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Proximate, Antinutritional and Mineral Estimation of Some Selected Consumed Green Vegetables in Afaha Eket, Akwa-Ibom State, Nigeria

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Abstract The present study evaluated the proximate, antinutritional and mineral contents of five selected vegetables consumed by Afaha Eket indigenes, Akwa Ibom State, Nigeria. Standard analytical procedures were employed in this assay. The analysed leafy vegetables include; *Telferia occidentalis, Ocimum grattissimum, Lasianthera africana, Heinsia crinita* and *Gnetum africanum*. The result of the proximate analysis showed greater amount as follows; Protein (*O. grattissimum*, 28.27%), fibre (*O. grattissimum*, 9.62%), ash (*G. africanum*, 7.39%), moisture (*G. africanum*, 10.35%), Carbohydrate (*L. Africana*, 47.47%) and crude fat (*O. grattissimum*, 8.17%) when comparatively evaluated. The Antinutritional assay revealed the presence of oxalate and phytic acid in all the tested leafy vegetables. Oxalate was highest in *O. grattissimum* (9.72 mg/g) and least in *L. Africana* (5.28 mg/g) while highest phytic acid value was recorded in *T. occidentalis* (18.09 mg/g) followed by *G. africanum* (16.29 mg/g) and least in *H. crinita* (7.34 mg/g). Mineral analysis of this study showed the highest concentration (mg/g) values; copper (*O. grattissimum*, 13.92), iron (*L. africana*, 3.28), magnesium (*O. grattissimum*, 9.49) and zinc (*L. africana*, 19.97). The finding of this study therefore showed that the tested leafy vegetables are nutritionally sound to the living system.

Keywords: *nutrition, proximate composition, antinutrients and leafy vegetable*

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1. Introduction

The nutritional benefits of plants are increasingly tremendous in the world today due to their unrestrained roles in human health and constituent active ingredients. Vegetables are fresh edible portions of herbaceous plants which can be eaten raw or cooked and act as important sources of protective foods [1,2].

Interestingly, plants produce food in the leaves, but do not store these foods in the leaves [3]. The significance of leafy vegetables have immensely been manifested in human diet supplying the body with low calories, substantial amount of carbohydrates, oil, minerals, vitamins and act as precursors of hormones as well as protein and energy [3,4]. The elicitations of these properties by vegetables are held greatly to the biological active substances possessed by them such as secondary metabolites, high vitamin and mineral contents. They equally help in the amelioration and prevention of diseases [5,6].

In the Southern part of Nigeria, most people consume indigenous green leafy vegetables such as *Telferia occidentalis, Ocimum grattissimum, Lasianthera africana, Heinsia crinita* and *Gnetum africanum.*

Telferia occidentalis belongs to the family Cucurbitaceous. It is a tropical vine grown mainly for the leaves which constitute an important component of the diet of many people in West African countries [7]. In Nigeria, it has different tribal names; it is called "Ugu" in Igbo, "Iroko" or "akporoko" in Yoruba, "Ubong" in Efik, "Umee" in Urhobo and "Umeke" in Edo [8]. The leaves are a rich source of protein, oil, vitamins, minerals, which nourish, protect and heal the body. The seeds are potentially valuable as a high protein for human and animal food. It provides an appreciable cash income to a small scale farmer. The young shoot and leaves of the plants are also used in preparing edikang ikong soup because of the pleasant taste [9].

Ocimum grattissimum is a tropical plant species that belongs to the family of Labiatae. The plant has clusters of flowers with fragrant leaves that have serrated margin. It is commonly called Scent leaf. In the Southern part of Nigeria, it is called 'Efirin nla' by the Yoruba speaking tribe, 'Nchanwu' in Igbo land while the Northern part of Nigeria; it is called 'Daidoga' [10]. This home grown shrub is used mainly as a spice for cooking delicacies due to its unique aromatic taste. [11] reported that the extracts of scent leaf impaired growth on all the fungi tested and as such, possesses fungistatic and fungicidal properties. In

the coastal area of Nigeria, *Ocimum gratissimum* is used in the treatment of epilepsy, high fever, diarrhoea and can be employed in the treatment of cough and catarrh when inhaled [12]. This plant has a huge medicinal value that depends on certain active chemical substances, which have physiological impact on the human body [13]. These vital bioactive substances include; tannins, oligosaccharides, phenols, flavonoids and alkaloids.

Lasianthera africana belongs to the family, Icacinaceae and it is locally called "Editan" in Akwaibom State, Nigeria. *L. africana* is commonly used as antacid, analgesic, antiplasmodic, laxative, antipyretic, antiulcerogenic, anti-diabetic and antimalarial [14,15]. The leaf extract has been reported to contain alkaloids, terpenes, saponins, tannins, flavonoids, anthraquinones and cardiac glycosides with LD_{50} value of 5000mg/kg [15].

Heinsia crinita, a common vegetable in the south-eastern part of Nigeria with the local name "Atama" has been used as a component of various herbal portions in ethno-medicine. The plant part has been previously used in the treatment of umbilical hernia and skin rashes [16]. There is dearth of information on the scientific rationale behind the use of this plant, but the leaf of this plant is used in cooking soup.

Gnetum africanum is referred to as Afang leaf in Akwaibom State and belongs to the family Gnetacea. It has an ellipse and small seeds. Primarily, afang leaves are used as a vegetable for soups and stews, commonly called afang soup. The leaves may be used as a remedy for nausea, sore throats, or as a dressing for warts, treatment of piles, hypertension, enlarged spleen and sore throats [17,18]. Medicinally, the stem of the plant may be eaten to alleviate pains during childbirth and possesses antiinflammatory, anticarcinogenic and antioxidant properties [19].

Therefore, the thrust of this present study was to evaluate the nutritional and medicinal potentials of five selected vegetables consumed by Afaha Eket indigenes, Akwa Ibom State, Nigeria by quantifying their proximate, antinutritional and mineral compositions.

