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RESEARCH ARTICLE

Nutritional and mineral composition of selected green leafy vegetables

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Abstract: Green Leafy Vegetables (GLV) is essential for healthy life. The analysis of nutritional composition and some essential major elements such as calcium, magnesium, potassium and sodium of the leaves of *Cardiospermum halicacabum, Premna latifolia, Delonix elata, Argyreia pomacea, Mollugo pentaphylla* and *Pisonia grandis* were carried out using standard methods. The results ranged as follows; moisture (62.86 ±2.55 - 77.80 ±3.27%), ash (7.33 ± 0.38 - 12.49 ±0.22 %), fat (2.18 ±0.09 - 4.75 ±0.22 %), fiber (7.88 ±0.61 - 15.30 ±0.59 %), protein (0.53 ±0.04 -3.52 ±0.06 %) and carbohydrate (0.89 ±0.09 - 5.65 ±0.11%). Vitamin C content was determined using a well-established 2, 4-dinitrophenyl hydrazine method (DNPH). Vitamin C content of GLVs ranged from 134.50 ±2.61 mg/100g for *D. elata* to 12.43 ±3.44 mg/100g for *A. pomacea.* Total phenolic content was in the range of 4.28 ±1.2mg GAE/100g for *M. pentaphylla* and 46.07 ±3.42 mg GAE/100g for *D. elata*. The mineral elements were ranged as follows: Sodium (116.4 ±3.8 - 190.2 ±2.6 mg/100g), potassium (94.5 ±2.9 - 127.3 ±2.4 mg/100g), calcium (84.9 ±2.2 - 272.6 ±2.8mg/100g) and magnesium (28.3 ±2.5 - 103.6 ±4.2 mg/100g). The results suggest that the green leafy vegetables contain considerable amount of essential micronutrients in addition to the presence of high amounts of vitamin C. The results also indicate that the high intake of GLVs could provide nutritional requirements necessary for the normal growth thus giving adequate protection against diseases arising from malnutrition.

Keywords: Ascorbic acid, green leafy vegetables, mineral composition, nutrient composition.

INTRODUCTION

Green Leafy Vegetables (GLV) play an important role in human nutrition. They are made up of cellulose, hemi-cellulose and pectin substances that give them their texture and firmness (Mohammed and Sharif, 2011). They provide adequate amount of dietary fibers, minerals, vitamins and other nutrients to people in developing countries. Apart from the variety which they add to the menu (Asaolu *et al*., 2012), they are valuable sources of nutrients especially in rural areas where they contributes substantially to minerals, vitamins, fibers, proteins and other nutrients which are usually in short supply in daily diets. They are very important protective foods and useful for the maintenance of health and for prevention of various diseases (Mohammed and Sharif, 2011). Leafy vegetables have low energy densities thus recommended for weight management (Nwanekezie and Obiakor, 2014). The availability of indigenous vegetables has declined drastically because of excessive cultivation of field crops. There is also growing ignorance among young people about the existence of these readily available nutritionally rich food plants (Odhav *et al*., 2006).

The supply of minerals is inadequate to meet the dietary requirements of rapidly growing human population in the world (Mohammed and Sharif, 2011). Minerals cannot be synthesized by humans and animals thus they must be provided through food and water (Mohammed and Sharif, 2011). Leafy vegetables contain numerous minerals such as Ca, Fe, Cu, P, Zn, Cl, and Na which are vital for growth and metabolism. The predominant elements found in green leafy vegetables are Ca, K, Fe and Na. These provide alkalizing effect to the acidity produced by other foods, especially those of animal origin (Angela *et al*., 2010). The recommendations for nutritional requirements for different growth stages of humans used by dieticians in Sri Lanka are actually come from studies done in India, Malaysia, Thailand and other regional countries. Except few studies on the mineral content in some leafy vegetables, mineral contents in green leafy vegetables grown in Sri Lanka have not been reported (Sukumal, 2007).

