Journal of Applied Pharmaceutical Science Vol. 3 (08), pp. 072-074, August, 2013
Available online at http://www.japsonline.com
DOI: 10.7324/JAPS.2013.3812
ISSN 2231-3354

Investigations of Heavy Metals in Different Medicinal Plants

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ARTICLE INFO

Article history:
Received on: 16/06/2013
Revised on: 30/06/2013
Accepted on: 18/07/2013
Available online: 30/08/2013

Key words:
Heavy metals, Medicinal Plants, Atomic Absorption Spectrophotometer.

ABSTRACT

The present study was conducted to determine the concentration of heavy metals in some selected medicinal plants taken from District Karak, Khyber Pakhtunkhwa, Pakistan. Essential and non essential heavy metals such as Zn, Fe, Mn, Cu, Ni, Cr, Pb and Cd were investigated in *Rhyzia stricta*, *Withania coagolans*, *Conyza canadensis*, *Steleria media*, *Medicago denticulata*, *Parthenium hysterophorous*, *Malvastrum tricuspidatum* and *Launaea nodicaulis* by using Atomic Absorption Spectrometry. Plants showed different metal concentration in the range of: 10.11-55.98mg/kg for Zn, 40.47-101.87mg/kg for Fe, 29.11-105.46mg/kg for Mn, 15.06-34.52mg/kg for Cu, 1.02-10mg/kg for Ni, 0.01-0.76mg/kg for Cr, 0.99-15.46mg/kg for Pb and 0.10-1.41mg/kg for Cd. High contents of Fe and Mn were found in all eight plants. Other heavy metals were present in low quantity. The purpose of this study was to identify each type of metal associated with a given plants contaminated by environmental pollution and also to highlight the toxic heavy metals present in these plants.

INTRODUCTION

Medicinal plants are worldwide used in various disciplines of health care systems such as herbal, Ayurvedic, Unani and homeopathic systems of medicines in the form of herbs and standardized extracts. According to the advanced researches it has been suggested that plants contain secondary metabolites which are not only contain toxic substances (alkaloids), but they are also contaminated with environmental pollutants specially heavy metals, which are very dangerous to all living organisms upon long term exposures (Itanna, 2002; Lasis *et al*., 2006; Obi *et al*., 2006). Heavy metals are classified in two main categories i.e. essential and non essential heavy metals. Essential heavy metals (Cu, Cr, Zn, Fe, and Co) are present in very little concentration in the body for the proper functioning of enzyme systems, vitamin synthesis and hemoglobin formation in men and also required for the growth, development and photosynthesis in plants. On the other hand toxic metals (Pb, As, Cd and Hg) are not needed to perform specific function in the body and they have deleterious effects even at very low concentrations (Darwish *et al*., 2009; Friberg *et al*., 1986). According to the advanced research which has shown that crude extract of herbal origin can prove fatal for the health because these drugs may contain toxic metabolites or Some trace elements which cause damages to health. (Islam *et al*., 2007; Sing *et al*., 2006) Some heavy metals are needed by the body in very low concentration for proper functioning to synthesis various biomolecules inside the body. These trace elements are called essential heavy metals. Heavy metals are present in the environment which is subjected to bioaccumulation in food chains (WHO, 2007). Anthropogenic processes, involving the organic manure, synthetic fertilizers, industrial residues and lime upon exposer contribute various amounts of heavy metals to the ecosystem (Khan *et al*., 2002, Martins *et al*., 2008). Heavy metals cannot be decomposed by the microorganisms as they resistance to biodegradation (WHO, 2007). During cultivation process addition of synthetic fertilizers or lime is one cause which lead to enhance the concentration of heavy metals to the soil from where they are absorbed by the plants. Industrial exhaust, vehicle exhaust and careless handling of wastes are also the main cause of producing heavy metals which may pollute the environment (Khan *et al*., 2002). These contamination of heavy metals in medicinal plants remain continue during storage and transportation process of plants where these are exposed to environmental pollution, and heavy metals. The major source of accumulation of heavy metals in human organs because these medicinal plants are not only used as folk medicines and food supplements, but many of them is utilized as condiments in daily routine. WHO/FAO has put forward this critical issue and analyzed heavy metals in the herbal medicines along with other necessary

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chemical, biological, and environmental analysis in their guidelines (WHO, 1993,) and also suggested the absorption, elimination, and toxic profiles of heavy metals. Although herbal drugs are utilized on large scale by the people but these may be contaminated with heavy metals beyond their recommended level. The biological effect caused by these heavy metals necessitates the need to assess the heavy metals level of medicinal plants before they are utilized or taken for medicinal purposes (Rehman *et al*., 2013).

