

ETHNOBOTANICAL IMPORTANCE AND NUTRITIONAL POTENTIAL OF WILD LEAFY
VEGETABLES OF MEGHALAYA STATE IN INDIA

Tapan Seal* and Kausik Chaudhuri

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

*Author for correspondence e-mail : kaktapan65@yahoo.co.in

ABSTRACT : The nutritional potential of five wild edible leaves of the plant e.g. *Chenopodium album*, *Alternanthera philoxeroides*, *Homalomena aromatica*, *Zanthoxylum rhetsa* and *Cajanus indicus* collected from Meghalaya state in India were evaluated by determining proximate and phytochemical composition. 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 0.69 ± 0.02 - 2.30 ± 0.02 %. The crude protein content was determined high in the leaves of *Cajanus indicus* (15.77 ± 0.03 %) and in *Zanthoxylum rhetsa* (13.75 ± 0.05 %) while the available carbohydrate content was the highest in the leaves of *Alternanthera philoxeroides* (73.67 ± 0.30 %). The nutritive value ranged from 77.41 ± 0.53 - 344.52 ± 0.33 kcal/100g 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 (10.42 ± 0.10 - 45.86 ± 0.22 mg /g) followed by calcium (5.93 ± 0.15 - 26.47 ± 0.18 mg/g) and sodium (0.32 ± 0.01 - 8.25 ± 0.07 mg /g). Micronutrients, such as iron, zinc, copper, manganese and magnesium were also analyzed in the different plant specimens.

The result indicates that the nutritional values and mineral contents of these leafy vegetables 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 leafy vegetables , Meghalaya, nutritional composition, mineral contents

INTRODUCTION

In most developing countries the wild edible plants are good sources of food and provide adequate level of nutrition to mankind. These wild plants serve as an indispensable constituent of human diet, they are known to be excellent source of minerals, vitamins and certain hormone precursors, in addition to protein and energy (Akubugwo *et al*, 2007 ; Valvi and Rathod, 2011). Being the rich source of minerals and vitamins, the wild edible plants can reduce the risk of diseases like diabetes, cancer, coronary heart disease, neurodegenerative ailment (Saikia and Deka, 2013).

The wild edible plants with high diversity are widely distributed in the western ghats and in the north-eastern regions of India. Nutritional profile of many wild edible plants have found comparable and sometime better to many cultivated varieties (Prashanth Kumar and Shiddamallayya, 2014). Meghalaya 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 (Mao *et al*, 2009) . 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 local tribal people. These plants also provide some useful products like medicine, fibre, fodder, dyes etc (Kayang, 2007). A large part of the region is botanically under-explored or even unexplored. The local inhabitants survive on limited agriculture and local products of plant and animal origin. The area is, thus, very interesting ethnobotanically (Jain and Dam 1979). Though several investigations has already been done on the nutritive properties of various types of edible wild plants in this area, but more remains to be done. 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 *Chenopodium album*, *Alternanthera philoxeroides*, *Homalomena aromatica*, *Zanthoxylum rhetsa* and *Cajanus indicus* 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. The traditional use and ethnobotanical importance of these plant has also been mentioned.

Chenopodium album belonging to the family Chenopodiaceae is known as polong in Meghalaya State. The leaves are cooked as vegetable. It is very bioactive plant and used in various diseases like blood, heart, spleen, eye and in biliousness conditions, cough, abdominal pain, pulmonary obstruction and in nervous disorders. The leaves are rich in potassium & vitamin C. The seeds are chewed in treatment of urinary problems and are considered useful for relieving the discharge of semen through urine. Pharmacological studies on the plant reveals the proven activity of its as hypoglycemic, antibacterial, spasmolytic, antipruritic, anti-inflammatory, hepatoprotective, antioxidant, anticancer (Suganthi and Nair, 2011 ; Sikarwar *et al*, 2013).

Alternanthera philoxeroides (Mart) Griseb belonging to the family Amaranthaceae is known as kanchi sag in Meghalaya State. The leaves and young stems are cooked as vegetable. The young shoot paste with black pepper is prescribed to cure acute cough. Leaves with pinch of salt are orally administered to cure intestinal worms (Panda and Misra, 2011).

