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# STUDY OF HEAVY TRACE METALS IN SOME MEDICINAL–HERBAL PLANTS OF PAKISTAN

**MANZOOR IQBAL KHATTAK[1*] AND MAHMOOD IQBAL KHATTAK[2]**

[1]*Chemistry Department, Balochistan University, Quetta, Pakistan,* [2]*PSCIR Laboratories, Karachi*
[*]*E-mail: manzoor_iqbal@yahoo.com*

**Abstract**

The paper presents heavy trace metals analysis in some widely used medicinal- herbal plants of Pakistan by using Inductively Coupled Plasma. Because these commonly used medicinal- herbal plants from Pakistan are being specifically utilized for the treatment of various diseases, so samples of medicinal-herbal plants were collected from open market and from the fields. Collected samples were digested and analyzed for their nutritional trace metals (Pb, Cd, Fe, Zn, Ni, Cu & Mn) composition and then the results obtained were compared to international and national standards as required by World Health Organizations. The deficiency or excess of the samples for essential trace metals are reported.

## Introduction

Heavy metals are naturally present in the environment. Their occurrence, however, has gradually been increasing with the increase of industrialization. Agricultural soils, as an essential part of the environment, are no exception of this phenomenon. Cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) are among the most abundant heavy metals in the agricultural soils (Förstner, 1995). Copper and Zn, when present in low concentrations, are important micronutrients, while in high concentrations, these two metals become toxic to plants. Although Cd and Pb have no known role as nutrients, plants readily accumulate them in their system. The ability of plants to accumulate heavy metals is used in the process of phytoremediation where the green plants are employed to cleanse contaminated soils.

The screening of the actual bioactive elements of plants origin and assessment of elemental composition of the widely used medicinal plants is highly essentials (Saiki *et al*., 1990). The quantitative estimation of various trace elements concentrations are necessary for the effective determination of medicinal plants for the treatment of various diseases and also for the understanding of their pharmacological actions.

There are two major reasons to monitor levels of toxic metals in medicinal plants (De Smet, 1992). The first reason is contamination of the general environment with toxic metals has increased (Ali, 1983). The sources of this environmental pollution are quite varied, ranging from industrial and traffic emissions to the use of purification mud and agricultural expedients, such as cadmium-containing dung, organic mercury fungicides and the insecticide lead arsenate (Gosselin *et al*., 1984; Schilcher *et al*., 1987). The second reason is that exotic herbal remedies, particularly those of Asian origin, have been repeatedly reported to contain toxic levels of heavy metals and/or arsenic.

Several investigators have studied the residual levels of toxic metals in medicinal herbs (Schilcher, 1982; Ali, 1983, 1987; Peters & Schilcher, 1986; Schilcher *et al*., 1987). Most studies on residual levels of toxic metals in medicinal herbs have focused on lead, cadmium and mercury (Schilcher, 1985; Ali, 1987; Schilcher *et al*., 1987).

Medicinal plants appear to be a good choice for phytoremediation since these species are mainly grown for secondary products (essential oil) thus the contamination of the food chain with heavy metals is eliminated. Aromatic and medicinal plants also have a demonstrated ability to accumulate heavy metals (Schneider & Marquard, 1996; Scora & Chang, 1997; Zheljazkov & Nielsen, 1996). Research has shown that heavy metals accumulated by aromatic and medicinal plants do not appear in the essential oil (Scora & Chang, 1997; Zheljazkov & Nielsen, 1996) and that some of these species are able to grow in metal contaminated sites without significant yield reduction. There is therefore, a need for major interest to establish the levels of some metallic elements in commonly used herbal plants because at elevated levels these metals may also be dangerous and toxic (Schumacher *et al*., 1991).

Medicinal plants occurring wild show more anomalous values than cultivated herbs, in particular with respect to lead levels Peters & Schilcher, (1986) and Schilcher *et al*., (1987). The reason is, of course, that drugs grown wild are more difficult to control for all the potential ways of environmental pollution. As was to be expected, the research group also demonstrated that the levels of lead and cadmium in the same crude herb may vary considerably with plant part.

It is estimated that 70-80% of people worldwide rely chiefly on traditional largely herbal - medicine to meet their primary healthcare needs (Farnsworth *et al*., 1991; Shengji, 2001). The global demand for herbal medicine is not only large but is growing as per the increasing of the population (Srivastava, 2000). Factors contributing to the growth in demand for traditional medicine include the increasing human population and the frequently inadequate provision of Western (allopathic) medicine in developing countries (Table 1). The Traditional Medical Systems are especially concentrated in Asia and some of the more widely familiar are in Chinese Traditional Medicine, Tibetan Medicine, Ayurveda, Siddha and Unani.

