

Nutritional compositions and antioxidant properties of typical Urhobo Nigerian soups.

Nyerhovwo J. Tonukari^{1,2}, Oghenetega J. Avwioroko^{1,2}, Guanah Seitonkumoh², Chinoye C. Enuma¹, Samson O. Sakpa¹, Linda Eraga¹, Theresa Ezedom^{1,2}, Ufuoma Edema¹, Enovwo Odiyoma¹ and Akpovwehwee A. Anigboro². ¹African Research Laboratories, Otorho-Agbon, Delta State, Nigeria. ²Department of Biochemistry, Faculty of Science, Delta State University, P.M.B. 1, Abraka, Nigeria.

Abstract

In this study, the nutritional compositions and antioxidant properties of six typical Urhobo (Nigerian) soups; Amiedi (*Elaeis guineensis* extract), Palm oil ('Oghwo-ewwri'), Egusi (*Citrullus lanatus*)–Okro (*Abelmoschus esculentus*) soup ('Emuigari-ishavwo'), Pepper (Iribo-erhare), Egusi-vegetable ('Emuigarifo'), and Egusi-Pepper ('Ovwowwo') were investigated. The results show that the typical Urhobo soups were rich in protein and contained extremely low concentrations of reducing sugars. The highest concentrations of high density lipoprotein (HDL)-cholesterol (7.35 ± 0.25 mg/ml), low density lipoprotein (LDL)-cholesterol (1.19 ± 0.67 mg/ml), and triglycerides (6.67 ± 0.29 mg/ml) were observed in 'Ovwowwo', 'Amiedi' and 'Emuigari ishavwo', respectively. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay results showed that all the soup samples exhibit high antioxidant properties. Also, the highest radical scavenging effect was observed in Amiedi and Emuigari-ishavwo soups. The high amount of phenolic and flavonoid compounds in the soups is a measure of their antioxidant capacities. The soups are not only nutritious but also health protective.

Keywords Typical Urhobo soups, Nutritional compositions, Phenols, Flavonoids, DPPH radical, Antioxidant activity.

Email: tonukari@gmail.com.

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Introduction

Traditionally, some foods are referred to as soups depicting that such are liquid nutritious preparations eaten simultaneously with a solid or strong carbohydrate or protein mixture. In Nigeria, where many ethnic groups and tribes exist, a particular tribe or ethnic group have dishes or soups traceable to them and used as part of their identity. The 'Urhobo' people in Delta State, Nigeria are one of such ethnic groups in the nation that have such unique soups, approximately 6 or more, that are specific to them. They live in a territory bounded by latitudes 6° and 5°, 15° North and longitudes 5°, 40° and 6°, 25° East in Nigeria (Asagba, 2005).

Soups considered to be Urhobo in nature include Egusi egusi (*Citrullus lanatus*) vegetable soup (Emurigari-ifo), egusi (*C. lanatus*) –okro (*Abelmoschus esculentus*) soup (Emurigari-ishavwo), palm fruit (*Elaeis guineensis*) oil soup (Oghwo-ewwri), Pepper soup (Iribo-erhare), Ogbono (*Irvingia gabonensis*) soup, Banga or palm fruit (*E. guineensis*) extract soup ('Amiedi'), Melon (*C. lanatus*) pepper soup ('Iriboerhare') and Pepper soup without melon ('Ovwowwo'). Typical Urhobo soups are prepared with special spices and ingredients which gives it, its nutritional value and antioxidant activity. Such ingredients and spices include 'atama' leave ('Beletientien'), bitter leaves (*Vernonia amygdalina*), chilli pepper, crayfish (*Procambarus zonangulus*), vegetables (Pumpkin *Cucurbita* spp), melon or egusi (*C.*

lanatus). Most foods are known to contain natural antioxidants from the spices that help protect the body against cancer and other diseases (Senthil *et. al.*, 2004).