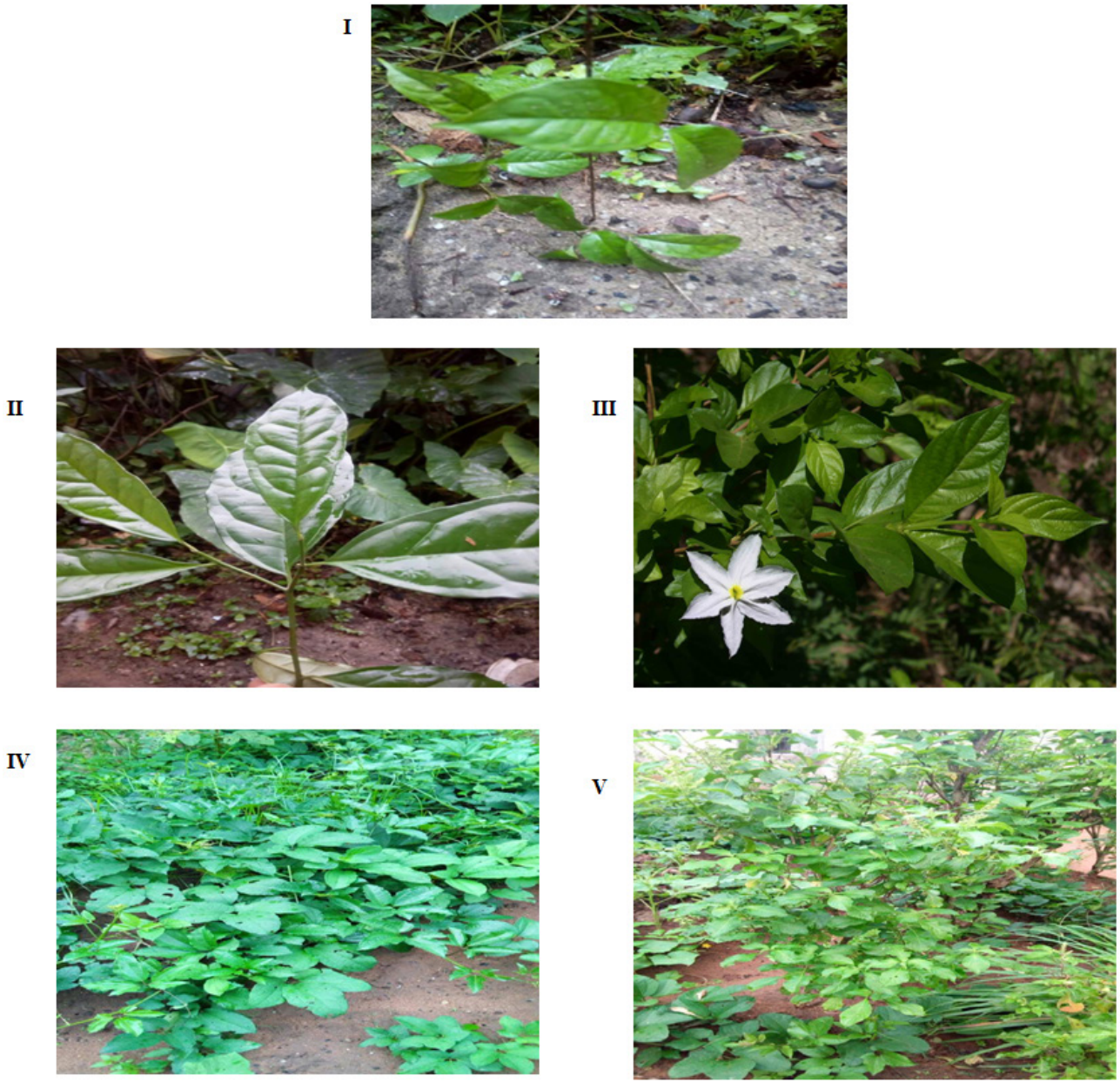

Figure 1. Pictorial view of the assayed leafy vegetables; (I) *G. africanum*; (II) *L. Africana*; (III) *H. crinita*; (IV) *T. occidentalis*; (V) *O. grattissimum*

2. Materials and Methods

2.1. Collection and Preparation of Samples

Fresh leaves of *Telferia occidentalis* (Pumpkin), *Ocimum grattissimum* (Scent leaf), *Lasianthera Africana* (Editan), *Heinsia crinita* (Atama) and *Gnetum africanum* (Afang) were procured at Afaha Eket Market. The leaves of the different samples were handpicked, rinsed with tap water and then with deionized water. These samples were air-dried for seven (7) days. The dried samples were macerated with a mechanical homogenizer, and then passed through 0.5 mm mesh size sieve. Each of the samples was stored in an air-tight plastic container until analysis and properly labeled.

2.2. Proximate and Antinutritional Analysis of the Leafy Vegetables

The proximate compositions of the selected five leafy vegetables, namely, moisture, ash crude lipid, nitrogen content, crude fibre, and carbohydrate were determined according to the recommended methods of the Association of Official Analytical chemists [20].

2.2.1. Oxalate Determination

The titration method as described by [21] was followed. 1g of sample was weighed into a 100ml conical flask. 75ml 3M H_2SO_4 was added and stirred for 1hr with a magnetic stirrer. This was filtered using a Whatman No 1 filter paper. 25ml of the filtrate was then taken and titrated while hot against 0.05M $KMnO_4$ solution until a faint pink colour persisted for at least 30 sec. The oxalate content was then calculated by taking 1ml of 0.05m $KMnO_4$ as equivalent to 2.2mg oxalate [22].

2.2.2. Phytate Content Determination

This was determined by the method of [23]. 100ml of the sample was extracted with 3% trichloroacetic acid. The extract was treated with $FeCl_3$ solution and the iron content of the precipitate was determined using Atomic Absorption spectrophotometer (CyeUnicam 2900). A 4:6 Fe/P atomic ratio was used to calculate the phytic acid content [24].

2.3. Determination of Mineral Content

1g of the sample was weighed and digested for a short period of time in 69% HNO_3 and 30% H_2O_2 (v/v: 10ml) and later heated at 120 ^{0}C. The digested solutions were filtered using Whatman no1 filter paper and diluted to 50ml with deionized water. The concentrations of K, Mg, Fe, Zn, and Cu in the digested solutions were determined using Atomic Absorption Spectrophotometer [25].

2.4. Statistical Analysis

All the assays were made in triplicate and the results were expressed as mean ± SD (standard deviation). The mean and the standard deviation were presented in bar charts using EXCEL software.

