INTERNATIONAL RESEARCH JOURNAL OF PHARMACY
www.irjponline.com
ISSN 2230 – 8407

Research Article

ELEMENTAL ANALYSIS OF *CAESALPINIA BONDUCELLA* LEAVES

Shirish S. Pingale [1]*, Manohar G. Chaskar [2], Nirmala R. Kakade [3]
[1]P.G. Department of Chemistry, Gramonnati Mandal's Arts, Com. & Science College, Narayangaon, Pune, India
[2]Department of Chemistry, Baburaoji Gholap College, Sangavi, Pune, India
[3]Dadapatil Rajale Arts & Science College, Adinathnagar, Ahmednagar, India
*Corresponding Author Email: drsspingale@gmail.com

Article Received on: 13/12/16 Revised on: 08/01/17 Approved for publication: 20/01/17

DOI: 10.7897/2230-8407.080113

ABSTRACT

The presence of lipids, proteins and carbohydrates are essential for the growth of humans. The inorganic micronutrients like Cr, Mn, Fe, Cu and Zn etc. are also required for proper metabolic processes. The excess or deficiency of micronutrients may disturb the biochemical functions of the human body. The aim of the present work is to study the elemental analysis of dried powder of *Caesalpinia bonducella* leaves. The leaves were collected from the Garbhagiri ranges in Pathardi of Ahmednagar in Maharashtra, India. The leaves were dried in shade and the powder was prepared. The further analysis was carried out by the process of di-acid digestion method (9:4 mixtures of HNO_3 and $HClO_4$) with the help of atomic absorption spectrophotometer (AAS). In this elemental analysis study, the presence of Iron (Fe), Copper (Cu), Cobalt (Co), Manganese (Mn), Nickel (Ni), Cadmium (Cd) and Zinc (Zn) was found. The Iron (Fe) was found at higher concentration 360 mg/kg followed by Manganese (Mn) 108 mg/kg and Zinc (Zn) 69 mg/kg. The concentration of different elements in this plant is the matter of interest from the point of view of their therapeutic value as well as the toxic nature of some elements.

Keywords: Elemental Analysis, *Caesalpinia bonducella*, di-acid digestion, AAS

INTRODUCTION

The herbal medicines play very important role in the health system for humans as well as animals. In therapy, medicinal plants are used not only in prevailing ailments of the person but also as a potential source to maintain good health. It is required to understand the specific constituents in the herbal medicines which are effective in the different therapies. There are many proofs indicating the importance of herbal plants used in the different conventional systems. The realization that the herbal medicines are safe and more reliable has increased the interest in these medicines[1]. It is observed that many medicinal plants are used to cure diseases like digestive problems, cardiovascular disorders, metabolic problems, liver disorders and central nervous systems. The plant extract is predominantly used as a source of many western drugs[2]. In Lekhana karma, the drugs remove extra fats (meda) by lowering or removing the unnecessary dhatu i.e. tissues as well as mala i. e. metabolic wastes[3]. There are many therapies. The medicinal plants are very important in some of the therapies traditionally. The standard of the medicine, the safety and the effectiveness is to be assured to make the safe use of the traditional herbal plants. At the most 5% of the 300,000 species of the plants worldwide have been studied scientifically for their medicinal use. It is noticed by the researchers that the developing countries depend on the herbal plants to cure the diseases particularly in the region where there is the lack of hospitals[4]. Along with medicinal properties, the presence of lipids, proteins, carbohydrates are essential for growth of humans. The inorganic micronutrients like Fe, Cu, Co, Mn, Ni, Cd, Zn, Cr etc., are also required for proper metabolic processes. The excess or deficiency of micronutrients may disturb the biochemical functions of the human body[5-7]. So, it is necessary to analyze macro as well as micronutrients in medicinal plants.

The aim of the study was to find out the preliminary elemental concentration in *Caesalpinia bonducella*. *C. bonducella* is widely useful to treat various diseases. The concentration of different elements in this plant is the matter of interest from the point of view of their therapeutic value as well as the toxic nature of some elements. *Caesalpinia bonducella* is classified under the family of Caesalpiniaceae. It is also known as *C. bonducella* Flem and *C. crista* Linn. Commonly it is called Fever Nut, Bonduc Nut and Nicker Nut also[8]. It is found in hotter parts of India especially in west Bengal and the southern states of India.

