Profile of Elemental Composition of *Oroxylum indicum* L. (Vent.) Collected from Different Geographical Regions of India

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**ABSTRACT**

Mineral content was quantified in *Oroxylum indicum* L. (Vent.) collected from two different geographic regions of India viz. Western Ghats (Maharashtra) and Northern Uttar Pradesh. The main aim of this study was determination of elemental composition in different parts of the plant *Oroxylum indicum* L. (Vent.), which is extensively used in Ayurvedic preparations. Specific parts (leaves, stem and root) often used in Indian ayurvedic system were analyzed for 10 elements viz Cu, Na, Ca, Cr, Mn, Fe, Ni, Cd, Zn and Pb by employing ICPES techniques. All of the detected values for metallic elements in plant studied here were found to be below the WHO permissible levels. The elemental concentration in different part of medicinal plants and their biological effects on human beings are discussed.

**Key words:** *Oroxylum indicum* L. (Vent.), ICPES, elemental composition.

**INTRODUCTION**

The curative properties of plants have been well documented in ancient Indian literature. The different parts of the plant are used as ingredients in several medicinal preparations in different systems of medicine including Ayurveda. The importance of herbal medicines in the health care system of the larger section of the world’s population, the developing countries, is also an undeniable fact. They form and inseparable part of the traditional systems of medicine and in many cases bridge the gap between the availability of and demand for modern medicine. World Health Organization estimates that about 80% of the population living in rural areas use or depend on plant based medicinal preparations for preventive and curative health care.

Epidemiological studies over the past decades have documented the importance of trace elements in human health and disease. Prompted by this development the pharmaceutical companies have been marketing as general tonics a variety of formulations containing combinations of different trace element contents. Various medical studies over the past decades have focused on the clinical significance of trace elements in human health and disease. Trace quantities of these elements are essential for enzyme catalyzed biological processes in plants. Consequently, the presence of these elements attributes medicinal properties to the plant. It is often observed that these elements are present at varying levels of concentration in different parts of the plants such as roots, stem, leaves etc. It is also observed that these elements concentration vary depending upon the geographical location of the plant.

It has been reported that whatever is consumed as medicine could cause metabolic disturbances subject to the allowed upper and lower limits of trace elements.[1] Both the deficiency and excess of essential micronutrients and trace elements of toxic metals may cause serious effects on human health.[2,3]

According to WHO, medicinal plants should be checked for the presence of heavy metals. It is an established fact that the overdose or prolonged ingestion of the medicinal plant leads to the chronic accumulation of different elements which cause various health problems.[4,5] In this context elemental contents of the medicinal plants are very important and need to be screened for their quality control.[6]

For the present study, *Oroxylum indicum* L. (Vent.) a medicinal plant, belonging to the family Bignoniaceae was selected. It is
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Perchloric acid was then added to the above solution and heated for 5 min. This was followed by addition of aqua regia and heated. The volume was then made up to 250 ml in a standard flask by adding de ionized water.

Estimation of elements was carried out using Inductively Coupled Plasma - Atomic Emission Spectrometer (Model: ARCOS from M/s. Spectro, Germany)

RESULTS AND DISCUSSION

The results presented in table 1 exhibit that the various plant parts of Oroxylum indicum L. (Vent.) are a good source of trace and major elements.

Copper: Copper content was found to be variable among the plant parts in the two plants, ranging from 19.16 ppm to 55.69 ppm, with Oroxylum indicum L. (Vent.) stem sample from Western Ghats recording the highest level. This is in accordance with reports which state that range of copper content in 50 medicinally important leafy materials growing in India is in the range of 17.66 ppm to 56.3 ppm. Copper (Cu) is an essential redox-active transition element that play vital role in various metabolic processes. Being toxic, its quantity should be mentioned very low. It is well known that the high content of transition metal like Cu catalyzes the formation of hydroxyl (OH) radicals, hence their excess quantity can cause oxidative stress in plants and consequently increase the antioxidant response.