Use of medicinal–herbal plants for amelioration of toxic effects in man and animals is receiving attention worldwide. The magnitude of their uses during recent years for the cure of various ailments is obvious from the report of the World Health Organization (Anon., 1998) which indicated that many people in developing countries still rely on herbal medicine for treatment of various ailments. Medicinal plants today are cultivated commercially in polluted environments where soil (Sahu *et al*., 1987), water (Chandra, 1980) and air (Sadasivam, 1987) contain rather high levels of pollutants. Therefore, the environment required for growth and synthesis of these plants is affected drastically, and the possibility that toxic pollutants are deposited in the plants cannot be disregarded. Little is known about the status of toxic metals in these medicinal-herbal plants grown in polluted environments. The possibility that toxic pollutants can be trans-located to humans and animals through the use of herbs grown in polluted zones has concerned scientists who promote use of herbal medicines.

**Table 1. Ratios of doctors (practicing western medicine) and traditional medical practitioners (TMPs) (practicing largely plant-based medicine) to patients in East and Southern Africa.**

| Country | Doctor : Patient | TMP: Patient |
|---|---|---|
| Ethiopia | 1 : 33,000 | |
| Kenya | 1 : 833 (urban) | 1 : 987 (urban) |
| Malawi | 1 : 50,000 | 1 : 138 |
| Mozambique | 1 : 50,000 | 1 : 200 |
| South Africa | 1 : 17,400 | 1 : 700-1200 |
| Swaziland | 1 : 10,000 | 1 : 100 |
| Tanzania | 1 : 33,000 | 1 : 350-450 |
| Uganda | 1 : 25,000 | 1 : 708 |

This study was therefore, designed to assess the levels of heavy metals (i.e., Copper, Iron, Nickel, Zinc, Manganese, Lead and Cadmium) in commonly used medicinal-herbal plants in Pakistan.

## Materials and Methods

A total of 17 commonly used parts of medicinal plants were used in present investigation, the plants were identified and authenticated prior to toxic metal analysis from the area of Karachi. The identities, as well as the medicinal properties, of the herbal plant samples under investigation are presented in Table 2.

**Table 2. Medicinal-herbal plants under investigation; name, parts studied and medicinal properties.**

| Plant species | Local name | Part used | Medicinal properties |
|---|---|---|---|
| *Mangifera indica* | Aa'm | Leaf | Antidiabetic |
| *Andrographis paniculata* | Kalmegh | Whole plant | Stomachic, bactericidal, laxative, tonic, alterative |
| *Datura alba* | Dahtoora | Leaf | Sedative, hypnotic |
| *Ipomoea hederacea* | Kaladana | Seed | Narcotic, psychedelic |
| *Ferula foetida* | heing | Root-gum | Carminative and intestinal anti-septic |
| *Zingiber officinale* | Adrak | Root | stimulant and used to cure diarrhea |
| *Allium sativum* | Lahsan | Root | Antihypertensive, astringent |
| *Lagenaria sicerana* | Lauki | Fruit | Antibacterial, analgesic and sedative |
| *Beta vulgaris* | Chuqandar | Root | Cooling, diaphoretic |
| *Ocimum basilicum* | Niazboo | Flower | Stimulant, styptic, diuritic and carminative |
| *Pongamia glabra* | Tukham-karanjwa | Seed | Antihyperglycaemic |
| *Gentiana kurroo* | Nilkhanth | Root | Anthelmintic |
| *Emblica officinalis* | Amal | Fruit | Revitalizer |
| *Abelmoschus esculantus* | Bhindi | Fruit | Venereal diseases, pneumonia, bronchitis, pulmonary tuberculosis |
| *Achyranthes aspera* | Safed aghedo | plant | Laxative, anti-periodic in malaria, stomachic |
| *Azadirachta indica* | Neem | Leaf | Antiseptic, tonic, spermicidal |

A total of 35 commonly used medicinal plants were colleted from Sindh & Balochistan area of Pakistan. The plants were identified through literature (Ali *et al*., 1983 & 1987) given in Table 3. The materials used were Nitric Acid and Perchloric Acid etc., details can be found in Ogunwande *et al*., (2006). The samples were washed with deionized water and allowed to dry in oven for 72 hours at a tempareture of $65^0$C. The samples were then ground and sieved through 0.5 mm sieve. The powdered sample then subjected to the acid digestion using nitric acid and perchloric acid (Ogunwande *et al*., 2006).

Digested samples were analyzed for their metal content by using Inductively Coupled Plasma (ICP) in PCSIR Laboratories of Karachi. The performance of the instrument was checked daily. For routine analysis one of the primary parameters is the stability of the instrument.

For the second time, samples analysis were made by Flame Atomic Absorption Spectrophotometer (A-1800 Hitachi Japan) following specific instrumental conditions given in Table 4. Analysis of each sample was made in duplicate Calibration of the instrument was repeated periodically during operation.

**Quality control:** All the samples were preserved during the whole analytical procedure from sampling to final analysis (Cornelis *et al*., 1994; Gardiner *et al*., 1988). For the purpose of reliability of the data reference to environmental protection. A number of contamination risks were identified: The eventual leaching from tubes used during sample handling; impurities in the nitric acid and impurities in the internal standard selected.

