ISSN 1996-3343

Asian Journal of Applied Sciences

http://knowledgiascientific.com

Knowledgia SCIENTIFIC
A Place to Publish Outstanding Research

Asian Journal of Applied Sciences 4 (3): 238-246, 2011
ISSN 1996-3343 / DOI: 10.3923/ajaps.2011.238.246

Determination of Nutritive Value, Mineral Contents and Antioxidant Activity of Some Wild Edible Plants from Meghalaya State, India

Tapan Seal
Botanical Survey of India, Acharya Jagadish Chandra Bose Indian Botanic Garden, Shibpur, Howrah, India

ABSTRACT

The study was carried out to analyze the nutritional composition, mineral contents and antioxidant activity of the leaves of *Clerodendron colebrookianum, Oenanthe linearis, Sonchus arvensis, Zanthoxylum acanthopodium,* roots of *Houttuynia cordata, Potentilla lineata* and seeds of *Castanopsis indica* collected from different market of Meghalaya state, India using standard method of food analysis. For different plant species the crude fat content ranged between 0.579±0.01-2.46±0.04% and crude fibre 0.59±0.03-6.30±0.45%. The crude protein content was determined high in the leaves of *Z. acanthopodium* (28.06±0.14%), *C. colebrookianum* (27.67±0.42%) and *O. linearis* (21.80±0.41%) while the carbohydrate content was highest in the nuts of C. *indica* (61.86±1.42%) and roots of *H. cordata* (23.45±2.11%). The nutritive value ranged from 883.75±54.03-2724.86±54.50 cal kg^{-1} in the various wild edible plants. Among the various macronutrients estimated in the plant samples of different wild edible plant potassium was present in the highest quantity (16.10-84.40 mg g^{-1}) followed by calcium (5.85-23.70 mg g^{-1}) and sodium (0.95-3.20 mg g^{-1}). Micronutrients, such as iron, zinc, copper, manganese and chromium were analyzed in the different plant specimens. The antioxidant activity of wild edible plants was examined. The content of total phenolics in the aqueous methanolic extracts was calculated as Gallic Acid Equivalent (GAE) and radical scavenging activity was estimated as IC_{50} values using 1,1- diphenyl-2-picrylhydrazyl (DPPH). The total phenol varied from 17.32±0.10 to 552.01±0.48 mg g^{-1} in the extracts. The highest radical scavenging effect was observed in *C. indica* with IC_{50} = 115.27±0.24 μg mL^{-1}. The greater amount of phenolic compound leads to more potent radical scavenging effect as shown by *C. indica*. Nutritive values of these plants were compared to the other wild and commercial leafy vegetables and fruits. It has been observed that the mineral contents and nutritional values of the plants evaluated in the present study were richer than that of the conventional leafy vegetables and fruits.

Key words: Wild edible plants, nutritive values, mineral contents, antioxidant activity, Meghalaya

INTRODUCTION

All human beings require sufficient food for growth, development and to lead an active and healthy life and it depends upon the quality and quantity of foodstuffs he or she is able to include in his regular diet. The quality of a food depends upon the presence of relative concentrations of various nutrients such as proteins, fat, carbohydrate, vitamins and minerals. Carbohydrates, fats and proteins are some times referred to as proximate principles and form the major portion of the diet while minerals play an important role in the regulation of the metabolic activity in the body (Gopalan *et al.*, 2004). It has been established that antioxidants found in large quantities in the crude extracts of fruits, herbs, vegetables, cerals and other plant materials act as reducing agent

and thereby improve the quality and nutritional value of the food. The importance of the antioxidant constituents of plant materials has also been established in the maintenance of health by acting against stress related diseases such as infections, diabetes, cancer and coronary heart disease (Idowu *et al*., 2006).

