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Determination of Some Trace Elements and Macro Minerals of *Sesbania bispinosa* (Jacq.) W. F. Wight

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ABSTRACT

The safety and quality of herbal medicines have become increasingly important for health authorities, the scientific community and the public alike. Natural products have provided important therapeutic use in several areas of medicine. Medicinal plants are the plants which contain substances that could be used for therapeutic purposes. In the present study, evaluation of mineral contents from *Sesbania bispinosa* (Jacq.) W. F. Wight, belonging to Fabaceae family growing in Smt. C. H. M college campus was carried out. The roots, stem, leaf and seeds were analyzed for mineral contents using ICP-AES. The mineral composition was determined on aliquots of the acid extract prepared from the ash, so as to develop a stronger basis for appreciating curative effects of the plant. The mineral contents of the plant have to be within the permissible limit for its effectiveness. This paper describes the analysis of selected trace elements viz. [Chromium (Cr), Manganese (Mn), Nickel (Ni), Copper (Cu), Cadmium (Cd), Iron (Fe), Zinc (Zn) and Lead (Pb)] and macro minerals viz. [Phosphorus (P), Potassium (K), Sodium (Na), Calcium (Ca),and Magnesium (Mg)] respectively in roots, stem, leaves and seeds of *Sesbania bispinosa* (Jacq.). The plant species under study is a potential source of nutrients and minerals. Various elements of biological importance for human metabolism were found to be present in varying concentrations. The present study indicates that *Sesbania bispinosa* (Jacq.) is a rich source of major minerals and beneficial trace elements. The results were discussed with reference to established role of elements in physiology and pathology of human life. The data obtained would serve as a tool for deciding dosage of an ayurvedic drug prepared from this plant.

INTRODUCTION

Natural products and their derivatives are obtained from the medicinal plants, which play a significant role in the discovery of modern drugs. The medicinal values of some plant species used in the homoeopathic system may be due to the presence of Ca, Cr, Cu, Fe, Mg, K and Zn (Vartika *et al.*, 2001). Mineral nutrients are usually present in plants in low concentrations and they fluctuate to a great extent, with respect to both space and time and also due to environmental factors such as weather, climate and physico-chemical properties, including soil type, soil pH and erosion (Chaves *et al.*, 2013; Maathuis and Diatloff, 2013). Medicinal plants possess some important elements in small doses, which have both therapeutics and prophylactic properties. The elements are referred to as trace elements (Hutchinson and Dalziel, 1963). Knowledge of the elemental content in medicinal plants is very important since many trace elements play significant roles in the formation of active constituents responsible for the curative properties. The environmental factors including atmosphere and pollution, the season of sample collection, the age of plant and soil conditions in which plant grows, affect the concentration of elements, as it varies from plant to plant and region to region.

Medicinal plants also contain toxic elements; if not taken care of or consumed in wrong dosages may cause serious problems. Lack of knowledge of the elemental constituents of the medicinally important plant often poses a danger to consumers as many of them take an overdose to speed up healing, ignorant of the dangers in doing so (Mino and Ota, 1984). Thus, screening of the elemental composition of these medicinal plants is highly essential (Saiki *et al.*, 1990).

Minerals are of critical importance in the diet, even though they comprise only 4–6% of the human body. Major minerals are those required in amounts greater than 100 mg per day and they represent 1% or less of bodyweight. These include calcium, phosphorus, magnesium, sulphur, potassium, chloride and sodium. Trace minerals are more essential in much smaller amounts, less than 100 mg per day, and make up less than 0.01% of bodyweight. Essential trace elements are zinc, iron, silicon, manganese, copper, fluoride, iodine and chromium (Baysal, 2002).

Trace elements have positive and negative effects on both human health and the environment. Many researchers are interested in the analysis of the trace metal contents of the environmental samples and in a particular food (Soylak et *al.*, 2006; Gonzalvez *et al.*, 2008). Accurate and adequate data of food composition are invaluable for assessing the adequacy of nutrients essential to assess risks of exposure to toxic consumption of heavy metals (Onianwa *et al.*, 2001). In this context, determination of the elemental composition of the medicinal plants is very important since some essential metals induce toxic effects when their intake is in high concentration. In order to maintain good health, the human body requires a number of minerals. Macro and micro elements play an important role in the biochemical processes, thereby influencing the human metabolism (Kolasani *et al.*, 2011). Deficiency or excess of elements may cause a number of disorders.

