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Determination of trace metals in the leaves of *Rauwolfia serpentina* by using atomic absorption spectroscopy

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Abstract

The leaves of Indian medicinal plant *Rauwolfia serpentina* were digested with HNO₃ and HClO₄ (4:1) and the contents of trace elements such as As, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Ni, Mn, Pb and Zn were determined by atomic absorption spectroscopy. The presence of beneficial element i.e., Ca, Co, Fe, K, Mg, Mn and Zn are within limit but the concentration of Ni is high. The concentration of heavy trace elements Cd, Cu and Pb are within limit but the concentration of as and Cr are high.

Keywords: *Rauwolfia Serpentina*, atomic absorption spectroscopy, essential trace elements, heavy metals

Introduction

Rauwolfia serpentina L. Benth belongs to family Apocynaceae. It is known as sarpagandha, chandrabagha, snake root plant, chotachand, Harkaya, Chandrikaetc^[1]. It is an evergreen, woody, globrous shrub with height up to 60 cm. It is an herb of medicinal value as described in Ayurvedic, Siddha, Unani and Western system of medicines^[2]. It is found in Northern Himalayas especially in Gharwal region, Punjab, Gangetic plains, Andaman and Nicobar Islands, Indonesia, Sri Lanka, Pakistan, Thailand etc.^[3]. Its roots, leaves, seeds and fruits are used in the treatment of pneumonia, body aches, burns, skin disease, excitement, epilepsy, anxiety, schizophrenia etc. in Ayurvedic medical system^[4-6]. Its leaves are used in removal of opacities of cornea. It is used as antifungal, anti-inflammatory, anti-proliferative, anti-cancerous, antidiuretic, anti-dysentery, anti-hypotensive, antioxidant, tranquillizing agent, antiarrhythmic etc.^[7-12]. It is well known that trace metals play an important role in chemical physiological, biochemical, metabolic, catabolic and enzymatic reactions. They have great significance due to their tendency to accumulate in vital human organs over prolonged period of time. The deficiency and excess of essential trace elements may cause adverse effects on human health. As the plant is used for various ailments, it is essential to establish the safety of the herb. Among various methods used for detection of elements, atomic absorption spectroscopy is widely used^[13-14]. In the present work an attempt has been made to determine the presence of various trace elements and heavy metals in the leaves of plant by atomic absorption spectroscopy.

Experimental

Leaves of *Rauwolfia Serpentina* are picked from Agra College, Agra. For fourteen days the leaves were dried under shade. Leaves were powdered with the help of kitchen mixer grinder. In a 250 ml conical flask, 2.5 gm ground dried plant leaves were placed and in it 2.5ml concentrated nitric acid was added slowly with constant shaking. On a hot plate, the mixture was heated until the evolution of brown fumes ceases. Then it is cooled and 10 ml. of 70% HClO₄ was added. It was heated again very gently until the solution turns colorless and was allowed to evaporate in to a small volume. Now, it is cooled and in it double distilled water was added and filtered into a 100 ml flask, using Whatman filter paper. Now, the volume was diluted with double distilled water. The total concentration of essential trace elements i.e., Ca, Co, Fe, K, Mg, Mn, Ni, Zn and harmful heavy metals i.e., As, Cr, Cd, Cu and Pb were analyzed by atomic absorption spectroscopy (Model: Perkin Elmer A Analyst 100).

Table 1: Essential Trace Elements in the leaves of *Rauwolfia Serpentina*

Element	Ca	Co	Fe	K	Mg	Mn	Ni	Zn
Mean (ppm)	340.240	0.163	162.382	30.642	112.226	28.572	3.380	14.656

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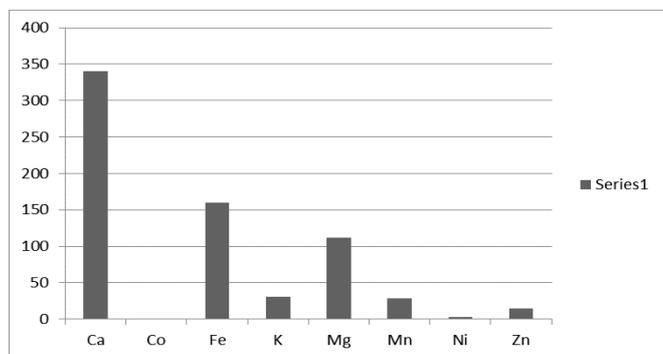