The techniques like atomic absorption spectrophotometry (AAS), inductively coupled plasma-atomic emission spectrometry (ICP-AES), inductively coupled plasma - mass spectrometry (ICP-MS), energy dispersive X-ray fluorescence (EDXRF) and electro thermal atomic absorption spectrometry (ETAAS) are there. They have their own advantages and limitations in respect of accuracy, precision, specificity and sensitivity. The arrival of ICP-AES and ICP-MS all with multi element capabilities has reduced the AAS/AES market. Yet, AAS/AES technology is established in the field of analytical techniques[9].

MATERIALS AND METHODS

The leaves of *Caesalpinia bonducella* were collected from the Garbhagiri ranges in Pathardi of Ahmednagar in Maharashtra, India and identified from the Department of Botanical Survey of India, Pune. The leaves were thoroughly washed using tap water

to remove foreign matter and rinsed in de-ionized water. They were dried in shade at room temperature. The fine powder was prepared by grinding. All glass wares and plastic wares were washed in detergent and then soaked with 10% nitric acid for 24 hours. They were rinsed in tap water and then by distilled de-ionized water. The glass wares were dried in the oven at temperature105° C while the plastic wares were dried in the open rack.

The further analysis was carried out by the process of di-acid digestion method. 0.5 gm finely ground mixture of the plant sample was taken in a 100 ml volumetric flask. Then 5 ml of acid mixture (9:4 mixtures of HNO_3 and $HClO_4$) was added to it. Then the flask was placed on the low heat hot plate and heated at higher temperature until red NO_2 fumes ceased. The mixture was evaporated until the volume reduced to about 3 ml but not to dryness and digestion liquid became colourless. After being cooled, 20 ml of distilled water was added then it was filtered through Whatman No. 41 and made the volume 100 ml with distilled water. Then the mixture was used for the elemental analysis by using atomic absorption spectrophotometer. Fe, Cu, Co, Mn, Ni, Cd, Zn and Cr were determined by Atomic Absorption Spectrophotometer using a mixture air - acetylene flame[17].

Table 1: Standard Atomic Absorption Conditions

Element	Wavelength (nm)	Slit (nm)	Relative Noise	Characteristic Concentration (mg/L)	Characteristic Concentration Check (mg/L)	Linear Range (mg/L)
Cd(48)	228.8	0.7	1.0	0.028	1.5	2.0
Co(27)	240.7	0.2	1.0	0.12	7.0	3.5
Cr(24)	357.9	0.7	1.0	0.078	4.0	5.0
Cu(29)	324.8	0.7	1.0	0.077	4.0	5.0
Fe(26)	248.3	0.2	1.0	0.11	5.0	6.0
Mn(25)	279.5	0.2	1.0	0.052	2.5	2.0
Ni (28)	232.0	0.2	1.0	0.14	7.0	2.0
Zn (30)	213.9	0.7	1.0	0.018	1.0	1.0

