

QUANTITATIVE ANALYSIS OF PROXIMATE AND MINERAL COMPOSITION OF A FEW
IMPORTANT MEDICINAL PLANTS OF NORTH EAST REGION

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ABSTRACT: The nutritional potential of five ethno botanically important medicinal plants e.g. *Acorous calamus*, *Corchorous fascicularis*, *Plantago erosa*, *Ocimum sanctum* and *Bryophyllum pinnatum* were evaluated in the present study. The plants/herbs collected from different places of North East India were evaluated by determining the Proximate and Mineral composition. Few of these plants are used by the local people of North East India as their food. They have immense medicinal properties as evident from the literature survey. The present study was undertaken to determine their nutritional importance. The results revealed, the crude fat content ranged between 0.64-2.91% ; the crude protein content was higher in the leaves of *plantago erosa* (21.45 %) followed by *Ocimum sanctum* (20.84%) and *Corchorous fascicularis* (18.38%), while the available Nitrogen free extract content was the highest in the leaves of *Acorous calamus* (75.03%). The nutritive value ranged from 216.25-297.75 kcal/100g in the various edible plants. Among the various micronutrients estimated, iron was present in the highest quantity (36.00-294.00mg /kg) followed by zinc (0.14-6.06mg/kg) and calcium (0.6-1.9mg /kg). The result indicates that the nutritional values and mineral contents of these medicinal plants under investigation were superior to many commercially used nutritive herbs. Hence, they can be utilized for their nutritional potential.

Key words: Medicinal plants, nutritional composition, mineral content

INTRODUCTION

Since time immemorial plants are used ethnobotanically for food, shelter, medicine, clothing, hunting and religious ceremonies, but their primary use is for health care (Aumeeruddy, 1996). According to World Health Organisation (WHO) 80% of the population rely on traditional medicine as a source of primary health care needs (Mukhopadhyay, 1998). About 8000 species of medicinal plants are in current use by local communities all over India. The foot hills of North East region are the richest reservoir of medicinal plants. Most of the Tribal communities still largely depends on traditional medicinal system as they are easily available and has no side effects and ecofriendly. The increasing research has created clear evidence on the positive role of traditional medicine in prevention and control of various diseases. The demand of medicinal and aromatic plants has been increased in the recent years due to rapid growth of pharmaceutical industries. A great variety of wild plants are used for suitable preparation of drugs either from the dried/whole plant or a specific part of it (root, leaves, fruit, flower and seed). In India, about 2000 drugs used are of plant origin. (Dikshit, 1999). Plants generally produces many secondary metabolites which are biosynthetically derived from primary metabolites and constitute an important source of microbicides, pesticides and many pharmaceuticals. As the efficacy of the herbs lies in the organic constituents, trace elements also play an important role from toxicological and nutritional point of view (Dim *et al*, 2004). Many herbs and spices act as an appetizer, digestion stimulant, anti bacterial, antioxidant, anti inflammatory and immunostimulant etc.

For example Cinammon, Cloves, Cardamom, laurel and mint increase appetite (Loo and Richard, 1992). Use of herbal medicinal plants in animal diet as an alternative source to antibiotics is also reported as they enhance the productive performance of animals. Literature survey revealed that scanty and sporadic works have been carried out regarding the nutritional and mineral composition of the selected medicinal plants. Consequently, the present study was carried out for quantitative analysis of proximate and mineral composition of these medicinal plants.

