

*Full Length Research Paper*

# Estimation of macro and micro nutrients in some important medicinal plants of Soon Valley, District Khushab, Pakistan

Abdul Ghani<sup>1</sup>, Zulfaqar Ali<sup>1</sup>, Muhammad Ishtiaq<sup>2\*</sup>, Mehwish Maqbool<sup>2</sup> and Saira Parveen<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, University of Sargodha, Sargodha, Pakistan.

<sup>2</sup>Department of Botany, Mirpur University of Science and Technology (MUST), Bhimber Campus, Bhimber Azad Kashmir, Pakistan.

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Plants are potential source of therapeutic values in different traditional medicine systems of the world. Ethnomedicinal uses of 10 medicinal plants (MPs) of soon valley (Khushab) of Pakistan were documented and explored for trace (Zn, Cu, Cr, Ni, Co, Cd, Pb, Mn and Fe) and major (K, Na, Ca and Mg) elemental composition by atomic absorption spectrophotometer (AAS). Results depicted that Zn was 15.36 ppm in *Convolvulus arvensis*. Cu showed max conc. was in *P. harmala* (18.72 ppm). Cr was highest in *Cannabis sativa* (30.39 ppm). Ni conc was 30.39 ppm in *C. sativa*. *B. campestris* had highest value of Co (8.44 ppm) in analyzed specimens, while *H. vulgare* recorded least amount of 0.98 ppm. Cd concentration was 2.76 ppm in *A. aspera*. *H. vulgare* exhibited higher Pb higher concentration (32.64 ppm). The occurrence range of Mn was 74.60 ppm in *P. harmala* and 105.56 ppm in *A. aspera*. Fe in the studied plants was max in *H. vulgare* (1889.69 ppm). *B. campestris* exhibited higher concentration of Ca (4210.92 ppm). The contents of Mg were 13342.88 ppm in *C. arvensis* and 6350.63 ppm in *A. aspera*, respectively. The quantity of macro and micro elements in analyzed MPs was high and beyond the safety standards of WHO. It demonstrates that use of botanical medicines or its products by man may be fatal and injurious for health and culminating into death. It is necessary to study and accomplish thorough analytical research on herbal medicines (MPs) of Pakistan in order to bring them at par with international standards.

**Key words:** Soon valley, elemental contents, medicinal plants, safety standards, Khushab, Pakistan.

## INTRODUCTION

Plants have been used as source of food, fodder, shelter and medicines. Many plants which are used in different traditional medicine systems of the world are termed as medicinal plants (MPs) (Ishtiaq et al., 2007). These therapeutic plants have always been valued as a mode of treatment of variety of ailments in folk cultures and have played a very important role in the discovering of the modern day medicines with novel chemical constituents (Chan, 2003; Haider et al., 2004; Ishtiaq and Khan, 2008; Devi et al., 2008; Shirin et al., 2010). The efficacy of medicinal plants for curative purposes is often accounted

for in terms of their organic constituents like essential oils, vitamins, glycosides and other bioconstituents. Now, it has been an established fact that over dose or prolonged ingestion of medicinal plants may lead to chronic accumulation of different elements which cause various health problems (WHO, 1992; Sharma et al., 2009). In this context, elemental contents of the medicinal plants and their ratios should be checked in accordance with health safety measures and it is imperative to screen for their quality control (QC) (Schroeder, 1973; Somer, 1983; Liang et al., 2004; Arceusz et al., 2010). In recent years, several authors across the world have reported in many studies, on the importance of elemental constituents of the herbal drugs which enhanced the awareness of trace elements in the plants (Wong et al.,

\*Corresponding author. E-mail: drishtiaqajk@gmail.com.

1993; Sharma et al., 2009; Koe and Sari, 2009; Basgel and Erdemoglu, 2006).

Most of these studies concluded that essential metals can also produce toxic effects when the metal intake is in high concentrations, whereas non-essential metals are toxic even in very low concentrations for human health. Phytotherapy is also a common practice in Pakistan (Hayat et al., 2008, 2009; Ashraf et al., 2009). Overseas reports are scanty with respect to elemental constituents of endemic herbal plants of Pakistan. The present study was carried out in Soon Valley which harbours quite rich medicinal plants. Several ethnobotanical studies in the basin have been documented and presented in literature with folklore recipes (Marwat et al., 2004; Hussain et al., 2008; Abbasi et al., 2009).

