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Original Research Paper

Analysis of Some Heavy Metals from Fruits of Medicinal Plants *Phyllanthus emblica*, *Terminalia bellirica* and *Terminalia chebula* From India and Nepal by ICP-OES Technique

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ABSTRACT

Heavy metals as environmental contaminants of terrestrial ecosystems is not a recent phenomenon. As certain plants have a tendency of storing heavy metals from soils, polluted water and atmosphere, heavy metals are a matter of concern in the herbal drugs. Therefore, test for heavy metals is essential for herbal medicines. Fruits of Amalaki (*Phyllanthus emblica* Linn.), Bibhitaki (*Terminalia bellirica* (Gaertn.) Roxb. and Haritaki (*Terminalia chebula* Retz.) are used individually or in combination as Triphala in number of formulations. Triphala and its constituents act as cardio-tonic, control blood pressure, improve blood circulation and reduce cholesterol levels. Because of such wide use of these fruits in various herbal formulations, it is necessary to analyse at least common heavy metals from the raw materials before they can be processed further. To meet the heavy demand for this raw material and due to the easy accessibility, some supply also comes from neighbouring countries like Nepal and Bhutan. In the present paper fruits of Amalaki, Bibhitaki and Haritaki procured from India (Karjat) and Nepal (Baghlongh) were analysed for five heavy metals Cu, Zn, Pb and Hg by Optical Emission Spectroscopy, which uses the technique of inductively coupled plasma. There was a significant variation in the heavy metal content of fruits collected from India and Nepal.

INTRODUCTION

Heavy metals are a matter of concern in herbal drugs, especially as certain plants have a tendency of accumulating them from soils, polluted water and atmosphere (Raskin et al. 1994). In all, there are 38 heavy metals (Passaw 1978). All the metals play a variety of roles in biological systems, ranging from regulations of biological process to being important structural component in proteins (Borovik 1994). Heavy metal toxicity is widely talked about and makes every traditional drug industry as well as scientific community in fervour. The main sources of metal contaminants in soils are from metalliferous mining and smelting activities, industrial emissions and effluent, urban development, vehicle emissions, dumped waste materials, contaminated dusts and rainfall, fertilizers and pesticides. A trace element is considered as essential for both man and animals, but when it crosses the limits it becomes toxic and degenerates the system. The soil is the primary supplier of trace metals to the soil-plant-animal system. Haritaki, Bibhitaki and Amalaki are the three widely used plant drugs in various Ayurvedic and herbal formulations (Mishra 2004). Because of such wide use of these plants, it is necessary to analyse the raw material for common heavy metals before they can be used in the formulations. To meet the heavy demand for this raw material, some supply also comes from neighbouring countries like Nepal and Bhutan.

In the current investigation samples of Amalaki, Bibhitaki and Haritaki were collected from India (Karjat) and Nepal (Baghlongh). Cu, Zn, Pb, Ni and Hg were analysed using ICP-OES technique.

MATERIALS AND METHODS

Fruits of Amalaki, Bibhitaki and Haritaki were authenticated from Agharkar Research Institute, Pune. The voucher specimen numbers for Amalaki, Bibhitaki and Haritaki are Auth 08-65, Auth 08-67 and Auth 08-66 respectively.

Fruits were separately washed, dried, deseeded and placed in preset incubator at 45±5°C for 1 week. The deseeded fruits were powdered using electrical mixer grinder and sieved through 85-mesh (BSS) sieve. The fine powder was stored in airtight pet containers. These powders of different geographical regions were analysed for their heavy metal content by ICP-OES method.

RESULTS

The results of heavy metal analysis in the three medicinal plants are given in Tables 1 and 2.

Copper (Cu): The concentration of Cu was within the normal range in Bibhitaki (9.54ppm) and Haritaki (<1 ppm) but it was slightly more than the normal range in Amalaki (19.35 ppm) from Maharastra. Concentration of copper exceeded the normal range in Amalaki (36.50 ppm), Bibhitaki (30.74 ppm) and Haritaki (28.60 ppm) collected from Nepal.

Zinc (Zn): The concentration of zinc was found to be within the normal range in fruits of Amalaki, Bibhitaki and Haritaki from both India and Nepal.

