COMPOSITIONAL STUDIES OF *BAPHIA PUBESCENS* (UROHUN) LEAVES

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ABSTRACT

Baphia pubescens is a commonly consumed vegetable in Western part of Nigeria especially among the Ikale people of Ondo state. The plant has been observed for its medicinal properties. The present study was aimed at evaluating the nutrient composition of the plant. Proximate analysis showed that the plant contain high percentage of carbohydrate 45.27±2.31, crude fibre 12.36±1.51, protein 12.00±2.08, Ash 11.85±0.96, Moisture content 8.87±0.66, crude fat 6.59±0.61. Phosphorus was the most abundant mineral (26.85±0.64), followed by potassium, magnesium, sodium and zinc with values 25.99±3.44, 24.66±2.95, 22.49±3.89, 21.66±3.62, 21.60±2.29mg/100g respectively. Among the anti-nutrients studied, phytic acid has the highest concentration (16.58 ± 0.92mg/100g) while oxalates (3.45 ± 0.28) and tannin (1.97±0.21) were low in concentration. Amino acid analysis revealed the presence of essential amino acids in good quantities (g/100g protein); arginine (5.11), Phenylalanine (4.31), valine (4.23), lysine (4.07), threonine (3.41) and isoleucine (3.29). Glutamic acid was the most abundant amino acid while the amino acid with lowest concentration was cystine (0.97). This result therefore indicates and implicates its consumption as a good nutritive source to meet the required nutritional demands of man.

Keywords: Baphia pubescens, nutrient composition, leaves, minerals, amino acids.

INTRODUCTION

Baphia pubescens belongs to the family Leguminoseae -papillonoideae. It is a perennial non-climbing shrub or small tree that sometimes has a distinct bole and grows to a height of 6 - 15metres with trunk to 20cm diameter. It is commonly found in most African countries including Nigeria, Togo, Ghana, Liberia, Zarie, Congo, Ivory Coast, Cameroon, Gabon and Benin Republic (Anowi *et al*., 2014a). The plant is commonly known as Awewi, urohun, Maajigi in Yoruba and Benin-camwood in English (Craig, 1999; Anowi *et al*., 2014a). The geographical distribution of *Baphia pubescens* has been said to be similar to that of *Baphia nitida.*

Generally, the tree is harvested from the wild for its timber, chemical and medicinal applications. The plant is locally used because of its acclaimed efficacious medicinal effects, most of which are antimicrobial, anti-inflammatory, anti-pyretic and analgesic properties. The presence of phytochemicals such as flavonoids, alkaloids, terpenoids, steroids, tannins, saponins, reducing sugar, proteins and carbohydrates have been reported in the leaves of *Baphia pubescens* which might be responsible for the anti-inflammatory activity observed in rats (Onwukaeme, 1995; Anowi *et al*., 2014b).

The leaves as well as the leaf juice are used for treatment and prevention against parasitic skin diseases. In addition, leaf infusion of *Baphia pubescens* is orally taken by the local

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people as effective medicine to cure enteritis and other gastrointestinal infections. The bark, bark oil and sap are medically useful; the bark is used to treat arthritis and rheumatism, the bark oil for kidney diseases and diuretics while the sap is used for eye treatments (FAO, 1996; Konkon *et al*., 2011). The dyes, stains, inks, tattoos and mordants (which are chemical products obtained from the timber) are of immense economic value while the wood is used for carpentry and related applications.

The plant is consumed as vegetable and as spices by the Ikale people of Okitipupa Local Government area of Ondo state, Nigeria. They also use different part of this plant in form of traditional concortion for treatment of wide variety of ailments ranging from inflammation, swelling to fever. This practice has also been observed among the people of Ogidi in Idemili Local Government area of Anambra State, Nigeria where *Baphia pubescens* has been reported to have anti pyretic, anti-inflammatory, analgesic, emetic and antimicrobial properties. The decoction of the leaves is used to treat running stomach (diarrhea), aches and pains, pains from swollen joints, as well as fever (Anowi *et al*., 2014c).

Despite the wide claims of the immense importance of *Baphia pubescens*, there is dearth of information on nutrient composition of this plant. This research is therefore aimed at determining the proximate, mineral, anti-nutrient and amino acid composition of *Baphia pubescens* obtained from Okitipupa Local Government, Ondo State, Nigeria.