Bhasma has its unique place in ayurvedic therapeutics. Bhasmas are basically made from metals and minerals (Dhatus and Khanij Dravya). The process of Bhasmikaran is used to transform Dhatus and khanij into Bhasmas. Bhasma- an integral part of Ayurveda describes about using metals and minerals for chronic disorders in various combinations, dosages forms & at various levels of purities (Vahalia *et al.*, 2011). The addition of mineral nutrients to a commonly eaten food refers to the fortification. Both iodine fortification of salt and iron fortification of wheat flour are examples of fortification strategies that have produced excellent results (Vitamins Report, FAO/WHO, 1998).

Legumes/pulses are considered to be a very important group of plant food stuff, particularly in the developing world, as a cheap source of protein when animal protein is scarce. A significant part of the human population relies on legumes as a staple food for subsistence, particularly in combination with cereals. They are unique foods because of their rich nutrient content including starch, protein dietary fibre, oligosaccharides, phyto-chemicals and minerals (Kathirvel and Kumudha, 2012).

Each element has its individual impact on the structural and functional integrity of the living cells and organisms. The present study is undertaken to detect and determine the concentration level of 13 different mineral elements in *Sesbania bispinosa* (Jacq.) W. F. Wight, (Syn. *S. aculeata* Poir.) belonging to Fabaceae. It is commonly known as Prickly Sesban or Dhaincha, a crop generally cultivated for its nutritive value to the soil (Chandra and Farooqi, 1979). It is usually found as a weed in the rice fields or water logged areas in the plains of India (Prasad, 1993). It consists of an erect 1.5 to 2.5 m tall, annual, sub-shrub. Stems are fairly thick, hairless, branched from the base but soft and pithy, with minute prickles on rachis and young branches.

Leaves are long, bipinnately compound. It bears purple spotted yellow flowers from September to November in Indian climatic conditions and produces pods which contain light brown seeds (Chadha, 1976).

The plant is used in Ayurveda and Sidha and its decoction as antacid and febrifuge. Bark and seeds are astringent, for diarrhea. Seed powders are given to induce hunger. Leaf paste applied to small babies all over the body and also given bath against a whooping cough. Flowers smoke used as mosquito and insect repellant. Emetic powdered root is given to a person bitten by a snake. Leaves wash as a preventive to *tsetse* flies.

The fiber and seeds of *Sesbania bispinosa* yield gums such as galactomannans, lignins and cellulose (Salpekar and Khan, 1997). Although generally *Sesbania bispinosa* has not been considered as an important medicinal crop, it possesses several value added medicinal properties (Misra and Siddiqi, 2004). Some of the commercially valuable products of *Sesbania bispinosa* include food, fodder, fiber, resin and medicine.

Kirtikar and Basu (2005) reported that around Las Bela, it is used for wounds and powdered roots are administered to snakebite victims, inducing emesis and perhaps a cure. Medicinally, seeds are mixed with flour and applied to ringworm, other skin diseases, and wounds (Duke, 1981). Ayurvedics regard the root as alexiteric, anthelmintic, diuretic, and galactagogue and used to treat eye diseases. Seeds are stimulant, emmenagogue and astringent (Parotta, 2001).

But no work has been reported on elemental profile of *Sesbania bispinosa* (Jacq.) W.F. Wight. With this background, the present work is undertaken.

MATERIALS AND METHODS

Sample collection

The various plant parts of *Sesbania bispinosa* (Jacq.) W. F. Wight belonging to family Fabaceae were collected in the month of August - September from Smt. C. H. M College campus in Ulhasnagar of Thane district. The plants were identified at Blatter herbarium, St. Xavier's College, Mumbai. The voucher specimens were deposited in St. Xavier's College Herbarium and Botany department of Smt. C. H. M College for further reference. The accession number for *Sesbania bispinosa* (Jacq.) W. F. Wight is SYJ1.

Sample preparation

The plant parts viz., roots, stems, leaves, and seeds were separated and surface contaminants of plant samples were removed by washing with de-ionized water. They were shade dried for 7 days and then subjected to grinding for powder formation. The powder was stored in air tight glass containers with silica gel and used for further analysis.

Digestion

Dry ashing: One gram of sample was placed into a high form porcelain crucible. The furnace temperature was slowly increased from room temperature to 450˚C in 1 hr. The samples were kept for about 6 hours until a white or grey ash residue was obtained.

