JHER Vol. 25, No. 1, September, 2018, pp. 34 – 44

Proximate Analysis and Organoleptic Attributes of *Ukpo Ogede* and *Uloka* (Local Dishes) of South-South Zone of Nigeria

Lano-Maduagu A. T.
Department of Science and Technology Education
University of Lagos, Akoka, Lagos, Nigeria.

Abstract

The study determined the organoleptic attributes and proximate composition of two locally consumed dishes in Edo State namely *Ukpo Ogede* and *Uloka*. *Ukpo Ogede* and *Uloka*. The proximate analysis were determined using AOAC (2005) method. Organoleptic evaluation revealed the dishes were highly rated in terms of color, flavour, appearance, texture and general acceptability. The selected proximate analysis results revealed that *Ukpo Ogede* and *Uloka* are rich source of carbohydrate (28.64 and 47.35 respectively) but *Ukpo Ogede* is low in protein while *Uloka* is average (2.24 and 5.31 respectively), Ash (0.34 and 1.89). The fat content of *Uloka* is relatively high, while that of *Ukpo Ogede* is low with high moisture content also *Ukpo Ogede* has high significance than *Uloka*.

Key Words: *Ukpo Ogede*, *Uloka*, Proximate, Organoleptic, Analysis.

Introduction

In Nigeria and many other parts of Africa, plantain (*Musa paradisiaca*) serves as a major staple food (Oladele & Khokhar, 2011). Plantains can be consumed in the unripe, fairly ripe, ripe and overripe stages (Okorie *et al*, 2015). Plantains is an important staple food in Central and West Africa, which along with bananas provides 60 million people with 25 percent of their calories (Adetuyi *et al*., 2012). According to FAO (2009), over 2.11 million metric tons of plantain are produced in Nigeria annually. However, about 35-60 percent post-harvest losses had been reported and attributed to lack of storage facilities and inappropriate technologies for food processing (Adetuyi *et al*., 2012). When processed into flour it is used traditionally for preparation of gruel which is made by mixing the flour with appropriate quantities of boiling water to form a thick paste. The use of plantain flour for production of baked goods if feasible would help to lessen Nigeria's dependence on imported wheat. Plantain is widely grown in

Nigeria, particularly the eastern part of the country (Onuoha *et al*, 2014).

In Nigeria, unripe plantain pulp could be eaten boiled, fried, or roasted. It is also commonly made into chips by frying thin slices in oil and salting it (Onuoha et al, 2014). Roasted unripe plantain (called '*bole*' in the Western part of Nigeria) is prepared by roasting unripe plantain pulp over balls of red-hot coal until it is cooked. This is then eaten with any traditional Nigerian soup (Onuoha *et al*, 2014). Boiled unripe plantain is either eaten with sauce, or pounded into '*foo-foo*' and eaten with any Nigerian soup. Unripe plantain pulp is also dried, ground into flour (Onuoha et al, 2014). This flour may be reconstituted in boiling water to make '*amala*' which is eaten with any Nigerian soup (Onuoha et al, 2014). The flour is also used for several other traditional dishes ranging from '*akara*', '*ukpo ogede*' and soups (Onuoha et al, 2014).

Plantain moi moi, traditionally known as *ukpo ogede*, is a Nigerian delicacy prepared basically with overripe plantains and unripe plantain flour. As a recipe of Plantain, *ukpo ogede* therefore could be regarded as a hypoglycemic diet. According to Rambdath (2004), this is because unripe plantain is a low glycemic index food since it contains starch that has only small concentrations of sugar and these sugars are released slowly over time. This is why unripe plantain dishes are usually consumed by Nigerian diabetics to reduce post-prandial blood glucose level (Foster *et al*., 2003).