Vitamins are important for human health and among the vitamins, vitamin C is an essential micronutrient required for normal metabolic functions of the body. Vitamin C plays an important role as a component of enzymes involved in the synthesis of collagens and carnitine. Vitamin C is the major water-soluble antioxidant in the human body. Not only does a vitamin C intake markedly reduce the severity of a cold, it also effectively prevents secondary viral or bacterial complications (Rahman et al., 2006). Numerous studies have shown that an adequate intake of vitamin C is effective in lowering the risk of developing cancers in breast, cervix, colon, rectum, lung, mouth, prostate and stomach. For maintaining a good health and to prevent from colds, some scientists are of the view that the human body should be kept saturated with vitamin C (Rahman, 2006; Levine, 1995).

There are about 8,000 naturally occurring plant phenolics, of which half of them represent flavonoids

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(Harborne and Herbert, 1993). Phenolics possess a wide spectrum of biochemical activities such as antioxidant, anti mutagenic, anti carcinogenic as well as the ability to modify the gene expression (Marinova *et al*., 2005). Phenolics are the largest group of phytochemicals that account for most of the antioxidant activity in plants or plant products (Sulaiman, 2013). Many studies have revealed a direct relationship between antioxidant activity and phenolic content of plant extracts (Liu *et al*., 2008).

The green leafy vegetable, *Cardiospermum halicacabum* is pubertal or almost glabrous, yearly or perpetually having slim twigs that climb by tendrillar hooks. It acts as a diaphoretic, diuretic, emetic, laxative, refrigerant, stomachic, sudorific, antibacterial and exhibits anticancer effect (Sheeba and Asha, 2009). *Premna latifolia* is an important medicinal plant, widely distributed in tropical and subtropical regions in Asia, Africa, Australia, and the Pacific Islands. They have been found to display a wide spectrum of pharmacological effects involving anticancer, antibacterial, antifungal, and anti-leishmania activities (Suresh and Babu, 2011). *Delonix elata* is a deciduous tree and sparsely distributed in the dry forests. The plant is also for problems like pain and stiffness of the joints, especially the knees. Leaves are used for the treatment of bronchitis in infants, fever, malaria, flatulence, and paralysis or as carminative (Pavithra *et al*., 2010). *Argyreia pomacea* has many bioactivities such as antiulcer, antitumour, antidiabetic, hypoglycemic, hypotensive, spasmolytic, antifilarial, antimicrobial and primary central nervous system depressant (Srivastava *et al*., 1998). *Mollugo pentaphylla* is locally abundant as a minor weed in cultivated areas, including rice fields and open grasslands, but also in sandy or stony localities, at low and medium altitudes. The plant is antipyretic, antiseptic, appetizer, emmenagogue, laxative and stomachic (Sahu *et al*., 2011). *Pisonia grandis* is an evergreen glaborous garden tree with young shoots which are minutely puberulous. It is used in traditional medicine as an anti-diabetic and anti-inflammatory agent (Elumalai *et al*., 2012).

Batticaloa is a district in Eastern region of Sri Lanka, where a number of GLVs are grown, and their occurrence has not been reported. Therefore this study was carried out to evaluate the constituents of six different varieties of the green leafy vegetables. Nutritional composition, vitamin C, Total phenolic content and mineral composition were carried out to determine the nutrient content of the selected green leafy vegetables found in the Batticaloa district.

MATERIALS AND METHODS

Sample Collection

Samples of healthy, diseases free, commonly consumed six different Green Leafy vegetables (GLV) were collected from farmers field and home gardens from three different locations in the Batticaloa district. Nine samples were collected from each leafy vegetable. Edible parts of the plants were separated and washed thoroughly under running tap water and then were rinsed in the distilled water. Randomly selected green leafy vegetables were shade dried without any contamination for 1 week until completely dried. The dried samples were powdered in a blender (Model: GK 240, UK) and were stored in dark colored glass airtight containers for future use. Randomly selected samples of fresh green leafy vegetables were used for the analysis of Vitamin C and Total phenolic Content (TPC).

The details of the tested Green leafy vegetables in respect of their local names are elaborated in Table 1.

