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Proximate Composition, Phytochemicals and Antioxidant Status of Banga Soup (*Elaeis guineensis* extract)

Otuaga, Efe Juliana , Okpoghono, Joel * and George, Betty Omenebelle
Department of Biochemistry, Faculty of Science, Delta State University, Abraka, Nigeria
**Corresponding author: okpoghono@gmail.com*

Abstract
Most African food are prepared from plant materials that are reported to contain phytochemicals useful to the body. Information on most soups cooked using such plant materials are under reported. This study was designed to ascertain the phytochemicals, proximate composition, non-hemeiron and antioxidant indices of banga soup, a popular soup prepared from the aqueous extract of palm nut fruits. Soup samples were prepared using aluminium pot (soup A) and castiron pot (soup B) following the traditional method.Qualitative phytochemical properties indicated the presence of reducing sugar, tannin, alkaloid, saponin, flavonoid, and steroids. In addition, the quantitative phytochemical measurements also showed no significant difference ($p > 0.05$).Proximate composition analysis of samples showed no significant difference ($p > 0.05$) in the amount of moisture, crude protein, ash and carbohydrate.In conclusion, soup prepared with aluminium and cast iron pot are rich in phytochemicals. Crudelipid and fibrecontent of soup B were significantly higherthan soup A.

Keywords: Proximate analysis; phytochemicals; banga; soup

Introduction

Spices are products of plants which are used in various forms such as fresh, ripe, dried, broken or powdered mostly to contribute to colour, taste, aroma, flavour and pungency of food (Parveen *et al.,* 2014). Spices have been used for centuries by many cultures to enhance flavor, aroma and as preservative and medicinal agents (Otunola *et al.,* 2014). Banga soup is a native soup popular among people from Delta State in Southern Nigeria. It is a delicious soup made from palm kennel fruit, fresh fish and spices. Lete (2013) reported that the soup is loaded with spices such such as beletete (bush apple leaves; *Heinsia crinita*), (*Tetrapleura tetraptera*), ataiko (*Aframomum sceptrum*), Obenetietien (sweet basil leaves; *Ocimum basilicum*), a stick of oburunbebe *(Glycyrrhiza glabra*), chopped

onion (*Allium cepa*) and chili pepper (*Capsicum frutescens*).As various spices are often consumed as food along with their medicinal benefits, evaluating the medicinal significance in relation to the knowledge and use of these spices can help to understand their worth and the awareness of the populace. The nutritional compositions and antioxidant properties of some typical Urhobo Nigerian soups have been reported (Tonukari *et al.*, 2013). Li *et al.* (2014) reported that natural polyphenols is a large group of plant secondary metabolites ranging from small molecules to highly polymerized compounds, having at least one aromatic ring with one or more hydroxyl functional groups attached.

The interactions between food and local kitchen utensils (aluminium and cast iron) can be a potential source of aluminium and iron released, which can contribute to aluminium and iron ingestion in the human body. Hence, it is important to identify the possible effects of such an interaction. Medical researches link aluminium to various brain, blood, and bones diseases. The cause of Alzheimer disease is still unknown, but aluminium might play a major role for the cause of it (Mohammad *et al.*, 2011).

Iron is a mineral that is normally present in numerous foods and their products. It is also available as a dietary supplement and many products are fortified with this nutrient (Erdman *et al.*, 2012). Iron plays its basic role in exchanging of gases mainly oxygen from lungs to all over the body cells.An insufficiency of iron in the body can leave a man feeling worn out and drowsy, and can prompt a turmoil called anemia (Jain, 2018). Dietary spices are rich in polyphenol (Zhou *et al.*, 2016). Oluwatoyin and Adebukola (2018) reported that polyphenols in food sources inhibits heme iron bioavailability. This work is designed to assess the phytochemicals, proximate composition, antioxidant indices and non-heme iron content of banga soup cooked with Al pot and cast Fe pot.

