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Comparative determination of trace elements from *Allium sativum*, *Rheum australe* and *Terminalia chebula* by atomic absorption spectroscopy

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Abstract

In present study the bulb of *Allium sativum,* root of *Rheum australe* and fruit of *Terminalia chebula* were selected for trace elements analysis by Atomic Absorption Spectrophotometer. The plant samples were digested with concentrated Nitric acid (HNO_3) and concentrated Perchloric acid ($HClO_4$). The analysis for trace elements in the sampled plants indicated that Sodium, Potassium, Calcium, Magnesium, Copper, Zinc, Iron, Cobalt, Manganese, and Lead were present in all samples of all selected plant species at different levels which play a vital role in cure of diseases. The results of the present study provide justification for the usage of these plants in daily diet for nutrition as well as for medicinal usage in the treatment of different diseases. Toxic element Pb were also found but at low concentration. These results can give the importance about these plants and used to set new standards for prescribing the dosage of the herbal drugs prepared from these plant materials in herbal remedies and in pharmaceutical companies.

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Introduction

The ethno botanical information is useful in the conservation of traditional cultures, biodiversity and also for community health care and drug development (Ajaib, 2010). The authentic knowledge of medicinal plants is passed on from one generation to another, after refining and additions (Haq et al., 2011). Plant based recipes have been in use in the amelioration of various ailments from common cold to cancer (Rajua et al., 2006) and are prepared either from the whole plant, different organs or from their secondary products such as gum, resins and latex (Khan et al., 2011). Plants supply the body with energy, protein, minerals, vitamins and certain hormone precursors (Antia et al., 2006). The role of major and trace elements in the health and disease of human body was observed during the last few years (Khan et al., 2011). Elements research has definitely been part of this explosion of scientific knowledge (Said et al., 1996). Trace elements are required in very small quantities for plant life (Herber and Grobecker, 1995). Relatively high concentration of certain essential elements, such as Fe, Mn, Zn, and Ca, has been demonstrated to influence the retention of toxic elements in animals and human beings (Calabrese, 1981; Wang at al., 1996). The quantitative estimation of various trace element concentrations is important for determining the effectiveness of the medicinal plants in treating various diseases and also to understand their pharmacological action (Rajua et al., 2006). The imbalance in human health has been linked with the excess or deficiency of trace elements in soils, water, plants and animals (Khan et al., 2011). The continuous intake of diets that are excessively high in a particular trace element can influence changes in the functioning, forms, activities of some organs or concentrations of such element in the body tissue and fluids can rise above the permissible limit (Obiajunwa et al., 2002).

Keeping in mind the wide application *Allium sativum, Rheum australe* and *Terminalia chebula* in traditional medicine were therefore analyzed for trace elements contents.

Materials and methods

The study was conducted during the year 2010. The fresh bulb of *Allium sativum*, root of *Rheum australe* and fruit of *Terminalia chebula* were cleaned and oven dried to a constant weight at 60°C for 72 h. After drying, the plant materials were ground into fine powder using an electric grinder. The powder of each plant species were weighted 0.5g separately and put in a separate 100ml conical flasks and 30ml nitric acid (HNO_3) were added. Each flask were placed on magnetic stirrer heater in fume hood for four hours at 250C° and the color solution were changed to milky solutions which were cooled for 10 minutes and then 15ml concentrated Perchloric acid ($HClO_4$) were added and heat the solutions until colorless solutions were obtained. The colorless solutions were filtered to remove the impurities for trace elements analysis by Atomic Absorption Spectroscopy.

Statistical analysis

The data obtained were expressed as means ± standard deviation and are presented in table 1. All observations are mean of five readings.

Result and discussion

The investigation for various trace elements in *Allium sativum, Rheum australe* and *Terminalia chebula* showed that Na, K, Ca, Mg, Cu, Zn, Fe, Co, Mn, and Pb were present in all samples of each plant species in different concentration. These elements are responsible for curing various diseases and play a vital role in the formation of secondary metabolites. The comparative study (table 1) determined by Atomic Absorption Spectroscopy showed that the bulb of *Allium sativum* was maximum in K, Fe, Mn, and Pb concentration. The root of *Rheum australe* was maximum in Na, Ca, Mg and Co concentration. The fruit of *Terminalia chebula* was maximum in Cu and Zn concentration.

