Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 12 (4): 171-175, 2013
ISSN 1682-3974 / DOI: 10.3923/ajps.2013.171.175

Evaluation of Proximate and Mineral Composition of Wild Edible Leaves, Traditionally used by the Local People of Meghalaya State in India

Tapan Seal, Kausik Chaudhuri and Basundhara Pillai
Botanical Survey of India, Acharya Jagadish Chandra Bose Indian Botanic Garden,
Shibpur, Howrah, India

Abstract: The proximate composition and mineral contents of six wild edible leaves of the plant e.g., *Allium porrum*, *Carpesium cernuum*, *Tricyrtis pillosa*, *Spilanthes acmella*, *Leea sambucina* and *Neptunia olearacea*, collected from Meghalaya state in India were evaluated. These plants are used by the local people of Meghalaya state in India as their food. The present study revealed that for different plant species, the crude fat content ranged between 0.57±0.03-2.84±0.03%. The crude protein content was determined high in the leaves of *Neptunia olearacea* (46.24±0.02%), *Allium porrum* (29.53±0.03%), *Spilanthes acmella* (27.00±0.03%) and *Leea sambucina* (22.53±0.02%) while the available carbohydrate content was highest in the leaves of *Leea sambucina* (63.32±0.04%). The nutritive value ranged from 284.26±0.12-350.66±0.19 kcal 100 g^{-1} in the various wild edible plants. Among the various macronutrients estimated in the plant samples of different wild edible plants potassium was present in the highest quantity (20.19±0.14-52.11±1.35 mg g^{-1}) followed by calcium (5.42±0.11-8.90±0.12 mg g^{-1}) and sodium (0.15±0.004-0.38±0.005 mg g^{-1}). Micronutrients, such as iron, zinc, copper, manganese and magnesium were analyzed in the different plant specimens. The result indicates that nutritional values and mineral contents of these leaves under investigation were richer than that of the commercial vegetables and could be used for nutritional purpose. The present study also gives an account of ethnobotanical importance of the wild plants under investigation.

Key words: Wild edible leaves, Meghalaya, nutritional composition, mineral contents

INTRODUCTION

Meghalya is a small state in north-eastern India. It comprises of South Garo hills, West Garo hills, East Garo hills, West Khasi hills, East Khasi hills, Ribhoi and Jaintia Hills districts. About one third of the state is forested (Mao *et al*., 2009). The forests of Meghalaya are notable for their biodiversity of mammals, birds and plants (Kayang, 2007). A large part of the region is botanically under-explored or even unexplored. The local inhabitants subsist on limited agriculture and local products of plant and animal origin. The area is, thus, very interesting ethnobotanically (Jain and Dam, 1979). The forests of Meghalaya provide a large number of plants whose fruits, seeds tubers, shoots etc., make an important contribution to the diet of the tribal people. These wild plants serve as an indispensable constituent of human diet supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy (Akubugwo *et al*., 2007). 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 *Allium porrum*, *Carpesium cernuum*, *Tricyrtis pillosa*, *Spilanthes acmella*, *Leea sambucina* and *Neptunia olearacea* collected from different market of Meghalaya state, India for their nutritional composition and mineral contents. The main target of our research was to find out the nutritional potential of these wild edible plants.

MATERIALS AND METHODS

Plant materials: The six plant materials e.g the leaves of *A. porrum*, *C. cernuum*, *T. pillosa*, *S. acmella*, *L. sambucina* and *N. olearacea* were collected from different places of Meghalaya state, India on August 2011 and authenticated in our office. The voucher specimens were preserved in the Plant Chemistry department of our office under registry no BSITS 36, 37, 38, 39, 40 and 41, respectively. The plant parts were shed-dried, pulverized

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

and stored in an airtight container and proximate composition and mineral contents 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 (AOAC, 1990).

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 (AOAC, 1990).

Determination of crude fat content: Two gram moisture free of each sample was extracted with petroleum ether (b.p. 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. The difference in weight was expressed as percentage of crude fat content (AOAC, 1990).