3. Results

Figure 2 below shows the result of proximate analysis of *Telferia occidentalis*. From the result, it shows the presence of protein (25.12%), fibre (8.12%), ash content (5.84%), moisture content (10.20%), carbohydrate (44.70%) and fat content (6.04%).

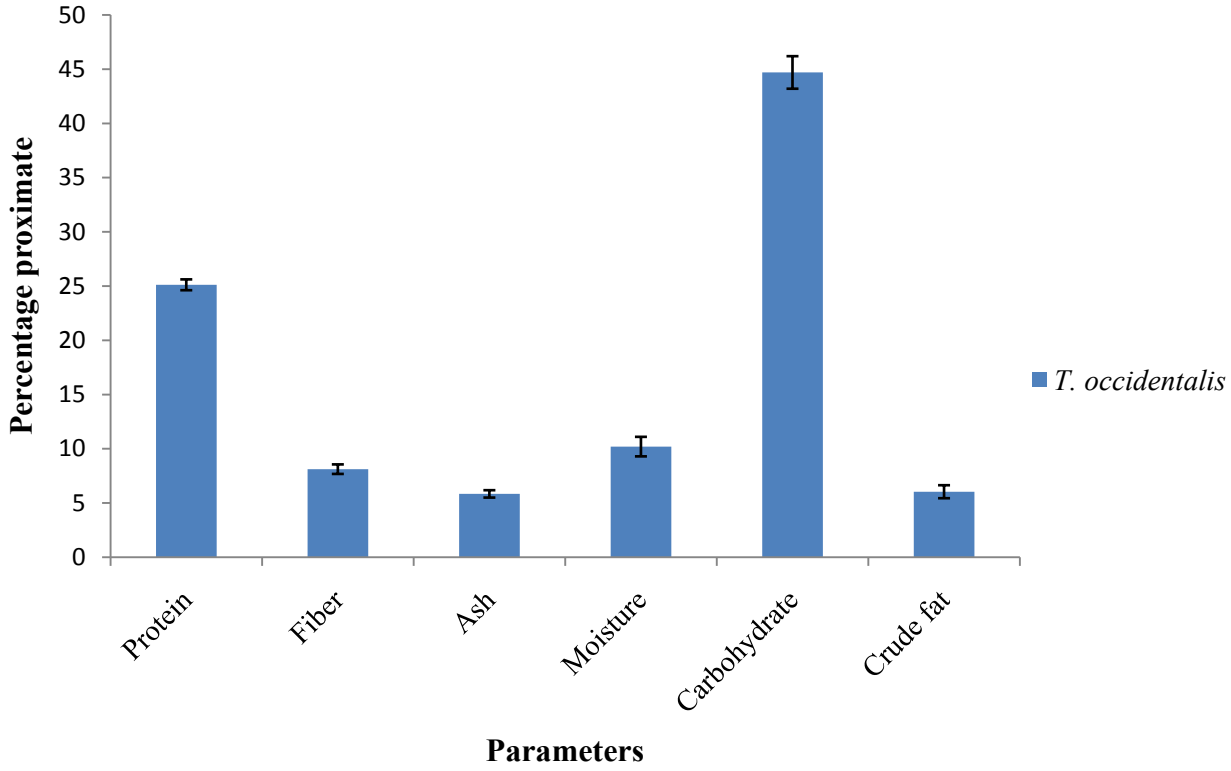

Figure 2. Percentage proximate composition of *Telferia occidentalis*

Figure 3 below shows the result of proximate analysis of *Ocimum grattissimum*. From the result, it shows the presence of protein (28.27%), fibre (9.60%), ash content (6.85%), moisture content (8.36%), carbohydrate (38.55%) and fat content (8.17%).

Figure 4 below shows the percentage proximate composition of *Lasianthera africanum*. The assayed parameter was not more than 47.47% which was found in percentage carbohydrates and least in fats (5.42%).

Figure 5 below shows the percentage proximate composition of *Heinsia crinita* with least percentage ash content and highest percentage in carbohydrate with (6.38%) and (41.75%) respectively.

Figure 6 below shows the result of proximate analysis of *Gnetum africanum*. From the result, it shows the presence of protein (24.38%), fibre (9.20%), ash content (7.39%), moisture content (10.35%), carbohydrate (41.75%) and fat content (6.95%).

