



Research Journal of
**Medicinal
Plant**

ISSN 1819-3455



Academic
Journals Inc.

www.academicjournals.com

Phytochemical Screening, Proximate and Mineral Composition of *Launaea taraxacifolia* Leaves

^{1,3}M.B. Adinortey, ¹J.K. Sarfo, ¹E.T. Quayson, ¹A. Weremfo, ²C.A. Adinortey, ¹W. Ekloh and ¹J. Ocran

¹Department of Biochemistry, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana

²Department of Molecular Biology and Biotechnology, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana

³Department of Pharmacology, School of Pharmacy and Pharmaceutical Sciences, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Corresponding Author: M.B. Adinortey, Department of Biochemistry, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana Tel: +233332136922

ABSTRACT

The leaves of *Launaea taraxacifolia* plant have been used for centuries in Ghana as vegetables in salads and sauces and also as a remedy for various diseases such as abdominal disorders, heartburns, dyslipidaemia and liver diseases. Though the leaves are used as food in our diet, little is known about the nutrient composition. The aim of this study was to determine the phytochemical and nutrient composition of *Launaea taraxacifolia* leaves. Various standard methods were used in the phytochemical analysis and in proximate analysis; nitrogen content was determined by micro-Kjeldahl method. Total carbohydrate was calculated by the difference method while mineral analysis was carried out after acid digestion using spectrophotometry and flame photometry. The phytochemical screening revealed the presence of cardiac glycosides, terpenoids, tannins, saponins, flavonoids and steroids in the leaves. Results of proximate analysis, on dry weight basis, per 100 g of *Launaea* leaves showed crude protein: 26.67%±1.23, total carbohydrate: 30.56%±1.30, total ash: 21.22%±0.08, crude fat: 6.50%±0.01, crude fibre: 15.05±0.07 and pH: 6.80±0.01. The total calorific value of *Launaea* leaves per 100 g was 287.47±0.6 kcal (1202.78±0.6 kJ). Mineral analysis in mg/100 g showed in the *Launaea* leaves Cu, 1.37±0.01; Fe, 40.05±1.20; Zn, 4.95±0.02; Na, 485.00±0.14; Mn, 5.82±0.02; Mg, 408.00±0.24; Ca, 2306.56±0.15; K, 5067.30±0.13 and P, 67.89±0.02. Se and Co were not detected. The results of the study indicated that *Launaea taraxacifolia* leaves are potential sources of useful nutrients and could be used to fulfil the growing demands of plant-based food for Ghanaians.

Key words: Compositae, *Launaea taraxacifolia*, mineral content, calorific value, nutrient composition, dandelion

INTRODUCTION

Launaea taraxacifolia (Compositae) commonly known as Dandelion is a member of the family Asteraceae. It is a plant found mainly in the Tropics. It is a perennial herb of about 150 cm tall with a creeping root system. The plant has an erect stem with the leaves at the base in a rosette form or alternate position capped by golden yellow flowers (Burkill, 1985; Agyakwa and Akobundu, 1998; Sakpere and Aremu, 2008).

Launaea taraxacifolia has been used for centuries as a remedy for various ailments such as skin and eye diseases-conjunctivitis, yaws, measles and diabetes mellitus and also rubbed on the limbs of toddlers to facilitate walking (Ayensu, 1978; Adebisi, 2004; Obi *et al.*, 2006). The leaves of *L. taraxacifolia* plant are fed to nursing cows to stimulate lactation and also to sheep and goat to induce multiple births. The leaves of *L. taraxacifolia* have been reported to have hypolipidaemic effect and also ability to treat water retention disorders (Wichtl, 1994; Adebisi, 2004).

