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Elemental status of the medicinal plant-*Moringa oleifera*

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ABSTRACT

Different elements at trace levels of plants play an effective role in the medicines prepared. Characterization of elements in different parts of Moringa oleifera including leaves, stems and seeds has been studied using Scanning Electron Microscope (SEM) with an energy dispersive x-ray spectrometer (EDX). The present paper work highlights the elemental profile of this plant. Analysis was carried out for individual plant part (leaves, stems and seeds) of Moringa oleifera. The plant samples were found to contain essential elements such as sodium, magnesium, calcium, potassium, copper and zinc which are well known for their important roles in herbal drugs. Most of the medicinal plants were found to be rich in one or more of the essential elements under study. The obtained data will be helpful for making medicinal formulation and deciding dosage of the medicine made from this plant.

Graphical Abstract

Moringa leaves *Moringa* stems *Moringa* seeds

Highlights

- Elemental profile of the three parts of *Moringa oleifera* was studied using SEM-EDX.
- The samples consist of elements such as Sodium, Magnesium, Calcium, Potassium, Copper and Zinc.
- The present findings will be useful in the preparation of medicine.

Keywords: Elemental profile, medicinal plants, *moringa oleifera*, SEM-EDX.

INTRODUCTION

Medicinal plants are the oldest known health care products used for the treatment of various ailments. They are rich source of antioxidants and essential inorganic elements [1]. They may also contain toxic

elements as well. The medicinal plants are gaining popularity as alternative and complementary therapies around the world because human body is more accustomed to natural products. Therefore, scientific studies of medicinal plants are required to test their potentials and characterize the medicinal properties. Moreover, medicinal plants contain several bio-chemical substances that produce definite physiological actions in the metabolism of the human body. Inorganic elemental levels present in medicinal plants are of great importance due to their pharmacological actions [2]. Quantification of essential and toxic inorganic elements is an important task in determining the effectiveness of the medicinal plants in treating certain diseases.

In this modern era of research and technology this futile search still continues to discover novel herbal drugs and alternate source of nutritional supplements. One such promising tree which has successfully cleared all the tests of nutritional benefits, medicinal properties, environmental and consumption safety is the perennial, multipurpose, softwood-tree *'Moringa oleifera'* of the monogenetic family Moringaceae. M. oleifera is reputedly known as 'horseradish' tree, 'drumstick' tree, 'ben-oil tree' or 'benzoyl tree', 'cabbage tree', 'mother's best friend' and 'miracle tree'. It is a native of Indian sub-continent and is cultivated worldwide owing to its numerous utilities [3-5]. A single Moringa tree can provide leaf as a source of nutrition for human and livestock, seed-oil for cooking and biodiesel, seed-cake for water purification and wood to build shelter. Every part of this tree is edible and the leaves, roots, seeds, root-bark, stem-bark and pods have medicinal properties. The unopened flowers are eaten as vegetable or used to make tea which provides adequate amounts of calcium and potassium. The young pods are also used in various culinary preparations and pickles [6]. *Moringa* was highly valued in the ancient world. The history of *Moringa* dates back to 150 B.C. which reveals that the ancient kings and queens preferred *Moringa* leaves and fruit in their diet to sustain mental alertness and healthy skin. The ancient Marian warriors of India were fed with *Moringa* leaf extract in the warfront. The elixir-drink was assumed to add them extra vigour and relieve them of the trauma incurred during war [7]. In present study an attempt was made to determine essential elements present in three parts of the plant- *Moringa oleifera* by using SEM-EDX analysis.

MATERIALS AND METHODS

Sample collection: The leaves, stems and seeds of *Moringa oleifera* were collected from local area of Hyderabad region and were washed with running tap water and then with distilled water. All materials were air-dried, powdered and protected from light until further analysis.

Moringa leaves. *Moringa* stems. *Moringa* seeds.

Figure 1. Plant materials of *Moringa oleifera*

RESULTS AND DISCUSSION

Energy Dispersive X-ray Spectroscopy (EDX) analysis: Scanning electron microscopy is a powerful technique which allows evaluating morphological changes on the surface, for example, changes in the cell wall composition after the metal ions binding. When SEM is combined with EDX technique, it can provide valuable input in determining the distribution of various elements on the surface [8]. The plant powder samples were subjected to the elemental analysis using Scanning Electron Microscope (SEM) with an energy dispersive x-ray spectrometer (EDX).

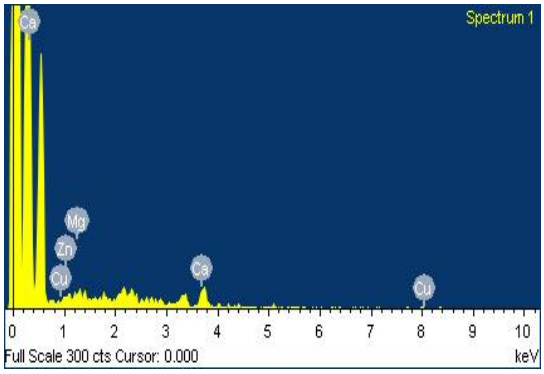

Figure 2. SEM-EDX spectrum of *Moringa oleifera* leaf powder.

