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COMPARATIVE NUTRITIONAL STUDY OF FOUR MOST CONSUMED VEGETABLES IN AKWA IBOM STATE, NIGERIA

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ABSTRACT

The study compared nutritional content of four most consumed vegetables [Gnetum africanum Welw, Hensia crinita (Afzel) G.Taylor, Lasianthera africana P.Beauv and Pterocarpus mildbraedii Harms] in Akwa Ibom State, Nigeria. Standard procedures were followed in these assessments: Proximate composition (carbohydrate, protein, fibre, lipid, ash and moisture), Mineral elements (magnesium – Mg, calcium – Ca, iron – Fe, potassium – K and sodium – Na), vitamin C and chlorophyll (a and b). The study showed varied proximate composition, mineral elements, vitamin C and chlorophyll contents across the vegetables assessed. For proximate composition, the following ranges were recorded: 2.78 – 8.99%, 9.63 – 14.00%, 5.43 – 12.15%, 0.001 – 0.013%, 1.91 – 3.14% and 63.38 – 78.01% for carbohydrate, protein, fibre, lipid, ash and moisture contents, respectively. Among the vegetables, G. africanum recorded the highest value for carbohydrate, fibre, lipid, Fe, vitamin C and chlorophyll b. However, recorded the least value for moisture, ash, Mg and K contents. Secondly, L. africana had highest value for moisture, Ca, K, and Na contents and least value for protein, fibre, lipid, vitamin C, chlorophyll a and b contents. The K content in L. africana was statistically different at $p \leq 0.05$ with other vegetables. The study recommends the consumption of these nutritious vegetables based on dietary requirement of individuals.

INTRODUCTION

Vegetables are the edible parts of herbaceous plants that are consumed wholly or in parts, raw or processed, as portion of main dish or salad. They may be bitter, sweet, or tasteless (Dhellot et al., 2006). They are identified to be vital sources of protective foods (Sheela et al., 2004). Fresh vegetables are tender plant parts cultivated in gardens and eaten as a side dish or soup with starchy staples among the communities in Nigeria (Nnamani et al., 2009). The leafy vegetables are largely rich in fibre, whereas cereals, root vegetables and other foods are comparatively poor sources of nutrients and this accounts for the role of leafy vegetables as major dietary components in African population (Akindahusi & Salawu, 2005; Fasuyi, 2006). Nigeria is home to many vegetable species that are used as flavor in human foods or as additional feeds to livestock (Taiwo et al., 2007). Vegetables have also been described to be good sources of nutrients such as carotene, protein, vitamins, calcium, iron, ascorbic acid and tangible concentration of trace minerals (Adenipekun & Oyetunji, 2010).

According to George (2003), the potassium content of leaf vegetable plays an important role in the management of diuretic and hypertensive difficulties. He also reported the available proteins in vegetables are greater than those in fruits but lower than those in grains. Vegetable fats and oils are known to lower blood lipids thereby reducing the occurrences of diseases with the damage of the coronary artery (Adenipekun & Oyetunji, 2010). Leafy vegetables are extremely useful in the preservation of good health conditions and prevention of diseases. They serve as valuable sources of food components that can be used to build-up and improve the body positively (Hanif et al., 2006). They are also sources of essential and trace elements which play essential part in the normal functioning of the body system, maintaining regular metabolic processes and repair of worn out cells and tissues in man (Bruijnzeel et al., 2010). For years, there has been increasing

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demand for fresh vegetables mainly for their convenience as ready-to-eat products in addition to health benefits associated with their consumption (Odedeji & Rasheed, 2007; Ajayi et al., 2018). In Nigeria, and in most other tropical African countries, where the daily meals are mostly carbohydrate foods, vegetables are the inexpensive and most readily available source of vital nutrients such as proteins, vitamins, minerals and essential amino acid (Akubugwo et al., 2007). In many Nigerian's diet, leafy vegetables are crucial components besides spicing-up meals. (Sobukola et al., 2007), they are important sources of nutrients particularly in rural areas where they add substantially to protein, minerals, vitamins, fibres and other nutrients which are usually in short supply in daily diets (Mohammed & Sharif, 2011). The numerous vitamins present in vegetables provide health-promoting effects for its consumers (Fayemi, 2000). The levels of these vitamins in the leaves however vary from one plant to another and one location to another.

