometric at 760nm [30] and phytate was by method of Haugh and Lantzsch [9]. The alkaline precipitation gravimetric method of Harbone [6] was used to determine the alkaloids present and hydrogen cyanide was analyzed by Onwuka method [29].

E. Microbiological analysis

The microbial analysis was done by the standard method of Harrigan and McCance [7]. One gram (1g) of the sample was weighed aseptically and carefully transferred into 9ml of sterile distilled water and 1ml of the dilution was mixed with molten agar and pour-plated on Nutrient agar media (bacteria determination), and MRS agar media (total lactic acid bacteria–LAB determination) and for fungi, sabouraud dextrose agar (SDA) was used, and these were incubated at 37°C for 48h in air tight jars. The microbial counts were done after the incubation and were expressed as 10^3 colony forming units (cfu) per gram of sample.

F. Sensory analysis

The sensory evaluation was done using a twenty-member panel who were regular consumers of *azama*. The panelist rated the *azama* samples colour, aroma, taste, texture and overall acceptability on a 9-point hedonic scale as described by Ihekoronye and Ngoddy [11]. The rating scale was 1- dislike extremely, 2- dislike very much, 3- dislike moderately, 4- dislike slightly, 5- neither like nor dislike, 6- like slightly, 7- like moderately, 8- like very much and 9- like extremely.

G. Statistical analysis

All data obtained were statistically analyzed with one way analysis of variance (ANOVA) to determine significant difference at 5% level of acceptance using SPSS version 17. All data were expressed as mean + standard deviation of average of three replicates per treatment.

III. RESULTS AND DISCUSSION

A. Proximate composition of azama samples

The results of the proximate composition of *azama* samples are shown in Table 1. The moisture, protein, crude fibre, fat, ash and carbohydrate ranged from 5.88 – 6.15%, 20.86 – 21.06%, 7.00 – 7.10%, 3.80 – 3.85%, 4.00 – 4.15% and 58.01 – 58.20% respectively and some of the samples were not significantly different ($p>0.05$) from each other. This may be due to the use of the same processing methods (toasting and dehulling) for the production of the samples. The moisture content of the samples (5.88 – 6.15%) are below 10% and this is in harmony with the moisture level recommended for safe storage by SON [34]. The low moisture content of the snacks indicate low chances of microbial attack and increased shelf life when properly packaged [19], because growth of microorganisms are restrained at such low moisture level [24]. The moisture contents recorded low values with samples AN (6.15%) and AS (6.12%) having significantly ($p<0.05$) higher moisture than the other samples. This may be due to differences in toasting time and temperature and differences in the moisture content of the raw African yam bean seeds used.

The protein content was high for all the samples but samples UN (21.06%) and OH (21.02) recorded the highest while sample AS (20.86%) recorded the lowest value. The differences observed in protein content may be a result of differences in moisture content of the

samples. Protein in the diet is necessary in building and maintaining cells.

The crude fibre, fat and ash of the samples were not significantly different ($p>0.05$) from each other and these ranged from 7.00-7.10%, 3.80-3.85% and 4.00-4.15% respectively. Crude fibre is desirable in the diet because of its advantage of increasing faecal bulk and lowering serum cholesterol, risk of coronary heart diseases, colon cancer, breast cancer and hypertension, improve glucose tolerance and enhance insulin sensitivity [8; 17].

Table 1: Proximate content of *Azama* samples (%).

Samples	Moisture	Protein	Crude fibre	Fat	Ash	Carbohydrate
AS	6.12^{b}	20.86^{f}	7.00^{c}	3.85^{a}	4.10^{c}	58.07^{d}
AN	6.15^{a}	20.92^{d}	7.05^{b}	3.83^{b}	4.02^{d}	58.03^{f}
BD	6.00^{d}	21.00^{c}	7.00^{c}	3.80^{d}	4.00^{e}	58.20^{a}
OH	5.88^{f}	21.02^{b}	7.00^{c}	3.85^{a}	4.15^{a}	58.10^{c}
US	6.00^{d}	21.00^{c}	7.05^{b}	3.80^{d}	4.00^{e}	58.15^{b}
UN	5.92^{e}	21.06^{a}	7.10^{a}	3.81^{c}	4.10^{c}	58.01^{g}
IK	6.10^{c}	20.90^{e}	7.00^{c}	3.85^{a}	4.11^{b}	58.04^{e}
LSD	0.00195	0.00185	0.00265	0.00222	0.00139	0.00227

