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Full Length Research Paper

Elemental analysis of some medicinal plants used in traditional medicine by atomic absorption spectrophotometer (AAS)

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Different elemental constituents at trace levels of plants play an effective role in the medicines prepared. Elemental composition of different parts including leaves, seeds and fruits have been determined by using Atomic Absorption Spectrophotometer (AAS). A total of 14 elements K^{+}, Mg^{+2}, Ca^{+2}, Na^{+}, Fe^{+2}, Co^{+3}, Mn^{+2}, Cu^{+3}, Cr^{+3}, Zn^{+2}, Ni^{+3}, Li^{+1}, Pb^{+4} and Cd^{+2} have been measured. Their concentrations were found to vary in different samples. Medicinal properties of these plant samples and their elemental distribution have been correlated.

Key words: Elemental analysis, medicinal plants and atomic absorption spectrophotometer.

INTRODUCTION

Herbal drugs are being used as remedies for various diseases across the world from ancient time. In recent years, increasing interest has been focused on phyto-medicines as safer and more congenial to the human body. Medicinal plants come into preparation of various drugs singly or in combination or even are used as the principal source of raw material for the other medicines (Mohanta et al., 2003).

More than 40 elements have been considered essential to life systems for the survival of both mammals and plants. An element is considered essential when reduction of its exposure below a certain limit results consistently in a reduction in a physiologically important function, or when the element is an integral part of an organic structure performing a vital function in that organism (Armah et al., 2001).

Two main criteria are considered when elements are said to be essential. The first one is absence form diet results in departures from normal growth and metabolism, and development of pathological symptoms, while the second dist heat pathological symptoms can be relieved by replacing the element. To be pharmacologically effective or essential, the trace element may need to be combining or chelated with some ligand, in order to be physiologically absorbed to prevent or cure impairment caused by deficiency of the element (Linder, 1991).

Active constituent of medicinal plants are metabolic products of plant cells and a number of trace elements play an important role in the metabolism (Rajurkar and Damame, 1997). The screening of the actual bioactive elements of plant origin and assessment of elemental composition of the widely used medicinal plants is highly essential. In present study an attempt was made to determine what essential elements are present and their levels in medicinal plants by using Atomic Absorption Spectrophotometer (AAS).

EXPERIMENTAL

Five medicinal plants including; *Fagonia indica* Burm., *Argemone mexicana* L., *Cnicus benedictus* L., *Silybum marianum* (L.) Gaertn. and *Solanum suratense* Burm. f. were analyzed in the from of aerial parts. Plants material was collected freshly from the filed. All plants material

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Table 1. Botanical names and uses of selected medicinal plants.

No.	Species name	Family	English name	Local name	Part used	Medicinal uses
01	*F. indica* Burm.	Zygophyllaceae	Southern Cyprus	Dhamaya	Aerial parts	Fever, hepatitis, itching, skin diseases, tonic for liver and stomach, blood purification, cough and diabetes.
02	*A. mexicana* L.	Papaveraceae	Mexican prickly poppy	Kandiari	Aerial parts	Diuretic, purgative and sedative.
03	*Cnicus benedictus* L.	Asteraceae	Holy Thistle	Kandiari	Aerial parts	Digestive complaints, Astringent; Bitter; Diuretic; Stomachic; Tonic
04	*Silybum marianum* (L.) Gaertn.	Asteraceae	Milk thistle	Shafa-e-Jigar	Seeds	Diuretic, Anticancer, stimulates the cardiovascular system and antiviral and spermicidal, carminative, hepatitis, asthma, cough, bronchspasm, sore throat, constipation.
05	*Solanum suratense* Burm. f.	Solanaceae	Yellow berried nightshade	Mohakari	Aerial parts	Anticancer, stimulates the cardiovascular system, antiviral and spermicidal, carminative, asthma, cough, bronchspasm, sore throat, constipation, an effective expectorant and diuretic.

was first cleaned dried and then powdered using a electric blender.