Acorus calamus, a medicinal herb occasionally planted in the home gardens and often found as garden escape in Kutenai wetlands of Kerala, India. It is commonly known as sweet flag. Traditionally, the rhizomes were used for toothache and powdered rhizome for congestion. It has insecticidal, antifungal, antibacterial (Phongpaichit *et al*, 2005), tranquilizing, antidiarrhoeal, antidiyslipidemic, neuroprotective, antioxidant, anti-cholinesterase, spasmolytic, vascular modulator activities (Shaha and Gilani, 2010). We have reported anti ulcer, anti arthritic and memory enhancing activity of *A. calamus* in ethanol extract of rat and mice (Communicated). *Ocimum sanctum* (Tulsi) has been used from the time of Ayurveda for its diverse healing properties. The dried leaves of Tulsi have been used as an insect repellent (Biswas and Biswas, 2005). The extract of *Ocimum sanctum* (Tulsi) leaves is hypoglycaemic, immuno-modulatory, anti stress, analgesic, antipyretic, anti-inflammatory, anti-ulcerogenic, antihypertensive, radio-protective, anti-tumour and antibacterial (Das and Vasdevan, 2006).

Bryophyllum pinnatum is a perennial herb commonly known as air plant, miracle leaf, love plant. It is used in folk medicine in tropical Africa, tropical America, India, China, and Australia. It is well known for its wound healing and haemostatic properties. Traditionally, it is used for medicinal purpose for treatment of various ailments viz. anthelmintic, immunosuppressive, hepatoprotective, anti-nociceptive, anti-inflammatory and anti-diabetic, nephroprotective, antioxidant, antimicrobial, analgesic and anticonvulsant, neuropharmacological and antipyretic activities (Muhammad *et al*, 2012).

Corchorous fascicularis Lamm. is an annual herb found throughout India. Powder of entire plant is used as tonic to anaemic patient (Patil, 2003). The aerial parts of *C. fascicularis* has been traditionally used for treating various ailments including pruritis, itching, inflammation, scabies, worm infestation, gonorrhoea, syphilis, leprosy, edema, tumours, and sexual incompetence (Kiritikar and Basu, 1987; Khan *et al*, 1997). The leaves play an economical role in the strategy of food security of urban populations (Gockowski and Ndoumbe, 1997).

Plantago erosa Wall, synonym- *Plantago major* Linn is a glabrous perennial herb very common in moist, wasteland in the valley of Manipur, India. It is also commonly known as *Yempat* in Manipuri and *Luhuriya* in Hindi. It has been used by the local indigenous people (Maaiba) of Manipur in treating fever, boils, dysentery, diarrhoea, urinary tract complaints, headache, tooth ache, and various inflammatory conditions (Marak *et al*, 2014). In our previous study we have reported its anti inflammatory (Barua *et al*, 2010), analgesic (Barua *et al*, 2011) and anxiolytic activity of the hydroethanol extract of *Plantago erosa* (Barua *et al*, 2009). The seeds of the plant have been used as abortifacient (Chakraborty *et al*, 2008).

MATERIALS AND METHODS

Plant materials

The five plant materials e.g. *Acorous calamus*, *Corchorous fascicularis*, *Plantago erosa*, *Ocimum sanctum* and *Bryophyllum pinnatum* were collected from different places of North East region were authenticated by taxonomist Dr. I.C. Barua, Principal Scientist, Agronomy, AAU, Jorhat. Voucher specimens are deposited. The plant parts were shade-dried, pulverized and stored in an airtight container for future use.

(i) Estimation of ash: About 2g of the sample was weighed and taken in a vitreosil basin. The basin was heated in a low flame at the beginning till no fumes were given off by the charred mass. It was broken by a glass rod carefully and burnt in a muffle furnace at 550- 600°C for 4-5 hrs. The muffle was allowed to cool to 150°C. The basin was then cooled in a desiccator and the ash content was then weighed. The total ash was calculated as follows:

$$\% \text{ of total ash} = \frac{\text{weight of the ash} \times 100}{\text{weight of the sample}}$$

(ii) Estimation of moisture content

Fresh sample materials were taken in a flat bottom dish and kept overnight in a hot air oven at 100-110°C and weighed. The loss in weight was regarded as a measure of moisture content.