For the accuracy of the analytical results by Flame Atomic Absorption Spectrophotometer, Citrus Leaves Standard Reference Material (SRM 1572, National Bureau of Standards, Washington) was analysed percent recoveries of analysed metals in the SRM were found to be in the range of 99-105%.

Analysis of Variance was performed, using SPSS Software Version 11.0. Difference between mean values were determined using Tukey's test at $p<0.05$.

## Results and Discussion

Heavy metal contents in spices and medicinal plants depend on climatic factors, plant species, air pollution, and other environmental factors (Sovljanski *et al*., 1989). In Table 2 are listed medicinal-herbal plants analyzed for trace metals, local name, parts used and medicinal properties. The results of analysis are shown in Table 5 and Figure I & 2.

**Table 3. List of studied medicinal plants.**

| Botinical name | Family | English name | Vernicular name | Part used |
|---|---|---|---|---|
| **Curcuma longa** | Zingiberaceae | Tumeric | Hadi | Roots |
| *Syzgium aromaticum* | Myrtacae | Clove | Lounga | Flower buds |
| *Amomum Subultum* | Zingiberacea | Large Cardamom | Badi Elaichi | Fruits |
| *Cuminum cyminm* | Umbelliferae | Cumin | Zira Safaid | Fruits |
| **Cuminum nigrium** | Umbelliferae | Black Carway | Kalajira | Fruits |
| *Piper nigrum* | Piperacae | Black Pepper | Black March | Fruits |
| *Cinnamomum Zeylanicum* | Lauracea | Cinnamon | Dalchini | Bark |
| *Myristica fragrans* | Myristicaceae | Mace | Javitri | Seeds |
| *Mentha arvensis* | Labiatae | Mint | Pudina | Leaves |
| *Eucalyptus citriodora* | Myrtaceae | Eucalyptus | Safaidah | Leaves |
| *Azadirachta Indica* | Meliaceae | Neem | Neem | Leaves |
| **Cassia fistula** | Leguminosae | Cassia | Amaltas | Pods |
| **Coriandrum sativum** | Umbelliferae | Coriander | Dhania | Fruits |
| **Cichorium intybus** | Compositae | Chicory | Kasni | Seeds |
| *Ricinus communis* | Euphorbiaceae | Castor | Arand | Seeds |
| **Ocimun basilicum** | Labiteasae | Basil | Niyazbo | Seeds |
| *Glycyrrhizagalbra* | Leguminosae | Liquorice | Mulathi | Roots |
| *Foeniculum vulgare* | Umbelliferae | Fennel | Saunf | Seeds |
| *Elettaria Cardamomum* | Zingiberacea | Small Cardamom | Choti Elliachi | Fruits |
| *Peganum harmala* | Zygophllaceae | Syrian rue | Harmal | Seeds |
| *Zingiber officinale* | Zingiberaceae | Ginger | Adrak | Fruits |
| **Trachyspermum ammi** | Umbelliferae | Bishop's weed | Ajwain | Seeds |
| **Capcicum frutenscens** | Solanoceae | Chilli | Surkh Mirch | Fruits |
| *Aneilema scapiflorum* | Commelinaceae | Musli | Musli Siyah | Seeds |
| **Ziziphus vulgris** | Rhamnaceae | Jujube Fruit | Unnab | Fruits |
| **Nigella sativa** | Renunculaceae | Black Cumin | Kawanji | Seeds |
| *Mimosa pudica* | Leguminosae | Sensitive plants | Lajvanti | Seeds |
| *Syzigium cumin* | Myrtaceae | Black Plum | Jaman | Fruits |
| *Aloe barbedensis* | Lilliaceae | Aloe | Mosabar | Leaf Pulp |
| **Citrullus colocynthis** | Curcurbitaceae | Colcynth | Tumba | Fruits |
| *Rheum emodi* | Poygonaceae | Rhubarb | Revendchini | Roots |
| *Gymnem sylvester* | Asciepiabaceae | God Mar | Gurmar Buti | Leaves |
| *Trapa bispinosa* | Onagraceae | Water chestnut | Singhar | Fruits |
| *Cassia absus* | Leguminosae | Chaksu | Chaksu | Seeds |
| *Withania coagulans* | Soleaceae | Nuts-cooling | Paneer Buti | Seeds |

**Table 4. Instrumental conditions for heavy trace metals analysis by FAAS.**

| | Zn | Mn | Cu | Fe |
|---|---|---|---|---|
| Wavelength (nm) | 213.8 | 279.6 | 324.8 | 248.3 |
| Band Pass (nm) | 1.3 | 0.4 | 1.3 | 0.2 |
| Lamp Current (m A) | 10 | 7.5 | 15 | 10 |
| Fuel Pressure (Kg $cm^{-2}$) | 0.3 | 0.3 | 0.3 | 0.3 |
| Burner Height (mm) | 7.5 | 7.5 | 7.5 | 7.5 |
| Calibration Range (mg $L^{-1}$) | 0.3-3.0 | 1.0-7.0 | 0.3-5.0 | 1.0-10.0 |
| Detection Limit (mg $L^{-1}$) | 0.01 | 0.2 | 0.04 | 0.4 |
| Flame Composition [a] | | | | |
| Oxidant Pressure [b] (Kg $cm^{-2}$) | | | | |
| Atomizer [c] | | | | |
| Measurement Mode [d] | | | | |