It is essential to the human body since it forms a component of many enzyme systems, such as cytochrome oxidase, lysyl oxidase and an iron-oxidizing enzyme in blood. The observation of anemia in copper deficiency is probably related to its role in facilitating iron absorption and in the incorporation of iron in hemoglobin. However copper deficiency in humans is a rare occurrence. Copper could be toxic depending on the dose and duration of exposure.

The permissible limit set by FAO/WHO in edible plants

MATERIALS AND METHODS

Sample collection
Whole plant parts of Oroxylum indicum L. (Vent.) were collected during the flowering season from two different geographical regions viz., Western Ghats (Village – Pophali, Kumbharli Ghat near Chiplun, dist Raigarh, Maharashtra) and Khiri village, dist Lakhimpur, Northern U.P.

The plants were identified and authenticated at Blatter’s herbarium, St. Xavier’s College, Mumbai, (Accession No 54436). The plants collected from different regions were sorted out and individual plant parts were separated.

Sample Preparation
Plant parts were washed with de ionized water and oven dried at 40 °c for four days and then subjected to grinding for powder formation. The powder was stored in air tight glass containers and used for further analysis.

Digestion
Two gram powder of each plant part was dissolved in nitric acid and heated until the reddish brown fumes disappear.

Table 1: Concentration of elements in Oroxylum indicum L. (Vent.) collected from different regions of India

<table>
<thead>
<tr>
<th>Elements Analysed</th>
<th>Western Ghats</th>
<th>Uttar Pradesh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Root</td>
<td>Stem</td>
</tr>
<tr>
<td>Cu</td>
<td>45.45</td>
<td>55.69</td>
</tr>
<tr>
<td>Na</td>
<td>279.22</td>
<td>272.98</td>
</tr>
<tr>
<td>Ca</td>
<td>4513.49</td>
<td>7708.04</td>
</tr>
<tr>
<td>Cr</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Mn</td>
<td>46.70</td>
<td>12.49</td>
</tr>
<tr>
<td>Fe</td>
<td>2288.34</td>
<td>233.77</td>
</tr>
<tr>
<td>Ni</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Cd</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Zn</td>
<td>27.85</td>
<td>59.94</td>
</tr>
<tr>
<td>Pd</td>
<td>nd</td>
<td>nd</td>
</tr>
</tbody>
</table>

(All values in ppm – microgram per gram; nd—values less than 0.01 ppm)
FIGURES: Elemental concentration in *Oroxylum indicum* L.(Vent.) collected from different regions of India.

**Figure 1:** Concentration of Copper in different plant parts collected from different regions of India (WG – Western Ghats; UP – Uttar Pradesh)

**Figure 2:** Concentration of Sodium in different plant parts collected from different regions of India (WG – Western Ghats; UP – Uttar Pradesh)

**Figure 3:** Concentration of Calcium in different plant parts collected from different regions of India (WG – Western Ghats; UP – Uttar Pradesh)

**Figure 4:** Concentration of Manganese in different plant parts collected from different regions of India (WG – Western Ghats; UP – Uttar Pradesh)

**Figure 5:** Concentration of Iron in different plant parts collected from different regions of India (WG – Western Ghats; UP – Uttar Pradesh)

**Figure 6:** Concentration of Zinc in different plant parts collected from different regions of India (WG – Western Ghats; UP – Uttar Pradesh)
Calcium: Calcium is an important trace element because of its role in bones, teeth, muscular system and heart functions. It is required for absorption of dietary Vit. B, for synthesis of neurotransmitter acetylcholine and is also required for activation of enzyme pancreatic lipase. It is observed that amongst all the metals studied in the analyzed samples, calcium accumulation is highest in all parts than the concentration of other metals. Maximum concentration is found in leaves than the other plant parts. U. P root sample showed the lowest concentration 3275.90 ppm while U.P. leaf has the highest amount i.e. 106.57 ppm.

Chromium: Chromium is known to regulate carbohydrate, nucleic acid and lipoprotein metabolism and it also potentiates insulin action. Chronic exposure to Cr may result in liver, kidney and lung damage. Chromium also acts as an activator of several enzymes. Deficiency of chromium decreases the efficiency of insulin and increases sugar and cholesterol in the blood. Chromium deficiency can cause an insulin resistance, impair in glucose tolerance and may be a risk factor in atherosclerotic disease. The permissible limit for chromium as set by FAO/WHO in edible plants is 0.2 ppm. However the permissible limit for medicinal plants has not yet been set. The chromium concentration in all the samples studied was below the permissible levels.