MATERIALS AND METHODS

Collection and Preparation of Sample

Baphia pubenscens leaves were obtained locally within Ikale land in Okitipupa Local Government Area of Ondo State, Nigeria and identified in the Department of Microbiology and Botany, University of Ibadan, Nigeria. Herbarium specimen, with voucher number UIH22480, was deposited at the Herbarium of the University of Ibadan, Nigeria.

The leaves were removed from their stalks, thoroughly washed with tap water and rinsed with distilled water to remove sand and other impurities. They were air-dried in the laboratory for twenty (20) days. The dried leaves were subsequently ground into fine powder by using a commercial blender. The powdered samples were stored in polythene bag until used. All analyses were carried out in triplicates.

Analysis of the Sample

Proximate Composition and Mineral Analysis

Crude fibre, moisture content, crude fat and total ash were carried out according to the methods of the Association of official Analytical Chemists (AOAC, 1990). The nitrogen was determined using the micro-Kjedahl method as described by Pearson (1976) and the nitrogen content obtained was converted to protein by multiplying by a factor of 6.25.

Mineral element composition was determined using Atomic Absorption Spectrophotometer after acid digestion and measurements taken were reported as mg/100g.

Amino Acid Analysis

4g of the ground sample was defatted with chloroform/methanol mixture for 15 hours in soxhlet extraction apparatus. About 30 – 35mg of the defatted sample was weighed into a glass test tube. 7ml of 6M HCl was added and oxygen was expelled by flushing with nitrogen gas. The sealed glass test tube was put in an oven at 110^{o}C for 22hours. This was allowed to cool before the content was filtered. The filtrate was evaporated to dryness at 40^{o}C under

vacuum using a rotator evaporator. The residue obtained was dissolved with 5ml acetate buffer (pH 2.0).

The method of amino acid was by ion-exchange Chromatography using the Technicum Sequential Multi Sample Amino Acid Analyzer (TSM) (Technicum Instruments Corporation, New York).

Anti-nutrient Analysis

The anti-nutrient levels in the sample for example phytate, tannins and oxalate were determined using the methods of Association of official Analytical Chemists (AOAC, 1990) and Ravindran *et al*., (1994).

Statistical Analysis

Data generated in triplicates were expressed as means of 3 determinations ± S.D. The SPSS (15.0, SPSS 2 Inc., Chicago, Illinois, USA), was used for the analysis.

RESULTS AND DISCUSSION

The proximate composition (% by weight) of *Baphia pubescens* are presented in Table 1. The moisture content is low compared to *Cnidoscolus aconitifolius*, *Brassica oleracea*, *Veronia amygdlina, Hibiscus sabdariffa* and *Telfaira occidental leaves* (Adanlawo and Elekofehinti, 2012; Asaolu *et al*., 2012; Yahaya *et al*., 2014). The value is in close agreement with those reported for *Calotropis procera* and *Mucuna sloanei* leaves (Okunade and Idris, 2008). Arkroyed and Doghty (1964) had earlier reported moisture content values ranging between 7.0 and 10% for legumes. However, according tot3.3his result, the moisture content of *Baphia pubescens* is higher than what was reported for *Citrullus lanatus* seed and *Moringer oleifera* (Ojieh *et al*., 2008; Asaolu and Omotayo, 2007). Low moisture content of *Baphia pubescens* makes the leaves less prone to microbial deterioration.

Table 1. **Proximate composition (% dry weight) of *Baphia pubenscens* (Urohun) leaves**

Composition	% by weight
Moisture	8.87 ± 0.66
Ash	11.85 ± 0.96
Crude protein	12.00 ± 2.08
Crude fibre	12.36 ± 1.51
Crude fat	6.59 ± 0.61
Carbohydrate	45.27 ± 2.31
Energy value (Kcal/100g)	45.27 ± 2.31

Values are means ± SD. n = 3

The carbohydrate content (45.27%) was higher than the values (20, 23.7 and 39.05%) reported for *Senna obtusfolia, Amaranthus incurvatus* and *Momordica balsamina* leaves respectively (Hassan and Umar, 2006) but lower compared to *Drymaria cordata, Leucas plukenetii* and *Eclipta alba* with values of 48.66, 51.39 and 66.54% respectively (Pobi and Kalita, 2014). High carbohydrate content in *Baphia pubescens* confers on it, important roles to human health. This is because carbohydrate is a potential energy source for almost all organisms. It is also required in various biochemical reactions that are not directly involved

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in energy metabolism as well as serving as major substrates, through Shikimic acid pathway, in the synthesis of aromatic amino acids and phenolic compounds which may imbue antioxidant ability on the plant (Shovon *et al*., 2013).