Naturally occurring antioxidant in vegetables and spices are ascorbic acid (vitamin C), flavonoids, tannins, phenol and carotenoids which possess the ability to reduce the oxidative damage associated with many disease (Bharti *et. al.*, 2012). Antioxidants are absolutely critical for maintaining optimal cellular and systemic health and wellbeing (Le Belle, 2011).

In this study, the nutritional compositions (lipid profile, total reducing sugar and total protein contents) as well as the antioxidant capacities of six typical Urhobo Nigerian soups [banga (*E. guineensis*) extract soup (Amiedi), palm fruit (*E. guineensis*) oil soup (Oghwo-ewwri), egusi (*C. lanatus*) –okro (*A. esculentus*) soup (Emuigari-ishavwo), pepper soup (Iribo-erhare), egusi-vegetable soup (Emuigarifo), and egusi pepper soup (Ovwowwo)] were investigated.

Materials and methods.

Preparation of Soup Sample

Banga or Palm Fruit (*E. Guineensis*) Extract Soup ('Amiedi').

Palm fruits were washed and boiled with water for about 30 min. These were pounded in a mortar with a pestle till all the endocarp was separated from the nut to smooth pulp to get the soup extract. Beef and dried fish with one bulb of onion (*Allium cepa*) and maggi cube

(sodium glutamate) were parboiled for about 20 min. While the beef was being cooked, the crushed endocarp-palm oil mixture (usually rich in triglycerides and essential fatty acids) was extracted with warm water to a required volume and thickness (depending on the pot size and quantity of mashed palm fruits). Extracted palm fruit was allowed to stand for some time, and was slowly filtered and poured into the pot that was used to cook the “amiedi”. The vegetable was washed and cut into tiny pieces. The remaining bulb of onion was cut; crayfish (*P. zonangulus*) and pepper were ground and set aside. The pot of palm fruit oil was set on the gas cooker and left to boil till clear oil was noticed at the surface of the “amiedi”. The parboiled mixture of beef, dry fish and stock, the onions (*A. cepa*), crayfish and pepper was then added and was cooked for 5 min. The vegetable was then added and salted (NaCl) to taste and was then left for 2 min.

Pepper Soup (‘Irhibo-Erhare’).

African catfish (*Clarias gariepinus*) was washed and cut into 1-inch thick slices. Some fresh water was boiled and poured on the pieces of the fish which firmed them up and also to remove slimy dirt from the fish. The “Erhie” spice seeds (African nutmeg) was roasted (stirring continuously) using an old frying pan till it was smelled (a distinctive aroma). The outer membrane (epicarp) of all the “Erhie” spice seeds was peeled off and the endocarp was ground with a dry mill. The onion was cut into tiny pieces. The dry ‘uziza’ spice (*Piper guinensis*) was broken into tiny pieces by rubbing them with the fingers. The pieces of the catfish were placed in a pot and enough water which was able to cover the content of the pot was added. The ground Erhie (African nutmeg), crayfish (*P. zonangulus*), dry uziza (*P. guinensis*), chilli pepper and NaCl salt (to taste) were added. The pot was covered and left to cook for 10 min.

Egusi (C. Lanatus) Soup with Vegetable (‘Emuigarifo’).

A pot was placed on the cooker and allowed to get hot, with all residue of water drying out. Red palm oil was added with care since it could smoke and splash around. This was allowed to warm for about 1 min. Blended tomatoes, fresh/dried pepper, and onion paste was then added and stir-fried for about 10-15

min. cooked meat is added and the pot is covered and allowed to simmer for about 3 min. The soup was stirred intermittently to prevent burning. Egusi (*C. lanatus*) paste (or fried), vegetables, salt (NaCl) and one or two cubes of maggi (sodium glutamate) were added to taste and allowed to boil for a further 10 min.

Egusi (C. Lanatus)-Okro (A. Esculentus) Soup (‘Emuigari Ishavwo’).

