

# **PROCEDURE AND INDISPENSABLE INGREDIENTS IN THE PRODUCTION OF “OKPA” A READY TO EAT FOOD PRODUCT: A SURVEY**

**Nzelu, I. C**

Food Technology Department, Federal Polytechnic Oko  
Email: [ijforjcml@yahoo.com](mailto:ijforjcml@yahoo.com)

## **ABSTRACT**

*The processing technique and the indispensable ingredients used in the processing of “Okpa” food product (OFP), a gelled Nigerian food product made from Bambara groundnut seeds’ flour was surveyed. Answer from a 37 point questionnaire returned from 189 respondents and analyzed revealed the following: The recipe was: one painter measure 2.5kg-3kg BGN Flour, one liter of palm oil, about six liters of potable water, 5-10g of salt. The use of ground pepper was optional. Four steps were involved in the production of “okpa” food product from bambara groundnut (BGN) seeds. Step 1, was the production of flour by milling the cleaned bambara groundnut seeds into flour. The second step was the thorough mixing of the flour with three indispensable ingredients namely: water, palm oil, pepper and salt to produce the slurry/paste. In step three, this slurry was packaged into retail unit packs after thorough mixing, and was dropped into a pot containing boiling water and, on a steady heat source, for cooking to take place. Cooking (the fourth stage) was allowed for about 3hrs for the slurry/paste to fully gel or get cooked. At the end of the cooking period, cooling of the retail units was allowed. However, the commercial producers enclosed the hot retail packs in available improvised insulators for the “Okpa” food product, so as to retain its*

*heat for the sales' period.*

**Keywords:** *BGN flour, indispensable ingredients, packaging, cooking, "Okpa" Food Product*

## **INTRODUCTION**

Bambara groundnut (BGN) is one of the underutilized tropical dry beans (Bhat and Karim, 2009; Bamishaiye *et al*, 2011). It is an indigenous tropical crop grown widely across the African continent and is the third important grain legume after groundnut and cowpea (Dambaba *et al*, 2016). It has the potential to improve nutrition, boost food security, promote rural development and support sustainable landcare (Ojimekwe, 2009). Like most common beans and pulses, it is a diverse resource of high nutritional value with about 19% protein, 63% Carbohydrate, 6.5% Oil, then fiber, vitamins and minerals (Atiku *et al*, 2004). It is used for subsistence agriculture, and it is generally grown by women, and referred to as "poor man's meat". One of the major constraints to bambara groundnut seeds' consumption is its' hard to cook (HTC) defects (Enwere, 1998). This is due to the long cooking time through which scarce fuel (especially fire wood) reserve is consumed in vulnerable communities. This probably led to the act of reducing the BGN seeds to flour before usage of same for "Okpa" food product (OFP), a gelled Nigerian food product. The major way of consuming BGN seed is through the production of "Okpa" food product. "Okpa" is popular in South Eastern States in Nigeria especially in Enugu State. It is a ready to eat food product used for snacks and dinner and has become of commercial importance. "Okpa" food product is known in most states of Nigeria Including Lagos State. Onuora, (2011) reported of its production in many homes of people in the middle belt and Eastern parts of Nigeria, and that the product is marketed in motor parks and along major roads between the East and the Northern routes."Okpa food product" production is often regarded as an enterprise for the females. However, standard "Okpa" is not available in the market because traditionally prepared foods e.g, "akara", "moin moin", "Okpa" etc, are influenced by cultural values

which in turn affects the quality of the end product. The other common form for the consumption of BGN, is by boiling the freshly harvested and washed pods for consumption and the emerging roasting of the seeds and, the consumption of the same, with or without palm kernel nuts (Nzelu, 2014a). Despite its nutritional and economic importance, no industrial use of the crop is made anywhere in Nigeria. Due to scarce information in literature on the utilization patterns of this edible BGN crop or its food product, this survey was carried out. Information from this work will benefit users and entrepreneurs on the crop or products. “Okpa” food product plays an important role in the diet of all classes of human beings from nursery school children to the working class people and even to high energy requiring labourers in most Igbo land communities.