Aliquot: 0.5 gram ash of root, stem, leaf and seed was dissolved in 10 ml. of nitric acid and heated until the ash dissolves. It was allowed to cool, 5 ml. of perchloric acid was then added to the above solution and heated till it becomes colourless. The volume was then made up to 100 ml in a standard volumetric flask by adding de-ionized water. The aliquot was kept overnight, filtered in the morning and was stored for further use in a coloured bottle (Kumar, 2003). A blank control was prepared in the same way using the solvent alone.

Sample analysis

Metal content in the digested samples of plant parts were analyzed for Chromium (Cr), Manganese (Mn), Nickel (Ni), Copper (Cu), Cadmium (Cd), Iron (Fe), Zinc (Zn) and Lead (Pb), Phosphorus (P), Potassium (K), Sodium (Na), Calcium (Ca) and Magnesium (Mg). Estimation of elements was carried out using Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) - (*Model: ARCOS from M/s. Spectro, Germany*) at Saif, IIT-B Mumbai. A blank reading was also taken and necessary corrections were made during the calculation of the concentration of various elements. This method provides both sensitivity and selectivity since other elements in the sample will not generally absorb the chosen wavelength and thus, will not interfere with the measurement.

Working Principles

ICP- AES is an emission spectro-photometric technique, wherein the excited electrons emit energy at a given wavelength as they return to ground state after excitation by high temperature Argon Plasma. The fundamental characteristic of this process is that each element emits energy at specific wavelengths peculiar to its atomic character. The energy transfer for electrons when they fall back to ground state is unique to each element as it depends on the electronic configuration of the orbital. The energy transfer is inversely proportional to the wavelength of electromagnetic radiation, $E = hc/ \lambda$ ... (where h is Planck's constant, c the velocity of light and λ is wavelength), and hence, the wavelength of light emitted is also unique.

The intensity of the energy emitted at the chosen wavelength is proportional to the amount (concentration) of that element in the sample being analyzed relative to a reference standard (Thompson and Walsh, 1989). The wavelengths used in AES range from the upper part of the vacuum ultraviolet (160 nm) to the limit of visible light (800 nm).

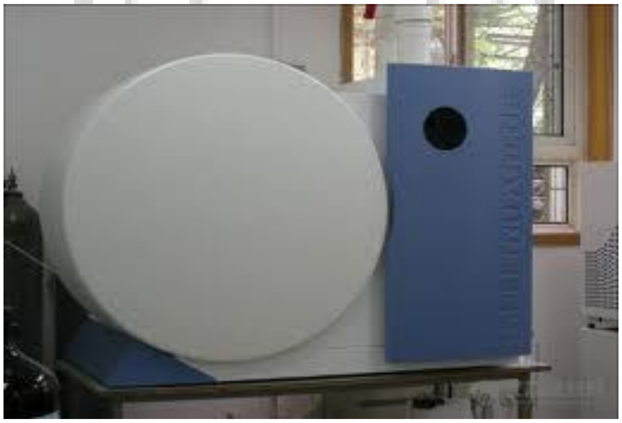

Plate 1: Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES) (*Model: ARCOS from M/s. Spectro, Germany*) at SAIF, IIT-B Mumbai.

RESULTS

The Literature survey revealed that optimal intake of elements such as sodium, potassium, magnesium, calcium, manganese, copper, zinc and iodine could reduce individual risk factors, including those related to cardiovascular disease for both human beings and animals (Anke *et al.*, 1984; Mertz, 1982; Sanchez-Castillo et *al.*, 1998).

The various plant parts of *Sesbania bispinosa* (Jacq.) W. F. Wight are a good source of trace and macro elements. Since these trace elements constitute a minute fraction in different parts of medicinal plants, a sensitive and reliable technique is a prerequisite for obtaining precise and accurate data. In the present investigation, we have applied one of the sensitive ICP-AES analytical techniques.

The concentration of trace elements and macro minerals in root, stem, leaf and seed of *Sesbania bispinosa* (Jacq.) is reported in table 1 and table 2 respectively. The order of concentration of elements in ppm (mg/kg) showing the trend in root, stem, leaf and seed of *Sesbania bispinosa* (Jacq.) is given in table 3.

