Production and Organoleptic Attributes of *Ogiri-Ahuekere* Produced from Groundnut (*Arachis hypogaea* Linn) Seeds

Chukwu, M. N., Odom, T. C., & Nwogu, O.
Department of Food Science and Technology,
mchukwu30@yahoo.com

Nwokocha, N. J.
Dept. of Science Laboratory Technology,

Ndulaka, J. C.
Dept of Chemistry/Biochemistry,
Abia State Polytechnic,
Aba

Kabuo, N. O., & Onyeka, E. U.
Department of Food Science & Technology,
Federal University of Technology,
Owerri

Abstract
Production and evaluation of ogiri-ahuekere- a fermented groundnut (Arachis hypogaea Linn) seed condiment were studied. The groundnut seeds were sundried, dehulled and boiled for 8 hours. The cooked groundnut cotyledons were ground into a paste and wrapped in small portions (30g) with blanched plantain leaves. The wrapped samples were fermented anaerobically in an air-tight container for 1–10 days while the unfermented cooked groundnut paste was used as a control. The samples were dried in the oven at 50^{o}C-70^{o}C. The effects of fermentation time (day) on the organoleptic characteristics of ogiri-ahuekere samples were evaluated. Statistical analyses of the data were carried out using ANOVA method with the application of SPSS Version 20. The significant difference between the mean values was determined by Turkey's test at 95% level of confidence. The mean overall acceptability of soups prepared with ogiri-ahuekere samples were as follows: unfermented ahuekere sample had approximately 5.0 (neither like nor dislike); 1-3 day(s) samples had approximately 4.0 (dislike slightly); 4 and 5 days samples had 6.0 (like slightly); 6 and 7 days samples had approximately 7.0 (like moderately) and 8-10 days samples had approximately 8.0 (like very much). This showed that increase in the fermentation time improved the organoleptic properties (quality) of the ogiri-ahuekere samples.

***Key Words**: Ogiri-ahuekere, groundnut, organoleptic attributes, fermentation time, condiments.*

Introduction

Fermentation is one of the oldest and most economical methods of producing and preserving foods in developing countries (Achi, 2005). Fermentation remains of interest since they do not require refrigeration during distribution and storage (David and Aderibigbe, 2010).Fermentation is an energy yielding metabolic process which involves the decomposition of substrate in the anaerobic condition. Members of the fermenting organisms are important; for example, *Bacillus spp* in *ogiri* preparation. Some of microorganisms could

be proteolytic in their actions while some are lipolytic, others are amolytic. *Bacillus substilis* had been confirmed as being amylolytic in action according to Barber *et. al.* (1989). Fermented foods are essential part of diets for the world particularly in Africa (Odunfa, 1985b). Cereals, legumes and oil seeds are also used in production of fermented foods. Seeds of legumes may account for up to 80% of dietary protein and may be the source of protein for some low income earners. Their cooked forms are eaten as condiments to enhance the flavours of foods. With high content of protein, legume condiments can serve as a tasty meal or complement of sauces and soups, and can substitute for fish or meat (Odunfa, 1985a).

Condiments are edible substances which are added to impart a particular flavor, enhance its flavour, and in some cultures to complement the dish. Many condiments are packaged in single-sachets/packets e.g. mustard, ketchup etc (Odunfa, 1985a; Achi, 2005). They are prepared from both plant and animal materials using processes in which micro-organisms play active roles in the physical, nutritional and sensory modification of the starting materials. The local condiment is an oily paste with strong putrid ammonical odour made from fermented vegetable protein (Achi, 2005).

Groundnut is an important oil crop of Brazilian origin, is cultivated in tropical and warm temperate climates. The crop is grown usually as a component of a variety of crop mixtures including sorghum, millet, cowpea and maize. Groundnut is an important oil seed and cash crop accounting for more than one-third of the total oil seeds in the world (Sahayaraj and Martin, 2003). *Arachis hypogaea*, commonly referred to as groundnut, is known in India as *cheenabadam*, in Ghana as *dagomba* and in Nigeria as *ahuekere (Ibo), jada (Hausa)* (Musa *et. al*., 2010). Groundnuts are not only rich in proteins which are easily digestible and consequently, a higher biological value, but also rich in B-complex vitamins. It is an important item in several confectionery products and formulations in combination with cereals and pulses in developing countries.

