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BIDENS BITERNATA (LOUR.) MERR. AND SHERIFF. - A POTENTIAL PLANT TO SOLVE NUTRITIONAL DEFICIENCY PROBLEMS

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Bidens biternata belongs to the family Asteraceae, is an erect annual herb, commonly known as *"Thunilotty / Ottupullu / Alenchappu"*, a wide spread weed of cultivated areas, and is common, particularly in Western Ghats regions of Kerala state in India. It is used as a leafy vegetable by Panikyar, Chetti and Kattunaayika tribes of Waynadu districts in Kerala and also to cure hepatitis, cold, cough and dysentery. The present study aimed to evaluate various nutritional and antinutritional factors in *Bidens* giving emphasis to vitamins, amino acids and macronutrients. Different vitamins like vitamin-A, C, E, B_1, B_2, B_3 and amino acids like glycine, tyrosine, phenyl alanine, serine, aspartic acid, proline, cysteine, isoleucine, methionine, tryptophan and lysine were studied by standard estimation methods. The other important nutritional factors like carbohydrates, proteins, cellulose, starch, amylose, amylase, and anti-nutritional factors like total phenol, trypsin inhibitor, phytic acid, tannic acid etc. were analysed along with macronutrients like carbon, phosphorous and nitrogen. Present study revealed that this wild leafy plant has high amount of vitamins, amino acids and other nutritional factors but has only low level of antinutritional factors. Wild edible plants are very much important to provide nutritionally valuable supplements in the form of ingredients, vegetables and beverages and can be used to overcome the nutritional deficiency problems.

Keywords: Amino acids; Antinutritional factors; *Bidens biternata;* Nutritional factors; Vitamins.

Introduction

India has a tribal population of 42 million, of which 60% live in forest areas and depend on various edible products from forest for their daily diet[1]. Studies on traditional uses of wild plants and their products throughout the world have increased now. About 1000 species of these plants provide sustenance to tribal inhabitants in India[2]. Leafy greens form the second important category of vegetables next to starchy vegetables and they are typically low in calories. Majority of the Indian population is vegetarian and a daily intake of at least 100 g of fresh leafy vegetable is recommended by the nutrition expert's well balanced diets[3]. Leafy vegetables does not have poisonous alkaloids and do not cause any gastrological disturbance when they are consumed as food. The nutritional value of traditional leafy vegetables is higher[4] than several common vegetables.

Many species of vegetables containing high amounts of digestable carbohydrates (starch, sucrose, glucose, and fructose), non-digestible carbohydrates (cellulose, hemicelluloses, pectin, protides) vitamins, minerals and significant amount of iron[5]. Consumption of fresh leafy vegetables enables full assimilation of vitamins in the human body. Minerals such as Ca, Fe, Cu, P, Zn and Na are well represented in vegetables and they provide alkalizing effects, neutralizing the acidity produced by other foods, especially those of animal origin[6]. Leafy greens also contain antioxidants which offer protection against many chronic diseases like heart diseases and certain types of cancers[7].

Bidens biternata belongs to the family Asteraceae consumed by tribes like Panikyar, Chetti and Kattunaayika of Western Ghats in India posses medicinal properties also. It is important to analyze nutritional and antinutritional factors for effective utilization of the plant. Different nutritional factors like carbohydrates, proteins and micronutrients in *B. biternata* were reported by Pradeesh *et al.* [8]. Present study intended to evaluate factors like vitamins, amino acids and antinutrient contents in *Bidens biternata* which could be used as a potential plant for solving nutritional deficiency problems.

Material and Methods

Bidens biternata were collected from Western Ghats of Kerala state in India. Fresh samples of mature leaves, young leaves, stem and root were used for the analysis of

amino acids; vitamin and antinutritional factors and experiment were done in triplicate. The analysis were performed following standard methods for estimation of nutritional factors like vitamin-A (β-carotene), vitamin-C (ascorbic acid), vitamin-E (tocopherol), vitamin B_1 (thiamine), vitamin B_2 (riboflavin), vitamin B_3 (niacin), amino acids like glycine, tyrosine, phenyl alanine, serine, aspartic acid, proline, cysteine, isoleucine, methionine, tryptophan and lysine. The other nutritional factors like cellulose, starch, amylose, amylase and antinutritional factors like total phenol, trypsin inhibitor, phytic acid, and tannic acid etc. were analysed. β-carotene (vitamin-A) was determined following the method of Bayfield and Cole[9], vitamin-C, B_1, B_2, B_3 present in the sample was analyzed by the method of Sadasivam and Balasubramanian[10] and vitamin-E by the method of Rosenberg[11]. The amount of amino acids present in the samples was estimated by Moore and Stein methods[12], cellulose by Updegroff method[13], starch by Anthrone reagent[14], amylose by Thayumanavan and Sadasivam[14] and amylase activity was determined by adapting the method of Peter Bernfield[15]. Folin-Ciocalteau method was used for total phenol estimation[16], phytic acid content was estimated by Wheeler and Ferrel[17] method, tannin acid by Folin - Denis method[18] and trypsin inhibitor was determined following Kakade *et al.*[19].