(iii) Estimation of crude protein (Micro-Kjeldahl Method)

Digestion: About 2gm of sample was taken in a Kjeldahl flask, 10gms of sodium sulphate and 0.5 gm of copper sulphate was added and mixed well. A few glass beads were added into the flask to prevent spurting while heating. Then 25 ml of concentrated H₂SO₄ was added and then heated atleast for 15-20 mins in inclined position. The solution was boiled until a greenish colour was obtained. It was allowed to cool.

Distillation

About 100 ml of distilled water was added to the Kjeldahl flask, shaken properly and transferred it into a 250 ml volumetric flask. Then the final volume was made upto 250 ml by adding distilled water. In a conical flask, 10-15 ml of 2% Boric acid was taken and the flask was placed below the condenser of the distillation apparatus.

Thereafter, 5 ml of aliquot was transferred to the Micro Kjeldahl steam distillation apparatus and added 1 drop of phenolphthalene and 10-15 ml 40% NaOH. The distillation was carried out atleast for 5-10 mins until ammonia was free from aliquot.

Titration: The distillation product was then titrated against N/10 H₂SO₄

Calculation is done as follows:

$$\% \text{ of Nitrogen} = \frac{\text{ml of N/10 H}_2\text{SO}_4 \text{ used} \times 250 \times 0.0014 \times 100}{\text{Volume of aliquot} \times \text{gm of the substance taken}}$$

$$\% \text{ of crude protein} = \% \text{ Nitrogen} \times 6.25$$

iv) Estimation of crude fat (Ether extract)

Five gm of dry sample was weighed on a piece of glazed paper and transferred into an extraction thimble. The thimble was introduced into soxhlet extractor over a pad of cotton wool, so that top of the thimble is well above the top of the siphon. A clean dry flask was taken, weighed and was fitted with the extractor. Ether was poured along the side of the extractor until it begins to siphon off. Then another half-a siphonful of ether was added. The equipment thus assembled with the flask was placed on a water bath at 60-80°C and the extractor was connected with the condenser. Cool water circulation was started in the condenser and allowed the extraction for 8 hr. Then the thimble with the material was removed from the extractor. The apparatus was assembled again and heated on a water bath to recover all the ether from the receiver flask. The receiver flask was disconnected and dried it in a hot air oven at 100°C for 1 hr, cooled and weighed.

$$\% \text{ of Ether extract} = \frac{(\text{Wt. of oil flask with ether extract} - \text{Wt. of the oil flask}) \times 100}{\text{gm of the substance taken}}$$

(v) Determination of crude fibre

About 2 gm of moisture and fat free sample was weighed and transferred to the spout less one litre beaker. Thereafter, 200 ml 1.25% H₂SO₄ was added. The beaker was placed on hot plate and allowed to reflux for 30 mins, timed from onset of boiling. The content was shaken after every 5 min. The beaker was removed from the hot plate and filtered through a muslin cloth using suction. The residue was washed with hot water till it was free from acid. The material was transferred to the same beaker and added 200ml of 1.25% NaOH solution and refluxed for 30 mins. Again filtered and the residue was washed with hot water till it was free from alkali. The total residue was transferred to a crucible and placed in hot air oven, allowed to dry to a constant weight at 80-110°C and weighed. The residue was ignited in muffle furnace at 550-600°C for 2-3 hrs, cooled and weighed again. The loss of weight due to ignition was the weight of crude fiber.

$$\% \text{ of Crude Fiber} = \frac{(\text{Wt of the crucible with dry residue} - \text{Wt of crucible with ash}) \times 100}{\text{gm of the substance taken}}$$

(vi) Determination of carbohydrate

Carbohydrate content is calculated by following formula-

$$\% \text{ of Carbohydrate} = 100 - (\text{Crude Protein \%} + \text{Moisture \%} + \text{Crude Fiber \%} + \text{Ether Extract \%} + \text{Total ash \%})$$

Procedure for Mineral analysis

(i). Estimation of Fe, Zn and Cu

For this study, 0.5 gm of powdered dried sample was taken in a crucible and converted to ash in the muffle furnace at 580°C for 3 hrs. After cooling in a desiccators 10 ml of concentrated Nitric acid, 4 ml of Perchloric acid and 1ml of Sulphuric acid was added and digestion at high temperature was carried out until the content became clear, then the tube was cooled and the solution was transferred quantitatively to 50 ml volumetric flask and the final volume was adjusted to 50 ml by adding distilled water. The solution was used for determination of Fe, Zn and Cu through the atomic absorption spectrometry (AA203D). Calcium and Phosphorous estimation were done as per method described by Talapatra et al, (1994).