A pot was placed on a stove or heat source and allowed to get hot, with all residue of water drying out. Red palm oil was added in the pot with care since it could smoke and splash around. The oil was allowed to warm for about 1 min. Blended tomatoes, fresh/dried pepper, onion (*A. cepa*) paste was then added to the oil and stir-fried for about another 10-15 min. Now the cooked meat is added to the stew base and the pot is covered and allowed to simmer for about 3 min. The soup was stirred intermittently to prevent burning. The melon (egusi) paste (or fried) was added to the stew with meat in it. Okro (*A. esculentus*), salt (NaCl) and one or two cubes of maggi (depending on the total volume of soup) were added to taste and allowed to boil for about 10 min.

Palm (E. Guineensis) Oil Soup (Oghwo-Evwri).

Water was poured into the cooking pot and allowed to boil for 5 min after which, palm (*E. guineensis*) oil and blended pepper was added to the cooking pot and allowed to boil. The meat was boiled with salt and maggi to taste. Starch was dissolved in water and mixed very well. This involves a little expertise that entails using a little water and observing the feeling on one’s hand until a less gritty feeling is being observed. Fish, shrimps, meat and salt were added to the soup after 5 min. Thereafter the maggi cubes and potash (‘Ikewun’) were added but utmost care has to be taken when adding the potash so as to prevent the soup from pouring out. The soup was left to cook for 5 min.

Egusi (C. Lanatus)-Pepper Soup (‘Ovwovwo’).

A pot containing blended egusi (*C. lanatus*) mixed with water, pepper; Ehu (Calabash Nutmeg) seeds was placed on the cooker and allowed to boil for some minutes. The dry ‘uziza’ spice (*P. guinensis*) was broken into tiny pieces and also added to the boiling mixture. Now cooked meat and fish was added

to the boiling soup and the pot is covered and allowed to simmer for about 3 min. The soup was stirred intermittently to prevent burning. Salt and one or two cubes of maggi were added to taste and allowed to boil for about 10 min. The cooking methods of these soups may vary depending on palatability, family background and personal taste. Cooking methods may even vary between individuals.

Homogenisation and Centrifugation of Soup Samples.

The soup samples were separately homogenized using a mortar and a pestle to obtain the homogenate. The homogenates were collected into test tubes and then centrifuged at 4000 rpm for 15 min. The supernatants were collected into separate test tubes and then re-centrifuged at 4000 rpm for 5 min to obtain a pure supernatant.

Nutritional Parameters Assayed.

Total Reducing Sugar Content.

The reducing sugar content of each soup sample was determined according to the method of Miller (1959) with some modifications. Three milliliter (3 ml) of DNS reagent was added to 3 ml of soup sample and then, test tubes were tightly capped to avoid loss of liquid due to evaporation. Test tubes contents were heated at 90°C for 5 -15 min to develop a red/brown colour. One milliliter (1 ml) of a 40% potassium sodium tartrate (Rochelle salt) was added to stabilize the colour. After cooling to room temperature in a cold water bath, absorbance was read in a spectrophotometer at 575 nm wavelength against reagent blank.

Total Soluble Protein Content.

The total soluble protein content of each soup was determined by means of Biuret method as described by Gornal *et. al.* (1949) with some modifications. 1.5 ml of Biuret reagent was added to 0.5 ml of each soup in their respective test tubes and thoroughly mixed. Thereafter, the test tubes were left to stand for 30 min at room temperature and then the absorbance of each sample, and serum bovine albumin (standard protein) were determined in the spectrophotometer at 540 nm wave length against reagent blank.

Levels of Triglyceride, HDL-Cholesterol, And LDL-Cholesterol.

The concentrations of triglyceride, HDL-cholesterol, and LDL-cholesterol in the typical Urhobo soups were determined using RANDOX kits. The procedure described by the kit manufacturer for each assay was duly followed as stated in the manual.

Markers of Antioxidant Capacity Assayed

Total Flavonoid Contents of Soups.

