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Short Communication

Estimation of Heavy Metals in Medicinal Plants as a Source of Herbal Medicine Used in Cardiovascular Diseases

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Abstract. Essential and non-essential heavy metals like Zn, Cu, Cr, Mg and Mn were quantified in selected medicinal plants including *Terminalia arjuna, Cassia fistula*, and *Eucalyptus camaldulensis* which are extensively used in the preparation of herbal medicines for heart diseases and tonic for general human health. High Cr contents were observed in *T. arjuna* bark 0.3480 mg/100 g. The high Mn concentration was found in *E. camaldulensis* leaves 1.4654 mg/100 g and high Mg concentration in *C. fistula* twig was 0.5441 mg/100 g.

Keywords: medicinal plants, *Terminalia arjuna*, *Cassia fistula*, *Eucalyptus camaldulensis*

Oriental herbal medicines have a prominent role to play in the pharmaceutical and health markets of the 21st century (Kleinschmidt and Johnson, 1977). Plants are rich in a wide variety of secondary metabolites that have found anti-microbial properties. (Ramar and Ponnampalam, 2008).

Heavy metal analysis of Pb, Cd, Hg, Cu, Ni, Fe, Mn, Cr and As in medicinal plants is getting lot of scientific interest as these plants are used as an alternate form of medicine in different parts of the world (Abdul-Wahab *et al*., 2008; Kala, 2005; Katewa *et al*., 2004; Wong *et al*., 1993).

In the present study, *T. arjuna, C. fistula* and *E. camaldulensis* were used for heavy metals estimation as they are well recognized as medicinal plants used for cardiovascular diseases, (Nadkarni, 1976).

Collection and post harvest treatment of plant material. Experiment was carried out at PCSIR Laboratories, Lahore. Plants were collected from natural habitat of PCSIR vicinity. Each type of medicinal plant species was collected from 10 sampling sites (locations). Result reported was arranged for all 10 samples within an area of approximately one square kilometer to get better sampling representation. Samples were washed in fresh running water to eliminate dust, dirt and possible parasites, and then treated with deionized water. Each demoisturized plants sample was crushed in an agate mortar as fine as possible and analyzed three times.

Acid digestion of plant samples. About 1 g of crushed and powdered portion from each part of plants i.e. leaves, bark, fruit and twig in a crucible form were heated in an oven at 110 °C to remove moisture. The dried samples were charred and then heated in a furnace for 4 h at 550 °C. The contents of crucible were cooled in desiccator and 5 mL concentrated HNO_3 was added into the dish to dissolve its contents. The solution was filtered and transferred to a 100 mL flask and diluted upto the mark (Radojevic, 1999). Estimation of heavy metals was carried out on atomic absorption spectrometer, Analyst 800 (Perkin Elmer).

Reagents. All reagents were of analytical reagent grade and high purity distilled water was used for making the solutions. It has been reported that at least 31 elements can be linked to cardio vascular disorders (Vohora, 1983).

Three plants *E. camaldulensis, C. fistula* and *T. arjuna* were selected for this study because of their medicinal values. The concentrations of Zn, Cu, Mg, Mn and Cr in selected medicinal plants have been shown in Table 1.

Metals composition of *T. arjuna*. The *T. arjuna* locally known as 'kumbuck' belongs to the family Combretaceae (Sarveswaran *et al.,* 2006). *T. arjuna* is a large deciduous tree with a height of about 60 to 80 feet and trunk 10 to 12 feet circumference. It has leaf 3 to 8 inches broadly elliptic, cuneateat base and clustered at the ends of branchlets (Kapoor, 2005).

Metal composition of *T. arjuna* shows that its fruit is very rich in Cu (18.248 mg/100 g) and Mg (0.417 mg/100 g) as shown in Table 1 and its bark contains maximum Cr as compared to other selected medicinal

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Table 1. Heavy metal concentration in plant samples on dry basis