#### **Materials and Methods**

A "37 points" questionnaire was administered and about 189 fully answered questionnaires were collected from "Okpa food product" producers. The “Okpa food product” producers (who also were the respondents) were selected from twelve areas in both Enugu and Anambra State. The areas were Ogbete main market, Kenyatta market, (both in Enugu); Amechi town, Amokwe town, Naachi town, Four Corner Junction market and Oji Triangle market, Oji all in Enugu State. Then Nkwo Oraifite, Eke Oko market, Eke Ekwulobia market, Afo Ufuma market, Nkwo Umunze market, Federal Polytechnic Oko Community market all in Anambra State. Producers’ consent was obtained by explaining the purpose of the study, assuring them that the information obtained was for research purpose only. The questionnaire was divided into two sections. Section A: part of the questionnaire covered questions like the sex, age groups and the age of the “Okpa” production enterprise exercise. Section B covered such questions as the known Bambara Groundnut Nut (BGN) varieties, the varieties of choice and why, the main ingredients, recipe and spices, any use of leafy edible vegetables and which, sequence of ingredients’ addition during the mixing before packaging for cooking, types of packaging

materials of use, procedure and duration of cooking, means of determining the adequacy of cooking, how long the cooked product would last before spoilage and comparative estimation of the gastrointestinal (GI) resident time of "Okpa" food product, with cowpea's moi-moi, "akara" and beans' pottage, how regularly consumers consumed "Okpa" food product, and how else BGN seeds could be consumed?

### RESULTS AND DISCUSSION

The Results obtained from the survey were summarized on Table 4.1.

*Table 4.1: Production procedure and qualities of okpa*

Parameters assayed	Results Obtained			
Periods of Okpa Food Production	1-10yrs <b>Frequency 81:</b> 42.86%	11-20yrs <b>Frequency 48:</b> 25.40%	21-30yrs <b>Frequency 36:</b> 19.05%	1-40yrs <b>Frequency 24:</b> 12.70%
Types of BGN Seeds known	<p>Qualities</p> <p>(1) White or cream coloured – 95.23% usage: (i) Enhanced water absorption during mixing</p> <p>BGN Seeds/flour coloured Okpa Food Product</p> <p>(ii) Brighter orange</p> <p>(iii) Better taste and quality</p> <p>(iv) Economical with palm oil</p> <p>(v) Absence of spots in both flour and food product</p> <p>(vi) The white/cream variety was more readily available in the Market</p> <p>(vii) onset of degeneration or spoilage was easily noticed due to its</p>			

***Nzelu IC – Procedure and ingredients for ‘okpa’ food production***

	clear colour	
	(2) Red BGN	
	(3) Brown BGN	
	(4) Black BGN	(i) Has a bitter taste and is believed to be medicinal (ii) Consumes too much oil i.e. uneconomical with palm oil
Recipe per 2.5-3kg flour	Traditional Recipe	
	Palm oil .....1L Water .....5-6L Salt.....5-10g Pepper (fresh or dry) by choice Adherents = 85.71% Frequency = 162	Modern Recipe Palm oil .....1L Water .....5-6L Salt.....5-10g Other additions includes: Crayfish, Onions, Food colour, Leafy vegetables, Maggi cubes and Spices Adherents =14.29%, Frequency = 27
BGN Seeds of Choice	White/Cream	95.23% -Frequency 180: adopted the white/cream BGN seeds
	Other seeds	4.77% -Frequency 9: managed non-white BGN seeds in the absence of the white BGN seeds
Measured ingredients' addition sequence to the mixing bowl.	(i) BGN Flour → palm oil/palm oil sauce→ mixing→ water→ mixing other ingredients→ thorough mixing→ wrapping→ cooking (ii) BGN Flour → water/palm oil sauce→ mixing→ measured ingredients→ thorough mixing→ wrapping→ cooking (iii) Ingredients→ water/palm oil sauce → BGN Flour → thorough mixing→ wrapping→ cooking (iv) Others 90.48% (frequency:17.1) adopted option 1 2.66% (frequency:5) adopted option 2 2.66% (frequency:5) adopted option 3 4.20% (frequency:8) adopted option 4	
Types of leafy vegetables	Nil	Fluted pumpkin leaves ( <i>T. occidentalis</i> ) (Ugu Leaves)  <i>A. chlorostachys</i> (Spinach leaves) <i>V. amygdalina</i> (Bitterleaf leaves)