Maize (*Zea mays L.)* is a member of the grass family (gramineae). It originated from South and Central America (Oladejo & Adetunji, 2012). It was introduced to West Africa by the Portuguese in the 10th century (Oladejo & Adetunji, 2012). Maize is a major cereal crop for both livestock feed and human nutrition (Ridhi, 2014). With its high content of carbohydrates, fats, proteins, some of the important vitamins and minerals, maize acquired a well-deserved reputation as a poor man's "nutricereal"(Ridhi, 2014). Corn contain vitamin B-complex such as B1 (thiamine), B2 (niacin), B3 (riboflavin), B5 (pantothenic acid) and B6 that makes it commendable for hair, skin, digestion, heart and brain (Dilip and Aditya 2013). It contains vitamin C, A and K together with large amount of beta-carotene and fair amount of selenium that help to improve thyroid gland and play important role in proper functioning of immune system(Dilip and Aditya 2013). It has higher content of protein and fat as compared to other cereals (Dilip and Aditya 2013). Corn silk contains maizeric acid, fixed oils, resin, sugar, mucilage, salt and fibres essential in diet(Dilip and Aditya 2013).Corn syrup is useful in manufacturing of jams, jellies, and other sweets and as an additive for cane sugar and maple syrup(Dilip and Aditya 2013). Edible oils obtained from seeds are useful in salad and for cooking (Dilip and Aditya 2013). Roasted seeds are used

as coffee substitute (Dilip and Aditya 2013). Maize is the third most important cereal in the world after rice and wheat and ranks fourth after millet, sorghum and rice in Nigeria (FAO, 2009). It is a good source of carbohydrate, vitamins and minerals and it can be processed into a wide range of food items and snacks. Some of the maize-based snacks in Nigeria include: *aadun* (maize pudding), *kokoro* (maize cake) and *donkwa* (maize-peanut ball) (Idowu, 2015).

Ukpo Ogede is a mixture of mashed ripe plantain with plantain flour or yam flour, salt, pepper, crayfish, palm oil and steamed into a pudding (*Madukwe and Ene-Obong, 2006).* One very unique thing about this food is that it is a delicacy that can help households avoid food spoilage and wastage (Omotosho, 2017). Rather than throw those over ripe plantains (as long as it is not rotten), it can be easily converted into a delicious delicacy that can be enjoyed by individuals (Omotosho, 2017). According to *Madukwe and Ene-Obong (2006) 100g of ukpo ogede contains* Iron (1.74 ± 0.14) mg, copper (0.09 ± 0.02) mg, zinc (3.15 ± 0.06) mg, phytate (12.73 ± 0.04) mg and phytate zinc molar ratios (PZMR) (0.04 mg). "*Uloka*" is a snack prepared from roasted whole meal maize flour, red pepper and other spices thoroughly mixed in palm oil to obtain a uniform product of different shapes.

Objectives of the Study

The major purpose of this study was to carry out the organoleptic evaluation and analyze the proximate composition of *ukpo ogede* and *uloka* local dishes peculiar among the people of Edo in Edo state. Specifically, the study determined:

1. proximate composition: moisture content, ash content, protein content, fat content and crude fibre of the two products
2. organoleptic attributes of the two products based on colour, appearance, texture, flavor/taste.

Materials and Methods

Materials

All ingredients for the preparation of the dishes were purchased from the Idi-Oro Plantain and food stuff Market, Mushin, Lagos State, Nigeria. For each of these dishes the materials purchased and quantity (recipecs) as follows:

Dish- *Ukpo Ogede* (plantain Moimoi) Recipe

Ripe plantain	2 medium size
Unripe plantain flour	2 cups
Palm oil	2 cooking Spoon
Cray Fish (ground)	3 table spoonful
Dried pepper	2 table spoonful
Onion	1 medium size
Seasonings	2 cubes
Dried fish (optional)	2mediumsize
cutlet	
Water	200 ml
Salt	to taste

Snack-*Uloka* (ground roast corn with spices) Recipe

Corn	286g
Palm oil	2 cooking spoon
Dried pepper (grounded)	1 tablespoonful
Ginger (grounded)	1 tablespoonful
Garlic (grounded)	1 tablespoonful
Sugar	3 cubes

Procedure for the preparation of *Ukpo Ogede*

1. Wash and peel the ripe plantain, cut into slices, mash or blend.
2. Beat in the unripe plantain flour.
3. Add water, pepper, dried fish, Cray fish and Maggi cubes.
4. Mix thoroughly and add salt to taste.
5. Line the base of the pot with stalks of the broad leaves.
6. Add some water to the pot and allow to boil.
7. Clean the broad leaves and scoop the plantain mixture into the leaves and place in the pot to steam for about 35 minutes.

Procedure for the preparation *Uloka* (roast corn with spices)

1. Pick the unwanted articles from the corn
2. Roast the corn.
3. Grind into powder and put into a bowl.
4. Add the pepper, ginger, sugar and mix thoroughly.
5. Add the palm oil and
6. mold into required shape.