Materials and Methods

Soup ingredients

The banga soup ingredients were purchased in Ughelli main market, Delta State. The ingredients were measured as follows; 500 g palm oil fruit, 500g of fresh catfish, 1 tablespoon of ground ataiko (*Aframomum sceptrum*). A tablespoon of Obeletientien (sweet basil; *Ocimum basilicum*), 10 g of onion bulb (*Allium cepa*) finely chopped, 1 tablespoonful ground crayfish, 2 cubes of maggi, Chili pepper (*Capsicum frutescens*) and 2 tablespoonful of salt.

Banga Soup Preparation

The banga soups were prepared in AP and CIP following the local procedure. The palm kernel fruit was boiled (120 – 140°C for 30 minutes) and pound gently not to break the nut in a mortar and pestle. Thereafter, little hot water was poured and the extract was strained through a sieve. The kernels including other solid fibrous mescocap were removed leaving behind the aqueous portion. About 1.2 L of the aqueous extract was poured into pot and then allowed to boil until it thickens and oil rise to the top.The chopped onions, pepper, ground crayfish,banga spices and maggi cube were added, then the pot was covered and allowed to cook for 8 minutes. Thereafter, the fresh fish was added and allowed to cooked. Then, Obeletientien leaves and salt to taste were added and simmered for 1 minute and the banga soup was ready.

Preparation of banga soup extract

The banga soups were allowed evaporate to dryness in an electric oven (40^{o}C). Fifty grams of the dried samples was homogenized in 450 ml aqueous tween 80 (5 % tween 80) to dissolve the present in the soup, and then filtered with clean muslin cloth. The extract was used for biochemical analysis.

Proximate composition of the soup sample

Moisture content: Percentage moisture content of soup samples was determined by a gravimetric method (Association of Official Analytical Chemists(AOAC) 2000). One gram of each sample was weighed (W1) into pre-weighed moisture plate and placed in an oven at 105°C for 24 h. The sample was removed from the oven, cooled in a desiccators and reweighed (W2). Moisture percentage was calculated according to the formula:

$$\text{Moisture (\%)} = (W1 - W2)/W1 \times 100$$

Ash content: Ash content was evaluated at 600°C (Association of Official Analytical

Chemists, 2000). Two grams of each soup sample was weighed into a pre-weighed porcelain crucible and placed on an electric heater and then transferred to a muffle furnace at 600°C for 2 h. The crucible was removed from the furnace, than allowed to cool in a desiccator and weighed. Ash content was calculated using the formula below:

$$\text{Ash (\%)} = (\text{Final weight of sample/weight of sample}) \times 100$$

Crude fiber: It was estimated according to method of AOAC (2000). One gram of each defatted sample was placed in a glass crucible followed by digestion using about 150 mL of H_2SO_4 (1.25 %) for 30 min. Afterwards, the acid was filtered off and the residue washed using boiling water. The resulting residue was again digested with 150 ml of NaOH (1.25%). Thereafter, the crucible was oven dried at 105°C overnight after removing it from the extraction unit. The sample was allowed to cool in a desiccator and then weighed (W1) followed by ashing using 550°C in a furnace for 2 h. This was again allowed to cool and reweighed (W2). Extracted fibre of sample was calculated according to the formula:

$$\text{Crude fibre (\%)} = \text{Digested sample (W1)} - \text{Ashed sample (W2)/Wt of sample} \times 100$$

Fat content: It was determined out using soxhlet apparatus. About 3 g of sample was allowed to dried at 105^{o}C for about 3-4 hthen cooled. The sample was wrapped using filter paper and placed in the extraction unit using n- hexane as extracting solvent.

$$\text{Crude fat (\%)} = (\text{Extracted fat/Sample weight}) \times 100$$

Crude protein: Crude protein was determined by the Kjeldahl method as described by AOAC (2000). Sample (2 g) was placed in a Kjeldahl flask and about 5g of Na_2SO_4plus 1 g of $CuSO_4$ and 25 ml Conc. H_2SO_4 was added. The mixture was cooled afterwhich about20 mL distilled water was poured in. Twenty-five millilitres of NaOH (40 %) was added followed by distillation. The NH_3given out was collected in boric acid and this was titrated with 0.1MHCl. A blank was prepared and titration was done in the same manner. The percentage of protein was calculated as follows:

$$\text{Crude protein (\%)} = (\text{sample titre} - \text{blank titre}) \times 14 \times 6.25 \times 100/\text{sample weight}$$

Where 14 is the molecular weight of nitrogen and 6.25 is the nitrogen factor.

