MINERAL NUTRIENT COMPOSITION AND PROXIMATE ANALYSIS OF SELECTED EDIBLE GREENS OF MEDICINAL IMPORTANCE

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Abstract
Greens are very nutrient-dense and incredibly healthy. They are rich in minerals, fibre content, vitamins and also vital sources of antioxidants. Keeping in view, this study attempted to analyse a few important constituents of selected edible greens. In the present study, leaves of a total of five selected medicinally important edible greens namely Centella asiatica, Eclipta prostrata, Mukia maderaspatana, Sesbania grandiflora and Solanum procumbens were analysed for mineral nutrient composition and proximate values. The quantitative determination of the mineral composition of edible greens such as potassium, calcium, iron, magnesium, phosphorus was analyzed. Similarly, proximate analysis was also tested for the estimation of crude carbohydrates, crude protein, crude fat and crude fibre content for the selected edible greens. Ash value, moisture content and energy value of the selected edible greens were also observed. The results of the mineral analysis show that the greens are rich in Calcium followed by potassium, magnesium, phosphorous, iron and copper. Mukia maderaspatana exhibited a higher amount of vitamin C when compared to other greens. Proximate analysis reveals that Centella asiatica possesses high proximate content such as crude protein of about 68.49±1.82%, crude fat 4.34±0.67% and crude fibre of about 5.89±0.87%. Significant value of crude carbohydrate is noticed in Sesbania grandiflora of about 42.12±0.83%. Subsequent to Centella asiatica, notable proximate content was also observed in Eclipta prostrata, Sesbania grandiflora and Solanum procumbens. Among the various macronutrients estimated, calcium was present in the highest quantity in S.procumbens (38.20±1.45 mg/100g) followed by M. maderaspatana (37.40±1.00 mg/100g). Iron is present in the least amount, highest in S. grandiflora (1.98±0.12 mg/100g). This study on the selected edible greens scientifically proves that greens possess a significant amount of minerals and proximates so can be commercially cultivated further for its greater utilization as human food.

Keywords: Edible greens, nutritional profile, minerals, vitamins, proximate, medicinal.

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1. INTRODUCTION

Nature food and green vegetables are rich in proteins, vitamins and minerals and their nutrients help in maintaining healthier and disease free life in human beings (Enker, 2013, Park *et al*., 2013; Natesh *et al*., 2017). Regular consumption of greens helps us to overcome mineral deficiency and provide good health conditions. Green leafy vegetables are the best source of folic acid, which helps in skin protection. Most of the greens contain lutein, which is helpful in the protection of eyes. Greens control food allergies, inflammatory diseases and obesity thereby maintaining the fittest life (Grusak *et al.*, 1999; Dias, 2012; Slavin and Lloyd, 2012).

Centella asiatica which is commonly known as vallarai, is a tropical medicinal plant belonging to the family Apiaceae. It has been used as a medicinal herb for thousands of years in India. It is commonly used in anti-aging preparations for the skin. It is also supposed to be effective in the healing of tuberculosis, syphilis, amoebic dysentery, and common cold (Kartnig, 1988; Ponnusamy *et al*., 2014). The whole plant of *Eclipta prostrata* is considered as an effective drug for hepatotoxicity and spleen enlargement (Rownak *et al.*, 2014; Siddiqui *et al*., 2009). Beneficial in jaundice and skin diseases, and leaves are widely used in hair oil, a decoction of leaves is used in uterine haemorrhage. The whole plant is used as expectorant, leaves and tender shoot is used for diuretic and stomach ache. The paste of seeds and leaves are applied for body ache, roots of this plant are useful for