This was determined by colorimetry using a method described by Jia *et. al.* (1999) with some modifications. Two hundred and fifty microliter (250 µl) of the extract was added to 1.25 ml of distilled water and 75 µl of 5% NaNO₂. After 5 min, 150 µl of 10% AlCl₃.H₂O was added, followed by 500 µl of 1 M NaOH and 275 µl of distilled water after 6 min. The solution was properly mixed and the colour intensity of the mixture read at 510 nm. Ascorbic acid was used as the standard.

Total Phenol Content of Soup.

This was carried out according to the method described by Singleton and Rossi (1965). One milliliter (1 ml) of Folin C reagent was added to 1 ml of the sample. After 3 min, 1 ml of saturated Na₂CO₃ solution was added and the solution was made up to 10 ml with distilled water. The reaction mixture was kept in the dark for 90 min. The absorbance was read at 725 nm. Ascorbic acid was used as the standard.

2, 2-Diphenyl-1-Picrylhydrazyl Radical (DPPH[•]) Scavenging Activity Assay.

This was estimated according to the method described by Hatano *et al.* (1988) with little modification. To 100 µl of the soup homogenate, 2.7 ml methanolic solution of DPPH radical (6 x 10⁻⁵ mol/l) was added. The mixture was shaken vigorously and left to stand for 60 min in the dark until stable absorption values could be obtained. The reduction of the DPPH radical was determined by measuring the absorption at 517nm. The standard used was ascorbic acid. The radical scavenging activity was calculated by the formula:

$$\%RSA = [(A_{DPPH} - A_S) / A_{DPPH}] \times 100.$$

Where, %RSA denotes the % DPPH discolouration; A_{DPPH} denotes the absorbance of DPPH solution, and A_S denotes the absorbance of the solution when the sample was added at a particular level.

Results and discussion.

Nutritional Compositions/Relevance of Typical Urhobo Soups

Total Soluble Protein and Reducing Sugar Contents.

The typical Urhobo soups analyzed in this study appear to contain significantly higher amounts ($p < 0.05$) of protein than reducing sugars (Figures 1a, b, c). This could be as a result of the nutritious fresh fish, crayfish (*P. zonangulus*), periwinkles (*Littorina littorea*), smoked fish and beef that are often used, in different combinations, in the preparation of these sumptuous soups. Fish and beef are generally known as sources of animal protein (Albrechtsen *et al.*, 2006; Onyia *et al.*, 2010) and the large quantity of them used in the cooking of Urhobo soups makes the dishes truly rich in protein as evident in the results of this study (Figures 1a, c). The soup with the highest concentration of protein ($62.0 \pm 1.0 \mu\text{g/ml}$) is ‘Emurigari ifo’ [Egusi (*C. lanatus*) vegetable soup], while that with the least concentration of protein ($33.0 \pm 1.0 \mu\text{g/ml}$) is ‘Ovwovwo’ (Melon pepper soup).

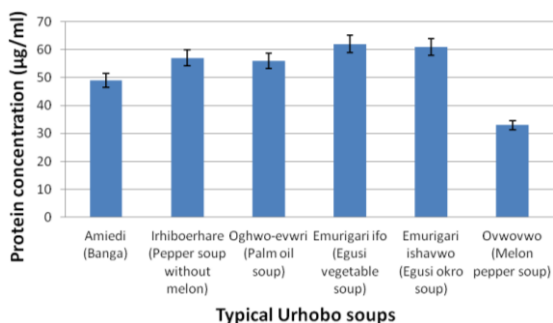


Fig 1a. Protein concentrations (µg/ml) of typical Urhobo soups.

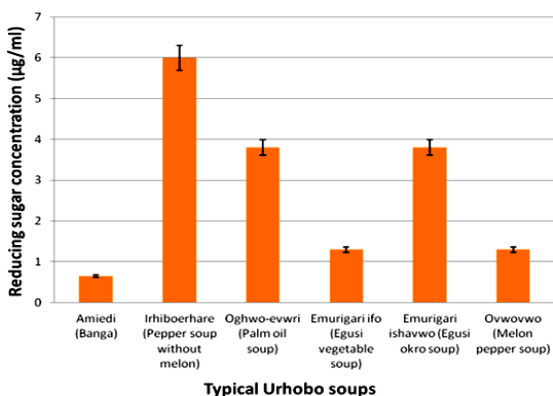


Fig 1b. Concentrations of reducing sugars (µg/ml) in typical Urhobo soups.

