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Full Length Research Paper

Elemental profile of 24 common medicinal plants of Pakistan and its direct link with traditional uses

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At least 15 elements can be considered as an essential nutrients for human health but their toxic concentration should also be considered for preparation of herbal medicines. 24 medicinal plants were selected for metals analysis renowned for their therapeutic medicinal use. The metals analyzed include sodium (Na), potassium (K), lithium (Li), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), lead (Pb), manganese (Mn), cupper (Cu), nickel (Ni), chromium (Cr) and cadmium (Cd) by flame emission spectroscopy and atomic absorption spectroscopy. It was investigated that the level of essential elements was higher as compared to trace elements as Zn, Pb, Mn, Cu, Ni, Cr and Cd were not detected, depicting their lesser concentration in selected plants. The highest concentration (ppm) of macro nutrients Na (792), Li (78) were found in Gauzuban (*Onosma bracteatum*); and Ca (164), K (180 found in Dandelion (*Taraxacum officinale*); and that of Mg (11.5) both in Neem (*Azardirachta indica*) and Gainda (*Tagetes minuta*). The results also showed that Methi (*Trigonella foenum-graceum*) has highest concentration of Fe (29.8); Gainda (*T. minuta*) has highest concentration of Zn (29.8). Presence of different metals in these medicinal plants was correlated to their medicinal use.

Key words: Medicinal plants, elemental, spectrophotometry.

INTRODUCTION

Medicinal plants and herbs are of great importance to the health of individual and communities. Herbal drugs are being used as remedies for various diseases across the world from ancient time (Prajapati and Prajapati, 2002; Latif et al., 2003; Shinwari et al., 2006). In the recent past, increasing research evidence clearly indicate the positive role of traditional medicinal plants in the prevention or control of some metabolic disorders like diabetes, heart diseases and certain types of cancers (Zhang, 1976). Medicinal plants come into preparation of various drugs singly or in combination or even are used as the principal source of raw materials for the other medicines (Mohanta et al., 2003). Each medicinal plant species has its own nutrients composition besides having pharmacologically important phytochemicals. These nutrients are essential for the physiological functions of human body. Such nutrients and biochemicals like carbohydrates, fats and proteins play an important role in satisfying human needs for energy and life processes (Hoffman et al., 1998; Dingman, 2002; Pandey et al., 2006).

The trace elements to be pharmacologically effective or essential, 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 elemental composition of the widely used medicinal plants is highly essential. As various medicinal plant species are used either in the form of extract or decoction by the local people in different regions of Punjab, Pakistan, therefore, evaluating their nutritional significance can help to understand the worth of these plants species. In this present study, an attempt was made to determine essential elements along in relation to their ethno medicinal uses in Punjab, Pakistan.

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Abbreviations: FES, Flame emission spectrophotometer; **AAS,** atomic absorption spectrometer; **RDA,** recommended dietary allowance.

Table 1. Medicinal uses and pharmacological action of different parts of selected plant species.

