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# EFFECT OF REGIONAL VARIATION ON HEAVY METAL CONTENT OF *MALLOTUS PHILIPPENSIS* USING AAS TECHNIQUE

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## ABSTRACT

Most herbal medicines, analysed for heavy metals, are found to be having higher concentration of one or more elements. Therefore, limit tests of heavy metals are essential for herbal medicines. There is also a need for heavy metal analysis to be an integral part of the standardization of herbal medicines. *Mallotus philippensis* is a plant distributed nearly throughout India. *Mallotus philippensis,* used for present study, has many pharmacological activities of which antibacterial, immunoregulatory, antifungal and anti-inflammatory activity are important. Eight heavy metals, lead, zinc, copper, chromium, iron, arsenic, cadmium and nickel were analysed by Atomic Absorption Spectroscopy (AAS).

## INTRODUCTION

Metals like zinc, copper and iron are important to humans, which form important components of cell and co-factors in several metalloenzymes. However, increased concentration of these metals can affect mineral and enzyme status of humans. The metals irreversibly bind to active sites of enzymes, thereby destroying normal metabolism producing high-level toxicity (Rai et al. 2002).

As certain plants have a tendency of storing heavy metals from soils, polluted water and atmosphere, heavy metals are matters of concern in the herbal drugs (Newall et al. 1996, Baker et al. 1994, Ghosh et al. 2001). During their evolution, plants did not develop uptake mechanisms that differentiate between essential and nonessential metals. Due to lack of selectivity, the presence or concentration of a metal in the tissue of a plant does not tell us anything about plant's requirement for that metal. In this respect, the accumulation of metals is related to the plant's age. This is one of the reasons for the observed variability of metal concentrations in plants.

In the past few years there has been resurgence in the usage of herbal medicines among the traditional as well as the modern consumers of herbal products. As a result, the demand for high standard, reliable and contaminant free herbal medicine is increasing by the regulatory agencies, consumer groups and manufacturing units. There are a number of reports indicating that plants may be able to acclimatize to presence of pollution and contamination (Borovik 1990, Passaw 1978, Ross 1994). However, the complete mechanism of metal tolerance for any plant has yet to be described. There is also limited information available on the limits of metal tolerance and the actual metal concentration (Arnon & Sdtout 1939). Thus, metal tolerance may be the result of genetically inherited physiological mechanism. The ability of a plant to respond phenotypically to a stress may, therefore, be an important mechanism in the survival of a plant (Baker et al. 1994, Peterson 1978, Schmid, 1992).

*Mallotus philippensis* is a plant distributed nearly throughout India. It has many pharmacological activities of which antibacterial, immunoregulatory, antifungal and anti-inflammatory activity

(Ainpure 1985, Bhaduri et al. 1968). Eight heavy metals, lead, zinc, copper, chromium, iron, arsenic, cadmium and nickel were analysed by Atomic Absorption Spectroscopy (AAS) in the present study.

## MATERIALS AND METHODS

Bark *of Mallotus philippensis* was procured from various geographical regions, powdered and analysed by using AAS and were authenticated by National Institute of Science Communication and Information Resources (NISCAIR). The collected bark of *Mallotus philippensis* was dried in shade, finely powdered and passed through 80 mesh sieve and stored in an airtight container at room temperature (25 ± 2°C). The bark powder was analysed later for heavy metals by AAS.