toothache (DeFilipps and Krupnick, 2018).
Mukia maderaspatana is an annual climbing herb with scandent stem and unisexual flowers. The whole plant of *Mukia* is used as an expectorant, leaves and tender shoot is used for diuretic and stomach ache. The paste of seeds and leaves are applied for body ache, roots of this plant are useful for toothache (Abdul Kader, 2014). The young leaves of *Sesbania grandiflora* are edible and quite often used to supplement meals. The plant has also been reported to be a potent antidote for tobacco and smoking related diseases (Labu *et al*., 2016). It is used in the treatment of night blindness, headache and fever. Leave juice extract is also used in the treatment of epilepsy. The powdered bark is applied in scabies ulceration of the tongue and the alimentary canal (Kavitha *et al*., 2013; DeFilipps and Krupnick, 2018).
The leaves and roots of *Solanum procumbens* are used for consumption in the form of a decoction and powder. The berries and flowers are administered for the treatment of cough. The decoction of diverse parts of the plant is used to treat chronic bronchitis. Its leaf decoction is said to possess antibiotic properties. It is used to cure pneumonia, typhoid and tuberculosis. Its leaves are cooked and eaten as a vegetable (Verma, 2017; Hai *et al*., 2019). Proximate analysis is a scientific analytical method done to determine approximate amounts of biochemical substances within a material. This technique is used to study things such as animal feed, coal, and biofuels and now it is also been used to study the plant samples. The process of proximate analysis is complicated and often involves extraction procedures or instruments to determine the varying amount of substances within one material, though different methods are used for different materials (Subramanian *et al.,* 2012).
Vitamins are complex organic molecules that are found in various foods that are supplied in the diet. They are organic components and are easily oxidized in air and heat. They are required in a very trace amount and are not synthesized in our body. Each vitamin has a specific role in our body. Their absence and the excess amount will lead to various health problems. Vitamins help in converting food to energy and repair cell damage. Greens, vegetables and fresh fruits are rich in vitamins (Lawal *et al*., 2015). Minerals are needed by human beings and animals which can help in preventing certain diseases. The mineral analysis is a widely used technique to detect and determine the presence and to quantify the amount of mineral in the plant using an atomic spectrophotometer. In plant, the determination of minerals is very important because the quality and medicinal type of the plant is depended only on the presence of minerals. Thus, in the present study mineral and proximate composition of selected edible greens were analyzed.

2. MATERIALS AND METHODS

2.1. Source of green samples

Five species of edible greens namely *Centella asiatica* (L.) Urb. (Apiaceae), *Eclipta prostrata* (L.) (Compositae), *Mukia maderaspatana* (L.) Roem. (Curcubitaceae), *Sesbania grandiflora* (L.) Pers. (Leguminosae) and *Solanum procumbens* Lours. (Solanaceae) were used for the present investigation. All the five species were purchased from the local green vendor in the Tambaram market, Chennai, India. The greens were identified and authenticated at the Centre for Floristic Research and Herbarium, Department of Botany, Madras Christian College. These specimens were subjected to nutrient and proximate analysis.

2.2. Minerals and vitamin Analysis

Minerals were determined by shade dried powder of leaves. The five inorganic macro elements calcium, iron magnesium, potassium, phosphorus and two micro minerals zinc and copper were determined according to the methods of AOAC (2003) and Shumaila and Mahpara (2009). Vitamin C is also determined by the dry powder of the greens by using 2, 4-Dichloro-phenol-Indophenol dye method (Hradesh *et al*., 2017).

2.2.1. Wet digestion of sample

One gram of the powdered sample was taken in digesting glass tube for wet digestion method. Twelve milliliters (12ml) of HNO3 was added to the food samples and mixture was kept for overnight at room temperature. Then 4.0 ml perchloric acid (HClO4) was added to this mixture and was kept in the fumes block for digestion. The temperature was increased gradually, starting from 50ºC and increasing up to 250-300oC which gets completed in about 70- 85 min as indicated by the appearance of white fumes. The mixture was cooled and the contents of the tubes were transferred to 100 ml volumetric flasks and the volumes of the contents were made to 100 ml with distilled water. The wet digested solution was transferred to plastic bottles labeled accurately. Store the digest and used it for mineral determination.

2.2.2. Iron (Fe), Zinc (Zn), Calcium (Ca), Copper (Cu) and Magnesium (Mg) analysis by Atomic Absorption Spectrometry

Principle: In this technique, the atoms of an element are vaporized and atomized in the flame. The atoms then absorb the light at a characteristic wavelength. The source of the light is a hollow cathode lamp, which is made up of the same element, which has to be determined. The lamp produces radiation of an appropriate wavelength, which while passing through the flame is absorbed by the free atoms of the sample. The absorbed energy is measured by a photo-detector read-out system. The amount of energy absorbed is proportional to the concentration of the element in the sample.