Local name	Botanical name	Family	Voucher no.	Part used	Medicinal value
Aam	*Mangifera indica* L.	Anacardiaceae	PU.IAGS.801	Leaves	Astringent, styptic, refrigerant, vulnerary , constipating, burns, scalds
Aak	*Calotropis procera W.T. Aiton*	Asclepiadaceae	PU.IAGS.802	Leaves	Tonic, paralysis, arthralgia, intermittent fever.
Bargad	*Ficus benghalensis L.*	Moraceae	PU.IAGS.803	Leaves	Ulcer, allergy, burning sensation
Banaphasha	*Viola odorata L.*	Violaceae	PU.IAGS.804	Leaves	Sore throat, fever, antipyretic
Chirayita	*Swertia chirayita (Roxb.ex Flem.) Karst.*	Gentianaceae	PU.IAGS.805	Leaves	Poultice for maggot-infested ulcers
Dandelion	*Taraxacum officinale F.H. Wigg*	Asteraceae	PU.IAGS.806	Leaves	Blood purifier, analgesic, dermatology, good health tonic
Dharek	*Melia azedarach L.*	Meliaceae	PU.IAGS.807	Leaves	Trichomonas infections
Gainda	*Tagetes minuta L.*	Asteraceae	PU.IAGS.808	Leaves	Mosquito repellent, liver diseases, skin diseases
Gauzuban	*Onosma bracteatum Wall.*	Boraginaceae	PU.IAGS.809	Leaves	Tonic, Refrigerant, relieves heart palpitation, stomach and bladder treatments
Jamun	*Syzygium cumini (L.) Skeels.*	Myrtaceae	PU.IAGS.810	Leaves	Strengthens teeth, gums, antibacterial
Kasni	*Cichorium intybus L.*	Asteraceae	PU.IAGS.811	Leaves	Hepatomegaly, dyspepsia, skin allergy ,jaundice, asthma
Khati buti	*Oxalis corniculata L.*	Oxalidaceae	PU.IAGS.812	Leaves	Diarrhea, dysentery, purifies blood
Kikar	*Accacia farnesiana (L.) Willd.*	Mimosaceae	PU.IAGS.813	Leaves	Gonorrhea
Makoy	*Solanum nigrum L.*	Solanaceae	PU.IAGS.814	Leaves	Antiseptic, cardio tonic, diuretic, rejuvenating, asthma
Mehandi	*Lawsonia inermis L.*	Lythraceae	PU.IAGS.815	Leaves	Carminative, antidepressant, stimulates blood flow
Methi	*Trigonella foenum-graceum L.*	Fabaceae	PU.IAGS.816	Leaves	Pancreas and Chest infection, Poultice ,fever
Nagdona	*Artemisia absinthium L.*	Asteraceae	PU.IAGS.817	Leaves	Stomachic, antiseptic
Neelophar	*Nymphaea alba L.*	Nymphaeaceae	PU.IAGS.818	Flower	Calming, sedative for nervous system, reduce sexual drive, useful in treatment of insomnia and anxiety

MATERIALS AND METHODS

Collection of plants

Five different medicinal plants Banaphasha (*Viola odorata),* Dandelion (*Taraxacum officinale),* Gauzuban *(Onosma bracteatum),* Nagdona (*Artemisia obsinthium)* and Senna (*Senna obtusifolia)* were collected from Khanaspur campus and remaining 19 from Quaid-e-Azam campus, university of the Punjab, Pakistan in the month of January, 2011. The identification and nomenclature of these medicinal plants was based on the flora of Pakistan (Nasir and Ali, 1978). The voucher specimens PU.IAGS.801-824 were deposited in the Herbarium, institute of agricultural sciences, Punjab University, Lahore. Botanical name, common name, family, voucher no. and medicinal uses of 24 plants are given in Table 1.

Drying and grinding of plants

Leaves of each plant were washed thoroughly with deionized water, air dried, spread on an aluminium foil then heat dried first under sunlight then in oven at 60°C. The dried leaves were grinded well into a fine powder (60 mesh sieve size) with pastel mortar. The powdered plant material was then stored in glass bottles at 4°C.

Sample preparation

0.25 g powder sample of each medicinal plant was dissolved in 5 ml of nitric acid and temperature was maintained at 80°C for 15 min. 2 ml of perchloric acid was added to above solution and resultant mixture was left for digestion for about 2 h until white dense fumes had

Table 2. Element profile of selected medicinal plants.