Dandelion leaves are used as common vegetable and eaten as salad or cooked in soups and sauces by Ghanaians. Over the years, several studies have revealed that wild or semi-wild plants are nutritionally important because of high vitamins, minerals, proteins, essential fatty acids and fibre contents (Asibey-Berko and Tayie, 1999; Jimoh and Oladiji, 2005; Okwu and Josiah, 2006; Ejoh *et al.*, 2007; Iniaghe *et al.*, 2009; Namrata *et al.*, 2011; Prasad and Bisht, 2011). Even though *L. taraxacifolia* leaves are used as food, there is paucity of information about their constituents' that make them nutritious and also exhibit their medicinal properties. The aim of this study was to determine the phytochemical and nutrient composition of *L. taraxacifolia* leaves and thus amass data to support and encourage its usage in human nutrition and in disease treatment.

MATERIALS AND METHODS

Plant collection: Fresh plant leaves were collected from the University of Cape Coast farms in August, 2010 and authenticated by Botanist at School of Biological Sciences Herbarium, University of Cape Coast, Ghana. The fresh plant material was then washed under running tap water, air dried, ground into a fine powder and stored in air-tight containers at 4°C.

Plant extraction: About 10 g of pulverized air dried leaves of *L. taraxacifolia*, was mixed with 100 mL of 70% ethanol in a conical flask, plugged with cotton and then kept on a shaker for 48 h. The mixture was then filtered and the solvent was evaporated using rotary vacuum pump. The crude extract obtained was stored in an air-tight desiccator for further analysis.

Determination of pH: About 10 g of the dried sample was transferred into a bottle with a screw cap and 25 mL of distilled water was added. The suspension was shaken for 15 min on a mechanical shaker after which the pH was measured (Udoh and Ogunwale, 1986).

Phytochemical screening: Phytochemical tests on the leaves of *L. taraxacifolia* were carried out on both the crude ethanolic extract and the ground powder using standard procedures as described by Sofowora (1993), Harborne (1973) and Evans (2002).

Proximate analysis: The estimation of the various food parameters namely moisture content, total ash, crude fat, crude fibre, crude protein and total carbohydrate on dry matter basis were carried out according to standard procedures using 50 g of dried powdered sample. In crude protein determination, Nitrogen was determined by Kjeldahl method (Pearson, 1976) and converted to protein by multiplying by a factor of 6.25. Moisture content, crude fat, crude fibre and total ash were determined by AOAC (1984) and to determine the total carbohydrate, the method of James (1995) based on difference was employed using the equation:

$$\text{Total carbohydrate} = 100 - [\% \text{crude protein} + \% \text{crude fat} + \% \text{crude fibre} + \% \text{crude total ash}]$$

Determination of energy or calorific value: The total energy value in the leaves of *L. taraxacifolia* in kcal/100 g was estimated using the method described by FAO (2003) as shown below:

$$\text{Energy value} = [\% \text{ crude protein} \times 4.0] + [\% \text{ crude fat} \times 9.0] + [\% \text{ carbohydrate} \times 4.0]$$

Mineral analysis: Test for the presence of minerals was carried out after acid digestion. The supernatant was decanted and the liquid was analyzed for the levels of Ca, Cu, K, Mg, Mn, Na, Fe, P, Co and Se using standard procedures. Sodium and potassium were determined using a flame photometer. Phosphorus level was determined using the Vanadate/molybdate yellow colour method by Allen and Deitz (1953). Calcium, magnesium, copper, chromium, zinc, iron, cadmium and lead levels were analyzed using Atomic Absorption Spectrophotometer. In order to avoid various interferences in the determinations, the mixtures were made to contain the same acid concentration. To overcome potential interference when determining Ca and Mg, a modifier 1% Lanthanum (w/v) was added to the final sample dilution and/all standards and blank which served as releasing agent. In the determination of Na, K, ionization interferences were dealt with by adding Caesium to both the sample and the standard. The concentration or level of each element in the sample solution was determined by reference to a calibration curve.