Table 1: Trace elements in various parts of *Sesbania bispinosa* (Jacq.) W. F. Wight

Sr.No.	Sample	Cu	Zn	Mn	Cr	Ni	Fe	Pb	Cd
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1.	ROOT	**0.3044**	**0.924**	**0.3632**	**0.1138**	**0.0202**	**10.4992**	**0.0028**	**0.0024**
2.	STEM	**0.5404**	**0.9528**	**0.3572**	**0.0198**	**0.0276**	**2.573**	**0.0214**	**0.0032**
3.	LEAF	**0.1262**	**0.9944**	**1.062**	**0.0126**	**0.0078**	**4.173**	**0.0394**	**0.0026**
4.	SEED	**0.315**	**5.4352**	**0.4068**	**0.014**	**0.0304**	**1.2938**	**0.003**	**0.0022**

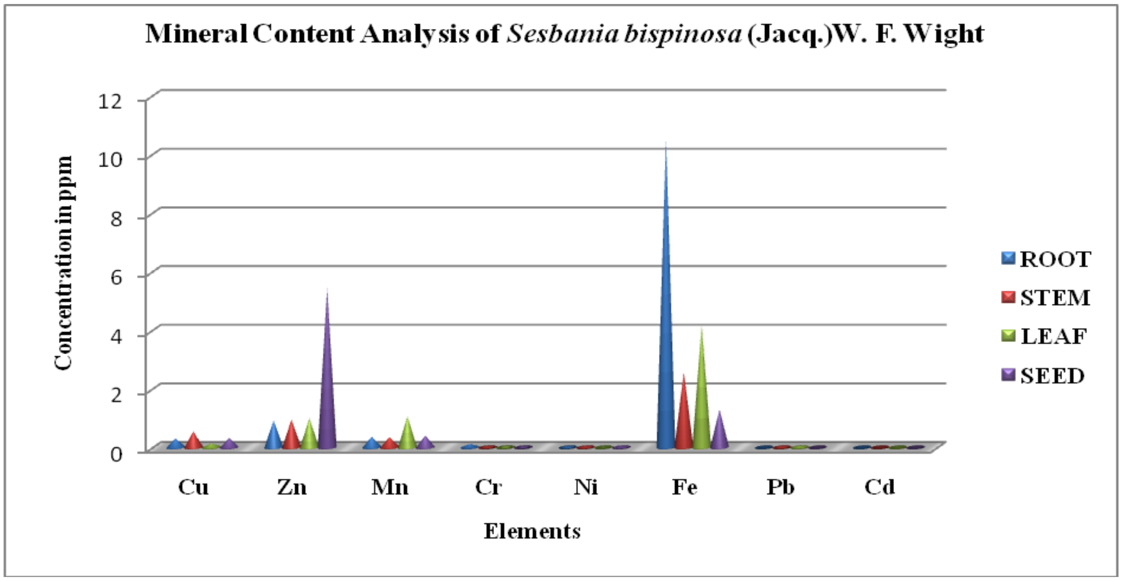

Fig. 1: Trace elements in various parts of *Sesbania bispinosa* (Jacq.) W. F. Wight

Table 2: Macro-minerals in various parts of *Sesbania bispinosa* (Jacq.) W. F. Wight

Sr.No.	Sample	K	Na	Ca	Mg	P
		ppm	ppm	ppm	ppm	ppm
1.	ROOT	**113.279**	**56.0524**	**11.704**	**5.088**	**2.80**
2.	STEM	**149.1796**	**38.4694**	**14.128**	**1.536**	**2.52**
3.	LEAF	**95.3814**	**1.0242**	**36.872**	**5.088**	**2.92**
4.	SEED	**104.862**	**0.1658**	**8.496**	**6.72**	**5.32**