Plant	Metal												
	Na	K	Li	Ca	Mg	Fe	Zn	Pb	Mn	Cu	Ni	Cr	Cd
AAK	378	66	77	41	11	14.2	2.38	ND	ND	ND	ND	ND	ND
AAM	360	24	55	57	9.6	15.4	2.1	ND	ND	ND	ND	ND	ND
BARGAD	360	100	13	48	10.9	17.9	2.1	ND	ND	ND	ND	ND	ND
BANAFSHA	528	100	39	78	11.2	19.4	2.17	ND	ND	ND	ND	ND	ND
CHIRAYITA	370	78	40	162	10.5	29	2.24	ND	ND	ND	ND	ND	ND
DANDELION	740	180	78	106	6.4	19.5	2.32	ND	ND	ND	ND	ND	ND
DHAREK	374	95	42	73	10.5	14.4	2.71	ND	ND	ND	ND	ND	ND
GAINDA	208	80	32	109	11.5	14.3	2.33	ND	ND	ND	ND	ND	ND
GAUZUBAN	792	83	48	164	11.2	18.5	2.22	ND	ND	ND	ND	ND	ND
JAMAN	156	30	15	90	11.2	12.7	2.38	ND	ND	ND	ND	ND	ND
KASNI	720	92	22	127	10.4	13.6	2.24	ND	ND	ND	ND	ND	ND
KEEKAR	270	50	48	92	9.0	13.9	2.38	ND	ND	ND	ND	ND	ND
KHATI BUTI	310	42	12	85	10.3	21.6	2.62	ND	ND	ND	ND	ND	ND
MAKOY	586	75	43	51	11.1	16.8	2.27	ND	ND	ND	ND	ND	ND
MEHNDI	296	36	10	48	9.8	29.8	2.2	ND	ND	ND	ND	ND	ND
METHI	270	50	25	88	11.0	14.2	2.24	ND	ND	ND	ND	ND	ND
NAGDONA	144	65	17	66	10.5	27	2.4	ND	ND	ND	ND	ND	ND
NEELOPHAR	242	50	11	22	7.9	22	2.008	ND	ND	ND	ND	ND	ND
NEEM	176	68	28	92	11.5	10.5	2.04	ND	ND	ND	ND	ND	ND
PITPAPTRA	740	102	62	74	6.2	22.8	2.16	ND	ND	ND	ND	ND	ND
SAFEDA	200	35	13	130	11.1	15.2	2.26	ND	ND	ND	ND	ND	ND
SENNA	362	25	25	102	10.8	27.8	2.03	ND	ND	ND	ND	ND	ND
SHISHUM	375	41	30	75	9.9	12.5	2.07	ND	ND	ND	ND	ND	ND
SUKH CHAIN	360	37	61	50	9.6	15.4	2.48	ND	ND	ND	ND	ND	ND

appeared. The clear solution was diluted up to 50 ml with deionized water and filtered with Whatman No. 01 filter paper.

Atomic emission and absorption spectrophotometery

The standard working solutions of test elements were prepared to make the standard calibration curve. Atomic flame emission spectrophotometer (FES) (Model no. PEP-7, Jenway) was used for the determination of 3 metals that is, sodium (Na), potassium (K) and lithium (Li) and flame atomic absorption spectrometer (AAS) (Model no. AANALYST 100, Perkin Elmer) was used for 10 metals that is, calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), lead (Pb), manganese (Mn), cupper (Cu), nickel (Ni), chromium (Cr) and cadmium (Cd). In AAS, cathode lamp was used as radiation source which provides both sensitivity and selectivity. Other elements in the sample generally not absorb the selected wavelength and thus, not interfere with the measurement. Concentrations of test metals were calculated from calibration curves obtained from standards.

RESULTS AND DISCUSSION

In this study, 4 major nutrients that are K, Na, Ca and Mg and 9 micronutrients namely Fe, Zn, Li, Pb, Mn, Cu, Ni, Cr, Cd were observed in all selected 24 medicinal plants commonly used in Pakistan and their concentration levels are given in Table 2. A total of 7 important elements have been determined by flame emission spectroscopy and atomic absorption spectroscopy. It has been observed that level of major elements was found higher as compared to trace elements. Among the 9 investigated micro elements, Pb, Mn, Cu, Ni, Cr and Cd were not detected in any test species at applied concentration. Results showed a wide range of variation in the elemental constitution of different plants leaves. The presence and concentration 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 presence of Ca, Mg, Na, K, Co, Cr, Cu, Fe, Mn, Ni and Zn also reflect their function as essential nutrient elements, often as co-factor activators in metal-ligand enzyme complexes (Valkovic, 1975).

