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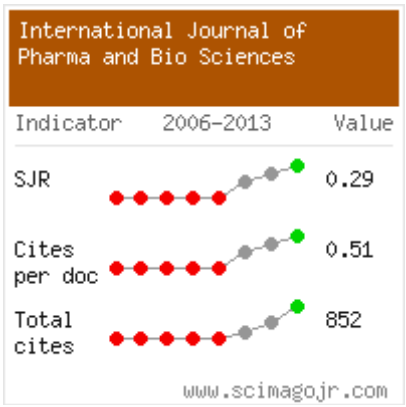

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PROXIMATE ANALYSIS AND MINERAL COMPONENTS OF SOME EDIBLE MEDICINALLY IMPORTANT LEAFY VEGETABLES OF KAMRUP DISTRICT OF ASSAM, INDIA

POBI GOGOI* AND J.C. KALITA

Animal Physiology & Biochemistry Laboratory, Department of Zoology, Gauhati University, Jalukbari, Guwahati -781014, Assam, India.

ABSTRACT

The present study was conducted to evaluate nutritional properties of certain traditional medicinally important edible leafy vegetables of Assam, India. Nutritive value and mineral composition of *Alternanthera sessilis*, *Drymaria cordata*, *Eclipta alba*, *Houttuynia cordata* and *Leucas plukenetii*, which are basically used as medicine of different ailments, were determined. Proximate analysis revealed high amount of carbohydrate content ranged from 38.46-66.54%. Moisture content was found to be highest in *Eclipta alba* (89.1%) while protein was higher in *Houttuynia cordata* (19.68%). Fat content was relatively less and fiber content ranged from 9.4 - 23.52%. These vegetables were found to be rich sources of macroelements as well as trace minerals. Potassium was the most abundant macroelement ranging from 6240.0-14570.0 mg/kg, followed by sodium, calcium and magnesium. Among the trace elements Iron was highest (252.8-712.9mg/kg), followed by zinc, manganese and Copper. The results demonstrated that these 5 selected underutilized medicinal plants have great nutritional significance.

KEYWORDS: **Proximate analysis, Ailments, Macroelements, Trace elements.**

POBI GOGOI
Animal Physiology & Biochemistry Laboratory, Department of Zoology, Gauhati University, Jalukbari, Guwahati -781014, Assam, India.

***Corresponding author**

INTRODUCTION

Plants are the nature's gift to mankind and from the very beginning of time plants have been used as an important source of food and medicine[1]. India has a rich tradition of plant-based knowledge on healthcare[2]. According to World Health Organization (WHO) medicinal plants are those plants that contain properties or compounds that can be used for therapeutic purposes or those that synthesize metabolites to produce useful drugs (WHO 2008). The wild edible medicinal leafy vegetables occupy an important place among food crops as these provide adequate amount of crude fiber, fats, carbohydrates, proteins, water and mineral elements like Ca, Na, K, Fe, Mg, Mn, Cu, Zn etc, in addition to vitamins and certain hormone precursors[3]. Studies have shown that vegetarians are less susceptible to disease and live longer, healthier and having stronger immunity[4, 5]. Most of the medicinal plants have potential to provide nutrients present in them to the consumers and utilization of these plants can provide a solution to the problem of malnutrition to a great extent[6]. In nature, there are many underutilized green leafy vegetables of promising nutritive value, which can nourish the ever increasing human population. Although, they can be raised comparatively at lower management costs even on poor marginal lands, they have remained underutilized due to lack of awareness and popularization of technologies for utilization[7]. Hence, in my present study an attempt has been made to determine nutritional values as well as macro and microelements of five edible medicinally important leafy vegetables of Kamrup district, in order to provide necessary information for their wider utilization and contribution to food security.

MATERIALS AND METHODS

Plant sample collection and Processing: All the selected plant species were collected in March 2014, from four different localities of Kamrup district of Assam and identified by a plant taxonomist of Botany Department, Gauhati University. The fresh vegetables were washed and the edible parts were dried in the shade and then ground to fine powder. The dried powdered samples were used for determination of mineral composition and proximate analysis.Proximate Analysis: Chemical estimation of moisture, ash, fat, fiber, carbohydrate and protein content were done by following AOAC (1995) guidelines[8].

(i) Estimation of total 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. The charred mass 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- % of total ash = weight of the ash × 100 / 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 2g of sample was taken in a Kjeldahl flask, 10gms of sodium sulphate and 0.5gm of copper sulphate was added and mixed well. A few glass beads were added into the flask to prevent spurting while heating. 25 ml of concentrated H_2SO_4 was added and then heated atleast for 15-20 minutes in inclined position. The solution was boiled until a greenish color was obtained. It was allowed to cool.

Distillation

About 100 ml of distilled water was added to the Kjeldahl flask, shake properly and transferred it into a 250 ml volumetric flask. Then the final volume was made 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. 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 minutes until ammonia was free from aliquot.