In Africa, two different species of Gnetum (Gnetum africanum and Gnetum buchholzianum) belonging to the family Gnetaceae are found and distributed in the tropical rainforests from Nigeria through Cameroon, the Central African Republic, Gabon and the Democratic Republic of Congo to Angola (Lowe, 1984). Gnetum africanum Welw, also known as wild spinach and commonly known as "Afang" by the Efik people of Nigeria, is dioecious (Letouzey, 1986). Also, Heinsia crinita (Afzel.) G. Taylor, known as 'Bush apple' and called "Atama" by Efik ethnic group in Nigeria, is indigenous to West Africa especially the Eastern-part of Nigeria, but it is now cultivated well in Central Africa (Babady-Billa et al., 1994) and it belongs to the family Rubiaceae. It is found across the tropical region from Guinea to Western-Cameroon, Fernando Po and across the Congo basin to East and South Central-Africa (Ajibesin et al., 2008). Lasianthera africana P. Beauv belonging to Stemonuraceae family, commonly known as "Editan" by Efik and Ibibio ethnic groups of Nigeria, is one of the sixth most consumed green leafy vegetables by the Efik and Ibibio ethnic groups in Nigeria (Williams et al., 2009). Again, Pterocarpus mildbraedii Harms of the Papilionoidaea, commonly known as "Mkpafere" in Efik ethnic group of Nigeria, occurs in lowland rainforest, dry evergreen and riverine forests, up to 1250 m altitude, in Sierra Leone, Nigeria, Liberia, Ghana, Cameroon, Equatorial Guinea and Tanzania (Keay, 1989; Bosch, 2004).

People in different parts of the world depend on plant resources for their basic needs and many of these plants in the ecosystem are being harness for various purposes. Hence, the need for comparative investigation of the proximate composition, minerals, vitamins and pigment composition in leafy vegetables remains crucial. This study thus compares the proximate, mineral, vitamin C and chlorophyll content of four leafy vegetables (G. africanum, H. crinita, L. africana and P. mildbraedii) consumed in Akwa Ibom State, Nigeria.

MATERIALS AND METHODS

Source of Materials and Identification

The leaves of G. africanum, H. crinita, L. africana and P. mildbraedii were collected from College of Agriculture, Obio-Akpa Teaching and Research Farms Oruk-Anam Local Government Area, Akwa Ibom State. The plants were wrapped with paper, bagged in polyethene bags and transported to the Herbarium unit of Plant Science and Biotechnology Department University of Port Harcourt for proper identification by the curator.

Analyses of Plant Materials

Proximate analysis (moisture, ash, protein, carbohydrate, lipid content and crude fibre) of the plants was determined following the standard method of Association of Analytical Chemists (AOAC, 1990) while the extraction and determination of **v**itamin C was evaluated through titrimetric method (Okwu, 2004). Also, the chlorophyll content of the leaves was determined using the method of Comar and Zscheile (1942).

Mineral Analysis

The leaf samples were digested using hydrochloric acid (Okalebo et al., 2002). The mineral contents (Mg, K, Ca, Na, and Fe) of the plants were determined using Atomic Absorption Spectrophotometer (AAS).

RESULTS

Proximate Analysis, Vitamin C and Chlorophyll Content

The nutritional content of G. africanum, H. crinita, L. africana and P. mildbraedii are presented in Figure 1. The following ranges were recorded: 2.78 – 8.99%, 9.63 – 14.00%, 5.43 – 12.15%, 0.001 – 0.013%, 1.91 – 3.14% and 63.38 – 78.01% for carbohydrate, protein, fibre, lipid, ash and moisture contents, respectively. The lipid content of G. africanum, H. crinita, L. africana and P. mildbraedii were less than 0.015%. Gnetum africanum had the highest lipid content (0.013%) followed by P. mildbraedii (0.009%), H. crinita (0.007%) while L. africana recorded the least lipid content at 0.001%. The leaves had higher protein content than carbohydrate. Lasiathera africana leaf had the least fibre content in relation to other leaves, while the reverse was the case for moisture content. Across the plants, the protein and fibre contents had the same trend.

The vitamin C and chlorophyll contents of G. africanum, H. crinita, L. africana and P. mildbraedii are presented in Figure 2. Vitamin C across the plants ranged from 2.2 – 3.0%. Among the leafy vegetables, L. africana and P. mildbraedii had the lowest vitamin C content while G. africanum and H. crinita recorded 3.0% and 2.4%, respectively. Also, the chlorophyll content varied across plants but chlorophyll a was lower than chlorophyll b in all cases. Gnetum africanum and P. mildbraedii had the highest value for chlorophyll a and b, respectively, while L. africana had the least value for chlorophyll a and b.