Lack of adequate food preservation technology is a major problem contributing to food insecurity in Nigeria. The high cost and infrastructural requirement of many advanced food preservation methods such as canning, freezing, refrigeration and irradiation have reduced their applications in the developing countries. This implies that promoting fermentation technology in Nigeria is helping to promote food security (Enujiugha, 2000). In Nigeria, protein-energy malnutrition is common due to high cost of protein from animal source and method of processing. Protein isolate is produced at very high temperatures. The processing method does not get rid of some of the anti-nutrients in groundnuts but unfortunately many of the proteins are denatured in the process including lysine (Achi, 2005).

The main objective of this work is to produce *ogiri* condiments from groundnut seeds using a traditional fermentation method. This will be achieved specifically by fermenting the cooked groundnut seeds traditionally and sensory evaluation of the product (*ogiri*) will be analyzed in order to determine the consumers' acceptability. It is hoped that at the end of this study, postharvest losses of groundnut seeds will be reduced because it will be converted to fermented condiments (*ogiri-ahuekere*) hence promoting food security in Nigeria. The condiment produced could be used in reducing the protein-energy malnutrition among rural dwellers or low income earners.

Materials and Methods

Production of *Ogiri* from Raw Groundnut Seeds

Five hundred grams (500g) groundnut seeds were weighed and spread under the sun for easy

removal of the seed coats (hulls). The hulls were removed by rubbing the seeds in-between the palms in accordance with the method described by Wakshama *et. al.* (2010).

The cotyledons were boiled for eight (8) hours. After which the water was drained–off and allowed to cool. The cooked cotyledons were ground into a paste. The paste was wrapped in small portions of approximately 30g with blanched banana/plantain leaves and left to ferment anaerobically in an air-tight container for 1–10 days (Omafuvbe *et. al.*, 2003a,b). The unfermented sample served as control and the other ten samples were known as *ogiri-ahuekere* (fermented groundnut condiment). Both the fermented condiment and unfermented condiment were used for analyses. The samples were put in the oven at 50^{o}C-70^{o}C to dry. Figure 1 shows the flow diagram for the production of *ogiri-ahuekere*.