Manganese: The highest concentration of manganese found in the sample, UP leaf was 10657.53 ppm and the least was found in W. Ghat stem i.e. 12.49 ppm. The permissible limit for Mn is 2 ppm in edible plants. However the permissible limit for medicinal plants has not yet been set. The chromium concentration in all the samples studied was below the permissible levels.

Iron: The permissible level set by WHO for Iron in edible plants was 20 ppm. Iron is important for the formation of haemoglobin and also plays an important role in oxygen and electron transfer in human body. In all the samples studied, the amount of iron accumulated is much higher than the permissible levels. Studies suggest that the intake of Iron in higher concentration is hazardous to health. W.Ghat root sample showed highest concentration 2288.34 ppm and lowest concentration was found in W.Ghat stem, 233.77 ppm.

Nickel: Nickel is considered to be highly mobile element within a plant. Accumulation of Ni takes place only in the leaves. Ni toxicity in human is not very common occurrence as its absorption by the body is very low. The permissible limit for nickel set by WHO in edible plants was 1.63 ppm and the amount of nickel concentration in all the samples analyzed was below the permissible level. The permissible limits for medicinal plants have yet not been set.

Cadmium: Cadmium is toxic metal having functions neither in human body nor plants. Accumulation of Cd in kidney leads to high blood pressure and renal diseases. Its accumulation also leads in damaging the nerve cells, inhibition of release of acetylcholine and activation of choline esterase enzyme, resulting in a tendency for hyperactivity of the nervous system.

The permissible level (WHO) for cadmium in edible plants was 0.21 ppm and for medicinal plants is 0.3 ppm. The amount of cadmium concentration in all the samples analyzed was found to be within the permissible limits. This may be due to low level of cadmium present in the available soil for plant growth.

Lead: Exposure to increased concentrations of lead is a health hazard. The permissible limit for lead set by FAO/WHO in edible plants was 0.43 ppm. The amount of lead concentration in all the samples analyzed was in minimal amount and well below the permissible level.

Zinc: Zinc is essential to all organisms and has an important role in metabolism, growth, development and general wellbeing. It is an essential co-factor for a large number of enzymes in the body. Zinc deficiency leads to coronary heart diseases and various metabolic disorders. Highest amount found in W. Ghat plant stem 59.94 ppm and lowest in 17.60 ppm in U.P. stem.

The results above indicated that the plants contain large amounts of nutrients and are rich in Fe, Copper, Ca and Na. The abundance of Fe, Ca and Cu, in the result of this analysis, was in agreement with previous findings that these three elements represent the most abundant metal constituents in plants. High contents of Ca are important, because of its role in human and studied plants show satisfactory level of Ca accumulation.

CONCLUSIONS

In view of above facts, the medicinal plant, Oroxylum indicum L. (Vent.) studied is a source of biologically important elements, which may play a part in the observed therapeutic use of this plant. Ayurvedic formulations do demonstrate
significant success in treatment of many diseases. These medicines contain trace elements whose activity has an impact on its overall pharmacological action. There is no direct link that has been established between elemental content and curative capability of the plant. But such studies will help us to understand the pharmacological action of the herb and thus provide the vital link between the two. The data obtained in the present work will be helpful in the synthesis of new Ayurvedic drugs which can be used for the control and cure of various diseases. However, in order to develop a stronger basis for appreciating the curative effects of medicinal plant, *Oroxylum indicum* L.(Vent.) there is a need to study the effect of soil and climatic conditions on the elemental contents of this medicinal plant. Medicinal plant *Oroxylum indicum* L.(Vent.) is rich in metals Fe, Copper, Ca and Na and it is expected that plants with high contents of the above-mentioned macro and micronutrients, might play an important role in maintenance of human health. Also, all of the detected values for metallic elements in plant studied here are below the WHO permissible levels and may not constitute a health hazard for consumers.

**REFERENCES**