Table 2: Concentration of Elements in mg/Kg

Elements	Fe	Cu	Co	Mn	Ni	Cd	Zn	Cr
mg/Kg	360	18	4.29	108	1.78	0.80	69	0.00

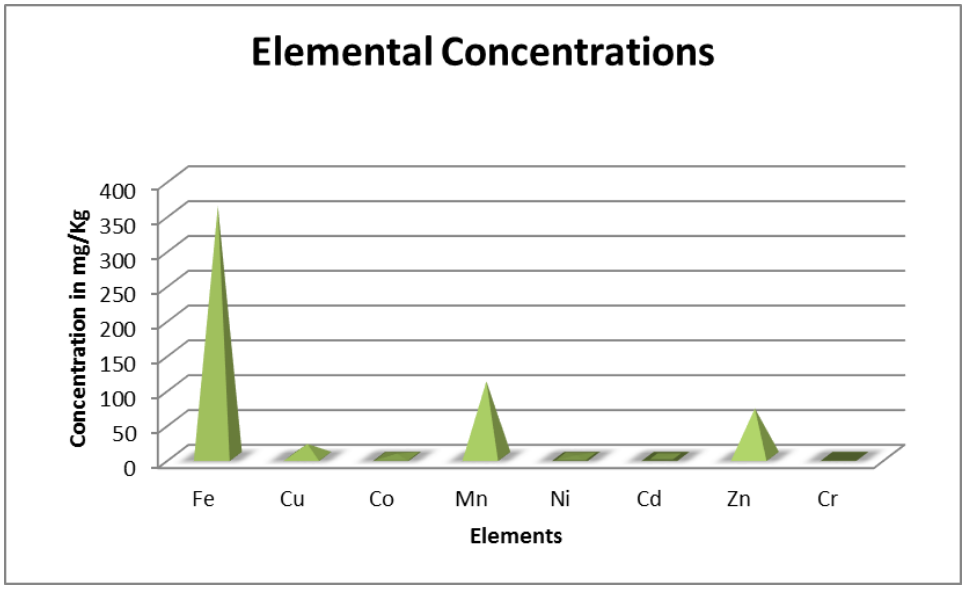

Figure 1: Elements versus Elemental Concentrations

RESULTS AND DISCUSSION

Iron

The human body needs Fe for the formation of the oxygen carrying proteins, haemoglobin and myoglobin, cytochromes, metalloflavoproteins and certain enzymes like catalase and peroxidase. It means that Fe is essential element in the oxygen and electron transfer in human body and for operation of oxidation systems within the tissue cells[10, 11]. Fe plays an important role in normal functioning of the central nervous system and in the oxidation of carbohydrates, proteins and fats to control body weight, which is very important factor in diabetes[12]. Fe is also needed in the synthesis of neurotransmitters like dopamine or epinephrine and serotonin[10]. The deficiency of Fe is responsible for various diseases such as anemia, adverse pregnancy outcomes, depression, poor resistance to infection and weakness[14]. Iron deficiency is also responsible in chronic mucocutaneous candidiasis and its supplementation may support recovery from candidal infection secondary to primary immune deficiency. A higher quantity of iron in diet may increase the risk of development of colorectal and liver cancer[15]. In the leaves of this plant, concentration of Iron was found to be maximum i.e. 360 mg/kg. Whereas the dietary limit of iron in the food is 10-60 mg per day.

Copper

Copper is an essential constituent of various enzymes like cytochrome oxidase, Cu-Zn superoxide dismutase and ceruloplasmin which have antioxidant function; lysyl oxidase which is essential in the formation and function of connective tissue throughout the body; tyrosinase which is useful in the synthesis of melanin pigment and ceruloplasmin, an iron-oxidizing enzyme in blood. Cu deficiency causes Menkes disease, neutropenia and weakened growth, particularly in children. The observation of anemia in copper deficiency may possibly be connected to its role in helping iron absorption and in the incorporation of iron into haemoglobin[13, 15]. Traces of Cu are essential for normal haemoglobin synthesis. Neurological conditions such as Alzheimer's disease, Prion disease, Wilson's disease is due to Cu overload. It also causes dermatitis, metallic taste in the mouth, hair and skin discoloration etc. when it is excess in quantity[14]. It is observed that copper deficiency occurs rarely and may be poisonous depending on its dose[16]. The concentration of Cu is recorded 18 mg/Kg in this plant. The safe and adequate intake is 1.5 to 3.0 mg/day in adult[15].

Cobalt

Every mammal requires Cobalt in a small amount. In human beings, it is used in the treatment of cancer and anemia. If it is given in high proportion, it results into heart diseases[18]. The average concentration of Co was found in C. bonducella 4.29 mg/Kg

Manganese

Manganese plays very important role in protein as well as carbohydrates metabolism and in the treatment of diabetes[10]. Mn activates pyruvate, arginase, and carboxylase which are metaloenzymes. It functions as a co factor in the respiratory enzymes as well as disease resistant. The deficiency of Mn causes skeletal and reproductive failure in both male and female while its excess causes adverse effects on the lungs and brain[14]. Manganese plays important role in blood coagulation by enhancing the platelets aggregation process. Consequently, it arrests the bleeding[15]. It is essential in the growth of normal bone structure and working of the central nervous system. Amino acids, lipids and carbohydrates metabolism require manganese[16]. The concentration of Mn is recorded 108 mg/Kg in this plant.