Assessment of Nutritional Composition

Standard methods (AOAC, 2012) were used to quantify the nutritional composition of the Green leafy vegetables. For the determination of moisture content, ten fresh, mature 4th and 5th leaves from the samples were weighed in Petri dishes and dried in an oven (Model-SAP 2200, Gallenkamp, UK) at 105°C until constant weight was obtained. The loss in weight was expressed as percentage moisture content. Ash content was determined by the incineration of a 2g sample in a muffle furnace at 500°C for 6 hrs until the ash turned white. Fat content was determined by petroleum ether (Boiling point 60-80°C) extraction in a Soxhlet apparatus. The fiber content was determined by acid- base digestion using 1.25% H_2SO_4 (v/v) and 1.25% NaOH (w/v) solutions.

Table 1: Basic details of Green Leafy Vegetables used in the study.

Green Leafy Vegetables	Family	Common Name	Local Name (T-Tamil, S-Sinhala)
Cardiospermum halicacabum	Sapindaceae	Balloon plant	Mudakothan (T) Penela-wel (S)
Premna latifolia	Lamiaceae		Pasu mullai (T) Maha midi (S)
Delonix elata	Fabaceae	Yellow Gul-Mohur	Vatham-Nairaini (T)
Argyreia pomacea	Convolvulaceae		Manpanchan (T)
Mollugo pentaphylla	Molluginaceae	Itch flower	Thirai (T) Hinipala (S)
Pisonia grandis	Nyctaginaceae	Cabbage tree	Ledchakaddai (T) Wathabanga (S)

The protein content was estimated by the Kjeldahl method. Total protein was calculated by multiplying the evaluated nitrogen by a factor of 6.25. Soluble carbohydrates (g/100 g) were estimated using a difference method (Greenfield and Southgate, 2003) by subtracting the sum of the per cent of protein, moisture, fat and ash from 100. All the analysis was carried out in triplicates for all the six Green leafy vegetables collected from nine different locations.

Estimation of Vitamin C content

To determine content of Vitamin C in leafy vegetables, a well-established 2, 4-dinitrophenyl hydrazine method (DNPH) (Rahman *et al*., 2006) was used. This is a simplified method for the simultaneous determination of total vitamin C employed coupling reaction of 2, 4-dinitrophenyl hydrazine dye with vitamin C and followed by spectrometric determination (Rahman *et al*., 2006). 5% Metaphosphoric acid + 10% acetic acid: Fifteen grams of solid metaphosphoric acid were dissolved in mixture of 40 mL of glacial acetic acid (BDH) and 450mL of distilled water in a 500 mL volumetric flask. The solution was filtered and stored in a dark bottle. 10% Thiourea solution: 2,4-Dinitrophenyl-hydrazine solution, 85% Sulphuric acid were prepared. Standard Vitamin C solution: 0.05g standard crystalline ascorbic acid was dissolved in 100 mL of distilled water to prepare 500 ppm standard solution.

Green leafy vegetables of 10g was blended and homogenized with 50 mL of 5% metaphosphoric acid-10% acetic acid solution. It was transferred into a 100 mL volumetric flask and was shaken gently until a homogeneous dispersion was obtained. The solution was diluted up to the mark by the 5% metaphosphoric acid-10% acetic acid solution. Then the solution was filtered and the clear filtrate was collected for the determination of vitamin C in that sample.

To the filtered sample solution a few drops of bromine water were added until the solution became colored (to confirm the completion of the oxidation of ascorbic acid to dehydroascorbic acid). Then a few drops of thiourea were added to it to remove the excess bromine and thus a clear solution was obtained. Then 2, 4-dinitrophenyl hydrazine solution was added thoroughly with all standards and also with the oxidized ascorbic acid. Total vitamin C employing coupling reaction of 2,4-dinitrophenyl hydrazine dye with vitamin C and followed by spectrophotometric determination. All were done for nine samples. All chemicals used in the analysis were in Analytical Reagent Grade, purchased from Sigma Chemicals, UK.