In most developing tropical countries the food situation is a major problem due to rapid growth of population, shortage of land for cultivation, high prices of available staples and restrictions on the importation of food. This has resulted in a high incidence of hunger and peoples are suffering from malnutrition. The poor people frequently collect wild edible plants for food and other plants from natural habitats to meet their subsistence needs. To meet the caloric requirements of human being some desired plant species had been cultivated in the garden and fields. Some biochemical methods have also been used to obtain high quantity crops. It has been reported in recent studies that cultivated plants with high chemical inputs such as fertilizers, plant growth regulator, herbicides etc has lost their natural taste, appearance and nutritive values (Sekeroglu *et al*., 2006). Recently a lot of interest is currently being focused on the possibilities of exploiting the vast numbers of less familiar plant resources existing in the wild. The forests of Meghalaya (Northeastern region in India) provide a large number of plants whose fruits, seeds tubers, shoots etc make an important contribution to the diet of the local people. These plants also provide some useful products like medicine, fibre, fodder, dyes etc. (Kayang, 2007) The study of wild edible plants is important not only to identify the potential sources which could be utilized as alternative food but also to select promising types for domestication.

The present communication deals with the analysis of the leaves of *Clerodendron colebrookianum* (Walp.), *Oenanthe linearis* (Wall.), *Sonchus arvensis* (Linn.), *Zanthoxylum acanthopodium* (DC.), roots of *Houttuynia cordata* (Wall.), *Potentilla lineata* (Trevir.) and seeds of *Castanopsis indica* (Roxb.) collected from different market of Meghalaya state, India for their nutritional composition, mineral contents and antioxidant activity. The main target of our research was to find out the nutritional potential of these wild edible plants.

C. indica known as Soh-ot in Khasi, Hinguri in Assamese, Chakkum-khokrok in Garo, khasi badam in Hindi, Akhar in Nepali belongs to the family Fagaceae. Nuts of this plant are eaten with great delicacy by the local people of Meghalaya. The nuts are also sold in local markets of Jowai, Nongstoin, Mairang in Khasi and Jaintia hills and in Tura in Garo hills of Meghalaya (Agrahar-Murugkar and Subbulakshmi, 2005).

C. colebrookianum known as Jarem in Khasi, Phuinam in Mizo belongs to the family Verbenaceae. It has been used as a home remedy by the Mizo people of North Eastern (NE) region of India in their folklore medicine as a cardioprotective (mainly against high blood pressure) agent. Leaves are eaten raw or bolied with meat or fish (Bhardwaj *et al*., 2008; Hynniewta and Kumar, 2008).

H. cordata known as Jamyr-doh in Khasi belongs to the family Saururaceae. The whole plant eaten raw. Leaf juice is taken for cholera, dysentery, curing of blood deficiency and purification of blood (Hynniewta and Kumar, 2008). Teder young shoots and leaves are eaten raw or cooked as a pot-herb. A decoction of this plant is used internally in the treatment of many ailments including cancer, coughs, dysentery, enteritis and fever. Externally, it is used in the treatment of snake bites and skin disorders The leaves and stems are harvested during the growing season and used fresh in decoctions The leaf juice is antidote and astringent (Chopra *et al*., 1986).

O. linearis known as Jatira in Khasi belongs to the family Apiaceae. The young stems and leaves are cooked or fried as vegetable. It is also boiled with dry fish. The leaves and young stems are also boiled and taken to cure diarrhea and dysentery.

P. lineata known as Lynniang in Khasi belongs to the family Rosaceae. The roots are eaten by khasis as a substitute of betel nut. It is bitter in taste and is used for the treatment of round worms. The roots are sold almost throughout the year.

S. arvensis known as Jalynniar/ Jakhain in Khasi,belongs to the familiy Compositae. The leaves of this plant are eaten as salad by the Khasis and Jaintias. It is bitter in taste but its delicacy preferred by the local people. Plant is cooling, sedative, diuretic, diaphoretic, antiseptic, hypnotic, expectorant, useful in the treatment of coughs in phthisis, bronchitis, asthma and pertussis (Chopra *et al*., 1986).

Z. acanthopodium known as Jaiur in Khasi, belongs to the family Rutaceae. Fruits, leaves and seeds are eaten as vegetable (Kayang, 2007). Seeds are grounded and made into chutney. Seeds and bark used as an aromatic, tonic, in fever, dyspepsia and in cholera (Chopra *et al*., 1986).

MATERIALS AND METHODS

Plant materials: The seven plant materials *C. indica* (nuts), *C. colebrookianum* (leaves), *H. cordata* (roots), *O. linearis* (leaves), *P. lineata* (roots), *S. arvensis* (leaves), *Z. acanthopodium* (leaves), were purchased from different market of Meghalaya state, India on November 2008 and authenticated in our office. The voucher specimens were preserved in the Plant Chemistry department of our office under registry no BSITS 12/14, BSITS 7/14, BSITS 3/14, BSITS 5/14, BSITS 10/14, BSITS 4/14, BSITS 1/14, respectively. The plant parts were shed-dried, pulverized and stored in an airtight container. And proximate composition, mineral contents and antioxidant activities were carried out in our laboratory.