Phytochemical screening

Qualitativephytochemical analysis to detect the presence of bioactive compounds was done using standard procedures (De *et al.*, 2010). After the addition of specific reagents to the sample, visual observation of color change or precipitate formation was recorded. While the quantitative analysis was carried out following the standard method described by Ekwueme *et al.* (2015).

Antioxidant Determination

The determination of total phenolic content was carried out according to the method described by Liu and Yao (1997) using Folin-Ciocalteau reagent . Total phenolics contents of samples

were expressed as milligrams of gallic acid equivalent (mg GAE)/100 g of dry weight.Total flavonoid of the extracts was determined with colorimetric aluminium chloride methods as described by Ebrahimzadeh *et al.* (2008) using aluminium trichloride ($AlCl_3$) in methanol. The total flavonoid content was calculated using a standard curve with rutin (0-100 mg/l) as the standard. The free radical scavenging ability of the sample extracts against DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical was estimated using the method described by Ursini *et al*. (1994). Total antioxidant capacity (TAC)was evaluated by the phosphomolybdenum method according to the procedure described by Prieto (Prieto *et al.*, 1999). The assay is based on the reduction of Mo(VI) to Mo(V) by the extract and subsequent formation of green phosphate/Mo(V) complex at acid pH. The ferric reducing power (RP) was determined according to the method previously described by Oyaizu (1986). According to this method, the reduction of Fe^{3+} to Fe^{2+} is determined by measuring the absorbance of Perl's Prussian blue complex. The absorbance was measured at 700 nm. Increased absorbance of the reaction mixture indicated increased reducing power.

Non-heme Iron

Non-heme iron was analyzed by the Ferrozine method described by Ahn *et al*. (1993). Briefly, 0.50 g of freeze-dried sample was dissolved in 3 mL of 0.1 M phosphate buffer (pH 5.5) and 1 mL of 2% ascorbic acid in 0.2 M HCl and was left to stand at room temperature for 15 min before adding 2 mL of 11.3% trichloroacetic acid and then was centrifuged at 3000 rpm for 10 min. To 2 mL of the supernatant, 0.8 mL of 10% ammonium acetate and 0.2 mL Ferrozine reagent were added, and the absorbance was measured at 562 nm. Using 1000 mg/L stock solution of $FeCl_3$, standard solutions were adjusted at 10, 25, 50, and 100 mg/L.Standard curve was prepared by plotting the absorbance against the several concentrations of $FeCl_3$ standard solutions.

Statistical Analysis

All analysis was carried out in triplicates and the results were presented as means ± standard deviation (SD). Differences between the mean values were estimated using one-way analysis of variance (ANOVA). The results were considered statistically significant when $p < 0.05$.

Results

The results in Table 1, indicated that reducing sugar, tannin, alkaloid, saponin, flavonoid, and steroids were presence in in soup A and soup B. However, no significant differences were observed in these

parameters quantitatively when soup A was compare with soup B (Table 2). There were no significant difference ($p>0.05$) in the moisture, crude protein, ash and carbohydrate content of soup A when compare with soup B(Table 3). Significant increase wasobserved in crude fibre of soup A when compare with soup B. The crude lipid content of soup B was significantly higher compare with soup A. There were no significant difference ($p>0.05$) in reducing power, total phenol, and flavonoids of soup A in comparison with soup B (Table 4). Non-haeme iron content of soup B had no significant difference but little increase when compare with soup A. TACin soup B was significantly higher in comparison with soup

Table 1. Phytochemical screening of banga soup prepared in aluminium and cast iron pot.

