INTERNATIONAL JOURNAL OF ADVANCES IN PHARMACY, BIOLOGY AND CHEMISTRY

Research Article

Elemental analysis of Biophytum sensitivum DC.

C.Uma, K.G. Sekar.

Department of Chemistry, Avvaiyar Govt College for Women,

Karaikal. Puducherry, India-609602.

Department of Chemistry, National College, Tiruchirappalli.

Tamil Nadu, India-620001.

ABSTRACT

The present study was taken to evaluate the Phyto chemical profile and elemental analysis of Biophytum sensitivum DC, to access the quality standards. The Mg, Fe, Zn, Cu, Se, Si, As, Mn, Co, Ni, Cr, P, Cl, Pb was determined in leaf and root. These studies will help in future for identifying this plant for further research. The elemental concentration of the leaf shows a higher concentration of Fe, Cu, Si, As, P and the root is rich in Mg, Zn, Mn, Cl, Pb. Ni, Se, Co was not detected in this plant.

Keywords: Trace elements, Biophytum sensitivum Dc, Medicinal plants, Elements.

INTRODUCTION

The life of a man is closely associated with plants almost in every aspect. Primitive man tried to cure diseases from plants growing abundantly around him and such an experience of trial and error taught him a lot about the medicinal properties of different plants.

In India, charaka and sushruta are still living in the minds of traditional medicinal practitioners. The collection and identification of medicinally important plants were developed the pharmacology to a high level and important plant products were studied pharmaceutically. The screening of plants with respiration to the healing effect is done based on their biologically active principles. The importance of medicinal plants lies in their biological active principles, which are the real healers in the process of medication. Among the two types of plant chemicals (i) primary metabolites such as common sugars, carbohydrates, protein, amino acids and chlorophyll are present in all kinds of plants irrespective of its medicinal characters.(ii) The secondary metabolites includes a alkaloids, terpenoids, phenolics, ect vary in their distribution from plant to plant, and which are accumulated by plant cells in smaller quantities compared to primary metabolites. These secondary metabolites exert a profound physiological effect on the mammalian system and thus are known as the active principles of that plant, which is used for curing ailments. The use of crude drugs of plant origin is used in the Indian system of medicine.

Analysis of trace elements have thrown the lights on the technologies involved in the constructions of glass enamel inlays in Europe during the 4^{th} to the 1^{st} centuries B.C. Now a day's trace elements are recognized as a key factor in disease pathology like cancer, diabetes mellitus, cardiovascular disease etc. and also hold a key for their remedies. Elements were occupied an important place in biomedical research. Deficiencies or overload of minerals or their impaired metabolic pathways lead to abnormal physiological functioning causing the disease. The significance of these micronutrients arises largely from the fact that they interact and influence the functioning of enzymes and also form the integral part of many enzymes and hormones[1]. The metabolic pathway of all the elements and their interactions with other bio molecules and also their connection with disease pathology is not fully known yet and this offers a wide area of research. Complete understanding of the subject can lead to solve the secret of many diseases and their cure. Medicinal plants or their part can play a significance role in providing the essential nutrition in case of deficiency and also to augment the functioning of other parameters through trace and ultra trace interactions. To explore the secret of

healing effect of traditional medicines with their elemental contents learned from the traditional practitioners, palm leaves and manuscripts. In human, only ten trace elements (Fe, Zn, F, Cu, I, Se, Mn, Mo, Cr and Co) are considered to be essential[2]. These inorganic micro nutrients invariably have a catalytic function and are found in the metabolic pathways controlling the assimilation and utilization of other nutrients, in the synthesis of new tissue and in the use of energy.

B.sensitivum DC an important medicinal plant is used in traditional medicine by many people in Asia, Africa and Pacific islands especially in Indian medicine[3].The plant B.Sensitivum has been used for the various purposes in the traditional medicine like stomach ache, asthma, treating insomnia, convulsions, cramps, chest complaints inflammations, tumors and remedying chronic skin diseases. It is in the family of oxalidaceae and a small annual plant, growing throughout the tropical regions of south Asia, Africa and Madagascar. B.Sensitivum dc was widely used as broad spectrum in the ayurvedic medicinal field. This plant were used as antiseptic and for asthma and phthisis[4], inflammatory diseases and diabetes [5,6,7].The biological activity of the plant shows hypoglycemic[8], immunomodulatory[9], chemoprotective [10], hypocholesterolemic[11], apoptotic[12], inflammatory[13] and cell mediated immune response[14], antitumor[15], repetitive action potentials[16], effects on prostaglandin biosynthesis[17] . The whole plant decoction is used for asthma and phthises and the decoction of root is used for genorrtiea and lithiasis[18] (Inngierdingen et al 2006) specifically, the leaves are diuretic and relieve strangury and commly known as “Nagbeli” a folk medicine against “Madhumeha”(Diabetes mellitus) particularly in eastern Nepal[7,19]. The powdered leaves and seeds were used to apply on wounds [20]. B. Sensitivum dc is one of the plants used against snake envenomation. The whole part of plant is used to counteract the snake venom activity [21].