		O. <i>viridis</i> (Scent leaves) S. <i>macrocarpum</i> (Añara leaves)
Type of animal products added	Nil	Crayfish flour Boiled egg
Packaging material	Wilted or dry Banana leaves and cellophane paper or cellophane paper alone	Wilted or dry banana leaves and cellophane paper or cellophane paper alone
Period of cooking/Boiling (Standard)	1-3hours	1-3hrs
Perceived "okpa" flavour	Peculiar Beany flavour	Mixed flavour void of beany flavour
*Discovery	Colour additive	Colour additive

\* *Basic dye branded carbolic brown*

The results from this survey showed that "Okpa" food product producers were females including young school leavers, young housewives and elderly women. The age groups of the respondents were 15.873% (for 21-30yrs age group), 33.33% (31-40yrs age group), 30.16% (41-50yrs age group), 17.46% (51-60yrs age group) and 3.17% (for ≥ 60yrs age group). In the issue of the duration of the enterprise, the periods they had processed the "Okpa" food product ranged between 1 to over 42yrs.

All through the (2012-2013) survey period, only one male called "Okpa man" was observed in Obiagu area Enugu urban. "Okpa" food product production is therefore a means of job creation for both the youths and the elderly. It is an entrepreneurial outlet which is ripe for clusters' formation towards industrialization.

**1. How long have you processed Okpa food product?**

From the respondents, the processors had been in the “okpa” business for a period of between 1 and 42 years. 42.86% fell in to the class (1-10yrs); 25.40% belonged to the (11-20yrs), 19.05% fell into the (21-30yrs) as Okpa food product (OFP) processors while 12.70% had processed the product for between 31 and 40 years). Two women (in their 60's) had processed the product for between 40 years and 42 years respectively. It may be safe to conclude that “Okpa” food product production had been in existence for up to 50yrs and as such it is old enough to be industrialized with improvement in the techniques or processes. The “Okpa” food product has come to stay. No incident of food poisoning alarms from the “Okpa” is known.

All the processors learnt the technology of OFP processing transferred from their mothers or relations. All the processors testified to multiple benefits from the business to include self-employment, self-maintenance, and ability to feed the family as well as to sponsor children at school for their education. Two women expressed their joys as to their ability to have built family houses through the profit made from "okpa food product" production.

**2. How Many Okpa seed types (varieties) do you know?**

Four Bambara groundnut seeds varieties were known to the processors according to their seed-colour accessions. These were white (or cream), red, brown and black Okpa-seed varieties. This was in agreement with some researchers’ reports. Many researchers have attested to the availability of four to six (4-6) varieties based on seed colours. Ojimekwe (2009) reported of BGN seeds with seed testa colours of maroon red, black, russet brown and cream, all of which had white helium. Aykroyd and Doughty (1982) reported of six varieties. Massawe *et al* (2005) have reported that a large number of BGN landraces have been preserved by the small-scale farmers. However genetic diversity of the BGN seeds should be exploited to improve

yield through increased production. Five land races of BGN with distinct colour differences namely, cream black eye, cream white eye, brown, maroon and black were studied by Nti (2009)