Determination of crude fibre content: 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 washed residue was dried in an oven at 130°C to constant weight and cooled in a dessicator. The residue was scraped into a pre-weighed porcelain crucible, weighed, ashed at 550°C for 2 h, cooled in a dessicator and reweighed. Crude fibre content was expressed as percentage loss in weight on ignition (AOAC, 1990).

Determination of nitrogen content and estimation of crude protein: Two gram of dried plants were digested in a 100 mL Kjeldahl digestion flask and Macro Kjeldahl method was used to determine the nitrogen content in the plant. The Crude protein was estimated by multiplying the value obtained for percentage nitrogen content by a factor of 6.25 (AOAC, 1990).

Estimation of available carbohydrate: Percentage of available carbohydrate was given by: 100-(percentage of ash+percentage of fat+percentage of protein+percentage of crude fibre).

Estimation of energy content: Nutritive value of each plant samples were determined by multiplying the values obtained for protein, fat and available carbohydrate by 4.00, 9.00 and 4.00, respectively and adding up the values (Guil-Guerrero *et al*., 1998).

Analysis 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). All assays were carried out at least in triplicate and values were obtained by calculating the average of three experiments and data are presented as Mean±SEM.

RESULTS

The edible parts of fresh plant materials e.g., the leaves of *A. porrum*, *C. cernuum*, *T. pillosa*, *S. acmella*, *L. sambucina* and *N. olearacea* collected from different places of Meghalaya market have a relatively high moisture content when compared to ash, crude protein, crude fat, crude fibre and available carbohydrate content (Table 1).

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

DISCUSSION

The proximate analysis of the nutritive contents of five plants are depicted in Table 1. The results obtained from analytic chemical analysis of all six wild edible leafy vegetables establishes that energy content of the leaves of *L. sambucina* was maximum (350.66±0.19 kcal 100 g^{-1}) followed by the leaves of *N. olearacea* (338.61±0.19 kcal 100 g^{-1}), *S. acmella* (328.48±0.10 kcal 100 g^{-1}) and *A. porrum* (328.40±0.11 kcal 100 g^{-1}). The leaves of *T. pillosa* were found to be of less nutritive value

Table 1: Nutritional parameters of the plants collected from Meghalaya

Name of the plant	Local name at Meghalaya	Parts used	Ash (%)	Moisture (%)	Crude fat (%)	Crude fibre (%)	Protein (%) (6.25x % of N)	Carbohydrate (%)	Nutritive value (kcal 100 g^{-1})
Allium porrum	Ja-ut, Borhnah	Leaves	15.36±0.01	93.53±0.03	2.84±0.03	6.09±0.03	29.53±0.03	46.18±0.10	328.40±0.11
Carpesium cernuum	Jakhain	Leaves	17.58±0.01	85.18±0.03	2.10±0.03	13.98±0.06	17.22±0.03	49.12±0.13	284.26±0.12
Tricyrtis pillosa	Sohkhia blfi	Leaves	17.18±0.01	90.08±0.03	1.05±0.03	25.76±0.03	20.07±0.02	35.95±0.02	233.50±0.13
Spilanthes acmella	Ankasa	Leaves	12.58±0.02	87.64±0.02	0.57±0.03	6.02±0.04	27.00±0.03	53.83±0.06	328.48±0.10
Leea sambucina	Thingtupui	Leaves	9.91±0.02	81.34±0.03	0.81±0.03	3.43±0.03	22.53±0.02	63.32±0.04	350.66±0.19
Neptunia olearacea	Dumjong	Leaves	9.50±0.01	85.47±0.02	0.88±0.02	6.95±0.04	46.24±0.02	36.44±0.08	338.61±0.19

Each value in the table was obtained by calculating the average of three experiments (n = 3) and data are presented as Mean±SEM