MATERIAL AND METHODS

Plant material: The Fresh seasonal plant B.sensitivum DC was collected from Kannur District of Kerala State, India. Preparation of the extract: The plant parts (leaves and root) were washed in the fresh water, dried under shade and powdered using mortar and pestle. The plant leaves were made into fine powder. The petroleum ether extract of the leaf and root are extracted separately by soxhlet set up for 72 hours.

Preliminary analysis: The phytochemical tests were carried out using standard procedures to identify the constituents as described by Harbone [22.]

Mineral analysis: The elemental analysis of the plant was done in the EDXRF facility available at UGC-DAE CSR, Kolkata. The target was prepared from the powdered leaf and root samples of the plant using the KBr press. Four pellets were prepared from each part of the plant powder for verification of accuracy of results, and were subjected to X-ray radiation for obtaining the concentration of elements present in the leaf as well as root. The trace elements ranging from Mg to Pb are identified with their presence at ppm level. The concentration of elements are given in table.2

RESULTS AND DISCUSSION

The preliminary phytochemical investigation of selected ethano-medical plant showed the presence of phenolics, flavonoids, terpenoids, Tannin, Fixed oil and Fat, Saponin, glycosides and proteins. (Table.1)

Among the detected elements Silicon, Iron and Chlorine are found to be most abundant elements followed by phosphorus. It is also found to contain remarkable concentration of Magnesium. Selenium, Cobalt and Nickel are absent in this plant.

Magnesium:

Magnesium is essential to a large number of biochemical and physiological processes including neuromuscular conduction in skeletal and cardiac muscle[23]. It is also an important structural component of bone[24]. 60% of Mg is stored in bone along with calcium and phosphorus.

The administration of magnesium sulphate can control and prevent eclampsia during pregnancy[25]. There is an inverse relationship between the Mg concentration in drinking water and still birth[26]. Mg deficiency in healthy people is rare. It can occur secondarily to general malnutrition, alcoholism or other disease states that affect gastrointestinal electrolyte absorption or excretion or renal cation reabsorption[27]. Deficiency results in reduced levels of potassium and calcium as well as symptoms of nausea, muscle weakness, irritability and mental derangement[28]. Oral exposure to Mg is not toxic except in individuals with impaired renal function, who may experience nausea, vomiting and hypertension followed by central nervous system depression accompanied by a sharp drop in blood pressure and respiratory paralysis[23]. Inhalation exposure to magnesium oxide can cause metal fume fever [29].

The concentration of magnesium was recorded as 924 ppm in leaves and 1495 ppm in roots of the plant. RDA for Mg is 350mg/day for men and 280 mg/day for women with an extra 20mg/day during pregnancy and 75mg/day during lactation [24].

Iron:
Iron is one of the essential trace elements for human beings and animals. It is an essential component of hemoglobin. It facilitates the oxidation of carbohydrates, protein and fat to control body weight, which is very important factor in diabetes. Fe deficiency has been implicated in chronic mucocutaneous candidiasis and its supplementation may support recovery from candidal infection secondary to primary immune deficiency[30]. A high iron diet may increase the risk of development of colorectal and liver cancer[31]. This plant shows high content of Iron 4448 ppm in leaves and 4072 ppm in roots. RDA for iron is 10mg/day for adult males and 15 mg/day for adult females, with an additional 15mg/day recommended during pregnancy[24].

Zinc:
Zn is known to have beneficial effects on vision[32]. This trace element is crucial to vital processes, plying a unique role in growth and development. Dr.A.S. Prasad first described the clinical manifestations of Zn deficiency, viz., growth retardation, skin rash, hypogonadism, and alopecia[33].Afterwards many more deficiency symptoms have been reported such as acrodermatitis, poor wound healing, night blindness and neuropsychiatric manifestations. Zn also influences immune function. Zinc has been well known to be an important trace element as a cofactor for insulin. Zinc content 80 ppm in leaves and 108 ppm in roots. Whereas RDA for zinc is 15 mg/day for adult men and 12 mg/day for adult women[24].