Results and Discussion

Present investigation intended quantitative analysis of major nutritional and anti-nutritional factors in *Bidens biternata*. Vitamin-A (β-carotene) is a fat soluble vitamin supplied to the body in the form of its precursor, β-carotene, which is present in fruits, vegetables, leafy greens etc. and it is not stored in the body when consumed abundant[9]. The results showed that the young leaves has higher amount of vitamin-A (0.063 mg g^{-1}) compared to mature leaves, stem and root as shown in Fig.1. This amount was higher compared to *Centella asiatica* (0.053 mg g^{-1}) of Apiaceae, which was reported as a green leafy vegetable in India[20]. Vitamin-C is found in fruits, particularly fruits and juices and green leafy vegetables[21] which is a water-soluble antioxidant with unique capacity to "scavenge" aqueous peroxyl radicals before damaging the lipids[22]. High amount of vitamin-C was present in young leaves of *B. biternata* (0.126 mg g^{-1}) compared to the other parts like root (0.056 mg g^{-1}), stem (0.084 mg g^{-1}) and mature leaves (0.02 mg g^{-1}) (Fig. 1). The amount of vitamin-C was higher compared to other reported green leafy vegetable like *Trigonella foenum* (vitamin-C 0.010 mg g^{-1}) belongs to the family Papilionaceae[20]. Vitamin-E is one of the fat-soluble vitamins present in plant tissues and is considered to be the most active form of α-tocopherol[23]. It is an effective quenching agent for both singlet oxygen and for alkyl peroxides and vitamin E biosynthetic capacity is reported to be increased in response to the demands of oxidative stress[24]. The analysis of *B. biternata* also showed high amount of vitamin-E in young leaves (0.01mg g^{-1}) in comparison with mature leaves (0.004 mg g^{-1}), stem (0.003 mg g^{-1}) and root (0.002 mg g^{-1}) (Fig. 1).

Thiamine (vitamin B_1) occurs in outer layers of grains of many plants including cereals. It is water-soluble and over cooking cause leaching out or destruction of thiamine originally present in the food sources[10]. Riboflavin (vitamin B_2) is water-soluble and photosensitive[10]. Niacin is an important water-soluble vitamin, which is also called nicotinamide or nicotinic acid depending up on the presence or absence of the amide group. It is physiologically very important since two coenzymes, NAD^+, and $NADP^+$ are derived from this vitamin[10]. High amount of vitamin B_1 (thiamine), vitamin B_2 (riboflavin) and vitamin B_3 (niacin) were present in young leaves (0.008, 0.0016, 0.019 mg g^{-1}) of *B. biternata* (Fig. 1).

Present study showed that amino acid content was higher in both young leaves and stem compared to mature leaves and root (Fig.2a and 2b). Among the different amino acids, methionine, tyrosine, proline, cysteine, tryptophan (Fig. 2b) and lysine (Fig.2a) were present in higher amount in young leaves (1.97, 1.53, 1.56, 2.03, 1.32, 1.54 mg g^{-1}) of *Bidens*. The amount of amino acids was higher compared to other reported green leafy vegetables like *Sesamum indicum* (cysteine 0.010, methionine 0.010 and tyrosine 0.032 mg g^{-1}) of Pedaliaceae and *Balanites aegyptiaca* (cysteine 0.079, methionine 0.073 and tyrosine 0.031 mg g^{-1}) of Zygophyllaceae[25].

