Nutritional composition of Neglected Underutilized Green Leafy Vegetables and Fruits in South East Geo-Political Zone of Nigeria

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ABSTRACT

Background/Objective: Vegetables and fruits play a highly significant role in food security of the underprivileged in both urban and rural settings. The study was designed to determine the nutritional composition of some neglected underutilized fruits and vegetables in Southeast geopolitical zone of Nigeria.
Methodology: The commonly occuring underutilized fruits and vegetables were selected for the study. The food crops were harvested and identified at the Herbarium in the Department of Plant Science and Biotechnology, University of Nigeria Nsukka. Twenty underutilized fruits and vegetables each were cleaned and analysed for nutrients composition using standard methods. Data were presented using descriptive statistics, percentage, mean, standard deviation and frequency. **Results:** The proximate composition of the fruits ranged from 54.34-80.30 % moisture, 0.27-6.21 % protein, 0-3.08 % fat, 0.28-8.58 % fibre, 0.33-11.05 % ash and 9.08-36.61 % carbohydrate. The ranges for mineral values of the fruits were iron 0.10-9.60 mg, zinc 0.02-10.30 mg, manganese 0.10-6.60 mg and calcium 5.42-46.50 mg. The vitamin contents of the fruits ranged from beta-carotene traces -5666.67 RE, ascorbic acid 0-48.82 mg and vitamin E 0 -11.99 mg. The proximate composition of the vegetables ranged from moisture 60.45-91.00%, protein 0.02-6.60%, fat 0.02-2.19 %, fibre 0.04-5.01 %, ash 0.04-4.20 % and carbohydrate 10.30-36.61 %. The ranges for mineral values of the vegetables were iron 1.40-14.80 mg, zinc trace-9.40 mg, manganese 0.07-4.80 mg and calcium 18.19-400.00 mg. The vitamin levels of the vegetables were beta-carotene 15.20-1933.33 RE, ascorbic acid 2.40-38.40 mg and vitamin E traces - 6.67 mg. **Conclusion:** The use of these fruits and vegetables should be encouraged particularly in areas where they are not produced through nutrition education in order to promote the food use of these crops.

Keywords: Nutritional, composition; underutilized; vegetables and fruits.

1.INTRODUCTION

United Nations Food and Agriculture Organization (1) has widely noted that most widespread and debilitating nutritional disorders, like birth defects, mental and physical retardation, weakened immune systems, blindness and even death has resulted from poor fruits and vegetables consumption habits (2). The ideal strategy to fighting micronutrient deficiency is to improve the diet by including a large variety of food rich in micronutrients and to increase dietary absorption of these nutrients. According to Okigbo (3) while the crisis situation caused by lack of animal foods may require broad and fundamental rethinking about policy and action, traditional foods may be the short term remedy. Micronutrients are found in vegetables and fruits but in a form less easily absorbed unless taken at the same time with enhancers or processed in a way to enhance the absorption of these micronutrients (4). Quite large number of indigenous leafy vegetables and fruits have long been known and reported to have health protecting properties and uses. Vegetables and fruits are important sources of protective substances, which are highly beneficial for the maintenance of good health and prevention of diseases (5; 6). The inclusion of vegetables and fruits in the diets has provided basic nutritional requirements for man. The indigenous knowledge of the health promoting and protecting attributes of vegetables and fruits are clearly linked to their nutritional and non- nutrient bioactive properties. Indigenous fruits and vegetables have long been, and continue to be reported to significantly contribute to the dietary vitamin and mineral intakes of local populations (7). The potassium content of leafy vegetables and fruits are useful in the control of diuretic and hypertensive complications, because it lowers arterial blood pressure. The fiber content also contributes to the feeling of satisfaction and prevents constipation (8). In spite of the body of evidence confirming the nutritional contribution of indigenous vegetables and fruits to local diets, their health maintenance and protective properties, there has been very little concerted effort towards exploiting the biodiverse nutritional and health properties of fruits and vegetables to address the complex food, nutrition and health problems of the society. The ultimate goal of this research was to determine the chemical composition of these underutilized fruits and vegetables which will promote their use as food and consequently improve the nutritional status of both the rural and urban dwellers.

2. MATERIALS AND METHODS

2.1 Study Area/ Study Design

The study is experimental.

The study was carried out in South East Nigeria. South east Nigeria lies approximately between 4^{o} 30^{1} N and 7^{o} 00^{1} N latitude and 6^{o} 00^{1} E and 9^{o} 00^{1} E longitude, located in the mosaic of lowland rainforest and secondary grassland vegetation zone found in some parts of Nigeria. The zone occupies about 50, 000 km^2 of Nigeria's total area of 923 768 km^2. South East zone shares boundary with Cross River in the East, Akwa Ibom, Bayelsa and Rivers in the South, Kogi and Benue in the North and Delta in the West. In South east zone of Nigeria, due to their rich biodiversity, many underutilized indigenous leafy vegetables and fruits of promising nutritional values which can nourish the ever increasing human population exist.

2.2 Procurement/ Identification of Samples

A multi stage sampling technique was used to select 20 communities for the study. The samples were harvested in 20 communities in South East Nigeria. The plants harvested were identified at the Herbarium in the Department of Botany, University of Nigeria Nsukka, Nigeria. Some samples were randomly selected and used for further study.

2.3 Chemical analysis

Moisture determination

The moisture content of the samples was determined using the air oven method of AOAC (9).

Protein determination

Crude protein content of the samples was determined using the automated micro-Kjeldahl method as described by AOAC (9).

Fat determination

The fat content was determined using the Soxhlet extraction method (9).

Crude fibre determination

The crude fibre content of the samples was determined according to the procedure of AOAC (9).

Ash determination

The ash content was determined according to the procedure of AOAC (9).

Carbohydrate determination

Carbohydrate content was calculated by difference. The estimated percentages of crude protein, ash, fat, fibre and moisture was summed up and the value subtracted from 100%.

CHO = 100% - % (protein + fat + ash + fibre + moisture).

Mineral determination

The mineral contents, namely: Na, K, Ca, Mg, Cu, Mn, Hg and Pb contents were determined by the method described by Pearson (10) using a Pye Unicam SP9 Atomic Absorption Spectrophotometer (AAS) connected to an SP9 computer (Pye Unicam Ltd, York Street, Britain). Total phosphorus was determined by the spectrophotometric molybdovanadate (9).

Determination of ß-carotene

The extraction of carotenoids was carried out according to the method of Seo et al (11) with slight modifications.

Determination of vitamin E profile

Vitamin E content was analysed by the method described by Burri (12) using High performance liquid chromatography (HPLC).

Vitamin C determination

Vitamin C determination by iodine titration as described by Anne Helmenstine was carried out (9).

3. RESULTS

The list of underutilized vegetables selected for analysis was shown in table 1.

The list of underutilized fruits selected for analysis was shown in table 2.

The proximate composition of twenty underutilized indigenous vegetables were shown in table 3a. The moisture content of these indigenous vegetables ranged from 60.45-91.00% per 100g edible portion, with *Bombaceae spp* having the highest moisture content and *Blinghia unijugata* having the least value. The protein content varied from 0.02-6.60% per 100g sample with *Ficus elsticoides* having the highest protein content. The fat content of the samples ranged from 0.02 in *Moraceae spp* to 2.19% in *Vaccinium parvifolium* per 100g sample. The crude fibre contents of the samples ranged from 0.04-5.01%/100g, with *Bombaceae spp* having the highest crude fibre content. The ash content of the vegetables were between 0.04 in *Euphobiaceae spp* to 4.20% in *Pterocarpus santalinoides* while the carbohydrate content of the samples were between 10.30-30.49%.