RESULTS AND DISCUSSION

The phytochemical screening of *L. taraxacifolia* leaves (Table 1) reveals the presence of tannins, saponins, steroids, flavonoids, cardiac glycosides and terpenoids. The reported health benefits of *L. taraxacifolia* leaves may be attributed to these phytoconstituents that might be of medicinal value. In this study, *L. taraxacifolia* leaves did not show the presence of alkaloids, anthraquinones, reducing sugars and cyanogenic glycosides. Cyanogenic glycosides and anthraquinones are very poisonous metabolites and their absence in the leaves of *L. taraxacifolia* makes it safe to be eaten by humans.

The proximate analysis of *L. taraxacifolia* leaves revealed that it contain an appreciably high amount of proteins (26.67%) (Table 2). This means that every 100 g of *Launaea* leaves would contain 26.67 g of protein. The crude protein content obtained in this study is higher when compared to 6.30% in water Spinach, 4.60% in *Momordica foetida* leaves, 11.29% in balsam apple leaves (Hassan and Umar, 2006), 24.85% in sweet potatoes leaves (Oduro *et al.*, 2008). However, the crude protein of *Launaea taraxacifolia* leaves was found to be lower compared to 27.51% in *moringa oleifera* leaves (Oduro *et al.*, 2008), 29.78% in *Piper guineenses* and 31.00% in *Talinum triangulare* (Akindahunsi and Salawu, 2005). The RDA for protein is in the range 28-65 g for children, lactating mothers, pregnant women and adults. *Launaea* leaves can provide about 41-95% of RDA thus makes it good to be added to our diet as salads and sauce.

This study revealed that the moisture content (22.18%) of *Launaea* leaves (Table 2) is higher than those of some common leafy vegetables such as *Xanthosem sagittifolium* (14.7%), *Adansonia digitata* (9.5%), but lower compared to *Gnetum buchholsianium* (33.8%), *Vernonia amygdaline* (27.4%) (Ladan *et al.*, 1996) and 76.53% in *Moringa oleifera* leaves (Oduro *et al.*, 2008). The moisture content gives an indication of water soluble vitamins present.

The total ash content of 21.22% for *Launaea* leaves which is relatively high gives an indication to the rich source of inorganic minerals element that may be present in the leaves. The value

Table 1: Result of the phytochemical screening *Launaea taraxacifolia* leaves

Phytochemical constituents	Observation	Inference/results
Saponins	Yellow emulsion formed	+
Terpenoids	Reddish brown colour	+
Cardiac glycosides	Yellowish brown ring of upper layer	+
Steroids	Reddish brown colour	+
Tannins	Green black colour	+
Anthraquinones	Green colour	-
Alkaloid (Mayer's reagent)	No yellow precipitate formed	-
Flavonoids	Yellow colour persist	+
Reducing sugar	Green colour	-
Cyanogenic glycoside	No colour change	-

+: Present; -: Absent. Assays were all carried out in triplicates

Table 2: Proximate composition of *launaea taraxacifolia* leaves on dry matter basis

Parameter	Percentage values (Dry weight basis)
Total carbohydrate	30.56±1.30
Crude protein	26.67±1.23
Total ash	21.22±0.08
Crude fibre	15.05±0.07
Crude fat	6.50±0.01
Moisture content	22.18±0.50
Calorific value (kcal/100 g)	287.47±0.60
pH	6.80±0.01

Values expressed as % Mean±SEM, n = 3

obtained is higher compared to 1.8% reported in sweet potato leaves (Asibey-Berko and Tayie, 1999), 7.13% in *Moringa oleifera* (Oduro *et al.*, 2008), 5% in *Tribulus terrestris* leaves, 19.61% in *Amaranthus hybridus* leaves (Nwaogu *et al.*, 2000), 10.83% in water spinach leaves and 18.00% Balsam apple leaves (Hassan *et al.*, 2004).