Fig 1.1: Concentration of essential trace elements

Table 2: Harmful Heavy Metals in the leaves of *Rauwolfia Serpentina*

Element	As	Cr	Cd	Cu	Pb
Mean (ppm)	3.172	2.481	0.162	7.279	0.284

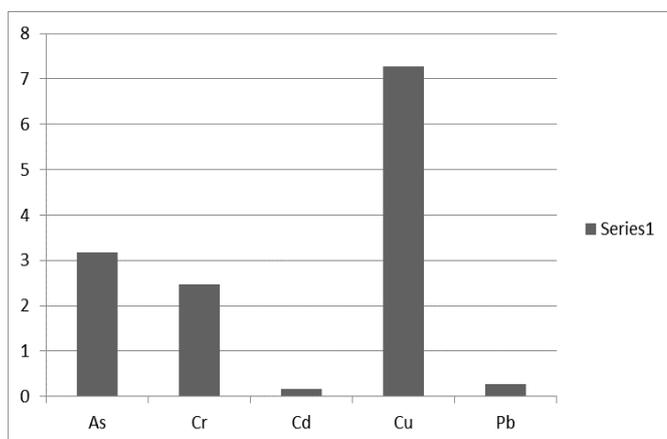


Fig 2.1: Concentration of heavy metals

Result and Discussion

The concentration of arsenic in the leaves is 3.172 ppm. Arsenic is required in ultra-trace amount. Arsenic poisoning may cause death through enzyme inhibition. The recommended concentration of arsenic in medicinal plants is less than 1.0 ppm. Excess of arsenic results in dermatitis, metabolic disorder, lung cancer, cardiovascular effects, neurological effects etc. [15]. Arsenic is more than permissible limit in the leaves of *Rauwolfia serpentina*.

The concentration of chromium in the leaves of *Rauwolfia serpentina* is 2.481 ppm. The permissible limit for chromium set by FAO/WHO (1984) in edible plant was 0.02 ppm. Chromium plays an important role in synthesis of fatty acids and cholesterol. Excess of Cr causes asthma, shortness of breath, liver and kidney damage, allergic reactions etc [16]. In the leaves of *Rauwolfia serpentina* it is more than permissible limit.

The concentration of cadmium in the leaves of *Rauwolfia serpentina* is 0.162 ppm. The permissible limit set by WHO for cadmium is 0.21 ppm. Excess of cadmium damages kidneys and liver and causes high blood pressure, gastrointestinal irritation, vomiting, diarrhoea. Cadmium is in within permissible limit in the leaves of *Rauwolfia serpentina*.

The concentration of copper is 7.279 ppm. Copper is a component of many enzymes i.e., ceruloplasmin, cytochrome oxidase, lysyl oxidase, superoxide dismutase. Alzheimer's disease, Wilson's disease, Prion disease is due to the excess of copper. For normal synthesis of haemoglobin, traces of copper are required. Copper is need for neurotransmitter synthesis, formation of myelin [17]. The permissible limit set by

FAO/WHO (1984) for copper in edible plants was 3.00 ppm. WHO (2005) set no limit for copper but limit set by China is 20 ppm and Singapore is 150 ppm (WHO, 2005). But according to Reddy and Reddy [18] copper concentration in medicinal plants in India were 17.6 ppm to 57.3 ppm. The concentration of copper is within limit in the leaves of *Rauwolfia serpentina*.

The concentration of lead is 0.284 ppm. Lead has no beneficial effects in humans. The permissible limit set by FAO/WHO (1984) for lead in edible plants was 0.43 ppm. Excess of lead causes anaemia, headache, central nervous system disorder, brain damage etc. The concentration of lead is within limit in the leaves of *Rauwolfia serpentina*.

The concentration of calcium is 340.240 ppm. Calcium is necessary for normal functioning of cardiac muscles, regulation of cell permeability, blood coagulation. Excess of calcium in blood results to calcification of several internal organs. Deficiency of calcium causes diseases like rickets, osteoporosis [19]. It is also required for strong bones and teeth. It is within limit in leaves of *Rauwolfia serpentina*.