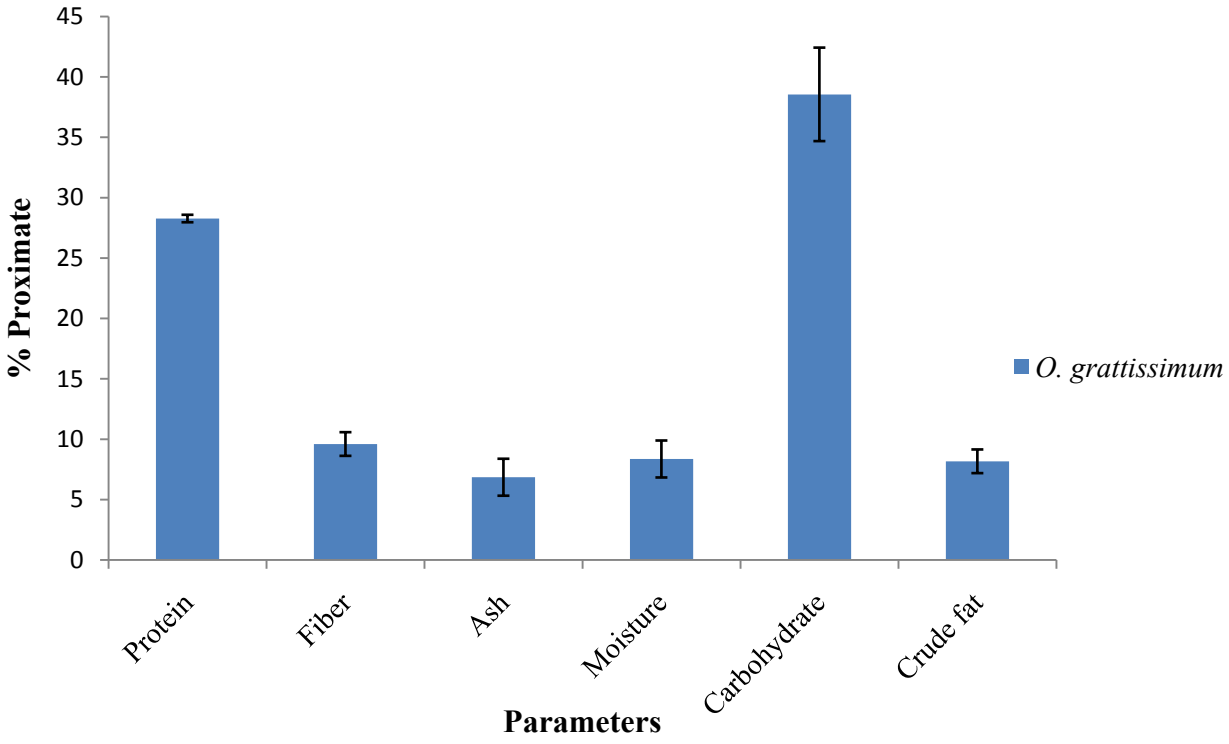

Figure 3. Percentage proximate composition of *Ocimum grattissimum*

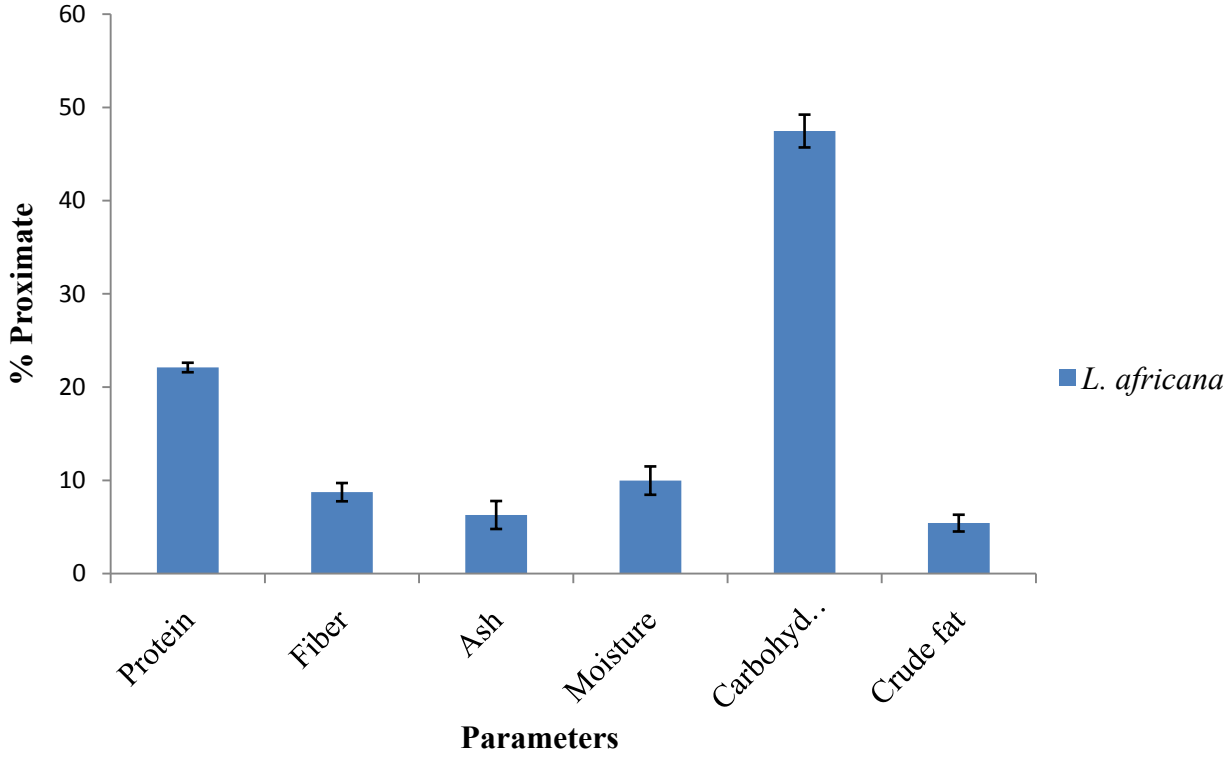

Figure 4. Percentage Proximate Composition of *Lasianthera africanum*

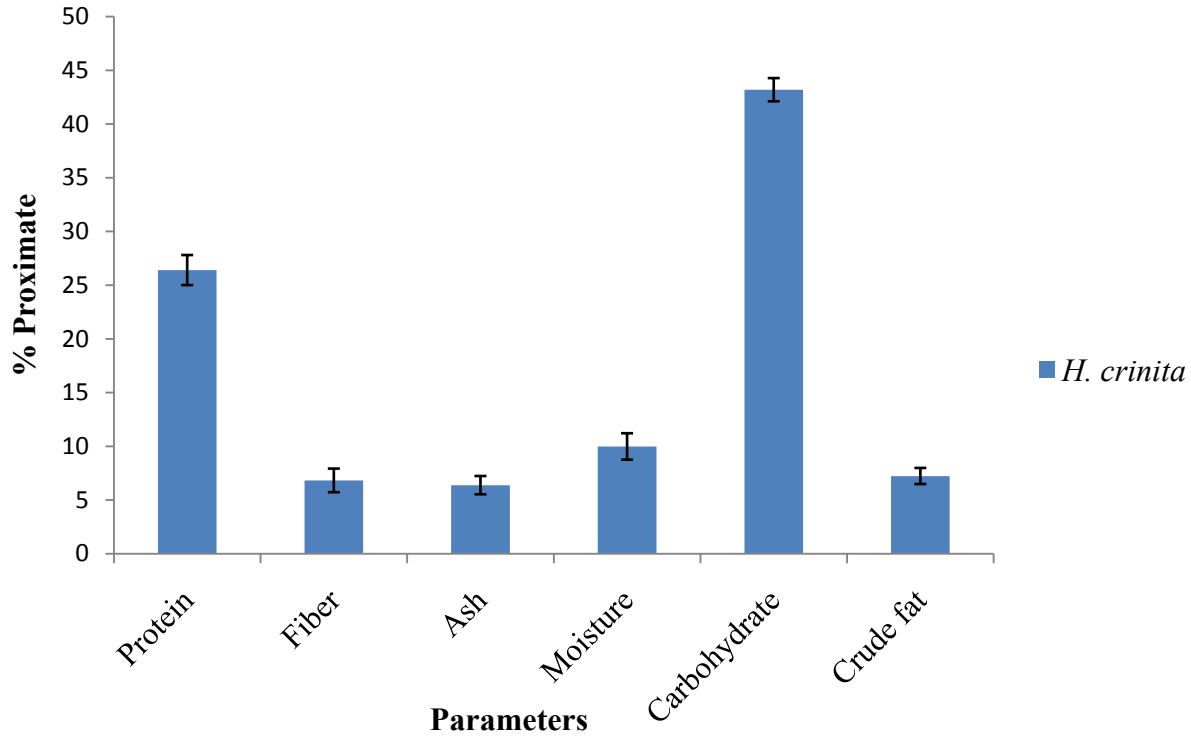

Figure 5. Percentage Proximate Composition of *Heinsia crinita*

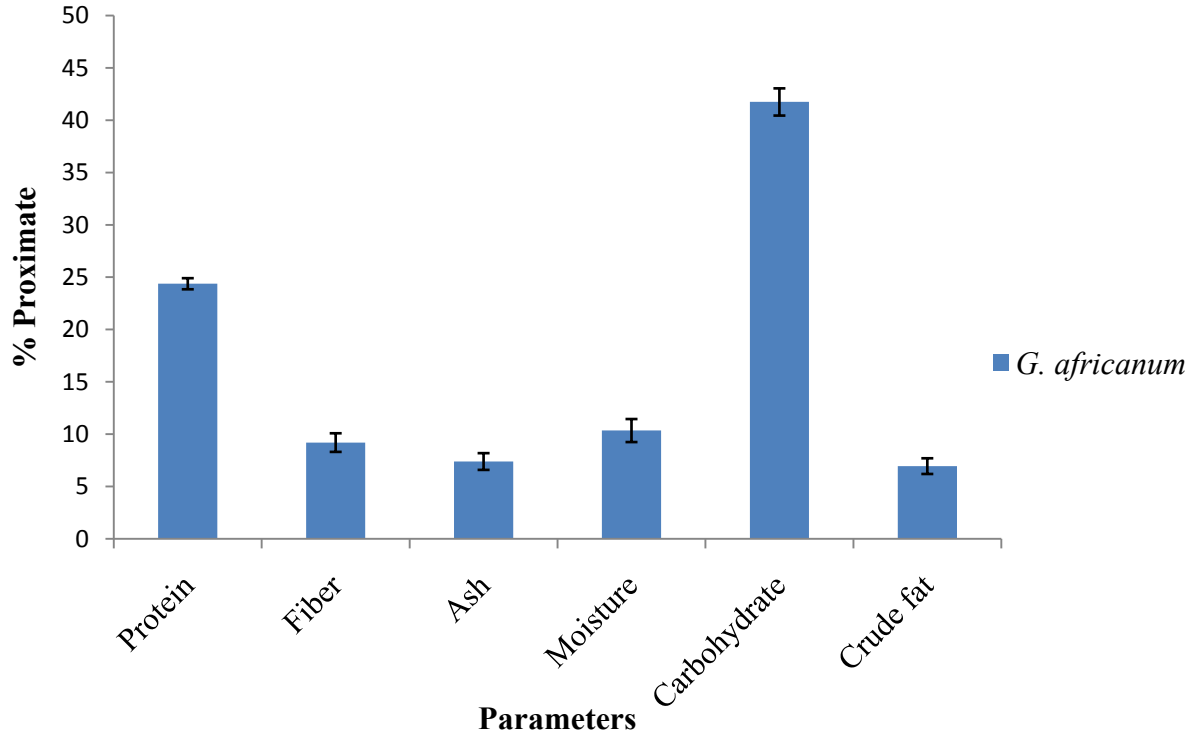

Figure 6. Percentage Proximate Composition of *Gnetum africanum*

The comparative proximate analysis of the selected leafy vegetables is shown in Figure 7. From the result, all the parameters were significantly present with the highest carbohydrate content in all the leafy vegetables, but more in *L. Africana* (47.47%) followed by *T. occidentalis* (44.70%) and least in *O. grattissimum* (38.55%). The trend of the result shows; CHO > protein > moisture > fibre > ash > fat in all the leafy vegetable with exception in *T. occidentalis* that had more fat content (6.04%) than ash (5.84%) and *O. grattissimum* with more fibre content (9.60%) than moisture content (8.36%) respectively.

The antinutritional estimation of the selected leafy vegetables revealed that the vegetables contain oxalate and phytic acid (Figure 8). The value of oxalate in mg/g equivalent was highest in *O. grattissimum* (9.72) when compared with other samples and least in *L. Africana* (5.28), while *T. occidentalis* had more value of phytic acid (18.09) and lowest in *H. crinita*.

The mineral composition revealed the presence of copper, iron, magnesium and zinc in the selected leafy vegetables (Figure 9). In order of concentration, Cu>Zn>Mg>Fe were found in *G. africanum* and *O. grattissimum*, while Zn>Cu>Mg>Fe were found in *L. Africana*, *T. occidentalis* and *H. crinita* when comparatively evaluated.