Proximate analysis.

The proximate compositions of each of the dishes were determined in the laboratory using AOAC (2005) techniques on l00g of each sample as follow:

Moisture Content: 5g of each sample was weighed into clean drying Cans of known weight. These cans were then placed in oven drier maintained at 105^0C. After about 16 to 18 hours, the drying Can was transferred into a desiccator for cooling to take place. Thereafter, the percentage Moisture content of each of the sample was determined using:

$$\%\text{Moisture Content (MC)} = \frac{W_2 - W_1}{S} \times 100$$

Where, W1=weight of empty drying Can, W2=weight drying Can with content and S=weight of sample.

Ash Content: 2g of each sample was weighed into a crucible which had been ignited and weighed. This is then placed on a hot plate inside a fume cupboard to char the organic matter. The remaining inorganic matter was then transferred into the muffle furnace maintained at 600^0C for 6 hours to ash the sample completely. Thereafter, the crucibles were transferred into the desiccators for cooling. The percentage ash content was determined using:

$$\%\text{ Ash content: } \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Where W_1= weight of Crucible, W_2=weight of Crucible plus sample before cooling, W_3= weight of Crucible plus sample after ashing.

***Protein Content*:** to between 0.20g and 0.25g of each sample in a digesting tube, concentrated Hydrogen Tetraoxosulphate (IV) acid and Hydrogen Peroxide 4ml each was added respectively to bring about the hydrolysis of the sample. To this one Selinium tablet of Kjedhal catalyst was added and the sample was digested on the digestion block at 375^0C for 3 hours. After cooling,

distilled water was added to the hydrolysates up to the mark on the tube before neutralization and titration would be carried out. The amount of total nitrogen in the raw materials were multiplied with both the traditional conversion factor of 6.25 and sample-specific conversion factors in order to determine total protein content.

Fat Content: Soxhlet extraction was used in the determination of fat content. 3g of each sample is weighed into the thimble. The thimble is blocked with cotton wool and placed in a clean extraction Barrel of the Soxhlet apparatus that had been oven dried and cooled in a desiccator. The sample is reflux for 6 hours; after the extraction, the thimble was removed and the extraction solvent distilled off until the flask is almost dried. The flask is detached, dried in the oven at 500^0C overnight, cooled in the desiccators and weighed.

$$\text{Fat content} = \frac{\text{Wt of flask plus fat} - \text{Wt of empty flask}}{\text{Wt of sample}} \times 100$$

Determination of total crude fibre**:** the samples were first defatted with Hexane in Soxhlet refluxing apparatus. 1g of the defatted sample is added into 600ml beaker, 100ml TCA reagent added to this and boiled for forty minutes. The digest is filtered and the residue washed six times with hot distilled water. The filer paper with the residue is transferred into a porcelain crucible, dried in oven at 100^0C overnight and weighed (A). Thereafter, it will be ached in a muffle furnace at 6000C for 6 hours, cooled in desiccators and weighed again (B).
Loss in weight during incineration is equivalent to fibre.

$$\% \text{ Fibre} = \frac{\text{weight (A)} - \text{weight (B)}}{\text{Sample weight}} \times 100$$

Organoleptic evaluation

Coded samples of the *Ukpo ogede* and *uloka* (Sample A- *ukpo ogede* ; Sample D- *uloka*) were placed on white saucers and presented to a ten-man taste panel consisting of staff of Faculty of Education University of Lagos. An evaluation sheet designed on a five point hedonic scale was used to assess the following attributes: Colour (Very Black-5, Just Black-4, Fairly Black-3, Ash-2, Gray-1), Appearance (Fresh-5, Smooth-4, Thick-3, Powdery-2, Greasy-1), Texture (Soft-5, Tender.4, Hard-3, Strong-2, Tough-1), Flavour/Taste (Fresh-5, Spicy-4, Pleasing-3, Off-odour-2, Pungent-1) and General acceptability (Very good & acceptable-5, Good & acceptable-4, Just acceptable-3, Slightly acceptable-2, Not acceptable-1). Water was supplied to the panelist to rinse their mouth in between tasting. Descriptive statistics such as mean, frequency and percentage were used to analyze the organoleptic attribute identified by the panelist.