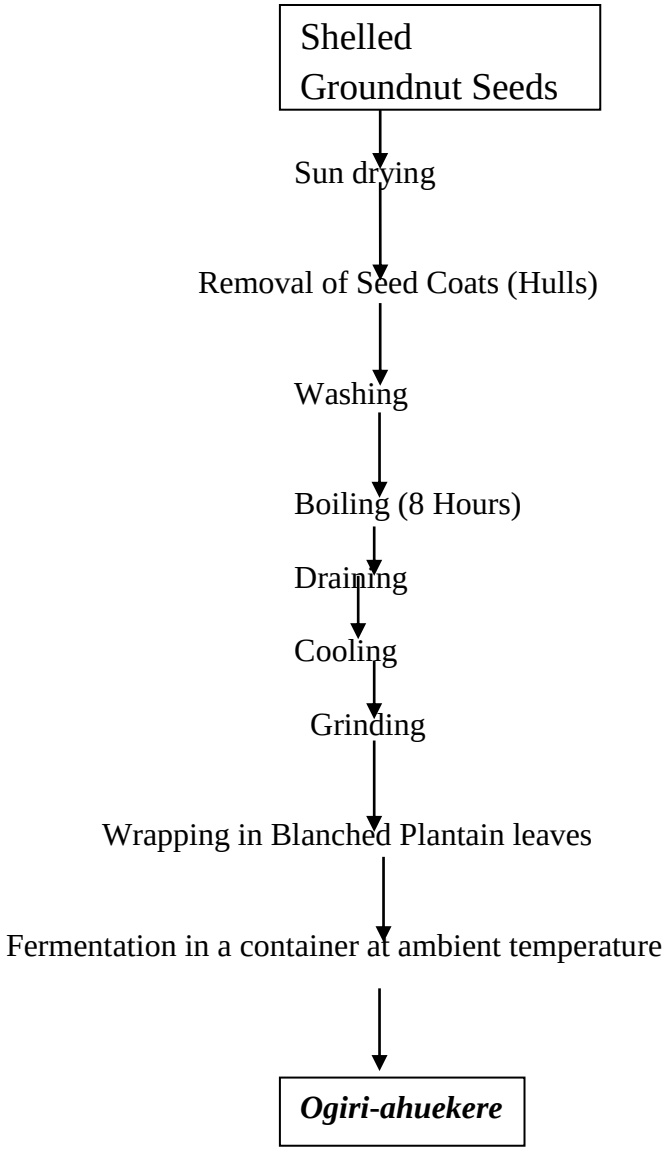

Fig 1: Flow Chart for the Production of Fermented *Ogiri–Ahuekere* Samples.

Preparation of *Oha* Soup

The recipe of the soup used for preparation of *oha* soup is outlined below.

Ingredients	Quantity
Beef	1000g
Oha leaves	10g
Achi (thickener)	10g
Ground Dry pepper	10g
Ogiri ahuekere	100g
Palm oil	3 tablespoons
Dry fish	3 pieces
Water	300ml
Crayfish	20g
Salt	added to taste

Source: Wokoma and Aziagba, 2001.

The beef was washed with clean water and put in a pot. Little pepper and salt were added and allowed to steam for a few minutes. The dried fish was washed and added to the beef with 100ml water and to boil for 20 minutes. About 200ml hot water and crayfish were added and allowed to boil. Then, 10g *achi*, (Igbo), *Brachystegen eurycoma* was added and allowed for 2-3 minutes. Then, the *ogiri-ahuekere* was added to taste. Lastly, the *oha* leaves were washed and added to the pot. Then, the soup was ready to be served.

Sensory Evaluation of Soups Prepared with *Ogiri-Ahuekere* Samples

Twenty (20) panelists, who were conversant with the fermented condiments and were used to soups prepared with them, were selected and briefed about the purpose of the evaluation and how it should be conducted. The panelists were semi-trained and drawn where the work was carried out in Abia State Polytechnic, Aba. The eleven samples used for this analysis were coded in order to hide their identity as FT_A, FT_B, FT_C, FT_D, ……., FT_K; each sample represented its fermentation time in days. The panelists were separated from each other so that none of them could influence each other's judgement of the samples. Water was also provided for rising of their mouth after tasting each sample. The sensory attributes of the samples tested were colour, aroma, taste, texture and overall acceptability. A nine-point hedonic scale was used for the rating of the sensory attributes of the sample (Ihekoronye and Ngoddy, 1985).

Where

9	=	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
1	=	dislike extremely

Statistical Analysis

The data obtained from the analyses were analysed statistically using the Analysis of Variance (ANOVA) method with the application of SPSS Version 20. The difference

between the mean values was determined by Tukey test. Significance was accepted at 5% probability level. Minitab 14 was used to determine their regressions and correlations accordingly (Pallant, 2004).

Results and Discussion

Organoleptic Attributes of *Ogiri-Ahuekere* Samples

Table 1 shows the sensory properties of soups prepared with *ogiri-ahuekere* samples. The properties tested were appearance, aroma, taste, texture and overall acceptability of the samples.

Table 1: Mean Score of Organoleptic Attributes of *Ogiri-Ahuekere* Fermented From 0 Day to 10 days