EXPERIMENTAL

Sample Collection

Samples of different medicinal plants including *Rhyzia stricta*, *Withania coagolans*, *Conyza canadensis*, *Steleria media*, *Medicago denticulata*, *Parthenium hysterophorous*, *Malvastrum tricuspidatum* and *Launaea nodicaulis* were collected from different areas of Khyber Pakhtunkhwa and were identified by Plant Taxonomist, Department of Botany, Kohat University of Science & Technology, Kohat, Pakistan. The samples were washed thoroughly with distilled water to eliminate dirt, dust and other possible parasites and then were properly rinsed with deionized water. The rinsed plants were dried under shade at 25-30^{0}C. The dried samples were powdered by mortar and pistol and then stored in clean, dried plastic bottles for further processing.

Analysis of Plant Samples

Specified weight of powdered plant sample was taken in china dish for heating in an oven at 110^{0}C for several hours to remove moisture. Then the moister free sample was placed in furnace. The furnace temperature was gradually increased from room temperature to 600^{0}C in 1 hour. The sample was ashed for about 5 hours until a grey or white ash residue was obtained. The contents of china dish were cooled to room temperature in desiccators and 2 mL of 6 M HNO_3 solution was added into china dish and the mixture was heated to dissolve its content. The solution was filtered through whatman (#42) filter paper into 25 mL flask and was diluted to the mark. The solutions were then stored in clean and dry plastic bottles (Rehman *et al*., 2013, Iqbal *et al*., 2013). Estimation of heavy metals like Zn, Fe, Mn, Cu, Ni, Cr, Pb and Cd were carried out on Flame Atomic Absorption Spectrophotometer (Parkin elmer 400).

RESULTS AND DISCUSSION

The present study was designed to determine the concentration of essential and non essential heavy metals in eight different medicinal plants having their medicinal properties are mentioned in table 1.The concentration of Zn, Fe, Mn, Cu, Ni, Cr, Pb and Cd in selected medicinal plants are given in table 2. According to the given information appended in table 2. High concentration of Zn, Mn and Fe was recorded in all eight plants. *P. hysterophorous* contained higher concentration of Zn 55.98mg/kg followed by *M. tricuspidatum* 40.32 mg/kg. The level of Zn in other plants was 11.23mg/kg, 10.11mg/kg, 26.71mg/kg, 21.45mg/kg, 30.92mg/kg and 15.41 mg/kg in *R. stricta*, *W. coagolans*, *C. canadensis*, *S. media*, *M. denticulata* and *L. nodicaulis* respectively. High concentration of Fe 101.37 mg/kg was found in *S. media* while *L. nodicaulis* contained low concentration of Fe 40.47 mg/kg. Range of Fe in other plants 88.37mg/kg, 99.41mg/kg, 89.26mg/kg, 60.81mg/kg, 60.30mg/kg and 51.38mg/kg were detected in *R. stricta*, *W. coagolans*, *C. canadensis*, *M. denticulata*, *P. hysterophorous* and *M. tricuspidatum* respectively. *W. coagolans* and *R. stricta* showed maximum concentration of Mn 100.02mg/kg, 105.46mg/kg. All other plants had the following contents of Mn *C. canadensis* 58.23mg/kg, *S. media* 40.56mg/kg *M. denticulate* 58.32 mg/kg, *P. hysterophorous* 50.56mg/kg, M. tricuspidatum 29.11mg/kg and *L. nodicaulis* 78.76 mg/kg. Highest concentration of Cu 34.52 mg/kg, 34.37mg/kg was found in *C. canadensis* and *P. hysterophorous* while the minimum concentration of Cu 15.06 mg/kg was detected in *L. nodicaulis*. *M. tricuspidatum* contained 16.80 mg/kg, *M. denticulata* 27.74 mg/kg, *S. media* contained 29.96 mg/kg *and W. coagolans* contained 18.70 mg/kg and *R. stricta* contained 31.23 mg/kg respectively. *R. stricta* showed the maximum concentration of Ni 10.11mg/kg while *C.canadensis* showed low concentration of Ni 1.02 mg/kg. The contents of Ni in other plants was 8.04 mg/kg in *W. coagolans*, 1.09 mg/kg in S. media, 4.36 mg/kg in M. denticulata, 7.40 mg/kg in P. hysteriphorous, 3.21 mg/kg in M. tricuspidatum and 5.00 mg/kg in L. nodicaulis. The concentration of Cr found in different plants were *R. stricta* 0.76 mg/kg, *W. coagolans* 0.41 mg/kg, *C. canadensis* 0.07mg/kg, *S. media* 0.08mg/kg, *M. denticulata* 0.01mg/kg, *P. hysterophorous* 0.39mg/kg, *M. tricuspidatum* 0.21mg/kg *and L. nudicaulis* 0.43mg/kg. The highest concentration of Cr was found in *R. stricta* 0.76 mg/kg. The maximum concentration of Pb 15.46mg/kg was recorded in *M. denticulata*. Pb was below the detection level in *M. tricuspidatum*.The range of Pb in other plants were: *R. stricta* 11.01 mg/kg, *W. coagolans* 7.04 mg/kg, *C. canadensis* 4.98 mg/kg, *S. media* 10.61 mg/kg and *P. hysterophorous* contained 3.21 mg/kg. *S. media* showed the maximum concentration of Cd 1.41 mg/kg, *C. condensis* and *L. nodicaulis* had almost the same concentration of Cd 1.00 mg/kg and 1.01 mg/kg. All other plants showed low concentration of Pb.