Table1. Mean concentration of trace metals in mg/L and Standard Deviation of *Allium sativum, Rheum australe* and *Terminalia chebula*. All observations are means of five readings.

Trace metals	*Allium sativum*		*Rheum australe*		*Terminalia chebula*	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Sodium (Na)	1.636	0.001	7.399	0.949	0.605	0.037
Potassium (K)	55.23	0.714	6.208	0.705	54.96	1.01
Calcium (Ca)	35.84	1.198	113.0	1.55	2.733	0.096
Magnesium (Mg)	8.623	0.118	14.75	0.84	4.411	0.613
Copper (Cu)	0.461	0.024	0.287	0.082	0.626	0.034
Zinc (Zn)	0.207	0.020	0.251	0.014	0.569	0.073
Iron (Fe)	7.148	0.143	5.409	0.828	0.711	0.096
Cobalt (Co)	0.048	0.011	0.052	0.008	0.020	0.007
Manganese (Mn)	0.219	0.039	0.209	0.028	0.009	0.001
Lead (Pb)	1.020	0.007	0.895	0.1	0.546	0.037

The concentration of micro- and macro elements is different in different parts of plant body (Singh *et al*., 2010). The toxicological effects of aqueous extract of powdered bulb of *Allium sativum* were investigated in experimental rabbits and there phytochemical screening reveals the presence of saponins, steroids, tannins, carbohydrates and cardiac glycosides, (Mikail 2010). The elements isolated from Rheum australe includes K, Ca, Fe, Mn, Na, Zn, Co, Li and Cu (Singh et al., 2010), the anthraquinone derivatives includes emodin glycoside, chrysophanol glycoside, emodin, chrysophanol and physcion (Malik, 2010). Recently the antioxidant and cytotoxic efficacies of methanolic and aqueous extracts of Rheum australe were also studied (Rajkumar, 2011). *Terminalia chebula* possess antibacterial activity against a number of bacterial species (Ahmad et al., 1998), antiviral activity (Badmaev et al., 2000; Yukawa et al., 1996; Shiraki et al., 1998), and also possess a strong anti-anaphylactic action (Shin et al., 2001).

The analytical results proved that the digested solution of *Rheum australe* was maximum in concentration of Sodium (Na) i.e. 7.399mg/L followed by *Allium sativum* (1.636mg/L) and *Terminalia chebula* (0.605). The reason of difference is due to their geological habitat and therefore different parts of the plant were used for medicinal purposes. *Allium sativum* was maximum in Potassium (K) concentration (55.23mg/L) followed by *Terminalia chebula* (54.96mg/L) and *Rheum australe* (6.208). Calcium (Ca) was maximum in *Rheum australe* i.e. 113.0mg/L while 35.84mg/L in *Allium sativum* and 2.733 mg/L in Terminalia chebula. The maximum concentration Mg was 14.75mg/L in *Rheum australe*, 8.623mg/L in *Allium sativum* and 4.411 mg/L in *Terminalia chebula*.

The concentration Cu was 0.626 mg/L in *Terminalia chebula* followed by 0.461mg/L in *Allium sativum* and 0.287mg/L in *Rheum australe*. The average concentration Zn was 0.569mg/L in *Terminalia chebula* while 0.251mg/L in *Rheum australe* and 0.207mg/L in *Allium sativum*. The maximum concentration Fe was 7.148mg/L in *Allium sativum* followed by 5.409 in *Rheum australe* and 0.711mg/L in Terminalia chebula. The average concentration Co was 0.052mg/L in *Rheum australe*, 0.048mg/L in *Allium sativum* and 0.020mg/L in *Terminalia chebula*. The maximum concentration Manganese (Mn) was 0.219mg/L in Allium sativum followed by 0.209 mg/L *Rheum australe* and minimum 0.009mg/L in *Terminalia chebula*. The maximum concentration Lead (Pb) was 1.020mg/L in *Allium sativum* followed by 0.895 mg/L *Rheum australe* and minimum 0.546mg/L in *Terminalia chebula*.

Trace elements play both restorative and protective role in skirmishing diseases. There is an immense scope to develop the preventive medicinal aspects of various trace elements (Hameed et al., 2008).