This wild edible plant *B. biternata* is reported to have high amount of the different nutritional factors like carbohydrates, proteins, reducing sugar, free fatty acids, crude fiber, lipids, pigments, phytochemicals and micronutrients like iron, manganese, magnesium, copper, zinc and aluminium[8]. Starch is the storage form of carbohydrate in plants abundantly found in roots, stem, fruits and cereals[26]. The analysis also showed that the young leaves has higher amount of cellulose (0.085 mg g^{-1}), starch (0.086 mg g^{-1}), amylose (0.045 mg g^{-1}) and amylase (0.894 mg g^{-1}) as shown in Fig.3. This nutrient rich leafy vegetable shows sufficient quantities of macronutrients like carbon, phosphorous and nitrogen (Table 1) in young leaves (nitrogen 4.0 % / weight) compared to other reported leafy vegetables like *Bidens*

Table 1. Macronutrients in *Bidens biternata*

Macronutrients	Mature leaves	Young leaves	Stem	Root
Carbon (mg l^{-1})	0.144 ± 0.038	0.141 ± 0.003	0.127 ± 0.021	0.087 ± 0.044
Phosphorous (mg l^{-1})	0.126 ± 0.037	0.076 ± 0.001	0.032 ± 0.001	0.023 ± 0.002
Nitrogen (%/weight)	1.6 ± 0.6	4.0 ± 1.02	0.4 ± 0.04	0.8 ± 0.05

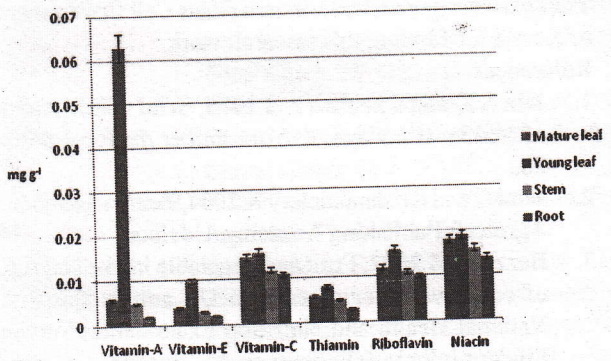

Fig.1. Vitamins in *Bidens biternata.*

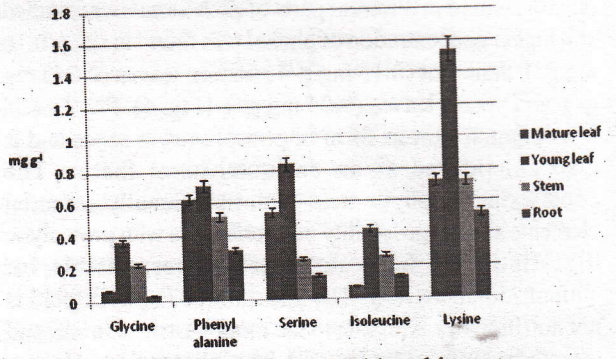

Fig.2a. Aminoacid analysis of *Bidens biternata.*

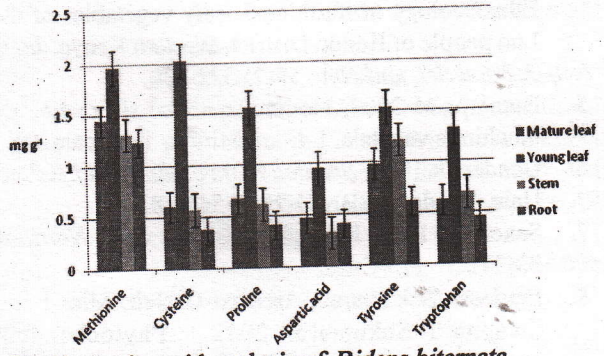

Fig.2b. Aminoacid analysis of *Bidens biternata.*

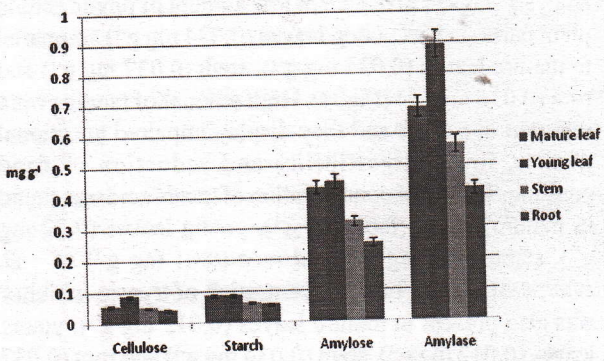

Fig. 3. Nutritional factors of *Bidens biternata.*

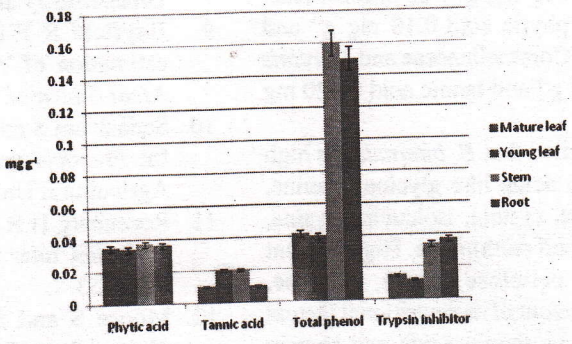

Fig.4. Antinutritional analysis of *Bidens biternata.*

pilosa (3.05 % / weight) of Asteraceae[27].

