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Evaluation of Some Heavy Metals in *Swertia* Species Collected from Different Geographical Regions

SUNITA SHAILAJAN*, K.K. JARIPATKE and S. SMRUTI
Herbal Research Laboratory, Ramnarain Ruia College, Mumbai-400 019, India
E-mail: sunitashailajan@yahoo.co.in

In this paper, an attempt has been made to estimate heavy metal accumulation in an important herbal drug. *Swertia* and its species. Four common heavy metals Pb, Zn, Cu and Ni were analyzed by optical emission spectroscopy which uses the technique of inductively coupled plasma. Different species of *Swertia* are medicinally important and commonly used in various Ayurvedic formulations. Different samples of *Swertia* species were collected from different regions of India to compare heavy metal accumulation in them. The results indicate that metal accumulation depends both on plant species and the collection site of the plant. *Swertia* from Himalayan regions showed higher accumulation of heavy metals as compared to the western regions of India.

Key Words: *Swertia* species, ICP-OES, Heavy metals.

INTRODUCTION

Indigenous herbs are used as remedies for a variety of disease in traditional medicine or ethnomedicinal practice. Heavy metals are a matter of concern in herbal drugs especially as certain plants have the tendency of accumulating heavy metals from soils, polluted water and atmosphere[1,2]. The absorption and incorporation of heavy metals by plants facilitate their entry into the food chains[3]. Out of the various Indian medicinal plants known, *Ocimum sanctum, Tinospora cordifolia, Azadiracta indica, Nerium indicum* and *Acorus calamus* are the few plants which have been analyzed for trace elements by neutron activation analysis. Zinc was found to be higher in *Occimum sanctum* and *Azadiracta indica* leaves[4].

Swertia is a large genus comprising of herbs, distributed in the mountainous regions of tropical Asia, Europe, America and Africa. In India *Swertia chirata* is a medicinal plant indigenous to temperate Himalaya. Certain species of *Swertia* are found in Uttaranchal while *Swertia densiflora* and *Swertia corymbosa* are found in the Western Ghats[5]. About 40 species of *Swertia* are recorded in India of which *Swertia chirata* (Wall) Clarke. is medicinally most important. *Swertia chirata* is considered to have bitter tonic. In folk medicine *S. chirata* is a household drug for chronic fevers, anemia, gouty affections and boils. Its decoction is administered for liver disorders, gastrointestinal disorders, dyspepsia and anorexia. It is used as a tonic to prevent malaria. The constituents of the crude drug which are bitter have

been designated as amarogenin, amaroswerin, sweroside and swertiamarin[6]. Due to indiscriminate harvesting *Swertia chirata* (Wall) Clarke. is an endangered species. Several species of *Swertia* are used as substitutes and adulterants of *Swertia chirata* (Wall) Clarke. The availability of authentic *Swertia chirata* (Wall) Clarke. is therefore a major problem faced by manufacturers. The current study was carried out to document the heavy metal content in various species of *Swertia* and to identify the species with least heavy metal load that could be interpreted into therapeutic formulations.

Swertia and its species were analyzed for four common heavy metals Pb, Zn, Cu and Ni by optical emission spectroscopy which uses the technique of inductively coupled plasma, one of the techniques for analysis of trace elements.

EXPERIMENTAL

Different species of *Swertia* (whole plant) were collected from Himalyan regions (Uttaranchal) and Western Ghats of India. Various species of *Swertia* were authenticated from NBRI except *Swertia dentiflora* which was authenticated from Blatter Herberium-Xaviers College, Mumbai. The whole plant material was thoroughly washed with water to remove the dust particles adhering to roots and extraneous matter. The plant material was drained to remove excess of water by spreading over filter paper for 6 h in shade away from sunlight. The plant material was then placed in preset oven at 45 ± 5 ºC. The plant material was allowed to dry for 4 d. Immediately after drying, it was powdered using an electrical mixer-grinder and sieved through a BSS mesh No. 85 sieve and stored in an airtight Pearlpet® container[7]. The sieved powder was stored in commercially available airtight polyethylene containers labeled with details such as date of collection, weight of powder, time of collection and the region of collection. This powdered plant material was analyzed for heavy metal content by using ICP-OES. The plant powder were analyzed for 4 heavy metals copper, zinc, nickel and lead.

RESULTS AND DISCUSSION

The range of concentration of 4 heavy metals namely Zn, Cu, Ni and Pb in normal plants has been presented in Table-1[8], The results of these heavy metal analysis using ICP-OES technique have been presented in Table-2. The concentration of Cu was minimum in *S. densiflora* (7.93 ppm), while maximum (39.01 ppm) in *S. cordata*. The concentration of Pb was lowest (1.63 ppm) in *S. corymbosa* and highest (24.19 ppm) in *S. cordata*. In the case of Ni the concentration was minimum (2.14 ppm) in *S. densiflora* and maximum Ni (15.90 ppm) was found in *S. cordata*. The concentration of Zn was minimum (26.57 ppm) in *S. corymbosa* and maximum (106.15 ppm) in *S. chirata* (Fig. 1).