A Air: $C_2$ $H_2$; B 1.60; c Standard Burner, d Absorbance

A total of 7 metals (Pb, Cd, Fe, Zn, Ni, Cu and Mn) were determined in the medicinal herbal plant samples by Inductively Coupled Plasma (ICP). Table 5 show the mean concentration of trace metals in the medicinal herbal plants under study. Analytical results shows that the Pb concentration varies between 0.07 to 0.8 ppm in general except for *Beta vulgaris* Linn., (0.3 ppm). *Datura alba* had the lowest Pb level and *Lagenaria sicerana* the highest. The levels of Pb were comparable in *Zingiber officinale*, *Emblica officinalis*, *Ocimum basilicum*, *Pongamia glabra* and *Abelmoschus esculentus*. The maximum limit of lead prescribed in the local food laws is 0.8 ppm (Marshall, 1998; Sahu *et al*., 1987). The findings for lead residue in medicinal herbal plants as per present study remained within the stipulated tolerance limits. However, the level lead in *Lagenaria sicerana* Standl and *Beta vulgaris* Linn., samples is higher then permissible limit. Cd concentration varies between 0.05–2.5 ppm with *Beta* *vulgaris* Linn., had the highest Cd level and *Azadirachta indica* had the lowest. The permissible limit laid down in the local law for Cd in food stuff is 0.6 ppm (Sadasivam *et al*., 1987). Accordingly all commodities under study were found to be within permissible limits except for *Lagenaria sicerana* Standl and *Beta vulgaris* Linn., which contain Cd level higher then proposed limit.

The highest level of Fe was found in *Lagenaria sicerana* and lowest in *Mangifera indica*, whereas the Fe concentration varies from 90 to 590 ppm. The Mn concentration varied from 24 to 90 ppm and its mos values lying in the range of 24-70 ppm. Similar to the case of Fe *Mangifera indica* contains the lowest level of Mn and *Lagenaria sicerana* contains highest.

The highest level of Ni occurred in *Beta vulgaris* Linn., and the lowest were in *Azadirachta indica*. The Ni concentration varied from 0.2 to 4 ppm in general, except for *Beta vulgaris*. The concentration of Ni is comparable in *Zingiber officinale, Datura alba, Mangifera indica* and *Abelmoschus esculentus* with a range of 2 to 3 ppm, the same being true for *Ipomoea hederacea* and *Lagenaria sicerana* at 3.2 to 3.5 ppm. The results of present study except for *Beta vulgaris* shows Ni contents well within the permissible limit of 8 ppm.

