



Determination of Trace Metals in the Bark Root of *Phyllanthus emblica* (L)

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ABSTRACT

The bark root of *Phyllanthus emblica* were digested with HNO₃ and HClO₄ (4:1) and the contents of trace elements such as As, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Ni, Mn, Pb, and Zn were determined by atomic absorption spectroscopy. The presence of beneficial element i.e., Fe, Zn, K, Mg, Mn, Ca, Co, Ni are within limit. The concentration of heavy trace elements Cu, Cr, and Cd are within limit but the concentration of Pb and As are high.

Key words: *Phyllanthus emblica*, Atomic absorption spectroscopy, Essential trace elements, heavy metals.

INTRODUCTION

Phyllanthus emblica Linn. known as Indian gooseberry belongs to family Euphorbiaceae. It is a very richest source of vitamin C¹ found in abundant amount in deciduous forest of Madhya Pradesh. It is common all over tropical and sub-tropical India. It is known as amalaka in Sanskrit, amla in Hindi, olay in Punjabi, amla in Gujarati, nellikkai in Tamil, amala in Nepali, ma kham pom in Thai, usiri in Telgu, emblic myrobalan in English. It has antiaging, antiviral, chondroprotective², antibacterial³, anti-proliferative, anti-platelet⁴⁻⁶, anti-HIV-1, chemoprotective⁷, hypolipidamic, antiulcer, antidiabetic⁸ properties. It is used as antioxidant⁹, aphrodisiac, as chelating agent, in constipation, dental problems, diarrhoea,

diuretic fevers, gonorrhoea, hair growth, headache¹⁰, inflammation mouth ulcers, respiratory problems, skin whitening etc. Leaves of *Phyllanthus emblica* possess antineutrophilic activity. It reduces blood cholesterol and triglyceride levels¹¹⁻¹².

Heavy metals are a definite human health hazard because of their bioaccumulativity¹³ and they belong to group of undesirable substances. Due to the essential or toxic nature of heavy metals, their distribution in plants is of interest. For example, zinc, iron, cobalt, chromium, copper and manganese are essential, while cadmium, lead, mercury are toxic¹⁴. In past few years research of trace element distribution in medicinal plants¹⁵⁻¹⁶ becomes important. Trace elements are the essential for human health and they prevent several

diseases. The atomic absorption spectroscopy¹⁷⁻¹⁸ is an important method for detection of trace elements.

EXPERIMENTAL

Bark roots of *Phyllanthus emblica* are picked from Agra and Firozabad. For fifteen days, the samples were air dried under shade. Then powdered with the help of warming blender, 2.5gm ground dried plant leaves were placed in a 250 ml conical flask, 2.5 ml concentrated HNO₃ was added slowly with constant shaking. The mixture was heated on a hot plate until the production of brown fumes ceases. The content of beaker was cooled and 10 ml of 70% HClO₄ was added. It was heated again very gently until the solution turns colorless and allowed to evaporate to a small volume. Now cooled and added double distilled water and was filtered into a 100 ml flask using Whatmann filter paper and volume was diluted with double distilled water. The total concentrations of Zn, Fe, Ni, Mn, K, Ca, Mg, Co, Cr, Cu, Cd, Pb, As etc. were analyzed by atomic absorption spectroscopy (Model: Perkin Elmer A Analyst 100)

RESULTS AND DISCUSSION

The concentration of copper is 0.814ppm in bark root sample of Agra and 0.762ppm in sample of Firozabad. For some essential enzymes such as

super oxide dismutase, cytochrome oxidase, lysyl oxidase etc. copper is required. Excess of copper causes dermatitis, metallic taste in the mouth, hair and skin decoloration etc. Copper¹⁹ play role in some neurological conditions like Alzheimer's disease, Wilson's disease, Prion disease. In edible plants permissible limit set by FAO/WHO in 1984 was 3.00 ppm. Thus in *Phyllanthus emblica* copper is within limit. Sample of Agra contains more copper in comparison to sample of Firozabad.