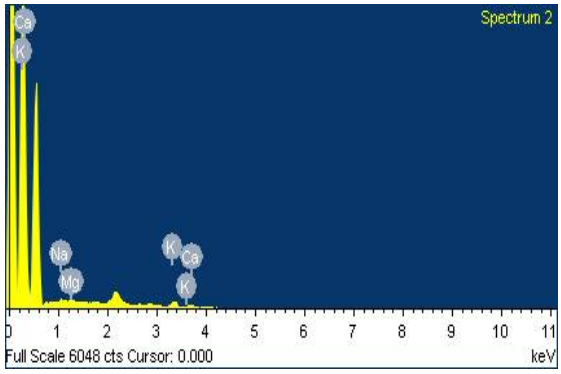

Figure 3. SEM-EDX spectrum of *Moringa oleifera* stem powder.

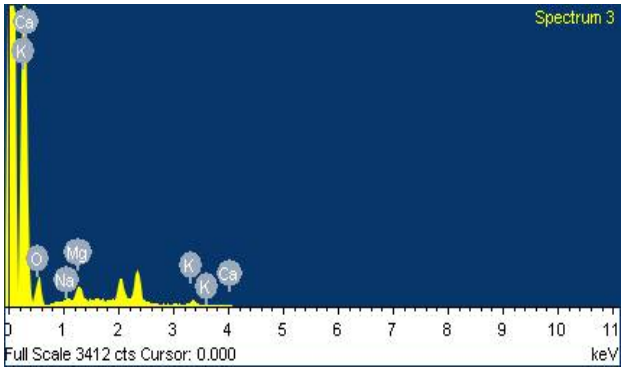

Figure 4. SEM-EDX spectrum of *Moringa oleifera* seed powder.

The SEM–EDX spectra of the different parts of the plant were showed in figures 2-4. The results of the elemental composition of various parts of selected medicinal plant using SEM - EDX technique were showed in table 1 and it was shown graphically in the figure 5. Calcium, magnesium, copper and zinc are present in the leaves; potassium, calcium, sodium and magnesium are in stems and seeds of the plant. The most abundant macroelements found in our analysis were Ca, Mg, and K.

In contrast, the K content was higher in the stems and seeds, while Ca was rich in leaves of the plant.

Table 1: Weight percentage of elements in the different parts of the plant

Part of the plant	**Mg**	**Ca**	Cu	Zn	Na	**K**
leaves	5.03	**76.90**	2.43	15.64	---	---
stems	7.48	23.16	---	---	9.34	**60.03**
seeds	16.58	0.82	---	---	1.93	**18.43**

Moringa oleifera is perhaps the most useful traditional medicinal plant found in several African and Asian countries. Anecdotal evidence of the benefits of *Moringa oleifera* has fuelled a recent increase in the exploitation and attention to its many healing benefits, specifically the high nutrient composition of the leaves, stems and seeds. The most abundant macro elements found in our analysis were Ca, Mg, and K. The elements Ca and Mg are present in all the three parts of the plant and the elements K and Na are present in stems and seeds of the plant, while Zn and Cu are only in the leaves. In the Philippines, *Moringa oleifera* is known as “the mother’s best friend” due to its use to increase nursing Mothers’ milk production [**9**]. This effect can be attributed to Cu and Zn, which are essential in increasing the rate of pregnant female milk production [**10**]. Calcium is an essential

element for plants, animals and human. It is an integral part of bones, teeth and blood. It is required for absorption of dietary Vitamin B and is also required for activation of enzyme pancreatic lipase [**11**]. Our results have shown that the given leaves of the plant are rich source of calcium. Magnesium is essential to all living cells, where they play a major role in the functioning of important biological polyphosphate compounds like ATP, DNA and RNA. The finding revealed that higher potassium contents in the stems and seeds of this plant make better for hypertensive patient since potassium reduces blood pressure. The stems and seeds are moderate source of sodium, can be used to control blood pressure and blood volume. Our body also needs sodium for our muscles and nerves to work properly. The elemental profile of the selected medicinal plant *Moringa oleifera* is responsible for various medicinal properties, which plays a vital role in regulating body's Chemistry.

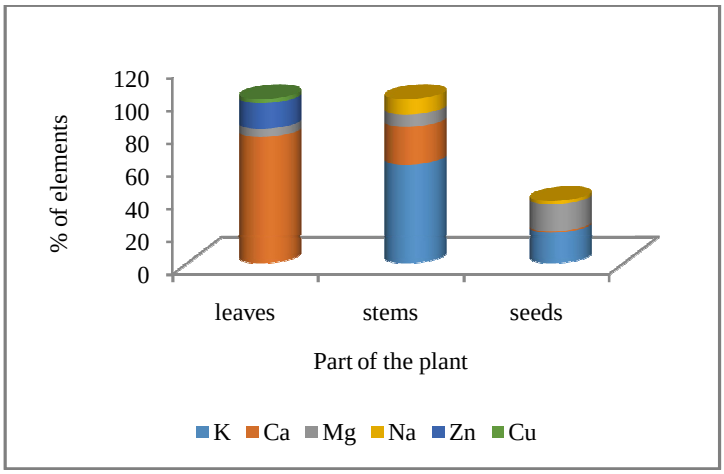

Figure 5. Weight Percentage of elements present in the parts of the *Moringa oleifera*..

APPLICATION

The present study of elemental analysis of the medicinal plant reveals the presence of various elements which are the required nutrients for the metabolism of our body.

CONCLUSION

The elemental analysis of *Moringa oleifera* shows that it is rich in biologically important elements which have therapeutic values hence, it could serve as supplement of macro and micro elements in the body. The data obtained in the present work will be useful in synthesis of new herbal drugs, which can be used in the treatment of different diseases at global level generally.

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