### **3. Which type (variety) of BGN seeds do you use and why?**

Cultivar selection was one of the factors that influenced utilization. 95.23% of the respondents/processors adopted the white/cream coloured BGN seeds' flour as their raw material for the production of OFP as against the use of other coloured BGN seeds' flour. Their reasons for that choice included the following: (i) The white/cream variety of BGN used for OFP was economical in the use of palm oil or palm fruit sauce. (ii) the resultant colour of the slurry/OFP turned bright orange/yellow colour; (iii) the BGN flour had the ability to absorb reasonable amount of water during mixing (thus enhancing yield and profit), (iv) the OFP had better taste and quality as well as higher preference by customers. (v) The left over OFP possessed non-degenerating taste. The white/cream BGN Flour required less ingredients, preserved better, consumed less palm oil. (vi). The white/cream BGN seeds were more readily available than other BGN varieties. Again some of the processors could detect the onset of spoilage due to clear colour of the BGN (both for seed, flour and food product). The white/cream BGN seeds' flour did not contain black spots consequently; the flours would never have spots. The 4.77% respondents could manage various other BGN varieties in the absence of the white/cream BGN seeds. According to Hillocks *et al* (2012), the cream or the white seeded BGN are more sought after in Ghana

### **4. What Recipe and spices do you use?**

The utilization of "Okpa" the gelled Nigeria food product has been as old as anyone could remember (particularly in the present day Enugu state, especially in Nkanu and Udi Local Government Areas). Its production had been based on the traditional recipe and the use of the indispensable ingredients namely: the flour, palm oil, water, pepper and salt were generally mixed into orange coloured slurry or paste due

### *Nzelu IC – Procedure and ingredients for 'okpa' food production*

---

to the palm oil. The slurry was then wrapped with wilted banana or plantain leaves, and the numerous wraps dropped into a pot containing hot water and then, the wraps would be cooked overnight. The researcher discovered the following: (a) The recipe could be summarized as: 1 painter a common volume measure which amounts to (2.50-3.0kg) BGN flour to 1 lucozade bottle (1 liter) of palm oil, five to six liters of water and 5-10g of salt. Fresh or ground pepper was added according to choice (through interviews). (b) That all who used cellophane paper, with or without wilted banana or plantain leaves sneaked in some food colour into the slurry/paste, for the purpose of yielding deep orange colour in the cooked OFP product.

With the advent of exotic flavour enhancers and other food additives, as well as consumer's demands, some processors would deviate from that old traditional recipe to what they termed "modern recipe". In the modern recipe, items like ground crayfish, non BGN flour, onions, maggi cubes etc were added.

About 85.71% of the respondent/processors maintained the traditional recipe (BGN Flour, water, palm oil, pepper (optional) and salt), while 14.29% of the respondents are advancing to the modern recipes. The adherents to the traditional recipe also complained that the use of crayfish marred the "okpa" beany taste while onions resulted to accelerate souring of OFP. Compliance to the traditional recipe yielded the peculiar beany flavor or aroma (taste) peculiar to OFP, while the non-common aroma of OFP was regarded as adulteration, resulting (as they claimed), to a moi-moi type of taste. "Moi-moi" food product is made from cowpea while "Okpa" is made from Bambara groundnut seeds' flour. The survey notably revealed that "Okpa" food product processors added a colour additive which yielded a deep orange color to their products. The present day "Okpa" colors are based on that food color sneaked in and not on palm oil alone.

### **5. Which leafy vegetables do you use**

It is a known fact now, that some “Okpa” processors added leafy and non-leafy vegetables as well as colour additive to the “Okpa” food product. The preceding paragraph revealed that 14.29% of the respondents in this survey were practicing the “modern recipe” advances. Within the past decade, “Okpa” processors have added some leafy vegetables to their products. While some did this on customer's demand (as they claimed), others did so to attract more sales. Among the leaves added were fluted pumpkin leaves (*ugu*), spinach (green), bitter leaf (*onugbu*), *Ocimum viridis* (scent leaves) *Solanum sp* leaf (*añara*), fermented *Pentaclethra macrophylla* (*ukpaka* slices) and boiled whole egg(s) or combinations of these additives. While the above additives would enhance the total plant protein, ash and fibre some could enhance the anti-nutrients and protein quality of the product. Again additional sand may be introduced to the "Okpa" food product. 33.33% of the respondents used “Ugu” leaves, 26.94% of the respondent's added spinach (green). The addition of leaves was practiced by all the age groups for use in *special “Okpa”* (as they referred to it). Some of the respondents suggested the use of either bitter leaf, or boiled egg or “ukpaka slices”. The adherents to the original traditional pattern (39.68%) avoided the addition of edible leafy vegetable. They adhered to the use of the BGN flour, palm oil, water, pepper (optional) and salt. It may be safe to conclude that the present day “Okpa” processors are deviating from the traditional recipe of just the use of BGN flour, water, palm oil and salt, to the use of various other additives. Since the consumers have neither complained nor strongly rejected the products, they are concurring to these changes. Besides, there are no regulations on these products yet. This is the more reason why the producers should form “clusters”, agree on what they should use for industrializing this “Okpa” food products. Products could be stabilized and exportable. However, Adumanya *et al* (2012) have reported on the use of the edible leaves of *Telfeiria occidentales* and *Ocimum viridis* in the production of “Okpa” food product. From the researcher's additional investigation, it could be