The crude protein content (12.00%) compared favourably with that of *Leucas plukenetii* (12.8%). The level of protein in the sample is high, and thus indicates that *Baphia pubescens* is a rich source of protein. Plant foods that provide more than 12% of their calorific value from proteins are noted to be good sources of protein (Ali, 2009). Additionally, the protein may be useful as a preferred alternative to animal proteins especially for diabetics.

Availability of crude fibre in the diet is essential for digestion and removal of wastes. High fibre content of *Baphia pubescens* (12.36%) indicates that the plant is a good source of fibre which has been implicated in lowering absorption of cholesterol (Hanif *et al*., 2006). Fibre has been reported to stimulate contraction of muscular walls of digestive system, hence preventing constipation, piles and bowel problems (Asaolu *et al*., 2012). High fibre content is indirectly proportional to occurrence of cardiovascular diseases, obesity and colorectal cancer (Ogunlade *et al*., 2011).

The total crude fat level (6.59%) of the vegetable was lower when compared to *Vernonia amygdalina*, *Amaranthus hybridus* and *Telfaira occidental* (Asaolu *et al*., 2012). Interestingly, this low value is in agreement with findings of several authors which revealed that leafy vegetables are poor sources of lipids (Ejoh *et al*., 1996). Excess fat intake has been implicated in obesity, atherosclerosis, cancer and ageing because it aids increased blood cholesterol level (Antia *et al*., 2006; Shovon *et al*., 2013). Therefore, the low fat content of *Baphia pubescens* is advantageous as the plant may be preferred in reduction of coronary heart disease risk as well as reducing the risk of hypertention.

According to this study, ash content obtained (11.85%) was lower than the value obtained for Scent leaf, *Amaranthus hybridus, Ceiba patendra, Cnidoscolus aconitifolius* and *Telfaira occidental* but higher than the values reported for *Moringa oleifera, Hibiscus sabdariffa* and bitter leaf (Asaolu *et al*., 2012; Adanlawo and Elekofehinti, 2012; Oulai *et al*., 2014; Yahaya *et al*., 2014). Since ash content indicates micronutrient content of foods (Yahaya *et al*., 2014), the high ash content of this plant implies that the mineral content is high.

The energy value of 288.41 ± 11.70 for the leaves of *Baphia pubescens* is lower than the values 300.94±5.31, 354.20 ±0.7, 363.60±1.2 and 319.80±0.7Kcal/100g reported for leaves of water spaniach, *Telfaira occidental*, *Moringa oleifera* and *Brassica oleracea* respectively (Umar *et al*., 2007; Yahaya *et al*., 2014). This is in agreement with the fact that the calorific values of most vegetables are low (Yahaya *et al*., 2014). Energy value of a food estimates its value to the body as a source of fuel. It also measures the available chemical energy that is inherent in the bonds of the foods organic compounds like carbohydrate, protein and fat constituents as well as minor components such as organic acids.

Table 2. **Anti-nutrient content (mg/100g) of *Baphia pubenscens* (Urohun) leaves**

Anti-nutrient	Concentration (mg/100g)
Tanin	1.97 ± 0.21
Phytic acid	16.58 ± 0.92
Oxalate	3.45 ± 0.28

Values are means ± SD. n = 3

The anti-nutrients analysed include oxalate, tannin and phytic acid as shown in Table 2. 16.58±0.92, 1.97±0.21 and 3.45±0.20mg/100g were obtained for phytic acid, tannin and oxalate respectively. These values are higher than those reported for *Cnidoscolus aconitifolius, Brachystegia eurycoma* harms and *Pipper guineense* schum and thorn (Adanlawo and Elekofehinti, 2012; Ajayi *et al*., 2014). The tannin contents are considered low in comparison with the values of 21.19±0.25, 4.56%, 3.87%, 2.56% obtained for *Moringa oleifera* leaves, *Senna alata, Cajanus cajan* and *Epicrates anquifer* respectively (Soetan *et al*., 2010; Ogbe and John, 2012; Ogunkoya *et al*., 2006). It is known that high content of these anti-nutrients has negative impacts on the bioavailability of some mineral nutrients. For instance, the high phytic acid content in the sample can bind divalent minerals like calcium, zinc, iron and other minerals and thereby prevent their absorption in humans as reported by Oboh *et al.*, (2003). Although Hassan *et al*., (2008) reported that Zinc is the most affected by phytate among the minerals in animals and humans, phytates are known to inhibit the normal absorption of Ca^{2+} in man because all phytate that survives hydrolysis eventually renders an equivalent amount of Ca^{2+} unavailable. In addition, phytic acid has been linked with complicated consequences on human system including flatulence and food indigestion (Maynard *et al.*, 1994).