Rapid industrialization and urbanization in the area are major threats to the local medicinal flora in the context of heavy metals pollution (Salman and Fida, 2009; Sial et al., 2006; Rehman et al., 2008). Therefore, it is important to have a look on good quality control of medicinal herbs in order to protect consumers from contamination and health risks. The primary aim of this study was to establish detailed findings on the trace elements (Zn, Cu, Cr, Ni, Co, Cd, Pb, Mn and Fe) and major elements (K, Na, Ca and Mg) in selected (ten) species used as herbal medicines in Soon Valley. Secondly, to prepare comparative bioconstituents statement in accordance with international standards and describe the safeness of MPs for consumers as per rules of WHO for health.

## MATERIALS AND METHODS

### Sample collection

Three field trips were arranged throughout the Soon Valley in order to collect previously reported medicinally important plants from October 2009 to June 2010. Details of these plants are given in Table 1. The identification and nomenclature of these plants was based on The Flora of Pakistan (Nasir and Ali, 1978). Voucher specimens were deposited in herbarium of University of Sargodha (UOS), Sargodha, Pakistan.

### Sample preparation

Plant samples were washed with de-ionized water and oven dried at 80°C for 2 days and then subjected to ground for powder formation.

### Digestion

Two grams powder of each plant sample was dissolved in 10 ml of nitric acid (HNO<sub>3</sub>) for 12 h and then heated until the reddish brown fumes disappeared. About 4 ml of perchloric acid was added to the above solution and heated for 5 min then 10 ml of *aqua regia* was added and heated to small volume and marked up to 250 ml by adding deionized water (Rio et al., 2002).

### Atomic absorption spectrophotometer (AAS)

Major and trace elemental contents were determined using flame

atomic absorption spectroscopy using Perkin Elmer A Analyst 700.

## RESULTS AND DISCUSSION

### Zinc

The content of Zn ranged between 15.36 ppm in *Convolvulus arvensis* and 26.92 ppm in *Hordeum vulgare* (Table 2). The maximum tolerable zinc level has been set at 500 ppm for cattle and 300 ppm for sheep (National Research Council, 1984). The permissible limit set by FAO/WHO (1984) for edible plants was 27.4 ppm. After comparison of metal limit in the studied medicinal plants with those proposed by FAO/WHO (1984), it was found that only *Achyranthes aspera*, *C. arvensis* and *Withania somnifera* are within this limit, while all others plants accumulated Zn above this limit. However, for medicinal plants, the WHO (2005) limits has not yet been established for Zn. According to the study of Bowen (1966) and Allaway (1968), the range of Zn in agricultural products should be between 15 and 200 ppm.

### Copper

The lowest content of Cu (6.38 ppm) was in *S. nigrum* and maximum concentration was estimated to be 18.72 ppm in *Peganum harmala* (Table 2). The permissible limit set by FAO/WHO (1984) for edible plants was 3.00 ppm. After comparison of metal limit in the studied medicinal plants with those proposed by FAO/WHO (1984), it was found that all plants accumulated Cu above this limit. However, for medicinal plants, the WHO (2005) limits has not yet been established for Cu, although, in medicinal plants, permissible limits for Cu set by China and Singapore were 20 and 150 ppm, respectively (WHO, 2005). According to Bowen (1966) and Allaway (1968), the range of Cu in agricultural products should be between 4 and 15 ppm. Reddy and Reddy (1997) reported that the range of Cu contents in the 50 medicinally important leafy material growing in India were 17.6 to 57.3 ppm.

### Chromium

The range of Cr varied between 1.30 ppm in *C. arvensis* to 30.39 ppm in *Cannabis sativa* (Table 2). Chronic exposure to Cr may result in liver, kidney and lung damage (Zayed and Terry, 2003). The permissible limit set by FAO/WHO (1984) in edible plants was 0.0 ppm.

