

**ANALYSIS OF HEAVY METAL CONTENT IN *ANDROGRAPHIS PANICULATA***

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**ABSTRACT**

The aim of this study was to determine the heavy metal content in leaf, root and stem samples of *Andrographis Paniculata* using flame atomic absorption spectrometry. The homogenized samples of leaf, root and stem were subjected to overnight HNO<sub>3</sub> digestion and analyzed for the presence of Cr, Ni, Zn, Cu, Fe and Cd. An overnight digestion with HNO<sub>3</sub> yielded Cr, Cu, Fe and Cd recoveries among which Fe and Cr were found in significant amounts in leaf, root as well as stem whereas Cu and Cd were found to be present only in the leaf samples.

**Keywords:** *Andrographis Paniculata*, Heavy metal, Acanthaceae.

**INTRODUCTION**

*Andrographis* is a genus of the Acanthaceae family comprising of about 40 species several members of which enjoy a reputation in traditional medicine. *Andrographis Paniculata* is an erect annual herb extremely bitter in taste in each and every part of the plant body<sup>1</sup>. *Andrographis paniculata* has been used for centuries for the treatment of fever and many infectious diseases. The plant is native to tropical and sub-tropical regions of India and is also used as a pain killer, anti-inflammatory, antibacterial and anti-viral agent. Andrographolide and neoandrographolide have been identified as the main chemical constituents that are responsible for the therapeutics of the plant. Andrographolide, in particular, has shown cytotoxic and cytostatic activity against cancer cells and hepatoprotective activity<sup>2</sup>.

Heavy metal uptake by the *Andrographis paniculata* is therefore a main pathway of metal transfer from sediments and water to the food web. The metal uptake by the plant is determined by metal mobility and bioavailability, which in turn are influenced by soil or sediment characteristics. For monitoring and research purposes the plant samples are regularly subjected to heavy metal analyses. Destruction of the plant biomass for dissolving the metals must be sufficiently vigorous. Most of the procedures adopted involve dry ashing or a wet digestion using nitric acid alone, or in combination with perchloric acid or hydrogen peroxide. Significant differences in metal contents could be related to the destruction method applied, taking into account the very rigid structure of the plants. This study adopts the procedure of overnight wet digestion with nitric acid alone for the determination of heavy metals.

The chemical constituents in plants, including metal ions, are partially responsible for their medicinal and nutritional properties as well as for its toxicity. As trace elements they are important metabolic products for the plant cells and also play an important role in the plant

metabolism and biosynthesis as cofactors for enzymes<sup>3</sup>. Plants can accumulate metals in roots and in above ground organs and transfer heavy metal pollutants from soils into the food chain<sup>4</sup>. This accumulation is one of the most serious environmental concerns of the present day, not only because of the phytotoxicity of many of these metals, but also because of the potential harmful effects that toxic metals could have on animals and human health. In protecting the public from hazards of these metals, the monitoring of heavy metals in medicinal and edible plants is therefore of great importance. Some metals are also essential nutrients (zinc, iron, copper, chromium and cobalt) and only become toxic at higher concentrations, while others (lead, mercury and cadmium) have no known beneficial properties and are exclusively toxic<sup>5</sup>. The essentiality of trace elements as well as their biochemical and pathological significance to human and animals are well known.

The aim of the present study was to determine the amounts of certain essential (Fe, Cr, Cu) and toxic (Cd) metals in the leaf, root and stem samples of *Andrographis paniculata*.

**MATERIALS AND METHODS****Sample collection and preparation**

Whole plants of *Andrographis paniculata* were collected from sites near Vellore district (Tamilnadu, India). They were fractionated into leaves, stems and roots. The samples were thoroughly washed with deionized water, shade dried at ambient temperature for about 15 days, ground into powder with a mechanical grinder and homogenized. The samples are subsequently stored in separate sample bottles.

**Overnight digestion with conc. HNO<sub>3</sub>**

Ten milliliters of concentrated HNO<sub>3</sub> (ultrapure 65%) was added to 1.000 g each of leaf, root and stem sample and allowed to stand overnight at room temperature. The samples were then heated for 4 h at 120°C, after which



the temperature was increased to 140°C. The digestion was continued at this temperature until about 1ml of acid remained. After cooling, the suspension was filtered in a 50ml volumetric flask and diluted to the mark. Thus the samples each of leaf, root and stem of the plant *Andrographis Paniculata* were prepared<sup>6-8</sup>.

### Standard solution preparation

Stock standard solutions of Fe, Cr, Cu and Cd containing 1000ppm of each metal were prepared by dissolving weighted quantities of appropriate dried analytical grade salts in distilled water. Calibration standards of 1ppm, 2ppm and 3ppm of each element were obtained by appropriate dilution of the stock solutions.

### Atomic absorption spectrometry

In each of the leaf, root and stem extract of *Andrographis Paniculata*, Fe, Cr, Cu and Cd contents were measured using flame atomic absorption spectrometry. The elements were measured under the optimum operating conditions with an air-acetylene flame.

## RESULTS AND DISCUSSION

A total of 4 elements viz. Fe, Cu, Cr and Cd were determined in the homogenized leaf, root and stem samples of *Andrographis Paniculata* by atomic absorption spectrophotometry (AAS). Table 1 shows the result of heavy metal contents from the analyzed samples (mg/kg). From the study it was revealed that all the heavy metals (Fe, Cr, Cu and Cd) were accumulated to greater or lesser extents by the leaf extracts and only Fe and Cu were accumulated by the root and stem extracts.

**Table 1:** Result of heavy metal contents from the analyzed samples (mg/kg)

<i>Andrographis paniculata</i> Extract	Heavy metal concentration, mg/kg			
	Fe	Cr	Cu	Cd
Leaf	69.75	15.7	1.0	0.45
Root	64.65	14.45	-	-
Stem	43.75	14.9	-	-

The levels of Fe in the leaf extract of *Andrographis Paniculata* was found to be comparatively higher viz. 69.75 mg/kg than that in the root viz. 64.65 mg/kg and stem viz. 43.75 mg/kg. Although iron is an essential nutrient for plants, its accumulation within cells can be toxic. Plants, therefore, respond to both iron deficiency and iron excess by inducing expression of different gene sets<sup>9</sup>.

The Cr levels was similarly found to be higher in the leaf extract viz. 15.7 mg/kg than in root viz. 14.45 mg/kg and in stem viz. 14.9 mg/kg. Chromium is found in all phases of the environment, including air, water and soil. Naturally occurring in soil, Cr ranges from 10 to 50 mg/kg depending on the parental material. Chromium

compounds are highly toxic to plants and are detrimental to their growth and development<sup>10-12</sup>.

The leaf extract of *Andrographis Paniculata* was alone found to have a significant concentration of Cu viz. 1.0 mg/kg. Copper is naturally present in fruits and vegetables and is necessary for the proper growth and functioning of plants. The primary source is from the soil, but small amounts may result from copper-based fungicides. Although copper concentrations in plants tend to increase with increasing copper concentrations in the soil, soil properties such as the acidity level and organic matter content can affect the amount of copper taken up<sup>13</sup>.

Similarly, Cd was also found to be present only in the leaf samples at a concentration of 0.45 mg/kg. When cadmium is present in soils it can be extremely dangerous, as the uptake through food will increase. Soils that are acidified enhance the cadmium uptake by plants. This is a potential danger to the animals that are dependent upon the plants for survival. Cadmium can accumulate in their bodies, especially when they eat multiple plants<sup>14</sup>.

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