Estimation of Total Phenolic Content (TPC)

The Total phenolic content was estimated spectrophotometrically using the recommended method (Mathiventhan and Sivakaneshan, 2013). GLVs (2g), in 30 ml of methanol were ground using a mortar and pestle. It was made up to 50 ml with methanol, mixed thoroughly and centrifuged to obtain a clear supernatant. All analysis was carried out in triplicates. A sample of methanolic extract (0.2 ml) was mixed with 1 ml of *Folin-Ciocalteau* reagent (tenfold diluted) followed by the addition of 0.8 ml of 2% Na_2CO_3. The volume was made to 10 ml with 4:6 water/ methanol. This was allowed to stand for 30 minutes and absorbance read at 754 nm in a spectrophotometer. Concentration was calculated using Gallic acid as standard and the results were expressed as mg gallic acid equivalent/100 g wet weight.

Gallic acid, in varying concentrations (0, 50, 100, 150, 250 and 500 mg/l), were used to prepare a standard curve. This curve was used to relate the absorbance of the unknown samples to Gallic acid equivalents (GAE).

Determination of Mineral Content

A sample (3 g) was weighed into a crucible was subjected to ashing in furnace for 6 hour at 500°C. After cooling in desiccator, 2.5 mL of 6N HNO_3 was added to the crucible and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5.0 ml of de ionized water was added and heated until a colorless solution was obtained. The mineral solution in each crucible was transferred into a 100.0 ml volumetric flask by filtration through filter paper and the volume was made to the mark with de ionized water. The extract was prepared in triplicates.

The samples were analyzed for Ca, Mg, Na, K, and Fe. Mg, Na, K and Fe were determined using Atomic Absorption Spectrophotometer (GBC, *SensAA*, Dual, USA). Ca was determined by Ethylene diamine tetra-acetic acid (EDTA) titration. Total hardness was determined by EDTA titration and then the Ca concentration was determined by subtracting the concentration of Mg from total hardness.

RESULTS AND DISCUSSION

Nutritional Composition of the Green Leafy Vegetables

Nutritional analysis of GLVs except moisture was carried out on dry basis and has been given in the Table 2. The moisture content of green leafy vegetables was found to be highest for *C. halicacabum* (77.80%), while *D. elata* showed the lowest value of 62.86%. *P. latifolia*, *M. pentaphylla*, *A. pomacea* and *P. grandis* has the moisture content of 69.38%, 73.99%, 73.20% and 71.43% respectively. The high moisture content may induce a greater activity of water soluble enzymes and co-enzymes involved in metabolic activities of these leafy vegetables (Iheanacho and Ubebani, 2009).

The ash content is generally recognized as a measure of quality for the assessment of the functional properties of foods (Hofman *et al*., 2002). Here ash value turned out to be higher in *M. pentaphylla* (12.49%) and lower in *C. halicacabum* (7.33%). This indicates *M. pentaphylla* could be good sources of mineral elements. The earlier findings showed that *C. halicacabum* have ash content of 7.3±0.08 (Ashish *et al*., 2013), which is very close to this study. However, *P. grandis* was reported to have 5.04% (Jayakumar *et al*., 2011) which is little lower than our findings. Commonly consumed leafy vegetables like Amaranthus viridis and Alternanthera sessilis have ash content of 1.85% and 1.5%, respectively. This indicates

Table 2: Nutritional Composition of selected commonly consumed Green Leafy Vegetables.

Species name	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)	Carbohydrate (%)
P. latifolia	69.38±4.27	9.12±0.14	3.38±0.23	15.30±0.59	1.35±0.07	1.47±0.08
C. halicacabum	77.80±3.27	7.33±0.38	4.75±0.22	7.88±0.22	1.17±0.07	1.07±0.03
M. pentaphylla	73.99±2.06	12.49±0.22	2.18±0.09	9.29±0.75	0.53±0.04	1.52±0.06
D. elata	62.86±2.55	10.30±0.13	4.48±0.45	13.19±0.60	3.52±0.06	5.65±0.11
A. pomacea	73.20±1.10	11.86±0.26	3.88±0.26	9.17±0.72	1.00±0.05	0.89±0.09
P. grandis	71.43±0.92	9.37±0.28	4.09±0.32	10.87±0.23	1.67±0.04	2.57±0.06

Each value represents the mean ± SD of three determinations on dry weight (DW) basis.

that the studied leaves have high mineral content compared to the previous findings of leafy vegetables (Nisha *et al*., 2012; Gotruvalli *et al*., 2016).