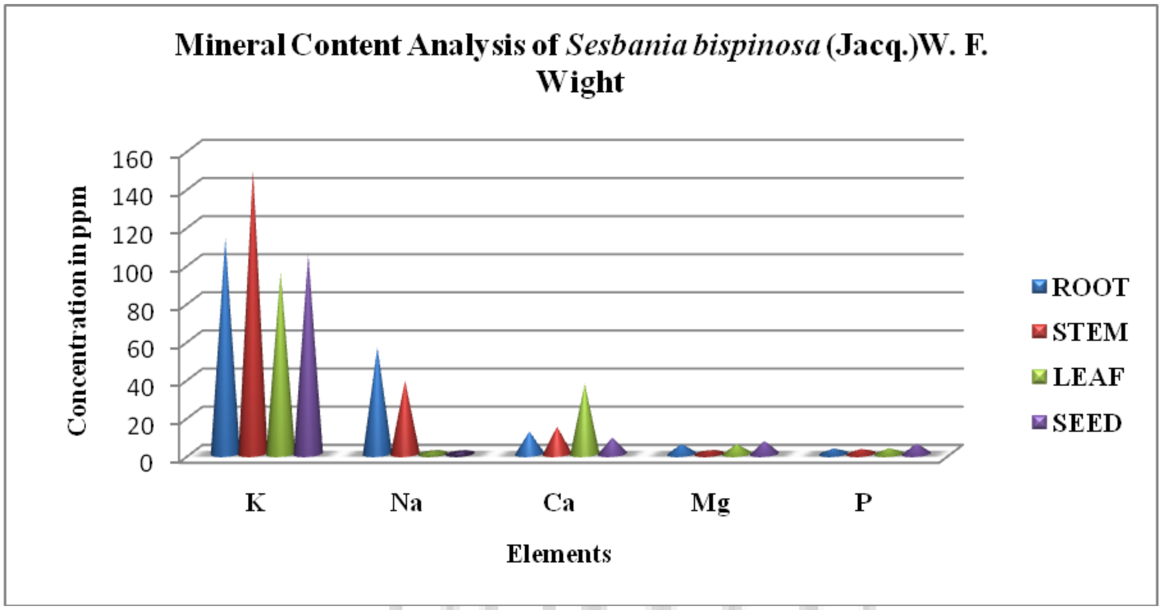

Fig. 2: Macro-minerals in various parts of *Sesbania bispinosa* (Jacq.) W. F. Wight

Table 3: Trend of elements in various parts of *Sesbania bispinosa* (Jacq.) W. F. Wight

Plant Parts	Trend of Elements
Root	K > Na > Ca > Fe > Mg > P > Zn > Mn > Cu > Cr > Ni > Pb > Cd
Stem	K > Na > Ca > Fe > P > Mg > Zn > Cu > Mn > Pb > Ni > Cr > Cd
Leaf	K > Ca > Mg > Fe > P > Mn > Na > Zn > Cu > Pb > Cr > Ni > Cd
Seed	K > Ca > Mg > Zn > P > Fe > Mn > Cu > Na > Ni > Cr > Pb > Cd

DISCUSSION

The ash content is a measure of the total amount of minerals present in a plant, whereas, the mineral content is a measure of the amount of specific inorganic components present within a plant, such as Ca, Na, K, and Mg. The quality of many products depends on the concentration and type of minerals they contain, including their taste, appearance, texture and stability. High mineral contents are sometimes used to retard the growth of certain microorganisms. Some minerals are essential for a healthy diet (*e.g.*, calcium, phosphorous, potassium and sodium) whereas, others can be toxic (*e.g.*, lead, mercury, cadmium and aluminum). It is often important to know the mineral content of product during processing because this affects the physicochemical properties of the product.

Copper:

The lowest content of Cu is 0.1262 ppm which was seen in a leaf of *Sesbania bispinosa* (Jacq.) and maximum concentration was detected as 0.5404 ppm in the stem of *Sesbania bispinosa* (Jacq.) (Table 1 and Fig. 1). In root, the Cu concentration was found to be 0.3044 ppm and in seed, it was 0.315 ppm. The permissible limit set by FAO/WHO for copper in edible plants was 3.00 ppm (FAO/WHO, 1984). However, for medicinal plants, the WHO limits have not yet been established for Cu. Permissible limits for Cu set by China and Singapore for medicinal plants were 20 ppm and 150 ppm, respectively (WHO, 2005).

Copper (Cu) is an essential redox -active transition element that plays a vital role in various metabolic processes. Being toxic, its quantity in plants should be very low. It is essential to the human body since it forms a component in many enzyme systems, such as cytochrome oxidase, lysyl oxidase and an iron-oxidizing enzyme in the blood. The observation of anaemia in copper deficiency is probably related to its role in facilitating iron absorption and in the incorporation of iron in haemoglobin. However, copper deficiency in humans is a rare occurrence. Cu could be toxic depending on the dose and duration of exposure (Obi et *al.*, 2006). Our results indicate that concentration of Cu was well below the permissible limit.