RESULTS AND DISCUSSION

Proximate Composition

The proximate composition of the five selected medicinal plants is depicted in Table 1. The proximate composition viz Total Ash, Calorific Value, NFE, Crude protein, Crude fat, Crude Fibre and Moisture were carried out as per the method of AOAC, 2005 on DM basis. The nutritive value was maximum in *A. calamus* (297.75Kcal/100g) followed by *O. sanctum* (262.84 Kcal/100g), *C. fascicularis* (251.56Kcal/100g), *B. pinnatum* (243.85Kcal/100g) and *P.erosa* (216.25 Kcal/100g). Amongst the five selected medicinal plants, *P.erosa* showed the highest concentration of protein followed by *O. sanctum* and *C. fascicularis*. The Crude fat ranged from 0.64% (*B. pinnatum*) to 2.91% (*A. calamus*). The moisture content was different for each species of plants after drying. The moisture content was minimum in *C. fascicularis* (9.9%) and the total ash concentration was found the highest in *P.erosa* (18.0%) indicating the plant may be a good source of minerals. The crude fiber and NFE content was found highest in *C. fascicularis* (20.0%) and *A. calamus* (75.03%). The high fiber content is good for easy passage and absorption of food through the alimentary canal.

Mineral Composition

The medicinal plants contain varying concentration of minerals like Calcium, Phosphorous, Iron, Zinc and Copper and are presented in Table 2. High concentration of calcium and phosphorous were present in *Corchorous fascicularis* followed by *Ocimum sanctum* and *Plantago erosa*. Calcium and Phosphorous is essential for bone development and prevention of osteoporosis (Wardlaw and Smith, 2007). Calcium is also required for blood clotting and normal integrity of intracellular cement substances (Okaka and Okaka, 2001). Therefore, high calcium content of plants helps normal cell integrity (Okwu and Josiah, 2006).

Table 1: Proximate Composition of five Selected Medicinal Plants Species on (DM) basis

Specimens	Moisture (%)	Crude protein (%)	Ether Extract (%)	Crude fiber (%)	Total ash (%)	Nitrogen Free Extract (%)	Calorific value (Kcal/100g)
1. <i>Acorous calamus</i>	13.7	6.56	2.91	9.5	6.0	75.03	297.75
2. <i>Corchorous fascicularis</i>	9.9	18.38	0.64	20.0	8.0	52.98	251.56
3. <i>Plantago erosa</i>	13.4	21.45	1.57	16.5	18.0	42.48	216.25
4. <i>Ocimum sanctum</i>	11.44	20.84	1.32	10.0	14.5	53.34	262.84
5. <i>Bryophyllum pinnatum</i>	14.35	12.50	0.65	8.50	17.0	61.35	243.85

Table-2: Mineral Content of five Selected Medicinal Plants Species

Specimens	Calcium (%)	Phosphorous (%)	Zinc (ppm)	Iron (ppm)	Copper (ppm)
1. <i>Acorous calamus</i>	0.8	0.330	0.27	36.0	0.03
2. <i>Corchorous fascicularis</i>	1.9	1.35	6.06	294	0.01
3. <i>Plantago erosa</i>	0.9	0.742	0.14	165	0.02
4. <i>Ocimum sanctum</i>	1.8	1.07	0.49	189	0.01
5. <i>Bryophyllum pinnatum</i>	0.6	0.85	0.33	42	0.97

Iron (Fe) is an important trace element in the human body. It plays a vital role in haemopoiesis, control of infection and cell mediated immunity (Bhaskaram, 2001; Kozat, 2007). Iron deficiency anemia is estimated to affect more than one billion people worldwide (Trowbridge and Martorell, 2002). We have analysed and found very good amount of iron in *C. fascicularis* (294ppm) followed by *O. sanctum* (189ppm), *P.erosa* (165ppm), *B. pinnatum* (42ppm) and *A. calamus* (36ppm). Hence, in addition to their well-known medicinal properties, use of these plants as haematinic can also be recommended.