However, the presence of tannins may be necessary for the prevention and management of clinical conditions such as dysentery, diarrhea, and leucorrhoea. Tannins have also been reported to adversely affect digestibility of protein (Sathe and Salunkhe, 1984). As polyphenols found in plant, they possess the ability to complex with metals ions and other macro-molecules including polysaccharides and proteins (De-Brune *et al*., 1999). As reported by Emijiugha and Agebede (2000), tannin often interacts with proteins to form insoluble complexes, resulting in interference with their bioavailability. Thus, protein deficiency can be elicited which can cause kwashiorkor and other related protein-deficiency diseases. Also, high tannin content in diets has been generally linked with poor palatability (Mehansho *et al*., 1987). Oxalates reduce calcium assimilation. This could enhance the formulation of renal calcium. Hence, oxalates are undesirable components of human diets (Fagboya, 1990).

Table 3. **Mineral composition (mg/100g) of *Baphia pubenscens* (Urohun) leaves**

Minerals	Concentration (mg/100g)
Na	21.60 ± 2.29
K	25.99 ± 3.44
Ca	22.49 ± 3.89
Mg	24.66 ± 2.95
Zn	21.66 ± 3.62
Fe	6.16 ± 0.43\
Pb	-
Cu	0.03 ± 0.12
Mn	5.64± 0.62
P	26.85 ± 0.64
Ca/P**	0.84
Na/K**	0.83

Values are means ± SD. n = 3. **Calculated values.

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The presence of anti-nutrient in high amount poses potential health risk. Fortunately, researches have revealed that proper preparation via cooking before intake greatly reduces anti-nutrients in vegetables (Akwaowo *et al*., 2000). It has been advised that extensive processing should be done to remove these anti-nutrients and to enhance the overall dietary suitability of *Baphia pubescens*.

The mineral composition of *Baphia pubescens* in Table 3 showed that the leaves are rich sources of minerials. According to this study, the plant contained high amount of phosphorus (26.85±0.64), potassium (25.99±3.44), magnesium (24.66 ± 2.95) and calcium (22.49±3.89).

The predominance of phosphorus is in agreement with the report of Ojieh *et al*., (2008) but contrary to the observations of Olaofe and Sanni (1988), and Aremu *et al*., (2005) who claimed that the most predominant element in Nigerian Agricultural products was potassium. As seen in this research, potassium ranked second to phosphorus in concentration for *Baphia pubescens* leaves.

The other important minerals found in high amount in the plant include zinc and sodium with 21.60±2.29 and 21.66±3.62 mg/100g values respectively. The sample has a very low copper content of 0.03±0.12 while lead was absent. Minerals are essential substances which are often involved in many metabolic functions and high level of minerals could make a vegetable an excellent antioxidant (Adanlawo and Elekofehinti, 2012). For example, Sodium participates in the regulation of plasma volume, muscle contraction, acid-base balance as well as in impulse transmission. Potassium is also highly vital for regulating water and electrolyte balance as well as acid-base balance in the body. It is responsible for action of nervous system and contraction of the muscles. Its deficiency results in muscle paralysis (Akpabio and Ikpe, 2013). Both potassium and sodium are vital extracellular and intracellular cations respectively. High potassium has been reported by researchers for its protective action against excessive sodium consumption whereas low content of sodium in diet has been said to have beneficial effect in the prevention of hypertension (Champe and Harvey, 1994).

Phosphorous is a macromineral that forms an important constituent of bone mineral and energy intermediates. The body requires calcium for bone development. Deficiency of calcium-phosphorus balance leads to diseases such as arthritis, osteoporosis, rickets, pyorrhea and decaying of teeth.