Homalomena aromatica Schott belonging to the family Araceae is known as shrew in Meghalaya State. The leaves and underground stems are cooked as vegetable. It grows in wasteland, foothill and also sometimes planted as pot plant. The rhizome of the plant is crushed and dipped in the fresh fruit juice of *Averrhoa carambola* and kept overnight by adding a pinch of sodium bicarbonate salt and the filtrate is used to treat asthma by both Meitei and Meitei-pangal communities (Khan and Yadava, 2010). The rhizome juice of this plant is taken orally in jaundice and in other liver complaints (Shankar *et al*, 2012).

Despite of its aroma and essential oil, the species has some other ethno biological utility among the people of Assam. Its rhizome serves as good source of nutrition and is used for treating stomach problem, jaundice, and diarrhoea. In Chinese medicines also the aromatic rhizomes of all available species of *Homalomena* are used medicinally to treat injuries, fractures, joint and muscle pains, stomach pains, lumbago, intestinal parasites etc. (Barua *et al*, 2014)

Zanthoxylum rhetsa (Roxb.) DC. belonging to the family Rutaceae is known as chingjal in Meghalaya State. The leaves and young stems are cooked as vegetable.

In Tamilnadu the Kanikkar tribes applied the paste prepared by rubbing the hard spines on a rock along with water on the breast to give relief from pain and increase lactation in nursing mothers (Lalitharani *et al*, 2012). The shoots of *Zanthoxylum rhetsa* is use as folk food by indigenous people of Arunachal Pradesh. The Adi tribe of East Siang District of Arunachal Pradesh use *Zanthoxylum rhetsa* as folk medicine also. In Adi this folk vegetable is called "onger" (Payum *et al*, 2013).

Cajanus indicus (L) Millsp. belonging to the family Rutaceae is known as Bethleng in Meghalaya state. The leaves and pods are cooked as vegetable. The Garo tribal community of Bangladesh utilizes this plant as for the treatment of Diabetes and as an energy stimulant. In some parts of Tamilnadu, the leaf, stems and young stems are used to cure gingivitis, stomatitis and as a toothbrush. It is an important folk medicine in eastern Rajasthan as fresh juice/boiled leaves are given orally to nullify the effect of intoxication and also as laxative. Leaf paste is applied in oral ulcers and inflammations. Leaves and seeds are applied as poultice over the breast to induce lactation (Pal *et al*, 2011).

MATERIALS AND METHODS

Plant materials

The five plant materials e.g the leaves of *Chenopodium album*, *Alternanthera philoxeroides*, *Homalomena aromatica*, *Zanthoxylum rhetsa* and *Cajanus indicus* were collected from different tribal market of Meghalaya state, India on December 2012 and authenticated in our office. The voucher specimens were preserved in the Plant Chemistry department of our office under registry no BSITS 49, BSITS 51, BSITS 53A, BSITS 56 and BSITS 58 respectively. The plant parts were shed-dried, pulverized and stored in an airtight container and proximate composition and mineral contents were carried out in our laboratory

Estimation of ash: Five gm of each sample were 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 until the weight became constant (ash became white or grayish white). Weight of ash gave the ash content (AOAC, 1990).

Estimation of moisture : Two gm of each sample were 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).

Estimation of crude fat: Two gm moisture free of each sample were extracted with petroleum ether (60-80°C) in a Soxhlet apparatus for about 6-8h. 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 content (AOAC, 1990).

Estimation of crude fibre : Two gm of moisture and fat-free material of each sample were treated with 200 ml of 1.25% H₂SO₄. After filtration and washing, the residue was treated with 1.25% NaOH. It was filtered, washed with hot water and then 1% HNO₃ 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 two hours, cooled in a dessicator and reweighed. Crude fibre content was expressed as percentage loss in weight on ignition (AOAC, 1990).

Estimation of crude protein: The crude protein was determined using micro Kjeldahl method. 2 gm of each sample compound were decomposed by digestion with concentrated sulphuric acid in the presence of a catalyst, and ammonium sulphate is produced. An excess of sodium hydroxide solution was added to the diluted reaction mixture, the liberated ammonia was distilled in steam and absorbed in a measured excess of standard sulphuric acid. Titration of the residual mineral acid with standard sodium hydroxide gives the equivalent of ammonia obtained from the weight of the sample taken. The percentage of nitrogen in the compound was accordingly calculated. On the basis of early determinations, the average nitrogen (N) content of proteins was found to be about 16 percent, which led to use of the calculation $N \times 6.25$ ($1/0.16 = 6.25$) to convert nitrogen content into protein content (AOAC, 1990).