All the tested Green leafy vegetables have almost same amount fat content which ranges between 2.18±0.09% for M. pentaphylla and 4.75±0.22% for *C. halicacabum*. This is in agreement with the general observation that the leafy vegetables contain low fat and plays a significant role in avoiding obesity (Nisha *et al*., 2012).

The dietary fiber content of green leafy vegetables is found to be the highest in *P. latifolia* (15.30%) and lowest in *C. halicacabum* (7.88%). All studied leafy vegetables have a moderate dietary fiber content and these values are comparatively much higher than the leafy vegetables *Amaranthus viridis* (1.93 %) (Nisha *et al*., 2012) and *Alternanthera sessilis* (3.4±0.7%) (Gotruvalli *et al*., 2016). The higher amounts of dietary fiber contribute significantly to nutrient intakes since fiber lowers the body cholesterol level, thus decreasing the risk of cardiovascular diseases (Hanif *et al*., 2006).

The protein content is within the range of 0.53±0.04 and 3.52±0.06. The results are close to the reported leafy vegetables *Amaranthus viridis* (Nisha *et al*., 2012) and *Alternanthera sessilis* (Gotruvalli *et al*., 2016) which contain 2.11% and 4.5%, respectively. However, the protein content is very much lower than some other leafy vegetables *Moringa oliefera* (20.72%) and *Momordica balsamina* (11.29 %) (Asaolu *et al*., 2012). This suggests that the tested leafy vegetables are poor source of protein.

The soluble carbohydrate content is the highest in *D. elata* (5.65±0.11) and lowest in *A. pomacea* (0.89±0.09). One of the main functions of the soluble carbohydrate in the body is for energy supply and is observed that leafy vegetables may not be an important source of carbohydrates due to their consumption along with other carbohydrate rich food such as cereals. The values are lower than that of commonly eaten *Amaranthus viridis* (Nisha *et al*., 2012) and *Alternanthera sessilis* (Gotruvalli *et al*., 2016), which makes the studied GLVs more valuable to add in main diet.

Vitamin C Content of Green Leafy Vegetables

L-dehydro**ascorbic** acid reacts with 2, 4-dinitrophenylhydrazine and produces an osazone which on treatment with 85 % H_2SO_4 forms red colored solution (Rahman, 2006). The λ_{max} of the colored complex was found to be 523 nm, the absorbance of the all standards were taken to construct a calibration curve. Using the calibration curve the vitamin C content of Leafy vegetables was determined (Table: 3).

The Vitamin C content of 16 common leafy vegetables was found to be between 5.25mg/110g (*Centella asiatica*) to 416.2 mg/100 g for *Drega volubilis* on wet weight basis (W/W) (Mathiventhan and Sivakaneshan, 2015). The Vitamin C content of studied vegetables is also within this range. In the earlier investigation the vitamin C content was found to be 85.17±11.07 in *Cardiospermum helicacabum*, 183.17±13.43 in *Delonix elata* and 17.50±3.71 in *Pisonia grandis* (Mathiventhan and Sivakaneshan, 2015), which shows similar results with *C. halicacabum* but higher in *Delonix elata* and *Pisonia grandis*. This may be due to different procedures used.

Other commonly consumed leafy vegetables such as *Alternanthera sessilis, Amaranthus viridis, Sesbania grandiflora* have the vitamin C content of 36.17±3.42, 35.58±4.37 and 134.75±14.07mg/100g respectively (Mathiventhan and Sivakaneshan, 2015), which shows that rarely consumed leafy vegetables like *C. halicacabum* and *D. elata* have higher vitamin C content than commonly eaten GLVs. As vitamin C has been demonstrated to be an effective antioxidant (Bendich *et al*.., 2007), the results indicate that *D. elata* has high Antioxidant Activity. The Vitamin C content of studied leafy vegetables was found between 134.50±2.61 mg/100g for *D. elata* and 12.43±3.44 mg/100g for *A. pomacea.*