After comparison of metal limit in the studied medicinal plants with those proposed by FAO/WHO (1984), it was found that all plants accumulated Cr above this limit. However, for medicinal plants, the WHO (2005) limits has not yet been established for Cr, although, in medicinal plants, permissible limits for Cr set by Canada, were 2

**Table 1.** Common medicinal herbs used in folk remedies by inhabitants of Soon Valley, Pakistan.

S/N	Plant species	Local name	Part use	Disease cure	Reference
1	<i>Achyranthes aspera</i> L.	Puthkanda	Whole plant	Cough, asthma, kidney stone, anti-inflammatory, diuretic	Abbasi (1999) Marwat et al. (2004) and Hussain et al. (2008)
2	<i>Tribulus terrestris</i>	Bhakra	Whole plant	It is used as a nutritional supplement and extracted from the plant. Chinese use this herb for centuries in the treatment of dizziness, liver disease, headaches.	Marwat et al. (2004)
3	<i>Brassica campestris</i> L.	Sarsoon	Whole plant	Leucorrhoea, menstrual disorder, body weakness, internal pain, skin diseases	Abbasi (1999)
4	<i>Cannabis sativa</i> L.	Bhang	Leaves	Body inflammation, boils, sedative, relaxant	Abbasi (1999), Marwat et al. (2004) and Hussain et al. (2008)
5	<i>Convolvulus arvensis</i> L.	Liali	Whole plant	Skin disorder, constipation	Abbasi (1999), Marwat et al. (2004) and Hussain et al. (2008)
6	<i>Solanum nigrum</i>	Mako		<i>S. nigrum</i> is a widely used plant in oriental medicine. It is anti-tumorigenic, antioxidant, anti-inflammatory, hepatoprotective, diuretic and antipyretic.	Marwat et al. (2004) and Hussain et al. (2008)
7	<i>H. vulgare</i> L.	Jou	Seeds	Jaundice, hepatitis	Abbasi (1999) and Abbasi et al. (2009)
8	<i>Phyllanthus emblica</i>	Amla	Whole plant	Anti-hysterical, dysentery, anti-amoebic	Marwat et al. (2004)
9	<i>Peganum harmala</i>	harmal	Whole plant	stomach disorder, swelling, chambal, against scorpion sting	Abbasi (1999), Matin et al. (2001) and Hussain et al. (2008)
10	<i>Withania somnifera</i> L.	Dunal Asghand	Whole plant	Aphrodisiac, diuretic, bronchitis, ulcer	Hussain et al. (2008)

ppm in raw medicinal plant material and 0.02 mg/day in finished herbal products (WHO, 2005).

### Nickel

*C. arvensis* accumulate the lowest Ni (2.70 ppm) and *C. sativa* accumulate the maximum (30.39 ppm) (Table 2). The permissible limit set by FAO/WHO (1984) in edible plants was 1.63 ppm. After comparison of metal limit in the studied medicinal plants with those proposed

by FAO/WHO (1984), it was found that all plants accumulated Ni above this limit. However, for medicinal plants, the WHO (2005) limits has not yet been established for Ni. Ni toxicity in human is not a very common occurrence because its absorption by the body is very low (Onianwa et al., 2000).

### Cobalt

*Brassica campestris* have higher Co concentration, that is, 8.44 ppm than the others, while *H. vulgare*