Wild edible plants consumed by tribal people are rich in several nutrients. However, the main problem related to the nutritional exploitation of wild edible plants is the presence of antinutritional and toxic compounds[28]. The anti-nutritional factors may be defined as those substances generated in natural feed stuffs by the normal metabolism of the species and by different mechanisms *(e.g.,* inactivation of some nutrients, diminution of the digestive process or metabolic utilization of feed) which exert effects contrary to optimum nutrition[29]. The total phenol content in different parts of *B. biternata* was studied and higher concentration of phenol was found in stem (0.16 mg g^{-1}) than root (0.15 mg g^{-1}) , mature leaves (0.042 mg g^{-1}) and young leaves (0.04 mg g^{-1}) (Fig. 4). Phytic acid is a common storage form of phosphorus in seeds and is also considered as an antinutritional factor. The complexing of phytic acid with nutritionally essential elements and the possibility of interference with proteolytic digestion have been suggested as responsible for antinutritional activity. The phosphorus in phytic acid is not nutritionally available to the monogastric animals, and interferes with calcium and iron absorption. Hence, estimation of phytic acid in food becomes essential[30]. The analysis showed presence of low amount of phytic acid in plant parts such as young leaves (0.034 mg g^{-1}) compared to mature leaves (0.035 mg g^{-1}), stem (0.037 mg g^{-1}) and root (0.036 mg g^{-1}) (Fig. 4). High amount of tannins were reported in cereals and they display impaired nutritional quality, lower digestibility and reduction of food consumption[9]. Low concentration of tannic acid was found in mature leaves (0.01 mg g^{-1}), young leaves (0.02 mg g^{-1}), stem (0.02 mg g^{-1}) and root (0.01 mg g^{-1}) of *B. biternata* (Fig. 4). Low concentration of trypsin inhibitor was also present in mature leaves (0.015 mg g^{-1}), young leaves (0.012 mg g^{-1}), stem (0.034 mg g^{-1}) and root (0.037 mg g^{-1}) of *B. biternata* (Fig. 4) compared to other leafy vegetables reported like *Smilax zeylanica* (phytic acid 0.02 mg g^{-1} and tannic acid 0.1110 mg g^{-1}) of Smilacaceae, *Commelina benghalensis* (phytic acid 0.10 mg g^{-1} and tannic acid 0.008 mg g^{-1}) of Commelinaceae and *Garcinia indica* (phytic acid 0.06 mg g^{-1} and tannic acid 0.020 mg g^{-1}) of Clusiaceae[31].

Present study revealed that *B. biternata* has high amount of vitamins, amino acids like glycine, alanine, serine, aspartic acid, proline, cystein, isoleucine, lysine, phenyl alanine, tryptophan and methionine. High amount of nutritional factors like cellulose, starch, amylose, amylase etc. and very low amount of antinutritional factors such as phenol, phytic acids, tannic acids and trypsin inhibitor were also present in *B. biternata* compared to common leafy vegetables reported. The low values of antinutritional factors give us idea about the suitability of plants for consumption. So it can be concluded that *B. biternata* has many nutrients and it can be proposed as an alternate nutrient rich plant which needs domestication. Utilization of edible plants from the wild will definitely help us to achieve food security of the nation.

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References

1. Jain S K and Chauhan A S 1998, Wild edible plants of Sikkim Himalaya. *J. Non- timber for Prod.* 5 20-28.
2. Mini C and Krishnakumary K 2004, *Leafy vegetables.* Agrotech Publishing Academy, Udaipur.
3. Bazzano M 2002, Fruit and vegetable intake and risk of cardiovascular disease in US adults: the first National Health and Nutrition Examination Survey Epidermiologic fellow-up study. *American J. Clin. Nut.* **76** 93-99.
4. Orech F O, Aagaard, Hansen J and Friis H 2007, Ethnoecology of traditional leafy vegetables of the Luo people of Bondo District, Western Kenya. *Inter. J. Food Sci. and Nutr.* **58**(7) 522-530.
5. Butnariu M 2007, Notiuni teoretice si practice de biochimie vegetala. Editura Mirton, Timisoara. 95.
6. Genders R 1994, *Scented Flora of the World.* Robert Hale. London. ISBN O-7090-5440-8.
7. Saxena R 1999, How green is your diet? *Nutrition* 33(3) 9.
8. Pradeesh Sukumaran, Archana G Nair, Mini I and Swapna T Sukumaran 2012, Phytochemical investigation of *Bidens biternata* a nutrient rich leafy vegetable from Western Ghats of India. *J. Applied Biochemistry and Biotechnology* 9652-5.
9. Bayfield R F and Cole E R 1980, Colorimetric estimation of Vitamin A with trichloroacetic acid. *Meth Enzymol.* **67** 189-95.
10. Sadasivam S and Theymoli Balasubramanian 1987, In: *Practical manual in Biochemistry.* Tamil Nadu Agricultural University, Coimbatore. 14.
11. Rosenberg H R 1992, *Chemistry and physiology of Vitamins.* Inter Science Publishers Inc., New York. 452 -453.
12. Moore S and Stein W H 1948, In: *Methods in Enzymology* [Eds. Colowick S P and Kaplan N D]