Total Phenolic Content (TPC)

Total phenolic content of fresh GLVs ranged from 4.28±1.2mg GAE/100g for *M. pentaphylla* to 46.07±3.42mg GAE/100g for *D. elata* as indicated in the Table: 3. In an earlier investigation, the levels of TPC of *C. halicacabum, D. elata, A. pomacea and P. grandis* were found to be 206.4±29.4, 560.1±51.8, 74.7±31.1 and 125.2±76.5 respectively (Mathiventhan and Sivakaneshan, 2013). However the earlier investigation was done using Tannic acid as standard, but here Gallic acid is used as standard. Phenolic compounds are the major antioxidant constituents in selected herbs, vegetables and fruits and there are direct relationships between their antioxidant activity and TPC (Mathiventhan and Sivakaneshan, 2013).

Table 3: Vitamin C and Total Phenolic Content (TPC) of the tested GLVs.

Green Leafy Vegetables (GLVs)	Vitamin C (mg/100g)	TPC (mg GAE/100g)
P. latifolia	36.68±2.15	13.93±1.82
C. halicacabum	86.12±1.96	19.67±2.1
M. pentaphylla	58.00±3.12	4.28±1.2
D. elata	134.50±2.61	46.07±3.42
A. pomacea	12.43±3.44	11.73±1.12
P. grandis	30.62±2.87	16.3±0.96

Each value represents the mean ± SD of three determinations on wet weight (WW) basis.

Table 4: Mineral (mg/100g) composition of selected Green Leafy Vegetables.

Green Leafy Vegetables	Na	K	Ca	Mg
P. latifolia	130.6±3.5	127.3±2.4	110.5±3.1	30.6±2.3
C. halicacabum	190.2±2.6	116.8±4.7	106.5±4.3	74.3±3.6
M. pentaphylla	116.4±3.8	94.5±2.9	84.9±5.2	28.3±2.5
D. elata	186.7±4.2	114.9±4.4	90.7±2.1	35.7±2.1
A. pomacea	126.8±2.9	126.8±6.1	137.8±3.7	103.6±4.2
P. grandis	182.9±5.3	100.6±2.3	272.6±2.8	34.2±2.7

Each value represents the mean ± SD of three determinations on dry weight (DW) basis.

This indicated that *D. elata* has high antioxidant activity that is good for the heart health and help to lower the risk of infections and cancer.

Mineral Content

Mean values for mineral content of the selected leafy vegetables are presented in Table 4. Sodium and potassium are important intracellular and extracellular cations respectively, which are involved in the regulation of plasma volume, acid-base balance, nerve and muscle contraction. Sodium content was within 190.2 and 116.4 mg/100g range, which is remarkably lower than 246.7±3.5mg/100g reported for the leaves of *Alternanthera sessilis* (Gotruvalli *et al*., 2016**)**. However*, Amaranthus viridis* has 108mg/100g (Nisha *et al*., 2012). Potassium concentration in the samples analyzed ranged from 127.3mg/100g to 94.5mg/100g which is much lower than for *Amaranthus viridis* and *Alternanthera sessilis* having value of 3460mg/100g and 412.2mg/100g respectively (Nisha *et al*., 2012; Gotruvalli *et al*., 2016**).**

According to our findings, the sodium to potassium ratio of less than one has been recommended for the prevention of high blood pressure (Vanessa and Ellen, 2014). Thus *C. halicacabum, D. elata* and *P. grandis* could serve to reduce high blood pressure and related diseases in the human body. Calcium functions as a constituent of bones and teeth, regulation of nerve and muscle function. Calcium content was found to be high in *P. grandis* (272.6mg/100g) and low in *M. pentaphylla* (84.9mg/100g). Magnesium is a mineral, known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders. Mg content was found to be in the range of 103.6mg/100g and 28.3mg/100g.