Nickel

Nickel is essential element in insulin production and its deficiency causes liver disorder[14]. Healthy skin and bone structure are the health benefits of nickel. There is relation between the chronic exposure to Ni and increased risk of lung cancer, cardiovascular disease, neurological deficit, developmental deficits in childhood and high blood pressure. Iron metabolism requires Nickel[16]. The concentration of Ni is recorded 1.78 mg/Kg in this plant. The permissible limit of Nickel for medicinal plants has not till been decided by WHO.

Cadmium

The functions performed by cadmium are not in human body or in plants as it being toxic. The kidney, the skeletal system and the respiratory system are affected by Cd. It is grouped as a human carcinogen. Disturbances in calcium metabolism and the formation of kidney stones are the results of high intake of cadmium. It also results into softening of the bones and osteoporosis. Nerve cells are damaged and the tendency for hyperactivity of nervous system is increased by it[16]. It is very dangerous to human being. Accumulation of Cd in the environment by the food chain poses a serious danger to the people. High blood pressure, damages to kidneys and liver are caused by it[14]. Cd is also responsible for acute and chronic poisoning. At the same time kidney, liver, heart, vascular and immune system are affected by cadmium. Brain damage, subtle abortion, reduced fertility of men because of sperm damage; reduced learning abilities of children and disruption of nervous systems are also the adverse effects of Cd[10]. The concentration of Cd is recorded 0.80 mg/Kg in this plant. The permissible limit set by WHO for cadmium is 0.2 to 0.81 ppm[14].

Zinc

To maintain normal metabolism, growth and development of all organism zinc is necessary. Many enzyme systems which are responsible for DNA and RNA synthesis contain Zinc as a co-factor. It plays very significant role in the growth and multiplication of cells. It also contributes in bone metabolism, taste and eyesight. Sexual maturation is prevented by its deficiency. The deficiency of Zn may also cause growth retardation and hair loss, skin rash, hypogonadism and alopecia, wound healing delay and emotional disturbance, acrodermatitis, night blindness and neuropsychiatric manifestations[15, 16]. Our vision is benefited by Zn. Nearly 200 proteins and enzymes contain Zinc. It is necessary for forebrain development, steroidogenesis and bone formation. Zinc is neurotoxin when it is in high concentration[14]. It stimulates the immune response and stabilizes a membrane. Impaired growth and malnutrition is due to its deficiency. Zinc supplementation has positive effects on the growth of stunted children. Nearly 20% of the world's population lack Zn[12]. The deficiency of Zinc also causes sickle cell disease and this disease can be treated with it[11]. The concentration of zinc in the leaves sample of *Caesalpinia bonducella* is 69 mg/Kg.

Chromium

Chromium III regulates glucose metabolism by enhancing the insulin's action and lipid metabolism. Chromium III forms a complex like glucose tolerance factor by combining with nicotinic acid and amino acids. Cr-VI has mutagenic and carcinogenic properties[15]. Chromium deficiency results into growth inhibition, diabetes, hyperglycemia, neuropathy and atherosclerosis. The normal metabolism of cholesterol, fat and glucose needs Cr-III. Chromium VI is mucous membrane as well as skin irritant[14]. Chromium governs nucleic acid, carbohydrate and lipoprotein metabolism. Lack of Chromium results into the disturbance of glucose and lipids metabolism in humans and animals. It is poisonous and is destructive at high doses. The human body needs it in a very small amount. Its long-lasting contact damages kidney, lung and liver[16]. Chromium is absent in this plant.

CONCLUSION

Several minerals are required by the human body to sustain good health. The excessive number of elements can result into the creation of free radicals and consequently oxidative damage. The aim of the current study is to review and compile ethno botanical use of *Caesalpinia bonducella*. The presentation of metallic contents of this plant given here shows that this plant contains optimum values as compared with daily mineral intake standards.

ACKNOWLEDGEMENTS

We express our deep gratitude and sincere thanks to the management, principal and staff of the Department of Chemistry, Baburaoji Gholap College, Sangavi, Pune and Dadapatil Rajale Arts and Science College, Adinathnagar, Ahmednagar(MS) for providing necessary facilities to carry out this work.