**Table 5. Result of the metal contents from the analyzed samples (ppm).**

| | Plants | Pb | Sigma | Cd | Sigma | Fe | Sigma | Zn | Sigma | Ni | Sigma | Cu | Sigma | Mn | Sigma |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | *Mangifera indica* | 0.19 | 0.02 | 0.11 | 0.02 | 90.6 | 1.12 | 35.57 | 0.02 | 2.00 | 0.03 | 3.55 | 0.01 | 24.5 | 0.01 |
| 2. | *Andrographis paniculata* | 0.45 | 0.01 | 0.13 | 0.01 | 181 | 0.82 | 40.58 | 0.01 | 1.12 | 0.01 | 4.67 | 0.01 | 25.3 | 0.01 |
| 3. | *Datura alba* | 0.07 | 0.03 | 0.06 | 0.01 | 242 | 0.11 | 32.57 | 0.01 | 2.87 | 0.02 | 3.65 | 0.02 | 25.3 | 0.02 |
| 4. | *Ipomoea hederacea* | 0.34 | 0.02 | 0.13 | 0.01 | 319 | 11.3 | 46.09 | 0.01 | 3.49 | 0.03 | 3.92 | 0.01 | 33.8 | 0.01 |
| 5. | *Ferula foetida* | 0.78 | 0.01 | 0.11 | 0.01 | 159 | 10.6 | 62.63 | 0.01 | 4.00 | 0.01 | 7.69 | 0.01 | 42.7 | 0.03 |
| 6. | *Zingiber officinale* | 0.26 | 0.01 | 0.12 | 0.02 | 468 | 2.28 | 17.54 | 0.02 | 2.87 | 0.01 | 9.19 | 0.01 | 50.9 | 0.01 |
| 7. | *Allium sativum* | 0.41 | 0.03 | 0.06 | 0.01 | 196 | 1.12 | 37.58 | 0.01 | 4.31 | 0.06 | 5.96 | 0.01 | 58.0 | 0.01 |
| 8. | *Lagenaria sicerana* | 0.71 | 0.01 | 0.09 | 0.02 | 589 | 0.02 | 42.08 | 0.02 | 3.21 | 0.02 | 9.12 | 0.05 | 90.6 | 0.02 |
| 9. | *Beta vulgaris* | 0.30 | 0.01 | 0.34 | 0.03 | 340 | 1.02 | 32.57 | 0.03 | 1.05 | 0.03 | 4.64 | 0.01 | 68.5 | 0.02 |
| 10. | *Ocimum basilicum* | 0.26 | 0.01 | 0.25 | 0.01 | 242 | 0.01 | 27.56 | 0.01 | 0.21 | 0.01 | 6.72 | 0.01 | 72.9 | 0.01 |
| 11. | *Pongamia glabra* | 0.19 | 0.01 | 0.13 | 0.02 | 385 | 1.0 | 47.60 | 0.02 | N.D | ND | 4.93 | 0.02 | 32.8 | 0.01 |
| 12. | *Gentiana kurroo* | 0.09 | 0.02 | 0.07 | 0.02 | 317 | 0.02 | 61.62 | 0.02 | 0.61 | 0.01 | 7.78 | 0.02 | 69.3 | 0.02 |
| 13. | *Emblica officinalis* | 0.30 | 0.01 | 0.10 | 0.01 | 536 | 10.4 | 77.15 | 0.01 | 0.31 | 0.03 | 2.98 | 0.02 | 82.5 | 0.01 |
| 14. | *Abelmoschus esculantus* | 0.26 | 0.01 | 0.16 | 0.01 | 521 | 3.52 | 56.11 | 0.01 | 2.37 | 0.02 | 5.63 | 0.01 | 71.7 | 0.01 |
| 15. | *Achyranthes aspera* | 0.52 | 0.01 | 0.13 | 0.02 | 264 | 0.62 | 17.54 | 0.02 | 1.63 | 0.01 | 5.88 | 0.01 | 76.3 | 0.01 |
| 16. | *Azadirachta indica* | 0.56 | 0.01 | 0.05 | 0.02 | 196 | 0.02 | 21.04 | 0.02 | 0.12 | 0.01 | 4.99 | 0.01 | 74.7 | 0.03 |

The Zn concentration varied from 17 to 77 ppm, most samples having contents between 30 to 50 ppm. *Zingiber officinale* had the lowest Zn concentration and *Emblica officinalis* the highest. The concentration of Zn was compared in *Beta vulgaris* and *Datura alba*, similarly, between *Ipomoea hederacea* and *Pongamia glabra* in a range of 46 to 48 ppm. The concnentration of Cu varied from 2 to 19 ppm. Most of the samples containing Cu level between 3 to 9 ppm , *Lagenaria sicerana* contains the highest level of Cu and *Emblica officinalis* contains the lowest. There is no permissible limit prescribed in local food law or by WHO, however, range of 4-15 ppm for Cu and 15-200 ppm for Zn is considered to be safe. After comparison of the metal limits as proposed, it is found that in the case of Cu except for *Lagenaria sicerana* all other herbs contain Cu level within the proposed limits. In case of Zn all the samples contains level of Zn within the proposed limits.

While for the second time samples collection, Atomic Absorption Spectrometry has been successfully used for the determination of four essential heavy trace metals i.e., Zn, Mn, Fe & Cu in 35 species of medicinal plants commonly used for the treatments of various ailments. Metals levels are given in Table 6.