Zinc:

In the case of Zinc the highest concentration was found in seeds of *Sesbania bispinosa* (Jacq.) which was 5.4352 ppm where as in leaves it was found to be 0.9944 ppm, in stem 0.9528 ppm and in root it was 0.924 ppm (Table 1 and Fig. 1). Zinc is essential to all organisms and has an important role in metabolism, growth, development and general well- being. It is an essential co-factor for a large number of enzymes in the body. Zinc deficiency leads to coronary heart diseases and various metabolic disorders. Zinc fortification programmes are being studied, especially for populations that consume predominately plant foods. Fortification of cereal staple foods is potentially attractive interventions which could benefit the whole population as well as target the vulnerable population groups, namely children and pregnant women. Such addition of zinc to the diet would decrease the prevalence of stunting in many developing countries with low-zinc diets because linear growth is affected by zinc supply in the body (Vitamin: report of FAO/WHO, 1998).

Manganese:

The activity of this element is noticed in the metabolism of food which is incorporated into the bone. Manganese is essential element required for various biochemical processes (Guenther and Konieczynski, 2003). The kidney and liver are the main storage places for the manganese in the body. Mn is essential for the normal bone structure, reproduction and normal functioning of the central nervous system. Its deficiency causes reproductive failure in both male and female (Lokhande *et al.*, 2010). Apart from physiological importance, experimental data has pointed out the pharmacological implication of this element especially in prevention and treatment of diabetes mellitus (Debrah *et al.*, 2011).

High concentration of manganese is found in the leaf of *Sesbania bispinosa* (Jacq.). Our results indicate that the concentration of Mn in roots is 0.3632 ppm, in stem 0.3572 ppm, in leaf 1.062 ppm where as in seeds it is found to be 0.4068 ppm (Table 1 and Fig. 1). The permissible limit set by FAO/WHO (1984) for Mn was 2 ppm in edible plants. However, the permissible WHO (2005) limits for Mn in medicinal plants have not yet been set.

Chromium:

Chromium is known to regulate carbohydrate, nucleic acid, and lipoprotein metabolism and it also potentiates insulin action (Kaplan *et al.*, 2003). Chronic exposure to Cr may result in liver, kidney and lung damage (Zayed & Terry, 2003). Chromium also acts as an activator of several enzymes. Deficiency of chromium decreases the efficiency of insulin and increases sugar and cholesterol in the blood. Chromium deficiency can cause an insulin resistance, impair in glucose tolerance and may be a risk factor for atherosclerotic disease. The chromium concentration in all the parts studied of *Sesbania bispinosa* (Jacq.) was below the permissible limit for chromium in edible plants which is 2 ppm (FAO/WHO, 1984). Our results indicate that the concentration in roots is 0.1138 ppm, in stem it is 0.0198 ppm, in leaves it is 0.0126 ppm and in seed it is 0.014 ppm (Table 1 and Fig. 1).

Nickel:

The amount of nickel concentration in all the parts of *Sesbania bispinosa* (Jacq.) studied was below the permissible level. In roots 0.0202 ppm, in stem 0.0276 ppm, in leaves 0.0078 ppm, and in seeds it is 0.0304 ppm (Table 1 and Fig. 1). The permissible limit for nickel set by WHO in edible plants was 1.63 ppm and the permissible limits for medicinal plants have yet not been set. Nickel is considered to be a highly mobile element within a plant. Accumulation of Ni takes place only in the leaves (Mc Grath, 1995). But our results show that Nickel has also accumulated in roots, stems and seeds also. Nickel toxicity in human is not of very common occurrence, as its absorption by the body is very low (Onianwa, *et al.*, 2000).

Iron:

Iron is an essential element for human beings and animals and is an essential component of haemoglobin. It facilitates the oxidation of carbohydrates, protein and fat to control body weight, which is a very important factor in diabetes. Studies suggest that the intake of Iron in higher concentration is hazardous to health (Critchley, 1986).

Low Fe content causes gastrointestinal infection, nose bleeding, and myocardial infarction. The role of iron in the body is clearly associated with hemoglobin and the transfer of oxygen from lungs to the tissue cells. Iron deficiency is the most prevalent nutritional deficiency in humans and is commonly caused by insufficient dietary intake, excessive menstrual flow or multiple births. In this case, it results, especially in anemia (Sigel, 1978 ; Reddy *et al.,* 1987). This element is used by the body to make tendons and ligaments. Certain chemicals in our brain are controlled by the presence or absence of iron. It is also important for maintaining a healthy immune system.

In all parts of *Sesbania bispinosa* (Jacq.) studied, the amount of iron accumulated is much lower than the permissible levels. The highest concentration of iron is found in roots which is 10.4992 ppm, followed by leaves which is 4.173 ppm, in stem 2.573 ppm and in seeds it is 1.2938 ppm (Table 1 and Fig. 1). The permissible level set by WHO for Iron in edible plants was 20 ppm (Saraf & Samant, 2013).