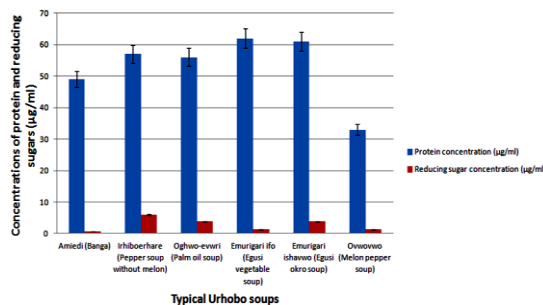


Fig 1c. Comparative plot of protein and reducing sugar concentrations (µg/ml) in typical Urhobo soups.

Consumption of foods (such as the Urhobo soups) rich in protein would help to make available a pool of protein in the small intestines where their molecules or their digested forms (amino acids) would be absorbed in the body to increase the blood protein level (Antai *et al.*, 2009). The available protein in the blood, which is later transported to body tissues and organs, helps to build up worn out tissues or facilitate healing of wounds. Some of the proteins could be apoenzymic in nature and upon transport to some specific organs or tissues, are activated into potent enzymes that are involved in general metabolism (Anderson and Moore, 2004). The rich protein content of the typical Urhobo soups could also be considered as a biochemical reason why it is rare to find an Urhobo young child, who feeds on any of these soups three times daily, having Kwashiokor (a protein deficiency disease) (Brock, 1966; Müller and Krawinkel, 2005). Aside the protein contents of these soups, the vegetables (pumpkin, water leaves, okro etc) sometimes used in the preparation of some of these Urhobo soups also help in keeping the native consumer in good health since these vegetables are rich sources of vitamins (Heinen *et al.*, 2012; Kubota *et al.*, 2011).

Another outstanding discovery about the typical Urhobo soups analyzed is their relatively very low reducing sugar contents compared to their protein levels (Figures 1b, c). The highest concentration of reducing sugar ($6.0 \pm 0.1 \mu\text{g/ml}$) was observed in ‘Irhiboerhare’ (Pepper soup without melon), whereas the least reducing sugar concentration ($0.65 \pm 0.21 \mu\text{g/ml}$) was observed in ‘Amiedi’ or Banga soup [Palm (*E. guineensis*) fruit extract soup]. Many studies have reported on the risk of induction of diabetes mellitus with consistent or daily consumption of high sugar-containing foods (Tirosh *et al.*, 2005;

Tuomilehto *et. al.*, 2001). However, the consistent daily intake of these Urhobo soups by most old and young people in this region of Delta State (Delta central) Nigeria does not appear to pose any risk of diabetes because of the relatively very low amounts of reducing sugar in the soups. This is true especially when any of these soups is consumed with the usual Urhobo solid staples like ‘Eba’ (cooked garri, a cassava product), cooked starch (*Manihot esculenta* Crantz starch), boiled yam (*Dioscorea rotundata*), or unripe plantain (*Plantago lanceolata*). It must be noted, contrarily, that though the extremely low content of reducing sugars in the typical Urhobo soups is an indication of their absence of diabetes risk factor, daily consumption of them with ripe plantain or pounded ripe plantain (which usually contains very high amounts of glucose and fructose) could predispose one to the risk of induction of type 2 diabetes mellitus (Tirosh *et. al.*, 2005; Tuomilehto *et. al.*, 2001).

Levels of Triglyceride, LDL- and HDL-Cholesterols in Typical Urhobo Soups.

