



Determination of Heavy Metal Levels in Pakistani Branded Herbal Medicines Used for Cardiac and Liver Disorders by Atomic Absorption Spectroscopy

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ABSTRACT

Heavy metals levels in Pakistani branded herbal medicines used for cardiac and liver disorder were investigated using atomic absorption spectroscopy. The collected samples were prepared for analysis by wet digestion method using nitric acid and per chloric acid. Five metals iron, lead, copper, manganese and zinc were analyzed. Iron has the highest concentration with a range of 91.25-10.00 ppm and Pb the lowest with values in the range 8.15-0.50 ppm in the herbal medicines used for heart disorder. Copper and zinc was found in the range of 18.35-1.40 ppm and Zn 49.20-8.65 ppm respectively whereas manganese was below detection limit. In herbal medicines used for liver disorder zinc has the highest concentration with a range of 70.20-15.60 ppm and Pb the lowest values in the range of 28.40-4.70 ppm. Iron and copper were found in the range of 59.20-11.90 ppm and 33.40-0.50 ppm respectively, where manganese was below detection limits. Results are comparable with the reported values in literature. The heavy metal levels were below toxic limits in all of the samples.

Keywords: Heavy metals, herbal medicines, atomic absorption spectroscopy

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INTRODUCTION

Herbal medicine or phytomedicine are one or more parts of a plant (seeds, berries, roots, leaves, bark, or flowers) used to relieve physical and psychosomatic problems avoid diseases or just to develop overall health and vitality. These medicinally significant botanicals and their products now exist as herbal drugs despite a significant development in medical sciences. The demand of herbal medicine is increasing and becoming popular day by day due to their efficiency, rare chances of side effects in the treatment and good reliance of society on herbal medicine and also their products.¹

Numerous plant species are used by diverse indigenous systems such as Siddha, Ayurveda, Unani and Allopathy for the treatment of different ailments. In Africa, up to 80% of the residents use traditional medicine for primary health care.²

Toxic metal is defined as that metal, which is neither essential nor has beneficial effect, on the contrary, it displays severe toxicological symptoms at low levels,³ and heavy metal is defined as a metal with a density more than 5 g/cm³, atomic weight 63.546 to 200.590 and a specific gravity greater than 4.0.⁴ They enter into the food material and from there they ultimately make their passage into the tissue.⁵

Metals are found in all living organisms where they play a variety of functions. Metals such as Fe, Cu, Pb, Mn and Zn are important for human body but chronic metabolic disorder may occur due to the deficiency or excess of these metals.⁶ It is important to keep the level of these metals in their suitable ranges for maintaining an appropriate metabolic functions in human body. Over the last few decades, there has been growing interest in determining heavy metal levels in the environment and attention was drawn to the measurement of contamination levels in public food supplies. Unnecessary elements such as Pb, Cd, Cr, Ni and As are considered to be toxic and their existence in the body can cause intense biochemical and neurological changes in the body.⁷

Heavy metal like zinc causes intestinal distress which includes vomiting, stomach cramps, diarrhea, headache and nausea. Copper causes liver and kidney damages and stomach and intestinal irritation. Lead causes inhibition of the synthesis of red blood cells. Manganese causes intestinal as well as abdominal pain, allergies, cardiovascular disease and kidney disorders.

Different analytical techniques are used for determination of heavy metals but here we used AAS for determining heavy metals like iron, lead, copper, manganese and zinc.

MATERIALS AND METHOD

Materials

The herbal products were purchased from local market in the Peshawar and Kohat city, Pakistan. Selection of the products used was based on the popularity of the products among the general public and the reputation of the manufacturer.

Instrumentation

The heavy metal levels were determined by using atomic absorption spectrophotometer model A- Analyst 400, Perkin Elmer.

