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Copper and Zinc Accumulation in Few Medicinal Plants and Their Commercial Product in Tiruchirappalli Gandhi Market, Tamilnadu, India

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Abstract: The main motivation of the study is to create awareness among the medicinal plant consumers about the use of such medicinal plant and was collected from Gandhi market and natural habitation in Tiruchirappalli. In this study, concentration of two essential trace metals like copper and zinc have been estimated in twenty one different plant species part including roots, stem and leaves which is having potentiality for medicinal value. Among the considered metals, copper content was the highest one and varied from 17.2 to 47.6 mg/kg, while the contents of Zn were remarkably lower and ranged from 0.6 to 5.5 mg/kg. Findings of the present study indicated that the medicinal plants or plant product available in the market must be checked for heavy metal contamination in order to make them safe for human consumption. Since we advise to the consumers to consume the minimum quantity of plant extract which may reduce the side effect.

Key words: Atomic Absorption Spectrophotometer · Copper · Diseases · Herbal product · Medicinal Plant · Zinc

INTRODUCTION

A World Health Organization (WHO) survey indicated that about 70-80% of the world populations rely on non-conventional medicine mainly of herbal sources in their primary healthcare and medicinal plants and its trace elements concentration play an important role in the treatment of diseases [1]. Medicinal plants are widely consumed as home remedies and raw materials for the pharmaceutical industries. The past several decades has seen a significant increase in the use of herbal medicine. Rapidly growing of human population and commercial life style are leading to the environmental contamination and degradation through the wild growth of urbanization and industrialization, expansion and substantial intensification of agriculture and forests destruction. Since total environment condition especially in developing countries like India having contamination of irrigation water, atmosphere, soil, improper sterilization methods, frequent pesticides usage, heavy metals and afflotoxins storage all factors play an important role in contamination of medicinal plants. Heavy metals occur as natural constituents of the earth crust and are persistent environmental contaminants since they cannot be degraded or destroyed but the problem is sense when it enters the human physiological system through food chain or consumption of medicinal plants. Heavy metals may contaminate deferent plants causing serious health hazards such as injury of kidney, symptoms of chronic toxicity, renal failure and liver damage.

Several investigators have performed studies on residual levels of toxic metals in medicinal herbs [2, 3]. Contamination of herbal medicine raw materials with afflotoxins can cause potential carcinogenic effects if absorbed even in small amounts [4]. To a small extent, they enter the body system through food, air and water and bio-accumulate over a period of time [5]. Some heavy metals like Fe, Zn, Ca and Mg have been reported to be of bio-importance to man and their daily medicinal and dietary allowances. However, some others such as, Cd, Pb and mentholated forms of Hg have been reported to have no known bio-importance in human biochemistry and physiology and consumption even at very low concentrations can be toxic [6-10]. Even for those that

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have bio-importance, dietary intakes have to be maintained at regulatory limits, as excesses will result in poisoning or toxicity, which is evident by certain reported medical symptoms that are clinically diagnosable [6, 9-11]. Zinc is a 'masculine' element that balances copper in the body and is essential for male reproductive activity [9]. It serves as a co-factor for dehydrogenating enzymes and in carbonic anhydrate [11]. The biotoxic effects of heavy metals refer to the harmful effects of heavy metals to the body when consumed more then the biologically recommended limits like Zinc deficiency causes anemia and retardation of growth and development [7]. Humans are in turn exposed to heavy metals by consuming contaminated plants and animals and this has been known to result in various biochemical disorders. The aim of the present research is to monitor some medicinal plants heavy metals to assure safety and quality.