REFERENCES

1. Vibha Singh and Pramod Raghav. Review of pharmacological properties of *Caesalpinia bonduc* L. International Journal of Medicinal and Aromatic Plants 2012; 3(2): 514 – 530.
2. Khan Nazeerullah, Kumar Sunil, Singh Rishi Pal, Dhankhar Neelam. A Pharmacognostic and Pharmacological Overview on *Caesalpinia bonducella*. Research Journal of Pharmaceutical, Biological and Chemical Sciences 2012; 3(1): 480 – 496.
3. Kumari Rajesh, Kotecha Mita. Physicochemical and nutritional evaluation of Yuva (*Hordeum vulgare* Linn). International Research Journal of Pharmacy 2015; 6(1): 70-72.
4. Olutayo O, Michael A, John AA, Olusola A. Antimicrobial activity and Elemental analysis of *Cassia siberiana* leaves Using Atomic Absorption Spectrometer. Journal of Natural Product and Plant Resources 2012; 2 (1): 9-18.
5. Prasad AS. Essential and toxic elements in human health and disease. New York: Wiley-Liss; 1993.
6. O'Dell BL, Sunde RA. Handbook of Nutritionally Essential Mineral Elements. New York: Marcel Dekker Inc; 1997.
7. Iyengar GV. Elemental analysis of biological systems - biomedical, environmental in: Compositional and Methodological Aspects of Trace Elements. Boca Raton: CRC Press; 1989.
8. Khare CP. Indian Medicinal Plants: An Illustrated Dictionary. New York: Springer Science+ Business Media; 2007.
9. Arun Kumar, Singh RP, Singh NP. Analysis of macro and micro nutrients in some Indian, medicinal herbs grown in Jaunpur (u. p.) soil. Natural Science 2011; 3(7): 551-555.
10. Shahin Aziz, Koushik Saha, Nasim Sultana, Husna Parvin Nur, Md. Aminul Ahsan, Shamim Ahmed, Md. Kamal Hossain. Comparative studies of elemental composition in leaves and flowers of *Catharanthus roseus* growing in Bangladesh. Asian Pacific Journal of Tropical Biomedicine 2016; 6(1): 50–54.
11. Adongo SO, Murungi J, Wanjau R. Determination of Levels of Selected Essential Elements in the Medicinal Plants used by Chuka Community, Meru-Kenya using AAS. International Journal of Physical and Social Sciences 2012; 2(5): 69-82.
12. Bhowmik S, Datta BK, Saha AK. Determination of mineral content and heavy metal content of some traditionally important aquatic plants of Tripura, India using atomic absorption spectroscopy. Journal of Agricultural Technology 2012; 8(4): 1467-1476.
13. Indrayan AK, Sharma S, Durgapal D, Neeraj Kumar and Manoj Kumar. Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttaranchal. CURRENT SCIENCE 2005; 89(7): 1252-1255.
14. Gupta J, Gupta A, Gupta AK. Determination of trace metals in the stem bark of *Moringa oleifera Lam.* International Journal of Chemical Studies 2014; 2(4): 39-42.
15. Uma C, Sekar KG. Elemental analysis of *Biophytum sensitivum* DC. International Journal of advances in Pharmacy, Biology and Chemistry 2014; 3(3): 583-588.
16. Saraf A and Shinde P. Elemental analysis of different plant parts of *Derris Heyneana* (wight and arn) benth collected from Western Ghats of Maharashtra. World Journal of Pharmacy and Pharmaceutical Sciences 2016; 5(3): 1452-1461.
17. Bhargava BS and Raghupati HB, Analysis of plant materials for macro and micronutrients. In: Tandon HLS, editor. Methods of analysis of soils, plants, waters and fertilizers. New Delhi (India): FDCO; 1993.
18. Faizul Haq, Shamsur Rehman, Habib Ahmad, Zafar Iqbal, Rahat Ullah. Elemental Analysis of *Paeonia emodi* and *Punica granatum* by Atomic Absorption Spectroscopy. American Journal of Biochemistry 2012; 2(4): 47-50.

Cite this article as:

Shirish S. Pingale, Manohar G. Chaskar, Nirmala R. Kakade. Elemental analysis of *Caesalpinia bonducella* leaves. Int. Res. J. Pharm. 2017;8(1):66-69 http://dx.doi.org/10.7897/2230-8407.080113

Source of support: Nil, Conflict of interest: None Declared