Sample preparation

Wet digestion method

Eighteen commercial herbal products of various brands were analyzed for their toxic metal concentrations. The details of these herbal drugs are given in Table 1 and Table 2. They were available in both solid and liquid dosage forms. One g of herbal drug was taken in a flask, 10 ml of concentrated nitric acid (63 %) was added and heat on electrical hot plate at 60°C for about 30 minutes and then we add Perchloric acid (2 mL) to the sample and concentrated on a hot plate at 120°C. The residue was cooled, diluted with double distilled water up to 10 mL and filtered through Whatman filter paper No. 42. Sufficient double distilled water was added to make the volume up to 25 mL and was kept in a transparent bottle until analyzed by using atomic absorption spectrometer (AAS) for various heavy metals with the results expressed in parts per million (ppm).

Table 1: Herbal Drug samples for cardiac disorder

Sample Code	Herbal Drugs Name	Ingredients	Indications
HC1	Shafai Tablets	Rauwalfiaserpentinan, talumalbum, coriandrumsativum, Base.	An effective remedy for lowering hypertension
HC2	Khamira Gaozaban ambri	Gaozaban, Thukmeblongo, Todrisurah, Anbar, Behmansupaid, behmansurh, Kashnez.	Effective tonic which strengthens the heart
HC3	Khamira Marwareed	Santalums album, Rosa indica, Salixcaprea, Agatepulvis, Sugar, Pandanusodoratissimus, Yaqootpulvis.	Heart tonic
HC4	Kardil	Roxb seed, sentlum album, Coral calcium, Kushtaagate, Oyster shell calcium, Serpentinebezoar, Coriandrumsativum,	Effective in cardiac arrhythmia
HC5	Rooh-e-dil	Behmensurkh, Roxb seed.	Effective in cardiac

			arrythma
HC6	Mufarrah Shaikhur Raees	Aquilariaagallocha (Agar), Bambusaarundinacea (bansalochan), Bombyxmori, Camphoraofficinarum, Centaureabehen, Coralliumrubrum, Crab, Crocussativus, Cucumismelo, Honey, Lactucascariola, Lagenariavulgaris, Rosadamascene, Silverfoil, Zingiberzerumbel.	Cardiac preparation Relives palpitation
HC7	Dawa-ul-misk Mutadil	Rosa demascena, Salviaheamatodes, Coriandrumsativum, Parmillaperiatadoronicum, Santalualbum, Portulacaolercea, Boragoofficinalis, Bambusaspinosa, Silkcocoon, Pistacialintiscus, Musk, Oystershell, Agate, Pearls, Ruby, Emerald, Silverfoil, Glucose.	Cardiac preparation Relives palpitation
HC8	Hayat-e-dil	Balcher, Gulsurkh, kishmish, Behmensurkh, Gaozaban, Audhindi, Abresham, Tukhm-e-rehan, Allachikhurd, Shikakal, Gulgaozaban, Naranj, Arjun.	Excellent Cerebral cardiac and nervous tonic
HC9	Khamira gaozaban (sada)	Boragooffinalis, Cantaurabehenlinn, Saliva heamatodes, Doronicumpardalianches, Nepetaruderalismam, Salivaegyptiaca, Lepidiumiberislinn, Saccharum base.	Effective in cardiac arrythma

Table 2: Herbal Medicine used for liver disorder

Sample Code	Herbal Drugs Name	Ingredients	Indications
HL1	Ark Mako	Solanumnigrum	Effective in relieving the inflammation of liver
HL2	Icterene	Achilleamillefolium, Berberisaristata, Fagoniaarabica	A Herbal treatment for jaundice
HL3	Majoon Khabs-ul-hadeed	Piper nigram, Allium ascolonicum, piper longum	Potentiates liver and stomach functions
HL4	Jigrina	Zaajakhdar, Falfalasoood, Hertakisabz	Herbal tonic for effected liver
HL5	Akseer-e-Jigar	Ammonium chloride, Potassium nitrate, Base, Violaodorata, Foeniculumvulgare, Cichoriumintybus, Solanumnigrum, Boragoofficinails	Effective for hepatic disorder, anemia
HL6	Jan-e-Jigar	Takhumkansi, Zarshakshreen, karfis	Corrects liver functions, Produces fresh blood