The health risk-free status of the typical Urhobo soups analyzed in this study is further revealed by their concentrations of triglyceride, HDL-cholesterol and LDL-cholesterol (Figure 2). The highest concentration of LDL-cholesterol (1.19 ± 0.67 mg/ml) was observed in ‘Amiedi’ (Banga soup, palm oil fruit extract soup), while the least LDL-cholesterol concentration (0.012 ± 0.001 mg/ml) was observed in Emuigari ifo (Egusi vegetable soup). Also, while ‘Ovwovwo’ (Melon pepper soup) has the highest concentration of HDL-cholesterol (7.35 ± 0.25 mg/ml), ‘Emuigari- ishavwo’ (Egusi okro soup) contained the lowest HDL-cholesterol concentration (1.00 ± 0.04 mg/ml).

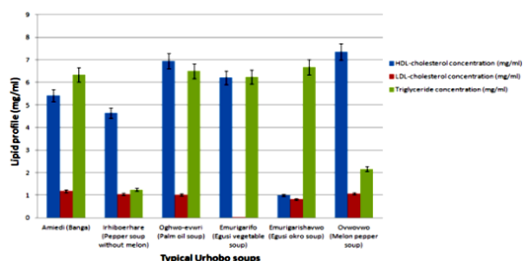


Fig 2. Concentrations of triglyceride, HDL-cholesterol and LDL-cholesterol (mg/ml) in typical Urhobo soups.

In all the soup samples investigated, the concentrations of LDL-cholesterol (mg/ml) is significantly smaller ($p < 0.05$) than those of HDL-cholesterol. Various studies have

asserted that high blood level of LDL-cholesterol, or low ratio of HDL-cholesterol/LDL-cholesterol, is a potential risk factor of cardiovascular disease especially atherosclerosis (Stamler *et. al.*, 1986; Shepherd *et. al.*, 1996; Baba *et. al.*, 2007). Similarly, it has long been known also that while a high level of HDL-cholesterol in the blood or plasma does not pose threat to health, a low plasma level of HDL-cholesterol is another powerful predictor of increased cardiovascular risk (Barter *et. al.*, 2007; Gordon *et. al.*, 1989). There is also evidence that oxidized LDL has a pathogenic role in the development of atherosclerosis (Steinberg *et. al.*, 1989; Baba *et. al.*, 2007). These findings suggest that consumption of the typical Urhobo soups (Figure 2), even on a daily basis as most people do, would not predispose one to the risk of atherosclerosis or other cardiovascular diseases because they have relatively very high contents of HDL-cholesterol and very low amounts of LDL-cholesterol, which upon absorption in the small intestines into the blood stream will also result to high and low blood level of HDL-cholesterol and LDL-cholesterol, respectively. Also very notable is the high levels of triglyceride in the soups. The highest concentration of triglyceride (6.67 ± 0.29 mg/ml) was observed in ‘Emuigari ishavwo’ [Egusi (*C. lanatus*)–okro (*A. esculentus*) soup], while the least triglyceride concentration (1.25 ± 0.35 mg/ml) was observed in Irhiboerhare (Pepper soup without melon). Triglycerols are made up of a glycerol backbone and three fatty acid acyl chains attached to the backbone (Mu and Porsgaard, 2005). The fatty acids in the triglycerides contained in these soups upon consumption and absorption, can be channeled into metabolic generation of energy (ATP) for the body through β -oxidation when the body is in direful need of energy and the ATP generated from all carbohydrate sources have been depleted (Schulz, 1991).

Antioxidant Properties of Typical Urhobo Soups

Free radicals have been claimed to play an important role in affecting human health by causing several diseases including cancer, hypertension, heart attack and diabetes (Bruckdorfer, 2012; Ghafar *et. al.*, 2010). These free radicals are generated during body metabolism. Exogenous intake of antioxidants

can help the body scavenge free radicals effectively. Furthermore, many studies have shown that increased dietary intake of natural phenolics correlates with reduced coronary heart disease, cancer mortality with longer life expectancy (Halliwell, 2012). Moreover, these polyphenolic compounds have been found effective in many health-related properties, such as antioxidant, anticancer, antiviral and anti-inflammatory activities (Russo *et al.*, 2012; Bharti *et al.* 2012). On other hand, concern about the safety of the commonly used synthetic antioxidants such as butylated hydroxyanisole (BHA) and tertiary butylhydroquinone (TBHQ) have led to increased interest on natural antioxidants which occur in plants as secondary metabolites or soups prepared with naturally-occurring ingredients.