Estimation of ash: Five gram of each sample was weighed in a silica crucible and heated in muffle furnace for about 5-6 h at 500°C. It was cooled in a desiccator and weighed. It was heated again in the furnace for half an hour, cooled and weighed. This was repeated consequently till the weight became constant (ash became white or grayish white). Weight of ash gave the ash content (Indrayan *et al*., 2005).

Estimation of moisture: Two gram of each sample was taken in a flat-bottom dish and kept overnight in an air oven at 100-110°C and weighed. The loss in weight was regarded as a measure of moisture content (Indrayan *et al*., 2005).

Estimation of crude fat: Two gram moisture free of each sample was extracted with petroleum ether (60-80°C) in a Soxhlet apparatus for about 6-8 h. After boiling with petrol, the residual petrol was filtered using Whatman no. 40 filter paper and the filtrate was evaporated in a preweighed beaker. Increase in weight of beaker gave crude fat (Indrayan *et al*., 2005).

Estimation of fibre: Two gram of moisture and fat-free material of each sample was treated with 200 mL of 1.25% H_2SO_4. After filtration and washing, the residue was treated with 1.25% NaOH. It was the filtered, washed with hot water and then 1% HNO_3 and again with hot water. The residue was ignited and the ash weighed. Loss in weight gave the weight of crude fibre (Indrayan *et al*., 2005).

Estimation of crude protein: The crude protein was determined using micro Kjeldahl method. The total protein was calculated multiplying the evaluated nitrogen by 6.25 (Indrayan *et al*., 2005).

Estimation of total carbohydrate: Percentage carbohydrate was given by: 100-(percentage of ash + percentage of moisture + percentage of fat + percentage of protein) (Indrayan *et al*., 2005).

Estimation of nutritive value: Nutritive value of each plant sample was determined by multiplying the values obtained for protein, fat and carbohydrate by 4.00, 9.00 and 4.00, respectively and adding up the values (Indrayan *et al*., 2005).

Estimation of minerals in plant material: Plant material was taken in a precleaned and constantly weighed silica crucible and heated in a muffle furnace at 400°C till there was no evolution of smoke. The crucible was cooled at room temperature in a desiccator and carbon-free ash was moistened with concentrated sulphuric acid and heated on a heating mantle till fumes of sulphuric acid ceased to evolve. The crucible with sulphated ash was then heated in a muffle furnace at 600°C till the weight of the content was constant (~2-3 h). One gram of sulphated ash obtained above was dissolved in 100 mL of 5% HCl to obtain the solution ready for determination of mineral elements through Atomic Absorption Spectroscopy (AAS) (AA 800, Perkin-Elmer Germany). Standard solution of each element was prepared and calibration curves were drawn for each element using AAS (Indrayan *et al*., 2005).

Extraction of plant material for antioxidant activity: One gram of each plant material was soaked in 20 mL aqueous methanol (20%, v/v) for 18 h at room temperature. The extracts were filtered and diluted to 50 mL and aliquot were analyzed for their total phenolic content and their free radical scavenging capacity.

Estimation of total phenolic content: The amount of total phenolic content of crude extracts was determined according to Folin-Ciocalteu procedure (Singleton and Rossi, 1965). 20-100 μL of the tested samples were introduced into test tubes; 1.0 mL of Folin-Ciocalteu reagent and 0.8 mL of sodium carbonate (7.5%) were added. The tubes were mixed and allowed to stand for 30 min. Absorption at 765 nm was measured (UV-visible spectrophotometer Hitachi U 2000 Japan). The total phenolic content was expressed as gallic acid equivalents (GAE) in miligram per gram (mg g^{-1}) of extract.