Mean value in the same column with same letters are not significantly different ($p<0.05$)

Key: AS= Aba South sample, AN= Aba North sample, BD= Bende sample, OH= Ohafia sample, US= Umuahia South sample, UN= Umuahia North sample and IK= Ikwuano sample

B. Mineral content of azama samples

The mineral content of the samples are shown in Table 2. There were significant differences ($p<0.05$) in the magnesium, calcium, potassium, phosphorus, sodium, iron and zinc content of some of the samples. The predominant mineral for the *azama* samples was calcium followed by magnesium and potassium respectively. Iron, sodium and zinc were also detected. It was observed that sodium content was significantly higher ($p<0.05$) in samples AN (1.02mg/100g) and AS (1.01mg/100g) and this could be due to addition of salt to the samples by the producers during processing. The mineral analysis in this study indicated that *azama* is a good source of calcium, magnesium and potassium. Houston *et al*., [10] opined that increased intake of dietary calcium, magnesium and potassium have been reported to lower blood pressure in people suffering from hypertension. Potassium is an abundant mineral in agricultural products in Nigeria [27]. Potassium is required for maintaining body fluid and electrolyte balance and cell integrity. Mineral elements such as iron, magnesium and calcium act as catalyst for enzymes during normal metabolic process. Calcium is important for bone health and iron is needed for prevention of anaemia.

Table 2: Mineral content of *azama* samples (mg/100g).

Samples	Magnesium	Calcium	Potassium	Phosphorus	Sodium	Iron	Zinc
AS	40.20^{d}	225.00^{c}	200.62^{e}	35.50^{a}	33.00^{a}	10.10^{e}	4.22^{b}
AN	40.10^{g}	223.50^{e}	201.10^{a}	36.10^{a}	30.15^{e}	10.00^{g}	4.10^{e}
BD	41.10^{a}	225.10^{b}	200.50^{f}	36.00^{a}	30.00^{f}	10.02^{f}	4.00^{f}
OH	40.12^{f}	225.00^{c}	201.01^{c}	35.65^{a}	32.12^{b}	10.27^{b}	4.25^{a}
US	40.15^{e}	223.80^{d}	201.05^{b}	35.68^{a}	32.10^{c}	10.20^{d}	4.11^{d}
UN	41.00^{b}	223.00^{f}	200.68^{d}	36.00^{a}	30.50^{d}	10.33^{a}	4.15^{c}
IK	40.77^{c}	225.00^{a}	200.50^{f}	36.12^{a}	30.50^{d}	10.25^{c}	4.00^{f}
LSD	0.00154	0.00204	0.00202	0.26807	0.00205	0.00175	0.00167

Mean value in the same column with same letters are not significantly different ($p<0.05$)

Key: AS= Aba South sample, AN= Aba North sample, BD= Bende sample, OH= Ohafia sample, US= Umuahia South sample, UN= Umuahia North sample and IK= Ikwuano sample

C. Anti-nutritional factors content of azama samples

The anti-nutritional factors in the azama samples are presented in Table 3. There were significant variations in the tannin, phytate, saponin, hydrogen cyanide, alkaloid, oxalate and trypsin inhibitor values of some of the samples and they ranged from 3.00 – 3.85mg/100g, 6.00 – 6.62mg/100g, 0.50 – 1.05mg/100g, 0.10 – 0.18mg/100g, 5.10 – 6.20mg/100g, 0.00 – 3.01mg/100g and 0.09 – 1.16 IU/mg respectively. The differences observed in the anti-nutrient content of the samples may be as a result of differences in variety of samples used and/or differences in toasting temperatures and times. Also the differences may be due to the mode of dehulling employed. The low levels of phytate and tannin recorded indicate the possibility of higher nutrient bioavailability of the samples. Phytate has been

reported to form complexes with protein and minerals [5] and make them unavailable and tannins have been reported to adversely affect protein digestibility [32]. Therefore the low values recorded show that they are safe for human consumption. Also, the value recorded in this study for hydrogen cyanide is lower than the standard acceptable limit for HCN which is 25.30ppm in human being as reported by Onimawo and Egbekun [28]. Furthermore, the low oxalate content recorded for the samples is advantageous since high oxalate content has been implicated to interfere with protein digestion [12]. Following the same trend of low values are the contents of trypsin inhibitors, saponin and alkaloids. Kumar [15] noted that many anti-nutritional factors are heat labile; therefore the toasting and dehulling processing treatments reduced these anti-nutrients in the African yam bean seeds.