Methodology: Twenty one medicinal plant and plant product fresh samples of *Glycyrrhiza glabra, Aacalypha indica, Alternanthera sessitis and rographis paniculatas, Cynodon daction, Pongamia glabra, Helicteres isora, Setaria italica, Decalepis hamiltonii, Sison ammi, Coriandrum sativam, Gymnema sylvestre, Ipomoea aquatica, Withania somnifera, Muraiya koenigii, Ocimum sanctum, Terminalia chebula, Amaranthus tricolor, basella rubra, phyllanthus, Amorphophallus campanulatus* were purchased from medicinal plants market at Tiruchirappalli city as well as natural habitation around market, state of Tamilnadu in India. They were identified by Rabinat Herbarium Unit, Department of Plant Biology and Biotechnology St'Joseph College, Trichy and receipt specimens were deposited there for future reference. Plant parts (Table 1) which is used for medicinal purpose were washed in fresh running water to eliminate dust, dirt and possible parasites and then treated with distilled water and were dried in shade at room temperature. During sample processing, necessary measures were taken in order to avoid any loss or contamination of heavy metals. Samples were air-dried and pulverized to powder form with mortar and pestle and finally stored in airtight bottles. Approximately 5.00g of finely powdered samples were digested with hydrochloric acid (37% HCL) and nitric acid (69% HNO_3). Samples were swirled gently, covered with watch glass and left at room temperature until most of the samples were dissolved. The solutions were heated on the hot plate for 30 minutes until yellow fume was released. After cooling, the acid solutions were filtered into 50ml volumetric flask marked up with deionized water. Samples were digested in triplicates and analyzed for Cu and Zn. Three replications were prepared for each sample for the analysis of Cu and Zn with the help of Standard solution of each heavy metals and consideration (Zn, Cu) were prepared with distilled water as follows Cu as 2, 4, 6, 8, 10, 12 and 15ppm. Zinc as 0.8, 1, 1.2 and 1.4 ppm by FAAS Perkin Elmer Model with hollow cathode lamps.

Table 1: Shows the name of the Herbal plants under investigation name, parts used and medicinal properties from Tiruchirappalli market and natural habitation

S.No	Local name [Tamil name]	Botanical name	Part used
1.	Athimadhuram	Glycyrrhiza glabra	Root
2.	Kuppaimeni	*Aacalypha indica*	Total Plant
3.	Ponnanganni	*Alternanthera sessitis*	Leaf
4	Nilavembu	*Andrographis paniculatas*	Fresh Leaves
5	Arugambul	*Cynodon dactylon*	Roots, Stem, Leaves and Flowers
6	Pongum	*Pongamia glabra*	Root, Bark, Flower, Seed, Oil.
7	Kadukkai	*Terminalia chebula*	Seed
8	Valamburikkai	*Helicteres isora*	Roots and Stem
9	Thinai	*Setaria italica*	Seed Grains
10	Omum	*Sison ammi*	Flowers, Leaves
11	Nannari	*Decalepis hamiltonii*	Root
12	Kothamalli	*Coriandrum sativum*	Fresh leaves and Dried seeds
13	Sirukurinzan	*Gymnema sylvestre*	Leaf
14	Araikeerai	*Ipomoea aquatica*	Leaf
15	Amukkuranghizhangu	*Withania somnifera*	Root
16	Karuveppilai	*Muraiya koenigii*	Leaf
17	Thulsi	*Ocimum sanctum*	Leaf
18	Thandukkeerai	*Amaranthus tricolor*	Trunk and Leaves
19	Keezhanelli	*phyllanthus*	Total Plant
20	Pasalakkeerai	*Basella rubra*	Leaves
21	Boomisakkarakizhangu	*Amorphophallus campanulatus*	Root