HL7	Hepacure	Silybummarianum, Vitisvinifera, Cordiaratifolis , Sugar, Violaodorata, Glycyrrhizaglabra, Rosadamascene, Cassiasenna, Althaeaofficinalis seed and root, Tamarindus, Foeniculum seed and root,	Effective for hepatic disorder, jaundice, anemia
HL8	Jigri	Achilleamillefolium, Berberisaristata, Solanumnigram, Artemisiaabsinthium, Cichoriumintybus, Cinnamomumofficinalis, Fagoniaarabica, Foeniculumvulgare, Rheumemodi	For hepatic diseases
HL9	Hepasil	Silibummarianum, Terminaliaarjona, Solaanumnigrum, Capparispinusa, Chichoriumintybus, Achilleamelifolium, Berberisaristata, Tinospracardifolia	Jaundice, anemia and liver cirrhosis

Determination of elements

For the determination of each element, the recommended wavelength, burner position as well as flame conditions were used. The spectrometer was operated in the absorption mode (absorbance readings), using three standard solutions and a calibration curve was prepared. The concentrations of sample solutions after appropriate dilutions were then read directly from the instrument.

RESULTS AND DISCUSSION

Quantitative determination of Fe, Pb, Cu, Zn and Mn in the herbal medicines samples, collected from various sites of Kohat and Peshawar have been made using atomic absorption spectrometry.

The results are provided in Tables 3 and 4 and Figures 1 and 2.

Table 3: Concentration of heavy metals in herbal drugs used for cardiac disorder (ppm)

Sample code	Zn	Fe	Pb	Cu	Mn
HC1	27.5	43	6.55	4.25	-
HC2	26.2	75.5	8.15	16.7	-
HC3	30.4	91.2	4.6	11.7	-
HC4	32.8	33	5.45	19.2	-
HC5	19.7	21.9	0.5	1.4	-
HC6	49.2	42.5	1.10	18.35	-
HC7	20.3	98.5	5.8	7.45	-
HC8	8.65	67.5	5.35	1.60	-
HC9	31	66.5	4.27	1.80	-

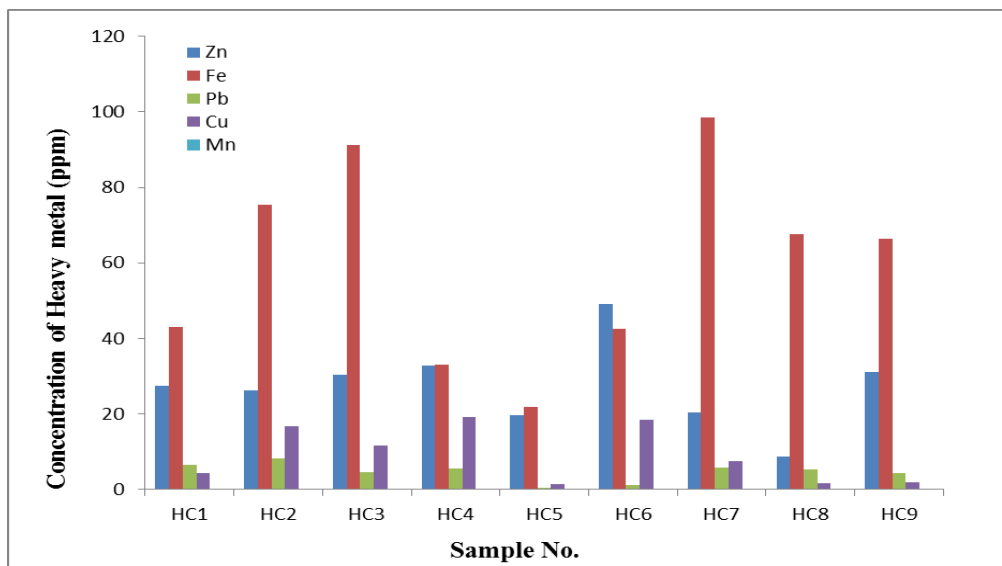


Figure: 1 Concentration of heavy metals in herbal drugs used for cardiac disorder (ppm)