Table 3: Anti-nutritional factors in Azama samples.

Samples	Tannin mg/100g	Phytate mg/100g	Saponin mg/100g	HCN mg/100g	Alkaloids mg/100g	Oxalate mg/100g	Trypsin inhibitor IU/mg
AS	3.00^{e}	6.20^{d}	0.50^{e}	0.10^{c}	5.60^{f}	1.00^{d}	0.09^{e}
AN	3.85^{e}	6.50^{b}	1.05^{a}	0.15^{b}	5.10^{g}	3.01^{e}	1.16^{a}
BD	3.00^{e}	6.00^{f}	0.55^{c}	0.10^{c}	6.00^{d}	0.00	0.10^{d}
OH	3.02^{c}	6.10^{e}	0.53^{d}	0.18^{a}	6.10^{c}	1.10^{c}	0.09^{e}
US	3.72^{b}	6.62^{a}	0.88^{b}	0.18^{a}	6.20^{a}	2.10^{b}	0.15^{b}
UN	3.01^{d}	6.21^{c}	0.50^{e}	0.10^{c}	6.11^{b}	1.00^{d}	0.11^{c}
IK	3.00^{e}	6.00^{f}	0.50^{e}	0.10^{c}	5.80^{e}	1.11^{c}	0.10^{d}
LSD	0.00189	0.00202	0.00215	0.00175	0.00195	0.00817	0.00158

Mean value in the same column with same letters are not significantly different ($p<0.05$)
Key: AS= Aba South sample, AN= Aba North sample, BD= Bende sample, OH= Ohafia sample, US= Umuahia South sample, UN= Umuahia North sample and IK= Ikwuano sample

D. Microbial counts of azama samples

The microbial counts of the *azama* samples are given in Table 4. There were significant differences ($p<0.05$) in the total bacterial count which ranged from 2.4 – $3.5x10^3$ cfu/g. The total fungal counts were also significantly different ($p<0.05$) and the values ranged between 1.3 – $1.8x10^3$ cfu/g. There were no coliforms detected in all the samples.

The different levels of bacteria and fungi present in the samples may be a reflection of the level of hygiene practiced by the producers and sellers. It can also be attributed to the different sources of raw materials and toasting temperatures and time regime differences. It could also be due to different storage and packaging materials used.

Table 4: Microbial counts of *azama* samples.

Samples	Total bacteria counts (CFU/g)	Total fungal counts (CFU/g)	Total coliform counts (CFU/g)
AS	2.4×10^{3g}	1.3×10^{3f}	ND
AN	2.6×10^{3f}	1.5×10^{3d}	ND
BD	3.2×10^{3b}	1.8×10^{3a}	ND
OH	3.5×10^{3a}	1.7×10^{3b}	ND
US	2.7×10^{3e}	1.4×10^{3e}	ND
UN	2.8×10^{3d}	1.6×10^{3c}	ND
IK	3.0×10^{3c}	1.8×10^{3a}	ND
LSD	0.00195	0.00207	-

Mean value in the same column with same letters are not significantly different ($p<0.05$)
Key: AS= Aba South sample, AN= Aba North sample, BD= Bende sample, OH= Ohafia sample, US= Umuahia South sample, UN= Umuahia North sample and IK= Ikwuano sample

E. Sensory analysis of azama samples

The result of the sensory analysis is presented in Table 5. There were significant variations ($p<0.05$) in the colour, aroma, taste, texture and overall acceptability of the samples. In terms of colour and texture, the sample UN (7.66 and 7.82) was rated highest whereas in terms of aroma, taste and overall acceptability, the sample BD (7.66, 7.75 and 7.63) was rated highest followed by the sample IK (7.59, 7.67 and 7.60) and the others. The differences in the score for colour, aroma and texture may be due to differences in toasting temperature and time regime. Also, the differences in taste may be as a result of the quantity of salt added since some producers add salt to enhance the taste. However, all the samples were accepted on all the parameters tested.

Table 5: Sensory analysis of *azama* samples.