Plant species	Plant part	Zn	Cu	Mg	Mn	Cr
		(mg/100 g)				
T. arjuna	Fruit	2.2019	18.248	0.417	0.0746	0.0246
	Leave	N.D	N.D	0.6171	0.0091	0.1594
	Bark	N.D	N.D	0.9602	0.0377	0.3480
	twig	0.2543	0.1696	1.0164	0.3931	0.1304
E. camaldulensis	Fruit	0.1872	N.D	1.4772	0.4169	0.0985
	Leave	0.3993	0.1962	1.2852	1.4654	0.1212
	Bark	0.0062	0.0456	1.055	0.2216	0.0406
	twig	0.0828	0.2123	0.7766	0.3241	0.0248
C. fistula	Fruit	N.D	N.D	0.3480	0.0061	0.0193
	Leave	N.D	N.D	0.2729	N.D	0.1075
	Bark	N.D	N.D	0.1922	0.0102	0.0941
	twig	N.D	N.D	0.5441	0.0035	0.1248

N.D = Not-detectable

plants shown in (Fig. 1). Copper (Cu) is an essential enzymatic element for normal plant growth and development but can be toxic at excessive levels higher than 20-100 ppm dry weight (DW). The Mg concentration in its bark is 0.9602 mg/100 g. The zinc concentration in fruit of *T. arjuna* is very high as compared to *E. camaldulensis* and *C. fistula* as shown in (Fig. 2).

Metals composition of *C. fistula*. *C. fistula* is a small to medium sized tree with compound leaves and large shining, dark green leaflets and 50 to 60 cm long cylindrical fruit. Its flowers are bright yellow in colour, drooping racemes, 30-60 cm long; shortly clawed petals to 3.5 cm across; stamens 10, upper three with erect filaments to 0.7 cm long. (Orwa *et al*., 2009). Heavy metals analysis of *C. fistula* shows that Zn and Cu were not detectable in all parts of the plant. However, Mg concentration was remarkable as shown in Fig. 3. Its twig is very rich in Cr (0.1248 mg/100 g) and very low amount of Mn (0.0035 mg/100 g). Its fruit contain maximum concentration of Mn as shown in Fig. 4. Chromium intake of 30 mg to 40 mg/day would likely be adequate if well balanced diets were consumed (Anderson, 1993).

The leaves of *C. fistula* tree are helpful in relieving irritation of the skin and in alleviating swellings and pains. Its pulp is an effective laxative and is used in the treatment of constipation. Its bark extracts possess significant anti-inflammatory and anti-oxidant properties (Raju *et al.*, 2005).The root of the *C. fistula* tree is a tonic and useful in reducing fever.

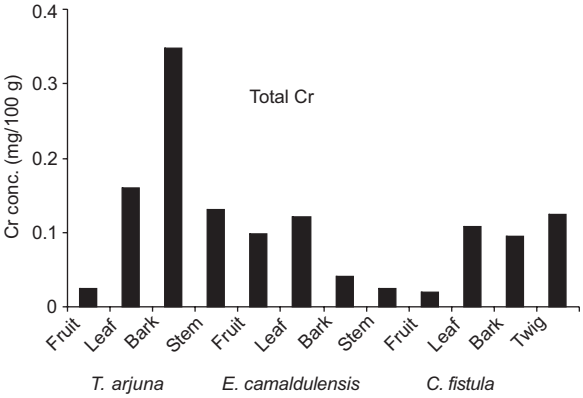

Fig. 1. The amount of total chromium in some selected medicinal plant.

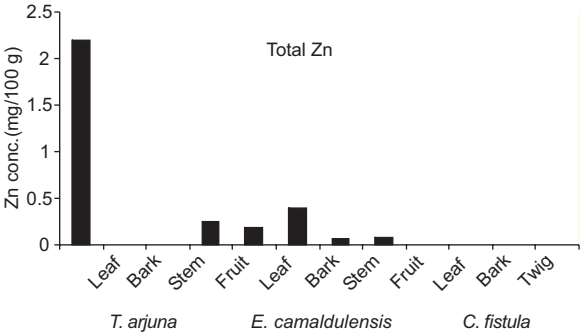

Fig. 2. The amount of total Zinc in some selected medicinal plant.