The proximate composition of some underutilized fruits were shown in table 3b. The moisture content of these underutilized fruits ranged from 54.34-80.30%, with *Phyllanthus debilis* having the highest moisture value and *Parkia clappatonia* having the least value. The protein content varied from 0.27-6.21% with *Irvingia gabonensis* fruits having the highest protein content. The fat content of the samples ranged from Traces-3.08%. The crude fibre contents of the samples ranged from 0.11-8.58%/100g, with *Ficus sur* having the highest crude fibre value. The ash content of the fruits were between 0.33-11.05%/100g sample while the carbohydrate contents of the samples were between 9.08-36.61%. All values are on wet weight basis.

The mineral composition of the twenty underutilized vegetables were shown in table 4a. The iron content of the underutilized vegetables were between 1.40-11.80mg/100g with *psychotria viridis* having the highest iron content and *Bombaceae spp and Blinghia nitens* having the least value. The copper content was highest in *Ipomea batata* (3.14mg/100g) and lowest in *Moraceae spp* (0.02mg/100g). The levels for other minerals are zinc (0.00-9.40mg/100g), manganese (0.07-4.80mg/100g), calcium (18.19-400.00mg/100g), magnesium (4.38-47.20mg/100g), sodium (0.27-3.01mg/100g), potassium (16.20-104.23mg/100g), and phosphorus (75.40-685.60mg/100g).

The mineral composition of some underutilized indigenous fruits were shown in table 4b. The iron contents of these underutilized fruits were between 0.10-9.80mg/100g with *Vevet tamarind* having the highest iron content and *Gongronema spp* having the least value. The copper content was highest in *Gongronema spp* (4.06mg/100g) and lowest in *Olax viridis* (0.00mg/100g). The levels for other minerals are zinc (0.02-10.30mg/100g), manganese (0.10-6.60mg/100g), calcium (5.42-46.50mg/100g), magnesium (0.21-31.82mg/100g), sodium (Trace-6.20mg/100g), potassium (2.43-410.00mg/100g), and phosphorus (1.70-44.66mg/100g).

The B-carotene and vitamin composition of some underutilized vegetables were shown in table 5a. The beta carotene contents of the underutilized vegetables were between 15.20-1933.33 RE/100g sample with *Vitex doniana* having the highest beta carotene value. The ascorbic acid contents varied between 2.40-38.40mg /100g sample while the vitamin E contents were from Traces-6.67mg/100g sample.

The B-carotene and vitamin composition of some underutilized fruits were shown in table 5b. The beta-carotene content of the underutilized fruits ranges from traces of beta-carotene to 5666.67RE /100g sample with *Cola parchycarpa* having the highest beta-carotene value. The ascorbic acid contents varied between 1.20 in *Cola gigantean* to 48.82mg/100g in *Artocarpus altilis* edible samples. The vitamin E contents ranged from traces in *Olax viridis, Napoleana imperialist* and *Icacina trichatha olive* to 11.99mg/100g in *Artocarpus altilis* samples.

4. DISCUSSION

4.1 Proximate analysis

4.2 Moisture

In the study, the moisture content of the underutilized vegetables were between 60.45-91.00%/100g sample. The result of the present study is in line with the value reported by Sheela et al. (5) who observed that the moisture content of thirty eight underutilized green leafy vegetables in Southern Karnatala were between the range of 68.00-93.00%. Fasoyiro et al. (13) observed that the moisture content of fruits were from 78.24-84.81%. This falls within the range of values obtained in this study (54.34-80.30%). The high moisture content in these vegetables and fruits were not a surprise as Ene-Obong (14) noted that the most single constituent of fruits and vegetable is water, which accounts for more than 80% of the nutrients. This will result to lower contribution of other proximate components. The high moisture content of these fruits and vegetables indicates that they will not have a long keeping quality.

4.3 Protein

The protein values (0.02-6.60%) obtained for these vegetables varied. Although vegetables are not good sources of protein, *Ficus elsticoides* had a high protein level (6.60%). Eyo et al. (15) observed that the protein levels of some vegetables are comparable to those of cereals (7.90%). The high protein content of *Ficus elsticoides* could be useful in fighting kwashiorkor in communities where protein energy malnutrition is prevalence provided it is consumed in significant quantity. The protein value obtained for the fruits were 0.27-6.21%. Inclusion of 100g portion size of *Ficus elsticoides* (6.60% protein), *Irvingia gabonensis* (6.21% protein) and *Sterculiar spp* (6.04% protein) as shown in the pictorial record to the diet may be capable of providing more than one-fifth of protein which will satisfy the RNI (27g protein) for children (16).

4.4 Fat

Generally, vegetables and fruits are not good sources of fat. The result of the study confirms this claim (0.02-2.19% fat) for vegetables and (traces-3.08% fat) for fruits. Consumption of these vegetables and fruits may help to reduce high incidence of obesity, diabetes, cardiovascular diseases, high blood pressure, which are associated with high intake of fatty foods. The results of the vegetables were in line with the values reported by Sheela et al. (5) (0.20-2.60%).

4.5 Crude fibre

The crude fibre levels of the underutilized vegetables (0.04-5.01%/100g) and fruits (0.11-8.58%) are of interest. The high fibre contents of *Pterocarpus santalinoides* (4.30%), *Bombaceae* spp (5.01%) and *Olax viridis* (8.58%) could provide bulk in the diet, enhance gastrointestinal function, prevent constipation and may reduce the incidence of metabolic diseases like maturity onset diabetes mellitus and hypercholesterolemia (17). Hundred gramme (100g) portion size of *Olax viridis* if consumed in a day may provide more than one-third of the (RNI) for fibre which is 18g (18).

4.6 Ash

Landolfolia dulcis fruit (11.05%) with high ash content suggests that the mineral content of this fruit may be high. The ash levels of foods are an indication of the mineral content of the food. The values (0.60-3.40%) reported by Ajayi et al.(19) as the ash contents of some leafy vegetables studied were within the range of values observed in this study (0.04-4.20%).

4.7 Carbohydrate

Vegetables and fruits are not major sources of carbohydrates compared to starchy foods, which form the bulk of food eaten. The very low carbohydrate contents of *Portulace oleraceae* (10.30%), *Ficus sur* vegetables (11.17%), *Phyllanthus debilis* (9.08%) and *Ficus sur* fruit (10.48%) is of interest. This is because low carbohydrate foods are good for people with obesity, high blood pressure and diabetes mellitus challenges.

4.8 Vitamins and Beta-carotene

4.9 Ascorbate

The ascorbic acid values (2.40-38.40mg) for all the vegetables studied were within the range of values (3.00-75.00mg) as observed by Sheela et al. (5) on 28 underutilized vegetables studied in Tanzania. The high ascorbate value for *Portulace oleraceae* (38.40mg), *Artocarpus altilis* (48.82mg) and *Ficus sur* fruit (40.22mg) is of interest. Consumption of adequate quantities of the fruits and vegetables with iron rich foods will enhance the absorption of iron. Ascorbic acid is important in connetive tissue and for proper absorption of iron and calcium. Adequate intake of the fruits and vegetables may assist in the prevention of early death from heart diseases and cancer and may also play a primary role in collagen formation which is essential for the growth and repairs of tissue cells, gums, blood vessels, bones and teeth. Vitamin C is an important antioxidant. The high Vitamin C level in the fruits and vegetables may help to battle against cancer and many degenerative diseases (i.e. Alzheimer's, Cardiovascular Disease, Diabetes, etc). (20).