Results

Table 1: Proximate composition of 100 grams *UkpoOgede* (A) & *Uloka* (D)

Samples	Carbohydrate	Protein	Fibre	Ash	Fat/oil	Moisture
A	28.64	2.24	2.58	0.34	0.47	63.74
D	47.35	5.31	2.75	1.89	30.06	11.67

Table 1 shows the percentage values of nutrients present in sample A which is *ukpo ogede* and sample D which is *uloka*. While the carbohydrate, protein, fibre, ash fat/oil and moisture content of *ukpo ogede* are 28.64%, 2.24%, 2.58%, 0.345 and 63.74 respectively, *uloka* contains 47.35% carbohydrate, 5.31% protein, 2.75% fibre, 1.89% ash, 30.06% fat/oil and 11.67 moisture.

Organoleptic evaluation

Table 2: Colour of Sample D (*Uloka*)

Variables	Sample D
Golden Yellow	6(30%)
Bright Yellow	10(50%)
Fairly Yellow	4(20%)
Blackish Yellow	-
Black	-
Total	**20(100%)**

Table 2 shows that based on the Colour of Samples D, 30% chose Golden Yellow, 50% chose Bright Yellow, while 20% chose Fairly Yellow. Neither Blackish Yellow nor Black was chosen.

Table 3: Appearance of Samples

Variables	Sample A	Sample D
Fresh	8(40%)	6(30%)
Smooth	7(35%)	5(25%)
Thick	5(25%)	5(25%)
Powdery	-	-
Greasy	-	4(20%)
Total	**20(100%)**	**20(100%)**

Table 3 shows the Appearance of Samples A, and D respectively, 40%, and 30% chose Fresh, 35% and 25% chose Smooth, while the remaining 25% and 25% chose Thick. Neither Powdery nor Greasy was chosen.

Table 4: Texture of Samples

Texture	Sample A	Sample D
Soft	5(25%)	3(15%)
Tender	10(50%)	10(50%)
Hard	5(25%)	7(35%)
Strong	_	-
Tough	-	-
Total	**20(100%)**	**20(100%)**

Table 4 shows that based on the Texture of Samples A, and D respectively, 25%, and 15% chose Soft, 50% and 10% chose Tender, while 25%, and 35% chose Hard. Neither Strong nor tough was chosen.

Table 5: Flavour/Taste of Samples

Flavour/Taste	Sample A	Sample D
Fresh	5(25%)	5(25%)
Spicy	10(50%)	10(50%)
Pleasing	5(25%)	5(25%)
Off-odour	-	-
Pungent	-	-
Total	**20(100%)**	**20(100%)**

Table 5 shows that based on the Flavour/Taste of Samples A and D

respectively, 25% and 25% chose Fresh, 50% and 50% chose Spicy, while 25% and 25% chose Pleasing. Neither Off-odour nor Pungent were chosen.

Table 6: General Acceptability of Samples

General Acceptability	Sample A	Sample D
Very good	10(50%)	5(25%)
Good & Acceptable	6(30%)	13(65%)
Just acceptable	4(20%)	2(10%)
Slightly Acceptable		
Not Acceptable	-	-
Total	**20(100%)**	**20(100%)**

Table 6 shows the general acceptability of samples of A and D respectively, 50% and 25% chose Very good & Acceptable, 30% and 65% chose Good & Acceptable, while 20% and 10% chose just acceptable. Neither Slightly Acceptable nor Not Acceptable was chosen.

Discussion of Findings

Results from the proximate composition of sample A and D show that the moisture content of D is lower than A comparatively. The moisture content of foods or its processed products gives an indication of its freshness and shelf life, high moisture content subjects food items to increased microbial spoilage and short shelf life, which can lead to its deterioration (Adepoju & Onasanya, 2008). Therefore, shelf life is the time during which a product will remain safe, maintain desired sensory, chemical, physical and microbiological properties, and comply with nutritional labeling. Many factors influence shelf life such as: water activity, pH, redox potential, oxygen, use of preservatives, and processing/ storage conditions (Sandulachi & Tatarov, 2012). Also the high ash content of *uloka* is an indication that the minerals in it is better in quantity than that of *ukpo ogede*. Though the protein content of *uloka* is higher than *ukpo ogede*, (Omuetti et al, 1992 in Ewulo *et al* 2017) had clarified that maize is deficient in essential amino acids that are essential for human nutrition. Research efforts has been concentrated on supplementing cereal food with legumes and has successfully enhanced the nutritional value and/or functionality of staple foods (Awolu *et al*, 2016a). Protein is an essential component of the diet needed for survival of animals and human being, its basic function in nutrition is to supply adequate amount of required amino acids. (Abubakar *et al,* 2016). *Uloka* is high in carbohydrate content and can be good sources of energy. It has higher value of carbohydrate than *ukpo ogede*.