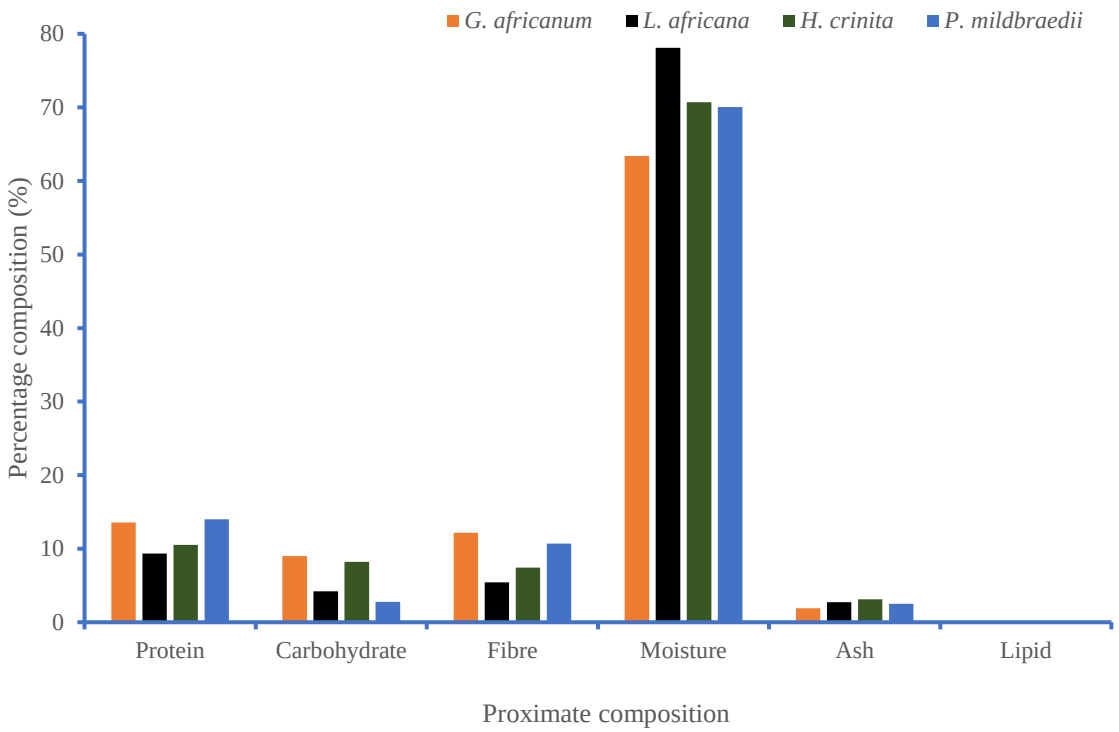

Figure 1. Proximate composition of four vegetables consumed mostly in Akwa Ibom

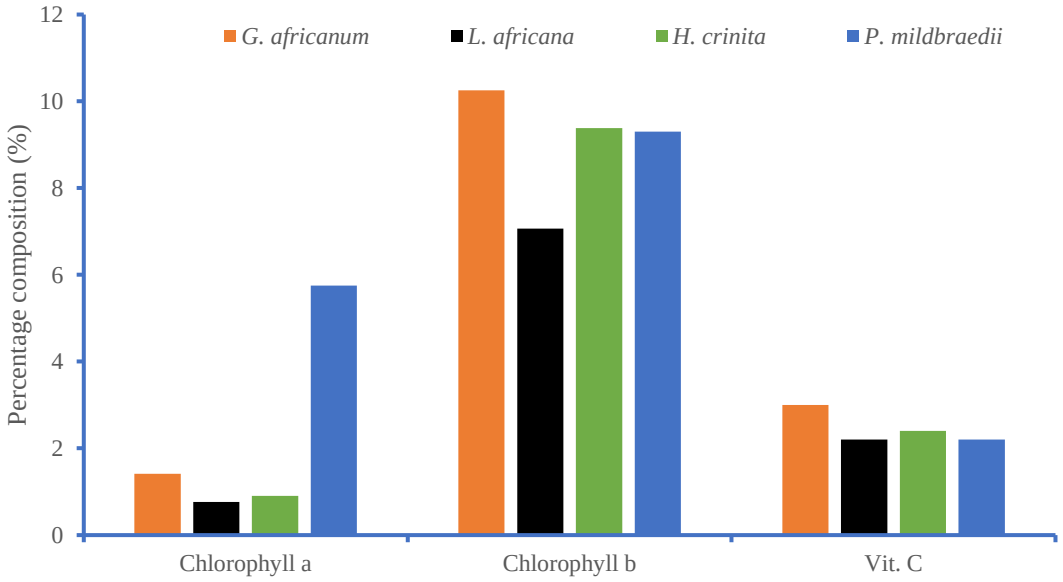

Figure 2. Chlorophyll and vitamin C content of four consumed vegetables in Akwa Ibom