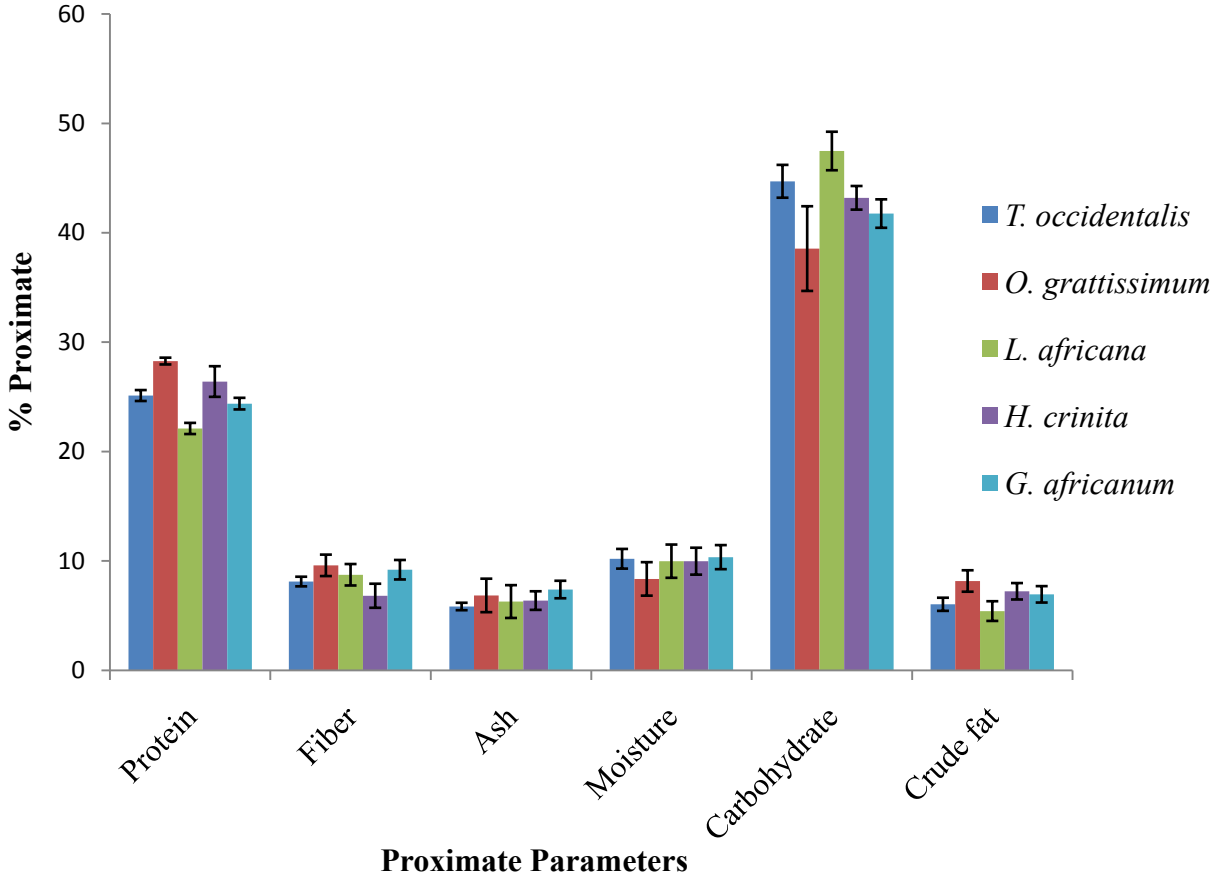

Figure 7. Comparative Percentage Proximate Compositions of Leafy Vegetables

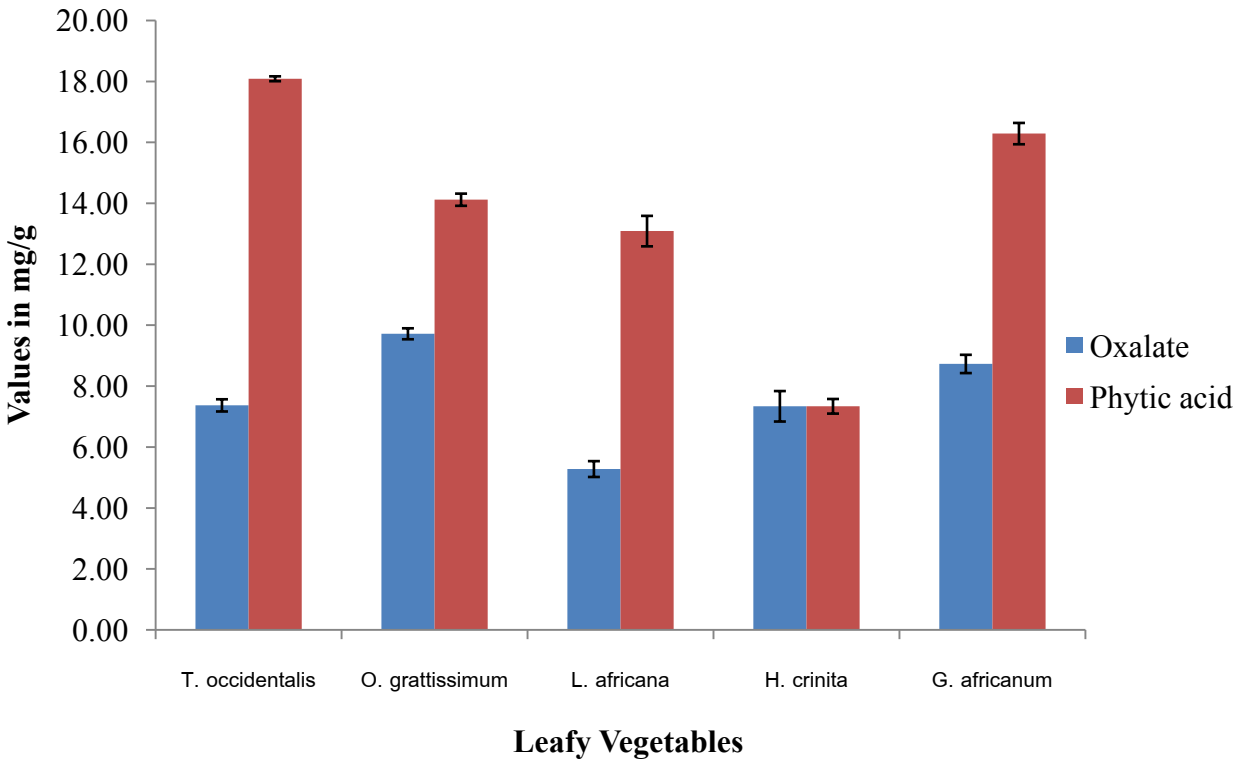

Figure 8. Antinutritional Factors of Some Selected Leafy Vegetables (mg/g)