Fermentation Time (Day)	Appearance	Aroma	Taste	Texture	Overall Acceptability
0	6.37 ± 0.35^{c}	4.20 ± 0.10^{e}	2.23 ± 0.12^{g}	6.27 ± 0.21^{d}	4.77 ± 1.97^{e}
1	4.37 ± 0.15^{de}	4.27 ± 0.06^{e}	3.50 ± 0.10^{f}	2.70 ± 0.30^{f}	3.71 ± 0.78^{fg}
2	3.73 ± 0.15^{e}	2.60 ± 0.10^{f}	3.60 ± 0.10^{f}	3.63 ± 0.25^{e}	3.39 ± 0.53^{g}
3	4.53 ± 0.06^{d}	3.87 ± 0.71^{e}	3.63 ± 0.06^{f}	5.03 ± 0.15^{d}	4.26 ± 0.63^{ef}
4	6.23 ± 0.15^{c}	5.33 ± 0.78^{de}	4.43 ± 0.15^{e}	6.53 ± 0.25^{cd}	5.63 ± 0.95^{d}
5	6.80 ± 0.10^{c}	5.97 ± 0.20^{cd}	5.43 ± 0.21^{d}	6.17 ± 0.21^{c}	6.09 ± 0.57^{cd}
6	7.03 ± 0.15^{bc}	6.50 ± 0.20^{c}	6.20 ± 0.10^{c}	6.90 ± 0.10^{bc}	6.66 ± 0.38^{c}
7	7.13 ± 0.06^{bc}	6.67 ± 0.25^{bc}	6.60 ± 0.20^{c}	7.00 ± 0.10^{bc}	6.85 ± 0.26^{bc}
8	7.60 ± 0.27^{b}	7.70 ± 0.30^{ab}	7.57 ± 0.15^{b}	7.20 ± 0.10^{b}	7.52 ± 0.22^{b}
9	7.93 ± 0.06^{ab}	8.07 ± 0.16^{a}	7.73 ± 0.06^{b}	7.37 ± 0.15^{b}	7.77 ± 0.30^{ab}
10	8.43 ± 0.15^{a}	8.37 ± 0.21^{a}	8.17 ± 0.12^{a}	8.07 ± 0.21^{a}	8.26 ± 0.17^{a}
LSD	0.764	1.113	0.436	0.671	0.736

Means with the different superscripts are significantly different from each other ($p \geq 0.05$) in the same column.

Appearance of *Ogiri-Ahuekere* Soups

Table 1 showed that there were significant improvements in the acceptability of the appearance of the soups prepared with fermented *ogiri-ahuekere* samples. Panelists' preference in appearance increased with the increase in the fermentation time. This increase in preference of the appearance of the soups did not start from day 1 fermented *ogiri-ahuekere* but the increase in preference started after 2 days of fermentation of the groundnut seeds. Chukwu *et al*. (2010) reported that during fermentation, metabolic activities of microorganisms give out moisture as one of their end products. Because of this fact, fermented *ogiri-ahuekere* samples were wet. The wetness of the condiments (*ogiri-ahuekere*) increased due to increase in fermentation time. The drying of the samples in oven caused the browning of the fermented *ogiri-ahuekere* samples. The panelists indicated their preference for the brown colour of the fermented *ogiri–ahuekere* samples in the soups (Table 1). This browning was caused by the reaction of sugars and amino acids (in the hot oven during the drying of samples) released by the microorganisms during fermentation. The soup prepared with unfermented *ahuekere* had the mean score approximately 6.0 which was significantly different from those of 1, 2 and 3 day(s) fermented *ogiri-ahuekere* samples but similar to the soups of 4 and 5 days fermented *ogiri-ahuekere* samples. However, soups prepared with fermented *ogiri-ahuekere* samples of 1 and 3 day(s) had mean scores approximately 4.0 (dislike slightly) that were similar but significantly different from the soup prepared with 2 days fermented *ogiri-ahuekere* sample according to the panelists' preference of acceptability. Soup sample prepared with fermented *ogiri–ahuekere* sample of 6 days fermentation had the mean score approximately 7.0 (like moderate) which was significantly similar to the soups prepared with unfermented *ahuekere* sample and 5, 7 and 8 days fermented *ogiri-ahuekere* samples but soup prepared with 5 days fermented ogiri-ahuekere sample had mean score approximately 7.0 which was significantly different from that of 8 days fermented *ogiri-ahuekere* sample. Morever, soup prepared with 10 days fermented *ogiri-ahuekere* sample had the mean score of approximately 8.0 (like very much) which was significantly similar to that of 9 days fermented *ogiri-ahuekere* sample but significantly different from that of 8 days fermented *ogiri-ahuekere* sample. Soup prepared with 8 days fermented *ogiri-ahuekere* sample had the mean score approximately 8.0 (like very much) which was significantly the same to that of 9 days fermented *ogiri-ahuekere* sample (Enujiugha, 2005).

