Profile of Essential and non Essential Metals in *Heliotropium strigosum*, A Medicinal Plant

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Abstract: Essential and non-essential metals were analyzed in a medicinal plant *Heliotropium strigosum* using flame atomic absorption spectrometer and flame photometer. The essential elements i.e. Zinc, Manganese, Copper, Chromium, Cobalt, Nickel, Sodium and potassium were found to be present in concentrations of 51.2, 100, 34.15, 11.55, 6.1, 7.65, 49.3 and 85 ppm respectively, while the non-essential element lead could not be detected and cadmium was found to be present in concentration of 0.65 ppm. *Heliotropium strigosum* belongs to family Boraginaceae. Traditionally, this plant is used as laxative and diuretic. The juice of the plant is used to treat gum boils, sore eyes and also as cure for stings of nettles, insects and snake bites. The aim of the study was to document the presence of essential and non essential metals in *Heliotropium strigosum*.

Key words: *Heliotropium strigosum* · Essential and non essential metals · Atomic absorption spectrometer and flame photometer

INTRODUCTION

Medicinal plants play an important role in curing diseases in the traditional system of medicine. Plants have chemical constituents including metal ions which are important for medicinal and nutritional purposes. Some metal ions may be toxic as well. The metals play an important role in the formation of bioactive compounds, plant metabolism and act as co-factors for enzymes [1].

The high level of various metals create health troubles like weaken the immune system by decreasing stores of iron and vitamin-C and also lead to upper gastrointestinal ulcers in a wide range of organisms due to bioaccumulation [2]. Nickel deficiency leads to decrease production of insulin and disorder of livers [3]. Excess of Mn effects brain and lungs [4]. Metals like zinc, iron, copper, chromium, cobalt, sodium and potassium are essential nutrients when present in normal range, while lead and cadmium have no known beneficial properties and thus are exclusively toxic [5]. The immune system becomes weak if food is rich with toxic metals like Pb, Cd etc. because of reducing body stores of Fe, vitamin C and other essential nutrients. Other problems include growth retardation and impaired psycho-social difficulties and disabilities associated with malnutrition [6]. WHO recommends that medicinal plants which form the raw material for the finished product should be checked for the presence of metals and the level of toxic metals like arsenic, cadmium and lead should not be more than 1.0, 0.3 and 10 ppm respectively [7,8].

*Heliotropium strigosum* belongs to family Boraginaceae [9]. Traditionally; this plant is used as laxative and diuretic. The juice of the plant is used to treat gum boils, sore eyes and also as cure for stings of nettles, insects and snake bites [10].

Experimental Collection and Post Harvest Treatment of Plant Material: Experimental work was carried out at Kohat University of Science and Technology, Kohat, Pakistan. Whole Plant materials were collected from Malakand (North West of Pakistan) and washed in fresh running water to remove dust, dirt and possible parasites and then treated with de-ionized water and dried in shade at 20-30 °C. Necessary measures were taken in order to prevent any loss or contamination of metals.
Acid Digestion of Plant Sample: One gram of crushed and powdered plant material in china dish was heated in oven at 110 °C to remove moisture. The dried sample after charring was heated in furnace for 4 hours at 550 °C. The china dish contents were cooled in desiccators and 2.5 ml of 6M HNO₃ added to dissolve china dish contents. The solution was filtered and transferred to 20 ml flask and diluted to the mark [5]. Quantitative analysis of eight important heavy metals i.e. Lead, Manganese, Zinc, Copper, Nickle, Cadmium, Chromium and Cobalt was done using flame atomic absorption spectrophotometer (Perkin Elmer 400, USA) and two alkali metals i.e. Sodium and Potassium using flame photometer (Jenway pfp7 UK).

RESULTS AND DISCUSSIONS

The determination of level of both essential and non essential elements in medicinal plants play important role with respect to public health safety, particularly when their concentrations are beyond the acceptable range. The problem is rather more serious in Pakistan, because medicinal plants which form the raw materials for the finished products are neither controlled nor properly regulated according to quality assurance parameters. Thus it is important to determine the concentrations of metals in medicinal plants. The table 1 summarizes concentrations of metals in *Helitropium strigosum* while the percentage of ash content was found to be 95 %.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Metals</th>
<th>Conc (ppm)</th>
<th>SD (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ni</td>
<td>7.65</td>
<td>0.007</td>
</tr>
<tr>
<td>2</td>
<td>Zn</td>
<td>51.2</td>
<td>0.016</td>
</tr>
<tr>
<td>3</td>
<td>Cd</td>
<td>0.65</td>
<td>0.000</td>
</tr>
<tr>
<td>4</td>
<td>Pb</td>
<td>nd*</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Mn</td>
<td>100</td>
<td>0.007</td>
</tr>
<tr>
<td>6</td>
<td>Cu</td>
<td>34.15</td>
<td>0.007</td>
</tr>
<tr>
<td>7</td>
<td>Cr</td>
<td>11.00</td>
<td>0.01</td>
</tr>
<tr>
<td>8</td>
<td>Co</td>
<td>6.1</td>
<td>0.01</td>
</tr>
<tr>
<td>9</td>
<td>Na</td>
<td>49.3</td>
<td>0.63</td>
</tr>
<tr>
<td>10</td>
<td>K</td>
<td>85</td>
<td>0.74</td>
</tr>
</tbody>
</table>