Procedure: The digested sample was analyzed for mineral contents by Atomic Absorption Spectrophotometer (AAS) in A-Z Pharmaceuticals Pvt. Ltd., Ambattur, Chennai. Different electrode lamps were used for each mineral. The equipment was run for standard solutions of each mineral before and during determination to check that it is working properly. The dilution factor for all minerals except P and Mg was 100. For determination of Mg, further dilution of the original solution was done by using 0.5 ml original solution and enough distilled water was added to it to make the volume up to 100 ml. Also for the determination of Ca, 1.0 ml lithium oxide solution was added to the original solution to unmask Ca from Mg. The concentrations of minerals recorded in terms of "ppm" were converted to milligrams (mg) of the minerals by multiplying the ppm with dilution factor and dividing by 1000, as follows:

$$MW = \frac{\text{absorbency (ppm) x dry wt. x D}}{\text{Wt. of sample x 1000}}$$

Note: D - Dilution factor for phosphorus is 2500, for magnesium 10000, and for other minerals including calcium, iron, potassium, sodium, manganese and chromium is 100.

2.2.3. Potassium (K) by flame photometer

Principle: The flame photometer measures the emission of radiant energy when atoms of an element return to their ground state after their excitation by the high temperature of the flame. The degree of emission is related to the concentration of the element in the solution.

Procedure: K analysis of the sample was done by the method of flame photometry. The same wet digested food sample solutions as used in AAS were used for the determination of Na and K. Standard solutions of 20, 40, 60, 80 and 100 milli equivalent/L were used both for Na and K. The calculations for the total mineral intake involve the same procedure as given in AAS.

2.2.4. Phosphorus (P) by spectrophotometry

Principle: Calorimetric determination is based upon the principle that certain elements or compounds on reaction with suitable reagent develop color. The intensity of the color is measured with colorimeter or spectrophotometer. The inorganic phosphorus reacts with ammonium molybdate. Ammonium phosphomolybdate is formed, which on reaction forms molybdenum blue. The blue colour of the solution is measured and the amount of the phosphorus is determined.

Preparation of the mix reagent: Twelve gram of the ammonium molybdate was taken and mixed with 250 ml-distilled water in a beaker (solution A). 0.2908 gm antimony potassium

tartarate was taken and dissolved in 500 ml H2SO4 (5N) solution in a volumetric flask. Enough distilled water was added to make the solution up to 1000 ml (solution B). The two solutions (A and B) were mixed in a 2000 ml volumetric flask to get mix reagent. The volume of the mix reagent was made up to 2000 ml by adding distilled water. 0.739 gm of ascorbic acid was mixed with 140 ml of the mix reagent in a beaker and left until dissolved to make color reagent. One milliliter of wet digested duplicate food sample was taken in a plastic bottle labeled properly and to it was added 4.0ml distilled water to make a diluted volume of 5.0ml. Five milliliters (5.0ml) of color reagent was added to this volume and the total volume of this mixture (final solution) was made up to 25.0ml. The dilution factor of this solution was 2500 (100 x 25). After some time, the color of this final solution turned blue. Sample from final blue solution was taken in a cuvett and introduced to spectrophotometer. The readings of the phosphorus were recorded in ppm.

2.2.5. Vitamin C

The ascorbic acid (Vitamin C) content was estimated by visual titration method using 2, 4-Dichloro-phenol-Indophenol dye method (Hradesh *et al*., 2017). Results were expressed as milligrams of ascorbic acid/100 g fresh weight.

$$\text{Ascorbic acid}\left(\frac{\text{mg}}{100\text{gm}}\right) = = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made} \times 100}{\text{Aliquot taken} \times \text{Sample weight}}$$

2.3. Proximate Analysis

Proximate analysis was done to test the nutritive value of the edible greens. The greens were quantitatively analysed for carbohydrate, crude protein, crude fat, crude fibre, total ash and moisture content (AOAC, 2003; Shumaila and Mahpara, 2009 and Indryan *et al.* 2005).

2.3.1. Total ash

Weight and clean the dry crucible. Weigh out appropriate amount of sample in the tread porcelain crucible. Reweigh the crucible with sample; place the muffle furnace at 760 c for 1 hr. Remove and allow cooling slightly then placing in the desiccation. Place back in muffle furnace for one hour. Cool and weigh for determining the total ash.