Samples in powder form were used for Atomic Absorption Spectrophotometer (AAS). Each plant material (0.25 g) were taken in 50 ml flask and add 6.5 ml of mixed acid solution that is, Nitric acid (HNO_3), Sulfuric acid (H_2SO_4) and Perchloric acid ($HClO_4$) (5:1:0.5) The sample boiled in acid solution in fume hood on hot plate (model VWR VELP scientifica, Germany) till the digestion has been completed which was indicated by white fumes coming out from the flask. Thereafter, few drops of distilled water were added and allowed to cool. Then these digested samples were transferred in 50 ml volumetric flasks and the volume was made up to 50 ml by adding distilled water in them. Then filter the extract with filter paper (Whatmann No. 42) and filtrate were collected in labeled plastic bottles. The solutions were analyzed for the elements of interest utilizing Atomic Absorption Spectrometer Shimadzu AA-670 with suitable hollow cathode lamps. The percentages of different elements in these samples were determined by the corresponding standard calibration curves obtained by using standard AR grade solutions of the elements i.e. K^+, Mg^{+2}, Ca^{+2}, Na^+, Fe^{+2}, Co^{+3}, Mn^{+2}, Cu^{+3}, Cr^{+3}, Zn^{+2}, Ni^{+3}, Li^{+1}, Pb^{+4} and Cd^{+2}.

RESULTS AND DISCUSSION

Plants analyzed in the present work with their botanical name, local name, part of the plant used, medicinal uses (Table 1). The results of elemental analysis obtained by comparator method of AAS techniques are shown in Table 2 in mg/g dry weight of the samples. It is to be noted that each result is an average of at least three independent measurements with a precision of about ± 1%.

The data obtained are cited in Table 2 and 3. The results show that *Fagonia indica* Burm., *Argemone mexicana* L., *Cnicus benedictus* L., *Silybum marianum* (L.) Gaertn. and *Solanum suratense* Burm. f. exhibits the highest concentration of the elements K^+, Mg^{+2}, Fe^{+2} and Na^+ (Table 2). The highest more concentration of K^+ was found in *Cnicus benedictus*. This shows that plants accumulate and assimilate several elements from the soil. In *Argemone mexicana* and *Silybum marianum* the Cu^{+3} and K^+ are absent. *Fagonia indica* has low concentration of Zn^{+2}. *Solanum surratense* has low concentration of Cd^+, Li^+ and$^+$ Cu^+. *Cnicus benedictus* has low concentration of Li^{+1} (Table 3). From the above presentation, it is obvious that most of these plants accumulate essential, important, necessary, useful and helpful elements for plant, man and animals. The presence of Ca^{+2}, Mg^{+2}, Na^+, K^+, Co^{+3}, Cr^{+3}, Cu^{+3}, Fe^{+2}, Mn^{+2}, Ni^{+3} and Zn^{+2} reflects their function as essential nutrient elements, often as co-factor activators in metal-ligand enzyme complexes (Valkovic, 1975). Ca^{+2} and Mg^{+2} are present in exchangeable amounts and act as binding agents to fuse the cell walls together (Dser, 1979). The high concentration of certain metals, Mg^{+2}, K^+, Ca^{+2} and Fe^{+2} in the plants are essential for proper growth and normal functioning of the plant (Underwood, 1971). Co^{+3}, Cr^{+3}, Cu^{+3} and Zn^{+2} (Valkovic, 1975) are essential for hair growth and for increasing the rate of milk production by pregnant

Table 2. Concentrations of K^{+}, Mg^{+2}, Ca^{+2}, Na^{+}, Fe^{+2}, Co^{+3}, Mn^{+2} (ppm) in medicinal plants.