Copper:
Copper is an essential component of many enzymes involved in cellular respiration, free radical defense and cellular iron metabolism. Lysyl oxidase is required for the formation and function of connective tissue throughout the body, tyrosinase is responsible for the synthesis of melanin pigment, Cu-Zn superoxide dismutase, cytochrome oxidase, and ceruloplasmin have antioxidant function. Cu deficiency causes anemia, neutropenia, and impaired growth, particularly in children. Menkes disease due to the deficiency and Wilson's disease due to the overload[34]. The copper content is 28 ppm in leaves and 17 ppm in roots. The estimated safe and adequate daily dietary adult intake is 1.5to3.0 mg/day.
Silicon: The element Si is used as treatment for flatulence and colic, digestion diarrhea. It is not an essential element for human. The concentration of silicon was recorded as 8621 ppm in leaves and 6682 ppm roots.

Arsenic:
Arsenic is reported to cause hypertension, peripheral arteriosclerosis, skin diseases and neurotoxicity[35, 36, 37]. Arsenic affects oxidative phosphorylation, endothelial damage, and loss of capillary integrity, capillary leakage and volume loss. Generally the level of As was lower in all medicinal plants hence the values are within the WHO Permissible limit (1 mg/kg). The Arsenic content in this plant is 14 ppm in leaves and 8 ppm in roots.
.

Manganese:
High Mn content of this herb is correlated with the use of this plant in the treatment of "raktapitta" which is the Sanskrit description of the ailment characterized by bleeding from different parts of the body[38]. Mn is to enhance the process of aggregation of platelets and thus help in the coagulation of blood[39], which is essential for the arrest of bleeding. For medicinal plants the WHO 2005 limits not yet been established for Mn. The concentration of Mn present in this plant is 137 ppm in leaves and 243 ppm in roots.
Phosphorus: phosphorus has many functions within your body. First, it is needed to grow and maintain bones and teeth. In fact, 85% of the Phosphorus in your body is stored in order for hormones and enzymes in your body to function properly. It is used in treatment of lead poisoning, dental cement and also used as Antioxidant, brain tonic. The concentration of phosphorus in 3552 ppm in leaves and 2247 ppm in root was detected.
Chlorine: Chlorine is mostly present in the form of inorganic chlorides both inside the cells as well as in the extra cellular fluids. It helps in cleaning or expelling waste matter to purity blood. It is a main factor for regulating body reactions, as it is the chief anion of the body and provides for about 2/3 of the anion of plasma. It act as antiseptic for wounds, anti malarial, disinfectant lie measles and has wound healing property. The concentration of chlorine was detected as 3790 ppm in leaves and 4742 ppm in roots of this plant. The amount of chlorine in root was greater than the amount present in leaves.

Chromium:
Chromium III functions in the control of glucose and lipid metabolism. In combination with nicotinic acid and amino acids, Cr-III forms a complex called glucose tolerance factor[40] . Cr-VI is a well known mutagen and carcinogen[41]. The recorded chromium as 25 ppm in both leaves and roots. Estimated safe and adequate daily dietary intake if Cr-III is 50-200 µg for adults.

Lead:

Pb was not detected in leaves and 4 ppm is only in roots. The long term Pb accumulation is associated with hypertension[42]. Permissible limit set by FAO/WHO[20] in edible plants was 0.43 ppm.

Elements like Si, Fe, P and Cu are more abundant in the leaf. Silicon is found in the highest concentration in the leaf .In the root, presence of Mg, Zn, Mn, Cl and Pb is more in roots when compared to leaves. (Table.2)

Conclusion:

The present study was taken to analyze the mineral and phytochemical profile of B.Sensitivum, to access the quality standard. These studies will help in future for identifying this plant for further research.

Table.1
Phytochemical Screening of Biophytum sensitivum dc.