Total Phenolic Contents of the Soups

From the results of this study, the total phenolic contents of the six typical Urhobo soups investigated ranged from 11.43 to 14.39 mg ascorbic acid equivalent /ml (Figure 3). While palm fruit (*Elaeis guineensis*) extract soup (popularly called ‘Banga’ soup or ‘Amiedi’) had the highest phenolic content (14.39 mg ascorbic acid equivalent /ml), palm oil-potash soup (‘Oghwo-ewwri’) had the least (11.43 mg ascorbic acid equivalent /ml) content. The relative abundance of total phenolics in melon-okro soup (‘Emuigari ishavwo’) and melon pepper soup without palm oil (‘Ovwowwo’), however, did not differ significantly ($p>0.05$). Similarly, there was no statistical significant ($p>0.05$) difference between the concentration of phenolics in melon-vegetable soup with palm oil (‘Emuigari ifo’) and pepper soup without melon and palm oil (‘Irhibo-erhare’).

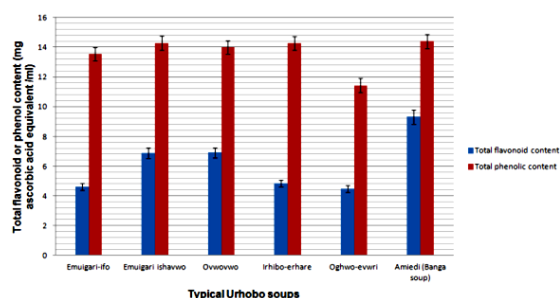


Fig 3. Total flavonoid and phenolic contents of soup samples.

The high phenolic content of the palm fruit (*E. guineensis*) extract soup (Banga soup or ‘Amiedi’) could be as a result of the whole

palm fruit extract which is used in its preparation unlike the palm oil-potash soup (‘Oghwo-ewwri’). The palm fruit extract is believed to be rich in phytonutrients that include carotenoids (α -, β - and γ -carotenes), vitamin E (tocopherols and tocotrienols) (Wattanapenpaiboon and Wahlqvist, 2003; Bharti, 2012), triglycerides, monosaccharides, essential amino acids, phenols, favonoids and even some essential fatty acids unlike the palm oil which is basically a combination of saturated and unsaturated fatty acids. The rich polyphenol contents of these typical Urhobo soups, amidst other vital nutrients arising from their natural ingredients, could be the biochemical reason why the Urhobos, and other individuals in the Niger-Delta region, who frequently consume these foods, appear to be very healthy and highly disease resistant in nature.

Total Flavonoid Contents of the Soups

The total flavonoid content varied between 4.47 and 9.31 mg ascorbic acid equivalent/ml among the soup samples (Figure 3). Again, the palm fruit extract soup (Banga soup or ‘Amiedi’) had the highest flavonoid content (9.31 mg ascorbic acid equivalent/ml) while palm oil-potash soup (‘Oghwo-ewwri’) had the least flavonoid content (4.47 mg ascorbic acid equivalent /ml). However, the other soup samples [melon pepper soup without palm oil (‘Ovwowwo’), melon-okro soup with palm oil (‘Emuigari ishavwo’), pepper soup without melon and palm oil (‘Irhibo-erhare’), and melon-vegetable soup with palm oil (‘Emuigari ifo’)] do not significantly differ ($p>0.05$) in their concentration of flavonoids (Figure 1). It has been recognized that flavonoids show antioxidant activity and their effects on human nutrition and health are considerable (Pourmorad *et al.*, 2006). The mechanisms of action of flavonoids are through scavenging or chelating process (Halliwell, 2012; Kessler *et al.*, 2003; Cook and Samman, 1996). The rich content of flavonoids in the typical Urhobo soups also shows that these routine soups in most homes in the Niger-Delta can exhibit appreciable antioxidant capacities when consumed by individuals under stress, especially the palm fruit extract (*E. guineensis*) soup (Banga soup or ‘Amiedi’) and Melon (*C. lanatus*) pepper soup without oil (‘Ovwowwo’).