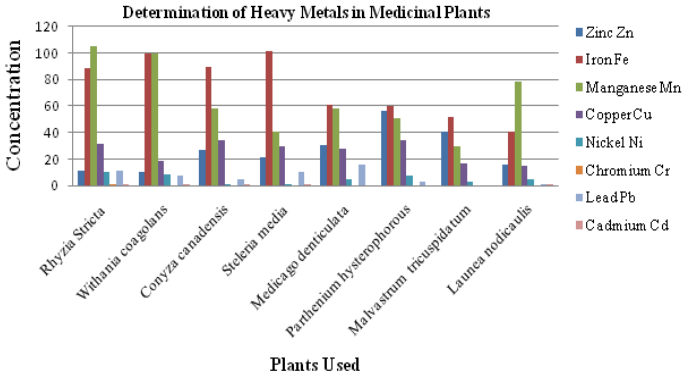

Fig. 1: Determination of heavy metals in medicinal plants.

Tab le. 1: Pharmacognostic properties of medicinal plants.

S. no	Botanical Name	Family	Common Name	Medicinal Properties
01	*Rhyzia stricta*	Apocyaceae	Senhwar	Fever,allergy,diabetes,dysentery,stomach problem and asthma.
02	*Withania coagolans*	Solonaceae	Indian Rennet	Anticancer, dyspepsia, intestinalinfection, asthma,ulcer , rheumatism, bronchitis, Alzheimer'sdisease, antifungal, antibacterial, antihyperglyceamic andante inflammatory.
03	*Conyza canadensis*	Asteraceae	Horseweed	Antispasmodic, anti inflammatory, slightly astringent, febrifuge, strongly tonic, epilepsy, anxiety and neuralgia.
04	*Steleria media*	Caryophyllaceae	Chickweed	Treatement for dry, cracked, inflamed tissue, sores, rashes, upset stomach and asthma.
05	*Medicago denticulata*	Fabaceae	Alfalfa	Treatement for digestive, kidney disorder, diabetes, bladder, anemia and premenstrual syndrome alleviator.
06	*Parthenium hysterophorous*	Asteraceae	Carrot weed	Herbicidal, nematicidal, insecticidal, anti ameobic dysentery and antihysteric.
07	Malvastrum tricuspidatum	Malvacae	False mallow	Diaphoretic, inflamed sores, chest and lung diseases, dysentery and preventing vomiting.
08	*Launaea nudicaulis*	Asteraceae	Jangli booti	Constipation, to relieve fever, itches of skin, ulcer swelling, eczema, eruption, rheumatism and toothache.

Table. 2: Contents of heavy metals (mg/kg) in some medicinal plants.

Plants Name	Zn	Fe	Mn	Cu	Ni	Cr	Pb	Cd
Rhyzia stricta	11.23	88.37	105.46	31.23	10.11	0.76	11.01	0.59
Withania coagolans	10.11	99.41	100.02	18.70	8.04	0.41	7.04	0.81
Conyza canadensis	26.71	89.26	58.23	34.52	1.02	0.07	4.98	1.00
Steleria media	21.45	101.37	40.56	29.96	1.09	0.08	10.61	1.41
Medicago denticulata	30.92	60.81	58.32	27.74	4.36	0.01	15.46	0.10
Parthenium hysterophorous	55.58	60.30	50.56	34.37	7.40	0.39	3.21	0.09
Malvastrum tricuspidatum	40.32	51.38	29.11	16.80	3.21	0.21	Nd	Nd
Launaea nodicaulis	15.41	40.37	78.76	15.06	5.00	0.43	0.99	1.01

Nd. Not detected

CONCLUSION

The present study was aimed to identify the essential and non essential elements in the given medicinal plants. These plants were properly identified i.e. their common name, family name and medicinal uses and also checked for the presence of heavy metals. The concentrations of heavy metals were investigated in eight medicinal plants which were different in all plants.