Mineral Analysis

The mineral content of the leaves showed that potassium content had the highest value, followed by magnesium, calcium, sodium and iron (Figure 3). Among the plants, potassium content was more in L. africana than H. crinita and P. mildbraedii while the least was recorded in G. africanum. Also, calcium content was observed to be greater in the leaf of L. africana than H. crinita, G. africanum and P. mildbraedii, in that sequence. The levels of iron were 94.75 mg/kg, 87.00 mg/kg, 74.15 mg/kg, and 66.60 mg/kg for G. africanum, P. mildbraedii, L. africana and H. crinita, respectively.

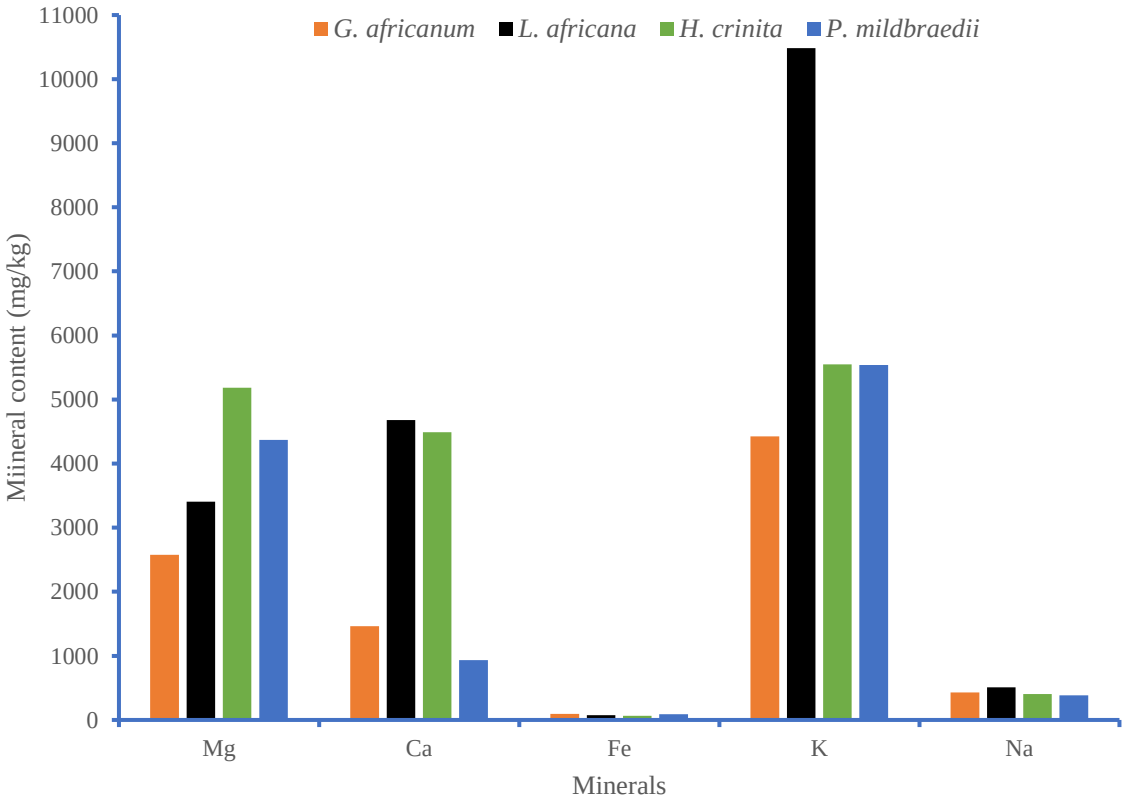

Figure 3. Mineral content of four mostly consumed vegetables in Akwa Ibom

DISCUSSION

The protein content of G. africanum and P. mildbraedii are within the range reported by Ekpo (2007) and Taiga et al. (2008) while L. africana and H. crinita are below the range. Ekpo (2007) reported a crude protein content of G. africanum at 17.5% while Taiga et al. (2008) reported a value of 13.33%. These differences in the protein contents may be attributed to the changes and forms of manure applied to improve the soil nitrogen content where these vegetables are harvested (Saidu & Jideobi, 2009). The moisture content of the tested leafy vegetables was high. According to Gbadamosi et al. (2011), high moisture content supports stabilization of protoplasmic contents of the cells and further preserves the homeostasis of the cells, while, food spoilage caused by microorganisms could be attributed to high moisture contents. Fagbohun et al. (2012) reported that the presence of mineral elements in vegetables is directly related to its ash content. This implies that increase in the ash content results to increase in mineral nutrition available in the plant. The highest ash content was obtained in H. crinita (3.14%) and the least in G. africanum (1.91%). Therefore, this observation concerning H. crinita ash content agrees with the findings of Adetuyi et al. (2011), while the values obtained for L. africana, G. africanum and P. mildbraedii are slightly closer to the range. Fibres are non-hydrolysable polysaccharides which possess the ability to dissolve or remains as solid state and increases faecal bulk. It forms complexes with cholesterol, sugars and protein. The excess consumption of fibre may decrease the danger of colon cancer and cleans the intestines thereby improving the performance of digestive system (Dawczynki et al., 2007). According to Ugbogu (2016), dietary fibre supports proper bowel movement and avert health related challenge such as diverticulosis by assisting trace elements absorption in the gut. The fibre content of H. crinita, L. africana, G. africanum and P. mildbraedii vegetables were high and in sufficient amount needed for normal body function, maintenance and growth.