4.10 Vitamin E

The high vitamin E content of some of the fruits and vegetables is desirable. Vitamin E is a powerful antioxidant thus neutralizing free radicals in the body that causes cellular damage. It also contributes to a healthy circulatory system and aids in proper blood clotting and improves wound healing. Some studies have shown that vitamin E decreases symptoms of premenstrual syndrome and certain types of breast disease (21). *Artocarpus altilis* fruit had 11.99mg/100g vitamin E, *Phyllanthus debilis* fruit had 8.00mg/100g, while *Blighia unijugata* vegetables had 6.67mg/100g. Consumption of 100g portion size of *Artocarpus altilis* (11.99mg/100g) and *Phyllanthus debilis* fruit (8.00mg/100g), could provide half of the daily RNI need of vitamin E for breastfeeding mothers (16.80mg), adult men, women and pregnant women (13.20mg) (22).

4.11 Beta-carotene

The high beta-carotene levels (15.20-1933.00RE) of the vegetables are not a surprise. Eyo et al. (15) observed that the yellow and green colours of vegetables indicate carotene, which is a precursor of vitamin A. Consumption of 100g portion size of majority of the vegetables studied (*Vitex doniana*-1933.33RE, *Ficus vogaliana*-163333RE, *Ceiba pentandra*-1866.67RE, *Pterocarpus santalinoides*-1233.33RE, *Moraceae spp*-450.00RE, *Bombaceae* spp-616.67RE, *Blighia unijugata* -591.67RE, *Brillantaisi nitens*- 700.00RE, *Vaccinium parvifolium*- 451.67RE, and *Gssampelus mucanta*- 701.67RE) could provide the RNI (400RE) for provitamin A (23). Majority of the fruits (*Nauclea diderrichii*-1233.33 RE, *Spondian mombin*-2000.00 RE, *Vitex doniana*-1333.33 RE, *Afromomium daniella*-566.67 RE, *Myristicaceae spp*-4333.33 RE, *Irvingia gabonensis*-416.67 RE, *Cola parchycarpa*-5666.67 RE and *Parkia clappatonia*-970.67 RE) have high beta carotene which are higher than the RNI (400RE) for Provitamin A. High level of beta-carotene in some of the vegetables and fruits is particularly important if they are consumed in significant quantity to reduce incidence and severity of respiratory tract infection of which pneumonia is the most serious (24). High consumption of the vegetables and fruits could help to maintain normal vision, promote healthy cell growth, improve iron utilization, gene expression, reproductive system, embryonic development, growth and immune function (25).

4.12 Minerals

4.13 Iron (Fe)

The high iron content of *Psychotria viridis* (11.80mg), *Napoleana imperialist* (9.40mg), *Hippocretae myrint* (9.60mg), *Afromomium daniella* (8.40mg), *Portulace oleraceae* (10.50mg), *Ficus fur* (10.60mg) and *Berlinia grandflora* (8.80mg) has nutritional significance. The fruits and vegetables with their high ascorbate levels could be useful in the fight against iron deficiency anemia. Vitamin C enhances the absorption of nonheme iron. The ascorbate levels for each of the fruits and vegetables were *psychotria viridis* (29.90mg), *Portulace oleraceae* (38.40mg), *Hippocretae myrint* (22.70mg), *Afromomium daniella* (14.80mg), *Ficus fur* (11.60mg) and *Berlinia grandflora* (11.40mg). Consumption of 100g portion size of *psychotria viridis* (11.80mg Fe), *Napoleana imperialist* (9.40mg Fe), *Hippocretae myrint* (9.60mg Fe), *Afromomium daniella* (8.40mg Fe), *Portulace oleraceae* (10.50mg Fe), *Ficus fur* (10.60mg Fe) and *Berlinia grandflora* (8.80mg Fe) may provide more than half of the RNI, for iron (12.00mg/day) (26). The result indicated that the iron content of some of the vegetables (1.40-11.80mg) were higher than those reported by Nnamani et al. (27) (3.68-7.34mg) and Maundu (28) (0.70-8.90mg) on underutilized vegetables.

4.14 Copper (Cu)

Copper is not found in large quantity in fruits and vegetables. The values (traces-4.06mg) observed for fruits were in line with the values (0.60-3.80mg) observed by Umran and Nevo (29) on fruits. Decuypene (26) observed that the estimated safe and adequate intake of copper per day is 1.50-3.00mg. Thus including 100g portion size of *Cola parchycarpa* fruits (2.01mg) and *Blinghia unijugata* vegetables (2.28mg) in daily diet ensures up to 50% of the daily RNI for copper. Daily consumption of 100g portion size of *Gongronema spp* (4.06mg) and *Ipomea batata* (3.14mg) may provide 100% RNI for copper which is an important component of many redox enzymes, including cytochrome oxidase (30).

4.15 Zinc (Zn)

The zinc contents of the vegetables studied were between 1.30-9.40mg/100g. The zinc levels in the fruits (0.02-10.30mg) were in line with the report of Umran et al. (31) who observed zinc levels of 1.80-9.10 mg on fruits. The zinc levels of *Vitex doniana* (9.40mg) and *Hippocretae myrint* (10.30mg) *are* of interest since plant foods are not major sources of zinc. Lippard and Berg (30) stated that zinc is a trace mineral element that plays a catalytic role in enzymes. The

RNI of Zn is 200mg/day. Shankar and Prasad (32) observed that zinc enrichment may be beneficial for health, but excess zinc may interact with Fe and Cu metabolism. Intake of significant quantity of the vegetables with high zinc levels (*Vitex doniana* (9.40mg) and *Hippocretae myrint* (10.30mg)) could reduce the duration and severity of diarrhea for infants and young children with acute diarrhea (33).

4.16 Manganese (Mn)

Consumption of 100g portion size of some of the vegetables and fruits such as *Ficus vogaliana* (4.80mg), *Hippocretae myrint* (6.60mg), *Icacina trichatha oliv*e (5.40mg), *Bombaceae spp* (4.30mg), *Uvaria chamea* (3.60mg), and *Daniella olivera* (4.02mg) may provide the daily need of manganese in both children and adult which is 2.00-5.00mg and 2.00-3.00mg, respectively (26). The result of the fruits studied (0.10-6.60) were in line with the values reported by Umran et al. (31) on fruits (0.70-5.70mg). Manganese is essential for processing oxygen (30).

4.17 Calcium (Ca)

Some of the vegetables studied are good sources of calcium. The values observed in this study (18.19-400.00mg) for vegetables and values (5.42-46.50mg) for fruits are of interest. Inclusion of 100g portion size of *Brillantaisi nitens* (400.00mg), *Irvingia gabonensis* (30.00mg) *Pterocarpus santalinoides* (343.40mg), *Bombaceae spp* (252.00mg), *Berlinia grandflora* (340.00mg), *Ceiba pentandra* (261.50mg), *Daniella olivera* (281.90mg) and *Gssampelus mucanta* (374.00mg) in daily diet may ensure 100% RNI (250mg calcium) for infants. Adequate intake of fruits and vegetables could help in building the structural frame work of the body, formation of bone, neutralize acidity, clear toxins and help blood stream (34).

4.18 Magnessium (Mg)

The result showed that some of these fruits and vegetables could provide some health benefits as dietary components because they contain significant quantities of magnesium. *Phyllanthus debilis* (31.82mg) and *Nauclea diderrichii* (26.10mg) has significant quantities of Mg. Magnesium is required for processing ATP and related reactions, build bone, cause strong peristalsis, increase flexibility, maintain blood pressure and acid –base balance (34). Magnesium also helps in maintaining proper muscle functioning and keeping the muscles relaxed, helps in absorbing calcium and phosphorus and is very important for proper functioning of the nervous system (35).

4.19 Sodium (Na)

The sodium levels of the vegetables (0.27-3.01mg) were lower than the values reported by Nnamani et al. (36) (7.00-21.00mg) and Taiyie and Asiebey-Berko (37) (6.44-21.82mg). The values (traces-6.20mg) obtained in the fruits were in line with the values observed by Nevo (38) (0.0-10.00mg) and Musinguzi et al. (39) (1.80-5.00mg) on fruits. Sodium is a very common electrolyte; not generally found in plant foods and the RNI is 200mg/day (34). The ion is very common in food as sodium chloride, or common salt.