concluded that over 90% of the “Okpa” processors now use varying quantities of colour additive, with palm oil or palm fruit sauce. It was only in Orumba (north and south) Local Government Areas that the traditional method of just the use of BGN flour, water, pepper, oil, or palm fruit sauce, and salt was being maintained. This was probably for the sake of maximizing profit since extra money would be spent on some added additives with little or no enhancement in volume. One can interpret these changes as “consumers” or processor choice/desire for some changes in the quality of OFP. In the questionnaire, the respondents (processors) were encouraged to suggest which of the areas (the mixing process, the cooking, preservation, general quality or others) of the OFP processing and production that required improvement and only 11.11% (21 respondents) suggested that the mixing stage needed attention. Many housewives and other beginners produced Okpa Food Product that had textural segments and curdled slumps in the food product. This could be part of the reasons that informed the respond form the 21 respondents. Nothing was said about the other stages or steps. The processors reported that curdles in the paste could be removed with sieves while in the slurry form and by implication this critical stage would partially determine the success of the final product.

**6. State the sequence of ingredients’ addition during the mixing and before wrapping.**

The sequence options were as follows: (1) to the measured BGN flour was added palm oil, and mixed. Then the measured hot water/cold water was added and mixed. Lastly the other ingredients were added and mixed thoroughly before wrapping and cooking; (2) to Okpa flour, was added measured hot/cold palm fruit sauce and mixed. Lastly, the other measured ingredients were added and thoroughly mixed; (3) all ingredients were ground separately, and mixed with hot water and palm oil, then the Okpa flour was added. Then everything was mixed homogenously through thorough stirring; (4) others. Efforts must be made to avoid lumps in the slurry. Some producers would use potable

and circular shaped sieve to remove the lumps, break the lumps and add the smoothened portion back to the mixture.

About 90.48% of the processors practiced option 1. About 2.66% respondents practiced each of options 2 and 3, while 4.20% of the respondents practiced option 4. Some of those that chose option four agreed that they would add palm oil and hot water, or palm sauce to the Okpa flour, and mix until a homogenous mixture was obtained, then they would add the other ingredients and stir thoroughly. The use of palm oil was mostly practiced in Enugu State while the use of palm fruit sauce as oil sauce, was practiced more by the Orumba (North and South) LGAs OFP processors, and by the Oji River area OFP processors; however Oji River area processors were guilty of sneaking in the food colour.

#### **7. What packaging material type do you use?**

Generally the Okpa food product processors used either wilted plantain or banana plant leaves of which Murevanhema and Jideani (2013) attested to. However, processors have advanced to the use of these leaves in combination with polythene material or, the wilted plantain/banana plant leaves alone. The slurry/mixture was first enclosed in the polythene and finally wrapped with the plantain/banana plant leaves. On the other hand most OFP processors in Orumba north and south LGAs in Anambra State and, Oji river LGA in Enugu State used only the wilted plantain/banana plant leaves, for the packaging of the OFP slurry where they generally used palm fruit sauce as oil source. This variation in the issue of oil source (whether palm oil or palm fruit sauce), and the packaging material should be standardized.