The study also revealed that there was a good amount of fibre (15.05%) in the leaves an indication that it can serve as a good source of fibre which might aid digestion, help reduce serum cholesterol level, risk of coronary heart disease and hypertension (Ganong, 2003). The crude fibre content of *Launaea* leaves is high compared to 7.20% in sweet potatoes leaves, 13% in *Tribulus terrestris* leaves but low compared to 19.25% in *Moringa oleifera* leaves (Oduro *et al.*, 2008), 29.00% in balsam apple leaves (Hassan and Umar, 2006). The RDA for fibre is 18 - 35 g that means *L. taraxacifolia* can provide about 43-84% of the daily fibre requirements of the body.

The total carbohydrate content of *L. taraxacifolia* leaves was found to be 30.56%. The carbohydrate content of the leaves is considerably low compared to some other leafy vegetables like *Tribulus terrestris* 55.67%, 54.20% in water spinach leaves and 75% in sweet potato leaves (Asibey-Berko and Tayie, 1999), 43.88% in *moringa oleifera* (Oduro *et al.*, 2008) and 82.8% in *Corchorus tridens* leaves (Asibey-Berko and Tayie, 1999). This relatively low carbohydrate content makes it suitable to be eaten when one wants to lose weight.

The fat content of *L. taraxacifolia* was found to be 6.50% which is lower than 11% in water spinach leaves, 12% in *Senna Obtusifolia*, but higher when compared to spinach leaves (0.3%), Chaya leaves (0.4%) and 1.60% in *Amaranthus hybridus* leaves (Nwaogu *et al.*, 2000) and 2.23% for *moringa oleifera* (Oduro *et al.*, 2008). Crude fats are the principal sources of energy. One gram

of lipid provides 9.0 kcal (37.33 kJ) of energy (FAO, 2003) which indicates that 100 g of *Launaea taraxacifolia* leaves lipid should provide about 58.5 kcal (244.76 kJ) of energy.

The estimated total energy value in the leaves of *Launaea* per 100 g was 287.47 kcal/100 g (1202.78 kJ/100 g) of the dry sample (Table 2). This value is low compared to the daily energy requirement of 2500-3000 kcal (10460-12552 kJ) for adults (WHO/FAO, 1985). The value is higher than 133.34 kcal/100 g (557.90 kJ/100 g) reported by Amata (2010) for leaves of *Myrianthus arboreus*. However, lower compared with 248.8-307.1 kcal/100 g (1040.98-1284.91 kJ/100 g) reported in Nigerian vegetables (Isong *et al.*, 1999; Ihedioha and Okoye, 2011) and 316.66-329.76 kcal/100 g (1324.91-1379.47 kJ/100 g) for sweet potatoes and 305.62 kcal (1278.71 kJ) per 100 g for *Moringa oleifera* leaves (Asibey-Berko and Tayie, 1999; Oduro *et al.*, 2008). The low calorific value of *L. taraxacifolia* leaves is an indication that it can be recommended to individuals suffering from overweight and obesity.

The inorganic mineral analysis of *Launaea taraxacifolia* leaves showed that it contained magnesium, sodium, potassium, calcium, phosphorus, manganese, iron, zinc and copper. These minerals were found in the order; Potassium > Calcium > Sodium > Magnesium > Phosphorus > Iron > Manganese > Zinc > Copper. However, cobalt and selenium were not detected, this indicates that these minerals are not present in a detectable amount in the leaves and this could be of great advantage to the consumers, since some of these minerals like cobalt and cadmium have been reported to be highly toxic even at low concentrations (Asaolu *et al.*, 1997).

The potassium content of *Launaea taraxacifolia* 5067.30 mg/100 g in this study is higher compared to 6.42 mg/100 g found in *Diospyros mespiliformis*, 42.74 mg/100 g in *Mucuna flagellipes* (Ihedioha and Okoye, 2011) and 220.00 mg/100 g in *cassia siamea* leaves (Hassan and Ngaski, 2007). The level was above the range reported in some green leafy vegetables consumed in Sokoto, Nigeria (Ladan *et al.*, 1996).