4.20 Potassium (K)

The potassium levels in the vegetables and fruits were 16.20-104.23mg and 2.43-410.00mg, respectively. The following fruits and vegetables had high K levels - *Blinghia grandflora* (104.23mg), *Hippocretae myrint* (281.00mg), *Napoleana imperialist* (110.00mg), *Spondian mombin* (260.00mg),*Vitex doniana* (130.00mg), *Afromomium daniella* (198.00mg), *Cola gigantean* (110.00mg), *Olax viridis* (240.00mg), *Phyllanthus debilis* (270.00mg), *Sterculia spp* (180.00mg), *Myristicaceae spp* (156.00mg), *Ficus sur* (126.00mg), *Landofolia dulcis* (210.00mg), *Parkia clappatonia* (220.00mg), *Gongronema spp* (192.00mg), *Irvingia gabonensis* (410.00mg). Intake of significant quantities of the fruits and vegetables may be useful in performing the functions of potassium in the body. Potassium is a common electrolyte that is required for keeping the heart, brain, kidney, muscle tissues and other important organs of the human body in good condition. It works in association with sodium to perform a number of critical body tasks (40).

4.21 Phosphorus (P)

The vegetables studied are good sources of phosphorus (75.40-685.60mg). The values determined in this study were higher than the values observed by Taiye and Asiebey-Berko (37) (9.42-48.95mg); Nnamani et al. (41) (37.00-57.00mg). The RNI for phosphorus is 200mg/day. Consumption of 100g of some of the vegetables like *Boerhavia diffusa* (685.60mg), *Ipomea batata* (257.20mg), *Ficus elsticoides* (375.40mg), *Berlinia grandflora* (363.22mg), *Vitex* *doniana* (602.00mg), *Vaccinium parvifolium* (339.12mg) and *Ficus fur* (444.25mg) would be able to meet up with the RNI for phosphorus. Phosphorus is required to build healthy bones and it is essential for energy metabolism (41).

6 Conclusion

The result of the study showed that *Phyllanthus debilis* is a good source of minerals especially magnesium and calcium. Some of the fruits and vegetables like *psychotria viridis*, *Napoleana imperialist*, *Hippocretae myrint*, *Afromomium daniella*, *Portulace oleraceae*, *Ficus fur* and *Berlinia grandflora* are good sources of iron. The vegetables could be useful in dietary formulations to fight iron deficiency anaemia. This important attribute of the vegetables should be explored. *Vitex doniana* and *Hippocretae myrint* are rich in zinc despite the fact that plant foods are not good sources of zinc. The high protein levels of some of the fruits and vegetables like *Ficus elsticoides, Irvingia gabonensis* and *Sterculiar spp* suggest that they could be used in dietary formulation or in supplementing low protein foods in the diet.

Vitex doniana, *Ficus vogaliana*, *Ceiba pentandra*, *Pterocarpus santalinoides*, *Moraceae spp*, *Bombaceae* spp, *Blighia unijugata*, *Brillantaisi nitens*, *Vaccinium parvifolium*, *Gssampelus mucanta, Nauclea diderrichii, Spondian mombin, Vitex doniana* fruits*, Afromomium daniella, Myristicaceae spp, Irvingia gabonensis* pulp*, Cola parchycarpa* and *Parkia clappatonia* has high levels of beta carotene. Consumption of the vegetables and fruits in adequate quantity could help to alleviate the problems associated with vitamin A deficiency. *Portulace oleraceae, Artocarpus altilis* and *Ficus sur* fruit are high in ascorbate which is a powerful antioxidant that could help fight degenerating diseases. If the vegetables and fruits are consumed with iron rich foods, the high ascorbate level will facilitate iron absorption. *Artocarpus altilis* fruit, *Phyllanthus debilis* fruit, and *Blighia unijugata* vegetables are rich in vitamin E which is a common antioxidant.

Fig 1: Portion sizes of hundred gramme (100g) of underutilized vegetables analyzed.

Boerhavia diffusa

Corchorus olitorius

Moraceae spp

Portulence oleraceae

Ceiba pentandra

Uvaria chamea

Berlinia grandflora

Daniella olivera

psychotria viridis

Vitex doniana

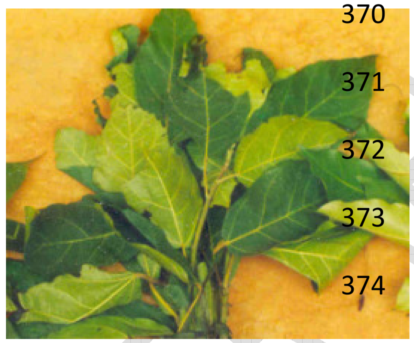
Bombaceae spp

Ficus vogaliana

Brillantaisi nitens

Pterocarpus santalinoides

Ipomea batata



Blighia unijugata

Gssampelus mucanta

Ficus elasticoides

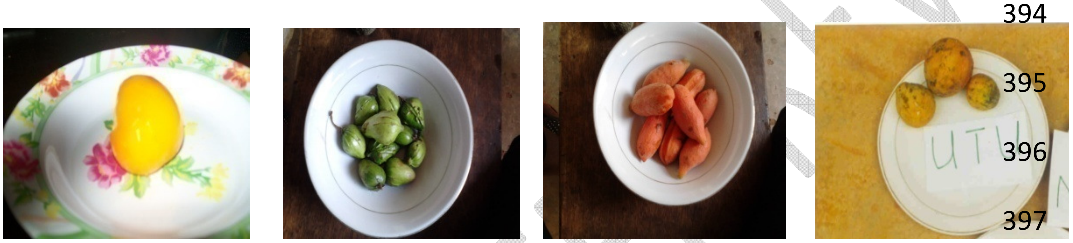
Ficus fur

Figure 1 shows the pictorial record of underutilized vegetables analyzed.

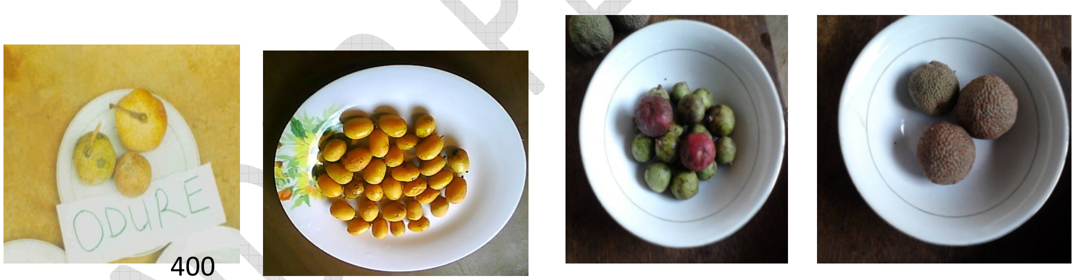
Fig 2: Portion sizes of hundred grammes (100g) of the underutilized fruits analyzed.

Velvet tamarind *Afromomium daniella* *Parkia clappatonia* *Artocarpus altilis* *Sterculiar spp*

Phyllanthus debilis *Irvingia gabonensis* *Myristicaceae spp* *Olax viridis*



Cola parchycarpa *Hippocretae myrint* *Cola gingatean* *Landolfolia dulcis*



Napoleana imperialist *Spondian mombin* *Ficus sur* *Nauclea diderrichii*

Icacina trichatha olive

Gongronema spp

Figure 3 shows the pictorial record of underutilized fruits analyzed.

Table 1: List of underutilized vegetables randomly selected for analysis.