Aroma of *Ogiri-Ahuekere* Soups

Table 1 also indicates that there was significant improvement in the aroma of the soups prepared with *ogiri-ahuekere* due to increased fermentation time. The panelists had the mean score of soups prepared with unfermented *ahuekere* and 1 day fermented *ogiri-ahuekere* samples approximately 4.0 (dislike slightly) which were significantly the same with soups of 1, 3 and 4 days fermented *ogiri-ahuekere* samples but were significantly different from those of 2 and 5 days fermented *ogiri-ahuekere* samples. The significant improvement in aroma started from four days. Soup prepared with 4 days fermented *ogiri-ahuekere* sample had the mean score approximately 5.0 (neither dislike nor like) which was significantly the same with that of 5 days fermented *ogiri-ahuekere* sample (5.97) but was significantly different from that of 6 days fermented *ogiri-ahuekere* sample (6.50). Similarly, the aroma of soup prepared with 7 days fermented *ogiri-ahuekere* sample had the mean score approximately 7.0 (like moderately) which was significantly the same with those of 5, 6 and 8 days fermented *ogiri-ahuekere* samples while soup of 8 days fermented *ogiri-ahuekere* sample had mean score approximately 8.0 (like very much) which was significantly different from that of 7 days fermented *ogiri-ahuekere* sample but was similar with those of 9 and 10 days fermented *ogiri-ahuekere* samples. This significant improvement in aroma was because of the aromatic substances released by the fermenting organisms (Ouoba *et al*., 2005).

Taste of *Ogiri-Ahuekere* Soups

Table 1 shows that there were significant differences in the taste quality of the soups prepared with *ogiri-ahuekere* samples fermented at various day(s). For instance, the soups made from *ogiri-ahuekere* samples of 1, 2 and 3 day(s) of fermentation had mean score of approximately 4.0 (dislike slightly) and these samples showed no significant differences among them; but were significantly different from the soups prepared with unfermented *ahuekere* sample and 4 days fermented *ogiri-ahuekere* sample. The soup made with *ogiri-ahuekere* sample fermented for 5 days had mean score of approximately 5.0 (neither dislike nor like). The soup prepared with 5 days fermented *ogiri-ahuekere* sample was significantly different from those of 4 and 6 days fermented *ogiri-ahuekere* samples (4.0 and 6.20 respectively). Similarly, the soups of 6 and 7 days fermented *ogiri-ahuekere* samples had mean tastes (6.0 = like slightly) which were significantly similar but were significantly different from those of 5 and 8 days fermented *ogiri-ahuekere* samples. The tastes of soups prepared with *ogiri-ahuekere* samples fermented for 8, 9 and 10 days were liked very much (approximately 8.0); but soup prepared with 10 days fermented *ogiri-ahuekere* sample was significantly different from the rest of the *ogiri-ahuekere* samples. This high rating (like very much) as a result of increased fermentation time which improved the taste of the *ogiri-ahuekere*. This was due to the release of amines, peptides and glutamic acids during the fermentation process (Dakwa *et al*., 2005).

Texture of *Ogiri-Ahuekere* Soups

Table 1 also shows that there was significant difference among the condiments (*ogiri-ahuekere*) due to increase in the fermentation time. The soup prepared with unfermented *ahuekere* sample had mean score approximately 6.0 which was significantly different from those of 1, 2 and 3 days fermented *ogiri-ahuekere* samples but similar to those of 4 and 5 days fermented *ogiri-ahuekere* samples. There were significant differences among textures of soups samples prepared with 1, 2 and 3 day(s) fermented *ogiri-ahuekre* samples. However, soups prepared with fermented *ogiri-ahuekere* samples of 6 and 7 days had mean scores approximately 7.0 (like moderately) were significantly the same with soups prepared with fermented *ogiri-ahuekere* samples of 8 and 9 days (approximately 7.0). The soup of 10 days fermented *ogiri-ahuekere* sample had mean score of 8.0 (like very much) which was significantly different from other fermented *ogiri-ahuekere* samples. This improvement in texture (mouth-feel) of the *ogiri-ahuekere* soups was due to the reduced fibrousness of the condiments. The fibre content had been reduced by the microorganisms thereby making the condiment to have good mouth-feel (texture).