Lead:

Lead has no biochemical or physiological importance and is considered as a toxic pollutant. It causes a rise in blood pressure, kidney damage, miscarriages and subtle abortion, brain damage, decline fertility of men through sperm damage, diminishing abilities of children and disruption of nervous systems (Khan et *al.,* 2011). With reference to WHO (1992), the permissible limit for lead set in edible plants was 0.43 ppm. However, for medicinal plants the limit was 10 ppm set by China, Malaysia, Thailand and WHO (Jabeen *et al.,* 2010) .

The amount of lead concentration in all the samples analyzed was in a minimal amount and well below the permissible level. Our results show that the lead concentration in roots was 0.0028 ppm, in stems 0.0214 ppm, in leaves 0.0394 ppm and in seeds it was 0.003 ppm (Table 1and Fig. 1). Exposure to increased concentrations of lead is a health hazard. The level of Pb obtained in the present study does not indicate a potential health hazard to users.

Reports have shown that leafy plant samples contained higher levels of Pb than the fruit and root sample. However, the present study showed very less concentration of Pb in roots and seeds than that of stem and leaves. The extent of contamination of Pb depends on the traffic densities and environmental pollution (Nasralla and Ali, 1985 ; Sovljanski *et al.,* 1990).

Cadmium:

The amount of cadmium concentration in the roots of *Sesbania bispinosa* (Jacq.) analyzed was found to be within the permissible limits. In roots 0.0024 ppm, in stem 0.0032 ppm, in leaves 0.0026 ppm and in seeds 0.0022 ppm (Table 1and Fig. 1). The permissible level (WHO) for cadmium in edible plants was 0.21 ppm and for medicinal plants is 0.3 ppm (Jabeen, *et al.*, 2010). This may be due to the low level of cadmium present in the available soil for plant growth.

Cadmium is a toxic metal having functions neither in human body nor plants (Hussain & Khan, 2010). Accumulation of Cd in kidney leads to high blood pressure and renal diseases. Its accumulation also leads in damaging the nerve cells, inhibition of release of acetylcholine and activation of choline esterase enzyme, resulting in a tendency for hyperactivity of the nervous system (Schumacher et *al.,* 1991).

Potassium:

Potassium is also an essential macro-element for a human. It is important because it is involved in muscle contraction, in lipids metabolism, in proteins synthesis, maintaining the fluid and electrolyte balance in the body and is responsible in the nerve impulses sending (Mogos, 1997). The necessary daily intake is 2-4 g/day. Potassium has the highest concentration in the leafy materials than other nutrients as it is an activator of some enzymes. One main feature of K is the high rate at which it is taken up by plant tissues. Usually, the absorption of K depends on the soil type.

It is observed that amongst all the elements studied in the analysed sample, potassium accumulation is the highest in all parts of *Sesbania bispinosa* (Jacq.) than the concentration of other metals. Soil could be a factor for accumulation of higher amount of K. The present study revealed that the concentration of Potassium was much higher in stem 149.1796 ppm than the concentration in roots 113.279 ppm followed by seeds 104.862 ppm and much lower in leaves 95.3814 ppm (Table 2 and Fig. 2) of *Sesbania bispinosa* (Jacq.). Potassium remains one of the major electrolytes in the blood. Potassium is of great importance for many regulation systems in the body. The minimum daily intake of Potassium is 3.5g (Baysal, 2002).

Sodium:

The concentration of Sodium element was observed to be much higher in roots 56.0524 ppm than the concentration in stem 38.4694 ppm, followed by concentration in leaves 1.0242 ppm and in seeds 0.1658 ppm of *Sesbania bispinosa* (Jacq.) (Table 2 and Fig. 2). Sodium is essential to all living organisms. Like Potassium, it is also one of the major electrolytes in the blood. Without sodium the body cannot be hydrated, it would dry off. At the point when some vital processes are taking place, sodium is not needed, too much of sodium will cause the cell to break down (Gbolahan, 2001). Na is of great importance for many regulation systems in the body. The minimum daily intake of Na is 2.4 g (Baysal, 2002).

Calcium:

Calcium is an important macro-element because of its role in bones, teeth, muscular system and heart functions (Broody, 1994). It is required for absorption of dietary Vitamin B, for the synthesis of the neurotransmitter acetylcholine and is also required for activation of enzyme pancreatic lipase (Lokhande et *al.*, 2010). Calcium is necessary for the coagulation of blood, the proper functioning of the heart and nervous system and the normal contraction of muscles. Its most important function is to aid in the formation of bones and teeth.. Similar to Sodium it is found that calcium accumulation is more in leaves than in roots.