The concentration of cobalt is 0.163 ppm. The permissible limit of cobalt in plants is 0.2 ppm. There is no limit set by WHO for cobalt. Excess of cobalt causes cardiomyopathy, hyperglycemia, memory loss, allergic dermatitis etc [20]. Deficiency of cobalt causes pernicious anaemia, severe fatigue, and hyperthyroidism. It is a part of vitamin B₁₂ which is essential for human health. It is within permissible limit.

The concentration of iron is 162.382 ppm. FAO/WHO (1984) set 20 ppm permissible limit for iron. But WHO (2005) limits not yet been set for iron. In Egypt 261 ppm to 1239 ppm limit set for iron in medicinal plants. Iron is required for synthesis of haemoglobin and myoglobin. Deficiency of iron causes anaemia, poor resistance to infection, weakness. Iron is essential components of many proteins and enzymes in the human body.

The concentration of potassium in the leaves of *Rauwolfia serpentina* is 30.642 ppm. Potassium helps in the proper function of brain and nerves, so it helps in prevention of stroke. It regulates acid-base and water balance in the blood and tissues. It is required for bone and in prevention of osteoporosis [21]. High potassium diet lowered blood pressure in individuals with raised blood pressure. Potassium is essential in protein bio-synthesis by ribosomes.

The concentration of magnesium is 112.226 ppm in leaves of *Rauwolfia serpentina*. Magnesium is required for synthesis of protein and function of enzymes, production and energy transport, contraction and relaxation of muscles. Lack of magnesium is associated with abnormal irritability of muscles and convulsions and excess of magnesium cause depression in the central nervous system.

The concentration of manganese is 28.572 ppm. For medicinal plants the WHO (2005) limits not yet been set for manganese. In Egypt 446 ppm to 338 ppm limit set for manganese in medicinal plants. The permissible limit of manganese in plants is 200 ppm. For glucose metabolism manganese is essential and its deficiency may cause glucose intolerance similar to diabetes mellitus in some species of animals [22]. Its deficiency also results in tissue damage and impairs CNS functions. Excess of manganese causes pneumonia, affects reproductive system, which may lead to infertility, adverse effects primarily on the lungs and on the brain. Manganese is within permissible limit in the leaves of *Rauwolfia serpentina*.

The concentration of nickel is 3.380 ppm. The permissible limit set by FAO/WHO (1984) in edible plants was 1.63 ppm. For medicinal plants the WHO (2005) limits not yet been

established for Ni. Excess of Ni causes allergic dermatitis known as nickel itch, which usually occurs when skin is moist. Nickel can cause cancer of different organs such as nose, prostate, lungs, thus it is carcinogen. Nickel is required for production of insulin. It is component of several enzymes i.e., carbon monoxide dehydrogenase, urease, hepatic microsomal enzymes etc. It is more than permissible limit.

The concentration of zinc is 14.656 ppm. The permissible limit set by FAO/WHO (1984) is 27.4 ppm. About 100-300 enzymes contain zinc. Zinc is known to govern the contractibility of muscles and helps to avoid prostrate problems. Zinc acts as a co-factor for enzymes in the body. It also takes part in synthesis of DNA, proteins and in insulin biosynthesis, storage, secretion^[23]. Zn is an important trace element and one of the several important micronutrients that is essential for proper functioning of the body. It is within limit. High concentration of zinc is neurotoxin.

Conclusion

Thus on the basis of above results, it is found that leaves of *Rauwolfia serpentina* contains useful trace elements Ca, Co, Fe, K, Mg, Mn, Zn are within limit but the concentration of Ni is high. Harmful heavy metals Cd, Cu and Pb are within limit but the concentration of As and Cr are high.

Conflict of Interest statement

We decline that we have no conflict of interest.