Common name	Igbo name	Scientific name
Vegetable		
Fig tree	*Ogbu ike*	*Ficus elasticoides*
Hog weed	*Azuigwe*	*Boerhavia diffusa*
-	*Ogbu*	*Ficus vogaliana*
Black plum	*Uchakiri*	*Vitex doniana*
-	*Uturukpa*	*Pterocarpus santalinoides*
_	*Anyazu*	*psychotria viridis*
Water leaf	*Ntioke*	*Portulace oleraceae*
-	*Agba*	*Daniella olivera*
Jute	*Arira/Elegule*	*Corchorus olitorius*
-	*Akwokwo akpu*	*Ceiba pentandra*
__	*Okwuruezikemba*	*Moraceae spp*
_	*Ogwuazu*	*Bombaceae spp*
_	*Okpokuko*	*Uvaria chamea*
_	*Akuokoro*	*Ficus fur*
_	*Ububa*	*Berlinia grandflora*
Akee/Ackee	*Uso*	*Blighia unijugata*
Huckleberry	*Ewa*	*Vaccinium parvifolium*
_	*Obuako-enwe*	*Gssampelus mucanta*
_	*Agbolu-uku*	*Brillantaisi nitens*
Potato leaves	*Akwukwo ji nnu*	*Ipomea batata*

Table 2: List of fruits randomly selected for analysis.

Common name Fruits	Igboname	Scientific name
Hog plum	*Echikara*	*Spondian mombin*
Black plum	*Mbembe*	*Vitex doniana*
-	*Icheku*	*Velvet tamarind*
-	*Osisiike/Karagu*	*Myristicaceae spp*
_	*Urumbia*	*Icacina trichatha olive*
_	*Mkpuruamunwaebule*	*Hippocretae myrint*
_	*Aku okoro*	*Ficus sur*
_	*Ose ohia*	*Afromomium daniella*
_	*Uvuru*	*Nauclea diderrichii*
_	*Uvurunwamkpi*	Artocarpus altilis
White rubber vine	*Utu*	*Landolfolia dulcis*
West African locust bean	*Nkpuru ugba*	*Parkia clappatonia*
_	*Achicha*	*Cola parchycarpa*
Bush mango	*Ujuru*	*Irvingia gabonensis*
_	*Oji-eyi*	*Cola gingatean*
_	*Osenga*	*Olax viridis*
_	*Aodo*	*Gongronema spp*
Gooseberry	*Akpuru*	*Phyllanthus debilis*
_	*Nkwukpo*	*Sterculiar spp*
_	*Odure*	*Napoleana imperialist*

Table 3a: Proximate composition of some underutilized vegetables on wet weight basis (%).

Scientific Name	Moisture	Protein	Fat	Fibre	Ash	CHO
Vitex doniana	64.10±0.01	5.20±0.59	2.10±0.00	0.40±0.11	1.60±0.21	26.60±0.88
Ficus elasticoides	68.80±0.07	**6.60±0.06**	0.70±0.08	2.10±0.13	2.90±0.12	18.90±0.26
Corchorus olitorius	70.20±0.10	3.30±0.03	0.80±0.53	1.00 ±0.20	1.80±0.70	17.90±0.15
Ficus vogaliana	61.60±0.03	2.80 ±0.01	0.40±0.00	2.80±0.15	3.70±0.11	28.70±0.13
Ceiba pentandra	69.70±0.23	2.70±0.02	0.10±0.00	1.20± 0.60	0.90±0.0.30	25.40±0.04
Portulace oleraceae	80.20±0.05	4.80±0.06	0.10±0.00	1.20±0.04	1.40± 0.21	**10.30±0.21**
Berlinia grandflora	74.20±0.23	1.22±0.02	1.27±0.64	1.92± 0.60	1.75±0.30	19.64±0.04
Boerhavia diffusa	65.90±0.07	3.60±0.15	0.20±0.02	1.60±0.18	2.40± 0.12	21.30±0.56
Blinghia unijuta	**60.45±0.05**	4.27±0.06	1.45±0.81	3.22±0.04	3.13± 0.21	27.48±0.21
Daniella olivera	71.10±0.04	3.90±0.01	0.40±0.04	1.70 ±0.01	0.90±0.73	18.00±0.15
Brillantaisi nitens	61.05±0.07	5.27±0.15	0.20±0.02	2.22±0.18	0.77±0.12	**30.49±0.56**
Vaccinium parvifolium	77.00±0.04	1.00±0.01	**2.19±0.04**	0.12 ±0.01	2.78±0.73	16.91±0.15
Pterocarpus santalinoides	60.80±0.04	4.20±0.05	0.40±0.08	4.30±0.02	**4.20±0.90**	26.10±0.31
psychotria viridis	66.40±0.14	1.40± 0.09	1.30±0.02	0.60±0.50	1.80±0.40	23.50±0.18
Moraceae spp	66.00±0.01	3.03±0.59	**0.02±0.00**	2.11±0.11	3.54±0.21	25.30±0.88
Bombaceae spp	**91.00±0.07**	**0.02±0.06**	0.90±0.08	**5.01±0.13**	0.92±0.12	2.15±0.26
Uvaria chmea	72.24±0.10	2.07±0.03	0.78±0.53	0.78 ±0.20	2.44±0.70	21.86±0.15
Ficus sur	84.22±0.03	0.22±0.01	2.11±1.00	**0.04±0.01**	2.24±0.11	11.17±0.13
Ipomea batata	68.12±0.14	2.12± 0.09	0.41±0.02	2.10±0.50	**0.04±0.00**	27.21±0.18
Gssampelus mucanta	80.23±0.04	0.48±0.05	0.62±0.08	1.16±0.02	1.11±0.90	16.40±0.31

Mean±Standard deviation

Table 3b: Proximate composition of some underutilized fruits on wet weight basis (%/).

ScientificName	Moisture	Protein	Fat	Fibre	Ash	CHO
Hippocretae myrint	72.40±0.09	0.30±0.10	0.10±0.09	0.28±0.66	0.55±0.74	26.37±0.30
Nauclea diderrichii	59.70±0.04	1.01±0.01	0.41±1.04	1.47±0.27	0.80±0.29	**36.61±0.22**
Icacina trichatha olive	73.50±0.40	0.90±0.06	0.37±0.43	**0.11±0.03**	0.73±0.30	24.39±0.63
Myristicaceae spp	60.90±0.63	1.20±0.21	0.52±0.36	0.93±0.80	0.68±0.75	35.77±0.35
Artorcarpus altilis	61.15±0.01	3.00±0.59	0.46±0.00	7.94±0.11	6.84±0.21	20.61±0.88
Landolfolia dulcis	70.40±0.07	2.08±0.06	1.52±0.08	1.48±0.13	**11.05±0.12**	13.47±0.26
Cola parchcarpa	59.27±0.03	4.57 ±0.01	1.03±1.00	3.67±0.15	5.72±0.11	25.74±0.13
Gongranema spp	75.40±0.23	2.60±0.02	**Trace**	1.38± 0.60	0.66±0.0.30	19.96±0.04
Irvingia gabonensis	67.42±0.05	**6.21±0.06**	1.65±0.81	7.80±0.04	4.80± 0.21	12.12±0.21
Olax viridis	73.10±0.33	0.72±0.71	0.39±0.01	0.39±0.10	0.71±0.52	25.08±0.44
Napoleana imperialist	70.90±0.28	0.70± 0.03	0.31±0.24	0.40±0.11	0.39±0.47	27.30 ±0.12
Parkia clappatonia	**54.34±0.10**	3.02±0.03	**3.08±0.53**	2.74 ±0.20	3.91±0.70	32.91±0.15
Afromomium daniella	71.30±0.36	**0.27±0.07**	0.27±0.26	1.01±0.60	0.65±0.78	26.50±0.16
Vevet tamarind	72.80±0.50	0.31±0.03	0.47±0.49	0.36±0.09	0.44±0.83	25. 62±0.53
Cola gigantean	71.02±0.04	2.11±0.01	2.38±0.04	1.17 ±0.01	**0.33±0.73**	22.99±0.15
Ficus sur	63.85±0.04	5.52±0.05	2.05±0.08	**8.58±0.02**	9.52±0.90	10.48±0.31
Phyllanthus debilis	**80.30±0.14**	3.42± 0.09	2.00±0.02	4.20±0.50	1.00±0.40	**9.08±0.18**
Spondian mombin	67.20±0.30	1.20±0.20	0.20± 0.06	2.02±0.02	3.00±0.62	26.38±0.74
Vitex doniana	61.70±0.04	1.30±0.30	2.50 ±0.41	0.76 ±0.06	2.79±0.13	30.95 ±0.0
Sterculia spp	68.92±0.07	6.04±0.15	1.46±0.02	5.27±0.18	3.36± 0.12	14.95±0.56

Mean±Standard deviation

Table 4a: Mineral composition of some underutilized vegetables on wet weight basis (mg/100g).