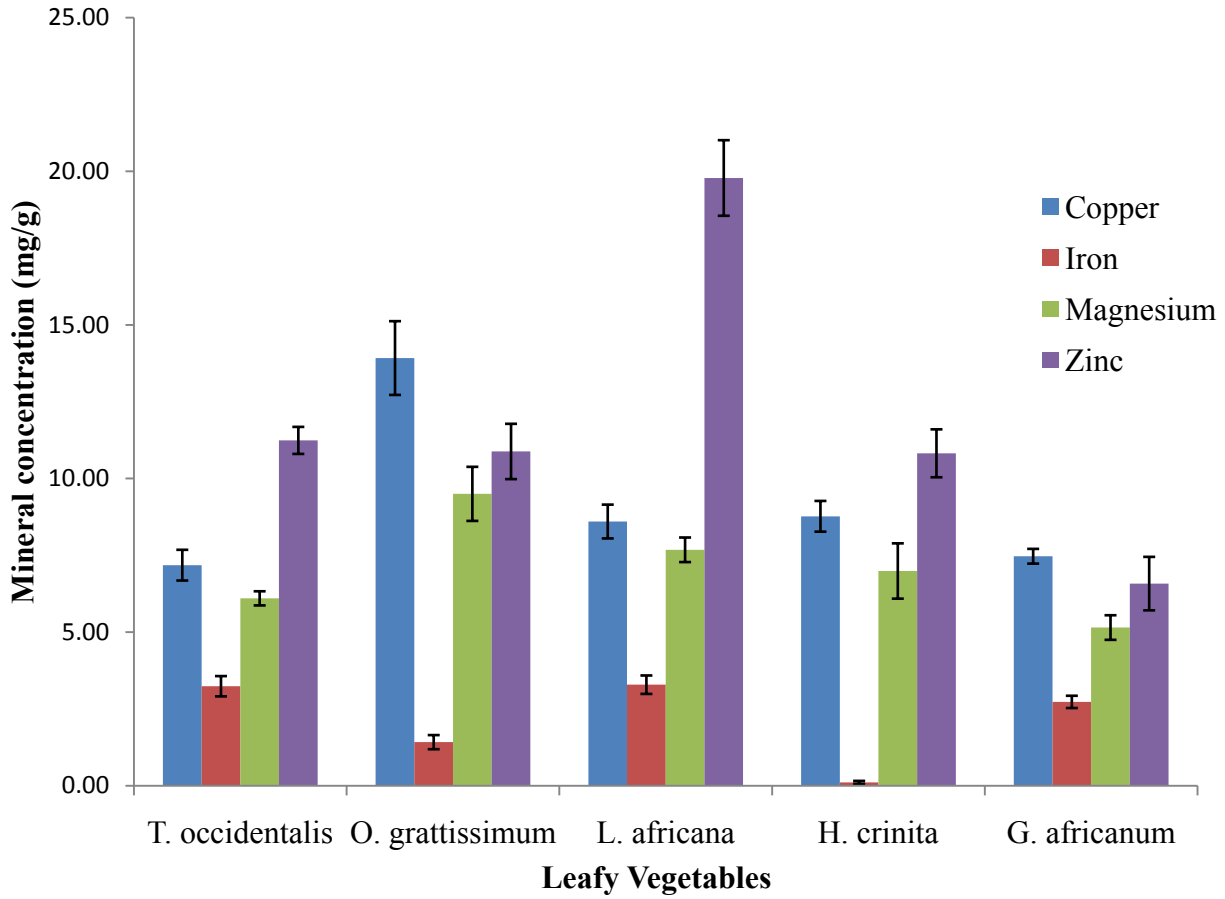

Figure 9. Mineral Compositions of Some Selected Leafy Vegetables (100mg/g)

4. Discussion

The significance and wakefulness of nutrition in public health problems and challenges have widened the horizon of the roles of nutrients in food [22]. Therefore, this present study evaluated nutrients and antinutrients assessment of five selected vegetables consumed by Afaha Eket indigenes, Akwa Ibom State, Nigeria.

4.1. Proximate Analysis

Proximate analysis involves the estimation of the major classes of food like protein, crude fiber, ash, moisture, carbohydrate and crude fat [26]. The results of proximate analysis of the selected leafy vegetables (*Telferia occidentalis, Ocimum grattissimum, Lasianthera africana, Heinsia crinita* and *Gnetum africanum*) are comparatively evaluated in Figure 7.

4.1.1. Proteins

Proteins are the building blocks of life and every cell in the human body contains protein which helps to repair and replace worn out tissues. Some proteins have catalytic activity and function as enzymes while others serve as structural elements, signal receptors, or transporters that carry specific substances in or out of the cells [27]. The deficiency of protein in diet especially in children leads to kwashiorkor and marasmus symptoms like retarded growth, fatty liver, oedema of the belly and legs [28]. The result of the present study showed the highest protein content in *O. grattissimum* (28.27%) followed by *H. crinita* (26.41%) and least in *L. Africana* (22.11%) while *T. occidentalis* and *G. africanum* had (25.12%) and (24.38%) respectively. Ekop (2007) reported a crude protein content of *G. africanum* as (17.5%). Also, [29] reported a value of (13.33%) and [30] a higher value of 61.7% in *Telfaria occidentalis*. These disparities in the protein contents by these researchers may be attributed to the differences and types of manure applied to enrich the nitrogen content of the soil where these vegetables are harvested [31]. Vegetables when consumed in adequate amount serves as a source of dietary protein and can help in meeting the daily requirement, this is due to the high amount of proteins in vegetables as analysed thereby reducing defects caused by low consumption of proteins.

4.1.2. Crude Fibre

Crude fibres or roughages are non-hydrolysable polysaccharides which can be in soluble or insoluble state and increase faecal bulk. They form complexes with protein, sugars and cholesterol. When taken in excess, they help to reduce the risk of colon cancer and scrub out the intestines leaving a much healthier digestive system [32]. Dietary fibre functions help in maintaining bowel movement and can prevent diverticulosis by aiding the absorption of trace elements in the guts [6]. In this study, the fibre contents were relatively of the same range, *O. grattissimum* (9.60%), *G. africanum* (9.20%), *L. africana* (8.74%), *T. occidentalis* (8.12%) and *H. crinita* (6.82%). Crude fibre content of *Ocimum grattissimum* is not in

consonant with the result obtained by [33] where they got (2.4%). Therefore, the selected leafy vegetables are considered as a main source of crude fibre.