Titration: The distillation product was then titrated against N/10 H_2SO_4
Calculation

$$\% \text{ Nitrogen} = \frac{\text{ml of N/10 } H_2SO_4 \text{ used up} \times 250 \times 0.0014 \times 100}{\text{Volume of aliquot} \times \text{gm of sample taken}}$$

$$\% \text{ of Crude Protein} = \% \text{ Nitrogen} \times 6.25$$

(iv)Estimation of crude fat (Ether extract)
5 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. Start cool water circulation in the condenser and allowed the extraction for 8 hours. Then 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 hour, cooled and weighed.

Calculation

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

(v) Determination of crude fiber
About 2 gm of moisture and fat free sample was weighed and transferred to the spout less one liter beaker.200 ml 1.25% H_2SO_4 was added. The beaker was placed on hot plate and allowed to reflux for 30 minutes, timed from onset of boiling. The content was shacked after every 5 mints. 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 minutes. 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 for2-3 hrs, cooled and weighed again. The loss of weight due to ignition was the weight of crude fiber.

Calculation

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

(vi)Determination of total carbohydrate
Carbohydrate can be calculated by following formula-
% of Carbohydrate=100 - (Crude Protein % + Crude Fiber % + Ether Extract % + Total ash %)

Procedure for Mineral analysis

(i). Estimation of Fe, Zn, Cu, Mn, Na, K:

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 desiccator 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, Mn, Cu through the atomic absorption spectrometry (Perkin Elmer AAnalyst 200 AAS) and Three-point calibration was done for each metal with certified AAS standards of 1000 mg/L (Merck, Germany).Na and K was estimated by using Flame photometry (FPM).

(ii). Estimation of Ca & Mg: Total hardness is defined as the sum of the calcium and magnesium concentrations in the water sample and is expressed as milligram calcium carbonate per liter. Total hardness of the water extract of plant samples was determined by EDTA complexometric titration using Eriochrome Black T indicator. Ethylenediaminetetraaacetic acid (EDTA, sodium salt) forms a chelated soluble complex when added to a solution of certain metal cations. A small amount of a dye Eriochrome Black T was added to an aqueous solution containing calcium and magnesium ions at pH of 10.0 ± 0.1, the solution becomes wine red. When EDTA was added as a titrant, calcium and magnesium were complexed, and when they were completely complexed, the solution turns from wine red to blue, marking the end point of the titration. Magnesium ion must be present to yield a satisfactory end point. To ensure this, a small amount of complexometrically neutral magnesium salt of EDTA was added to the buffer; this automatically introduced sufficient magnesium and obviates the need for a blank correction. For calcium hardness, the same procedure was followed but the indicator used to be Murexide. In this case, the end point was determined with change of color from purple to pink. Magnesium hardness was calculated by subtracting the value of calcium hardness from total hardness.

$$\text{Total hardness (as mg/L } CaCO_3) = \frac{\text{ml of EDTA used X 1000}}{\text{ml of sample}}$$

$$\text{Calcium, mg/L} = \frac{\text{A x 400.8}}{\text{mL of Sample}}$$

Where, A =volume of EDTA used in ml.

$$\text{Magnesium, mg/L} = \frac{\text{(B-A) x 400.8}}{\text{ml of sample x 1.645}}$$

Where, B = EDTA used for hardness (both Ca and Mg) determination.
A = EDTA used for calcium determination for the volume of sample.

RESULTS AND DISCUSSION

The results obtained from proximate analysis of the selected leafy vegetables are presented in the Table I. The edible parts of fresh plant materials e.g., the leaves of *L. plukenetii, E. alba, A. sessilis, H. cordata* and *D. cordata* collected from different localities of Kamrup district have a relatively high carbohydrate content when compared to ash, crude protein, crude fiber, crude fat and available moisture content. Almost all organisms use carbohydrates as their rich supply of potential energy to maintain life[9]. Carbohydrate content ranged from 38.46-66.54%. Moisture content (89.1%) and carbohydrate content (66.54%) was highest in *E. alba*. Ash content ranged from 13.5-18.81%. Total ash contains both the

soluble and insoluble minerals in the sample. Mineral composition of a plant gives the idea of possibility whether the plant should be used for any medicinal purpose[9]. Crude fiber is essential for the mechanical strength of plants and it is very essential for the digestion of food materials in the food canal of animals[9]. There was a variation in the fiber content, ranging from 9.4% (*Eclipta alba*) to 23.52% (*A. sessilis*). Highest crude protein percentage (19.68%) was found in *H. cordata*, while the highest nutritive value (306.97%) was for *Eclipta alba.* The studied medicinal leafy vegetables were poor sources of lipids and their consumption could be advantageous for individuals suffering from obesity[10]. Proteins are the primary components of living things. The presence of higher protein, carbohydrate and other primary metabolite level in the plants point towards their possible increase food value.