Overall Acceptability of *Ogiri-Ahuekere* Soups

Increase in the fermentation time of *ogiri-ahuekere* samples improved the consumers' acceptability of the soup samples. Soup prepared with 2 days fermented *ogiri-ahuekere* sample had the least overall acceptability (3.0 = dislike moderately) which was significantly similar to soup of 1 day fermented *ogiri-ahuekere* sample but was different from soup prepared with 3 days fermented *ogiri-ahuekere* sample. The soup prepared with unfermented *ahuekere* sample had mean score approximately 5.0 (neither like nor dislike) which was similar with soup of 3 days fermented *ogiri-ahuekere* sample. Soup of 5 days fermented *ogiri-ahuekere* sample had mean overall acceptability approximately 6.0 (like moderately) which was similar to the soups of 4 and 6 days fermented *ogiri-ahuekere* samples but significantly different from the soup prepared with 7 days fermented *ogiri-ahuekere* sample; although, soups of 6, 7 and 8 days were not significantly different from each other. Soups prepared with 9 and 10 days fermented *ogiri-ahuekere* samples had mean score approximately 8.0 (like very much). Soup of 10 days sample was significantly differently from 0-8 day(s) *fermented* ogiri-*ahuekere* samples. The soups with least overall acceptability

scores were 1-3 day(s) fermented *ogiri-ahuekere* samples while 8-10 days fermented *ogiri-ahuekere* samples had the best overall acceptability. Wakshama *et al*. (2010) confirmed that eight days was suitable for fermentation of groundnut seeds to produce condiments of desired attributes due to its high oil content. The *ogiri-ahuekere* of 10 days fermentation was the most acceptable in all the four quality attributes (taste, aroma, colour and texture). However, the scores in Table 4.3 showed rapid increase in panelists' preference of the *ogiri-ahuekere* from 8-10 days fermentation. This finding was in accordance with the report made by Asagbra *et al*. (2012) that there were improvement in the sensory attributes of fermented condiments as the days of fermentation increased.

Conclusion and Recommendation

The sensory characteristics of the *ogiri-ahuekere* showed that increase in the fermentation time (day) improved the sensory attributes of *ogiri-ahuekere*. The mean overall acceptability of soups prepared with *ogiri-ahuekere* samples were as follows: unfermented *ahuekere* sample had approximately 5.0 (neither like nor dislike); 1-3 day(s) samples had approximately 4.0 (dislike slightly); 4 and 5 days samples had 6.0 (like slightly); 6 and 7 days samples had approximately 7.0 (like moderately) and 8-10 days samples had approximately 8.0 (like very much). Soups prepared with 6 and 7 days fermented *ogiri-ahuekere* samples were better than soups of 0-5days fermented *ogiri-ahuekere* samples but soups of 8-10 days *ogiri-ahuekere* samples had improved sensory quality which were most accepted by the panelists.

Further work is recommended on packaging of *ogiri-ahuekere* in various forms such as cubes, granular and liquid. This will enhance storage, distribution and marketability of the product. The study of the flavour components of *ogiri-ahuekere* and their relationship with the fermenting microorganisms is also recommended.

References

Achi, O. K. (2005). The Upgrading of Traditional Fermented Foods Through Biotechnologies. *African Journal of Biotechnology 4:375-380*

Asagbra, A. E.; Okafor, J. W. C.; Onawola, O. O.; Etoamaihe, M. and Olatope, S. O. A. (2012). Sensory Properties of *Ogiri* in Nigerian *Onugbu* Soup Made from Two Varieties of Melon Seeds (*Cucumis melo* and *Cucumeropsis mani*). *Pakistan Journal of Nutrition 11: 596-599.*

Barber, L.; Ibiama, E. M. and Achinwehu, S.C (1989). Microorganism Associated with Fluted Pumpkin (*Telferia occidentalis*). *Int'l Journal of Scieence & Technology 24: 189-194.*