4.1.3. Ash

Ash content in leafy vegetables is directly proportional to the mineral elements present in the vegetables [34]. This implies the higher the ash content, the more nutritional the plant would be. The highest ash content from the result was recorded in *G. africanum* (7.39%) and least in *T. occidentalis* (5.84%). Therefore, the mean ash content of *G. africanum* (7.39%) in this study is in consonant with the findings of [35] (7.19–9.63 g/100 g), while other leafy vegetables are slightly closer to the range.

4.1.4. Moisture

The moisture content of the tested leafy vegetables was found in the highest order in *G. africanum* (10.35%) followed by *T. occidentalis* (10.20%), while *L. Africana* and *H. crinita* had the same value (9.98%) and least in *O. grattissimum* (8.36%). It has been shown that high moisture content aids in stabilizing the protoplasmic contents of the cells and as such maintains the homeostasis of the cells, although, high moisture contents have been implicated in food spoilage due to its growth thriving attributes exhibited in microorganisms [36].

4.1.5. Carbohydrates

The human system needs constant supply of Adenosine Triphosphate (ATP) to function properly by striking a balance between external and internal factors. This energy, inform of ATP could be gotten from carbohydrate. The deficiency of carbohydrate in our diet has resulted in poor mental function, fatigue, endurance and lack of stamina [37]. In all the tested macronutrients, carbohydrate was the highest value in the range of 38.55-47.47%. Highest values were recorded in *L. africana* (47.47%) followed by *T. occidentalis* (44.70%), *H. crinita* (43.19%) and least in *O. grattissimum* (38.55%). This implies the tested leafy vegetables could offer source of energy to the body.

4.1.6. Crude Fats

The fats and oil from vegetables have been shown to possess hypolipidemic activity and therefore could ameliorate the occurrence of diseases associated with hyperlipidemia like coronary artery disease, myocardial infarction, cerebrovascular accident and hypertension [38]. This decrease in blood lipid exhibited by these vegetables may have been their role in down regulation of Nicoatinamide adenine dinucleotide phosphate (NADPH) and reduced equivalent of Nicoatinamide adenine dinucleotide (NADH) cofactors involved in the metabolism of fatty acids [6]. The result of the assay showed highest percentage lipid in *O. grattissimum* (8.17%) and lowest in *L. Africana* (5.42%), while other vegetables have closely values of 7.23%, 6.95% and 6.04% as seen in *H. crinita*, *G. africanum* and *T. occidentalis* respectively.

4.2. Antinutritional Factors

Antinutritional factors are chemical substances produced by plants that have the potential of affecting the availability of nutrients by interfering with metabolic processes [39]. The result of the anti-nutrient of the present study is shown in Figure 8. From the result, oxalate and phytic acid were quantitatively present in all the tested leafy vegetables. Oxalate was highest in *O. grattissimum* (9.72 mg/g) and least in *L. Africana* (5.28 mg/g) while highest phytic acid value was recorded in *T. occidentalis* (18.09 mg/g) followed by *G. africanum* (16.29 mg/g) and least in *H. crinita* (7.34 mg/g). It has been reported that phytate and oxalates have the ability to form chelates with di-and trivalent metallic ions such as Cd, Mg, Zn and Fe to form poorly soluble compounds that are not readily absorbed from the gastrointestinal tract thus decreasing their bioavailability [40].

4.3. Mineral Composition

The mineral contents of five leafy vegetable species are presented in Figure 9. Nutritionally, minerals are very important in human system for diverse metabolic activities [41]. From the result, highest value of copper was recorded in *O. grattissimum* and least in *T. occidentalis* with 13.92 mg/g and 7.16 mg/g respectively. Copper contributes in haemoglobin formation, red blood cells in iron and energy metabolism [42]. It also helps in elastin formation, a vital skin protein that helps keep skin healthy and flexible, also helps in collagen formation, another vital protein for building bones, muscles, and connective tissues. It is needed to maintain healthy nerves and joints. It is not necessary to supplement this mineral as excessive copper intake can lead to toxicity. Toxic levels of copper can cause vomiting, joints and muscle pain and with extreme overdosing it can even be fatal [43].

L. africana leaf has the highest iron content (3.28mg/g) which is statistically insignificant with *T. occidentalis* (3.26mg/g). Iron is an important trace element in the human body, it plays roles in formation of haemoglobin, control of infection and cell mediated immunity [44]. Its deficiency causes anaemia. Iron toxicity is very serious and can lead to increased free radical production which can ultimately lead to heart disease and cancer (Sander, 2013).

Magnesium (Mg) is important in decreasing blood pressure by dilating arteries and preventing abnormal heart rhythm [45]. It is important in cell proliferation, contributing to DNA and RNA synthesis by acting as a catalyst to enzymes involved in metabolic function. It also protects soft tissues from hardening and also protects the linings of the arteries from stress due to fluctuations in blood pressure. Magnesium and vitamin B6 when combined help dissolve calcium phosphate kidney stones. The deficiency interferes with the transmission of muscle and nerve impulses and can result in irritability, muscle weakness, dizziness and heightened symptoms of PMS (premenstrual syndrome) [45]. All these are found in the tested leafy vegetable, but more in scent leaf which recorded the highest concentration value (9.49 mg/g).

Highest zinc content was recorded in *L. africana* leaf (19.79mg/g) when compared to other vegetables. Zinc is required for collagen formation and the synthesis of protein. It is an essential micronutrient for human growth and immune functions and also functions as part of enzymes and as cofactor. It aids the immune system and

prevents formation of free radicals. It protects the liver and is required for bone development. It maintains the proper balance and absorption of several vitamins in the body. Zinc deficiency results in a decreased sense of smell and taste, thin brittle nails, hair loss, high cholesterol, increased susceptibility to illness and infection, recurring colds and slow healing [43].

5. Conclusion

This work shows that the vegetables; *Telifaira occidentalis, Ocimum grattissimum*, *Lasianthera africana, Heinsia crinita* and *Gnetum africanum* analysed have high nutrient density content in macro and micro molecules as well as high mineral contents. The antinutritional factors analysed are below toxic levels and can even be removed during food processing such as washing, boiling or cooking; before they are consumed as part of the meal.

Therefore, the consumption of the analysed samples is advised as they supply adequate energy, protein and minerals for metabolic processes needed in maintenance of life.

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