Parameters	**Soup A**	**Soup B**
Reducing sugar	+	+
Tannins	+	+
Alkaloids	+	+
Saponin	+	+
Flavonoids	+	++
Steroids	++	++

\+ Present, ++ highly present

Soup A: Banga soup cooked in aluminium pot, Soup B: Banga soup cooked in cast iron pot.

Table 2. Quantitative phytochemicals analysis of banga soup prepared with two different pot.

Phytochemicals (mg/dl)	**Soup A**	**Soup B**
Reducing Sugar	78.23±0.23 [a]	80.95±0.53[a]
Tannin	58.25±0.98 [a]	60.50±1.32[a]
Alkaloid	48.39±1.84 [a]	50.43±1.28[a]
Saponin	40.50±0.86 [a]	44.31±3.95[a]
Flavonoid	33.54±2.70 [a]	36.40±3.91[a]
Steroids	35.18±4.92 [a]	37.55±6.95[a]

Mean of triplicate value for each soup parameters with the same letter are not significantly different at 5% level ($p>0.05$).

Table 3. Proximate analysis of banga soup cooked with cast iron pot and aluminium pot.

Parameters (%)	**Soup A**	**Soup B**
Moisture	19.37 ± 0.14 [a]	21.68 ± 0.33 [a]
Crude lipid	25.83 ± 2.21 [b]	31.00 ±1.00 [d]
Crude protein	18.02 ± 0.41 [a]	20.31 ± 0.75 [a]
Crude fibre	20.71 ± 0.77 [a]	27.17 ± 1.42 [b]
Ash	3.85 ± 0.47 [c]	2.70 ± 0.15 [c]
Carbohydrate	5.76 ± 2.87 [c]	3.59 ± 0.20 [c]

Triplicate value were represented in mean ± SD. Mean value for each soup parameters with different superscript letter differ significantly different at ($p>0.05$).

Table 4. Non-enzymatic antioxidant level and non-heme iron content of soup samples

Parameters (units/g DW)	Soup A	Soup B
Reducing power	340.71±9.20 [a]	344.54±15.20 [a]
Total phenol	60.47±5.14 [a]	64.62±3.66 [a]
Total antioxidant	470.30±10.98 [a]	480.43±10.35 [b]
Flavonoids	40.39±3.97 [a]	42.56±3.99 [a]
Non-Heme iron	17.53±4.19 [a]	19.91±1.31 [a]

Triplicate values were presented in mean ± SD. Mean with different superscript letter in the same horizontal row differ significantly at $p< 0.05$.

Table 5. 2,2′-diphenylpicryl-1-hydrazyl (DPPH) content of soup samples

	DPPH (% inhibition)		
Concentration (µg/mL)	**10**	**25**	**50**
Soup A	45.43±5.27 [a]	48.43±6.90 [a]	55.54±4.99 [b]
Soup B	50.56±6.26 [a]	53.23±3.33 [a]	61.50±5.22 [a]

Values (triplicate) were shown in mean ± SD. Mean with different superscript letter (a,b) in the same horizontal row differ significantly ($p< 0.05$).

Discussion

The consumption of aqueous extracts of palm fruits may be beneficial to humans as it has been reported that the aqueous extracts of palm fruits are rich in polyphenols (Ahmad *et al.,* 2008).. Polyphenols are known to be a potent antioxidant that could scavenge free radicals (Ahmad *et al.,* 2008). The study indicated that antioxidant phytochemicals such as tannin, alkaloid, saponin, flavonoid, steroids and reducing sugar were presence in soup A and soup B(Table 1 and 2). Spices and herbs in banga soup could provide additional sources of natural antioxidants. Antioxidants from spices are a large group of bioactive compounds which consist of flavonoids, phenolic compounds, sulphur-containing compounds, tannins, alkaloids, phenolic diterpenes and vitamins (Ma *et al.,* 2016; Patra *et al.,* 2016).