2.3.2. Moisture content

Moisture was determined by oven drying method 1.5 g of well-mixed sample was accurately weighed in clean, dried crucible. The crucible was allowed in an oven at 100-105^{o}C for 6 to 12 hours until a constant weight was obtained. Then crucible was placed in the desiccator for 30 min to cool after cooling it was weighed again. The percent moisture was calculated by following formula:

$$\%\ \text{of moisture} = \frac{W_1 - W_2 \times 100}{\text{Wt. of sample}}$$

Where

W_1 = Initial weight of crucible + Sample

W_2 = Final weight of crucible + sample

2.3.3. Energy or Calorific Value

The total energy value or calorific value of the greens was estimated as shown below and expressed in cal/100g of the sample

Energy value= (% crude protein× 4.0) + (% crude fat × 9.0) + (% crude carbohydrate × 4.0)

2.3.4. Crude protein

The crude protein was determined using kjeldahl method. The sample was digested by heating with sulphuric acid in the presence of digestion mixture. The mixture was then made alkaline. Ammonium sulphate thus formed, released ammonia which was collected in 2% boric acid solution and titrated against standard HCl. The total protein was calculated multiplying the amount of evaluated nitrogen by 6.25.

2.3.5. Crude fat

Dissolve 30 g in 100 ml of water, transfer to a separating funnel, acidify with 1m sulphuric acid and extract with successive quantities of 50, 40, 30 ml of ether. Mix the ether solutions in a separating funnel and wash with water until the washings are free from mineral acid. Transfer the ether solution to a tared flask, remove the ether and dry the residue of fatty acids to constant weight at 80 degree.

2.3.6. Total carbohydrate

Total carbohydrate was calculated by difference method. Percentage carbohydrate was given by: 100 – (percentage of ash +

percentage of moisture + percentage of fat + percentage of protein).

2.3.7. Crude fiber

The content of crude fibre was determined by enzymatic gravimetric method. In brief, aliquots of samples were first treated with amylase for 30 min at 60^{o} c to remove starch and then protease to solubilize protein. The enzymes treated mixture containing the buffer solution and non- digestible material was precipitated with four volumes of absolute ethanol. Then the ethanol insoluble residue was filtered with a fibre-tec system. The residue recovered was wash oven-dried and weighed to a give the gravimetric yield of the sample.

3. RESULTS AND DISCUSSION

Traditional knowledge of medicine now been used to cure various human aliments. Though the Traditional Medicine has long history it needs scientific documentation particularly in the light of modern scientific world. The present study made such an attempt to document nutritional value of some edible greens. In Ayurveda system of medicine, Greens which are generally considered as poor man's vegetable now gained lot of attention because of its properties of antioxidant, and anti- obesity. Green leafy vegetables are rich in mineral and helps in the nutrition fulfillment of our body (Regupathi and Chitra, 2014).

3.1. Mineral and Vitamin profile

Plants form the important source of minerals to human diet especially greens, which are rich in minerals and are used to cure mineral deficiency related ailments. Hence profiling of minerals and their quantity in plants is very much needed. This study investigated the mineral composition of edible greens in which elements like potassium, calcium, iron, magnesium, phosphorus were analyzed (Table 1). Calcium which is one the major element helps in strengthening of skeleton system and in promoting muscular contraction is present in higher amount than other macro minerals). Calcium is also the major constituent of bone and helps in teeth development (Brody, 1994). Among the five medicinal greens, calcium content is significantly higher in the greens when compared to other minerals. This is higher in *S. procumbens* (38.20±1.45 mg/100g) when compared to other samples followed by *M. maderaspatana* (37.40±1.00 mg/100g). Indrayan *et al.* (2005) reported that Ca is vital for the functioning of cardiac muscles, blood coagulation and milk clotting and also helps in the regulation of cell permeability. They also play a significant role in nerve-impulse transmission and in the mechanism of neuromuscular system. In the present study, *S. grandiflora* (18.40±2.67 mg/100g) shows highest amount of potassium followed by *E. prostata* (15.78±0.92 mg/100g) and *M. maderaspatana* (15.64±1.04 mg/100g). Association of potassium and calcium are helps in stimulating action on nerve endings, and also to improve heart contractile rate (Jeremy *et al*., 2007). Akpanyung (2005) stated that potassium involved in the regulation of plasma volume, acid-base balance, and muscle contraction.