Estimation of available carbohydrate: Percentage of available carbohydrate was given by: $100 - (\text{percentage of ash} + \text{percentage of fat} + \text{percentage of protein} + \text{percentage of crude fibre})$ (AOAC, 1990).

Estimation of nutritive value (energy): The three components of foods which provide energy are protein, carbohydrate and fat. One gram carbohydrate and protein yield 4 kcal energy each whereas one gram fat yield 9 kcal energy. The energy content 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 (AOAC, 1990).

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). 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 \pm SEM

RESULTS AND DISCUSSION

The edible parts of fresh plant materials e.g the leaves of *Chenopodium album*, *Alternanthera philoxeroides*, *Homalomena aromatica*, *Zanthoxylum rhetsa* and *Cajanus indicus* collected from different places of Meghalaya market have a relatively high moisture content when compared to ash, crude protein, crude fat, dietary fibre and available carbohydrate content .

The proximate analysis of the nutritive contents of five leaves are depicted in Table 1. The results obtained from analytic chemical analysis of all five wild edible leaves establishes that nutritive value of *Zanthoxylum rhetsa* was maximum (344.52 ± 0.33 kcal /100g) followed by *Cajanus indicus* (342.90 ± 0.15 kcal/100g) and *Alternanthera philoxeroides* (336.93 ± 0.51 kcal/100g) . The leaves of *Chenopodium album* were found to have lower energy content (77.41 ± 0.53 kcal/100g) but due to high ash and mineral content it has a very good nutritive value. The crude protein content ranged from 15.77 ± 0.03 % (*Cajanus indicus*) to 2.41 ± 0.05 % in the (*Homalomena aromatica*). The crude protein content in all the plants under investigation were found to be higher than the protein content in some commercial vegetables like Spinach (2%), lettuce (2.1%), cabbage (1.8%), susni sag (3.7%) etc. (Gopalan et al, 2004). These indicate that low cost plant samples are very good sources of protein. The leaves of *Alternanthera philoxeroides*, *Homalomena aromatica* , *Zanthoxylum rhetsa* and *Cajanus indicus* with high content of available carbohydrates (73.67 ± 0.30 %, 73.12 ± 0.09 % 70.29 ± 0.07 % and 68.39 ± 0.01 % respectively) compared well to that reported for carrot leaves (13.1%), colocasia leaves (42.3%) (Sundriyal and Sundriyal 2004) potato (22.6%), rape leaves (40.7%) etc. (Gopalan et al, 2004). and these could be a supplements in feed formulations. The ash content was found to be the lowest in *Cajanus indicus* (5.48 ± 0.02 %) and the highest in *Chenopodium album* (53.53 ± 0.34 %) and it indicates that the plant may contain a very good amount of minerals.

The fat content in the leaves of *Homalomena aromatica* (2.30 ± 0.02 %) and *Chenopodium album* (1.13 ± 0.03 %) was particularly high and well compared to that reported for some common leafy vegetables like Bengal gram leaves (1.4 %), susni sag (1.4%), tamarind leaves (2.1%) etc. (Gopalan *et al*, 2004). The leaves of *Chenopodium album* contained the highest amount of crude fibre (28.53 ± 0.23 %) and the lowest amount is found in *Alternanthera philoxeroides* (3.88 ± 0.04 %) and similar to commercial vegetables like broad beans (8.9%), cabbage (2.8%), potato (1.7%), spinach (2.5%) (Gopalan *et al*, 2004). The proximate composition of these plants were very much comparable to some other wild edible vegetables like *Allium porrum*, *Carpesium cernuum*, *Tricyrtis pillosa*, *Spilanthes acmella*, *Leea sambucina* and *Neptunia olearacea* etc, collected from different tribal market of Meghalaya (Seal *et al*, 2013).