REFERENCES

Abu-Darwish MS, Abu-Dieyeh ZH, Mufeed B, Al- Tawaha ARM, Al-Dalain SYA, Trace element contents and essential oil yields from wild thyme plants (*Thymus serpyllum L.*) grown at different natural variable environments, Jordan. J. Food Agr. Environ., 2009, 7(4), 920-924.

Friberg L, Nordbergs GF and Vouk VB. 1986. Hand book on the toxicology of metals 2nd ed. Vol.2, Amsterdam, Oxford:Elsevier Science Publishers BV, New York. pp.43,

Iqbal H, Khattak B, Ayaz S, Rehman A, Ishfaq M, Abbas MN, Malik MS, Wahab A, Imran, Mehsud S, Pollution based study of heavy metals in Medicinal Plants *Aloe vera* and *Tamarix aphylla*, J App Pharm. Sci, 2013, 3(4), 54-58.

Ishaq M, Rehman A, Adnan M, Ullah N, Ahmad I, Aamir M, Comparative study of Heavy metals in Albizia lebbeck, collected from different environmental sites, Int. J. Pharm. Sci. Rev. Res., 2013, 20(2), 5-9.

Islam E, Yang X, He Z and Mahmood Q. Assessing potential dietary toxicity of Heavy metals in selected vegetables and food crops. J. Zhejiang Univ. Sci. 2007, 8(1) 1-13.

Itanna F, Metals in leafy vegetables grown in Addis Ababa and toxicological implications. Ethiop. J. Health Dev., 2002,16(3), 295-302.

Khan SA, Khan L, Hussain I, Marwat KB and Akhtar N. Profile of heavy metals in selected medicinal plants. Pak. J. Weed Sci. Res., 2002, 14(1-2), 101-110.

Lasisi AA, Ejelonu BC, Nwosu FO, Olayiwola MA and Yusuff AA, Heavy metals and macronutrients contents in selected herbal plants of south-western Nigeria. Hamdard Medicus, 2006, XLIX(4), 71-76.

Martins TCG, De Nadai Farnandas EA, Ferrari AA Tagliaferro FS and Bacchi MA. Chemical characterization of agricultural supplies applied to organic tomato cultivation. J Radioanal Nucl Chem, 2008, 278(2), 517-520.

Obi E, Akunyili DN, Ekpo B and Orisakwe OE. Heavy metal hazards of Nigerian herbal remedies. Sci. Total Environ., 2006, 369(1-3), 35-41.

Rehman A, Iqbal H, Rehman H, Iqbal T, Ullah W, Rauf MK, Jabbar A, Shagufta BI, Ullah S, Ahmad, I, Study of heavy metals in medicinal plant *Solanum xanthocarpum.* International Journal of Science Innovations and Discoveries, 2013, 3(2), 254-260.

Rehman A, Ullah H, Khan RU, Ahmad I, Population based study of heavy metals in medicinal plant, *Capparis decidua*, Int. J. Pharm. Pharm, Sci. 2013, 5(1), 108-113.

Singh V and Garg AN . Availability of essential trace elements in Indian cereals, vegetables, and spices using INAA and the contribution of spices to daily dietary intake. Food Chemistry, 2006, 94 (1), 81-89.

WHO. 1993. Evaluation of certain food additives and contaminants, forty-first Report of the Joint FAO/WHO Expert Committee on Food Additives. WHO Technical Report Series, No.837, World Health Organization, Geneva. pp. 28-35.

WHO. 2007. Health risks of heavy metals from long range trance boundary air pollution. Joint WHO/Convention Task Force on the Health Aspects of Air Pollution, Scherfigheg 8 DK-2100 Copenhagen, Denmark, World Health Organization. pp.1-70.

How to cite this article:

Ali Rehman, Farhan, Tahir Iqbal, Sultan Ayaz, Hameed Ur Rehman., Investigations of Heavy Metals in Different Medicinal Plants. J App Pharm Sci. 2013; 3 (08): 072-074.