It is observed that amongst all the elements studied in the analysed sample, calcium accumulation is highest in leaves of *Sesbania bispinosa* (Jacq.). than the concentration of other metals. Soil could be a factor for accumulation of the higher amount of Ca. The concentration of Calcium in leaves is 36.872 ppm followed by the concentrations in stem 14.128 ppm , in roots 11.704 ppm and in seeds 8.496 ppm of *Sesbania bispinosa* (Jacq.) (Table 2 and Fig. 2). Calcium is the main component of bones and teeth. This element functions on cell membranes and muscles, by regulating endo-exo-enzymes and blood pressure (Kilic and Kose, 2001).

Magnesium:

Magnesium is important to all the cells in human**s**. It is present in many enzymes involved in proteins, lipids, and carbohydrate metabolism. In plants, Magnesium is present in chlorophylls. Mg is required in the plasma and extracellular fluid, where it helps maintain osmotic equilibrium.

It is required in many enzyme-catalyzed reactions, especially those in which nucleotides participate where the reactive species is the magnesium salt, e.g., Mg ATP. It can also prevent some heart disorders and lower blood pressure. Lack of Mg is associated with abnormal irritability of muscle and convulsions and excess Mg with depression of the central nervous system (Prasad, 1981).

Magnesium deficiency in humans caused muscle spasms and has been associated with a high blood pressure, many cardiovascular diseases, diabetes, and osteoporosis. The necessary daily intake is 350 mg/day for men and 300 mg/day for women (Mogos, 1997). Intracellular Magnesium deficiency is correlated with the impaired function of many enzymes utilizing high energy phosphate bonds, as in the case of glucose metabolism (Stef, *et al.,* 2010). The concentration of Magnesium was found to be highest in seeds 6.72 ppm (Table 2 and Fig. 2). The concentration of magnesium was found to be same in roots and leaves 5.088 ppm and in the stem of *Sesbania bispinosa* (Jacq.), it was 1.536 ppm , which is below the permissible level of 2000 ppm.

Phosphorous:

Phosphorus is one of the key elements necessary for the growth of plants and animals. Phosphates are formed from this element. It is an essential nutrient for all life forms and plays a role in deoxyribonucleic acid (DNA), ribonucleic acid (RNA), adenosine diphosphate (ADP), and adenosine triphosphate (ATP). It is required for these necessary components of life to occur.

Phosphorous maintain blood sugar level, normal heart contraction is dependent on phosphorous (Linder, 1991) also important for normal cell growth and repair, needed for bone growth, kidney function, and cell growth. It plays an important role in maintaining the body's acid-alkaline balance (Johns & Duquette, 1991). The highest concentration of phosphorus was found to be in seeds 5.32 ppm of *Sesbania bispinosa* (Jacq.) followed by the concentrations in leaves 2.92 ppm, in roots 2.80 ppm and in stem 2,52 ppm (Table 2 and Fig. 2). The ratio of calcium to phosphorus content (Ca/P) in soil, plants, fodder and human diet is an indicator of equilibrium necessary to the regular run of processes in the food chain (Sapek, 2003).

CONCLUSION

The data on trace and major elements in plants is of great importance to understand the pharmacological action of a medicinal plant. Medicines contain trace elements in a bioavailable form. The data obtained in the present work on elemental compositions of *Sesbania bispinosa* (Jacq.) will be useful in deciding the dosage of the drugs prepared from the plant and thus will be helpful in synthesis of new modern drugs with various combinations of plants which can be used for the control and cure of various diseases ethno-medicinally. However, in order to develop a stronger basis for appreciating the curative effects of *Sesbania bispinosa* (Jacq.), there is a need to study the effect of soil and climatic conditions on the elemental composition of this forage legume plant.

Sesbania bispinosa (Jacq.) is rich in metals such as K, Na, Ca, Fe, Mg, and P. It is expected that plants with high contents of the above-mentioned macro and micronutrients might play an important role in the maintenance of human health. All of the detected values for elements in the plant studied here are below WHO permissible levels for medicinal plants. As *Sesbania bispinosa* (Jacq.) has macro minerals in ample amount, it can be used as a good natural dietary supplement as well as for therapeutic uses.

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