No.	Species Name	K^{+}	Mg^{+2}	Ca^{+2}	Na^{+}	Fe^{+2}	Co^{+3}	Mn^{+2}
01	*Fagonia indica* Burm.	2293.68	1819.5	27.8	155.3	579.00	35.00	32.2
02	*Argemone mexicana* L.	1578.3	2023.42	73.0	361.60	618.6	24.6	62.00
03	*Cnicus benedictus* L.	6000.00	1764.64	305.5	156.48	730.8	38.8	34.6
04	*Silybum marianum* (L.) Gaertn.	154.78	1092.72	54.00	506.52	669.2	19.2	23.2
05	*Solanum suratense* Burm. f.	1085.38	1942.52	263.6	236.06	522.2	27.6	30.4

Table 3. Concentrations of Cu^{+3}, Cr^{+3}, Zn^{+2}, Ni^{+3}, Li^{+1}, Pb^{+4} and Cd^{+2} (ppm) in medicinal plants.

No.	Species name	Cu^{+3}	Cr^{+3}	Zn^{+2}	Ni^{+3}	Li^{+1}	Pb^{+4}	Cd^{+2}
01	*Fagonia indica* Burm.	1.8	9.6	0.42	12.4	4.00	54.00	3.4
02	*Argemone mexicana* L.	0.00	3.2	10.44	14.6	3.4	86.00	3.4
03	*Cnicus benedictus* L.	6.8	7.00	38.52	22.00	0.4	64.00	4.6
04	*Silybum marianum* (L.) Gaertn.	0.00	4.6	34.3	29.4	5.00	54.00	2.00
05	*Solanum suratense* Burm. f.	1.00	32.6	26.78	35.2	1.4	52,00	2.6

females. The botanical sources of large number of folk medicine found therapeutically effective in indigenous systems are still unknown or doubtful (Ahmad et al., 2008, 2009; Abbasi et al., 2009; Shah et al., 2009).

Chemotaxonomic markers including classical taxonomic and modern techniques have been used to detect adulterants from genuine source of the drug and solve the problems of confusion faced by herbalists, pharmacists, taxonomists and medicinal herb traders (Ahmad et al., 2008; Ahmad et al., 2009).

The active constituents of medicinal plant or the metabolic products of plant cells wherein a number of trace elements play an important metabolic role can be used medicinally for their therapeutic effect (Rasheed, 1995). In addition the plants are used as the principal source of raw materials in the preparation of drugs. The presence of high element concentrations in the plants under study gives a new insight into their potential use to compensate for element deficiencies in both man and animals as well as medicinal plants. The toxicity levels for the elements under study were within the safety baseline level for both man and animals (Bowen, 1979).

The presence and concentrations of various elements in different plant depend on the composition of the soil, water and fertilizers used as well as permissibility, selectivity and absorbability of plants for the uptake of these elements. Hence, the observed variations in concentration of the elements are attributed to the nature of the plant as well as its surroundings (Rajurkar and Damame, 1997).

The elements Fe^{+2}, K^{+}, Mg^{+2}, Na^{+}, Ca^{+2}, Co^{+3}, Mn^{+2}, Zn^{+2} and Cu^{+3} have been classified as essential elements, Ni^{+3}, Cr^{+3} are possibly essential while Cd^{+2}, Pb^{+4} and Li^{+1} are non essential elements for the human body. Among the various elements detected in different medicinal plants used in the treatment of different diseases. It is interesting to note that some of the medicinal plants used by local physician and common people have high concentration in the range of ppm of Mn^{+2}, Fe^{+2}, Cu^{+3}, Zn^{+2} etc. The concentration of K^{+} and Ca^{+2} are in the percentage level. Zn^{+2} is important in wound healing and also functions as an antioxidant. Mn^{+2} are essential for normal functioning of central nervous system and are a good anti-oxidant. The researchers are trying to link the contents of the trace elements and medicinal values of the plants. This is for the first time that such an exhaustive work on elemental content has been carried out on the medicinal plants.

The data obtained in the present work will be useful in synthesis of new herbal drugs with various combinations of plants, which can be used in the treatment of different diseases at global level generally and in Pakistan particularly.

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