Table 2: Minerals content of plants collected from Meghalaya

			Minerals present (mg g^{-1})							
Name of the plant	Local name at Meghalaya	Parts used	Na	K	Ca	Mn	Cu	Fe	Mg	Zn
Allium porrum	Ja-ut, Borhnah	Leaves	0.27±0.003	52.11±1.35	8.90±0.12	0.069±0.0008	0.014±0.0002	0.518±0.002	0.758±0.001	0.199±0.0010
Carpesium cernuum	Jakhain	Leaves	0.19±0.004	21.18±0.12	7.20±0.10	0.136±0.0008	0.016±0.0004	1.396±0.001	0.763±0.001	0.162±0.0009
Tricyrtis pillosa	Sohkhia blfi	Leaves	0.38±0.005	47.22±1.02	8.11±0.09	0.136±0.0009	0.014±0.0001	0.657±0.001	0.845±0.001	0.561±0.0010
Spilanthes acmella	Ankasa	Leaves	0.26±0.005	38.73±0.21	8.77±0.09	0.115±0.0008	0.025±0.0001	0.410±0.001	0.791±0.001	0.217±0.0010
Leea sambucina	Thingtupui	Leaves	0.15±0.004	33.67±1.00	6.11±0.09	0.072±0.0007	0.018±0.0002	0.281±0.001	0.784±0.001	0.160±0.0008
Neptunia olearacea	Dumjong	Leaves	0.23±0.004	20.19±0.14	5.42±0.11	0.218±0.0007	0.008±0.0003	0.240±0.001	0.764±0.019	0.199±0.0010

Each value in the table was obtained by calculating the average of three experiments (n = 3) and data are presented as Mean±SEM

Table 3: Nutritional parameters of some common vegetables and fruits

Name of the plant	Ash (%)	Moisture (%)	Crude fat (%)	Protein (%) (6.25x % of N)	Available carbohydrate (%)	Crude fibre (%)	Nutritive value (kcal 100 g^{-1})
Apple	1.2	84.6	0.3	0.2	10.5	3.2	58
Brinjal	1.6	88.7	0.3	1.4	1.7	6.3	24
Broad beans	2.8	82.4	0.1	4.5	1.3	8.9	48
Cabbage	1.6	91.9	0.1	1.8	1.8	2.8	27
Cauliflower	2.2	90.8	0.4	2.6	0.3	3.7	30
Lettuice	1.7	93.4	0.3	2.1	-	-	21
Lichi	1.0	84.1	0.2	1.1	-	-	61
Mango ripe	1.1	81.0	0.4	0.6	14.9	2.0	74
Papaya ripe	1.3	90.8	0.1	0.6	4.6	2.6	32
Potato	1.0	74.7	0.1	1.6	20.9	1.7	97
Spinach	2.3	92.1	0.7	2.0	0.4	2.5	26
Wood apple	6.9	64.2	3.7	7.1	18.1	-	134

(233.50±0.13 kcal 100 g^{-1}) but due to high moisture content (90.08±0.03%) it has a very good nutritive value and may be used as fodder.

The crude protein contents ranged from 46.24±0.02% (leaves of *N. olearacea*) to 17.22±0.03% in the (leaves of *C. cernuum*). The crude protein content in *N. olearacea* was found to be higher than those of almond (20.80%), cashewnut (21.20%) (Sundriyal and Sundriyal, 2001). The crude protein content in the leaves of *A. porrum* (29.53±0.03%), *S. acmella* (27.00±0.03%), *L. sambucina* (22.53±0.02%) and *T. pillosa* (20.07±0.02%) were very much high than the protein content in some commercial leafy vegetables like *Momordica balsamina* (11.29±0.07%), *Moringa oleifera* (20.72%) and *Lesianthera africana* leaves (13.10-14.90%) and *Leptadenia hastate* (19.10%) (Aberoumand, 2011). These indicates that low cost plant samples are very good sources of protein.

The leaves of *L. sambucina*, *S. acmella*, *C. cernuum* and *A. porrum* with high content of available carbohydrates (63.32±0.04, 53.83±0.06, 49.12±0.13 and 46.18±0.10%, respectively) compared well to that reported for some common leafy vegetables like agathi, broad bean leaves, carrot leaves, colocasia leaves potato (22.6%) etc., (Table 3) (Gopalan *et al*., 2004) and these could be a supplements in feed formulations. The ash content was found lowest in *N. olearacea* (9.50±0.01%) and highest in *C. cernuum* (17.58±0.01%). The fat content in the leaves of *A. porrum* (2.84±0.03%) and *C. cernuum* (2.10±0.03%) was particularly high and well compared to that reported for some common vegetables like agathi (1.4%), cabbage (0.10%), carrot leaves (0.5%), colocasia leaves (2%), spinach (0.7%) etc., (Table 3) (Gopalan *et al*., 2004). The leaves of *T. pillosa* contained the highest amount of crude fibre (25.76±0.03%) and the lowest amount is found in the leaves of *L. sambucina* (3.43±0.03%) and simmilar to commercial fruits and vegetables like agathi (2.2%), broad bean leaves (3.7%), cabbage (1%), potato (1.7%), spinach (2.5%) (Table 3) (Gopalan *et al*., 2004). The proximate composition of these plants were very much comparable to some other wild edible leafy vegetables like leaves of *Bauhinia purpurea*, *Diplazium esculentum* (Seal, 2012), *Ficus geniculata*, *Ficus pomifera*, *Gentiana pedicellata* etc., (Seal, 2011), collected from different tribal market of Meghalaya.