The results show the presence of variable amount of metals in these medicinal plant samples. In general, the order of concentration of metals in these medicinal plants has been found to be: Fe > Mn >Zn > Cu given in Figure 2. Plant samples of Black Caraway (*Cuminum nigrium*), Cassia (*Cassia fistula*), Coriander (*Coriandrum sativum*), Chicory (*Cichorium intybus*), Castor (*Ricinus communis*), Basil (*Ocimun basilicum*), Bishop's weed (*Trachyspermum ammi*), Musli (*Aneilema scapiflorum*), Black Cumin (*Nigella sativa*), Sensitive plants (*Mimosa pudica*), Water chestnut (*Trapa bispinosa*), Chaksu (*Cassia absus*) and Nuts-cooling (*Wathania coagulans*) contained comparatively higher amount of Zinc (i.e., <50 μg $g^{-1}$) whereas Clove (*Syzgium aromaticum*), Large Cardamom (*Amomum subultum*), Black Pepper (*Piper nigrium*), Cinnamon (*Cinnamomum zeylanicum*), Basil (*Ocimun basilicum*), Small Cardamom (*Elettaria cardamomum*). Fennel (*Foeniculum vulgare*), Syrian rue (*Peganum harmala*), Ginger (*Zingiber officinale*), Bishop's weed (*Trachyspermum ammi*), Musli (*Aneilema scapiflorum*), Black Cumin (*Nigella sativa*), Sensitive plants (*Mimosa pudica*), Rhubarb (*Rheum emodi*). God Mar (*Gymnem sylvester*), Water chestnut (*Trapa bispinosa*), Chaksu (*Cassia absus*) and Nuts-cooling (*Withania coagulans*) showed manganese levels >200 μg $g^{-1}$. Copper levels >50 μg $g^{-1}$ were found in Basil (*Ocimun basilicum*), Liquorice *(Glycyrrhizo glapra*), Fennel (*Foeniculum vulgare*), Syrian rue (*Peganum harmala*), Bishop's weed (*Trachyspermum ammi*),Chilli (*Capcicum frutenscens),* Musli (*Aneilema scapiflorum*), Jujube fruit (*Ziziphu vulgris),* Black Cumin (*Nigella sativa*), Sensitive plants (*Mimosapudica*), Colcynth (*Citrullus colocynthis ),* God Mar (*Gymnem sylvester*), Water chestnut (*Trapa bispinosa),* Chaksu (*Cassia absus*) and Nuts-cooling (*Withania coagulans*). Iron levels in these plant samples were found to be comparatively higher than all other metals investigated but some of the plants including Mint (*Mentha arvensis*), Liquorice *(Glycyrrhiza glapra*), Syrian rue (*Peganum harmala*), Musli (*Aneilema scapiflorum*), Sensitive plants (*Mimosapudica),* Rhubarb (*Rheum emodi*). God Mar (*Gymnem sylvester*), Chaksu (*Cassia absus*) and Nuts-cooling (*Withania coagulans*) Showed very high Iron contents (i.e., >400 μg $g^{-1}$).

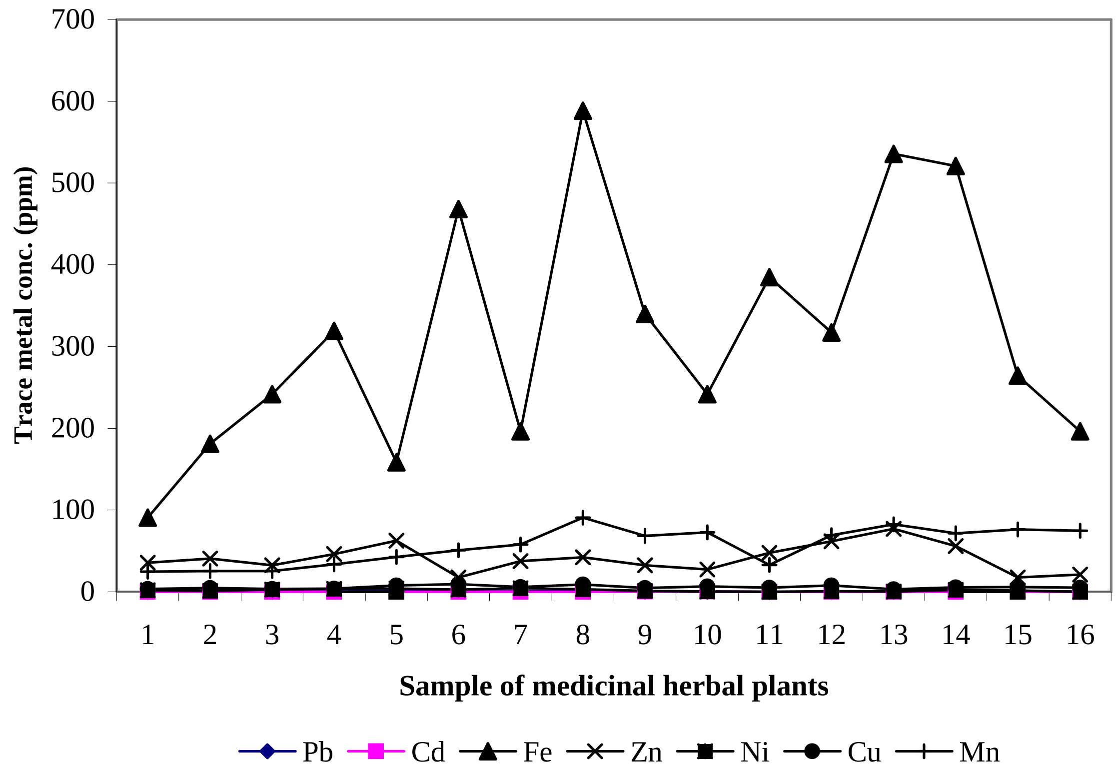


Fig. 1. Plot of trace metals conc. (ppm) vs Medcinal Herbal Plants.