Academic Press New York. 3 468.

13. Updegroff D M 1969, Semi-micro determination of cellulose in biological material. *Anal. Biochem.* **32** 420-424.
14. Thayumanavan B and Sadasivam S 1984, Physico chemical basis for the preferential uses of certain rice varieties. *Qual. Plant Foods Hum. Nutr.* **34** 253.
15. Peter Bernfield 1955, In: *Methods of Enzymology* (Eds Colowick, S. and Kaplan, N. O.). Academic Press, New York. 1 149.
16. Mayer V, Treutter D, Santos-Buelga C, Bauer H and Feuchat W 1995, Study of carbohydrate influence on protein tannin aggregation by nephelometry. *J. Agric. Food Chem.* **38** 1151 -1155.
17. Wheeler E L and Ferrel R E 1971, A method of Phytic acid determination in wheat and wheat fractions. *Cereal Chem.* **48** 312-316.
18. Schanderl S H 1970, *Methods in Food Analysis.* Academic Press, New York. 709.
19. Kakade M L, Rackie J J, Mc Ghee J E and Puski G 1974, Determination of trypsin inhibitor activity of soy products: A collaborative analysis of an improved procedure. *Cereal Chem.* 51 376.
20. Gupta Sheetal and Prakash Jamuna 2009, Studies on Indian green leafy vegetables of their antioxidant activity. *J. Plant Foods for Human Nutrition* **64** 39-45.
21. Block G, Patterson B and Subar A 1992, Fruits vegetables and cancer prevention. A review of epidemiological evidence. *Nutr. Cancer* **18** 1-29.
22. Rice-Evans C and Miller NJ 1995, Antioxidants: the case for fruit and vegetables in the diet. *Br. Food J.* **97** 35-40.
23. Mc Kersie D B 1996, "Oxidative Stress" Retrieved October 25, 2000 from the World Wide Web: http://www.agronomy.psu.edu/Courses/AGRO518/Oxygen.htm.
24. Hausladen A and Alscher R G 1993, Glutathione. In: *Antioxidants in Higher Plants.* (Eds. Alscher R G and. Ness J L.). Boca Raton, Ann Arbor. London, Tokyo: CRC Press. 1-23.
25. Kubmarawa D, Andenyang I F H and Magomya A M 2008, Amino acid profile of two non-conventional leafy vegetables, *Sesamum indicum* and *Balanites aegyptiaca. African J.Biotechnol.* **7**(19) 3502-3504.
26. Hodge J E and Hofreiter B T 1962, In: *Methods in Carbohydrate Chemistry.* (Eds. Whistler R L and Be Miller J N). Academic Press, New York.
27. Adeolu Adedapo, Florence Jimoh and Anthony Afolayan 2011, Comparison of the nutritive value and biological activities of the acetone, methanol and water extracts of the leaves of *Bidens pilosa* and *Chenopodium album. Acta Poloniae Pharmaceutica - Drug Research.* **68** 83-92.
28. Guil J L, Rodriguez-Garcia I and Torija E 1997, Nutritional and toxic factors in selected wild edible plants. *Plant Foods for Human Nutrition* **51** 99-107.
29. Kumar R 1983, Antinutritional factors, the potential risks of toxicity and methods to alleviate them. *Legume trees and other fodder trees as protein sources for livestock.* 145-160.
30. Bligh E G and Dyer W J 1959, Rapid method of total lipid extraction and purification. *Can. J. Biochem. Physiol.* **37** 911 - 917.
31. Mahadkar Shivprasad, Valvi Sujata and Rathod Varsha 2012, Screening of anti-nutritional factors from some wild edible plants. *J. Nat. Prod. Plant Resour.* **2**(2) 251-255.