CONCLUSIONS

The present study has shown that the leafy vegetables have high content of moisture. All leafy vegetables showed moderate ash content, and the high ash content of *M. pentaphylla* makes it a good source of minerals. The low fat content of all GLVs is in agreement with the general observation that leafy vegetables are low in lipids. All GLVs have moderate fiber content, however *P. latifolia* have fiber content much higher than commonly consumed leafy vegetables. All the investigated GLVs are poor sources of protein and soluble carbohydrates. Vitamin C content of fresh GLVs ranged from 134.50±2.61 mg/100g for *D. elata* and 12.43±3.44 mg/100g for *A. pomacea.* The high content of vitamin C in *D. elata* assures it to have high antioxidant activity. TPC of fresh GLVs ranged from 4.28±1.2mg GAE/100g WW for *M. pentaphylla* to 46.07±3.42mg GAE/100g WW for *D. elata*. High Sodium content is found in *C. halicacabum. P. latifolia* has high potassium content. *P. grandis* is found to be a good source of Calcium and Magnesium is high in *A. pomacea.* The results suggest that the vegetables if consumed in sufficient amount would contribute greatly towards meeting the nutritional requirement for normal growth and also could provide adequate protection against diseases arising from malnutrition.

REFERENCES

Angela, C., Rodica, C., Andrea, M.Z., Elena, T. and Camelia, G. (2010). Chemical Composition of Common Leafy Vegetables. University studies, *Series of Life Sciences* **20**(2): 45-48.

AOAC (2012). Official Methods of Analysis, 15th ed. Association of Official Analytical Chemists, Washington, DC.

Asaolu, S.S., Adefemi, O.S., Oyakilome, I.G., Ajibulu, K. E. and Asaolu, M. F. (2012). Proximate and Mineral Composition of Nigerian Leafy Vegetables. *Journal of Food Research* **1**(3): 214-218.

Ashish S., Duraiswamy, B., Upendra, B. and Nidhi, S. (2013). Pharmacognostical evaluation of *Cardiospermum halicacabum* Linn. Leaf and stem, *Ancient Science of Life* **16**: 15-21.

Bendich, A., Machlin, L.J., Scandurra, O. (2007). The antioxidant role of vitamin C. A*dvances in Free Radical Biology and Medicine* **2**(2): 419-444.

Elumalai, A., Eswaraiah, M.C., and Rahman, H. (2012). *Pisonia grandis R. Br*-A medicinal plant: A review. *International Journal of Pharma and Bio Sciences* **3**(1): 76-80.

Greenfield, H. and Southgate, D.A.T. (2003). Food composition data production, Management and use. Second edition, Food and Agriculture Organization of the United Nations Rome, 111-119.

Gotruvalli, M.P., Chikkappaiah, L. and Shiddamallayya, N. (2016). Nutritional analysis of edible wild plants used by hakki pikki tribes of Hassan district, Karnataka, India, *International Journal of Pharma Sciences* **8**(8): 390-393.

Hanif, L., Prakash, D., and Pal, M. (2006). Nutritional and anti nutritional comparison of vegetable and grain *Amaranthus* leaves, *Journal of the Science of Food and Agriculture* **57**: 573-585.

Harborne, J.B. and Herbert, H. (1993). Phytochemical Dictionary, Taylor and Francis, UK.

Hofman, P.J., Vuthapanich, S., Whiley, A.W., Klieber, A. and Simons, D.H. (2002). Tree yield and fruit minerals concentrations influence Hass avocado fruit quality. *Scientia Horticulturae* **92**: 113-123.

Iheanacho, K. and Ubebani, A.C. (2009). Nutritional composition of some leafy vegetable consumed in Imo State, Nigeria. *Journal of Applied Science and Environment Management* **13**: 35-38.

Jayakumar, S., Malarkodi, V., Vijayalakshmi, A. and Arthanarieswaran, P. (2011). Pharmacological studies on the leaves of *Pisonia grandis* R. *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **2**(2): 193-199.

Levine, M. (1995). Determination of optimal vitamin C requirements in humans. *The American Journal of Clinical Nutrition* **62**: 1347-1356.

Liu, X., Zhao, M., Wang, J., Yang, B. and Jiang, Y. (2008). Antioxidant activity of methanolic extract of emblica fruit (*Phyllanthus emblica* L) from six regions in China, *Journal of Food Composition and Analysis* **21**: 219-228.