Scientific name	Fe	Cu	Zn	Mn	Ca	Mg	Na	K	P
Vitex doniana	2.90± 0.04	0.40±0.01	**9.40±0.22**	1.70±0.72	134.04±0.16	37.70±0.56	1.65±0.11	92.24±1.42	602.50±4.22
Ficus elsticoides	6.40±0.22	1.30±0.79	4.30±0.03	3.80±0.03	101.60±0.54	18.20±0.10	1.92±0.76	96.01±0.93	375.40±0.79
Corchorus olitorius	1.60±0.01	0.66±0.39	6.90±0.08	2.32±0.04	238.00±0.67	17.50±0.34	2.30±0.36	83.33±0.16	128.20±2.22
Ficus vogaliana	6.20±0.19	1.22±0.77	2.90±0.15	**4.80±0.09**	240.60±0.44	20.10 ±0.80	1.88±0.72	53.87±0.23	**75.40±7.06**
Pterocarpus santalinoides	3.10±0.14	0.40±0.66	1.80 ±0.56	0.30±0.12	343.40±2.08	17.70±0.45	1.02±0.16	80.11±0.49	85.00±10.30
psychotria viridis	**11.80±0.23**	1.30±0.43	7.00±0.55	1.32±0.88	116.20±0.96	22.60±0.64	3.01±0.20	76.27±0.78	134.60±6.13
Moracae spp	2.60± 0.04	**0.02±0.01**	**Trace**	0.60± 0.72	180.40±0.16	32.14 ± 0.56	0.64±0.11	96.14±0.23	154.28±1.22
Bombaceas spp	**1.40±0.22**	0.60±0.79	2.10±0.03	4.30±.03	252.00±0.54	25.60±0.10	2.33±0.76	70.92±0.93	220.91±0.79
Uvaria chamea	6.80±0.01	0.90±0.39	1.70±0.08	3.60±0.04	220.00±0.67	**47.20±0.34**	**3.01±0.36**	48.00±0.16	161.45±1.22
Ficus sur	10.60±0.19	0.40±0.77	0.40±0.15	1.30±=0.09	**18.19±0.44**	42.26 ±0.80	2.13±0.72	54.00±0.23	444.25±0.06
Berlinia grandflora	8.80± 0.11	0.30±0.32	1.60±0.27	0.20±0.49	340.00±0.63	18.34±0.16	1.98±0.65	**104.23±0.17**	363.22±0.14
Blighia unijugata	3.45±0.54	2.28±0.17	2.06± 0.32	0.74±0.07	96.20±0.24	**4.38±0.74**	0.72±0.42	23.23±0.01	126.22±5.02
Brillantaisi nitens	**1.40±0.23**	0.20± 0.04	1.40±0.81	2.60± 0.43	**400.00±5.38**	41.00±0.28	**0.27±0.31**	**16.20±0.03**	216.00±0.70
Ceiba pentandra	3.60± 0.11	0.10±0.32	5.30±0.27	0.60±0.49	261.50±2.63	15.17±0.16	2.10±0.65	46.20±0.17	154.10±3.14
Boerhavia diffusa	6.10±0.15	0.95±0.0.18	5.20±1.02	**0.07± 0.31**	219.60±0.42	28.22±0.05	1.44±0.01	61.92±0.14	**685.60±9.53**
Daniella olivera	2.00±0.23	0.93± 0.04	1.30±0.81	4.02± 0.43	281.90±38	16.19±0.28	0.92±0.31	56.13±0.03	187.90±2.70
Vaccinium parvifolium	5.27±0.14	1.62±0.66	0.78 ±0.56	2.27±0.12	43.00±0.08	38.40±0.45	1.10±0.16	71.21±0.49	339.12±1.30
Gssampelus mucanta	2.76±0.23	0.98±0.43	3.21±0.55	0.91±0.88	374.00±2.96	16.10±0.64	2.15±0.20	57.20±0.78	122.20±0.13
Ipomea batata	1.91±0.15	**3.14±0.18**	3.96±1.02	1.67± 0.31	140.00±0.42	20.11±0.05	2.02±0.01	49.61±0.12	257.20±16.53
Portulace oleraceae	10.50±0.54	0.33±0.17	1.40±0.32	1.71±0.07	144.40±0.24	27.14±0.74	1.62±0.42	52.10±0.01	152.90±1.02

Mean ± Standard deviation

Table 4b: Mineral composition of some underutilized fruits on wet weight basis (mg/100g).

Scientific name	Fe	Cu	Zn	Mn	Ca	Mg	Na	K	p
Hippocretae myrint	9.60±0.16	0.03±0.00	**10.30±0.04**	**6.60±0.20**	13.04±0.02	3.00±0.03	1.00±0.03	281.00±6.18	20.00±0.93
Nauclea diderrichii	4.80±0.29	0.02±0.00	1.70±0.03	2.80±0.18	9.20±0.11	26.10±0.13	3.00±0.01	60.00±0.17	9.00±0.83
Icacina trichatha olive	2.10±0.11	0.04±0.01	2.80±0.21	5.40±0.47	20.70±0.03	10.40±0.14	3.00± 0.19	29.42±0.08	13.00±0.42
Napoleana imperialist	9.40±0.43	0.02±0.01	0.60±0.13	0.30±0.07	28.10±0.08	9.60±0.10	3.00±0.55	110.00±2.08	21.00±0.40
Spondian mombin	2.12±0.22	0.01±0.00	6.03±0.09	3.10±0.11	17.91±0.10	15.00±0.06	4.50±0.18	260.00±4.14	39.00±0.02
Vitex doniana	3.40±0.35	0.12±0.01	4.40±1.04	2.61±0.24	12.16±0.06	9.27±0.41	4.00±0.26	130.00±0.49	19.00±0.01
Afromomium daniella	8.40±0.09	0.01±0.00	0.40±0.04	**0.10±0.03**	17.20±0.03	2.04±0.15	**Trace**	281.00±3.04	14.00±0.05
Vevet tamarind	**9.80±0.27**	0.04±0.03	8.60±0.11	0.50±0.02	14.71±0.06	18.12±0.07	1.55±0.05	198.00±0.01	18.00±0.21
Irvingia gabonensis	2.00±0.54	0.30±0.17	2.20± 0.32	1.21±0.07	30.00±0.24	3.00±0.74	**6.20±0.42**	**410.00±1.01**	**1.70±0.02**
Cola gingatean	1.70±0.23	0.04± 0.01	0.10±0.00	0.32± 0.43	27.00±0.38	8.64±0.28	1.17±0.31	110.00±0.03	12.34±0.70
Ficus sur	1.43±0.14	0.02±0.66	1.29 ±0.56	2.27±0.12	31.20±0.08	3.25±0.45	1.61±0.16	240.00±1.49	39.42±0.30
Phyllanthus debilis	3.20±0.23	1.00±0.43	0.20±0.55	0.42±0.08	**46.50±0.96**	**31.82±0.64**	0.20±0.20	270.00±0.78	37.10±0.13
Sterculiar spp	1.04±0.15	Trace	0.42±0.02	0.11± 0.01	22.50 ±0.42	18.03±0.05	2.00±0.01	180.00±0.14	20.13±0.53
Myristicaceae spp	6.40±0.59	0.04±0.02	2.30±0.35	4.40±0.74	19.09±0.17	14.72±0.14	2.00±0.11	156.00±0.18	12.00±0.19
Olax viridis	3.60±0.35	0.00	0.10±0.61	0.30±1.09	18.47±0.22	12.88±0.56	1.00±0.40	126.00±0.60	14.00±0.26
Artocarpus altilis	4.76± 0.04	0.02±0.01	1.42±0.22	3.17± 0.72	11.30±0.16	4.60 ± 0.56	2.17±0.11	**2.43±0.23**	11.46±0.22
Landolfolia dulcis	3.85±0.22	0.03±0.01	**0.02±0.03**	0.98±.03	**5.42±0.54**	3.02±0.10	1.80±0.76	210.00±0.93	3.85±0.79
Parkia clappatonia	2.90±0.01	0.06±0.03	0.80±0.08	0.40±0.04	18.00±0.67	0.21±0.04	3.70±0.36	220.00±0.16	28.21±0.22
Cola parchycarpa	3.40±0.19	2.01±0.77	1.82±0.15	1.38±=0.09	32.10±0.44	1.71 ±0.80	4.12±0.72	96.00±0.23	6.79±0.06
Gongronema spp	**0.10± 0.02**	**4.06±0.32**	2.43±0.27	1.72±0.49	9.96±0.63	16.63±0.16	4.47±0.65	192.00±0.17	**44.66±0.14**