The mineral composition in edible parts of the plants are shown in Table 2. High concentrations of sodium (Na) were present, ranging from 0.15±0.004 mg g^{-1}

Table 4: Mineral contents in some common vegetables and fruits

	Minerals present (mg g^{-1})							
Name of the plant	Na	K	Ca	Mn	Cu	Fe	Cr	Zn
Apple	0.280	0.750	0.100	0.0014	0.0010	0.0066	0.0008	0.0060
Brinjal	0.030	2.000	0.180	0.0013	0.0012	0.0038	0.0007	0.0022
Broad beans	0.435	0.390	0.500	-	0.0017	0.0140	-	-
Cabbage	-	-	0.390	0.0018	0.0002	0.0080	0.0005	0.0030
Cauliflower	0.530	1.380	0.330	0.001	0.0013	0.0123	0.0003	0.0040
Lettuice	0.580	0.330	0.500	-	0.0008	0.0240	-	-
Lichi	1.249	1.590	0.100	-	0.003	0.0070	-	
Mango ripe	0.260	2.050	0.140	0.0013	0.0011	0.0130	0.0006	0.0027
Papaya ripe	0.060	0.690	0.170	-	0.0020	0.0050	-	-
Potato	0.110	2.470	0.100	0.0013	0.0016	0.0048	0.0007	0.0053
Spinach	0.585	2.060	0.730	0.0056	0.001	0.0114	0.0005	0.0030
Wood apple	-	-	1.300	0.0018	0.0021	0.0048	0.0006	0.0046

(*L. sambucina*) to 0.38±0.005 mg g^{-1} (*T. pillosa*). The sodium levels of some cultivated vegetables and fruits vary between 30-1249 mg kg^{-1} (Table 4) (Gopalan *et al*., 2004). The potassium (K) content was highest in the leaves of *A. porrum* (52.11±1.35 mg g^{-1}) and least in the leaves of *N. olearacea* (20.19±0.14 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 leaves of *L. sambucina* (224), *A. porrum* (193), *S. acmella* (148.96) and *T. pillosa* (124) and very much compared with some common leafy vegetables like Brussels sprouts 60.38, Spinach 3.52, Celery leaves 5.91, Colocasia 61.11 etc., (Gopalan *et al*., 2004).

The calcium (Ca) content was highest in the leaves of *A. porrum* (8.90±0.12 mg g^{-1}) followed by *S. acmella* (8.77±0.09 mg g^{-1}) and *T. pillosa* (8.11±0.09 mg g^{-1}). The calcium levels of some cultivated vegetables and fruits vary between 0.1-1.300 mg g^{-1} (Table 4). 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).

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). The sufficient amount of Copper (Cu) was present in the leaves *S. acmella* (0.025±0.0001 mg g^{-1}), *L. sambucina* (0.018±0.0002 mg g^{-1}) and in *C. cernuum* (0.016±0.0004 mg g^{-1}). An appreciable quantity of Zinc (Zn) was found to be present ranging from 0.160±0.0008 mg g^{-1} (*L. sambucina*) to 0.561±0.001 mg g^{-1} (*T. pillosa*).

Zinc is an essential element in the nutrition of human being where it functions as an integral part of numerous enzymes 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 poor development of gonadal function (Ihedioha and Okoye, 2011).