Lead (Pb): The Pb concentration exceeded the normal range in fruits of Maharastra. It was 10.38 ppm, 17.73 ppm and 15.61 ppm in Amalaki, Bhibhitaki and Haritaki respectively. The concentration of Pb in Haritaki (7.15 ppm) and Bibhitaki (7.99 ppm) of Nepal were in the normal range, whereas its concentration in Amalaki (20.86 ppm) was beyond the normal range.

Nickel (Ni): In case of Ni, the concentration was within the normal range in all the three fruits of India. It was < 1 ppm in Amalaki, 2.75 ppm in Bibhitaki and 1.91 ppm in Haritaki. Ni was in normal range in Haritaki (8.04 ppm) and was not detected at all in Amalaki and Bibhitaki collected from Nepal.

Mercury (Hg): The concentration of Hg was below the detection limit in fruits collected from India whereas not detected at all in fruits from Nepal.

DISCUSSION AND CONCLUSION

Total concentration of Cu was found to be maximum compared to other metals analysed. If the intake of copper exceeds the range of the human tolerance, it would cause toxic effects such as haemolysis, jaundice and even death. Nickel and Hg were minimum in fruits collected from both the geographical regions. Nickel was found to be beyond the normal range in Haritaki procured from Nepal. The presence of nickel in the soil, may be from a local geographical abnormality, from sewage sludge amendments, through fungicides from cultivated lands nearby or from industrial activity involving atmospheric emissions of nickel such as from smelters and refineries. All these sources add to the amount of nickel taken up by plants and lead to elevated levels. In small quantities nickel is essential, but when the uptake is high, it can be a danger to human health. This can cause various kinds of cancer in animals and humans, mainly those who live near refineries (Naik et al. 2006).

Table 1: Typical concentration of some metals in plants.

Metal	Normal range in plant material mg/g fresh weight	Concentration in contaminated plant µg/g
Copper	4-15	20-100
Zinc	3-100	100-400
Lead	0.1-10	30-300
Nickel	0.02-5	10-100
Mercury	0.015	-

Note: Source (Ross 1994).

Table 2: Metal concentrations (ppm) in fruits collected from India and Nepal.

	India (Maharastra)			Nepal (Baghlongh)		
Metal	Amalaki	Bibhitaki	Haritaki	Amalaki	Bibhitaki	Haritaki
Copper	19.35	9.54	< 1	36.50	30.74	28.60
Zinc	11.54	14.89	12.11	27.23	N.D.	4.36
Lead	10.38	17.73	15.61	20.86	7.99	7.15
Nickel	< 1	2.75	1.91	N.D.	N.D.	8.04
Mercury	< 1	< 1	< 1	N.D.	N.D.	N.D.

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

In Amalaki total metal concentration was maximum (84.59 ppm) in fruits collected from Nepal while minimum (41.27 ppm) in India. In Haritaki total metal concentration was highest (48.15 ppm) in Nepal while it was minimum (29.63 ppm) in fruits collected from India. There was not much variation in Bibhitaki of the two regions. The significant variation in the total metal concentration of the two geographical regions suggests the need and importance of heavy metal analysis of the raw material before it can be used in medicinal formulations. Further, the agroclimatic conditions and the soil profile of the region also need to be analysed. The data of metals may be used for the final selection of region for collection of raw materials of Amalaki, Bibhitaki and Haritaki.

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REFERENCES

Borovik, A.J. 1994. Cited in Ross M. Sheila 1994. Toxic Metals in Soil-Plant System, John Wiley and Sons, New York.

Naik, G.H., Priyadarsini, K.I. and Hari Mohan 2006. Free radical scavenging reactions and phytochemical analysis of Triphala, an ayurvedic formulation. Current Science, 90: 9.

Mishra, L.C. 2004. Scientific Basis for Ayurvedic Therapies. CRC Press, LLC, p. 49-165.

Passaw, 1978. Cited in Ross M. Sheila 1994, Toxic Metals in Soil-Plant System. John Wiley and Sons, New York.

Raskin, F., Kumar, N., Dushenkor, S. and Salt, E.D. 1994. Bioconcentration of heavy metals by plants. Current Opinion in Biotechnology, 5: 285-290.

Ross, M. Sheila 1994. Toxic Metals in Soil-Plant System, John Wiley and Sons, New York.