**Table 2.** Concentrations (ppm) of trace and major elements in the studied plants.

Plant	Zn	Cu	Cr	Ni	Co	Cd	Mg
<i>A. aspera</i>	20.91 ±4.61	7.06± 1.15	1.48± 0.90	5.90± 0.92	5.23± 0.42	0.59±0.41	6350.63± 3608.90
<i>Tribulus terrestris</i>	37.86 ± 2.79	9.13± 3.08	18.72± 1.62	9.98± 1.87	4.42± 0.70	25.49±0.85	5005.60±3314.57
<i>Brassica campestris L.</i>	39.36 ± 3.24	12.88± 4.36	8.19± 1.08	7.74± 1.88	8.44± 4.47	1.23± 0.56	3715.48± 950.54
<i>Cannabis sativa L.</i>	30.46 ± 4.91	9.70± 4.69	30.39± 3.94	16.90± 3.67	5.79± 1.56	2.76±0.66	35727.50 ±1182.59
<i>Convolvulus arvensis L.</i>	15.36 ±1.68	7.92 ±1.23	1.30 ±0.09	2.70 ±0.96	4.39 ±0.94	1.21 ±0.56	13342.76 ±1142.78
<i>Solanum nigrum</i>	31.62 ±6.84	6.38 ±3.57	5.30 ±2.40	4.09 ±1.46	6.48 ±1.45	0.98 ±0.26	34472.92 ±3533.39
<i>H. vulgare L.</i>	26.92 ±8.17	12.95±4.18	6.07 ±2.15	6.53 ±1.48	0.98 ±0.27	5.30 ±2.08	38642.78 ±3233.29
<i>Phyllanthus Amblica</i>	32.94 ±8.16	13.76 ±3.16	6.08 ±2.14	6.74 ±3.41	4.96 ±1.66	1.21 ±0.50	27990 ±10298.64
<i>Peganum harmala</i>	32.52 ±4.28	18.72 ±3.24	16.36 ±1.29	9.10 ±2.93	4.74 ±0.95	1.58 ±0.09	36572.92 ±3967.03
<i>Withania somnifera (L.)</i>	26.36 ±3.64	8.34 ±1.92	8.46 ±2.99	6.66 ±2.72	4.59 ±0.71	1.43 ±0.66	21247.76 ±1111.18

  

Plant	Pb	Mn	Fe	K	Na	Ca
<i>A. aspera</i>	9.28± 1.66	105.56± 6.70	455.94± 176.33	17786.25± 1123.11	145.59± 17.24	25575.00± 3535.53
<i>Tribulus terrestris</i>	10.69±3.98	44.49± 4.49	449.60± 33.23	12896.60± 2442.13	247.83± 76.67	21192.50± 248.184
<i>Brassica campestris L.</i>	9.72± 2.36	89.01± 5.22	1889.69 ± 18.89	17244.13± 3297.66	512.39± 68.58	42210.96± 5612.34
<i>Cannabis sativa L.</i>	11.58± 3.56	64.19± 21.54	367.59± 34.56	1256.40± 6280	113.49± 46.42	110.39 ±46.52
<i>Convolvulus arvensis L.</i>	3.18 ±0.97	79.34 ±13.97	395.77 ±22.90	9234.00 ±121.97	120.26 ±14.98	12342.76 ±1133.66
<i>Solanum nigrum</i>	5.18 ±2.03	34.64 ±16.32	406.32 ±35.45	16644.59 ±1130.81	192.28 ±228.13	306475.75 ±3533.39
<i>H. vulgare L.</i>	32.64 ±15.33	408.36 ±35.90	406.32 ±32.80	1511.26 ±1632.64	2176.36 ±19.32	165258.00 ±674.28
<i>Phyllanthus Amblica</i>	8.29 ±3.14	36.36 ±4.50	687.14 ±102.17	15415.00 ±4656.68	319.64 ±66.86	315.43 ±57.84
<i>Peganum harmala</i>	11.73 ±2.54	74.60 ±5.25	318.72 ±36.27	16176.93 ±2686.17	148.88 ±8.16	36466.02 ±3898.04
<i>Withania somnifera (L.)</i>	7.98 ±3.32	36.16 ±4.47	186.76 ±70.15	11526.00 ±7237.83	119.26 ±28.35	22247.76 ±1111.16

An average concentration of element ± standard deviation (n = 5) (mg/kg).

recorded the minimum accumulation, that is, 0.98 ppm (Table 2). There are no established criteria for Co in medicinal plants. Basgel and Erdemoglu (2006) determined Co concentration range between 0.14 ppm and 0.48 ppm in seven herbs in Turkey.

### Cadmium

In the studied plants, Cd concentration ranged between 2.76 ppm in *A. aspera* and 1.66 ppm in

*C. sativa* (Table 2). The permissible limit set by FAO/WHO (1984) in edible plants was 0.21 ppm. However, for medicinal plants, the permissible limit for Cd set by WHO, China and Thailand was 0.3 ppm. Similarly, permissible limits in medicinal plants for Cd set by Canada were 0.3 ppm in raw medicinal plant material and 0.006 mg/day in finished herbal products (WHO, 2005). After comparison of metal limits in the studied medicinal plants with those proposed by FAO/WHO (1984) and WHO (2005), it was found that all studied plants accumulated Cd above this limit. Cd

causes both acute and chronic poisoning, adverse effect on kidney, liver, vascular and immune system (Heyes, 1997).