As for the length of time of cooking, all the respondents agreed that the cooking time was overnight. Either the cooking lasted from 8pm till about 10:00pm, and then continued from about 4:00am till about 6:00am when the product would be carried to motor parks and other sales' centers. Alternatively, the producers cooked from about 3:00am till about 6:00am when the processors would rush out with their

products to supply traveler with very hot OFP for breakfast. Laboratory experiments and the results of the pasting properties analysis of the Bambara groundnut seed’s flour confirm that Okpa” food product gels sufficiently with 45mins to 60minutes steaming, Adumanya *et al* 2012 and Nzelu 2014. Thus their effective cooking time is about 3 hours. In answering the question on the storage period, processors agreed that every left-over for each day’s sales must be re-heated by the evening of same day. However if not re-heated within the next 24hours, the product might become slimy.

In comparing the gastrointestinal (GI) resident time of Okpa, with cowpea’s moi-moi, akara and beans pottage, 92.0% of the respondents agreed that Okpa was heavier in the body than the cowpea’s food product The other 8.0% of the respondents did not adopt any sequence when comparing “Okpa” with the other cowpea’s food products as per their GI resident time. The report of Onimwawo *et al* (2007), agreed with the response of the 92% of the respondents. Onimwawo *et al* (2007), reported the average glycemic index of “Okpa” food product as 38.33 while that of moi-moi from cowpea seeds had a GI of 77.94. Also Awaisheh *et al* (2005) reported that legumes have shown to have low glycemic index, hypocholesterolemic effect, breast cancer prevention and health benefits with respect to cardiovascular diseases and bone health. Hawkers could be seen selling boiled BGN seeds (within their pods).

In answering the question on what ways or dishes the respondents additionally consumed the BGN meals, many could not keep good record of how regularly they consumed OFP weekly. The striking thing was that many of the respondents did not know any other way through which the BGN seeds could be consumed. The respondents knew little or nothing about boiled BGN (in pods), or BGN flour prepared into semolina-like product, or BGN seeds cooked like beans (Cowpea) pottage, neither did they know about BGN seed or BGN flour used in any other form (roasted or otherwise). However, some respondents from Udi LGA, Enugu State, knew a little about roasted BGN seed eaten with palm kernel (as compliment); some respondents from Isi-

Uzo LGA, Enugu State, agreed that BGN seeds was used for “Akara” production or used for the production of a pasted food product such as semolina. In the study of Atoyebi *et al* (2017), 15 panelists and respondents, representing employees of the National Centre for Genetic Resources and Biotechnology, Moore-Plantation, Ibadan, Nigeria scored the looks and the taste of Bambara groundnut cooked pottage with an average of 58.3% and 58.2% respectively while similar parameters in Okpa food product were scored 64.27% and 71.24% respectively, during that sensory evaluation exercise in their company/institution. By implication, BGN pottage is not a commonly known food product. Accordingly to Uvere *et al* (1999), the bases of acceptability of Okpa Food Product include taste, firmness of the product and colour due to palm oil. Nzelu (2014)<sup>b</sup>, Siddiq and Uebersax (2014), Uvere *et al* (1999) and Hillocks *et al* (2011) reported of roasted BGN with or without palm kernel compliments as a veritable processing method used to manipulate both nutritional and sensory quality of Bambara nut seeds. Enhanced use of BGN seeds could be brought about through sensitization processes of some sorts. Hillocks *et al* (2012) suggested that compared to groundnut and some other legumes, there should be “promotion” to encourage commercial exploitation of Bambara groundnut (BGN).

## **CONCLUSION**

The results of the survey revealed that “Okpa” Food Product (OFP) process had been in existence for upwards of four decades in the eastern region of Nigeria. OFP had been a product of four major ingredients namely; Bambara groundnut seeds’ flour, water, palm oil (or palm fruit sauce), and salt. For commercial purposes, the BGN flour is generally produced from the white/cream BGN seeds, because of its advantages over other BGN seeds varieties. The use of pepper is optional. The original wrapping paper was wilted plantain/banana leaves. However, the producers have advanced to the use of cellophane paper alone, a combination of plantain/banana leaf and cellophane paper while the use of only plantain/banana leaf alone is also being