Samples	Colour	Aroma	Taste	Texture	Overall acceptability
AS	7.26^{e}	7.38^{c}	7.30^{d}	7.30^{d}	7.32^{e}
AN	6.15^{f}	7.57^{b}	7.38^{d}	6.55^{f}	6.62^{f}
BD	7.28^{d}	7.66^{a}	7.75^{a}	7.30^{d}	7.63^{a}
OH	6.88^{e}	7.24^{e}	6.33^{e}	7.60^{c}	6.80^{c}
US	7.40^{c}	7.33^{d}	7.38^{d}	7.27^{a}	7.36^{d}
UN	7.66^{a}	7.21^{e}	7.40^{c}	7.82^{a}	7.48^{c}
IK	7.52^{b}	7.59^{b}	7.67^{b}	7.68^{b}	7.60^{b}
LSD	0.0011	0.0012	0.0010	0.0011	0.0010

Mean value within same column with different letters are significantly different ($p<0.05$)
Key: AS= Aba South sample, AN= Aba North sample, BD= Bende sample, OH= Ohafia sample, US= Umuahia South sample, UN= Umuahia North sample and IK= Ikwuano sample

IV. CONCLUSION

The results indicated that *azama* samples consumed in Abia State, Nigeria differ in their proximate composition, mineral contents, antinutrients content, microbial counts and sensory analysis. These differences may be attributed to the use of different varieties of the seed and varying quantity of ingredients, differences in toasting temperature and time and differences in hygienic practices of the producers and handlers. Efforts should be made to enlighten the populace on the nutritional benefits of *azama* in order to increase its consumption. Furthermore, the producers and sellers should be educated on the importance of sanitation in the handling of food products.

Future Scope: Mechanization of the processing of azama snacks, proper packaging in polyethylene packs and shelf life studies.

Conflict of Interest. We declare that we have no conflict of interest.

REFERENCES

[1]. Akubor, P.I. (2004). Protein contents, physical and sensory properties of Nigerian snack foods (cake, chin-chin and puff-puff) prepared from cowpea-wheat flour blends. International Journal of Food Science and Technology **3**9: 419-424.

[2]. Aletor, O. and Ojelabi, A. (2007). Comparative evaluation of nutritive and functional attributes of some traditional Nigerian snacks and oil seed cakes. *Pakistan Journal of Nutrition,* **6**: 99-103.

[3]. AOAC (1990). Official Methods of Analysis of Association of Official Analytical Chemists, (15th Edition). Washington D.C., USA.

[4]. AOAC (2005). The Official Methods of Analysis. (18th Edition). Association of Official Analytical Chemist. Washington D.C., U.S.A., PP.223-225.

[5]. Bishnoi, S. and Khetarpaul, N. (1994). Protein digestibility of vegetables and field peas (*Pisum sativum*): Varietal differences and effect of domestic processing and cooking methods. *Plant Foods for Human Nutrition*, **46**: 71-76.

[6]. Harbone, J.B. (1973). Phytochemical Methods: A Guide to Modern Technique of Plant Analysis. Chapman and Hall, New York, pp. 31-40.

[7]. Harrigan, W.F. and McCance, M.E. (1979). Laboratory Methods in Microbiology. Academic Press, New York.

[8]. Hassan, L.G. and Umar, K.J. (2004). Proximate and mineral composition of seeds and pulp of *Parkia biglobosa. Nigeria Journal of Basic and Applied Sciences,* **13**: 15-27.

[9]. Haugh, W. and Lantzsch, H.J. (1993). Sensitive method for determination of phytate in cereals and cereal product. *Plant Foods for Human Nutrition,* **44**: 261-266.

[10]. Houston, M.C., Karen, J. and Harper, M.S. (2008). Potassium, magnesium and calcium: Their role in both the cause and treatment of hypertension. *Journal of Clinical Hypertension,* **10**: 3-11.

[11]. Ihekoronye, A.I. and Ngoddy, P.O. (1985). Integrated Food Science and Technology for the Tropics. Macmillan Publishers Ltd., London and Basingstoke, pp. 274-279.

[12]. Ijeh, I.I., Ejike, C.E., Nkwonta, O.M. and Njoku, B.C. (2010). Effect of traditional processing techniques on the nutritional and phytochemical composition of African breadfruit (*Treculia Africana*) seeds. *Journal of Applied Science and Environmental Management,* **14**(4): 169-173.

[13]. Iwuoha, C.I. and Eke, O.S. (1996). Nigerian indigenous fermented foods: their traditional process operation, inherent problems, improvements and current status. *Food Research International*, **29**(5-6): 527-540.