Marinova, D., Ribarova, F. and Atanassova, M. (2005). Total phenolics and total Flavonoids in Bulgarian fruits and vegetables, *Journal of the University of Chemical Technology and Metallurgy* **40** (3): 255-260.

Mathiventhan, U. and Sivakaneshan, R. (2013). Total Phenolic Content and Total Antioxidant Activity of Sixteen commonly consumed Green Leafy Vegetables stored under different conditions, *European International Journal of Science and Technology* **2**(8): 123-132.

Mathiventhan, U. and Sivakaneshan, R. (2015). Vitamin C content of commonly eaten green leafy vegetables in fresh and under different storage conditions. *Tropical Plant Research* **2**(3): 240-245.

Mohammed, M.I. and Sharif, N. (2011). Mineral Composition of Some Leafy Vegetables consumed in Kano, Nigeria, *Nigerian Journal of Basic and Applied Science* **19**(2): 208-212.

Nisha, S., Gupta, P.C. and Rao, C.V. (2012). Nutrient Content, Mineral Content and Antioxidant Activity of *Amaranthus viridis* and *Moringa oleifera* Leaves, *Research Journal of Medicinal Plants* **6**: 253-259.

Nwanekezie, E.C. and Obiakor-Okeke, P.N. (2014). Mineral Content of Five Tropical Leafy Vegetables and Effect of Holding Methods and Time. *American Journal of Experimental Agriculture* **4**(12): 1708-1717.

Odhav, B., Beekrum, S. and Baijnath, H. (2006). Preliminary assessment of nutritional value of traditional leafy vegetables in KwaZulu-Natal, South Africa. *Journal of Food Composition and Analysis* **20**: 430-435.

Pavithra, P.S., Janan,i V.S., Charumathi, K.H., Indumathy, R., Potala, S. and Verma, R. S. (2010). Antibacterial activity of plants used in Indian herbal medicine. International Journal of Green Pharmacy **4**(1): 22-28.

Rahman Khan, M.M., Rahman, M.M., Islam, M.S. and Begum, S. A. (2006). A Simple UV-spectrophotometric method for the determination of Vitamin C content in various fruits and vegetables at Sylhet Area in Bangaladesh, *Journal of Biological Sciences* **6**: 388-392.

Sahu, S.K., Das, D. and Tripathy, N.K. (2011). Anti-Inflammatory, Analgesic and Antipyretic Effects of *Mollugo Pentaphylla* L. *Rasayan Journal of Chemistry* **4**(3): 533-538.

Sheeba, M.S. and Asha, V.V. (2009). *Cardiospermum halicacabum* ethanol extract inhibits LPS induced COX-2, TNF-α and iNOS expression, which is mediated by NF-Ƙbregulation, in RAW 264.7 cells. *Journal of Ethnopharmacology* **124**: 39-44.

Srivastava, A., Shukla, Y.N., Jain, S.P. and Sushil, K. (1998). Chemistry and pharmacology of the elephant creeper *Argyreia speciosa*- A review, *Journal of Medicinal Aroma Plant Science* **20**(3): 774-778.

Sukumal, W. (2007). Minerals in Leafy Vegetables Consumed by Sri Lankans, *Proceedings of the Annual Research Symposium 2007*, Faculty of Graduate Studies, University of Kelaniya, 119 Pp.

Sulaiman, C.T., Sadashiva, C.T, Satheesh, G., Goplakrishnan, V. K. and Indira, B. (2013). Chromatographic Studies and in vitro Screening for

Acetyl Cholinesterase Inhibition and Antioxidant Activity of three Acacia Species from South India, *Analytical Chemistry Letters* **3**(2): 111-118.

Suresh, G. and Babu, K.S. (2011). Novel cytotoxic icetexane diterpenes from *Premna latifolia* Roxb. *Tetrahedron Letters* **52**: 1273-1276.

Vanessa, P and Ellen, T.C. (2014). Sodium-to-Potassium Ratio and Blood Pressure, Hypertension, and Related Factors, *Advances in Nutrition* **5**(6): 712-741.