It is a generally held opinion among the natives that for *ukpo ogede* to be acceptable, the colour has to be just black and sometimes very black due to the nature of plantain. Based on my findings on this experimental work, it can be deduced that it is acceptable because it can be seen that a high fraction went for very black and just black.

Also, the appearance of *ukpo ogede* is usually fresh, smooth and thick. It is freshly prepared and smooth because it is well blended. Based on my findings, it can be deduced that it is acceptable because it is highly

proportioned for freshness, smoothness and thickness.

The natives believe the texture of *ukpo ogede* should be soft and tender. It is cooked by steaming, hence should be soft and easily digestible by any age group. Based on my findings, it can be deduced that it is acceptable because it is highly proportioned for being soft and .tender.

The taste/flavour of *ukpo ogede* should be fresh, spicy and pleasing. When eaten, it should taste fresh because it has just been prepared. It should have a spicy flavour and taste due to the ingredients utilized and this should be pleasing as well. Based on this finding, it can be deduced that it is acceptable.

Ancestrally, for *uloka* to be acceptable, the color-has to be golden yellow, and in some cases bright yellow or fairly yellow with respect to the amount of palm oil used. Based on my findings on this experimental work, it can be deduced that it is acceptable because it can be seen that a high fraction went for golden yellow, bright yellow and fairly yellow.

The appearance of *uloka* is usually fresh, smooth and thick**.** It is freshly prepared and smooth because it is well blended. Sometimes it could be greasy due to the palm oil utilized. Based on my findings, it can be deduced that it is acceptable because it is highly proportioned for freshness, smoothness and thickness. The texture of *uloka* is usually soft and tender. Based on my findings, it can be deduced that it is acceptable because it is highly proportioned for being soft and tender.

The flavour/taste of *uloka* should be fresh, highly spicy and pleasing. When eaten, it should taste fresh because it has just been prepared. It should have a spicy flavour and taste due to the ingredients utilized and this should be pleasing as well. Based on my findings; it can be deduced
that it is acceptable because all choices were for being fresh, spicy and
pleasing.

Uloka is very good & Acceptable among the people of Edo state and based on my findings, generally, it is ranked to be very high in acceptability.

The proximate analysis showed that the two locally consumed dishes in Edo, Edo State contain in moderations the basic nutrients needed to meet the essential needs of man.

Conclusion

Proximate Analysis is a partitioning of compounds in a food product into six categories based on the chemical properties of the compounds. The six categories are: moisture content, ash content, crude protein (or Kjeldahl protein), crude lipid, crude fibre, nitrogen-free extracts (digestible carbohydrates). The Proximate Composition of *ukpo ogede* and *uloka* have been explored. Also, the acceptability of these products in terms of colour, texture, taste/flavor and appearance has been established using organoleptic evaluation. It is concluded that the consumption of

local foods should be encouraged rather than replaced with junks from fast food restaurants.

Recommendations

On the basis of the findings, the following recommendations are made:

- *Ukpo ogede* could be included in the on-going Federal government School feeding programmes because the ingredients for it could be sourced locally.
- The results of the organoleptic evaluation of both *ukpo ogede* and *uloka* could be used as a yard stick because these findings are consistent with opinions held by the natives and localities in Edo State of Nigeria where these meal originated from.
- Generally, maize-based snacks such as *uloka* are cereal-based foods which are rich in carbohydrate and low in protein and deficient in some essential amino acids particularly lysine. Since *uloka* is being consumed among all levels of the populace including school-aged children as refreshment in Southern Nigeria, incorporation of a suitable legume will make the snack useful protein and energy sources for its consumers.
- This paper explore the nutritional values of *ukpo ogede* and *uloka*. The information in proximate composition of these meal could be used in making informed decision. Therefore re-introduction of nutrition education into the school syllabus will teach the young ones to utilize foods within their localities, thus a partnership can be formed between ministry of education and ministry of health.
- More research of this nature should be encouraged.