Zinc is an essential trace element that is needed for human growth and stimulation of the immune response. It enhances adequate functioning of human reproductive system and nucleic acid metabolism. Zinc is also useful as an antioxidant and membrane stabilizer (Milbury *et al*., 2008). Not only that, zinc is essential for activation of certain enzymes including dehydrogenase, carboxypeptidase and alkaline phosphatase. In addition, zinc-containing organic materials are employed as astringent and anti-fungal compounds. Zinc also enhances wound healing and metabolism of insulin. Deficiency of Zinc can result in dermatitis while anaemia is associated with excess zinc intake (Akpabio and Ikpe, 2013).

The major role of calcium increases the permeability of the cell membrane and is also involved in the transmission of nerve impulses.

The ratios of calcium to phosphorus (Ca/P) and sodium to potassium (Na/K) are also shown in Table 3. The value of 0.83 obtained for Na/K ratio is less than one. This falls within the recommended range, suggesting that *Baphia pubescens* leaves could be a suitable option for consumption to reduce high blood pressure in hypertensive patients. The concept of Na/K ratio in the body is to actually prevent high blood pressure (Nieman *et al*., 1992; Ojieh *et al*., 2008).

If a diet contains high concentration of phosphorus compared to calcium, it may enhance the loss of calcium in the urine thereby reducing calcium concentration in bones. Thus, food sources with Ca/P ratio less than 0.5 are considered good. However, those with Ca/P ratio value above 1 are said to be poor. From the result of this study, the Ca/P ratio is 0.84 suggesting that the consumption of the plant would not hamper calcium absorption in the intestine to a significant level. It also implies that the plant would serve as source of minerals, to a moderate level, for bone formation (Ajayi *et al*., 2014; Etong, and Abbah, 2014).

Table 4. **Amino Acid composition (g/100g protein) of *Baphia pubenscens* (Urohun) leaves**

Amino Acid	Concentration: g/100g protein
Lysine*	4.07
Histidine*	2.35
Arginine*	5.11
Aspartic acid	8.55
Threonine*	3.41
Serine	3.00
Glutamic acid	10.38
Proline	2.55
Glycine	3.61
Alanine	4.10
Glycine	3.61
Alanine	4.10
Cystine	0.97
Valine*	4.23
Methionine*	1.10
Isoleucine*	3.29
Leucine*	8.19
Tyrosine	3.14
Phenylalanine*	4.31
Tryptophan*	0.98

* Essential amino acids

The amino acid content of *Baphia pubescens* leaves is shown in Table 4 unraveling glutamic acid, aspartic acid and leucine with 10.38, 8.55 and 8.19g/100g protein respectively as the three most abundant amino acids. Also, the plant contained considerable amount of essential amino acids (arginine 5.11, phenylalanine 4.31, valine 4.23, lysine 4.07, threonine 3.41, isoleucine 3.29, histidine 2.35 and methionine 1.10 g/100g protein). Percentage total essential amino acid is 38% and that of non-essential amino acid is 67.88%. This value is close to 39% considered to be adequate for ideal protein food for infants, more than 26% for children and 11% for adult (F.A.O./W.H.O. 1973). Therefore, leaves of *Baphia pubescens* could be used as a good source of essential amino acids such as arginine, phenylalanine, valine and lysine. The amino acids can be used, via protein synthesis, as precursors to repair and replace worn-out tissues.

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CONCLUSION

Based on this study, the plant has been identified as a source of vegetable with good nutritive value. It can thus be suggested for proper consumption because of its contribution to meeting nutritional requirements of humans as well as providing sufficient protection against diseases arising from malnutrition.

REFERENCES

[1] Adanlawo, I.G., & Elekofehinti, O.O. (2012). Proximate analysis, mineral composition and amino acid composition of *Cnidoscolus aconitifolius* leaf. *Advances in Food and Energy Security; 2*: 18-19.

[2] Ajayi et al., (2014). Proximate analysis, mineral contents, amino acid composition, anti-nutrients and phytochemical screening of *brachystegia eurycoma harms and pipper guineense* schum and thonn. *American Journal of Food and Nutrition*, *2*(1): 11-17

[3] Akpabio, U. D., & Ikpe, E. E. (2013). Proximate composition and nutrient analysis of *Aneilema aequinoctiale* leaves. *Asian Journal of Plant Science and Research*, *3*(2):55-61

[4] Akwaowo et al., (2000). Minerals and anti-nutrients of fluted pumpkin (*Telfeiria occidentalis* Hook. F.). *Journal of food chemistry*. *70*: 235-240.