[14]. James, C.S. (1995). Analytical Chemistry of Foods. Chapman and Hall: New York

[15]. Kumar, R. (1991). Anti-nutritional factors, the potential risks of toxicity and methods to alleviate them. In: Legume trees and other fodder trees as protein

sources for livestock. A. Speedy and P. Pugliese (eds). Proceedings of the FAO expert consultation held at Kuala Lumpur, Malaysia, October 1991, FAO Animal and Health Paper 102, FAO, Rome.
[16]. Lasekan, O.O. and Akintola, A.M. (2002). Production and nutritional evaluation of puffed soy-maize snack food. *Nigerian J. Tropical Agric.,* **3**: 270-275.
[17]. Michael, O.A., Dick, I.G. and Bibiana, D.I. (2013). Physicochemical and sensory evaluation of wheat bread supplemented with stabilized undefatted rice bran. *Food and Nutrition Science,* **4**: 43-48.
[18]. Moyib, O.K., Gbadegesin, M.A., Aina, O.O. and Odunola, A.O. (2008). Genetic variation within a collection of Nigerian accessions of African yam bean (*Sphenostylis stenocarpa*) revealed by RAPD primers. *African Journal of Biotechnology*, **7**(12): 1839-1846.
[19]. Nnam, N.M. (2002). Evaluation of complementary foods based on maize, soybean, pawpaw and mango flour blends. *Nigerian Journal of Nutritional Sciences,* **22**(23): 8-18.
[20]. NRC (1979). Tropical Legumes: Resources of the Future. Washington D.C.
[21]. NRC (2006). Lost Crops of Africa. Volume II: Vegetables. The National Academic Press. Washington D.C.
[22]. Nwosu, J.N. (2010). The effects of steeping with chemicals (trona and alum) on the functional properties and proximate composition of asparagus bean (*Vigna sesquipedalis*). *Nature and Science,* **8**(9): 111-120.
[23]. Obatolu, V.A., Fasoyiro, S.B. and Ogunsumi, L. (2001). Effect of processing on functional properties of yam beans (*Sphenostylis stenocarpa*). *Food Sci. Technol. Res.,* **7**(4): 319-322.
[24]. Ogazi, P.O. and Jones, M.C. (1990). Pilot-scale dehydration of plantain pulp for flour production using cabinet dryer. *Nigeria food journal,* **8**: 74-77.
[25]. Ogbo, A.I. (2002). Nutritional Values of Some Tropical Foods. Computer Edge Publishers Ltd., Enugu, Nigeria. Pp. 49-56.
[26]. Oke, O.V.,Oluwole,O.B., Adeyoju, O.A., Ajayi, T.O., Ozumba, A.U. and Solomon, H.M. (1995). Effects of packaging on moisture content and organoleptic qualities of coconut snack during storage. *Nigerian Food Journal,* **18**(2): 13-15.
[27]. Olaofe, O. and Sanni, C.O. (1988). Mineral contents of agricultural products. *Food Chemistry*, **30**: 73-77.
[28]. Onimawo, A.I. and Egbekun, K.M. (1998). Comprehensive Food Science and Nutrition. Ambik Press ltd. Benin, pp. 49-51.
[29]. Onwuka, G.I. (2005). Food Analysis and Instrumentation, Theory and Practice. Naphthali Print, Lagos, pp. 114-131.
[30]. Pearson, D. (1976). The Chemical Analysis of Foods. (7th Edition). Churchill Livingstone, Edinburgh, London.
[31]. Reber, E.F., Eboh, L., Aladeselu, A., Brown, W.A. and Marshall, D.D. (1983). Development of high-protein low-cost Nigerian foods. *Journal of Food Science*, **48**(1): 1365-2621.
[32]. Reed, J.D., Soller, H. and Woodward, A. (1990). Fodder tree and straw diets for sheep: Intake, growth, digestibility and the effect of phenolics on nutrient utilization. *Animal Feed Science and Technology*, **30**: 39-50.
[33]. Saka, J.O., Ajibade, S.R., Adeniyan, O.N., Olowoyo, R.B. and Ogunbodede, B.A. (2004). Survey of under-utilized grain production systems in the Southwest Agricultural Zone of Nigeria. *Agric. Food J.,* **6**: 93-108.
[34]. SON (2007). Nigerian Industrial Standards for Pastes. Standard Organization of Nigeria. ICS: 664, 68, pp. 1-8.
[35]. Udoh, E.J. and Ogunwale, J.A. (1986). Laboratory Manual for the Analysis of Soil, Plant and Water Samples. (2nd Edition). Macmillan Publishers, London, pp.67-137.
[36]. Uguru, M.I. and Madukaife, S.O. (2001). Studies on the variability in agronomic and nutritive characteristics of African yam bean (*Sphenostylis stenocarpa*). *J. Plant Pro. Res.,* **6**: 10-15.