S.No.	Reagents	Nature of colour change	Constituents
1.	Extract + Con HNO_3	Orage colour	Presence of protein
2.	Extract +H_2O is boiled. Then $FeCl_3$	Brownish green	Presence of Tannins
3.	Extract +H_2O Shaken	Frothing	Presence of Saponin
4.	Extract + NaOH	Greenish brown	Presence of Flavonoids
5.	Extract +Alcohol+$FeCl_3$	Greenish yellow	Presence of Phenolic cpds
6.	Extract + Tollens reagents	Silver mirror	Presence Carbohydrates
7.	Extract + Sudan red reagent + alcohol	Red	Presence of essential oil.
8.	Extract + HCl	Green	Presence of quinine
9.	Extract + Ninhydrin	Bluish colour	Presence of amino acids
10.	Extract + glacial acetic acid, + $FeCl_3$+Con.H_2SO_4	Reddish colour	Presence of glycosides

Table 2
Trace elements in Biophytum sensitivum dc.

Elements	Leaf (ppm)	Root (ppm)	Recommended/Permissible quantity (a40,41)
Magnesium	924	1495	310-320mg/day
Iron	4448	4072	10-15mg/day
Zinc	80	108	12-15mg/day
Copper	28	17	1.5-3mg/day
Selenium	ND	ND	-
Silicon	8621	6682	Non-essential
Arsenic	14	8	1mg/kg
Manganese	137	243	2.0-5.0mg/day
Phosphorus	3552	2247	700mg/day
Cobalt	ND	ND	-
Nickel	ND	ND	-
Chlorine	3790	4742	1.5 g/day
Chromium	25	25	50-200 µg/day
Lead	ND	4	0.43 ppm/ day

REFERECNES

1. Bogden, J.D. and L.M. Klevay (Eds.) Clinical nutrition of the essential trace elements and minerals. The guide for health professionals, Humana Press, NewJersey. 2000, pp.5.
2. Xiu YM. Trace elements in health and diseases. Biomed. Environ Sci. 1996; 9: 130-136.
3. Jirovettz L, Buchbauer G, Wobus A, Shafi MP, and Jose B. Medicinal used plants from India: Analysis of the essential oil of air- dried Biophytum sensitivum DC. Sci Pharm.2004; 72:87-96.
4. Pullaiah T. Medicinal plants in india. Volume 1. Regency publications. New delhi, 2002: pp 96-97.
5. Kritikar KR and Basu BD. Indian medicinal plants, vol 1, BSMP Singh. Deharadun 1984; Pp 440-441.
6. Mitra AP. and Ambasta (Ed), SP. The wealth of India, Raw materials, vol II-B CSIR. Delhi.1988; pp 151-152.
7. Puri D, Baral N, Upadhyaya BP. Indigenous plant remedies in Nepal used in heart diseases. J Nepal Med Assoc 1997; 36: 334-7.
8. Puri D, Baral N, Hypoglycemic effect of B.sensitivum in the alloxan diabetic rabbits. Indian J Physiol Pharmacol 1998; 42: 401-6.
9. Guruvayoorappan C, Kuttan G. Immunomodulatory and Anti tumour activity of Biophytum sensitivum Extract. Asian Pac J Cancer prev 2007; 8: 27-32.
10. Guruvayoorappan C, Kuttan G. Evalution of chemoprotective effect of Biophytum sensitivum (L) DC extract against cycophosphamide induced toxicity in swiss albino mice. Drug metabol Drug Interact 2007; 22: 131-50.
11. Puri D. Hypocholestrolemic effect of Biophytum sensitivum leaf water extract Pharm Biol 2003; 41: 253-8.
12. Guruvayoorappan C, Kuttan G. Apoptotic effect of Biophytum sensitivum on B16F-10 cells and its regulatory effects on nitri oxide and cytokine production on tumor-associated macrophages. Integer Cancer ther 2007; 6: 373-80.
13. Jachak SM, Bucar F, Kartnig TH. Anti-inflamatory activity of extracts of B. sensitivum in Carrageenin- induced Rat Paw Oedema. Phytother Res 1999; 13: 73-4.
14. Guruvayoorappan C, Kuttan G. Effect of Biophytum sensitivum on cell- Mediated immune response in Mice. Immunopharmacol Immunotoxicol 2007; 29: 337-50.
15. Bhaskar VH, Rajalakshmi V. Antitumour activity of aqueous extract of Biophytum sensitivum linn. Ann .Bio res 2010; 3: 76-80.
16. Takao sibanka applications of leaf Extract causes Repetitive action potentials in biophytum sensitivum journal of plant research, 1997; 110:485-487.
17. Bucar FS, Jachak M, Kartung Th, Noreen Y, perera P, Bolin L and Sehubert- zsilvavecu m. amento flavones, a cycloxygenase –I inhibitor from B-S. DC, 13th scientific conference of the Austrian pharmaceutical socity, Vienna, Austria, K-4 (Sci pharm 65, supplement I. 1997,pp.22.
18. Inngierdingen KT, Colibaly A, Diallo D, Michaelsen TE, Paulsen BS. A complement fixing polysaccharide from Biophytum. Petersianum Klotzch, a medicinal plant from Mali, West Africa. Biomacromolecules 2006; 7:48-53.
19. Pant PC, Joshi MC. Studies on some controversial indigenous herbal drugs based on ethnobotanical rearch: A review. J Res Edu in Indian Med 1993; 12:19-29.
20. The wealth of India: First Supplement series, NISC, CSIR, India 1 A-Ci 2000. P.140.
21. Gomes A, Das R, Sarkhel S, Mishra R, Mukhrjee S, Bhattacharya S, et al. Herbs and Herbal constituents active against snake bite. Indian J Ex boil 2010; 48: 865-78.
22. JB Harborne. Phytochemical methods; A guide morden techniques of plant analysis, 3rd edition, Chapman and Hall, London.2007; 125-175.
23. Beliles RP. (1994) the metals, In:Clayton G.D., Clayton E.E (Eds) Patty's industrial hygiene and Toxicology. John Wily &sons, New York. Pp.1879-2352.
24. Subcommittee on the Tenth Edition of the RDAs, commission on life sciences, Food and Nutrition Board .National Academy Press, Washington D.C. 1989.
25. The eclampsia collaborative group Lanchet. 1995; 345:1455-1463.
26. Elwood JM. J.Am.Coll.Nutr. 1994; 13:416-423.
27. Rivlin RS. Magnesium deficiency and alcohol intake: mechanisms, clinical significance and possible relation to cancer development (a review) J Am Coll Nutr. 1994; 13: 416-423.
28. Shils ME. Magnesium in health and disease. Ann. Rev.Nutr, 1988; 8: 429-460.

