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Detection of heavy metals from leaf powders of *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn. using ICP- OES technique

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ABSTRACT

Heavy metal content in leaf powders of *Annona squamosa* Linn., *Datura metel* Linn., *Vitex negundo* Linn. was analyzed with the help of 'Inductively Coupled Plasma- Optical Emission Spectroscopy' as a safety measure of the plants for use in a polyherbal combination. The above mentioned three plants have insecticidal properties and they are used against head lice. The heavy metals determined in three leaf powders were Cu, Pb, Hg, Ni and Zn. Mercury was not detected in any of the three leaf powders. Concentration of Nickel exceeded the normal range in *Annona squamosa* Linn. (6.05 ppm), *Datura metel* Linn. (22.86 ppm), and *Vitex negundo* Linn. (6.92 ppm). The concentrations of Copper were within the range in *Annona squamosa* Linn. (10.34 ppm) and *Vitex negundo* Linn. (9.77 ppm), while it was maximum in *Datura metel* Linn. (25.07 ppm). Lead concentration was within the normal range in leaf powders of *Annona squamosa* Linn. (6.82 ppm) and *Vitex negundo* Linn. (5.75 ppm) while it was found to maximum in leaf powder of *Datura metel* Linn. (20.40 ppm). Zinc concentration was within the normal range in all the three plants and they ranged 12.17 ppm in *Annona squamosa* Linn., 53.09 ppm in *Datura metel* Linn. and 26.52 ppm in *Vitex negundo* Linn.

KEYWORDS

Annona squamosa Linn.;
Datura metel Linn.;
Vitex negundo Linn.;
ICP- OES;
Heavy metals.

INTRODUCTION

Heavy metals are important environmental pollutants and many of them are toxic even at very low concentrations[1]. Pollution of the biosphere with toxic metals has accelerated dramatically since the beginning of the Industrial revolution. The primary sources of this pollution are the burning of fossil fuels, the mining and smelting of metalliferous ores, municipal wastes, fertilizers, pesticides, and sewage[1]. Toxic metal contamination of soil, aqueous waste streams, and groundwater poses a major environmental and human health problem, which is still in need of an effective and affordable technological solution. In spite of the ever-growing number of toxic metal-contaminated sites, the most commonly used methods of dealing with heavy metal pollution are still either the extremely costly process of removal and burial or simply isolation of the contaminated sites. In addition to sites contaminated by human activity, natural mineral deposits containing particularly large quantities of heavy metals are present in many regions of the globe. These areas often support characteristic plant species that thrive in these metal enriched environments. Some of these species can accumulate very high concentra-

tions of toxic metals to levels, which far exceed the soil levels. From soil and water, all plants have the ability to accumulate heavy metals, which are essential for their growth and development. However, excessive accumulation of these heavy metals can be toxic to most plants. The ability to both tolerate elevated levels of heavy metals and accumulate them in very high concentrations has evolved both independently and together in a number of different plant species[1].

In the present work *Annona squamosa* Linn., *Datura metel* Linn., *Vitex negundo* Linn. having insecticidal properties which can be used in antilice formulation were analyzed for their heavy metal content. Head lice are obligatory ectoparasites that require warmth and source of human blood to survive. Transmission is mainly by direct contact –head to head-with little evidence to support the common assertion that sharing article such as comb, brushes, headgear, facilitates transmission. Generally school going children especially girls in the age group of 9-15 are afflicted by this socially repugnant malady, even if there is small concentration of heavy metal present in plant extracts it may affect the tender skin of scalp. Therefore, it is necessary to evaluate the heavy metal content of these plants. The present paper proposes an analytical procedure for detection of five heavy metals from these plants, which are used in antilice formulation using ICP-OES technique.

MATERIALS AND METHODS

Annona squamosa Linn., *Datura metel* Linn. and *Vitex negundo* Linn. leaves were collected from Karjat, Dist. Raigad, Maharashtra in the flowering season. Herbarium of the plants were authenticated from Agharkar Research Institute, Pune and authentication numbers of the herbaria for *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn. are Auth08-71, Auth08-70 and Auth08-72 respectively. After collection, leaves were carefully segregated, washed and dried at 45^0C to constant weight. The dried leaves, free of moisture, were powdered and sieved through a BSS mesh No. 85 sieve and stored in airtight Pearl-pet containers. It was then analyzed for its heavy metal content by using ICP- OES technique.