Determination of free radical scavenging activity: The free radical scavenging activity of the plant samples and Butylated Hydroxyl Toluene (BHT) as positive control was determined using the stable radical DPPH (1,1-diphenyl-2-picrylhydrazyl) (Blois, 1958). Aliquots (20-100 μL) of the tested sample were placed in test tubes and 3.9 mL of freshly prepared DPPH solution (25 mg L^{-1}) in methanol was added in each test tube and mixed. Thirty minutes later, the absorbance was measured at 517 nm (UV-visible spectrophotometer Hitachi U 2000 Japan). The capability to scavenge the DPPH radical was calculated using the following equation:

$$\text{DPPH scavenged (\%)} = \{(Ac - At)/Ac\} \times 100$$

where, Ac is the absorbance of the control reaction and At is the absorbance in presence of the sample of the extracts. The antioxidant activity of the extract was expressed as IC_{50}. The IC_{50} value

was defined as the concentration in mg of dry material per ml (mg mL^{-1}) that inhibits the formation of DPPH radicals by 50%. Each value was determined from regression equation.

Values are presented as Mean±SE mean of three replicates. The total phenolic content and IC_{50} value of each plant material was calculated by using Linear Regression analysis.

RESULTS

The edible parts of seven plant materials *C. indica* (nuts), *C. colebrookianum* (leaves), *H. cordata* (roots), *O. linearis* (leaves), *P. lineata* (roots), *S. arvensis* (leaves), *Z. acanthopodium* (leaves), collected from different places of Meghalaya market have a relatively high moisture content when compared to ash, crude protein, crude fat, crude fibre and total carbohydrate content (Table 1).

The edible parts of all plants contain minerals like sodium, potassium, calcium, manganese, chromium, iron, zinc and copper in varying concentration with potassium having highest concentration and it is shown in Table 2.

There was a wide variation in the amount of total phenolics in the wild edible plants ranging from 17.32±0.10 to 552.01±0.48-mg g^{-1} (GAE) (Table 3). The highest total phenolic content was found in the nuts of *Castanopsis indica* and the lowest in the leaves of *Sonchus arvensis*.

The evaluation of anti-radical properties of wild edible plants was performed by DPPH radical scavenging assay. The 50% inhibition of DPPH radical (IC_{50}) by different wild edible plants was determined (Table 4). The nuts of *C.indica* showed the lowest IC_{50} value whereas the leaves of *C. colebrokianum* was found to have highest IC_{50} value.

Table 1: Composition of edible parts of plants collected from Meghalaya

Plant	Local name at Meghalaya	Parts used	Ash (%)	Moisture (%)	Crude fat (%)	Protein (%) (6.25x % of N)	Total Carbohydrate (%)	Crude fibre (%)	Nutritive value (cal kg^{-1})
Castanopsis indica	Soh-ot	Nuts	1.08±0.10	31.8±1.65	0.804±0.01	4.45±0.16	61.86±1.42	0.59±0.03	2724.86±64.50
Clerodendrum colebrokianum	Jarem	Leaves	7.23±0.24	55.24±1.63	1.72±0.05	27.67±0.42	8.13±2.16	4.73±0.49	1587.01±75.04
Houttuynia cordata	Jamyrdoh	Roots	6.03±0.20	56.21±1.73	2.07±0.06	12.22±0.22	23.45±2.11	2.40±0.37	1613.50±69.76
Oenanthe linearis	Jatira	Leaves	8.13±0.20	62.08±2.04	1.56±0.06	21.80±0.41	6.41±2.26	4.56±0.53	1269.53±80.03
Potentilla lineata	Lynniang	Roots	7.7±0.16	70.93±1.22	0.579±0.01	9.74±0.42	11.05±1.75	2.56±0.55	883.75±54.03
Sonchus arvensis	Jalynniar	Leaves	9.6±0.33	59.88±1.23	2.46±0.04	19.55±0.30	8.46±1.25	6.30±0.45	1342.50±40.72
Zanthoxylum acanthopodium	Jaiur	Leaves	7.2±0.24	56.88±2.67	1.99±0.08	28.06±0.14	5.86±2.53	5.73±0.49	1536.25±103.49

Each value in the table was obtained by calculating the average of three experiments and data are presented as Mean±SEM