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References

- Mallick SR, Jena RC, Samal KC. Rapid *in vitro* multiplication of an endangered medicinal plant sarpagandha (*Rauwolfia serpentina*). *American Journal of Plant Sciences*. 2012; 3:437-442.
- Ajayi IA, Ajibade O, Oderinde RA. Preliminary phytochemical analysis of some plant seeds. *Research Journal of Chemical Sciences*. 2011; 1(3):58-62.
- Singh P, Singh A, Shukla AK, Singh L, Pande V, Naliwal TK. Somatic embryogenesis and *in vitro* regeneration of an endangered medicinal plant sarpagandha (*Rauwolfia serpentina* L.). *Life Science Journal*. 2009; 6(3):74-79.
- Pant KK, Joshi SD. Multiplication of *Rauwolfia serpentina* Benth. Ex. Kurz through tissue culture. *Scientific World*. 2008; 6:58-62.
- Meena AK, Bansal P, Kumar S. Plant-herbal wealth as a potential source of ayurvedic drugs. *Asian Journal of Traditional Medicines*. 2009; 4(4):152-170.
- Poonam, Agarwal S, Mishra S. Physiological, biochemical and modern biotechnological approach to improvement of *Rauwolfia serpentina*. *Journal of Pharmacy and Biological Science*. 2013; 6(2):73-78.
- Azmi MB, Qureshi SA. Methanolic root extract of *Rauwolfia serpentina* Benth. Improves the glycemic, antiatherogenic and cardioprotective indices in alloxan-induced diabetic mice. *Journal of Applied Pharmaceutical Science*. 2013; 3(7):136-141.
- Itoh A, Kumashiro T, Yamaguchi M. Indole alkaloids and other constituents of *Rauwolfia serpentina*. *Journal of Natural Products*. 2005; 68(6):848-852.
- Yu J, Yan M, Jeanne D, Qi-Chen. Antitumor activities of *Rauwolfia vomitoria* extract and potentiation of carboplatin effects against ovarian cancer. *Current Therapeutic Research*. 2013; 75:8-14.
- Harisaranraj R, Suresh K, Babu SS, Achudhan VV. Phytochemical based strategies for pathogen control and antioxidant capacities of *Rauwolfia serpentina* extracts. *Recent Research in Science and Technology*. 2009; 1:67-73.
- Scalbert A, Manach C, Morand C, Remsey C, Jimenez L. Dietary polyphenols and the prevention of diseases. *Critical Reviews in Food Science and Nutrition*. 2005; 45:287-306.
- Rathi P, Kumari R, Chatrasal S, RajputSawhney SS. Therapeutic characteristics of *Rauwolfia serpentina*. *International Journal of Pharmacy and Pharmaceutical Sciences*. 2013; 2(2):1038-1042.
- Subramaniam R, Gayathri S, Rathnavel C, Raj V. Analysis of mineral and heavy metals in some medicinal plants collected from local market. *Asian Pacific Journal of Tropical Biomedicine*. 2012, S74-S78.
- Gupta Jaya, Gupta Amit, Gupta AK. Determination of trace metals in the stem bark of *Moringa oleifera* Lam. *International Journal of Chemical Studies*. 2014; 2 (4):39-42.
- Zhang WH, Cai Y, Tu C, Ma LQ. Arsenic speciation and distribution in an arsenic hyperaccumulating plant. *Science of the total Environment*. 2002; 300:167-177.
- Katz, Sidney A, Salem H. The toxicology of chromium with respect to its chemical speciation: A review. *Journal of Applied Toxicology*. 1992; 13:217-224.
- Amin NS, Kaneco T, Ohta K. Slurry sampling electrochemical atomic absorption spectrometric determination of copper in herbal medicines samples with a molybdenum tube atomizer. *Microchemical Journal*. 2003; 74:181-186.
- Reddy PR, Reddy SJ. Elemental concentration in medicinally important leafy materials. *Chemosphere*. 1997; 34:2193-2212.
- Susan A, Lanhman-New. The balance of bone teeth: tipping the scales in favour of potassium -rich, bicarbonate-rich foods. *Journal Nutrition*. 2008; 138:172S-177S.
- Elbetieha A, Thani AS, Rawdah K. Effects of chronic exposure of cobalt chloride on the fertility and testes in mice. *Journal of Applied Biological Sciences*. 2008; 2:1-6.
- He FJ, Mac Gregor GA. Beneficial effects of potassium on human health. *PhysiologiaPlantarum*. 2008; 133(4):725-735.
- Hussain FM, Arif MMA, Sheikh H, Nawaz AJ. Trace element status in type2 diabetes. *Bangladesh Journal of Medical science*. 2009; 8(3):12-17.
- Diwan AG, Pradhan AB, Lingojwar D, Krishna KK, Singh P, Almelkar SI. Serum zinc, chromium and magnesium levels in type-2 diabetes. *Int. J Diabet Dev Countries*. 2006; 26:122-123.