## RESULTS

The range of concentrations of the heavy metals for normal plants has been presented in Table 1 (Borovik 1990, Passaw 1978, Ross 1994, Alloway 1990). The results of heavy metals for *Mallotus philippensis* have been presented in Table 2. The concentration of Cu was minimum (4.98 ppm) in Thane, while maximum (5.20 ppm) in Mumbai. The concentration of Pb was minimum (0.10 ppm) in Mumbai, and maximum (0.15ppm) in Sindhudurga. The concentration of Zn was lowest (2.40ppm) in Sindhudurga and highest (2.60 ppm) in Thane. In case of Fe the concentration was minimum (44.44 ppm) in Thane while maximum (49.59 ppm) in Sindhudurga. The concentration of Ni was minimum (0.09 ppm) in Thane and maximum (0.11 ppm) in Sindhudurga. The concentration of Cr was minimum (1.92 ppm) in Mumbai, and maximum (1.94 ppm) in Thane. The concentration of Cd

Table 1: Typical concentration of metals in plants.

| Metals | Normal range in plant material, ppm | Concentration in contaminated plant, ppm |
|---|---|---|
| Copper | 4 - 15 | 20 - 100 |
| Lead | 0.1 - 10 | 30 - 300 |
| Zinc | 3 - 100 | 100 -400 |
| Iron | 50 - 300 | 300 - 400 |
| Nickel | 0.02 - 5 | 10 - 100 |
| Chromium | 1 - 10 | 2 0 - 100 |
| Arsenic | 0.1 - 1.0 | 1 - 100 |
| Cadmium | 0.01 - 0.4 | 0.4 - 2.3 |

Table 2: Metal concentration (ppm) in *Mallotus philippensis* collected from different regions.

| Metals | Mumbai | Sindhudurga | Thane |
|---|---|---|---|
| Copper | 5.20 | 5.11 | 4.98 |
| Lead | 0.10 | 0.15 | 0.11 |
| Zinc | 2.50 | 2.40 | 2.60 |
| Iron | 46.57 | 49.59 | 44.44 |
| Nickel | 0.10 | 0.11 | 0.09 |
| Chromium | 1.92 | 1.93 | 1.94 |
| Arsenic | 0.00 | 0.00 | 0.00 |
| Cadmium | 0.18 | 0.10 | 0.11 |

Note: Each metal value is mean of three values.

was minimum (0.10 ppm) at Sindhudurga, and maximum (0.18 ppm) in Mumbai. The concentration of As was below detection level in all the three regions.

## DISCUSSION

Among the eight metals analysed from *Mallotus philippensis*, Fe was found to be in maximum in concentration, and Cd minimum in plants of all the regions. There were no significant variation in the total metal concentration between various geographical regions, however, individual metal concentration varied in plant powders of different regions. Fe showed significant variation in its range in the analysed metals. These results, however, require further investigation, especially to correlate with the environmental levels of the heavy metals. Thus, *Mallotus philippensis* as investigated in the present study does not provide ample evidence to indicate pollution related accumulation of heavy metals. It is evident from the study that *Mallotus philippensis* does accumulate some heavy metals at levels more than normal range reported in other plants. This is specifically true with Fe, Ni and Cr. The major scientific and medicinal interest in iron is as an essential metal. There is 3-5 g of iron present in the body. Acute iron toxicity is nearly due to accidental injection of iron containing medicines (Klassen 1996). Iron in excess amount can impair the function of organs, especially liver, pancreas, heart, joints and pituitary whereas its deficiency may lead to anaemia, fissures at the corner of the mouth and koilonychias. Similarly, it is considered that nickel is a nutritionally essential metal. Nickel, administrated parenterally in animals, is rapidly distributed to the kidney, pituitary, lungs, skin, adrenals, ovaries and testes. The intracellular distribution and binding of nickel is not well understood. It has been known that occupational exposure to nickel predisposes humans to lung and nasal cancer whereas deficiency of nickel alters glucose metabolism and decreases tolerance to glucose. Excess of chromium leads to occupational renal failure, dermatitis and pulmonary cancer, whereas its deficiency leads to impaired glucose tolerance, peripheral neuropathy and confusion. Since the levels of these heavy metals do not vary much with the geographical regions of collection, it may suggest that these higher levels could be related to the normal physiology of the plant. The present study, however, has not determined the levels of these heavy metals in soil for confirming this role of the plant.

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