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Determination of Heavy Metals from *Bauhinia variegata* Using Inductively Coupled Plasma Technique

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ABSTRACT

Many mineral elements occur in animal and plant tissues in very minute quantities, which earlier were unable to be measured precisely by analytical methods then available. Modern analytical technique like inductively coupled plasma has the ability to measure almost all the trace elements in smallest of biological samples with great precision and accuracy. There is also a need for heavy metal analysis to be an integral part of the standardization of herbal medicine. *Bauhinia variegata* has been used against various ailments of which leucoderma, leprosy and asthma are few to name. Five common heavy metals As, Cr, Mg ,Pb and Zn were analysed by inductively coupled plasma in whole plant powder of *Bauhinia variegata*, and magnesium was found to have the highest concentration.

INTRODUCTION

Phytoremediation has gained increasing attention as a cost-effective method for the remediation of heavy metal contaminated sites. Because some plants possess a range of potential mechanisms that may be involved in the detoxification of heavy metals, they manage to survive under metal stresses. Heavy metals are a matter of concern in herbal drugs, especially as certain plants have the tendency of storing heavy metals from soils, polluted water and atmosphere (Baker et al. 1994, Newall et al. 1996). 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 above which further adaptation of metal or metals is possible (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 (Peterson 1978, Schmid 1992, Baker et al. 1994).

Bauhinia variegata is a medium sized deciduous tree, not indigenous, with white or pink coloured flowers, occurring in the mountain ranges and also in the dry forests of eastern, central and southern India. It has many pharmacological activities of which leucoderma, leprosy and asthma are a few to name. The bark powder of *Bauhinia variegata* was analysed for five common heavy metals viz. arsenic, chromium, lead, magnesium and zinc using inductively coupled plasma technique (ICP).

Often ICP is used in conjunction with other analytical instruments such as the Atomic Emission Spectroscopy (ICP-AES) also known as Optical Emission Spectroscopy (ICP-OES) and the Mass Spectroscopy (ICP-MS). ICP is a powerful instrumental technique for the quantitative determination of trace metals. The basis of ICP is the introduction of sample digestate into a region of high temperature (approx. 10000°C) resulting in excitation of the atoms present. These atoms release energy in the form of photons as they return to the normal atomic state. Each element releases photons of characteristic wavelengths when excited. The intensity of each wavelength of the emitted light is measured and compared with that of a known concentration for each element of interest.

Table 1: Metal concentrations (ppm) in *Bauhinia variegata.*

Metal	Concentration (ppm)
Mg	30800
Zn	10.44
Pb	3.26
As	2
Cr	1

MATERIALS AND METHODS

Stem bark of *Bauhinia variegata* from Bhayander region was collected, authenticated, dried in shade, finely powdered and stored in an airtight container at room temperature (25 ± 2°C). The powder was analysed later for heavy metals by ICP. The plant powder was analysed for five heavy metals, arsenic, chromium, lead, magnesium and zinc. Several advantages are associated with the plasma source. First, atomization occurs in a chemically inert environment, which tends to enhance the lifetime of the analyte by preventing oxide formation. In addition, and in contrast to arc, spark and flame, the temperature cross section of the plasma is relatively uniform; as a consequence, self-absorption and self-reversal effects are not encountered. Thus, linear calibration curves over several orders of magnitude of concentration are usually observed. ICP offers the greatest advantage in terms of sensitivity and freedom from interference.

RESULTS AND DISCUSSION

The results of heavy metal analysis using ICP are presented in the Table 1. The concentration of magnesium was 30800 ppm, zinc 10.44 ppm, lead 3.26 ppm, arsenic 2 ppm and chromium 1 ppm. Amongst the five metals analysed in the plant, magnesium was with highest concentration followed by zinc.

Metals like zinc form an important component of the cell and is co-factor in several metalloenzymes. However increased concentration of the metal can affect mineral and enzyme status of humans. The metal irreversibly binds to active sites of enzymes, thereby destroying normal metabolism producing high-level toxicity (Rai & Pal 2002).

The toxicological considerations of metals are also important in terms of accidental acute exposures. Deficiency of zinc shows signs of dwarfism, growth retardation, diarrhoea and pneumonia whereas zinc in excess amounts causes obesity (Tanuja et al. 1996). Excess of lead causes abdominal pain, headache, irritability, joint pain, fatigue and anaemia whereas its deficiency shows signs of anorexia, convulsions, coma and death due to cerebral oedema and renal failure. Deficiency of chromium leads to impaired glucose tolerance and confusion whereas chromium in excess amounts causes occupational renal failure, dermatitis and pulmonary cancer.

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