Sodium (Na) involves in the production of energy, transport of amino acids and glucose into the body cells. Potassium (K) is helpful in reducing hypertension and maintaining cardiac rhythm. In the human body, K play vital role in many physiological reactions and their deficiency or excess can affect human health (Ekinci et al., 2004). Calcium (Ca) overcome the problems of high blood pressure, heart attack, premenstrual syndrome, colon cancer and keeping the bones strong and reduces the risks of osteoporosis in old age. Ca ions are also involved in blood clotting, nerve impulse transmission and muscle contraction (Vander, 2001). Magnesium (Mg) improves insulin sensitivity, protects against diabetes and its complications, reduces blood pressure, prevents heart rhythm abnormalities and is found in chlorophyll (FNB, 1997; Wardlaw et al., 2004). Copper (Cu) play important role in treatment of chest wounds and prevent inflammation in arthritis and similar diseases. Zinc (Zn) deficiency may contribute to arrested sexual maturation, growth retardation and hair loss, delayed wound healing and emotional disturbance (Khan et al 2011). Iron (Fe) is an essential mineral to prevent anemia and cough associated with angiotensin-converting enzyme (ACE) inhibitors. It plays important role in immune function, cognitive development, temperature regulation, energy metabolism, and work performance (FNB, 2001). Some iron rich foods are poor sources of the mineral (Lehninger, 1982; Raju and Madala, 2005) and its bioavailability depends on factors that influence its absorption (Wardlaw et al., 2004). Cobalt (Co) is necessary in very small amounts in all mammals and is used to treat several different types of cancer in humans and treat anemia but the intake of high amount can cause heart diseases. Manganese (Mn) can help to assist the body in metabolizing protein, help the diabetic also metabolize carbohydrates and in treating diabetes. Lead (Pb) is toxic metal and non-essential element for human body as it causes a rise in blood pressure, kidney damage, miscarriages and subtle abortion, brain damage, declined fertility of men through sperm damage, diminished learning abilities of children and disruption of nervous systems (Obiajunwa et al., 2002; Kan et al 2011).

The environmental factors including atmosphere and pollution, season of collection sample, age of plant and soil conditions in which plant grows effect the concentration of elements as it varies from plant to plant and region to region.

Conclusion

Present study of *Allium sativum, Rheum australe* and *Terminalia chebula* indicated that each plant sample has different concentration of trace elements and therefore each plant species were used in the treatment of different diseases. The data obtained in present study will be helpful in the synthesis of new modern drugs with various combinations of plants which can be used in the cure of many diseases ethno

medicinally. However, more detailed analysis of chemical composition of these medicinal plants is required.

References

Ahmad I, Mehmood Z, Mohammad F. 1998. Screening of some Indian medicinal plants for their antimicrobial properties. J. Ethnopharmacol. **62(2)**, 183-93.

Ajaib M, Khan Z, Khan N, Wahab M. 2010. Ethnobotanical studies on useful shrubs of District Kotli, Azad Jammu & Kashmir, Pakistan. Pak. J. Bot. **42(3)**, 1407-1415.

Antia BS, Akpan EJ, Okon PA, Umoren IU. 2006. Nutritive and antinutritive evaluation of sweet potatoes (*Ipomoea batatas*) leaves. Pak. J. Nutr. **5**, 166-168.

Badmaev V, Nowakowski M. 2000. Protection of epithelial cells against influenza A virus by a plant derived biological response modifier Ledretan-96. Phytother. Res. **14(4)**, 245-9.

Calabrese E. 1981. Nutrition and Environmental Health: The Influence of Nutritional Status on Pollutant Toxicity and Carcinogenicity. John Wiley and Sons, New York, p. 486.

Ekinci N, Ekinci R, Polat R, Budak G. 2004. Analysis of trace elements in medicinal plants with energy dispersive X-ray fluorescence. J. Radioanal. Nucl. Chem. **260**, 127.

Food and Nutrition Board (FNB)-Institute of Medicine. 1997. Washington D.C.

Food and Nutrition Board (FNB)-Institute of Medicine. 2001. Washington D.C.