Major nutrients

All the tested medicinal plants depicted significant concentration of Na as the highest concentration 792 ppm was found in Gauzaban (*O. bracteatum*) followed by 740 ppm in Pitpapra (*Fumaria officinalis*) and

Dandelion (*T. officinale*) with minimum sodium concentration 144 ppm in Nagdona (*A. obsinthium*). Sodium is an electrolyte and major ingredient of extra cellular fluid cation and potassium is a cation of intracellular fluid. Sodium concentration in human blood plasma is 139 ppm. Gauzuban (*O. bracteatum*) is commonly used as health tonic, refrigerant for the treatment of stomach and bladder etc. Similarly calcium concentration was also found maximum of 164 ppm in Gauzuban (*O. bracteatum*) and minimum of 11 ppm in Neelophar (*Nymphaea alba*). In the treatment of cardiovascular diseases Na, K and Ca play an important role in the electrophysiology of cardiac tissue. Calcium ions increase the force of contraction of the heart, bone formation and blood coagulation (Bolland et al., 2010). Gauzuban (*O. bracteatum*) is also recommended for relieving heart palpitation that might be due to presence of higher contents of calcium. In the current study, highest Mg concentration (11.5 ppm) recorded for Gainda (*Tagetes minuta*) and Neem (*Azardirachta indica*) while minimum (6.2) in Pitpaptra (*F. officinalis*). Out of all twenty four investigated species, Dandelion showed highest K and Li contents (180; 78 ppm) while Aam (*Mangifera indica*) and Neelophar (*N. alba*) exhibited lowest 24; 11 concentration, respectively.

Micro nutrients

The different plant samples reflected a high level of Fe concentration, Methi (*Trigonella foenum-graceum*) showed maximum 2.48 ppm and Senna (*S. obtusifolia*) showed minimum 2.03 ppm. In present study, Pb, Cr, Cd, Mn and Cu metal had not been detected in any samples. (Nielsen et al., 1980) also reported similar to the observation and documented that in an environment with significant level of Fe, Ni and Cu might exhibit antagonistic interactions. 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, Fe, Cu, Zn etc. Zn is important in wound healing and also functions as an antioxidant (Bolland et al., 2010).

Li was found in the range of 10-78 ppm being highest 78 in Dandelion (*T. officinale*) and lowest 10 in Mehndi (*Lawsonia inermis*). Dandelion is recommended as blood purifier, this may be attributed due to the presence of higher Fe content 29 ppm in the present investigation. Hemoglobin contains the greatest amount of body iron (67%) and this largely in the red blood cells (Beliles, 1994). Fe and Zn are essential trace elements which play an important role in human metabolism and have recommended dietary allowance (RDA) while Cu, Mn and Cr have not found RDA (Hashmi et al., 2005). Concentration range of Zn ranges from 2.04-2.71 in all selected medicinal plants leaves. The traditional use of some plants like Senna (*S. obtusifolia*), Akk (*Calotropis procera*), Khati buti (*Oxalis carniulata*), Shisham (*Delberga sissoo*), Charaita (*Swertia chirayita*) and Neem (*A. indica*) leaf for the treatment of eye diseases can be well correlated with significant Zn concentration (>100 µg/g). Zn contents were found under the deficiency level in all the tested species higher amount 2.48 ppm in Sukhchain (*Pongamia pinnata*) and lowest 2.04 ppm in Neem (*A. indica*). The normal range of Zn is 25-150 mg/kg and upper toxic limit of Zn is between 100-500 mg/l (Macnicol and Beckett, 1985). Zn has been reported for beneficial effects on vision, hair growth and increased milk production by pregnant women (Valkovic, 1975). It will be helpful to develop an approach towards direct link between elemental content and its curative probability with traditional use. From the observed data, some of the traditional use of plant parts can well be correlated with their elemental profile.

It is evident that selected medicinal plants are vital source of essential mineral elements in reasonable amounts, necessary for disease treatments.

Conclusion

In this present study, 13 elements were determined in leaves of 24 different medicinal plants of Pakistan, used in the treatment of various diseases. Present study revealed that investigated medicinal plants are good source of Na, K, Ca, Mg, Fe, Li and Zn. However, 6 micro nutrients Pb, Mn, Cu, Ni, Cr and Cd were not detected in any plant species that might be present at trace level which were not detected. The elemental results show that all of these plant leaves contain elements of vital importance in human's metabolism and that they are required for growth, prevention, and treatment of various diseases. The data obtained from this study will be helpful in the formulation of new modern drugs with different plants combinations, which can be used in the cure of many diseases. However, detailed chemical analysis of composition is required for these medicinal plants. This preliminary study is providing baseline information about elemental contents of medicinal plants of Pakistan. It will be helpful to develop an approach towards direct link between mineral contents and its coherence with traditional therapeutic use.

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