DPPH Radical Scavenging Activity of the Soups

2, 2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity assay is a widely used investigative method or parameter in assessing the free radical scavenging ability of natural compounds (Barreca *et al.*, 2011; Zheng *et al.*, 2011). In the tests carried out, the antioxidants components of the indigenous soups were able to reduce the stable DPPH radical and the absorbance read at 517 nm. The effect of antioxidants on DPPH radical scavenging was conceived to be due to their proton-donating ability. Therefore, the antioxidant activity of a substance can be expressed as its ability to scavenge DPPH free radical (Zheng *et al.*, 2011; Bhateja, 2012). Our results in Figure 4 showed that all the six typical Urhobo soups investigated were effective at reducing the stable radical DPPH to the yellow-coloured diphenylpicrylhydrazine, indicating that these soups, daily or frequently consumed by the Urhobo people of Delta State, Nigeria, are active in DPPH radical scavenging. Whereas palm fruit extract soup (Banga soup or 'Amiedi') and 'Emuigari-ishavwo' soups exhibited the highest inhibition of DPPH radical (63.02% RSA respectively), Irhibo-erhare scavenged the radical the least (47.72% RSA). Though quite appreciably high, yet the DPPH radical scavenging activities (RSA) of the other three soups [Ovwovwo (54.5% RSA), Oghwo-evwri (55.5% RSA) and Irhibo-erhare (54.8% RSA)] were not statistically different ($p > 0.05$). The results also revealed that the DPPH radical scavenging effects of palm fruit extract soup ('Amiedi') and 'Emuigari-ishavwo' (63.02% RSA) was not significantly different ($p > 0.05$) from the DPPH scavenging activity of 0.5 $\mu\text{g}/100 \mu\text{l}$ standard antioxidant (ascorbic acid) used (64.89% RSA).

Since DPPH radical scavenging activity (RSA) is an index of the antioxidant capacity of a food or chemical substance, the high potential of these typical Urhobo soups to scavenge DPPH radical in this study (Figure 4) showed that they contain substantial amounts of antioxidants.

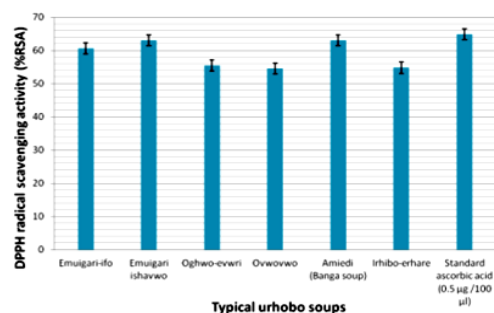


Fig 4. DPPH radical scavenging activity (%RSA) of the typical Urhobo soups.

This could be attributed to their rich contents of phenols and flavonoids (Figure 3). From previous researches, it has been established that antioxidants through their radical scavenging power are useful for the management of diseases in which oxidative stress is implicated such as Alzheimer's Disease, Arrhythmia, Asthma, Atherosclerosis, neurodegenerative diseases, Benign Prostatic Hyperplasia (BPH), and Parkinson's disease (Bhateja, 2012; Halliwell, 2012).

Conclusion

It could be concluded, therefore, that consumption of the Urhobo typical soups by these Delta Central people (the Urhobos) go a long way in helping their body cells to adequately prevent the occurrence of diseases resulting from free radical attack thereby supporting their general well-being.

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