Table 1 Mineral analysis of the leaves of edible greens - Macronutrients

Botanical Name	Calcium mg/100g	Iron mg/100g	Potassium mg/100g	Magnesium mg/100g	Phosphorus mg/100g
Centella asiatica	34.50±1.02	2.56±0.03	10.93±1.09	12.83±0.11	10.21±1.00
Eclipta prostata	25.70±0.98	2.89±0.35	15.78±0.92	10.56±1.45	14.56±1.57
Mukia maderaspatana	37.40±1.00	2.78±0.08	15.64±1.04	11.31±1.01	8.94±0.05
Sesbania grandiflora	21.30±0.07	1.98±0.12	18.4±2.67	11.30±0.86	10.11±0.29
Solanum procumbens	38.20±1.45	2.78±0.23	14.56±0.35	23.50±0.92	12.11±0.92

Values are represented as mean ± standard deviation (n=3).

Magnesium is another essential cofactor in many enzymatic reactions and it is required in many enzyme-catalysed reactions (Akpanabiater *et al*., 1998). In the present study, magnesium which is the second most abundant mineral and helps the activation of many enzymes in plants is higher in *S. procumbens* (23.50±0.92 mg/100g) whereas other greens show a lesser percentage. Chaturvedi *et al*. (2004) state that it helps to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders.

Phosphorus is an important constituent of nucleic acids and cell membranes, and is directly involved in all energy-producing cellular reactions (Knochel *et al*., 2006). In our study, *E. prostata* showed the highest phosphorus content of 14.56±1.57 mg/100g. Der-Jiuu *et al*. (2012) reported that iron deficiency is a common nutritional problem affecting many people worldwide. Iron is highly required physiologically for the formation and to enhance oxygen carrying capacity of red blood cells. The result of iron content is 2.89±0.35 mg/100g in *E. prostata* which is higher than the other greens. The iron contents of the studied greens were higher than recommended dietary allowance for males (1.37 mg/day) and females (2.94 mg/day) (FAO/WHO, 1988). According to Geissler and Powers (2005), iron involved in numerous biochemical roles in the body, including oxygen blinding in hemoglobin and acting as an important catalytic center in many enzymes as the cytochrome oxydase.

Zn is a component of many metalloenzymes, including some enzymes which play a central role in nucleic acid metabolism (Atukorala and Waidyanatha, 1987). Zn is also a membrane stabilizer of the immune system. Its deficiency leads to impaired growth and malnutrition (Prasad, 1981). Ma and Netts (2000) found that excessive ratio of zinc to copper (>16) from dietary sources causes an imbalance in their bioavailability and has been linked to increased risk of cardiovascular system disorders. Whereas, zinc and copper are required only in lesser amounts for the plant metabolism. These two elements are very essential in early development stage of sampling and for younger leaves to grow healthier without disease.

In the present study, as depicted in table 2, zinc content was maximum than copper in all the tested greens. *S. grandiflora* showed maximum zinc content of 15.40±0.91 mg/100g followed by *C. asiatica* (14.89±0.98 mg/100g), *M. maderaspatana* (12.89±0.10 mg/100g) and *E. prostata* (12.86±0.26 mg/100g) and finally *S. procumbens* (10.22±0.21 mg/100g). Quantity of Minerals varies in same medicinal plant growing in different region due to differences in botanical structure and composition of minerals in soil on which they grows. Mineral composition will be different in cultivated plants grown with fertilizer than its natural habitat due to its preference in absorption. Rekha Sinha (2018) analysed the minerals and heavy metals in some of the medicinal plants from local market in Salem and the results of mineral composition is comparatively similar to our results tabulated in Table 2.

Table 2 Mineral analysis of the leaves of edible greens – Micronutrients

Botanical Name	Zinc mg/100g	Copper mg/100g
Centella asiatica	14.89±0.98	0.98±0.05
Eclipta prostata	12.86±0.26	1.56±0.17
Mukia maderaspatana	12.89±0.10	0.56±0.00
Sesbania grandiflora	15.40±0.91	2.05±0.56
Solanum procumbens	10.22±0.21	1.34±0.23

Values are represented as mean ± standard deviation (n=3).