29.Agency for toxic substances and disease registry (ATSDR) Toxicological profile for Magnesium. Atlanta, GA. 1994.
30. Cunningham-Rundles S., Yeger-Arbitman R., Nachman S.A et al. Clin. Immunol. Immunopathol. 1990; 56:116-123.
31. Toyouni S. Free Rad. Biol. Med. 1996; 20:553-566.
32. Prasada AS. Essential and Toxic elements in human health and Diseases: An Update, wiley- Liss, New York. 1988.
33. Prasad AS, Rabbani P, Abbasi A, Bowerson F, Fox M.R.S. Ann Intern Med. 1978; 89:483-490.
34. Danks DM. Disorders of copper transport.In: Seriver C.R., Beaudet A.I., Sly W.S., Valle D. (Eds,). The metabolic basis of inherited disease. McGraw-Hill, New York, 1995; pp.2211-2235. 35. Cabrera HN, Gomez MI. Skin cancer induced by arsenic in water. Journal of Cutaneous Medicine and Surgery 2003; 7: 106-111.
36.Lee YL, Shih MC, Wu WJ, Chou YH, Huang CH. Clinical and urographic presentation of transitional cell carcinoma of the ureter in a black foot disease endemic area in Southern Taiwan Kaohsiung Journal of Medical Science.2002 ;18:443-449.
37.Lee MY, Jung BI, Chung SM, Bae ON, Lee JY, Park JD, Yang JS, Lee H, Chung JH. Arsenic-iduced dysfunction in relaxation of blood vessels.Environmental Health Perspective. 2003; 11:513-517.
38.Dass. BB. Material medica of indo-Tibetan medicine. Classics India Pub., New Delhi. 1989.
39.Auma HT, Shigekiyo, S. Mura. Y.Uno and S.Saito. Mechanism of potentiation by manganese ion of aggregation of porcine pancreatic elastase- treated human platelets. Thromb Haemost. 1989; 62: 984-988.
40.Mooradian A, Failla M, Hoogwerf B, Maryniuk M, Wylie-Rosett. J. Diabetes Care.1994; 17:464-479.
41.Anderson R.A. Diabetes and metabolism. 2000; 26:22-27.
42.Hu H, Aro, Payton M, Korrick S, Sparrow D, Weiss ST, Rotnitz . J.Am. Med, Assoc. 1996; 275: 1171-1176.