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EFFECT OF ENVIRONMENTAL POLLUTION ON HERB BHRINGARAJA (*ECLIPTA ALBA*) WITH SPECIAL REFERENCE TO HEAVY METAL CONCENTRATIONS

[1]Dr. Nataraj H.R, [2]Dr.Noor Fathima, [3]Dr.Satish Pai
[1]Associate professor ,Dept. of Agadatantra,SDMCAH,Hassan,[2]Assistant Professor, [3]Reader, Dept of Dravyaguna, JSSAMC,Mysuru.Karnataka, India

ABSTRACT

Environmental pollution and exposure to toxic material is an increasingly serious problem the world over. The unscientific use of hazardous materials in agriculture and industries and its dumping has created a great risk for human life, plants and animals. Similarly the heavy metals are assimilated in the environment from vehicle exhaust, from the smoke of industries or the spreading of industrial effluents through water in soil. In This Study, Plant and soil samples were analyzed to determine the heavy metals (Lead, Cadmium & Arsenic) Three Samples of Plant Bhringaraja and Soil were collected from Mysore urban area (i.e. near the drainage, Industrial area and less polluted area) and the one sample of Plant and soil from natural Habitat with very minimum pollution forest area. Physico Chemical studies were carried out as per Standard Protocol and heavy metals were analyzed using Atomic Absorption Spectrophotometry Technique.

KEYWORDS: Bhringaraja, Lead, Cadmium, Arsenic, Atomic Absorption Spectrophotometry.

INTRODUCTION

Accumulation of metals in plants is highly dependent on their availability in soil. Availability is defined as a dynamic three-step process involving a physico chemically driven desorption process, a physiologically driven uptake process and a toxico dynamic redistribution process within the body. Partitioning of metals over the solid phases and soil solution is affected by soil characteristics.[1.]

Environmental pollution and exposure to toxic material is an increasingly serious problem the world over. The unscientific use of hazardous materials in agriculture and industries and its dumping has created a great risk for human life, plants and animals. Similarly the heavy metals are assimilated in the environment from vehicle exhaust, from the smoke of industries or the spreading of industrial effluents through water in soil. The use of herbal medicines has been on the rise in recent years. There is a common concept among people that herbal medicines have no side effects and that “being natural in origin, herbs are safe”. The assimilation of heavy metals in plants is obvious because of wide spread heavy metals in the soil due to geo-climatic conditions. Medicinal plants are the raw material for many herbal formulations and popular supplements. Heavy metals have a great tendency to accumulate in human organs over prolonged periods of time. The presence of heavy metals beyond the permissible limits can

cause metabolic disturbances. Thus both the deficiency and excess of essential micronutrients such as Fe, Zn and Cu may be harmful to the human health[2].

Effects of toxic metals (Cd, Cr, Pb, Ni etc) on human health and their interaction with essential trace elements may produce serious consequences[3]. The World Health Organization (WHO) recommends that medicinal plants which form the raw materials for the finished products may be checked for the presence of heavy metals, pesticides, bacterial or fungal contamination[4]. The environmental impact of heavy metals such as Cd, Pb, Hg and As, as well as their health effects, has been a source of major concern [5, 6, 7.] The toxicity of trace metals on human health and the environment has attracted considerable attention in recent years. Plants are the main link in the transfer of heavy metals from the contaminated soil to humans. Heavy metals have low excretion rates through the kidney which could result in damaging effects on humans even at very low concentrations[8,9].In general, a number of health problems were linked to excessive uptake of dietary heavy metals including a decrease in immunological defenses, cardiac dysfunction, fetal malformation, impaired psychosocial and neurological behavior, gastrointestinal cancer, and many others[10,11.]

MATERIALS AND METHODS:

Three samples of the Bhringaraja were collected from different areas of Mysore city, and one sample is collected from Natural habitat Forest area.

Sample A: Collected from Siddalingapura near Sewage channel.

Sample B: Collected From JSS Ayurveda Medical College's Herbal garden.

Sample C: Collected From Natural Habitat near the Paddy fields.

Sample D: Collected From Hebbal Industrial area Mysore.

All the four samples of Bhringaraja are been authenticated by the experts and dried under shade. Powdered and subjected for Physico Chemical Studies as per Standard Protocol[12]. All the samples were analyzed for heavy metal concentration by the Perkin Elmer AAS, under the standard conditions of measurement. Samples were tested for Concentration of Cadmium, Lead and Arsenic.

The soil from where the samples are collected are been subjected for qualitative and quantitative analysis of possible heavy metal concentration.