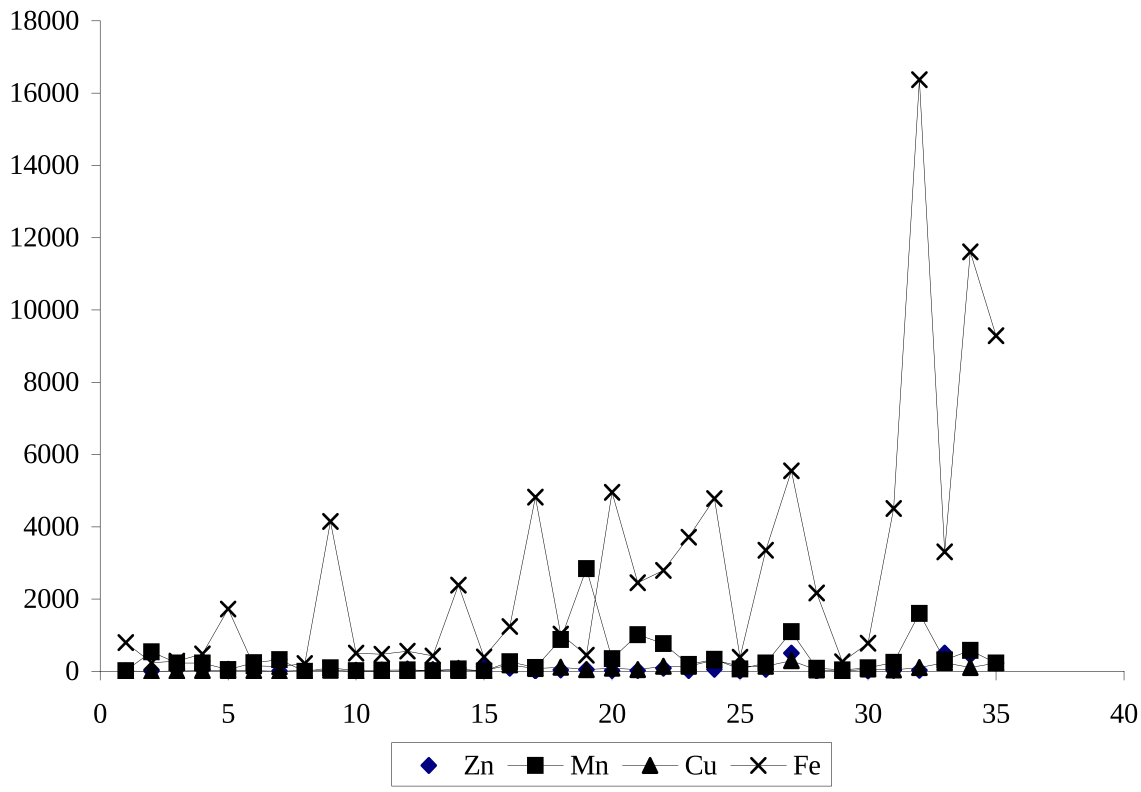


Fig. 2 . Heavy trace metals (Fe, Cu, Mn & Zn) in plants.

Earlier reported data show varation in studies related to the determination of miniral constituents in some medicinal plants of Pakistan. Syed *et al*., (1987), estimated lead in tumeric by atomic absorption spectrometry. Ahmad *et al*., (1994) reported the leaves of major, minor and trace elements in Henna (*Lawsonia intermis*) leaves. Saleem *et al*., reported the chemistry of the medicinal plants of the genus *Acacia*. They collected about 11 species of this genus and described the medicinal importance in treatments of various diseases.

**Table 6. Heavy Trace Metal levels in medicinal plants determined by flame atomic absorption spectrometry [metal concentration * (ug g-1 of the dried plant materials)].**