Mean ± Standard deviation

Table 5a: ßeta-carotene and Vitamin composition of some underutilized vegetables on wet weight basis.

Scientific name	ß-carotene (RE)	VitaminC (mg)	VitaminE (mg)
Vitex doniana	**1933.33±21.59**	12.10±0.35	0.96±0.11
Ficus elsticoides	**15.20±0.29**	32.90±0.09	0.11±0.01
Corchorus olitorius	16.00±0.35	3.60±0.02	1.92±0.76
Ficus vogaliana	1633.33±8.74	6.50±1.00	1.24±0.40
Ceiba pentandra	1866.67±18.17	12.20±0.26	3.11±0.01
Portulace oleraceae	31.20±0.14	**38.40 ± 0.62**	2.10±0.46
Daniella olivera	22.40±0.11	3.04±0.14	0.87±0.19
Pterocarpus santalinoides	1233.33±6.18	11.20 ±0.22	2.41±0.02
psychotria viridis	25.67±0.01	29.90±0.14	2.63±0.56
Boerhavia diffusa	1366.67± 0.19	16.10 ±0.60	1.86±0.08
Moraceae spp	450.00±0.59	**2.40±0.35**	Trace
Bombaceae spp	6161.67±1.29	12.80±0.09	1.24±0.91
Uvaria chemea	200.00±0.35	14.30±0.02	0.08±0.06
Ficus sur	356.67±2.74	11.60±1.00	0.67±0.40
Blinghia unijugata	591.67±1.14	4.12 ± 0.62	**6.67±0.46**
Brillantaisi nitens	700.00±0.11	14.20±0.14	1.12±0.19
Vaccinium parvifolium	451.67±2.18	5.27 ±0.22	3.25±0.02
Gssampelus mucanta	266.83±0.01	19.60±0.14	4.98±0.56
Ipomea batata	701.67± 0.19	8.67 ±0.60	5.57±0.08
Berlinia grandflora	356.67±1.17	11.40±0.26	3.36±0.01

Mean±Standard deviation

Table 5b: ßeta-carotene and Vitamin composition of some underutilized fruits on wet weight basis.

Scientific name	VitaminC (mg)	VitaminC (mg)	B-carotene (RE)
Hippocretae myrint	22.70±0.09	22.70±0.09	Trace
Nauclea diderrichii	13.40±0.05	13.40±0.05	1233.33±6.62
Icacina trichatha olive	4.90±0.42	4.90±0.42	16.67±0.94
Napoleana imperialist	3.80±0.14	3.80±0.14	Trace
Spondian mombin	9.30±0.07	9.30±0.07	2000.00±9.71
Vitex doniana	14.29±0.03	14.29±0.03	1333.33±0.76
Afromomium daniella	14.80±0.01	14.80±0.01	566.67±0.73
Vevet tamarind	8.60±0.16	8.60±0.16	Trace
Myristicaceae spp	14.90±0.07	14.90±0.07	4333.33±11.03
Olax viridis	2.40± 0.11	2.40± 0.11	16.67± 0.09
Artocarpus altilis	**48.82±0.35**	**48.82±0.35**	199.83±4.59
Irvingia gabonensis	35.80 ± 0.62	35.80 ± 0.62	416.67±2.14
Cola gigantean	**1.20±0.14**	**1.20±0.14**	46.67±0.11
Ficus sur	40.22 ±0.22	40.22 ±0.22	665.00±1.18
Phyllanthus debilis	14.26±0.14	14.26±0.14	141.67±0.01
Sterculia spp	13.68 ±0.60	13.68 ±0.60	60.00± 0.19
Landolfolia dulcis	17.40±0.09	17.40±0.09	48.33±0.29
Parkia clappatonia	18.90±0.02	18.90±0.02	970.67±1.35
Cola parchycarpa	11.61±1.00	11.61±1.00	**5666.67±2.74**
Gongronema spp	14.48±0.26	14.48±0.26	17.5±0.17

Mean ± Standard deviation

5. CONCLUSION

The result of the study showed that *Phyllanthus debilis* is a good source of minerals especially magnesium and calcium. Some of the fruits and vegetables like *psychotria viridis*, *Napoleana imperialist*, *Hippocretae myrint*, *Afromomium daniella*, *Portulace oleraceae*, *Ficus fur* and *Berlinia grandflora* are good sources of iron. The vegetables could be useful in dietary formulations to fight iron deficiency anaemia. This important attribute of the vegetables should be explored. *Vitex doniana* and *Hippocretae myrint* are rich in zinc despite the fact that plant foods are not good sources of zinc. The high protein levels of some of the fruits and vegetables like *Ficus elsticoides, Irvingia gabonensis* and *Sterculiar spp* suggest that they could be used in dietary formulation or in supplementing low protein foods in the diet.

Vitex doniana, *Ficus vogaliana*, *Ceiba pentandra*, *Pterocarpus santalinoides*, *Moraceae spp*, *Bombaceae* spp, *Blighia unijugata*, *Brillantaisi nitens*, *Vaccinium parvifolium*, *Gssampelus mucanta, Nauclea diderrichii, Spondian mombin, Vitex doniana* fruits*, Afromomium daniella, Myristicaceae spp, Irvingia gabonensis* pulp*, Cola parchycarpa* and *Parkia clappatonia* has high levels of beta carotene. Consumption of the vegetables and fruits in adequate quantity could help to alleviate the problems associated with vitamin A deficiency. *Portulace oleraceae, Artocarpus altilis* and *Ficus sur* fruit are high in ascorbate which is a powerful antioxidant that could help fight degenerating diseases. If the vegetables and fruits are consumed with iron rich foods, the high ascorbate level will facilitate iron absorption. *Artocarpus altilis* fruit, *Phyllanthus debilis* fruit, and *Blighia unijugata* vegetables are rich in vitamin E which is a common antioxidant.

REFERENCE

1 United Nations Food and Agriculture Organization FAO (2005). Increasing fruit and vegetable consumption becomes a global priority. Available from: http://fao.org/english/newsroom/focus/2003/fruitveg1.htm.