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

Table 1. Proximate composition of the wild edible leaves collected from Meghalaya state

Name of the Plant	Ash %	Moisture %	Crude fat %	Crude fibre %	Protein % 6.25x % of N	Carbohydrate %	Energy content kcal/100g
<i>Chenopodium album</i>	53.53±0.34	85.14±0.13	1.13±0.03	28.53±0.23	7.18±0.03	09.61±0.10	77.41±0.53
<i>Alternanthera philoxeroides</i>	13.16±0.23	73.25±0.08	1.02±0.03	3.88±0.04	8.26±0.05	73.67±0.30	336.93±0.51
<i>Homalomena aromatica</i>	13.61±0.03	65.42±0.05	2.30±0.02	8.54±0.03	2.41±0.05	73.12±0.09	322.86±0.10
<i>Zanthoxylum rhetsa</i>	6.02±0.03	56.21±0.05	0.92±0.03	9.00±0.04	13.75±0.05	70.29±0.07	344.52±0.33
<i>Cajanus indicus</i>	5.48±0.02	89.55±0.04	0.69±0.02	9.65±0.03	15.77±0.03	68.39±0.01	342.90±0.15

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 the wild edible leaves collected from Meghalaya state

Name of the Plant	Minerals present mg /g							
	Na	K	Ca	Cu	Zn	Mn	Fe	Mg
<i>Chenopodium album</i>	1.11±0.01	43.66±0.27	21.87±0.15	0.022±0.0001	0.33±0.0001	0.21±0.0005	5.84±0.0005	0.96±0.0001
<i>Alternanthera philoxeroides</i>	8.25±0.07	45.86±0.22	26.47±0.18	0.0535±0.0001	0.50±0.0002	0.06±0.0001	0.26±0.0007	0.91±0.0002
<i>Homalomena aromatica</i>	0.55±0.01	12.65±0.22	13.32±0.15	0.247±0.001	0.55±0.0001	0.40±0.0001	3.60±0.0006	0.97±0.0001
<i>Zanthoxylum rhetsa</i>	0.34±0.01	13.43±0.17	11.75±0.15	0.201±0.0001	0.20±0.0002	0.83±0.0006	0.27±0.0003	0.89±0.0001
<i>Cajanus indicus</i>	0.32±0.01	10.42±0.10	5.93±0.15	0.007±0.00002	0.39±0.0002	0.05±0.0001	0.28±0.0002	0.86±0.0001

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

High concentrations of sodium (Na) were present, ranging from 0.32 ± 0.01 mg g⁻¹ (*Cajanus indicus*) to 8.25 ± 0.07 mg g⁻¹ (*Alternanthera philoxeroides*). The sodium levels of some cultivated vegetables and fruits vary between 0.030-1.249 mg g⁻¹ (Gopalan *et al*, 2004). The potassium (K) content was the highest in the leaves of *Alternanthera philoxeroides* (45.86 ± 0.22 mg g⁻¹) and the least in the leaves of *Cajanus indicus* (10.42 ± 0.10 mg g⁻¹). Potassium also plays an important role to mental function as well as to physical processes. The proper level of potassium is essential for normal cell function (Mutalik *et al*, 2011). 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 (Sapui *et al*, 2009). The ratio of K/Na were significant in the leaves of *Zanthoxylum rhetsa* (39.5), *Chenopodium album* (39.33), *Cajanus indicus* (32.56) and *Homalomena aromatica* (23.0) and very much compared with some common vegetables (Brinjal 66.66, bitter gourd 71.25, Brussels sprouts 60.37, paruppu keera 10.65 etc. (Gopalan *et al*, 2004). The calcium (Ca) content was remarkably high in the leaves of *Alternanthera philoxeroides* (26.47 ± 0.18 mg g⁻¹) followed by *Chenopodium album* (21.87 ± 0.15 mg g⁻¹) and *Homalomena aromatica* (13.32 ± 0.15 mg g⁻¹). The calcium levels of some cultivated vegetables and fruits vary between 0.1-1.300 mg g⁻¹ (Gopalan *et al*, 2004). 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).

In human body, copper is another trace element essential to the proper functioning of organs and metabolic processes. It exists as an integral part of copper proteins ceruloplasmin, the enzyme that catalyzes the oxidation of iron ion (Sapui *et al*, 2009) . A very good amount of copper present in the leaves of *Homalomena aromatica* ($0.247\pm 0.001 \text{ mg g}^{-1}$) and in *Zanthoxylum rhetsa* ($0.201\pm 0.0001 \text{ mg g}^{-1}$). The sufficient amount of copper (Cu) was also present in *Alternanthera philoxeroides* ($0.0535\pm 0.0001 \text{ mg g}^{-1}$) and in *Chenopodium album* ($0.022\pm 0.0001 \text{ mg g}^{-1}$).