### Lead

Among the investigated medicinal plants, *H. vulgare* exhibited higher Pb concentration, that is, 32.64 ppm and *C. arvensis* possess minimum concentration of Pb, that is, 3.18 ppm (Table 2). The permissible limit set by FAO/WHO (1984)

in edible plants was 0.43 ppm. However, for medicinal plants limit was 10 ppm set by China, Malaysia, Thailand and WHO.

### Manganese

The range of Mn varied with values between 74.60 ppm in *P. harmala* and 105.56 ppm in *A. aspera* (Table 2). The permissible limit set by FAO/WHO (1984) in edible plants was 2 ppm. After comparison of metal limit in the studied medicinal plants with those proposed by FAO/WHO (1984), it was found that all plants accumulated Mn above this limit. However, for medicinal plants, the WHO (2005) limits has not yet been established for Mn. Sheded et al. (2006) reported that the range of Mn in their study was between 44.6 and 339 ppm in selective medicinal plants of Egypt.

### Iron

The range of Fe in the studied plants was high with a minimum of 186.76 ppm in *W. somnifera* and maximum of 1889.69 ppm in *H. vulgare* (Table 2). The maximum tolerable level for cattle was suggested to be 1000 ppm by National Research Council (1984). The permissible limit set by FAO/WHO (1984) in edible plants was 20 ppm. After comparison of metal limit in the studied medicinal plants with those proposed by FAO/WHO (1984), it was found that all plants accumulated Fe above this limit. However, for medicinal plants, the WHO (2005) limits has not yet been established for Fe. Sheded et al. (2006) reported that the range of Fe in their study was between 261 and 1239 ppm in selective medicinal plants of Egypt. Fe is necessary for the formation of haemoglobin and also plays an important role in oxygen

### Potassium

The range of K varied between 9234.00 ppm in *C. arvensis* and 1511.26 ppm in *H. vulgare* (Table 2). All the studied plant show high K contents and our results coincided with previous studies on medicinal herbs (Badri and Hamed, 2000; Ozcan and Akbulut, 2007).

### Sodium

The lowest content of Na, that is, 113.49 ppm was in *C. sativa* and maximum concentration was estimated as 512.39 ppm in *H. vulgare* (Table 2). All plants show low accumulation of Na, except *B. campestris*.

### Calcium

*B. campestris* exhibited higher Ca concentration, that is,

4210.92 ppm than the other plants and *P. harmala* possess minimum concentration of Pb, that is, 315.43 ppm than the other plants (Table 2). High concentrations of Ca is important because of its role in bones, teeth, muscles system and heart functions (Brody, 1994), and the studied plants show satisfactory level of Ca accumulation.

### Magnesium

The content of Mg ranged between 13342.88 ppm in *C. arvensis* and 6350.63 ppm in *A. aspera* (Table 2). The results indicate that the studied herbal plants showed a high content of Mg and this is agreeable with the previous findings (Chizzola and Franz, 1996; Lavilla et al., 1999; Ajasa et al., 2004).

### Conclusion

This elemental analysis of medicinal plants of Soon Valley for exploration of micro and macro-nutrients has revealed that the flora of the area is rich and good source of Na, K, Ca, Mg and Fe. These elements do provide important constituents for different body metabolic enzymes for man, wild fauna and domestic livestock. Albeit, these micro and macro bioconstituents are part and parcel of fauna and human healthy body, yet in some cases they also carry very high content of toxic metals, which is very prevalent due to industrial pollution and irrigation by polluted waste water (Salman and Fida, 2009; Sail et al., 2006; Rehman et al., 2008). Therefore, special care must be taken during the administration of routinely used medicinal plants as source of herbal therapeutics by man for himself and life stock. It is also important to have good quality control practices for herbal medicines for authentic screening in order to protect life of man and animal from injurious impacts of their toxicity.

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