The Manganese (Mn) concentrations of the plants studied varied between 0.069±0.0008 to 0.218±0.0007 mg g^{-1}. The highest Mn values was found in the leaves of *N. olearacea* (0.218±0.0007 mg g^{-1}) and appreciable amount of this element were observed in all other plants and our results were in the limits. This element is very much essential for haemoglobin formation (Indrayan *et al*., 2005). Manganese is one of the most important minerals for human physiology and daily requirement for healthy person is 4.50 mg (Sekeroglu *et al*., 2006). High concentration of iron (Fe) were present in the leaves of *C. cernuum* (1.396±0.001 mg g^{-1}) and *T. pillosa* (0.657±0.001 mg g^{-1}). This high Fe levels in some wild edible plants studied could be clarified with different soil characteristics of the growing area. A daily Fe requirement of human body is 15 mg and the deficiency causes some illness like anemia. Wild edible plants studied had sufficient and high Fe levels for human health (Sekeroglu *et al*., 2006). The Magnesium (Mg) concentrations of the plants studied varied between 0.758±0.001 to 0.845±0.001 mg g^{-1}. The highest Mg values was found in the leaves of *T. pillosa* (0.845±0.001 mg g^{-1}). A very good amount of Mg is also present in the leaves of *S. acmella* (0.791±0.001 mg g^{-1}) and *L. sambucina* (0.784±0.001 mg g^{-1}). This mineral is present in very small amount in all cells and required for cellular metabolism. Green leafy vegetables are very good source of magnesium.

So the mineral findings of all these plants obtained from present study were similar and comparable to the commercial vegetables and fruits.

CONCLUSION

The study showed that these wild edible leaves under investigation, collected from Meghalaya State in India were rich in protein, available carbohydrate, total dietary fibre and minerals and we believe that these plants could be used for nutritional purpose of human being due to their good nutritional qualities and adequate protection may be obtained against diseases arising from malnutrition.

ACKNOWLEDGMENTS

Author of this study is highly grateful to Dr. P. Singh, Director, Botanical Survey of India, Kolkata, Dr. D. K. Singh, Additional Director, Botanical Survey of India, Kolkata for their 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

AOAC., 1990. Official Methods of Analysis. 14th Edn., Association of Official Analytical Chemists, Washington, DC., USA.

Aberoumand, A., 2011. Screening of less known two food plants for comparison of nutrient contents: Iranian and Indian vegetables. Funct. Foods Health Dis., 10: 416-423.

Akubugwo, I.E., A.N. Obasi and S.C. Ginika, 2007. Nutritional potential of the leaves and seeds of black nightshade-*Solanum nigrum* L. Var virginicum from afikpo-Nigeria Pak. J. Nutr., 6: 323-326.

Gopalan, C., B.V.R. Sastri and S.C. Balasubramanian, 2004. Nutritive Value of Indian Foods. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India, pp: 2-58.

Guil-Guerrero, J.L., A. Gimenez-Gimenez, I. Rodriguez-Garcia and M.E. Torija-Isasa, 1998. Nutritional composition of *Sonchus* species (*S. asper* L., *S. oleraceus* L. and *S. tenerrimus* L.). J. Sci. Food Agric., 76: 628-632.

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.

Indrayan, A. K., S. Sharma, D. Durgapal, N. Kumar and M. Kumar, 2005. Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttaranchal. Curr. Sci., 89: 1252-1255.

Jain, S.K. and N. Dam, 1979. Some ethnobotanical notes from Northeastern India. Econ. Bot., 33: 52-56.

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

Mao, A.A., T.M. Hynniewta and M. Sanjappa, 2009. Plant wealth of northeast India with reference to ethnobotany. Indian J. Traditional Knowledge, 8: 96-103.

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.

Seal, T., 2011. Evaluation of Some wild edible plants from nutritional aspect used as vegetable in Meghalaya State of India. World Applied Sci. J., 12: 1282-1287.

Seal, T., 2012. Evaluation of nutritional potential of wild edible plants, traditionally used by the tribal people of Meghalaya State in India. Am. J. Plant Nutr. Fertili. Technol., 2: 19-26.

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., 5: 185-189.

Sundriyal, M. and R.C. Sundriyal, 2001. Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species. Econ. Bot., 55: 377-390.