The plants Vitamin C content studied ranges from 0.069 – 0.094 mg/100g was highest in G. africanum. This vitamin C content was lower in relation to the work of Edeoga et al. (2005) on the vitamin content (10 – 76 mg/100g) of some Nigerian vegetables. Also, other researchers (Babalola et al., 2010; Okunade & Adesina, 2014; Lawal et al., 2015) reported the vitamin C content of Telfairia occidentalis as 62.50 mg/100g, 42.22 mg/100g, 64.333 mg/100g, 17.27 g/100g and 3.16 g/100g, in that order. According to the National Research Council (1984), the daily recommended dietary requirement of vitamin C for adult is 30 mg/100g/day. Singh et al. (2012) reported that vitamin C is a crucial antioxidant present in the human system and have a range of functions such as: possess the ability to partake in enzymatic and hydroxylation reactions, involved in the oxidation-reduction reactions, it aids the absorption of micronutrients like Fe and Cu, available in trace element metabolism and protects cells from damage occasioned by the presence of free radical and environmental pollution. Vitamins serve as biological catalysts in many chemical reactions as well as precursors to various body factors. However, the body system readily releases water-soluble vitamins (such as vitamin C) faster than fat-soluble vitamins.

The high level of potassium to other mineral elements in leafy vegetables is in line with the works of other researchers (Mensah et al., 2008; Adeleke & Abiodun, 2010; Adeyeye et al., 2018). Udo et al. (2013) working on two lesser known vegetables in farming communities in Cross River State Nigeria reported that calcium may be useful in the prevention of osteoporosis in the elderly. The mineral compositions of these leafy vegetables (G. africanum, H. crinita, L. africana and

P. mildbraedii) were higher compared to the work of Idris (2011). According to Idris (2011), the mineral composition of T. occidentalis leaf extract was given as: Ca (0.67 mg/100g), P (0.40 mg/100g), K (0.15 mg/100g), N (3.41 mg/100g), Mg (0.43 mg/100g), Na (0.02 mg/100g), Zn (7.50 mg/100g), Fe (18.5 mg/100g), Mn (1.18 mg/100g). Ajibade et al. (2006) reported that the leaves of fluted pumpkin are rich in Fe, thus used to treat anaemia. Iron is a crucial trace element involved in the synthesis of haemoglobin, proper functioning of the central nervous system and in the oxidation of carbohydrates, proteins and fats (Adeyeye & Otokiti, 1999).

CONCLUSION

The present study has shown that the leafy vegetables examined are abundant in minerals (potassium, magnesium, calcium, sodium and iron) and vitamin C needed by the human body as daily supplement. Also, their rich proximate composition is an asset in confronting human nutritional challenges. The result suggests that the consumption of these vegetables in adequate amount would contribute greatly towards addressing human dietary requirement for proper development and suitable defense against illnesses arising from malnutrition. However, the study therefore recommends the consumption of these nutritious leafy vegetables based on dietary requirement of individuals.

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