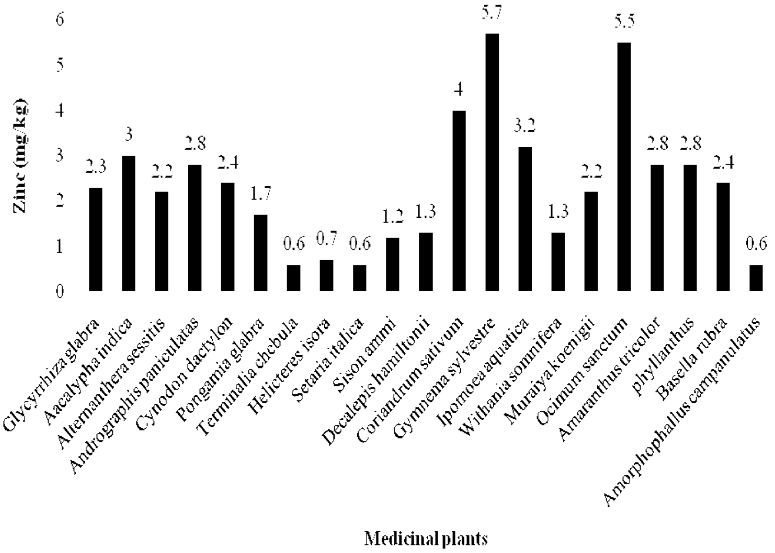

Fig. 1: Zinc concentration from the analyzed medicinal plant samples (mg/kg).

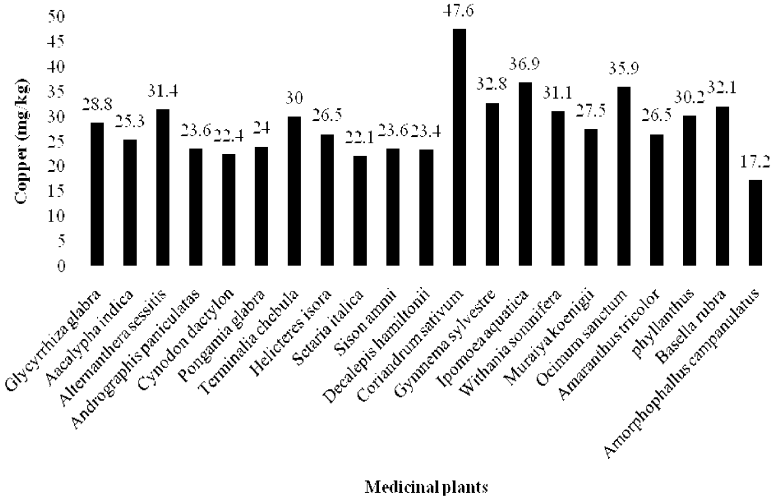

Fig. 2: Copper concentration from the analyzed medicinal plant samples (mg/kg).

RESULTS AND DISCUSSION

The medicinal plant heavy metal concentration of copper and zinc (Figure 1 and 2) was *Coriandrum sativam>Ipomoea aquatica >Ocimum sanctum >Gymnema sylvestre >Basella rubra > Alternanthera sessitis>Withania somnifera>phyllanthus>Terminalia chebula> Glycyrrhiza glabra>Muraiya koenjgii> Helicteres isora>Amaranthus tricolor> Aacalypha indica> Pongamia glabra>Sison ammi>Andrographis paniculatas>Decalepis hamiltonii > Cynodon dactylon >Setaria italica >Amorphophallus campanulatus* and *Amorphophallus campanulatus*, *Setaria italica*, *Terminalia chebula < Helicteres isora <Sison ammi <Decalepis hamiltonii < Withania somnifera <Pongamia glabra < Alternanthera sessitis*, *Muraiya koenigii <Glycyrrhiza glabra < Cynodon dactylon < Basella rubra <Andrographis paniculatas < Amaranthus tricolor < phyllanthus < Aacalypha indica < Ipomoea aguatica < Coriandrum sativum < Ocimum sanctum < Gymnema sylvestre*, respectively.