The concentration of cadmium in bark root is 0.082 ppm of Agra and 0.915 ppm in the sample of Firozabad. Cadmium is non-essential trace element and very hazardous to human. As cadmium accumulates in the environment throughout the food chain, it poses a serious threat to human beings. The industrial uses of cadmium are wide spread and increasing in electroplating, paint, plastic, alloy preparation, mining and silver-cadmium batteries. Cadmium biochemically replaces zinc and causes high blood pressure. Cd damages kidney and liver²⁰. Cadmium causes a disease known as Itai-Itai. The permissible limit set by WHO is 0.2 to 0.81 ppm. Thus in *Phyllanthus emblica* concentration of cadmium is within limit.

The concentration of lead in bark root sample of Agra is 10.216 ppm and 15.628 ppm in leaf sample of Firozabad. Lead is non-essential element and has no beneficial effects in humans.

Table 1: Essential trace elements

Element		Zn	Fe	Ni	Mn	K	Ca	Mg	Co
<i>Phyllanthus emblica</i> (bark root) of Agra	Mean	9.473 ppm	19.226 ppm	1.878 ppm	8.345 ppm	15.413 ppm	30.824 ppm	4.242 ppm	0.124 ppm
<i>Phyllanthus emblica</i> (bark root) of Firozabad	Mean	12.578 ppm	18.485 ppm	2.032 ppm	6.421 ppm	12.362 ppm	28.226 ppm	2.573 ppm	0.228 ppm

Table 2: Harmful heavy metals

Element		Cu	Cr	Cd	Pb	As
<i>Phyllanthus emblica</i> (Bark root) of Agra	Mean	0.814 ppm	0.628 ppm	0.082 ppm	10.216 ppm	5.821 ppm
<i>Phyllanthus emblica</i> (Bark root) of Firozabad	Mean	0.762 ppm	0.524 ppm	0.915 ppm	15.628 ppm	6.74 ppm

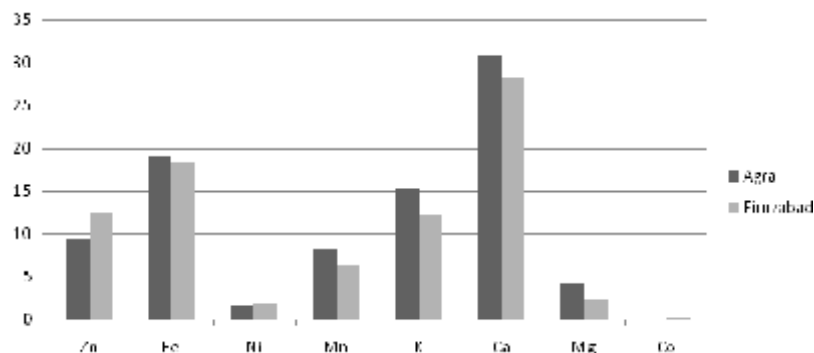


Fig. 1: Comparative study of essential trace elements in Agra and Firozabad

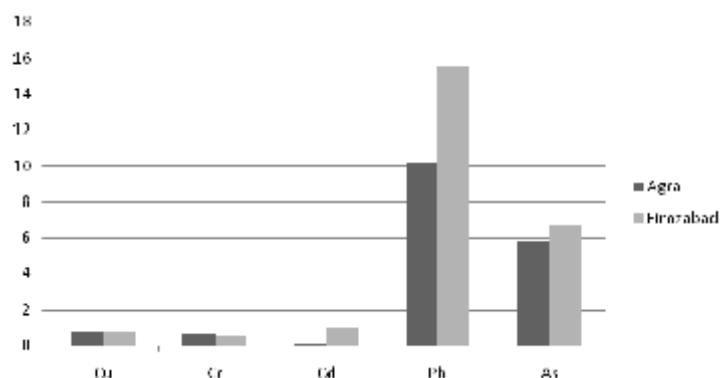


Fig. 2: Comparative study of harmful heavy metals in Agra and Firozabad

Exposure of lead produces harmful effects²¹⁻²². Lead can cause abnormal brain²³ and nerve function, chronic nephritis of kidneys, anemia etc. The permissible limit set by WHO is 0.1 to 10 ppm. Thus, concentration of lead in both the sample of *Phyllanthus emblica* are high.

The concentration of arsenic in bark root sample of Agra is 5.821 ppm and 6.743 ppm in the sample of Firozabad. In medicinal plants concentration of arsenic recommended is less than 1.0 ppm²⁴. So, it is more than permissible limit. Excess of arsenic causes metabolic disorder, dermatitis, lung cancer, cardiovascular and neurological effects.