Chukwu, O.; Orhevba, B. A. and Mahmood, B. I. (2010). Influence of Hydrothermal Treatments of Proximate Compositions of Fermented Locust Bean (*Dawadawa*). *Journal of Technology 8(3):99-101.*

Dakwa, S.; Sakyi-Dawson, E.; Diako, C.; Annan, N. T. and Amoa-Awua, W. K. (2005). Effect on the Fermentation of Soybeans into *Dawadawa* (*Soy-Dawadawa*). *International Journal of Food Microbiology 104: 69-82.*

David O. M and Aderibigbe, E. F. (2010). Microbiology and Proximate Composition of *Ogiri* and Oily Paste Produced from Different Melon Seeds. *New York Science Journal 3(4): 18-27.*

Enujiugha, V. N. (2000). Development of a New Food Paste from Seeds of *Pentaclethra* Species. *Applied Tropical Agriculture 5: 89–94.*

Enujiugha, V. N. (2005). Quality Dynamics in Processing of Underutilized Legumes and Oil Seeds. In: *Crops Growth Quality and Biotechnology*. Ed: Dris, R. WFL Publisher,

Helsinki. Pp 732-746.

Ihekoronye, A. I. and Ngoddy, P. O. (1985). *Integrated Food Science and Technology for the Tropics.* Macmillan Publishers, London. Pp 251–253.

Musa, A. K.; Dike, M. C. and Onu, I. (2009) Evaluation of Nitta (*Hyptis suaveolens poit*) Seed and Leaf Extracts and Seed Powder for the Control of *Trogederma granarium Everts* (*Celeoptera: Dermestidae*) in Stored Groundnut. *American Russian Journal of Agronomy 2(3):176 – 179.*

Odunfa, S. A. (1985a) Biochemical Changes in Fermenting African Locust Bean (*Parkia biglobsa*) During"*Iru*" Fermentation. *Journal of Food Technology 20:295 – 303.*

Odunfa, S. A. (1985b). Microbiological and Toxicological Aspect of Fermentation of Castor Oil Seeds for *Ogiri* Production. *Journal of Food Science 50: 1758 – 1759.*

Omafuvbe, B. O.; Shonukan, O. O. and Abiose, S. H. (2003a). Microbiological and Biochemical Changes in the Traditional Fermentation of Soybean for *Soy-Daddawa,* A Nigerian Food Condiment. *Food Microbiology 17: 469 – 474.*

Omafuvbe, B. O.; Shonukan, O. O. and Abiose, S. H. (2003b). Fermentation of Soybean (*Glycine max*) for *Soy-Daddawa* Production by Starter Cultures of Bacillus. *Food Microbiology 19:561-566.*

Ouoba, L. L.; Diawara, B.; Annan, N. T.; Poli, L. and Jakobsen, M. (2005). Volatile Compounds of Soumbala, A Fermented African Locust Bean (*Parkia biglobosa*) Condiment. *Journal Applied Microbiology 99: 1413–1421.*

Pallant, J. (2004). *SPSS Survival Manual.* Open University Press, Berkshire.

Sahayuraj, K. and Martin, P. (2003). Assessment of *Rhynocoris Marginatus* (fab.) (*Hemptera*: *Reduviidac*) as Augmented Control in Groundnut Pests. *Journal of Central European Agriculture 4(2): 103-110.*

Wakshama, P. S.; Akueshi, C. O and Ali, B.D (2010). Comparative Studies on the Proximate Composition and Some Physical Characteristics of Dry Matter Samples of Fermented and Unfermented Groundnut (*Arachis hypogaea* L.) Seed, Pumpkin (*Cureubita pepo* L.) Seed and Pulp. *Journal of Medical and Applied Biosciences 2:55- 59*

Wokoma, E. C. and Aziagba, G. C. (2001). Sensory Evaluation of *Dawadawa* Produced by the Traditional Fermentation of African Yam Bean (*Spherostylis stenocarpa* Harms) Seeds. *Journal of Applied Sciences and Environmental Management 5(1): 85 – 91.*