The sodium content of *Launaea* leaves 485.00 mg/100 g (Table 3) is high compared to 5.00 mg/100 g reported in *Tribus terrestris* leaves (Hassan *et al.*, 2005), 3.29 mg/100 g in *Mucuna flagellipes* (Ihedioha and Okoye, 2011) and 45 mg/100 g in *Senna obtusifolia* (Lintas, 1992) and 95-320 mg/100 g reported for leaves of some wild edible plants from India (Seal, 2011). The RDA for Na is 500 mg which means that *Launaea* leaves can provide 97% of RDA for an adult. The Na and K are important in our diet due to the role in blood pressure regulation (Yoshimura *et al.*, 1991). Na/K ratio of less than one in our diet is recommended hence, *Launaea* leaves with Na/K = 0.10 is good and adequate use of the leaves as vegetables in diets of hypertensive patients could be useful in lowering their blood pressure.

The calcium content in the leaves *Launaea taraxacifolia* is 2306.560 mg/100 g (Table 3) is high compared with the calcium content of 3.05 mg/100 g of *Diospyros mesipiliformis* (Hassan *et al.*, 2004), 941 mg/100 g in *Momordica balsamina* L. leaves (Hassan and Umar, 2006) and 17.95 mg/100 g in *Cassia siamea* leaves (Hassan and Ngaski, 2007) and 313.30 mg/100 g in *Mucuna flagellipes* (Ihedioha and Okoye, 2011). Calcium is needed for growth and maintenance of bone, teeth and muscles thus, *Launaea taraxacifolia* can contribute a meaningful amount of dietary calcium.

The phosphorus content of the *Launaea taraxacifolia* leaves 67.89 mg/100 g is high when compared to *Diospyros mespiliformis* 1.0 mg/100 g, 5.72 mg/100 g in *Mucuna flagellipes* (Ihedioha and Okoye, 2011) but low compared to 180.00 mg/100 g in *Cassia siamea* leaves (Hassan and Ngaski, 2007), 166-460 mg/100 g found in some green leafy vegetable consumed in Sokoto (Ladan *et al.*, 1996). Calcium and phosphorus are the minerals present in the largest

Table 3: Mineral composition of *Launaea taraxacifolia* leaves

Minerals	Value (mg/100 g dry matter)
Magnesium	408.00±0.24
Sodium	485.00±0.14
Potassium	5067.30±0.13
Calcium	2306.56±0.15
Phosphorus	67.89±0.02
Cobalt	ND
Selenium	ND
Manganese	5.82±0.02
Iron	40.05±1.20
Zinc	4.95±0.02
Copper	1.37±0.01
Na/K	0.096
Ca/P	33.98

ND means not detected. Values expressed as Mean± SEM, n = 3

quantity in the structure of the body and bones. Nieman *et al.* (1992) considered a food source good if the Ca/P is above 1 and poor if the ratio is less than 0.5. *Launaea taraxacifolia* leaves which had a Ca/P = 33.98 (Table 3) is therefore a good source of Ca and P needed in maintenance of bones, teeth and muscles (Turan *et al.*, 2003).

The magnesium content of *Launaea taraxacifolia* leaves is 408.00 mg/100 g (Table 3) which is high compared to 2.56 mg/100 g in *Diospyros mespiliformis* (Hassan *et al.*, 2004), 23.18 mg/100 g of *Amaranthus hybridus* leaves (Nwaogu *et al.*, 2000), 112.73 mg/100 g in *Mucuna flagellipes* (Ihedioha and Okoye, 2011) and 400.00 mg/100 g in *Cassia siamea* leaves (Hassan and Ngaski, 2007).

Copper plays a role in haemoglobin formation and it contributes to iron and energy metabolism. The copper content of *Launaea* is 1.37 mg/100 g (Table 3) which is higher compared to 0.01 mg/100 g in *Diospyros mespiliformis* (Hassan *et al.*, 2004), 1.28 mg/100 g in *T. terrestris* leaves (Hasan *et al.*, 2005), 1.33 mg/100 g in *Mucuna flagellipes* (Ihedioha and Okoye, 2011) and 0.50 mg/100 g in *Cassia siamea* leaves (Hassan and Ngaski, 2007).