[5] Ali, A. (2009). Proximate and mineral composition of the marchubeh (*Asparagus officinalis*). *World Dairy and Food Science*, *4*(2), 142-149

[6] Anowi et al., (2014a). Anti-Inflammatory, Phytochemical and Toxicological Investigations of Ethanol Extract of the Leaves of *Baphia Pubescens* Hook.F (Family Leguminosae). *Asian Journal of Biochemical and Pharmaceutical Research 2* (4): 247-248

[7] Anowi et al., (2014b). An investigation into the antipyretic activity of n-hexane extract of the leaves of *Baphia pubescens* Hook.F (familyLeguminosae). *Journal of Pharmacognosy and Phytochemistry*; *3* (2): 127-128

[8] Anowi et al., (2014c). An investigation into the Anti-inflammatory Activity of n-hexane Extract of the Leaves of *Baphia pubescens* Hook. F (Family Leguminosae). *Journal of Pharmaceutical, Chemical and Biological Sciences*; *2*(2): 104 – 106

[9] AOAC, (1990). *Official Methods of Analysis of the Association of Official Analytical Chemists* (15th edition), Washington DC, pp 1121-1180.

[10] [Aremu et al., (2005). Mineral content of some agricultural products grown in the middle Belt of Nigeria. *Oriental Journal of Chemistry*., *21*:419-426

[11] Arkroyed, W.R., & Doughty, J. (1964). Legumes in human nutrition, Food and Agricultural Organization nutrition studies publication, 19.

[12] Asaolu M., & Omotayo F. (2007). Phytochemical nutritive and anti-nutritive Composition of leaves of *Moringa Oleifera*. *Recent Progress in Medicinal Plant*, *17*: 339-344.

[13] Asaolu et al., (2012). Proximate and Mineral Composition of Nigerian Leafy Vegetables. *Journal of Food Research*; *1* (3): 216.

[14] Champe P., & Harvey R. (1994). Lippncott's illustrated reviews: Biochemistry. 2nd ed. Lippincott Raven Publishers, New Jersey, U.S.A. P. 303-340

[15] Craig, W. J. (1999). Health-promoting properties of common herbs. *American Journal of Clinical Nutrition*; *70*: 3: 491–499.

[16] De-Bruyne et al., (1999). Condensed vegetable tannins: Biodiversity in structure and biological activities. *In Biochemical Systematic and Ecology*, vol. *27*, pp 445-459

[17] Ejoh et al., (1996). Nutrient composition of the leaves and flowers of Colocasia esculenta and the fruits of Solanum melongena. *Plant Food for Human Nutrition 49*: 107- 112

[18] Emijuigha, V.N., & Agbede, J.O. (2000). Nutritional and antinutrtional characteristics of African oil bean (Pentaclethra macrohylla benth) seeds. *Applied Tropical Agriculture*. *5* (1): 11-14.

[19] Etong, D.I., & Abbah, E.A. (2014). Estimation of Nutrients and Anti-nutrients Components of Three Nigerian Leafy Vegetables. *Food Science and Quality Management 33*:10-20

[20] F.A.O/ W.H.O. (1973). *Energy and protein requirement*; Medical Report; Series No. 522, FAO/WHO, Genera, PP.1-18.

[21] Fagboya, O.O. (1990): The interaction between oxalate acid and divalent ions, Mg+, Ca^{2+} , Zn^{2+} in aqueous medium. *Food chemistry, 38*: 179-189

[22] FAO (1996). Some medicinal forest plants of Africa and Latin America. *Journal of Science*; *67*:75–78, 161–162.

[23] Hanif et al., (2006). Nutritional and antinutritional comparison of vegetable and grain Amaranthus leaves. *Journal of the Science of Food and Agriculture*; *57*: 573-585.

[24] Hassan, L.G., & Umar, K.J. (2006). Nutritional value of Balsama pple (*Momordica balsamina* L.) leaves. *Pakistan Journal of Nutrition*, *5*:522-529.