Sufficient amount of Zinc was present in *C. fascicularis* (6.06ppm) and *O. sanctum* (0.49ppm) and *B. pinnatum* (0.33ppm). Zn is another essential element in human nutrition. Its deficiency may lead to malnutrition and parasitic illnesses such as malaria. Zinc deficiency increases the level of *Plasmodium falciparum* in blood (Fokou and Ponka, 2009). Zinc deficiency leads to retarded growth, loss of appetite and impaired immune function. In more severe cases, hair loss, diarrhoea, delayed sexual maturation, impotence, hypogonadism in males, and eye and skin lesions may be seen. (Ryan-Harshman and Aldoori, 2005). The above mentioned plants can cure or revert zinc deficiency if given along with their diet as supplement or additive.

Copper level in the plants/herbs under study ranged from 0.01 to 0.97ppm. Copper content was the highest in *B.pinnatum* leaves as compared to other plants/herbs. Copper is also involved in the formation of red blood cells and synthesis of haemoglobin. It has a role in energy production, wound healing, skin and hair color as well. Copper is involved in stimulating body defence system. In combination with Zinc, it plays a role in superoxide dismutase activity and the removal of oxygen free radicals (Guo et al, 2010). Hence from this study, nutritional value of the medicinal plants has thrown some lights for considering their use also as herbal supplement or feed additive.

It was reported by other workers that *A.calamus* rhizome contains nutrients viz. carbohydrate, crude protein, crude fibre, crude lipid, total ash, ascorbic acid, beta carotene, tocopherol, minerals (Na,Ca,P,K,Cu,Zn,Mg)(Soman et al,2014). In our study whole plant was used instead of rhizome, hence the amount obviously varies. Use of whole plant is better than uprooting the plant for rhizome. Very few studies have been carried out on the nutritional and mineral composition of *O.sanctum*. Koche et al, (2011) reported the presence of high carbohydrate (68.05%), Protein (12.3%) and Ash (20%) content of *O.sanctum* leaves. In addition we have also studied crude protein, crude fat, crude fiber, total ash, NFE etc for its detail proximate composition along with few important minerals. *Bryophyllum pinnatum*, also a good source of bioactive properties, have useful minerals viz calcium and potassium with a high amount of carbohydrate, protein and crude fibre (Nwali et al, 2014). Likewise, the leaves of *C fascicularis* have been reported to contain a good amount of minerals like K, Ca, P, Mg, Cl, Na,Fe ,Cu etc (Nemba et al,2012). In our study, proximate and few mineral composition were studied. From our finding it is further observed that the plant has immense possibility to overcome the mineral and nutritional deficiency diseases. No report on its proximate composition was found so far. Similarly reports on proximate composition of *P.erosa* is however scanty. In this study we have tried to explore the nutritive value of these medicinal plants.

CONCLUSION

The present study shows that the selected medicinal plants are rich in protein, carbohydrate, fibre and minerals in addition to its medicinal properties. Among the five selected medicinal plants *C. fascicularis* is found to be the superior followed by *P. erosa* and *O. sanctum*. Incorporation of these plants in diet as nutraceuticals is worth recommendation. Moreover, they are ubiquitous, can be grown or cultivated and is not even endangered. We believed that the data provided by us will be helpful to explore individual medicinal plants. Further researches are necessary to determine precisely the different constituents' present especially amino acid and vitamin content.

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