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DETERMINATION OF HEAVY METALS FROM *LEUCAS ASPERA* USING ATOMIC ABSORPTION SPECTROSCOPIC TECHNIQUE

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ABSTRACT

Many mineral elements occur in plant and animal tissues in very minute quantities, which earlier scientists were unable to measure their precise concentration with analytical methods then available. Modern analytical technique like atomic absorption spectroscopy has the ability to measure almost all the trace elements in the smallest of biological samples with great precision and accuracy. There is also a need for heavy metal analysis to be an integral part of the standardization of herbal medicines. *Leucas aspera* is a herb with white colour flowers, largely occurring in plains. It has been used against various ailments of which anti-inflammatory, antioxidant activities and diabetes are few to name. Five common heavy metals Fe, Zn, Cr, Cu and Pb were analysed by atomic absorption spectroscopy. Among the five metals analyzed in whole plant powder of *Leucas aspera*, Fe showed higher concentration while others were within the normal range.

INTRODUCTION

In the past few years there has been resurgence in the usage of herbal medicines, among the traditional as well as the modern consumers of herbal products. As a result, the demand for high standard, reliable and contaminant free herbal medicine is increasing by the regulatory agencies, consumer groups and manufacturers.

Heavy metals are a matter of concern in herbal drugs, especially as certain plants have the tendency of storing heavy metals from soils, polluted water and atmosphere (Newall et al. 1996, Baker 1994). Out of the various Indian medicinal plants known, *Ocimum sanctum*, *Tinospora cordifolia*, *Azadirachta indica*, *Nerium indicum* and *Acorns calamus* are the few plants which have been analysed for trace elements by Neutron Activation Analysis (NAA). Zinc was found to be higher in *Ocimum sanctum* and *Azadirachta indica* leaves (Dahanukar et al. 2000). Although there has been considerable research on the response of plants to heavy metals, the mechanism, which helps plants to survive in metal contaminated environments, is still not very clear. This is particularly evident with respect to the plants having long life span, like trees. Most of the research carried out so far on heavy metals has been on herbaceous or short-lived plants (Borovik 1990, Passaw 1978, Ross 1994). Studies carried out on higher plants reveal that they can be used as accumulative monitors of many metal elements in polluted areas (Al-Shayeb 2002). There are a number of reports indicating that plants may be able to acclimatize to presence of pollution and contamination (Borovik 1990, Passaw 1978, Ross 1994). However, the complete mechanism of metal tolerance for any plant has yet to be described. There is also limited information available on the limits of metal tolerance and the actual metal concentration above which further adaptation of metal or metals is possible (Arnon 1939). Thus, metal tolerance may be the result of genetically inherited physiological mechanism. The ability of a plant to respond phenotypically to a stress may, therefore, be an important mechanism in the survival of a plant (Peterson 1979). *Leucas aspera* is a herb with white coloured flowers; largely occurring in plains. It rarely occurs in uplands and hilly areas. It has many pharmacological activities of which anti-inflammatory, antioxidant and in diabetes are a few to name (Sadhu 2003). Five common heavy metals, lead, zinc, copper, iron, and chromium were analyzed by atomic absorption spectroscopy (AAS).

MATERIALS AND METHODS

Leucas aspera from various geographical regions was collected, powdered and analysed by using AAS. The plant powder was analysed for five heavy metals, lead, zinc, copper, chromium and iron. AAS is the powerful instrumental technique for the quantitative determination of trace metals. The absorption of energy by ground state atoms in the gaseous state forms the basis of AAS.

RESULTS AND DISCUSSION

The normal range of concentration of five heavy metals namely lead, zinc, copper, chromium and iron in plants has been presented in Table 1 (Borovik 1990, Passaw 1978, Ross 1994, Alloway 1990). The results of the heavy metal analysis using AAS technique are presented in Table 2. The concentration of copper was minimum (3.46 ppm) in Thane, while maximum in Raigad (5.12 ppm). The concentration of lead was minimum (1.65 ppm) in Thane, while maximum in Raigad (2.19 ppm). The concentration of zinc was highest (4.69 ppm) in Raigad and lowest at Thane (2.48 ppm). The concentration of iron was maximum (350 ppm) at Sindhudurga, while minimum at Thane (315 ppm). The concentration of chromium was lowest (3.44 ppm) in Thane and highest at Raigad (4.98 ppm).

Amongst the five metals analyzed from *Leucas aspera* iron was found to be in maximum concentration whereas other metals were found to be within the normal range of all the regions. The major scientific and medical interest in iron is as an essential metal, but toxicological considerations are important in terms of accidental acute exposures and chronic iron overload, due to idiopathic haemochromatosis or as a consequence of excess dietary iron or frequent blood transfusions (Klassen 1996). As iron was found to be in excess in *Leucas aspens* it might impair the function of organs, especially liver, pancreas, heart, joints and pituitary; whereas iron deficiency may lead to anaemia and fissures at the corner of the mouth, and koilonychias. Deficiency of lead shows signs of anorexia, convulsions, coma and death due to generalized cerebral oedema and renal failure, whereas lead in excess amounts causes abdominal pain, headache, irritability, joint pain, fatigue and anaemia. Excess of chromium leads to occupational renal failure, dermatitis and pulmonary cancer, whereas its deficiency leads to impaired glucose tolerance and confusion.

There was no significant variation in total metal concentration among various geographical regions, but individual metal concentration varied in plant powders of different regions. These results, however, require further investigation, especially to correlate with the environmental levels

Table 1: Typical concentration of five metals in plants.

Metal	Normal range in plant material (ppm) fresh weight	Concentration in contaminated plant (ppm)
Copper	4-15	20-100
Zinc	3-100	100-400
Lead	0.1-10	30-300
Iron	50 - 300	300-400
Chromium	1 - 10	20- 100

Table 2: Metal concentrations (ppm) in *Leucas aspera*.

Metal	Collected from different regions		
	Thane	Sindhudurga	Raigad
Copper	3.46	4.58	5.12
Zinc	2.48	3.34	4.69
Lead	1.65	2.78	2.19
Iron	315	350	320
Chromium	3.44	3.79	4.98

Note: Concentration of metals is shown in ppm; Each reading is the mean of three values.

of the heavy metals. Thus, *Leucas aspera*, as investigated in the present study, does not provide ample evidence to indicate pollution related accumulation of heavy metals, though, it is evident from the study that *leucas aspera* does accumulate some heavy metals at levels more than the normal range reported in other plants. This is specifically true with iron; however, this seems to be a normal trend with most of the herbal medicines (Passaw 1978). The concentration of other heavy metals except iron in *Leucas aspera* is within the concentration limits present in plants contaminated with these metals. Since, the levels of these heavy metals do not vary with the geographical regions of collection, it may be suggested that these higher levels could be related to the normal physiology of the plant. The present study, however, has not determined the levels of these heavy metals in soil for confirming this role of the plant.

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