A total of two elements Zn and Cu were determined in the medicinal plant samples by atomic absorption spectrophotometer (AAS). In the present study copper concentration accumulation was high in kothamalli (*Coriandrum sativam)* (47.6 mg/kg) and low concentration accumulation in boomisakkarakizhangu (*Amorphophallus campanulatus)* (17.2 mg/kg), while other sample intermediate concentration from 17.2 mg/kg to 47.6 mg/kg. Zinc concentration is high in sirukurinzan

Table 2: Copper and Zinc accumulation in different Medicinal plant species compare with WHO standards

MPL [WHO] (mg/kg) Cu 20		Plant Name	MPL [WHO] (mg/kg) Zn 50	
28.8	>	Athimadhuram *(Glycyrrhiza glabra)*	>	2.3
25.3	>	Kuppaimeni *(Aacalypha indica)*	>	3.0
31.4	>	Ponnanganni *(Alternanthera sessitis)*	>	2.2
23.6	>	Nilavembu *(Andrographiis paniculatas)*	>	2.8
22.4	>	Arugambul *(Cynodon dactylon)*	>	2.4
24.0	>	Pongum *(Pongamia glabra)*	>	1.7
30.0	>	Kadukkai *(Terminalia chebula)*	>	0.6
26.5	>	Valamburikkai *(Helicteres isora)*	>	0.7
22.1	>	Thinai *(Setaria italica)*	>	0.6
23.6	>	Omum *(Sison ammi)*	>	1.2
23.4	>	Nannari *(Decalepis hamiltonii)*	>	1.3
47.6	>	Kothamalli *(Coriandrum sativum)*	>	4.0
32.8	>	Sirukurinzan *(Gymnema sylvestre)*	>	5.7
36.9	>	Araikeerai *(Ipomoea aquatica)*	>	3.2
31.1	>	Amukkuranghizhangu *(Withania somnifera)*	>	1.3
27.5	>	Karuveppilai *(Muraiya koenigii)*	>	2.2
35.9	>	Thulsi *(Ocimum sanctum)*	>	5.5
26.5	>	Thandukkeerai *(Amaranthus tricolor)*	>	2.8
30.2	>	Keezhanelli *(phyllanthus)*	>	2.8
32.1	>	Pasalakkeerai *(Basella rubra)*	>	2.4
17.2	<	Boomi sakaraikilangu *(Amorphophallus campanulatus)*	>	0.6

MPL = Maximum Permissible Level (WHO)

(*Gymnema sylvestre)* (5.7 mg/kg), low concentration in boomisakkarakizhangu (*Amorphophallus campanulatus)* (0.6 mg/kg), while other sample show slightly change from 0.6 mg/kg to 5.7 mg/kg. Hence zinc is highly accumulated compared to copper concentration with in the analyzed medicinal plants.

The above results for heavy metals such as Cu and Zn analysed from medicinal plants indicated that they exceed the upper limit of maximum admissible concentrations except for some plants (Table 2). Although high level of heavy metals concentration was discovered in the areas under this research finding in some medicinal value plants which was frequently used by the people, yet there are several environmental factors affecting their heavy metal accumulation from the substrate of medicinal plants. These findings imply that consumption of the medicinal usages plants by secondary consumer or human beings could be harmful to their health condition. According to WHO protein-rich foods, such as meat and marine organisms, contain high concentrations of zinc (10-50 mg/kg wet weight), whereas grains, vegetables and fruit are low in zinc (usually <5 mg/kg).

In the present analytical investigation zinc and copper contamination is influenced by several factors including species, level and duration of contaminant exposure and physiochemical composition of the habitat. In view of the above facts, the medicinal plants studies are a source of biologically important elements, which may play a part in the observed remedial properties of these plants. Hence it is expected that plants with high concentrations of the above-mentioned heavy metal, which in most cases are present in permissible levels, might play an important role in maintenance of human health. Wide applications of the medicinal benefits of these trace elements have been limited, due to insufficient work regarding the detection and estimation of trace elements of the medicinal plants available in naturally and marketable product from the Gandhi market. It was revealed that the detection of heavy metal accumulation is highly relevant for the assessment of medicinal plant quality and illustrated metal accumulation in various herbal plants used by people from trichy market in Tamilnadu. Figure 2 and 3 showing the distribution of some types of zinc and copper residues in the sample under investigation result indicate that zinc, copper predominated in most samples, there are two major reasons to monitor the level of toxic metal in medicinal plants. First one is contamination of the physical environment with toxic metal has increased and medicinal plants prepare as a marketable product.