However, no significant difference ($p>0.05$) were observed in moisture content, crude protein, ash and carbohydrate content of soup A when compare with soup B. Crude fibre was significantly higher in soup B compare to soup A. Fibre helps in removing carcinogens from the digestive tract. Also some of the dietary fibers in our food such as gum and mucilage's have been reported

to decrease blood cholesterol diabetes individual (Emebu and Anyika, 2011). Emebu and Anyika (2011) also showed that carbohydrates are vital nutrients required for adequate diet providing energy needed for the body. The high levels of moisture observed in soup samples suggests that they would not store for long time without spoilage. High water content could enhance microbial activity leading to food spoilage (Olayiwola and Okhiria, 2012). The values for moisture fell within the range of standard moisture content of the banga soup dry sample previously reported by Rekha *et al*. (2010). The crude lipid content of soup B was significantly higher compared with soup A. The high crude fat levels in the soups could be attributed to the high crude fat content of *E. guineensis* fruit extract used for the soup preparation.

The crude protein levels of soup A was 18.02 % and soup B was 20.31 %. These results are higher than the results of Kolawole and Obueh (2012) who reported 5.99 % crude protein for banga soup. The author showed that the soup can meet the recommended daily allowance for protein between21 g – 65 g for an individual of 70 kg body weight. The high protein content may also due to the assumption that the people in the South-South region of Nigeria consume high proportion of protein because of their love of fish and meat. The data obtained showed that the soup A and soup B would serve as an important sources of energy while the fish in the soups would be a source of protein . Essential oils from the palm oil fruit and spices have been reported to possess an interesting spectrum of antioxidant properties (Dubey *et al*., 2000; Ikechukwu *et al.*, 2017; Lauve *et al.*, 2015).

The carbohydrate, protein and lipid content of soup B were higher than that of soup A. Al in the soup may form complex with the carbohydrate, protein and lipid there by reducing the content of these parameters. Study have demonstrated that food cooked in Aluminium utensils has a higher aluminium content which can be detrimental for healthy individuals and particularly to persons with chronic renal failure. Food prepared with iron utensils may improve iron content in the food (Jain, 2018). Cast iron non-stick cookware helps in diminishing the emission of poisonous synthetic compounds like perafurocarbons (PFC) while other metals (such as Al and Cu) produces harmful vapour when overheated (Jain, 2018).

The reduction in total phenol and flavonoids level of soup A comparison with soup B were not significant ($p > 0.05$) (Table 4). The reduction may base on the complex formation of phenolic compounds with Al (Ordonez *et al.*, 2006). The DPPH of the soup sample had no significant difference at the concentration of 10 and 25 µg/ml. However, there were significant increasein DPPH of soup B in comparison with soup A, as the inhibition factor increases at 50 µg/ml (Table 5).TAC was significantly higher in soup B when compared withsoup A.Reducing power was not significant for soup cooked in both aluminium and cast iron pots. The high antioxidant capacity and DPPH scavenging activity exhibited by the soups could be ascribed to the synergistic action of the multi-antioxidant components of the soups. The observed antioxidant effects suggest that individuals who consume banga soup rich in spices such as ataiko (*A. sceptrum*), Obenetietien (sweet basil leaves; *O. basilicum*), chopped onion (*A. cepa*) , and chili pepper (*C. frutescens*) could effectively reduce oxidative damage

caused by free radicals generated in human body. It further indicates that individuals need not to consume excess banga soup cooked with cast iron potbefore they can achieve the health benefits desired.Non-heme iron content in soup cooked in both pots were not significant. However, little increase was showed in non-heme iron of soup B when compare with soup A (Table 4). Metal ions such as Fe, Al and Cu are likely inducers of oxidative processes which may alter electron-rich micronutrients such as phenols and carotenoids (Perron and Brumaghim, 2009; El Hajji *et al.,* 2006). An adequate dietary iron intake is important in the synthesis of new blood cells to assist in growth and development and insufficient iron intake causes anemia which may result in negative effects on brain development.

Conclusion

The study revealed that aqueous extract of palm oil fruit prepared using aluminium pot may have great impact on alteration ofphytochemicals and antioxidant indices than cast iron pot. Banga soup prepared with cast iron pot may improve Fe content of the soup than aluminium pot .Encouraging the consumption of iron rich banga soup especially among women may help in reducing anemia where iron deficiency anemia is endemic. Nevertheless, to enhance bioavailability they should be encouraged to increase the intake of fish or organic acids such as ascorbic acid to enhance absorption.