[25] Hassan et al., (2008). Proximate, Minerals and antinutritional Factors of *Daniellia Oliveri* Seed Kernel. *Chemical Class Journal*. *5*:31-36

[26] Konkon et al., (2011). Anti-inflammatory and cicatrizing activity of *Baphia nitida* exudates. *International Journal of Biosciences* (IJB); *1*(5):45-50

[27] Maynard et al., (1994). *Improvement of tropical pumpkin, Cucurbita moschata (Lam) poir*: In Cucurbitaceae 94, evaluation and enhancement of Cucurbita germplasm. Created by Wehner TC and TNg, South Padre Island. Pp 1-4

[28] Mehansho et al., (1987). Dietary tannin and salivary proline-rich proteins: interaction and defense mechanism. *Annual Review of Nutrition*. *7*: 423-430

[29] Milbury, P. E., & Richer, A. C. 2008. Understanding the Antioxidant Controversy: Scrutinizing the fountain of Youth. Greenwood Publishing Group

[30] Nieman et al., (1992). Nutritions: Wm. C. Brown publisher Dubugue, pp: 9

[31] Oboh et al., (2003). Dynamics of phytate-Zn balance of fungi fermented cassava products (flour and garri). *Plants Foods for Human Nutrition*. *58*: 1-7.

[32] Ogbe, A.O., & John, P.A., (2012). Proximate study, Mineral and Anti-nutrient composition of Moringa oleifera leaves harvested from Lafia, Nigeria: Potential

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benefits in poultry nutrition and health. *Journal of Microbiology, Biotechnology and Food Sciences*. *1*(3): 296-308.

[33] Ogunkoya et al., (2006). Determination of anatomical, proximate, minerals, oxalate, tannin and phytate compositions in Cuban boa (Epicrates anquifer). *Electronic Journal of Environmental Agricultural and Food Chemistry*. *5* (1): 1161-1166

[34] Ogunlade et al., (2011) A Comparative Study of Proximate Composition, Anti-Nutrient Composition and Functional Properties of Pachira glabra and Afzelia Africana Seed Flours. *African Journal of Food Science*, *5*: 32-35.

[35] Ojieh et al., (2008). Compositional studies of citrullus lanata (Egusi melon) seed. *The internet Journal of Nutrition and Wellness. 6*(1): 1-9.

[36] Okunade, O.A., & Idris, T. (2008). Nutritive and anti-nutritive evaluation of Sodom apple (*Calotropis procera*) and horse eye bean (*Mucuna sloanei*) leaves. *Science research annals*, 4(1): 91-94

[37] Olaofe, O., & Sanni, C.O. (1988). Mineral content of Agricultural products. *Food Chemisty*, *30*:73-79.

[38] Onwukaeme, N.D. (1995). Anti- inflammatory activities of flavonoids of Baphia nitida Lodd. (Leguminosae) on mice and rats. *Journal of Ethnopharmacology.* 46(2):121-124

[39] Oulai et al., (2014). Proximate Composition and nutritive Value Of leafy vegetables consumed in Northern Côted'ivoire. *European Scientific Journal* 10(6): 218-219

[40] Pearson, D. (1976). *Chemical Analysis of foods*, 7th Ed. London, Churchill Livinstone. pp 7-11

[41] Pobi, G., & Kalita, J.C. (2014). Proximate analysis and mineral components of some edible medicinally important leafy vegetables of kamrup district of assam, India. *International Journal of Pharma and Bio Sciences. 5*(4): 451 - 457

[42] Ravindram et al., (1994). Total and phytate phosphate content of various food and foodstuffs of plant origin. *Food chemistry*, *50*:133-136

[43] Sathe, S.K., & Salunkhe, D.K., (1984). Technology of removal of unwanted components of dry bean. CRC.*Critical Review of Food Science and Nutrition, 21*: 263-286.

[44] Shovon et al., (2013). Analysis of the proximate composition and energy values of two varieties of onion (Allium cepa L.) bulbs of different origin: A comparative study. *International Journal of Nutrition and Food Sciences 2(*5): 246-253

[45] Soetan et al., (2010). The importance of mineral elements for humans, domestic animals and plants: A review. *African Journal of Food Science*. *4* (5): 200-222

[46] Umar et al., (2007). Nutritional composition of water spinach (Ipomoea aquatic Forsk) leaves. *Journal of Applied Science*. *7*(6):804-807.

[47] Yahaya et al., (2014). Nutrient content of selected edible leafy vegetables. *American Journal of Applied Chemistry*, *2*(3): 43-44