The zinc content of *Launaea* leaves of 4.95 mg/100 g (Table 3) was found to be higher compared to 0.02 mg/100 g in *Diospyros mespiliformis* (Hassan *et al.*, 2004), 0.10 mg/100 g in *T. terrestris* leaves but lower when compared to 6.85 mg/100 g in *Cassia siamea* leaves (Hassan and Ngaski, 2007). It was found to be in the range for *Mucuna flagellipes* leaves (2.24-8.52 mg/100 g) reported by Ihedioha and Okoye (2011). The value of Zinc obtained for *Launaea* leaves implies it's a good source of zinc.

Manganese is another microelement essential for human nutrition. It acts as a cofactor of many enzymes (McDonald *et al.*, 1995). The Manganese content in *Launaea* leaves is 5.82 mg/100 g which is lower than 11.6 mg/100 g in *Momordica balsamina* leaves (Hassan and Umar, 2006) but higher than lettuce of 0.3 mg/100 g and cabbage (0.2 mg/100 g) (Turan *et al.*, 2003).

The iron content of *Launaea* leaves is 40.05 mg/100 g (Table 3) which is higher than 2.80 mg/100 g in *T. terrestris* and in some cultivated vegetables such as spinach (1.6 mg/100 g) lettuce (0.7 mg/100 g) and cabbage (0.3 mg/100 g) (Turan *et al.*, 2003) but lower than 70.00 mg/100 g in *Cassia siamae* (Hassan and Ngaski, 2007), 84.4 mg/100 g in *Helminthostachys* sp. and 57.08 mg/100 g for *Mucuna flagellipes* leaves (Ihedioha and Okoye, 2011). The RDA value

for iron is 10-15 mg (Nieman *et al.*, 1992), this means the leaves of *Launaea* can contribute more than twice of iron to the RDA. This shows that about 50 g of *Launaea* can provide the daily iron requirement. The use of *Launaea* leaves in our diet could help in boosting the blood level especially in anaemic conditions.

CONCLUSION

The results of the present study revealed that the leaves of *Launaea taraxacifolia* contain certain phytochemicals namely tannins, saponins, flavonoids, cardiac glycosides, steroids and terpenoids which may account for its reported medicinal benefits. It also has appreciable amount of macronutrients and micronutrients. These results indicate that the leaves of *Launaea taraxacifolia* contained essential nutrients which can compete favourably well with other conventional edible leaves.

RECOMMENDATION

The recommended use of *Launaea taraxacifolia* leaves could help fulfil the growing demands of plant-based foods for human nutrition. Research is ongoing in our laboratory to quantify the levels of vitamins, identify the essential and non essential amino acids, to determine the effect of different storage conditions on nutrient composition and also to determine the effects of intake of *Launaea* leaves on disease conditions such as dyslipidaemia.

ACKNOWLEDGMENT

The authors are grateful to the Department of Biochemistry, School of Biological Sciences, University of Cape Coast for support in terms of provision of reagents and chemicals needed in carrying out this research work.