The extent to which a plant can accumulate heavy metal varies from species to species[1]. The content of Zn in different species of *Swertia* especially found in the Himalayan region (50-87 ppm) is more as compared to those in western India (< 37 ppm). Since all the species have been collected during flowering season the higher

TABLE-1
TYPICAL CONCENTRATION OF SOME METALS IN PLANTS

Metal	Normal range in plant material (μg g^{-1}) fresh weight	Concentration in contaminated plant (μg g^{-1})
Copper	4-15	20-100
Zinc	3-400	100-400
Lead	0.1-10	30-300
Nickel	0.02-5	10-100

Note: The source of readings-normal range [Ref. 8, 9, 10, 11].

TABLE-2
METAL CONCENTRATIONS (ppm) IN *Swertia* COLLECTED FROM DIFFERENT REGIONS

Metal	*S. densiflora*	*S. corymbosa*	*S. cordata*	*S. chirata*	*S. panniculata*	*S. cililata*
Copper	7.93	12.69	39.01	14.14	25.83	34.62
Zinc	36.25	26.57	86.27	106.15	52.40	80.43
Lead	12.46	1.63	24.19	21.19	10.01	22.16
Nickel	2.14	2.82	15.90	8.31	7.98	5.28

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

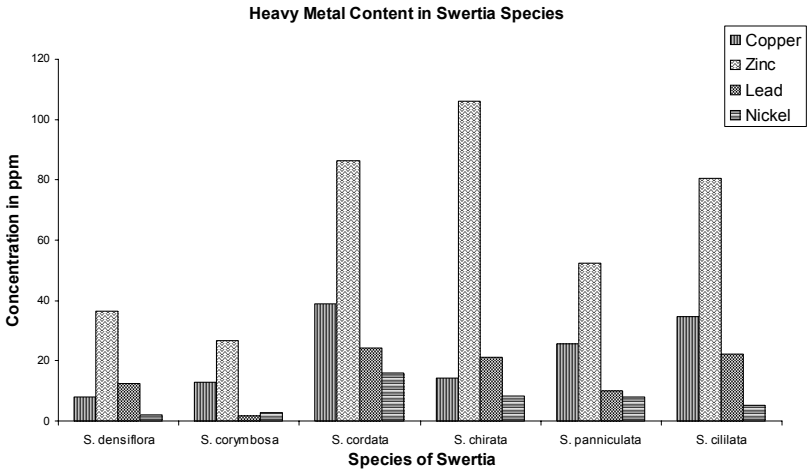

Fig. 1. Heavy Metal content in different species of *Swertia*

Zn concentration in Himalayan species could be correlated with the physiological requirement of the plant[8]. Of all the species, *S. chirata* has highest zinc content (106.15 ppm). This may be correlated to its use as a therapeutic agent in liver protection as Zn is a micronutrient with beneficial effect on liver.

Copper content of all Himalayan species except *S. chirata* is more than that found in the western India. *S. densiflora* has least Cu content (7.39 ppm). Major source of copper is organic manure and forest fires[9]. The high content of copper in *Swertia* from Himalyan region may be attributed to the extensive use of manure from live stock and frequent forest fires in Himalayan regions.

Lead is mainly present in environment as a pollutant from vehicular exhaust. The levels of lead in *Swertia* species of western India are comparatively lower than that found in *Swertia* from Himalayan region. Higher levels of lead in plants collected from Himalyan region are quite striking. This may be due to environmental displacement of Pb by natural cycling[9]. Additionally the torrential flow of rain water in Western ghat areas which has significant washing effect on the soil in these regions. Nickel concentration has been found to be significantly high in the *Swertia* species of Himalayan region. Nickel is primarily absorbed from the soil by plants and is therefore contributed from the soil. High concentration of nickel can be attributed to the extensive use of fungicides in agricultural lands nearby.

Conclusion

The result of the current study strongly suggest the evaluation of heavy metal content in the raw material of *Swertia* before using it in the formulations. As compared to the *Swertia* species from Himalayan region, *Swertia* species from Western ghats have lower heavy metal contents suggesting the preferential use of *Swertia* species from western ghats to those found in the Himalayan region. The use of *Swertia* species from the western ghat region will also ease pressure on already overexploited Himalayan regions. It is interesting to note that, *Swertia cordata* with hardly any reported medicinal use has the highest concentration of heavy metal amongst all species of *Swertia* analyzed in the study. The results in this study need further correlation with the heavy metal load in the soil where these plants are generally seen growing wild.

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