An appreciable quantity of Zinc (Zn) was found to be present ranging from $0.20\pm 0.0002 \text{ mg g}^{-1}$ (*Zanthoxylum rhetsa*) to $0.55\pm 0.0001 \text{ mg g}^{-1}$ (*Homalomena aromatica*).

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 0.05 ± 0.0001 to $0.83\pm 0.0006 \text{ mg g}^{-1}$. The highest Mn values were found in the leaves of *Zanthoxylum rhetsa* ($0.83\pm 0.0006 \text{ mg g}^{-1}$) and an appreciable amount of this element was 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). A very high concentration of iron (Fe) was present in the leaves of *Chenopodium album* ($5.84\pm 0.0005 \text{ mg g}^{-1}$) and moderate amount of iron was present in *Homalomena aromatica* ($3.60\pm 0.0006 \text{ mg g}^{-1}$) and *Cajanus indicus* ($0.28\pm 0.0002 \text{ mg g}^{-1}$). A daily Fe requirement of human body is 15 mg and the deficiency causes some illness like anemia. Wild edible plants studied have sufficient and high Fe levels for human health (Sekeroglu *et al*, 2006) .

The Magnesium (Mg) concentrations of the plants studied varied between 0.663 ± 0.001 to $0.781\pm 0.001 \text{ mg g}^{-1}$. The highest Mg value is found in the leaves of *Homalomena aromatica* ($0.97\pm 0.0001 \text{ mg g}^{-1}$). A very good amount of Mg is also present in all the leaves under investigation. Magnesium is required in human body for cellular metabolism. Its play a vital role in the cardiovascular diseases (Sekeroglu *et al*, 2006).

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

CONCLUSION

The study shows that the wild edible leaves collected from Meghalaya State in India rich in protein, available carbohydrate, total dietary fibre and minerals investigated and we believe that these plants can be used for the well-being of mankind due to their good nutritional qualities and adequate protection may be obtained against diseases arising from malnutrition.

ACKNOWLEDGEMENTS

Author of this paper 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 facilities. I am also thankful to Mr. R. Shanpru, Scientist, Botanical Survey of India, Eastern Regional circle, Shillong, Meghalaya for identifying the plant specimens.

REFERENCES

- Akubugwo I. E, Obasi A. N. and Ginika S. C. (2007). Nutritional potential of the leaves and seeds of black nightshade-*Solanum nigrum* L. var *virginicum* from Afiko-Nigeria, Pakistan Journal of Nutrition, 6 (4) : 323-326.
- AOAC, (1990). Official methods of analysis, 14th edition, association of Official Analytical Chemists, Washington DC. Arlington, Virginia, USA.
- Barua C. C , Talukdar A, Phukan B, Hazarika S, Barua A. G. and Baishva G. (2014). Phytochemical screening and *in vitro* antioxidant activity of ethanolic extract of *Homalomena aromatica* (Araceae) root, Der Pharmacia Lettre, 6 (1) : 128-138
- Gopalan C, Rama Sastri B. V. and Balasubramanian S. C. (2004). Nutritive value of Indian foods. Printed by National Institute of Nutrition, Indian Council of Medical research, Hyderabad 500 007, India, pp 2-58.
- Ihedioha J. N. and Okoye C. O. B. (2011). Nutritional evaluation of *Mucuna flagellipes* leaves: An underutilized legume in Eastern Nigeria. American Journal of Plant Nutrition and Fertilization Technology, 1: 55-63.