Inductively coupled plasma atomic emission spectroscopy (ICP-AES), also referred to as inductively coupled plasma optical emission spectrometry (ICP-OES), is an analytical technique used for the detection of trace metals. It is a type of emission spectroscopy that uses the inductively coupled plasma to produce excited atoms and ions that emit electromagnetic radiation at wavelengths characteristic of a particular element. The intensity of this emission is indicative of the concentration of the element within the sample[2,3].

For the analysis leaf powders were digested in 4:1 ratio of concentrated nitric and perchloric acids and taken to dryness. The residue was then leached with 5M hydrochloric acid and finally diluted to 1M HCl. The samples were analyzed for a multi-element suite including Cu, Pb, Hg, Ni and Zn by Inductively Coupled Plasma Atomic Emission Spectrometry. Plant samples were digested in fuming nitric acid followed by concentrated perchloric acid, leached with the same procedure as that used for soil and analyzed by ICP-OES[4].

RESULTS

The normal range of concentrations of five metal heavy metals, Copper, Lead, Mercury, Nickel and Zinc in plants has been presented in TABLE 1. The results of the heavy metal analysis of the plants has been presented in TABLE 2.

TABLE 1 : Typical concentration of some metals in plant

Metal	Normal range in plant material μgg^{-1} fresh weight	Concentration in contaminated plant μgg^{-1}
Copper	4 - 15	20- 100
Lead	0.1 - 10	100- 400
Mercury	0.015	-
Nickel	0.02- 5	30- 300
Zinc	3 - 100	10- 100

The source of readings-Normal range[5,6,7]

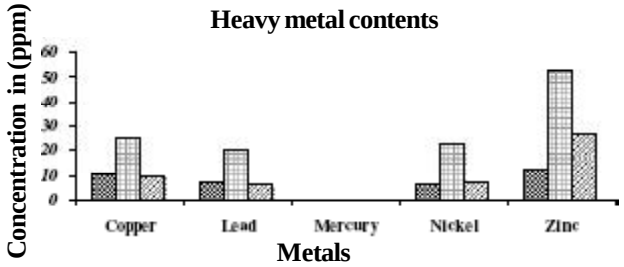

Figure 1: Heavy Metal content in *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn.

TABLE 1 : Metal Concentrations (ppm) in *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn.

Metal	*Annona squamosa* Linn.	*Datura metel* Linn.	*Vitex negundo* Linn.
Copper	10.34	25.07	9.77
Lead	6.82	20.40	5.75
Mercury	N.D.	N.D.	N.D.
Nickel	6.05	22.86	6.92
Zinc	12.17	53.09	26.52

Mercury: All the three leaf powders showed absence of mercury.

Nickel : Concentration of Nickel exceeded the normal range in *Annona squamosa* Linn. (6.05 ppm), *Datura metel* Linn. (22.86 ppm), *Vitex negundo* Linn. (6.92 ppm).

Copper : The concentrations of Copper were within the range in *Annona squamosa* Linn. (10.34 ppm) and *Vitex negundo* Linn. (9.77 ppm), were as it was maximum in *Datura metel* Linn. (25.07 ppm).

Lead : Lead concentration was within the normal range in leaf powders *Annona squamosa* Linn. (6.82 ppm) and *Vitex negundo* Linn. (5.75 ppm) while it was found to maximum in leaf found of *Datura metel* Linn. (20.40 ppm).

Zinc : Zinc concentration was within the normal range in all the three plants and they ranged 12.17 ppm in *Annona squamosa* Linn., 53.09 ppm in *Datura metel* Linn. and 26.52 ppm in *Vitex negundo* Linn.

CONCLUSION

Heavy metal analysis is a part of the guidelines suggested by WHO and AYUSH for herbal drugs as a safety measure. In the present study heavy metal Copper, Lead, Mercury, Nickel and Zinc were estimated from the leaf powders of *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn.. All the leaf powders showed heavy metal concentration within the normal range. Except *Datura metel* Linn. which had Copper concentration slightly higher than normal range in the plants. Leaf powders of *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn. have insecticidal property, and can be used as antilice agents in polyherbal combinations. Thus the data of five heavy metal concentration in *Annona squamosa* Linn., *Datura metel* Linn. and *Vitex negundo* Linn. can also contribute to the standardization of these plants, whenever they have to be used as an ingredient in the herbal formulation.

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