References

Abubakar, U., Yusuf, K.M., Safiyanu, I., Abdullahi, S, Saidu, SR, Abdu, GT, & Indee, AM, (2016). Proximate and mineral composition of corn cob, banana and plantain peels. International Journal of Food Science and Nutrition. 1. 25-27.

Adepoju OT, and Onasanya LO. (2008). Nutrient composition, anti-nutritional factors and contribution of native pear (Dacryoides edulis) pulp to nutrient intake of consumers. Nigerian Journal of Nutritional Science. 29(2):15- 23.

Adetuyi, F., Ajala, L and Ibrahim, T. (2012). Effect of the addition of defatted okra seed (abelmoschuesculentus) flour on the chemical composition, functional properties and Zn bioavailability of plantain (musa paradisiacal linn) flour. J. Microbiol. Biotechnol. Food Sci., 2: 69-82

Akunor, P.I., and Ishiwu, C.J. (2013). Chemical Composition, Physical and Sensory properties of caked supplemented with plantain peel flour. International Journal of Agricultural Policy and Research vol.1 (4), Pp. 087-092

Ali, M. Z., Musaiger, A. O., Ahmed, M. A., Rao, M. V. (1995). Composition of some traditional foods and dishes in the Arab countries of the Gulf. Proceedings, Workshop on Establishing Food Composition Data for the Arab Countries of the Gulf, UAE, 21-23 November 1995.

Al-Jebrin, A., Sawaya, W., Salji, J., Ayaz, M., & Khalil, J. (1983).Chemical and nutritional quality of some Saudi Arabian dishes based on cereals and legumes. I. Proximate composition, amino acid

content and nutritive value. Ecology of Food and Nutrition, 17,157.

AOAC (1990). Official methods of analysis, (15th ed Washington, DC: Association of Official Analytical Chemists.

Awolu, O.O., Omoba, O.S., Olawoye, O and Dairo M. (2016a). Optimization of production and quality evaluation of maize-based snack supplemented with soybean and tigernut. (Cyperus esclenta). Food Sci.Nutr:5:3-13.

Bagdonis, J.M., C.C. Hinrichs, and K.A. Schafft. (2009). "The Emergence and Framing of Farm to school Initiatives: Civic Engagement, Health and Local Agriculture," Agriculture and Human Values, Vol. 26, pp. 107-119.

Barham, E. (2003). "Translating Terroir: The Global Challenge of French AOAC Labeling," Journal of Rural Studies, Vol. 19, pp. 127-138.

Beecher, G. R., &Vanderslice, J. T. (1984). Determination of nutrients in foods: factors that must be considered.

Beery, M. and M. Valliantos. (2004). Farm to Hospital: Promoting Health and Supporting Local Agriculture. UEPI Papers-Research Brief. Urban and Environmental Policy Institute, Occidental College, Los Angeles, CA.

Brown, C. (2003). "Consumers' Preferences for Locally Produced Food: A Study in Southeast Missouri," American Journal 'of Alternative Agriculture, Vol. 18, pp. 213- 224.

Oguntona, C. R.B., Odunmbaku, J. A., Ottun, B. O. (1999) "Proximate composition of ten standardized Nigerian dishes", Nutrition & Food Science, Vol.99 Issue:6, pp.295-302, https://doi.org/10.1108/00346659910290466

Dilip K. and Aditya N. J. (2013). Nutritional, Medicinal and Economical importance of Corn: A Mini Review. Research Journal of Pharmaceutical Sciences. Vol. 2(7), 7-8

Durham, C.A., R.P. King, and C.A. Roheim.March (2009)."Consumer Definitions of 'Locally Grown' for Fresh Fruits and Vegetables. "Journal of Food Distribution Research, Vol. 40, pp 56-62.

Edman and S. Klein, 2003. A randomised trial of a low-carbohydrate diet for obesity, N. Engl. J. Med., 348: 2082-2090.

Ewulo T. O., Oluwalana I. B., Ewulo B. S. and Awolu O. O. (2017). Enrichment of traditional maize snack (Kokoro) with moringa (Moringa oliefera) leaf and soybean. African Journal of Food Science. Vol. 11(5) pp. 140-145.

F A O. (2009). Maize, rice and wheat: area harvested, production quality, yield Food and Agriculture Organization of the United Nations, Rome, Italy

FAO, IFAD, UNICEF, WFP and WHO. (2017). The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome, FAO.