Table 2: Mineral value of plants collected from Meghalaya

			Minerals present (mg g^{-1})							
Plant	Local name at Meghalaya	Parts used	Na	K	Ca	Mn	Cu	Fe	Cr	Zn
Castanopsis indica	Soh-ot	Nuts	0.95	16.60	5.85	0.125	0.004	0.162	NT	0.488
Clerodendrum colebrokianum	Jarem	Leaves	1.05	25.10	19.05	0.191	0.017	1.555	NT	0.184
Houttuynia cordata	Jamyrdoh	Roots	1.30	49.65	8.25	0.082	0.0083	0.984	NT	0.099
Oenanthe linearis	Jatira	Leaves	3.20	84.40	23.70	0.36	0.014	2.893	0.0018	0.422
Potentilla lineata	Lynniang	Roots	1.00	16.10	10.80	0.085	0.008	0.636	NT	0.060
Sonchus arvensis	Jalynniar	Leaves	2.55	64.00	22.95	0.025	0.014	0.651	NT	0.201
Zanthoxylum acanthopodium	Jaiur	Leaves	1.95	33.70	14.35	0.50	0.012	1.175	NT	0.867

Results are the mean values of three replicates of the same sample

Table 3: Total phenolic content of plants collected from Meghalaya

Plant	Local name at Meghalaya	Parts used	GAE mg g^{-1} of dry material (Mean±SEM)
Castanopsis indica	Soh-ot	Nuts	552.01±0.48
Clerodendrum colebrokianum	Jarem	Leaves	30.98±0.72
Houttuynia cordata	Jamyrdoh	Roots	24.60±0.44
Oenanthe linearis	Jatira	Leaves	40.59±0.64
Potentilla lineata	Lynniang	Roots	248.02±0.97
Sonchus arvensis	Jalynniar	Leaves	17.32±0.10
Zanthoxylum acanthopodium	Jaiur	Leaves	61.19±3.01

Each value in the table was obtained by calculating the average of three experiments and data are presented as Mean±SEM

Table 4: Free radical scavenging ability of the plant samples collected from Meghalaya by the use of a stable DPPH radical (Antioxidant activity expressed as IC_{50})

Plant	Local name at Meghalaya	Parts used	IC_{50} value (µg dry material mL^{-1}) (Mean±SEM)
Castanopsis indica	Soh-ot	Nuts	115.27±0.24
Clerodendrum colebrokianum	Jarem	Leaves	3333.99±516.22
Houttuynia cordata	Jamyrdoh	Roots	317.75±2.75
Oenanthe linearis	Jatira	Leaves	615.51±14.22
Potentilla lineata	Lynniang	Roots	119.84±0.13
Sonchus arvensis	Jalynniar	Leaves	1311.46±114.34
Zanthoxylum acanthopodium	Jaiur	Leaves	240.44±5.92

Each value in the table was obtained by calculating the average of three experiments and data are presented as Mean±SEM

DISCUSSION

The proximate analysis of the nutritive contents of seven plants are depicted in Table 1. The results obtained from analytic chemical analysis of all seven wild edible plants establishes that nutritive value of the nuts of *C. indica* was maximum (2724.86±64.50 cal kg^{-1}) followed by the roots of *H. cordata* (1613.50±69.76 cal kg^{-1}) and leaves of *C. colebrokianum* (1587.01±75.04 cal kg^{-1}). The roots of P. *lineata* were found to be of less nutritive value (883.75±54.03 cal kg^{-1}), but due to highest moisture content (70.93±1.22%) it has a very good nutritive value and may be used as fodder. The crude protein contents ranged from 28.06±0.14% in the leaves *Z. acanthopodium* to 4.45±0.16 % in the nuts of *C. indica*. The crude protein content in *Z. acanthopodium* (28.06±0.14%), *C. colebrokianum* (27.67±0.42 %) and *O. linearis* (21.80±0.41%) were found to be higher than those of Almond (20.80%), Cashewnut (21.20%) (Sundriyal and Sundriyal, 2004), the presence of high crude protein content in the leaves of *S. arvensis* (19.55±0.30%), C. *indica* (Nuts) (4.45±0.16%), *H. cordata* (roots) (12.22±0.22%), *P. lineata* (roots) (9.74±0.42%) as compared to very commercial and nutritive leafy vegetables like cabbage (1.80%), carrot leaves (5.1%), cauliflowers (5.9%), spinach (2.0%), potato (1.6%) (Gopalan *et al.*, 2004) indicates that these low cost plant samples are very good sources of protein. The nuts of *C. indica*, *H. cordata* (roots) and *P. lineata* (roots) with high content of carbohydrates (61.86±1.42, 23.45±2.11 and 11.05±1.75%, respectively) could be a supplements in feed formulations. The ash content was found lowest in *C. indica* (1.08±0.10%) and highest in *S. arvensis* (9.6±0.33%).