REFERENCES

- AOAC, 1984. Official Methods of Analysis. 14th Edn., Association of Official Analytical Chemists, Washington, DC., USA., pp: 522-533.
- Adebisi, A.A., 2004. *Launaea taraxacifolia* (Willd.) Amin ex C.Jeffrey. In: PROTA 2: Vegetables/Legumes, Grubben, G.J.H. and O.A. Denton (Eds.). PROTA, Wageningen, Netherlands.
- Agyakwa, C.W. and I.O. Akobundu, 1998. A Handbook of West African Weeds. 2nd Edn., International Institute of Tropical Agriculture, Ibadan, Nigeria, ISBN: 9781311290, pp: 564.
- Akindahunsi, A.A. and S.O. Salawu, 2005. Phytochemical screening and nutrient composition of selected tropical green leafy vegetables. *Afr. J. Biotechnol.*, 4: 497-501.
- Allen, G. and V.R. Deitz, 1953. Determination of phosphate by differential spectrophotometry. *Anal. Chem.*, 25: 1320-1324.
- Amata, I.A., 2010. Nutritive value of the leaves of *Myrianthus arboreus*: A browse plant. *Int. J. Agric. Res.*, 5: 576-581.
- Asaolu, S.S., K.O. Ipinmoroti, C.E. Adeyinwo and O. Olaofe, 1997. Seasonal variation in heavy metals concentration distribution in sediments of Ondo State Coastal Region. *Ghana J. Chem.*, 31: 11-16.
- Asibey-Berko, E. and F.A.K. Tayie, 1999. Poximate analysis of some under utilized Ghannian vegetables. *Ghana J. Sci.*, 39: 91-92.
- Ayensu, E.S., 1978. Medicinal Plants of West Africa. Reference Publication Inc., USA., pp: 36-39.

- Burkill, H.M., 1985. The Useful Plants of West Africa. 2nd Edn., The Royal Botanical Gardens, Ithaka Harbors Incorporation, Kew, UK., ISBN-10: 094764301X.
- Ejoh, R.A., D.V. Nkongha, G. Inocent and M.C. Moses, 2007. Nutritional components of some non-conventional leafy vegetables consumed in Cameroon. *Pak. J. Nutr.*, 6: 712-717.
- Evans, W.C., 2002. Trease and Evans Pharmacognosy. 15th Edn., Bailliere Tindall, London, ISBN-10: 0702026174.
- FAO, 2003. Food energy-methods of analysis and conversion factors. Food and Nutrition Paper 77, Food and Agriculture Organization of the United Nations, Rome, Italy, pp: 1-93.
- Ganong, W.F., 2003. Circulating Body Fluids: Review of Medical Physiology. 21st Edn., Typo Press, Lebanon.
- Harborne, J.B., 1973. Textbook of Phytochemical Methods. 1st Edn., Champraan and Hall Ltd., London, pp: 110-113.
- Hassan, L.G., F.W. Abdulrahaman and A.A. Zuru, 2004. Nutritional and phytochemical investigation of *Diospyros mespiliformis* (L.). *Nig. J. Basic Applied Sci.*, 13: 1-8.
- Hassan, L.G., K.J. Umar and A. Usman, 2005. Nutrient content of the leaves of *Tribulus terrestris* (Tsida). *J. Trop. Biosci.*, 5: 77-82.
- Hassan, L.G. and K.J. Umar, 2006. Nutritional value of balsam apple (*Momordica balsamina* L.) leaves. *Pak. J. Nutr.*, 5: 522-529.
- Hassan, L.G. and M.M.A. Ngaski, 2007. Nutritional evaluation of *Cassia siamea* leaves. *J. Chem. Soc. Nig.*, 32: 137-143.
- Ihedioha, J.N. and C.O.B. Okoye, 2011. Nutritional evaluation of *Mucuna flagellipes* leaves: An underutilized legume in Eastern Nigeria. *Am. J. Plant Nutr. Fertiliz. Technol.*, 1: 55-63.
- Iniaghe, O.M., S.O. Malomo and J.O. Adebayo, 2009. Proximate composition and phytochemical constituents of leaves of some *Acalypha* species. *Pak. J. Nutr.*, 8: 256-258.
- Isong, E.U., S.A.R. Adewusi, E.U. Nkanga, E.E. Umoh and E.E. Offiong, 1999. Nutritional and phytochemical studies of three varieties of *Gnetum africanum* (Afang). *Food Chem.*, 64: 489-493.
- James, C.S., 1995. Analytical Chemistry of Foods. 1st Edn., Chapman and Hall, New York.
- Jimoh, F.O. and A.T. Oladiji, 2005. Preliminary Studies on *Piliostigma thonningii* seeds: Proximate analysis, mineral composition and phytochemical screening. *Afr. J. Biotechnol.*, 4: 1439-1442.
- Ladan, M.J., L.S. Bilbis and M. Lawal, 1996. Nutrient composition of some green leafy vegetables consumed in Sokoto. *Nig. J. Basic Applied Sci.*, 5: 39-44.
- Lintas, C., 1992. Nutritional aspects of fruits and vegetables consumption. *Options Mediterraneennes*, 19: 79-87.
- McDonald, P., R.A. Edwards, J.F.D. Greenhalgh and C.A. Morgan, 1995. Animal Nutrition. 5th Edn., Longman Singapore Publishers (Pvt.) Ltd., Singapore.
- Namrata, L. Kumar, D. Ghosh, S.C. Dwivedi and B. Singh, 2011. Wild edible plants of uttarakhand Himalaya: A potential nutraceutical source. *Res. J. Med. Plant*, 5: 670-684.
- Nieman, D.C., D.E. Butterworth and C.N. Nieman, 1992. Nutrition. WMC. Brown Publisher, Dubugue, Pages: 50.
- Nwaogu, L.A., C.O. Ujowundu and A.I. Mgbemena, 2000. Studies on the nutritional and phytochemical composition of *Amarantus hybridus* leaves. *Bio-Res.*, 4: 28-31.
- Obi, R.K., I.I. Iroagba and O.A. Ojiako, 2006. Virucidal potential of some edible Nigerian vegetables. *Afr. J. Biotechnol.*, 5: 1785-1788.