Foster, G.D., H.R. Wyatt, J.O. Hill, B.G. McGuckin, C. Brill, B.S. Mohammed, P.O. Szapary, D.J. Rade, J.S. Rambdath, D.D., R.L.C. Isaac, S. Teclucksingh and T.M.S. Wolever, (2004). Glycemic index of selected staples commonly eaten in the Carribean and the effects of boiling vs crushing. Br. J. Nutr., 91: 971- 977

Idowu, A.O (2015). Nutrient composition and sensory properties of kokoro (a Nigerian snack) made from maize and African yam bean flour blends. International Food Research Journal. 22(2): 739-744

Institute of Child Nutrition. https://theicn.org/ accessed on 15th June, 2018

Kayode O.F, & Ozumba A.U, & Ojeniyi S, & Adetuyi D.O, & Erukainure, O (2010). Micro Nutrient Content of Selected Indigenous Soups in Nigeria. Pakistan Journal of Nutrition. 9. 10.3923/pjn.2010.962.965.

Madukwe, E. U.and Ene-Obong, H. N. (2006). Adequacy of micronutrient content of south eastern Nigerian meals in meeting the nutritional needs of vulnerable groups. Agro –Science Journal of Tropical Agriculture. Food Environment and Extension, 3 (2): pp. 37-44

National Policy on Food and Nutrition in Nigeria (2016)

Okorie DO, Eleazu CO, Nwosu P (2015) Nutrient and Heavy Metal Composition of Plantain (Musa paradisiaca) and Banana (Musa paradisiaca) peels. J Nutr Food Sci 5: 370. doi:10.4172/2155-9600.1000370

Oladejo, J.A. And Adetunji, M.O (2012). Economic analysis of maize (zea mays l.) production in Oyo state of Nigeria. Agricultural Science Research Journals.Vol. 2(2) pp. 77-83.

Oladele E, Khokhar S (2011) Effect of domestic cooking on the polyphenolic content and antioxidant capacity of plantain (Musa paradisiaca). World Journal of Dairy & Food Sciences. 6: 189-194

Omotosho, k. (July 19, 2017). How to make super delicious plantain moi. Retrieved from:https://www.pulse.ng/lifestyle/food-travel-arts-culture/ukpo-ogede-how-to-make-super-delicious-plantain-moi-moi-id7014892.html

Onabanjo, O. O., Akinyemi, C. O., Sanni, S. A. & Kupoluyi , M. T. (2009) Mineral and Heavy Metal Content of Nigerian Dishes, Journal of Culinary Science & Technology, 7:2-3, 168-180, DOI: 10.1080/15428050903313473

Onuoha, O.N., Eme P.E. and Ekpo, U.E. (2014). Chemical Evaluation of Unripe Plantain Dishes Commonly Consumed by Type 2 Diabetics Attending the University of Uyo Teaching Hospital in Akwa Ibom State, Nigeria. *Pakistan Journal of Nutrition* 13 (6): 331-334, ISSN 1680-5194 © Asian Network for Scientific Information

Ridhi Kataria (2014). Proximate Nutritional Evaluation of Maize and Rice - Gluten Free Cereal. IOSR Journal of Nursing and Health Science (IOSR-JNHS). Volume 3, Issue 2 Ver. V, PP 01-06. e-ISSN: 2320–1959.p- ISSN: 2320–1940.www.iosrjournals.org.

Sandulachi E. and Tatarov P. (2012). Water Activity Concept and Its Role in Strawberries Food. Chem. J. Mold.7 (2), 103-115.

Tchango, J., Bikoï, A., Achard, R., Escalant, J.V. & Ngalani, J.A. (1999).PLANTAIN: Post-harvest Operations. Centre de Recherches Regionales sur

United state department of agriculture food and nutrition services. http://www.nfsmi.org/ accessed on 15th June, 2018

USDA (1998).Agriculture research service. Nutrient database for standard reference, release 12. Washington, DC, USA: United States Department of Agriculture.

Yongfeng Ai and Jay-lin Jane (2015). Macronutrients in Corn and Human Nutrition. Comprehensive Reviews in Food Science and Food Safety. Vol 15 Pp: 581-598

WHO Study Group (1990).Diet, nutrition and the prevention of chronic disease. WHO Tech. Rep. Ser., 797, 105-120.