| | Zn | Mn | Cu | Fe |
|---|---|---|---|---|
| Metals detection limits | 1.0 (ug g-1) | 10 (ug g-1) | 4.0 (ug g-1) | 40 (ug g-1) |
| SRM 1572 certified value | 29.0 ± 2.0 | 23.0 ± 2.0 | 16.5 ± 1.0 | 90.0 ± 1.3 |
| Determined value | 30.4 ± 1.6 | 23.0 ± 0.6 | 16.3 ± 0.2 | 89.0 ± 1.3 |
| % Recovery | 105 | 100 | 99 | 99 |
| *Curcuma longa* | 18.3 ± 3.8 | 16.5 ± 2.2 | 5.3 ± 0.9 | 800 ± 103 |
| *Syzgium aromaticum* | 13.3 ± 0.6 | 539 ± 26 | 4.7 ± 1.7 | 235 ± 48 |
| *Amomum subultum* | 45.3 ± 5.2 | 223 ± 18 | 14.0 ± 3.3 | 285 ± 44 |
| *Cuminum cyminum* | 43.0 ± 2.6 | 228 ± 0.9 | 17.0 ± 3.7 | 482 ± 35 |
| *Cuminum nigrum* | 55.6 ± 22.2 | 43.3 ± 9.5 | 14.3 ±2.5 | 1726 ± 138 |
| *Piper nigrum* | 5.0 ± 5.3 | 237 ±3 | 14.3 ± 1.7 | 155 ± 69 |
| *Cinnamomum zeylanicum* | 10.0 ± 3.7 | 323 ± 15 | 4.0 ± 0.0 | 129 ± 49 |
| *Myristica fragrans* | 28.0 ± 11.5 | 4.3 ± 3.4 | 32.6 ± 4.9 | 222 ± 44 |
| *Mentha arvensis* | 40.3 ± 4.0 | 92.5 ± 4.8 | 30.6 ± 6.0 | 4144 ± 193 |
| *Eucalyptus citriodora* | 32.3 ± 6.5 | 19.1 ± 2.7 | 14 .3 ± 2.05 | 501 ±15 |
| *Azadirachta indica* | 33.3 ± 9.9 | 29.5 ± 4.1 | BDL | 475 ± 23 |
| *Cassia fistula* | 66.3 ± 20.4 | 35.3 ± 6.8 | 8.7 ± 2.5 | 559 ± 14 |
| *Coriandrum sativum* | 51.6 ± 19.4 | 21.0 ± 0.5 | 18.0 ± 2.5 | 424 ± 74 |
| *Cichorium intybus* | 89.6 ± 31.6 | 67.9 ± 6.6 | 21.3 ± 3.1 | 2390 ± 88 |
| *Ricinus communis* | 133 ± 12 | 14.0 ± 1.0 | 17.3 ± 0.9 | 397 ± 81 |
| *Ocimun basilicum* | 83.3 ± 6.2 | 264 ± 21 | 179 ± 10 | 1237 ± 124 |
| *Glycyrrhiza glapra* | 12.7 ± 0.0 | 107 ± 15 | 80.4 ± 24.2 | 4823 ± 1370 |
| *Foeniculum vulgare* | 37.5 ± 3.0 | 877 ± 85 | 117 ± 22 | 1034 ± 293 |
| *Elettaria cardamomum* | 50.6 ± 2.4 | 2840 ± 112 | 48.2 ± 20.6 | 441 ± 61 |
| *Peganum harmala* | 20.5 ± 9.5 | 352 ± 123 | 81.0 ± 5.7 | 4954 ± 684 |
| *Zingiber officinale* | 19.7 ± 1.9 | 1014 ± 52 | 49.4 ± 2.7 | 2457 ± 1110 |
| *Trachyspermum ammi* | 80.6 ± 24.1 | 771 ± 11 | 145 ± 27 | 2792 ± 304 |
| *Capcicum frutenscens* | 22.8 ± 12.7 | 194 ± 10 | 141 ± 34 | 3708 ± 919 |
| *Aneilema scapiflorum* | 61.2 ± 20.6 | 330 ± 41 | 316 ± 315 | 4782 ± 470 |
| *Ziziphus vulgaris* | 7.5 ± 4.0 | 67 ± 2 | 146 ± 34 | 384 ± 13 |
| *Nigella sativa* | 52.3 ± 4.5 | 231 ± 19 | 138 ± 40 | 3355 ± 333 |
| *Mimosa pudica* | 498 ± 30 | 1102 ± 99 | 293 ± 52 | 5547 ± 947 |
| *Syzigium cumin* | 1.1 ± 0.4 | 88 ± 9 | 42.3 ± 21.3 | 2165 ± 464 |
| *Aloe barbedensis* | BDL | 34 ± 3 | BDL | 269 ± 127 |
| *Citrullus colocynthis* | 13.6 ± 1.9 | 98 ± 11 | 63.7 ± 18.9 | 779 ± 127 |
| *Rheum emodi* | 16.7 ± 5.2 | 242 ± 27 | 33.9 ± 19.9 | 4507 ± 776 |
| *Gymnem sylvester* | 33.0 ± 5.2 | 1599 ± 179 | 102 ± 24 | 16373 ± 384 |
| *Trapa bispinosa* | 502 ± 6.0 | 310 ± 279 | 232 ± 226 | 3300 ± 1393 |
| *Cassia absus* | 451 ± 145 | 582 ± 52 | 100 ± 25 | 11613 ± 2691 |
| *Withania coagulans* | 231 ± 253 | 226 ± 9 | 230 ± 214 | 9293 ± 1200 |

Mean of triplicate measurements ± standard deviation; BDL below detection

## Conclusion

In conclusion that the analysis of medicinal herbs/plants in treating various diseases on the regard of their pharmacological action are helpful in regulating their use as certain elements are toxic at elevated levels. Further, it was found that all the studied plants contain good amount of trace elements like Pb , Cd, Zn, Fe, Ni, Cu & Mn etc., which have immunomodulatory functions in human system and the use of various spcies of herbs in local foods recipes and medicinal preparations is a source of essential trace metal supplements in addition to their antimicrobial characteristics. Therefore, it is suggested that the environment required for growth and synthesis of these plants and the possibility that trace metals are deposited in the plants cannot be disregarded. Moreover, the Inductively Coupled Plasma is very sensitive instrument for the determination of the trace metals concentration (ppm) reference to the chemical constitutional composition of the medicinal - herbal plants for the daily use by the public of society.

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