Zinc is a vital requisite in the synthesis of protein, in the development of normal body and recovery from illnesses. It is a co-factor in the function of the enzyme carbonic anhydrase required for carbon dioxide transport and as part of peptidases needed for protein digestion (Muhammad *et al*., 2011). Cu is also a component of many enzyme systems such as cytochrome oxidase, lysyl oxidase and

ceruloplasmin, an iron-oxidizing enzyme in blood (Saupi et al, 2009). The observation of anaemia in Cu deficiency may probably be related to its role in facilitating iron absorption and in the incorporation of iron into haemoglobin.

Vitamin-C is also known as ascorbic acid it is water-soluble and is readily oxidized due to its antioxidant properties (FAO, 2004). Apart from its facility to scavenge free radicals, vitamin C can renew other antioxidants such as tocopheroxyl from their radicals. (Halliwell and Gutteridge, 1999). In the present study, the ascorbic acid content was estimated as shown in the Figure 1. The result states that *M. maderaspatana* show higher amount of vitamin C (45.03±0.97 mg/100g) when compared to other greens. Vitamin-C analysis on the both fresh and dry vegetables are carried out in which the fresh one possess high content of vitamin-C when compared to dry vegetables (Arasaretnam *et al.*, 2017). It is evident from the study that edible greens are enriched with particular minerals.

3.2. Proximate Analysis

Proximate analysis was carried out for the estimation of carbohydrates, crude protein, crude fat, crude fibre, moisture and total ash content for the selected edible greens (Table 3)

The leaves of these edible greens contain maximum amount of crude protein. It is found abundant in these five medicinal greens accompanying carbohydrate as second maximum. Carbohydrate is found higher in *S.grandiflora* (42.12±0.83%) followed by *M. maderaspatana* (32.04±0.84%).

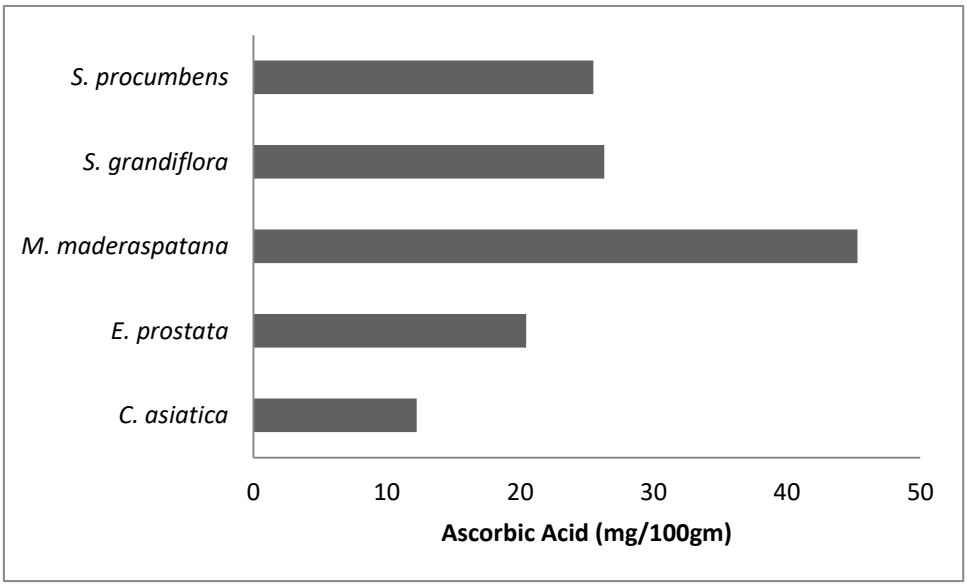

Figure 1. Estimation of ascorbic acid in the leaves of edible greens

Table 3 Proximate analysis of leaves of edible greens

Botanical Name	Total Ash (%)	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Total Carbohydrate (%)	Crude Fibre (%)	Energy value (K.Cal.)
Centella asiatica	13.80±0.49	9.54±0.46	68.49±1.82	4.34±0.67	11.33±0.81	5.89±0.87	357.44±0.84
Eclipta prostata	15.99±0.54	8.95±0.81	42.73±0.91	4.13±0.21	28.20±0.97	4.87±0.73	320.89±1.68
Mukia maderaspatana	19.93±0.84	9.29±0.47	37.78±0.86	0.96±0.07	32.04±0.84	5.05±0.24	287.92±0.83
Sesbania grandiflora	8.98±0.47	8.91±0.81	34.84±0.79	5.15±0.91	42.12±0.83	4.78±0.82	354.27±1.25
Solanum procumbens	13.49±0.77	13.26±0.46	52.59±0.29	1.33±0.12	9.33±0.46	4.56±0.28	300.05±0.65

Values are represented as mean ± standard deviation (n=3).