References

Ahmad, A.L., Chan, C.Y., Abd Shukor, S.R. and Mashitah, M.D. (2008). Recovery of oil and carotenes from palm oil mill effluent. *Chemical Engineering Journal* 141: 383-386.

Ahn, D. Wolfe, F. and Sim, J. (1993). Three methods for determining non-heme iron in turkey meat. *Journal of Food Science* 58 (2): 288–291.

AOAC, (Association of Official Analytical Chemists), (2000).Official Methods of Analysis. 17th Edition, *Association of Official Analytical Chemists,* Gaithersburg, MD,USA. Method 925.10,65.17,974.24,992.16.

De, S, Dey, Y.N. and Ghosh, A.K. (2010). Phytochemical investigation and chromatographic evaluation of different extracts of tuber of *Amorphaphallus paeoniiflius* (*Araceae*). *International Journal Pharmaceutical Biomedical Research*1(5): 150-157.

Dubey, N.K., Tiwari, T.N., Mandin, D., Andriamboavonjy, H. and Chaumont, J.P. (2000). Antifungal properties of *Ocimum gratissimum* essential oil (*Ethyl cinnamate chemotype*). *Fitoterapia* 7(15): 567-569.

Ebrahimzadeh, M.A., Hosseinimehr, S.J, Hamidinia, A. and Jafari, M. (2008). Antioxidant and free radical scavenging activity of *Feijoa sallowiana* fruits peel and leaves. *Pharmacologyonline* 1:7-14.

Ekwueme, F.N., Nwodo O. F. C., Joshua, P.E. Nkwocha, C. and Eluka, P.E. (2015).Qualitative and quantitative phytochemical screening of the aqueous Leaf extract of *Senna mimosoides*: Its effect in in vivo leukocyte mobilization induced by inflammatory stimulus.

*International Journal of Current Microbiology Applied Sci*ence 4(5):1176-1188.

El Hajji, H. Nkhili, E. Tomao V. and Dangles, O. (2006). Interactions of quercetin with iron and copper ions: Complexation and autoxidation. *Free Radical Research* 40, 303-320.

Emebu, P.K. and Anyika, J.U. (2011). Proximate and Mineral Composition of Kale (*Brassi caoleracea*) Grown in Delta State, Nigeria. *Pakistan Journal of Nutrition*10(2): 190 – 194.

Erdman JW, MacDonald IA. and Zeisel SH. (2012). Present Knowledge in Nutrition, Tenth edition Washington: Wiley Blackwell. Pp. 506-520.

Ikechukwu, R.U., Amarachi, A., Uchenna O.N., Kalu, A. N., Ikechukwu, E.S., Chukwuemaka, N.P. and Ngwu O.R. (2017). Evaluation of Antioxidant Activity of Aqueous Extracts of Palm Fruits (*Elaeis guineensis*). *Asian Journal of Biochemistry* 12: 49-58.

Jain, P. (2018). Effect of cooking utensil on iron content of food. *Journal of Public Health Cetology* **1(4):**89-92.

Kolawole, S.E and Obueh H.O (2012). Proximate and micronutrient compositions of some selected foods and diets in South–South Nigeria. *Scholarly Journals of Biotechnology* 1(3):45-48.

Lauve, R. Y., Tchokouaha, A.D., Tchamgoue, O. M. A., Odogwu, O, Funmilola, D, (2015). Comparative Antioxidant Capacity of the Spices of Some Traditional Soups in Nigeria. *Academic Journal of Bioscience* 3(1B):79-84.

Lete, N.L. (2013). How to make Banga Soup : Efik Banga Soup. Nigerian Food TV. https://www.nigerianfoodtv.com/how-to-make-banga-soup-urhobo-banga-soup/ (accessed 3rd January, 2019).

Li, A. N. Li, S., Zhang, Y. J. Xu, X. R. Chen, Y. M. and Li, H. B. (2014). Resources and biological activities of natural polyphenols. *Nutrients* 6 (12): 6020–6047.