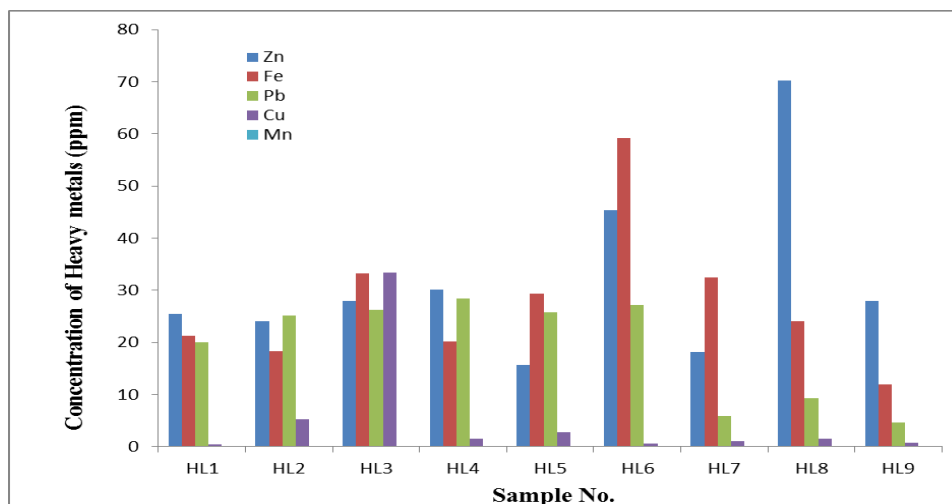


Figure 2: Concentration of heavy metals in herbal drugs used for liver disorder

Zinc

Although human body can accommodate high concentration of zinc, acute Zn toxicity can cause eminent health problems such as stomach cramps, skin irritation, nausea, vomiting and anemia while chronic deficiency may lead to copper deficiency in man.⁸ Very high level can damage pancreas and disturb the protein metabolism and cause arteriosclerosis. Extensive exposure to zinc chloride can cause respiratory disorders. It can cause respiratory disorder. It can be danger to unborn and newborn children when their mothers have absorbed large concentrations and the children get exposed through blood or breast milk.⁹

In cardiac samples, HC8 contain the highest concentration of zinc and the lowest was in the sample HC5.

All the collected samples used for the liver disorder contain high level of the zinc with a concentration range of 70.2-15.6 ppm. The highest concentration was found in HL8 and the lowest concentration was in the HL5.

Iron

The ingestion of large quantities of iron salts may lead to severe necrotizing gastritis with vomiting, hemorrhage and diarrhea followed by circulatory shock, also disease of aging such as Alzheimer's disease, other neurodegenerative disease, arteriosclerosis, and diabetes mellitus may all be contributed to by excess iron and copper.¹⁰ The herbal medicines which are used for heart disorder contain high level of iron with a concentration range of 91.2- 21.9 ppm. The highest concentration was found in HC3 and the lowest concentration was that of the HC5.

Among all the samples collected for liver disorder HL6 contain highest concentration of the iron and lowest concentration was in the HL9.

Lead

The absorbance of high concentration of Lead in the human blood stream may increase the lead level in the blood. Inorganic lead is certainly one of the oldest occupational toxins and lead poisoning is evident since Roman times. At very high level in blood is a powerful abortifacient, at low level it has been associated with miscarriage and low birth weight of infants. Some cases have shown reduced count mortality other include showing of sensory motor time in male, reduced resistance and increased mortality rate in experimental animal sand. Impairment of antibody production with reduction of immunoglobulin plaque-forming cells.¹¹

In cardiac samples Lead concentration was highest in sample HC2 and the lowest is in sample HC5. In liver samples Lead concentration was highest in HL4 and the lowest concentration was in the HL9.