Hameed I, Dastagir G, Hussain F. 2008. Nutritional and elemental analyses of some selected medicinal plants of the family polygonaceae, Pak. J. Bot. **40(6)**, 2493-2502.

Haq F, Ahmad H, Alam M. 2011. Traditional uses of medicinal plants of Nandiar Khuwarr catchment (District Battagram), Pakistan. Journal of Medicinal Plants Research **5(1)**, 39-48.

Herber R, Grobecker K. 1995. Fresenius J Anal Chem **351**, 577-582.

Khan KY, Khan MA, Niamat R, Munir M, Fazal H, Mazari P, Seema N, Bashir T, Kanwal A, Ahmed SN. 2011. Element content analysis of plants of genus *Ficus* using atomic absorption spectrometer. African Journal of Pharmacy and Pharmacology **5(3),** 317-321.

Lehninger AL. 1982. Principles Biochemistry. 2nd Edition Worth Publisher, New York.

Malik S, Sharma N, Sharma UK, Singh NP, Bhushan S, Sharma M, Sinha AK, Ahuja PS. 2010. Qualitative and quantitative analysis of anthraquinone derivatives in rhizomes of tissue culture-raised Rheum emodi Wall. plants. Journal of Plant Physiology **167(9)**, 749-56.

Mikail HG. 2010. Phytochemical screening, elemental analysis and acute toxicity of aqueous extract of *Allium sativum* L. bulbs in experimental rabbits. Journal of Medicinal Plants Research **4(4)**, 322-326.

Obiajunwa EI, Adebajo AC, Omobuwajo OR. 2002. Essential and trace element contents of some Nigerian medicinal plants. J. Radioanalytical Nuclear Chem. **252(3)**, 473-476.

Rajkumar V, Guha G, Kumar RA. 2011. Antioxidant and Anti-Cancer Potentials of Rheum emodi Rhizome Extracts. Evidence-based complementary and alternative medicine: eCAM 697986.

Raju SM, Madala B. 2005. Mineral Metabolism; in Illustrated Medical Biochemistry. Medical Publishers, New Delhi p. 98-109.

Rajua GJN, Saritaa P, Murtya GAVR, Kumara MR, Reddya BS, Charlesa MJ, Lakshminarayanaa S, Reddya TS, Reddya SB, Vijayanb V. 2006. Estimation of trace elements in some anti-diabetic medicinal plants using PIXE technique. Appl. Radiation Isotopes **64**, 893-900.

Said S, Saeed HMA, D'Silva LA, Zubairy HN, Bano Z. 1996. Medicinal Herbal, A Textbook for Medical Students and Doctors. Published by Hamdard Foundation Pakistan Nazimabad, Karachi 74600, Pakistan **1**, 272-291

Shin TY, Jeong HJ, Kim DK, Kim SH, Lee JK, Kim DK, Chae BS, Kim JH, Kang HW, Lee CM, Lee KC, Park ST, Lee EJ, Lim JP, Kim HM, Lee YM. 2001. Inhibitory action of water soluble fraction of Terminalia chebula on systemic and local anaphylaxis. J Ethnopharmacol **74(2)**, 133-40.

Shiraki K, Yukawa T, Kurokawa M, Kageyama S. 1998. Cytomegalovirus infection and its possible treatment with herbal medicines. Nippon Rinsho **56(1)**, 156-60.

Singh P, Negi JS, Rawat MSM, Pant GJN. 2010. Quantification of mineral elements of Rheum emodi Wallr. (Polygonaceae). Biological Trace Element Research **138(1-3)**, 293-9.

Vander A. 2001. Human physiology. 8th ed. Boston: McGraw-Hill.

Wang CF, Duo MJ, Chang EE, Yang JY. 1996. Essential and toxic trace elements in the Chinese medicine. J. Radioanal. Nucl. Chem. **211**, 333-347.

Wardlaw GM, Hampl JS, Disilvestro RA. 2004. Perspectives in Nutrition, McGrawhill-USA, p. 413 – 445

Yukawa TA, Kurokawa M, Sato H, Yoshida Y, Kageyama S, Hasegawa T, Namba T, Imakita M, Hozumi T, Shiraki K. 1996. Prophylactic treatment of cytomegalovirus infection with traditional herbs. Antiviral Res. **32(2)**, 63-70.