The mineral composition in edible parts of the plants are shown in Table 2. High concentrations of sodium (Na) were present, ranging from 0.95 mg g^{-1} (*C. indica*) to 3.20 mg g^{-1} (*O. linearis*). The potassium (K) content was higher in the leaves of *O. linearis* (84.40 mg g^{-1}) and least in the roots of *P. lineata* (16.10 mg g^{-1}). Na and K take part in ionic balance of the human body and maintain

tissue excitability. Na plays an important role in the transport of metabolites and K is important for its diuretic nature. The ratio of K/Na in any food is an important factor in prevention of hypertension and arteriosclerosis, with K depresses and Na enhances blood pressure (Saupi *et al*., 2009). The ratio of K/Na were significant in the roots of *H. cordata* (38.19), in the leaves of *O. linearis* (26.37), *S. arvensis* (leaves) (25.09) and *C. colebrokianum* (leaves) (23.90) and compared with leafy vegetables (cabbage 17.5, tomato 47.1, beet 3.9). The Calcium (Ca) content was highest in the leaves of *O. linearis* (23.70) followed by in the leaves of *S. arvensis* (22.95), *C. colebrokianum* (19.05) and *Z. acanthopodium* (14.35). Ca constitutes a large proportion of the bone, human blood and extracellular fluid. It is also very much required for the normal functioning of the cardiac muscles, blood coagulation, milk clotting and the regulation of cell permeability (Indrayan *et al*., 2005). The sufficient amount of Copper (Cu) and Zinc (Zn) were present in the leaves of *O. linearis, C. colebrokianum, S. arvensis* and *Z. acanthopodium*. Copper is another trace element essential in human body where it exists as an integral part of copper proteins ceruplasmin, the enzyme that catalyzes the oxidation of iron ion (Saupi *et al*., 2009). Zn is a component of many metalloenzymes, including some enzymes which play a central role in nucleic acid metabolism. In addition, Zn is a membrane stabilizer and a stimulator of the immune response. Its deficiency leads to growth failure and malnutrition (Indrayan *et al*., 2005). The Manganese (Mn) content was higher in the leaves of *Z. acanthopodium* and appreciable amount of this element were observed in the leaves of *O. linearis, C. colebrokianum* and in the nuts of *C. indica*. This element is very much essential for haemoglobin formation (Indrayan *et al*, 2005). High concentration of iron (Fe) were present in the leaves of *O. linearis*, *C. colebrokianum* and *Z. acanthopodium* while the leaves of *S. arvensis*, roots of *H. cordata* and *P. lineata* contain an appreciable amount of this element. So the mineral content of all these plants were similar and comparable to the commercial vegetables.

It has been recognized that phenolic compounds show antioxidant activity and their effects on human nutrition and health are considerable. Natural antioxidants have been established to promote health by acting against oxidative stress related diseases such as infections, diabetes, cancer and coronary heart diseases. It has been suggested that antioxidants found in large quantities in fruits and vegetables and protect the oxidative stress related diseases. Generally food antioxidants act as reducing agents, reversing oxidation by donating electrons and hydrogen ions (Idowu *et al*., 2006). Estimation of total phenolic content and DPPH stable free radical method are easy, rapid and sensitive method to evaluate the antioxidant activity of a specific compound or plant extracts (Koleva *et al*., 2002).

There was a wide variation in the amount of total phenolics in the wild edible plants ranging from 17.32±0.10 to 552.01±0.48 mg g^{-1} (GAE) (Table 3). The amount of total phenolic content of the plant under investigation can be arranged in descending order viz., *C. indica* (nuts) > *P. lineata* (roots) > *Z. acanthopodium* (leaves) > *C. colebrokianum* (leaves) > *H. cordata* (roots) > *S. arvensis* (leaves). The anti-radical properties of the plant materials was performed by DPPH radical scavenging assay. The 50% inhibition of DPPH radical (IC_{50}) by different wild edible plants was determined (Table 4), a lower value would reflect greater antioxidant activity of the sample. The nuts of *C. indica* showed the lowest IC_{50} value (115.27±0.24 μg mL^{-1}) whereas *C. colebrokianum* was found to have the highest IC_{50} value (3333.99±516.22 μg mL^{-1}). The radical scavenging activity of the plant extracts decreased in the following order: *C. indica*> *P. lineata*>*Z. acanthopodium*>*H. cordata*>*O. linearis*>*S. arvensis*>*C. colebrokianum*. The result of present study showed that the methanolic extract of *C. indica* which contain highest amount of phenolic compounds, exhibited the greatest antioxidant activity whereas the