- Oduro, I., W.O. Ellis and D. Owusu, 2008. Nutritional potential of two leafy vegetables: *Moringa oleifera* and ipomoea batatas leaves. *Sci. Res. Essay*, 3: 57-60.
- Okwu, D.E. and C. Josiah, 2006. Evaluation of the chemical composition of two Nigerian medicinal plants. *Afr. J. Biotechnol.*, 5: 357-361.
- Pearson, D., 1976. *The Chemical Analysis of Foods*. 7th Edn., Churchill Livingstone, London, ISBN: 0443014116, pp: 7-11.
- Prasad, K. and G. Bisht, 2011. Evaluation of nutritive, Antioxidant and mineral composition of *Pavetta indica* Linn. leaves. *Res. J. Phytochem.*, 5: 54-59.
- Sakpere, A.M.A. and O.A. Aremu, 2008. The growth of *Launaea taraxacifolia* (Asteraceae) and its response to shading. *Res. J. Bot.*, 3: 90-96.
- Seal, T., 2011. Determination of nutritive value, mineral contents and antioxidant activity of some wild edible plants from Meghalaya State, India. *Asian J. Applied Sci.*, 4: 238-246.
- Sofowora, A., 1993. *Medicinal Plants and Traditional Medicine in Africa*. 2nd Edn., Spectrum Books Ltd., Ibadan, Nigeria, ISBN: 978-246-219-5 Pages: 289.
- Turan, M., S. Kordali, H. Zengin, A. Dursun and Y. Sezen, 2003. Macro and micro mineral content of some wild edible leaves consumed in Eastern Anatolia. *Acta Agric. Scand. Section B Plant Soil Sci.*, 53: 129-137.
- Udoh, E.J. and A.J. Ogunwale, 1986. *Laboratory Manual for the analysis of soil, plant and water samples*. University Press, Ibadan, Nigeria, pp: 66-70.
- WHO/FAO, 1985. WHO FAO report: Energy and protein requirements. WHO Technical Report Series No. 724. Geneva.
- Wichtl, M., 1994. *Herbal Drugs and Phytopharmaceuticals*. CRC Press, Boca Raton, FL., pp: 486-489.
- Yoshimura, M., H. Takahashi and T. Nakanishi, 1991. Role of sodium, potassium, calcium, magnesium on blood pressure regulation. An antihypertensive dietary therapy. *Jap. J. Nutr.*, 49: 53-62.