The highest carbohydrate contents were reported for *Senna obtusfolia*, *Amaranthus incurvatus* and *Momordica balsamina* leaves (Hassan and Umar, 2006). In the present study, crude Protein content is higher in *C. asiatica (*68.49 g ±1.82%*)* than others.The proteins content have been reported for some high value leafy vegetables such as *Momordica balsamina* and *Moringa oleifera* (Asaolu *et al*., 2012). Ali (2009) reported that the plant foods which provide more than 12 % of their calorific value from proteins have been shown to be good source of proteins. This suggests that all the leafy vegetables investigated are good sources of proteins and could play a significant role in providing cheap and available proteins for rural communities. Uusiku et al. (2010) reported that protein content of *P. pellucida* is analogous to that of other leafy green vegetables, where the protein content ranged from 1 to 7% of fresh weight or 8 to 30% of dry weight basis.

In the present study, in *S. grandiflora* (5.15g±0.91%) crude fat (lipid) is found which is comparatively higher than the other greens investigated. The findings of many authors showed that leafy vegetables are poor sources of lipids (Ejoh *et al*., 1996). However, it is essential to our regular diet providing 1 – 2 % of its caloric energy as fat is said to be sufficient to human beings, as excess fat consumption yields to cardiovascular disorders such as atherosclerosis, cancer and aging (Kris-Etherton *et al*., 2002). In our finding, crude fibre is found to be abundant in *C. asiatica* (5.89 g±0.87%) than other greens analysed. The highest content of crude fibres in these greens would be advantageous for their active role in the regulation of intestinal transit and also increases dietary bulk due to their capacity to take up water (Jenkin *et al*., 1986). However, the results of the nutritional analysis done on few selected wild edible leafy vegetables, it is reported that *S. grandiflora* shows comparatively higher amount of protein compared to other selected greens (Rekha Sinha, 2018).

The total ash content is generally recognized as a measure of quality for the assessment of the functional properties of foods (Hofman *et al*., 2002). In the present study, ash value, moisture content and energy value of the selected edible greens were analysed and the results are shown in Table 3. The result showed that, moisture content is found higher in *S. procumbens* (13.26±0.46%) than *C. asiatica*. The highest moisture content of the selected leafy greens revealed that they need proper preservation process because they liable to deterioration and our result were correlated with the work of Kwenin (2011). In another study, Iheanacho and Udebuani (2009) reported that the high moisture content of leafy vegetable may greatly induce the activity of water soluble enzymes and co-enzymes involved in metabolic activities. In terms of natural product firmness, high moisture tends to encourage microbial contamination and chemical degradation as it provides a platform for various reactions to occur (Hussain *et al.*, 2009). Ash content is higher in *M. maderaspatana* (19.93±0.84%) when compared to other greens. These values indicate that these green species may be considered as good sources of minerals when compared to the cereals and tubers (FAO, 1986).

In our study, energy or calorific value (Table 3) is found higher in *C. asiatica* (357.44±0.84 K. Cal.). This value is most comparable to the energy value in some Ghanaian green leafy vegetables reported by Asibey-Berko and Tayie (1999). Lintas, 1992 found that the enerygy value contract with general examination that vegetables have little energy values. The proximate analysis shows that greens possess major biochemical and they are rich in proteins when compared to carbohydrates and fibre and less amount of fat (lipids). Results of mineral and physico-chemical analysis show that greens contain a higher amount of nutrition and energy value to fulfill the requirement for the metabolism of the human body.

4. CONCLUSION

As a conclusion, the present study documented comparative nutritional data of selected edible

greens. Among different greens evaluated, *Centella asiatica* is a potential leafy vegetable with high nutritional value. New biotechnological methods are required for large-scale cultivation, harvesting and preservation of these greens so that they are not only used for consumption but also to include them in value-added products.

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