leaves of *C. colebrokianum* exhibited minimum radical scavenging activity. The high radical scavenging property of *C. indica* may be due to the hydroxyl groups existing in the phenolic compounds chemical structure that can provide the necessary component as a radical scavenger. The methanolic extracts of all of the plants under investigation exhibited different extent of antioxidant activity and thus provide a valuable source of nutraceutical supplements. Depending on the values, some plants are more important than some others.

ACKNOWLEDGMENTS

Author of this study is highly grateful to Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkata for his encouragement and fecilities. I am also thankful to Mr. R. Shanpru, Scientist, Botanical Survey of India, Eastern Regional circle, Shillong, Meghalaya for identifying the plant specimens.

REFERENCES

Agrahar-Murugkar, D. and G. Subbulakshmi, 2005. Nutritive values of wild edible fruits, berries, nuts, roots and spices consumed by the Khasi tribes of India. Ecol. Food Nutr., 44: 207-223.

Bhardwaj, R., A. Singh, R.K. Singh, H. Tag, S. Upadhyaya and M. Devi, 2008. Nutritionally rich wild vegetables of tribal communities of northeast India: Learning and lessons about traditional bio-cultural resources. Proceedings of the International Symposium Underutilized Plant Species For Food, Nutrition, Income and Sustainable Development, March 3-7, Arusha, Tanzania, pp: 1-22.

Blois, M.S., 1958. Antioxidant determination by the use of a stable free radical. Nature, 181: 1199-1200.

Chopra, R.N., S.L. Nayar and I.C. Chopra, 1986. Glossary of Indian Medicinal Plants (Including the Supplement). 3rd Edn., Council of Scientific and Industrial Research, New Delhi, India.

Gopalan, C., Rama B.V. Sastri and S.C. Balasubramanian, 2004. Nutritive Value of Indian Foods. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad 500 007, India, pp: 2-3.

Hynniewta, S.R. and Y. Kumar, 2008. Herbal remedies among the Khasi traditional healers and village folks in Meghalaya. Indian J. Traditional Knowledge, 7: 581-586.

Idowu, T.O., E.O. Iwalewa, M.A. Aderogba, B.A. Akinpelu and A.O. Ogundaini, 2006. Antinociceptive, Anti-inflammatory and antioxidant activities of eleagnine: An alkaloid isolated from *Chrysophyllum albidum* seed cotyledons. J. Biol. Sci., 6: 1029-1034.

Indrayan, A.K., S. Sudeep, D. Deepak, N. Kumar and M. Kumar, 2005. Determination of nutritive value and analysis of mineral elements for some medicinally valued plants. Curr. Sci., 89: 1252-1254.

Kayang, H., 2007. Tribal knowledge on wild edible plants of Meghalaya, Northeast India. Indian J. Traditional Knowledge, 6: 177-181.

Koleva, I.I., T.A. Van Beek, J.P.H. Linssen, A. deGroot and L.N. Evstatieva, 2002. Screening of plant extracts for antioxidant activity: A comparative study on three testing methods. Phytochem. Anal., 13: 8-17.

Saupi, N., M.H. Zakaria and J.S. Bujang, 2009. Analytic chemical composition and mineral content of yellow velvetleaf (*Limnocharis flava* L. Buchenau)'s edible parts. J. Applied Sci., 9: 2969-2974.

Sekeroglu, N., F. Ozkutlu, M. Deveci, O. Dede and N. Yilmaz, 2006. Evaluation of some wild plants aspect of their nutritional values used as vegetable in eastern black sea region of Turkey. Asian J. Plant Sci., 6: 185-189.

Singleton, V.L. and J.A. Roosi, 1965. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Am. J. Enol. Viticuture, 16: 144-158.

Sundriyal, M. and R.C. Sundriyal, 2004. Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species. Econ. Bot., 58: 286-299.