*Cd* = Not detected

Cadmium: Cadmium is highly toxic element, which causes different kinds of hazards, including cell death or increase in cell division [15]. Cadmium concentrates in human body and effect mostly the kidney and liver [8]. Cadmium was found in a concentration of 0.65 ppm, while the maximum acceptable concentration for food stuff is around 1ppm [16].

Lead: Lead is considered very toxic for plants especially for microorganisms. Lead pollution may occur due to lead mines, fuel combustion, sewage sludge application and farmyard manure. This element has no beneficial effect in human body. Lead is known to produce a wide range of physiological, biochemical and behavioral dysfunction in laboratory animals and humans [13,17,18]. Pb was not detected in plant sample. WHO (1998) acceptable limit for lead contents in herbal medicines is 10ppm while the dietary intake limit for lead is 3mg/week [8].

Manganese: Manganese is another essential element for plant and animal growth. Manganese is present in fertilizer and sewage sludge. Its deficiency cause severe skeletal and reproductive abnormalities in mammals and affects the brain and lungs [3]. The Manganese concentration was found to be 100 ppm. In plants its concentration should be below 300 ppm DW (dry weight). The estimated safe and adequate dietary intake of manganese in adult is 11mg/day [19].

Copper: Copper is one of the essential elements for plants and animals. Pesticides, fertilizers, industrial and sewage sludge are the main sources of copper pollution in soil. Copper is required in numbers of essential enzymes including super oxide dismutase (sod), cytochrome oxidase, llysyl oxidase and ceruoplastmine but it can
produce free radicals due to which it is toxic [20]. Copper plays role in neurological condition such as Alzheimer disease [21]. The lower limit recommended by WHO (1996) for Cu is 20 ìg/mg of body weight daily. Copper was found in a concentration of 43.15 ppm. Copper deficiency results in anemia and Wilson’s disease [22].

**Chromium:** Chromium is one the most known environmentally health hazard chemical pollutants in the world. The major sources of chromium pollution are industries, sewage, sludge application and fly ashes. According to Barceloux [4] chromium is a trivalent trace metal which is necessary for the metabolism of fat, cholesterol and glucose. Deficiency of chromium in diet cause elevating concentration of circulating insulin, elevated body fat, decrease sperm counts, reduce fertility and shortened life span. Other related problems of Cr are upset stomach ulcer, respiratory problems, skin rashes and liver damage. The concentration of Cr was found to be 11ppm.

**Cobalt:** The source of cobalt pollutions are burning coal and oil and from car and truck exhausts. Cobalt is the structural part of vitamin B12, which is essential for human health. It stimulates the production of red blood cells thus can be used to treat anemia. However its excess causes the respiratory, heart and thyroid problems. Cobalt was found in a concentration of 6.1 ppm, while the recommended daily dietary intake of cobalt is about 0.04 mg by a person weighing 70kg [23].

**Sodium:** Sodium is a mineral element and is important part of human body. Its source is the common salt which is widely used for cooking as well as for dyeing and industrial purpose. Sodium is required for maintenance of acid base balance in human body [23]. Sodium is present in extracellular fluids of animals and humans. It is responsible for the depolarization of cell membrane. It also regulates water balance in between the intracellular and extracellular fluids [24].Sodium concentration was found to be 49.3 ppm.

**Potassium:** Potassium is also an essential microelement for human and responsible for many physiological function like muscle contraction, lipid metabolism, proteins synthesis, fluid and electrolyte balance and nerve impulse conduction in body [24]. Potassium usually enters in plants from fertilizers [23]. Potassium was recorded in a concentration of 85ppm and the necessary daily intake is between 2-4g/day [24].

**CONCLUSIONS**

The concentration of essential elements i.e. Zn, Cu, Mn, Ni, Co, Na and K determined in Helitropium strigosum, a medicinal plant are well below the critical limit while the non essential element, Cadmium was in trace amount and lead could not be detected. The results suggest that medicinal plants used for human consumption or for preparation of herbal products and standardized extracts should be collected from an unpolluted natural habitat and checked for the concentrations of heavy metals well before use. The study may be extended to other medicinal plants as well.

**REFERENCES**