Copper

Copper (Cu) is an essential trace element for humans and animals. The ability of copper to easily attach and accept electrons explains its importance in oxidative reduction processes and in disposing and removing free radicals from the organisms but the exact composition and structure of copper compounds, generated in the organism, are not yet fully elucidated. The role and the participation of copper and copper enzymes in the metabolism, as well as the interaction of copper with other micronutrients are not clearly specified.¹² Changes in copper concentrations in body fluids and tissues are observed in different diseases and conditions. There are indications of serious diseases, caused by disorders of the metabolism of copper in the organism, but the role of

copper in most of them is not completely clarified.^{13,14}

In herbal medicines samples used for cardiac disorders the Copper concentration was highest in the HC4 and lowest is in the HC5. In herbal medicines samples used for liver disorders Copper concentration was highest in the HL3 and lowest in HL1.

Mn

It is important here to note that Mn is an essential element required for various biochemical processes.¹⁵ Mn is also important for several enzymatic processes. It helps in eliminating fatigue and reduces nervous irritability. Manganese concentration was below detection limit in all the collected herbal medicines samples.

Table 4: Concentration of heavy metals in herbal drugs used for liver disorder

Sample code	Zn	Fe	Pb	Cu	Mn
HL1	25.5	21.2	20	0.5	-
HL2	24.1	18.3	25.1	5.2	-
HL3	28.0	33.3	26.2	33.4	-
HL4	30.1	20.1	28.4	1.5	-
HL5	15.6	29.3	25.8	2.8	-
HL6	45.4	59.2	27.2	0.6	-
HL7	18.2	32.5	5.8	1.1	-
HL8	70.2	24	9.3	1.50	-
HL9	28	11.9	4.7	0.7	-

Table 5: mg/day of herbal drugs used for Cardiac disorder

Sample No.	Zn	Fe	Pb	Cu	Mn
HC 1	1.23-2.47	1.93-3.87	0.29-.0.58	0.19-0.38	-
HC 2	13.1	37.75	4.07	8.35	-
HC 3	6.08	18.24	0.92	2.34	-
HC 4	2.73	2.74	0.45	1.59	-
HC 5	1.53	2.11	2.36	0.23	-
HC 6	31.34	43.21	23.12	1.23	-
HC 7	5.07	24.62	1.45	1.86	-
HC 8	29.34	14.23	23.43	1.23	-
HC 9	15.5	33.25	2.13	0.9	-

Table 6: mg/day of herbal drugs used for Liver disorder

Sample No.	Zn	Fe	Pb	Cu	Mn
HL 1	50.14	41.68	39.33	0.98	-
HL 2	2.98	2.26	3.10	0.64	-
HL 3	7.0	8.32	6.55	8.35	-
HL 4	16.10	10.75	15.19	0.80	-
HL 5	0.89	1.68	1.48	0.16	-
HL 6	35.48	46.26	21.25	0.46	-
HL 7	6.97	12.46	2.22	0.42	-
HL 8	37.64	12.87	4.98	0.80	-
HL 9	21.18	9.00	3.55	0.52	-

CONCLUSION

The results of present research investigation suggest that significant concentration of heavy metals like iron, lead; zinc and copper are not present in the selected Pakistani branded herbal medicine samples used for heart and liver disorders purchased from Kohat and Peshawar. Among the tested herbal products the levels of iron, lead, copper and zinc were below the recommended limits. This study from the toxicological point of view showed that these herbal preparations are safe and do not poses any likely harm to patients if prescriptions are adhered to as stipulated by the manufacturer.

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