practiced. Other advances include the addition of food colour to enhance customer perception, (which may be considered fraudulent until otherwise proved to be safe), and the addition of sliced edible leaves such as fluted pumpkin, spinach/green, bitter leaves, “scent” leaves and añara (*Solannium sp*) to the “Okpa” Food Product for the enhanced variations and nutrition. Fermented *Pentaclethra macrophylla* slices and boiled whole eggs are also being added for enhanced nutritional purposes and for enhanced economic gains. The production of the product was carried out mainly by females. The product was packaged with wilted plantain/banana, with or without first enclosing in a cellophane paper. The product got slimy after 24hours storage at ambient conditions. It is therefore necessary to standardize the production process and to design appropriate packaging for the product, while the coloured additive should be reviewed for health purposes and certification by the relevant bodies

#### **REFERENCES**

- Adumanya, O.C., Uwakwe, A.A., Onuoha, S.C., Odeghe, O.B., Obi-Adumanya, G.A. and Nwachukwu, P.C. (2012). Proximate analysis and sensory evaluation of “Okpa” prepared with fluted pumpkin and scent leaves. Canadian Journal on Scientific and Industrial Research, 3 (4): 174-178.
- Atiku, A.A., Avaiara, N.A. and Haque, M.A. (2004). Performance evaluation of a bambara groundnut sheller. Agric. Eng.: the CIGR J. Sc. Res. Develop. P.04002, VI July.
- Aykroid, N.R., Doughty, J. and Walker, A. (1982). Food and Agriculture Organization (FAO) of the United Nations, Rome.
- Bamishaiye, J.A., Adegbola, J.A. and Bamishaiye, E.I. (2011), Bambara Groundnut: An underutilized nut in Africa. Advances in Agricultural Biotechnology 1. [www.woaj.org/AAB](http://www.woaj.org/AAB). 60-72.
- Bhat, R. and Karim, A.A. (2009). Exploring the Nutritional potential of wild and underutilized legumes. Comparative Reviews in Food Science and Food Safety, 305-331.
- Danbaba, N., Nkama, I., Badau, M.H. and Ndindeng, A.S (2016) Development, Nutritional Evaluation and Optimization of Instant

- Weaning Porridge from Broken Rice Fractions and Bambara Groundnut (*Vigna subterranean L Verdc*) Blends, *Nig Food Journal* 34: 116-132.
- Enwere, N.J. (1998). *Foods of Plant Origin*. Afro-Orbis Publications, Nsukka.
- Massawe, F.J., Mwale, S.S., Azam-Ali, S.N. and Roberts J.A (2005) Breeding in Bambara Groundnut (*Vigna subterranean (L) Verdc*): Strategic considerations. *African Journal of Biotechnology*, 4(6): 463-471.
- Nzelu, I.C. (2014)<sup>a</sup>. Some Nutrients and Anti-nutrients properties of commercially roasted Bambara groundnut (*Vigna subterranean*). *Journal of Science and Technology*, 20: 80-87
- Nzelu, I.C. (2014)<sup>b</sup>. Production and quality evaluation of “Okpa”, A Gelled Nigerian Food product from Bambara Groundnut (*Vigna subterranean (L) Verdc*): Seed flour. A Ph.D Thesis submitted to Enugu State University of Technology.
- Ojmelukwe, P.C. (2009). Sourcing and processing of legumes in Onwughalu, P.A, Obasi, S.C. and Ukpabi, J.U. (2009) Editors. *Nigerian Agro Raw Materials Development*, Vol. 1: Some Industrial Crops and Salient Issues. Raw Materials Research and Development Council.
- Onimawo, I.A., Ijeh, I., Ukoha, U. and Nwachukwu, G.T. (2007). Determination of the glycemic index of steamed cakes using two different legumes bambara nut (*Vigna subterranean*) and cowpea (*Vigna unguiculata*). *African journal of Biochemistry Research*, 1 (7): 142-147.
- Onuorah, C.E. (2011). *Some indigenous Nigeria Food and Drinks: Methods of Preparations and suggestions for improving their quality and shelf life*. Published by Naphtali Prints Nig. Ltd, Pp 72.