In *Phyllanthus emblica* concentration of Ni in the sample of Agra is 1.878 ppm and 2.032 ppm in the sample of Firozabad. No limit yet been given by WHO in 2005 for Ni in medicinal plants. Ni plays an important role in the production of insulin. Nickel was thought to be essential to plants and

some domestic animals²⁵ but not considered to be a metal of biological importance. But after discovery of urease i.e., an nickel enzyme²⁶, it is consider as an element of biological importance. Ni is identified as suspected carcinogen. Nickel can cause a skin disorder known as nickel – eczema²⁷. Thus concentration nickel in *Phyllanthus emblica* is within limit.

In the sample of Agra concentration of iron is 19.226 ppm and 18.485 ppm in the sample of Firozabad. For Fe in medicinal plants limits not yet been established by WHO in 2005. For the formation of hemoglobin iron is necessary. Iron is required in the process of cellular respiration in human body²⁸. Deficiency of iron causes anemia, depression, poor resistance to infection²⁹, weakness etc.

Concentration of Cr in the sample of Agra is 0.628 ppm and 0.524 ppm in the leaf sample of Firozabad. Deficiency of chromium causes diabetes,

growth failure, hyperglycemia, neuropathy, and atherosclerosis. For the normal metabolism of cholesterol, fat and glucose³⁰, trivalent chromium is necessary. Hexavalent chromium is a mucous membrane and skin irritant. Chromium is one of the known environmental toxic pollutants in the world. Excess of chromium causes respiratory trouble, liver and kidney damage, skin rashes etc. By U.S. Toxicology Programme chromium is recognized as pulmonary carcinogen. No limit yet been established by WHO (2005) for Cr. In medicinal plants, Canada set 2 ppm permissible limit in raw medicinal plant material. Thus, concentration of Cr is within limit.

The concentration of zinc in the sample of *Phyllanthus emblica* is 9.473 ppm in the sample of Agra and 12.578 ppm in the sample of Firozabad. The permissible limit set by FAO/WHO (1984) in edible plants was 27.4 ppm. More than 200 proteins and enzymes contain zinc. It is required for brain development, DNA synthesis, steroidogenesis³¹ bone formation, wound healing³². Thus, concentration of zinc is within limit.

The concentration of calcium in the sample of Agra is 30.824 ppm and 28.226 ppm in the sample of Firozabad. For all organisms calcium is essential. Calcium helps in transporting of long chain fatty acids which helps in preventing high blood pressure, heart diseases and some other cardiovascular diseases. Deficiency of calcium causes osteoporosis, rickets, back pain etc. The concentration of calcium is within limit.

The concentration of magnesium in the sample of Agra is 4.242 ppm and in the sample of Firozabad is 2.573 ppm. Magnesium works with calcium to help transmitting nerve impulse in the brain. Mg is required in the plasma and extracellular fluid, where in helps in maintaining osmotic equilibrium. Magnesium has calming effect and

works on the nervous system of those peoples, suffering from depression. In blood its quantity is 2-4mg/100ml.

The concentration of K in bark root of *Phyllanthus emblica* is 15.413 ppm in the sample of Agra and 12.362 ppm in the sample of Firozabad. It is a major cation in the cytoplasm and important in nerve action. Potassium reduces blood pressure. It is essential in protein bio-synthesis by ribosomes. The concentration of cobalt in the sample of Agra is 0.124 ppm and in the sample of Firozabad is 0.228 ppm. Cobalt is found in Vitamin-B₁₂ and plays an important role in the synthesis of hemoglobin, DNA and several enzymes. There is no established criterion for cobalt in medicinal plants.

The concentration of manganese in the sample of Agra is 8.345 ppm and that of Firozabad is 6.421 ppm. Mn strengthens nerves and involved in the synthesis of cholesterol and fatty acids. Mn provides resistance to disease. Excess of manganese causes adverse effects on the lungs and brain. Its deficiency results in several skeletal and reproductive abnormalities. The estimated dietary intake of Mn in adults is 11 mg/day. WHO (2005) established no limit for Mn. Thus, manganese is within limit.

Thus on the basis of above results, it is found that *Phyllanthus emblica* contain useful trace elements Ca, Fe, Zn, Mg, K, Mn, Co, Ni are within limit. Harmful heavy metals Cu, Cr, Cd, Pb are also within limit but concentration of Pb and As are high.

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