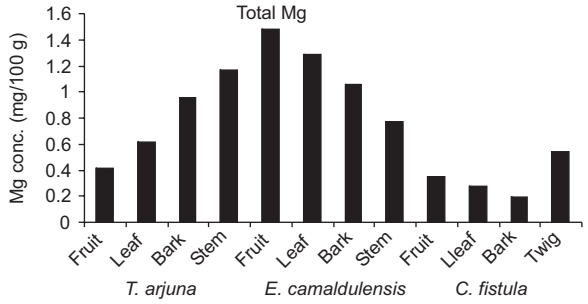

Fig. 3. The amount of total magnesium in some selected medicinal plant

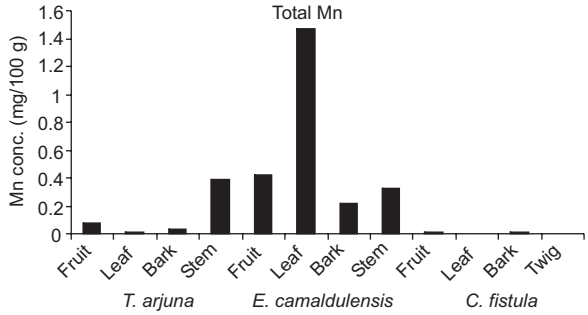

Fig. 4. The amount of total manganese in some selected medicinal plant.

Metals composition of *E. camaldulensis.* Heavy metals analysis of *E. camaldulensis* shows that its fruit is very rich in Mg (1.4772 mg/100 g), Zn (0.1872 mg/100 g) and Cr (0.0985 mg/100 g). Leaves contain maximum content of Mn as compared to *T. arjuna* and *C. fistula* as shown in Fig. 4. Mg content in its leaf, bark and twig are remarkable, as shown in Fig. 3.

High Cr contents were observed in *T. arjuna* bark (0.3480 mg/100 g). High Mn concentration was found in *E. camaldulensis* leaf as the 1.4654 mg/100 g whereas *E. camaldulensis* fruit contains high Mg concentration that is 1.4772 mg/100 g. Present study shows that the selected medicinal plants have been utilized in synthesis of herbal medicines for heart and liver diseases and tonic for general human health.

References

Abdul-Wahab, O.,El-Rjoob., Massadeh, A.M., Omari, M.N. 2008. Evaluation of Pb, Cu, Zn, Cd, Ni, and Fe levels in *Rosmarinus officinalis* Labiatae (Rosemary) medicinal plants and soils in selected zones in Jordan. *Environmental Monitoring and Assessment*, **140:** 61-68.

Anderson, R.A. 1993. Recent advances in the clinical and biochemical effects of chromium deficiency. In: *Essential and Toxic Trace Elements in Human Health and Diseases*. A.S. Prasad (ed), pp. 221-234, Wiley Liss, New York, USA.

Kala, C.P. 2005. Current status of medicinal plants used by traditional vaidy as in Uttaranchal state of India. *Ethnobotany Research and Applications,* **3:** 267-278.

Kapoor, L.D. 2005. *Hand Book of Ayurvedic Medicinal Plants.* 1st edition, Reprint Replika Press Pvt. Ltd., India.

Katewa, S.S., Chaudary, B.L., Jain, A. 2004. Folk herbal medicines from tribal area of Rajasthan. *Indian Journal of Ethnopharmacology*, **92:** 41-46.

Kleinschmidt, H.E., Johnson, R.W. 1977. Weeds of Queensland, 147 pp., Queensland Department of Primary Industry. Australia.

Nadkarni, K.M. 1976. *Indian Materi Medica*. Vol. **1**, 1287 pp., Popular Prakashan Pvt. Ltd., Bombay, India.

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., Simons, A. 2009. Agroforestry database. A tree reference and selection guide version 4.0, pp. 1-5. (http://www.worldagroforestry.org/af/treedb/).

Radojevic, M. 1999. *Vladimir Practical Environmental Analysis.* 366 pp., Royal Society of Chemistry, Cambridge, UK.

Raju, I., Moni, M., Subramanian, V. 2005. Anti-inflammatory and antioxidant activities of *Cassia fistula* Linn bark extracts. *African Journal Traditional, Complementary and Alternative Medicines*, **2:** 70-85.

Ramar, P. S., Ponnampalam, G. 2008. Therapeutic potential of plants as anti-microbials for drug discovery. *eCAM Advance Access Publication*, **24:** 1-12.

Sarveswaran, S., Marati, R.V., Maruthaiveeran, P.B. 2006. Effects of *Terminalia arjuna* bark extract on apoptosis of human hepatoma cell line hepg2. *World Journal of Gastroenterology*, **12:** 1018-1024.

Vohora, S.B. 1983. *Medical Elementology.* 1st edition, 9 pp., IHMMR Press Hamdard Nagar, New Delhi, India.

Wong, M.K., Tan, P., Wee, Y.C. 1993. Heavy metals in some Chinese herbal plants. *Biological Trace Elemental Research*, **36:** 135-142.