Liu, Q, and Yao H.Y. (2007). Antioxidant activities of barley seeds extracts. *Food Chemistry* 102:732-737.

Ma, Q., Eun-Young K., Elizabeth, A. L., and Okhee, H. (2012). Dietary polyphenols inhibit heme iron absorption in a dose-dependent manner in human Intestinal Caco-2 cells. *Journal of Food Science* 76(5): 143–150.

Mohammad, F. S., Al Zubaidy, E.A.H. and Bassioni, G. (2011). Effect of Aluminum Leaching Process of Cooking Wares on Food. *International Journal of Electrochemical Science* 6:222-230.

Tonukari, N.J., Oghenetega J.A., Guanah S., C. C E., Samson, O S., Eraga, L., Ezedom, T., Edema, U., Odiyoma, E. and Anigboro, A.A. (2013). Nutritional compositions and antioxidant properties of typical Urhobo Nigerian soups. *Nigerian Journal of Technological Research* 8(2): 55-63

Olayiwola, I.O and Okhiria, A.O (2012). Evaluation of Iron, Zinc, Sodium and Phytate Contents of Commonly Consumed Indigenous Foods in Southwest Nigeria. *Journal of Nutrition and Food Science* 2:169-173.

Oluwatoyin, B. O and Adebukola, A A. (2018). Dietary Iron intake in Nigeria. *Novel Techniques in Nutrition and Food Science* 1(4):1-8.

Ordonez, A.A.L., Gomez, JG., Vattuone, M.A. and Isla, M.I. (2006). Antioxidant activities of *Sehium edule* (Jacq.) Swart extract. *Food Chemistry*. 97;452-458.

Otunola, G. A., Oloyede, O. B., Oladiji, A. T. and Afolayan, A. J. (2014) Selected spices and their combination modulate hypercholesterolemia-induced oxidative stress in experimental rats. *Biological Research* 47:5-10.

Oyaizu, M. (1986). Studies of products browning reaction: Antioxidative activity of products of browning reaction prepared from glucosamine. *Journal of Nutritio*n 44: 307-315

Parveen, S., Das, S., Begum, A., Sultana, N., Hoque, M. and Ahmad, I. (2014) Microbiological quality assessment of three selected spices in *Bangladesh. Food Research International - Journal* **21**: 1327-1330.

Patra, K., Jana, K., Mandal, D.P. and Bhattacharjee, S. (2016). Evaluation of the antioxidant activity of extracts and active principles of commonly consumed Indian spices. *Journal of Environmental Pathology, Toxicology and Oncology* 35: 299–315.

Perron, N. R. and Brumaghim, J. L. (2009). A review of the antioxidant mechanisms of polyphenol compounds related to iron binding, Cell. *Biochemical and Biophysical Research* 53:75-100.

Prieto, P., Pineda, M. and Aguilar, M. (1999). Spectrophotometric quantitation of antioxidant capacity through the formation of a phospho-molybdenum complex: specific application to the determination of vitamin E. *Analytical Biochemistry*269: 337–341.

Rekha, M.N., Ramesh, A., Dharmesh, Y.S., Chauhan, A.S. and Ramteke, R.S. (2010). Evaluation of antioxidant properties of dry soup mix extracts containing dill (*Anethum sowa* L.) leaf. *Food Bioprocess Technology* 3: 441-449.

Ursini, F., Maiorino, M., Morazzoni, P., Roveri, A. and Pifferi, G. (1994). A novel antioxidant (IdB 1031) affecting molecular mechanisms of cellular. *Free Radical Biology and Medicine* 16:547-53.

Vayalil, P. K. (2002). Antioxidant and antimutagenic properties of aqueous extract of date fruit (*Phoenixdactylifera* L Arecaceae). *Journal of Agricultural Food Chemistry* 50: 610–617.

Zhou, Y., Li, Y., Zhou, T., Zheng, J., Li, S. and Li, H. B. (2016). Dietary natural products for prevention and treatment of liver cancer. *Nutrients* 8 (3):156-159.