2 Mwangi, S. & Mumbi, K.(2006). African leafy vegetables evolves from underutilized species to commercial cash crops. Research Workshop on Collective Action and Market Access for Smallholders (www.afri.veg/res).

3 Okigbo, B.N. (1986). Broadening the food base in Africa: The potentials of traditional food plants. Food and Nutrition Bulletin.12: 1 FAO/UN.

4 World Bank (1994). Enriching lives: Overcoming Vitamins and Mineral malnutrition. In Developing Countries (*http/nut.jorn.org*).

5 Sheela, K.., Kamal, G., Nath, D., Vijayalakshmi, G. M., Yankanchi & Roopa, B. P. (2004). Proximate Composition of Underutilized Green Leafy vegetables in Southern Karnataka. *Journal of Human Ecology*, 15(3), 227-229.

6 Nnamani, C.V., Oselebe, H.O. & Okporie, E.O. (2007). Ethnobotany of Indigenous Leafy Vegetables of Izzi Clan, in Ebonyi State, Nigeria. In: Proceeding of 20th Annual National Conference of Biotechnology Society of Nigeria. Abakaliki, November 14th-17th, 111-114.

7 Oboh, G. & Akindahunsi , A. A.(2004). Change in ascorbic acid, total phenol and antioxidant activity of sun-dried commonly consumed green leafy vegetables in Nigeria. Nutrition. & Health, **18,** 29-36.

8 Noonan, S.C. & Savage, G.P. (1999). Oxalate content of foods and its effect on humans. *Asia Pacific Journal of Clinical Nutrition*, 67,64-74.

9. AOAC (2000). Association of Official Analytical Chemist. Official methods of Analysis, Washington, D.C

10. Pearson, I.O. (1976). Fundamental of Food Biochemistry, 2^{nd} ed., Atlanta, Georgia, 30322 USA (www.en.wikipedia.org/wiki/special).

11. Seo, J. S., Burri, B.J., Quan, Z. & Neidlinger,T.R. (2005). Extraction and chromatography of carotenoids from pumpkin. *American Journal of Chromatography* 1073:371-375.

12. Burri, B.J.(2007). Analysis of vitamin E by HPLC. The Encyclopedia of Vitamin E. pp.

13. Oxford Dictionary of Biochemistry and Molecular Biology.(2006). Oxford University Press. ISBN 0198529171.(www.en.wikipedia.org/wiki/special).

14 Ene-Obong, H.N. (1998). Native species in National food consumption system. A paper presented during the inauguration of the R and D Team for the National Programme on indigenous crops and animals by the Federal Ministry of Science and Technology at the conference Hall of National centre for Genetic Resources and Biotechnology, Moor Plantation, Ibadan on 4^{th} May,1998. pp 5-34

15 Eyo, S.E., Molime, A. & Abel, H.J.(1983). Chemical composition and amino acid contents of *Gnetum africana*, *Heinia crinita* and *Piper guinense*. *Nigerian .Journal of Nutritional Science,* 4, 57-62.

16 FAO (1996). Fruits and vegetables processing by Dauthy, M.E, FAO Agriculture Service Bulletin, Rome 119: 437.

17 Mensah, J.K.., Okoli, R.I., Ohaju-Obodo, J.O. & Eifediyi, K. (2008). Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria. *African Journal of Biotechnology*. 7 (14), 2304-2309.

18 U.S. Department of Health and Human Services and U.S. Department of Agriculture (2005). Dietary Guidelines for Americans, 2005. 6th Edition, Washington, DC: U.S. Government Printing Office, January 2005.

19 Ajayi, I.E., Obasi, N.A., Chinyere, G.C. & Ugbogu, A.E. (2007). Nutritional and chemical value of *Amaranthus hybridus* L. leaves from Nigeria, *African Journal of Biotechnology*. 6 (24), 2833-2839.

20 Adnani, S. (2007). Health benefit of mineral. (http/www.organicfacts.net/health-benefits).

21 Dionne, I. (2009). Vitamin E with Vitamin C supplements or exercise boost bone health in older women (www.health info).

22 Aaron, B. (2009). Importance of Vitamin E. http/www.healthinforesources.blogspot.com)

23 Food and Nutrition Board, FNB & Institute of Medicine, IOM. (2001). Dietary Reference intakes for vitamin A, vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc. Washington, D.C., National Academy Press; 2001. p.82-393.

24. Barua, A.B. and Olson, J.A. (2001). β-Carotene is converted primarily to retinoids in rats in vivo. Journal of Nutr. 2000, 130, 1996-2001.

25 Robert M. and Russell (2007). Vegetables and fruits are nutrient rich. Higher fruit and vegetable intakes and concomitant nutrients have Multivitamin-multimineral supplements' effect on total nutrient intake . American Journal of Clinical Nutrion. 2007.

26 Decuypere, J., Henderickx, H. K. & Vervaeke, I.. (2010). Influence of nutritional doses of *Virginiamycin* and *Spiramycin* on the quantitative and topographical composition of the gastro-intestinal flora of artificially reared piglets. Zbl. Bakt Hyg, I Abt Orig. A223, 348–355.

27 Nnamani, C. V., Oselebe, H. O. & Agbatutu, A. (2009). Assessment of nutritional values of three underutilized indigenous leafy vegetables of Ebonyi State, Nigeria. *African Journal of Biotechnology*, 8 (9), 2321-2324, at http://www.academicjournals.org/AJB.

28 Maundu,P. (2006). Promotion of underutilized food plants in Sub-Sahara African: Experiences with leafy vegetables. International plant Genetic Resources Institute (IPGRI).

29 Umran and Nevo (1996). Grain zinc, iron and protein concentrations and zinc- efficiency (http//docpayer.net,45508521)

30 Lippard, S. J., & J. M. Berg. 1994. *Principles of Bioinorganic Chemistry*. University Science Books, Mill Valley, CA.

31 Shankar, A.H. & Prasad, A.S. (1998). Zinc and immune function; the biological basis of altered resistance of infection. *American Journal of Clinical Nutrition*, 68, 447-463.

32 Nelson, D. L.; & Cox, M. M.(2000) "Lehninger, Principles of Biochemistry" 3rd Ed. Worth Publishing: New York, ISBN 1-57259-153-6.

33 Nnamani, C. V., Oselebe, H. O. & Agbatutu, A. (2009). Assessment of nutritional values of three underutilized indigenous leafy vegetables of Ebonyi State, Nigeria. *African Journal of Biotechnology*, 8 (9), 2321-2324, at http://www.academicjournals.org/AJB.

34 Sahin OZ[1], Asci G, Kircelli F, Yilmaz M, Duman S, Ozkahya M, Dogan C, Odabas AR, Cirit M, Ok E.(2012).The impact of low serum sodium level on mortality depends on glycemic control. Eur J Clin Invest. 2012 May;42(5):534-40. doi: 10.1111/j.1365-2362.2011.02613.x. Epub 2011 Nov 3.

35. World Health Organization, UNICEF & Johns, H. B.(2007) School of Public Health, USAID .P.28 (www.en.wikipedia.publichealth).

36Nevo table (1996). Nevo Foundation, Netherlands Nutrition Centre.

37 Musinguzi, E.L, J.K. Kikafunda and B.T. Kiremire,(2007).Promoting indigenous wild edible fruits to complement roots and tuber crops in alleviating vitamin A deficiencies in Uganda. Proceedings of the 13th ISTRC Symposium, pp: 763-769.

38 Adnani, S. (2007).Health benefit of mineral. (http/www.organicfacts.net/health-benefits).

39 Corbridge, D. E. C. (1995). *Phosphorus: An Outline of its Chemistry, Biochemistry, and Technology* (5th ed.). Amsterdam: Elsevier. ISBN 0-444-89307-5.