COLLECTED FOUR SAMPLES

RESULTS:

MORPHOLOGICAL FEATURES OF FOUR PLANT SAMPLES

Sample –A: Sample was about 1 to 2 Feet in Length**,** Branches were slender, and Leaves are opposite about 7 to 10 in length /sessile, White Flowers. Plant was quite erect. Rooted at nodes. Flowers in Heads.

Sample-B: Sample was about 30 – 40 cms in length. White flowers, heads erect branch was covered with minute hairs. Leaves were about 7-10 cms with acute tip. Sessile, leaves were variable in breadth. Flowers were Solitary or two on unequal axillary peduncles.

Sample C: About 1-2 feet in length, Prostrate in nature with many branches. White flowers heads in axillary peduncles. Leaves were about 3.5 to 6 cms in length with sub acute tip and covered with small hairs. Plant has got small roots at all nodes.

Sample-D: Small in size compare to the collected samples, about 15-20 cms in length, prostrate in nature with white flower buds. Rooted at all nodes. Flowers in heads 6-8 mm solitary or two on unequal axillary peduncles.

PHYSICO-CHEMICAL ANALYSIS:

Table No.1: Physicochemical studies of Plant samples

Sl.No	Plant Samples	Alcohol Soluble Extractive	API Standars	Water Soluble Extractive	API Standards	Ash Value	API Standards of Ash Value
1	A	10%	Not less than 5%	24%	Not less than 15%	19%	Not more than 22%
2	B	12.4%		15.8%		19.5%	
3	C	13.6%		19.6%		15.5%	
4	D	10.8%		18.4%		22.5%	

ESTIMATION OF HEAVY METAL CONCENTRATIONS IN PLANT AND SOIL SAMPLES:

Table No.2: Concentration of Lead, cadmium and Arsenic in Plant Sample

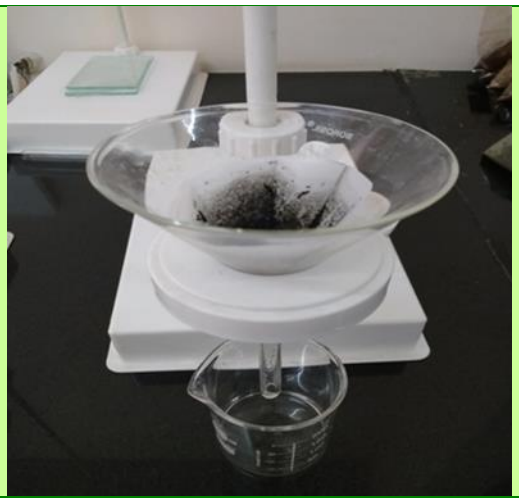
	Heavy Metals	Concentration
	Lead	0.001 mg/kg

Plant Sample A	Arsenic	0.001 mg/kg
	Cadmium	0.0003 mg/kg
Plant Sample B	Lead	0.01 mg/kg
	Arsenic	0.01 mg/kg
	Cadmium	0.003 mg/kg
Plant Sample C	Lead	0.01 mg/kg
	Arsenic	0.01 mg/kg
	Cadmium	0.003 mg/kg
Plant Sample D	Lead	0.01 mg/kg
	Arsenic	0.01 mg/kg
	Cadmium	**7.277 mg/kg**

Table No.3: Concentration of Lead, cadmium and Arsenic in Soil Samples

	Heavy Metals	Concentration
Soil Sample A	Lead	**58 mg/kg**
	Arsenic	<0.05 mg/kg
	Cadmium	<0.05 mg/kg
Soil Sample B	Lead	<0.05 mg/kg
	Arsenic	<0.05 mg/kg
	Cadmium	<0.05 mg/kg
Soil Sample C	Lead	<0.05 mg/kg
	Arsenic	<0.05 mg/kg
	Cadmium	<0.05 mg/kg
Soil Sample D	Lead	**58.72 mg/kg**
	Arsenic	<0.05 mg/kg
	Cadmium	**4.12 mg/kg**

Physicochemical analysis of plant samples



DISCUSSION:

Soil may become contaminated by the accumulation of heavy metals and metalloids through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, animal manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric deposition.[13,14] Heavy metals constitute an ill-defined group of inorganic chemical hazards, and those most commonly found at contaminated sites are lead (Pb), arsenic (As) & cadmium (Cd).[15] The adequate protection and restoration of soil ecosystems contaminated by heavy metals require their characterization and remediation. Combining Plants and Microbes for the Remediation of Heavy Metal Polluted Soils. Using Plants for Remediation of Heavy Metal Polluted Soils. Phytoremediation is an aspect of bioremediation that uses plants for the treatment of polluted soils. Phytoextraction is the most common form of phytoremediation. It involves accumulation of heavy metals in the roots and shoots of phytoremediation plants. These plants are later harvested and incinerated.[16, 17]