- Indrayan A. K, Sharma S, Durgapal D, Kumar N. and Kumar M. (2005). Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttaranchal. *Current Science*, 89 (7) : 1252-1255.
- Jain S. K. and Dam Namita. (1979). Some Ethnobotanical notes from North-eastern India. *Economic Botany*, 33(1) : 52-56.
- Kayang H. (2007). Tribal knowledge on wild edible plants of Meghalaya, Northeast India. *Indian Journal of Traditional Knowledge*, 6 (1) : 177-181.
- Khan Mohd Habibullah and Yadava P.S. (2010). Herbal remedies of asthma in Thoubal District of Manipur in North East India. *Indian Journal of Natural Products and Resources*. 1(1) : 80-84.
- Lalitharani S, Kalpanadevi V. and Mohan V.R. (2012). Pharmacognostic studies on the spine of *Zanthoxylum rhetsa* (ROXB.) DC. *Biosci. Disc.*, 4(1):05-11)
- Mao A. A, Hynniewta T. M. and Sanjappa M. (2009). Plant wealth of Northeast India with reference to ethnobotany. *Indian Journal of Traditional Knowledge*, 8 (1) : 96-103
- Mutalik V. K, Jagadish G. B, Mekali S. B, Gouda C. V. and Vardhaman N.B. (2011). Determination of estimation of potassium ion in dry fruits by flame photometry and their proximate analysis. *Journal of Chemical and Pharmaceutical Research*, 3(6): 1097-1102.
- Pal D. K, Mishra P, Sachan N, Ghosh A. K. (2011). Biological activities and medicinal properties of *Cajanus cajan* (L) Millsp. *Journal of advanced pharmaceutical technology and research*, 2(4) : 207-14.
- Panda A, Misra M. K. (2011). Ethnomedicinal survey of some wetland plants of south Orissa and their conservation. *Indian Journal of Traditional Knowledge*, 10 (2) : 296-303.
- Payum T, Das A. K, Shankar R, Tamuly C. and Hazarika M. (2013). Folk use and antioxidant potential determination of *Zanthoxylum rhetsa* DC. shoot-a highly utilized hot spice folk vegetable of Arunachal Pradesh, India. *Int J Pharm Sci Res*, 4(12) : 1000-05.
- Prashanth Kumar, G M and Shiddamallayya N. (2014). Documentation of wild plant tubers as food resources in Hassan District, Karnataka, *International Journal of Applied Biology and Pharmaceutical Technology*, 5(2) : 90-95.
- Saikia P. and Deka D. C. (2013). Mineral content of some wild green leafy vegetables of North-East India, *Journal of Chemical and Pharmaceutical Research*, 5(3) : 117-121.
- Sapui N, Zakaria M. H. and Bujang J. S. (2009). Analytic chemical composition and mineral content of yellow velvet leaf (*Limnocharis flava* L. Buchenau)'s edible parts. *Journal of Applied Sciences*, 9 (16) : 2969-2974.
- Seal T, Chaudhuri K. and Pillai B. (2013). Evaluation of proximate and mineral composition of wild edible leaves, traditionally used by the local people of Meghalaya state in India. *Asian Journal of Plant Sciences*, 12 (4) : 171-175.
- Sekeroglu N, Faruk O, Metin D, Ozbay D. and Nuri Y. (2006). Evaluation of some wild plants aspect of their nutritional values used as vegetable in Eastern Black sea region of Turkey. *Asian Journal of Plant Sciences*, 5 (2) : 185-189.
- Shankar R, Rawat M. S, Deb S. and Sharma B. K. (2012). Jaundice and its traditional cure in Arunachal Pradesh, *Journal of Pharmaceutical and Scientific Innovation*, 1(3) : 93-97.
- Sikarwar I, Wanjari M, Satyendra Singh Baghel S. S. and Vashishtha P. (2013). A review on phytopharmacological studies on *Chenopodium album* Linn. *Indo American Journal of Pharmaceutical Research*, 3(4) : 3089-3098.
- Suganthi V. and Nair A. L. R. (2011). Hepatoprotective activity of *Chenopodium album* against carbon tetra chloride-induced hepatotoxicity in rats. *International Journal of Pharma and Bio Sciences*, 2 (4) : 599-603.
- Sundriyal M. and Sundriyal R. C. (2004). Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species, *Economic Botany*, 58 (2) : 286-299.
- Valvi, S.R. and Rathod, V.S. (2011). Mineral composition of some wild edible fruits from Kolhapur district, *International Journal of Applied Biology and Pharmaceutical Technology*, 2(1) : 392-96.

ISSN : 0976-4550

INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY



Email : ijabpt@gmail.com

Website: www.ijabpt.com