In this work medicinal value of plants are collected from various cultivated village in and around the market, that industries might be occur near village area as well as soil and water may contaminated when using cultivation of medicinal plants determined the content of heavy metals in industrialized regions. Some type of metal such as Cu, Zn are the natural essential components of plant growth, photosynthesis and respiration so the level of toxic in high when it is going to beyond or exceed the limits, since zinc concentration is higher than copper concentration.

The continuity of such research in terms of periodical assessment of Cu, Zn and other metal concentration in all the known herbal plants used in traditional medicine, would go a long way toward predicting the quality assurance and safer use of herbal products. The studies conclude that medicinal plants having heavy metals concentration beyond the permissible limit except few, for each of them as compared to the WHO standards. The research findings indicate that the medicinal plants or plant product available in the market used for different types of diseases must be checked for heavy metal contamination in order to make them safe for human consumption. In other words, for local or pharmaceutical purposes, it should be collected from collected habitat also to safeguard from heavy metal contamination. Since we advise the medicinal plants consumer to check the heavy metal content in medicinal plants even if they were collected from less populated areas, before their use for local and medicinal purposes in future or aware about above mention the research findings. In summary, all living organisms within a given ecosystem are variously contaminated along their cycles of food chain and food web. The medicinal plants raw materials normally carry a great number of contaminant, often from growth and packing environment. Economical value of the medicinal plants international trade, as well as frequent use of some herbal preparations in infant, elderly and even normal persons and medicinal plant consumer bring to mind the authors try to fulfill the findings.

REFERENCES

1. Chan, K., 2003. Some aspects of toxic contaminants in herbal medicines Chemosphere, 52: 1361-1371.
2. Gravel, I.V., G.P. Yakovlev, N.N. Petrpov, S.S. Stulouskii and S.A. Listov, 1994. Holum, J.R., 1983. Elements of General and Biological Chemistry, 6th Edition, John Wiley and Sons, N.Y., pp: 324, 326, 353, 469.
3. Abou-Arab, A.A.K. and M.A. Abou Donia, 2000. Heavy Metals in Egyptian Spices and Medicinal Plants and the Effect of Processing on Their Levels. Agric. J. Food Chem., 48(6): 2300-2304.
4. Schilcher, H., H. Peters and H. Wank, 1987. Pestiszide and Schmermretalle in Arzneipmanzen and Arzneiplanzen Zubereitun-gen. Pharm. Ind., (49): 202-211.
5. Lenntech Water Treatment and Air Purification, 2004. Water Treatment, Published by Lenntech, Rotterdamseweg. Netherlands [www.excelwater.com/thp/filters/Water-Purification.htm].
6. Fosmire, G.J., 1990. Zinc Toxicity. Am. J. Clin. Nutr., 51(2): 225-227.
7. McCluggage, D., 1991. Heavy Metal Poisoning. NCS Magazine. Published by The Bird Hospital, CO, U.S.A., [www.cockatiels.org/articles/Diseases/metals.html].
8. Ferner, DJ., 2001. Toxicity, heavy metals. E. Med. J., 2(5): 1.
9. Nolan, K., 2003. Copper Toxicity Syndrome, J. Orthomol. Psychiatry, 12(4): 270-282.
10. Young, R.A., 2005. Toxicity Profiles: Toxicity Summary for Cadmium, Risk Assessment Information System, RAIS, University of Tennessee.
11. Holum, J.R., 1983. Elements of General and Biological Chemistry, 6th Edition, John Wiley and Sons, N.Y., pp: 324, 326, 353, 469.