It is evident that there is an urgent need to implement a regular monitoring and testing program on the quality of the local and imported herbs sold in the market. Further studies are required to determine the presence of toxic metals and to assess their long-term cumulative risk on consumer health. Atomic absorption spectrometry (AAS) is the most widely used techniques for heavy metals quantitative analysis in environmental samples. In AAS Atomic absorption is so sensitive that it can measure down to parts per billion of a gram (µg dm–3) in a sample. The technique makes use of the wavelengths of light specifically absorbed by an element[18]

Lead:

The FAO/WHO maximum permissible limit of lead in consumed medicinal herbs is 10mg·kg−1[19, 20]Lead is known to be one of the highly toxic environmental pollutants. It can complex with various biomolecules and adversely affect their functions. Lead exposure may have an adverse effect on the blood, nervous, immune, renal, skeletal, muscular, reproductive, and cardiovascular

systems causing poor muscle coordination, gastrointestinal symptoms, brain and kidneys damage, hearing and vision impairments, and reproductive defects. Exposures to lead at early childhood and prenatally are associated with slowed cognitive development, learning deficits, and many other effects [21, 22].

Though the presence of Lead was more than permissible limits in the soil sample collected from industrial area, Concentration of Lead was below detection limits in Plant sample collect from the same place, this may be due to Poor absorbability of Lead or less affinity of Bhringaraja Plant towards Lead compounds.

Cadmium:

The FAO/WHO maximum permissible limit of cadmium exceeding 0.3mg·kg−1. Cadmium is emitted to air by mines, metal smelters and industries using cadmium compounds for alloys, batteries, pigments and in plastics. Organic cadmium compounds are very unstable. In contrast to lead and mercury ions, cadmium ions are readily absorbed by plants. They are equally distributed over the plant. Cadmium is taken up through the roots of plants to edible leaves, fruits and seeds. During the growth of grains such as wheat and rice, cadmium taken from the soil is concentrated in the core of the kernel. Cadmium also accumulates in animal milk and fatty tissues. Therefore, people are exposed to cadmium when consuming plant- and animal-based foods.

Cadmium accumulates in the human body affecting negatively several organs: liver, kidney, lung, bones, placenta, brain and the central nervous system.[23]Other damages that have been observed include reproductive, and development toxicity, hepatic, hematological and immunological effects.[24, 25]

Arsenic:

The FAO/WHO maximum permissible limit for inorganic arsenic as 0.015 mg/kg body weight. & Organo-arsenic intakes of about 0.05 mg/kg body weight/day seemed not to be associated to hazardous effects.[26]Arsenic is a metalloid. It is rarely found as a free element in the natural environment, but more commonly as a component of sulphur-containing ores in which it occurs as metal arsenides. Arsenic is quite widely distributed in natural waters and is often associated with geological sources, but in some locations anthropogenic inputs, such as the use of arsenical insecticides and the combustion of fossil fuels, can be extremely important additional sources. Arsenic occurs in natural waters in oxidation states III and V, in the form of arsenous acid (H3AsO3) and its salts, and arsenic acid (H3AsO5) and its salts, respectively.[27]Chronic arsenic ingestion from drinking water has been found to cause carcinogenic and noncarcinogenic health effects in humans.[28] Most of ingested arsenic is rapidly excreted via the kidney within a few days. However, high levels of arsenic are retained for longer periods of time in the bone, skin, hair, and nails of exposed humans[28].

The adverse effects of arsenic in groundwater used for irrigation water on crops and aquatic ecosystems are also of major concern. The fate of arsenic in agricultural soils is less characterized compared to groundwater. However, the accumulation of arsenic in rice field soils

and its introduction into the food chain through uptake by the rice plant is of major concern mainly.[29]

CONCLUSION:

Present Study reveals the Presence of Cadmium & Lead in Higher Concentration in samples collected around Fields near Industrial Area, which can be related to Environmental Pollution due to Dumping of hazardous Industrial waste.

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CORRESPONDING AUTHOR
Dr. Nataraj H.R
Associate professor, Dept. of Agadatantra, SDMCAH, Hassan, Karnataka, India
Email: doc.nattu@gmail.com

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