Table I
Nutritional parameters of the 5 selected plants

Parameters	*L. plukenetii*	*E. alba*	*A. sessilis*	*H. cordata*	*D. cordata*
Moisture (%)	14.12	89.1	15.28	12.5	12.21
Ash (%)	11.48	17.1	13.5	18.81	17.22
Protein (%)	12.8	4.37	19.56	19.68	19.37
Crude fat (%)	4	2.59	4.95	2.2	2.95
Crude Fiber (%)	20.33	9.4	23.52	16.98	11.8
Carbohydrate (%)	51.39	66.54	38.46	42.33	48.66
Nutritive value (%)	292.76	306.97	276.63	267.84	298.67

Mineral composition

The edible parts of the 5 selected plants contain minerals like Na, K, Zn, Cu, Fe, Ca, Mg & Mn in varying amount and are shown in the following Table II.

Table II
Mineral content of the selected medicinal leafy vegetables of Kamrup district.

Name of the plants	Minerals (mg/kg)							
	Fe	Cu	Zn	Mn	Ca	Mg	Na	K
D. cordata	712.9	12.5	124.7	94.7	1527.0	214.6	1690.0	11250.0
L. plukenetii	339.2	7.40	104.2	6.4	1100.0	346.8	1460.0	14570.0
A. sessilis	527.8	14.5	45.0	87.1	2866.0	294.1	3580.0	6240.0
E. alba	252.8	21.8	35.7	64.1	2310.0	454.8	2410.0	8550.0
H. cordata	432.7	91.5	148.1	124.5	2102.0	751.8	2570.0	9040.0

The species analyzed in this study contained remarkably high amount of nutritionally important minerals like Na, K, Ca, Mg, Mn, P, Fe, Zn, Cu etc. The leafy vegetables under investigation contained high amount of K (6240.0-14570.0 mg/kg) and Na (1460.0-3580.0 mg/kg) with the highest value (14570.0 mg/kg; 3580.0 mg/kg) for *L. plukenetii* and *A. sessilis* respectively. Mg, Mn & Zn were quantified high (751.8mg/kg, 124.5 mg/kg and 148.1 mg/kg respectively) in *H. cordata.* The Fe content varied from 252.8 mg/kg (*E. alba*) – 712.9 mg/kg (*D. cordata*).The medicinal plants contained relatively less amount of Cu (7.4mg/kg – 91.5 mg/kg) when compared to other mineral. When a mineral is deficient in a characteristic syndrome is produced which reflects the specific function of that nutrient in the metabolism of the animal. Regular dietary use of *D. cordata, H. cordata, A. sessilis and L. plukenetii plants* is so much beneficial for the people who have diabetic complications because micronutrients present in these plants (Fe, Zn, Mg, Cu, Na and K) can activate B-cells of the pancreas to produce insulin[11]. Fe is an essential mineral and vital component of proteins (Haemoglobin) involved in oxygen transport. Consumption of Fe rich plants like *D. cordata, A. sessilis, H. cordata* and *L. plukenetii* can improve anemic conditions[12]. Fe is also an essential cofactor in the synthesis of neurotransmitters such as dopamine or epinephrine and serotonin[13]. In addition, consumption of all the edible,

medicinal plants under study would probably reduce high blood pressure diseases because the ratio of Na/K in all the plants was less than one. Na/K ratio less than one are recommended[14]. Sodium and potassium maintain osmotic and water balance, membrane potentials[15, 16]. *D. cordata, L.plukenetii* etc are K-rich plants and are recommended for the patients suffering from rheumatoid arthritis[1]. Zn undernutrition or defiency impairs cellular mediators of innate immunity such as phagocytosis, Natural Killer cells activities, impair growth & gonadal function [17, 18]. The diseases resulting from Zn deficiency can be cured if people use *D. cordata, L.plukenetii, H. cordata***.** Copper is involved in the formation of red blood cells, the synthesis of hemoglobin, and formation of bone, normal growth and development of fetus[9]. Cu has a role in energy production, wound healing, taste sensation, skin and hair color. Sufficient amount of Cu was found in the selected leafy vegetables. An appreciable quantity of Mg can be obtained by using *E. alba and H. cordata* in our regular diet, which involved in many enzymatic reactions of oxidative metabolism of nutrients and cell constituent synthesis, transmission of nerve impulses, body temperature regulation, detoxification, energy production and the formation of healthy bones and teeth[9]. Calcium is a component of bones; plays a role in signal transduction in hormonal action, muscle contraction, blood clotting, milk clotting structural role of proteins etc[19]. Mn is also required for normal insulin synthesis and secretion, enzyme metabolism etc[11].

CONCLUSION

The results of the present study clearly indicate that all the edible parts of the medicinal leafy vegetables are rich in carbohydrate, protein, fiber and ash contents. The selected plants for mineral analysis contain both macro & micronutrients in sufficient quantities. The edible, medicinal leafy vegetables under investigation have potential to cure numerous diseases because of the presence of important elements such as K, Na, Ca, Fe, Zn, Mn, Mg & Cu. As it has been proved by earlier workers that these elements are highly beneficial in treating various diseases, their consumption may be beneficial for health. These plants like *L. plukenetii*, *E. alba*, *A. sessilis*, *H. cordata* and *D. cordata* could help in reduction of deficiency diseases. Regular consumption of these plants can provide a solution to myriad of health problems, including malnutrition to a great extent and even in curing deadly diseases like cancer.

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