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Study on Trace Elemental Concentrations and Structural Morphology of Cancer Cure Medicinal Plant using SEM-EDX Method

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ABSTRACT:

The objectives of the study are to estimate the concentrations of trace elements and examine the structural morphology of Taraxcum officinale leaves used in the treatment of certain cancer disorders. Using Scanning Electron Microscope-Energy Dispersive X-ray (SEM-EDX) to analyze the trace elements present in the Taraxcum officinale leaves. This method allows for the identification and quantification of elements present in the sample. Fresh leaf sample of Taraxcum officinal medicinal plant was collected from Bidar, Raichur and Bijayapura districts of North- East Karnataka, India. The result of study were identified and their concentrations were estimated several trace elements in the plant sample, including Carbon (C), Oxygen (O) Magnesium (Mg), Al (Aluminum), Silicon (Si), Molybdenum (Mo), Cadmium (Cd), Potassium (K), Antimony (Sb), Calcium (Ca), Titanium (Ti), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni) and Zinc (Zn) and structural morphology using SEM-EDX. These elements are known to be present in varying quantities in plants. The presence of numerous trace elements concentrations in Taraxcum officinale suggests that the plant may have therapeutic potential in the treatment of various cancer conditions. Many studies have explored the medicinal properties of dandelion, including its potential anti-cancer effects.

Keywords: Medicinal plant, Taraxcum officinale Trace elements, Cancer, Scanning electron microscope- energy dispersive x-ray spectroscopy

INTRODUCTION:

Cancer disease is basically caused by uncontrolled and abnormal cell growth cycling and division resulting in tumors that may spread throughout the body [1]. Cancer cells typically attack as well as obliterate normal cells. Genetic changes occur at many levels, from gain or loss of entire chromosomes to a mutation affecting single DNA nucleotides. Tumor suppressor genes are which inhibit cell division, survival or other properties of cancer cells. Tumor suppressor genes are often disabled by cancer-promoting genetic changes. Typically changes in many genes are required to transform a normal cell in to a cancer cell [2]. Cancer is a major public health burden in both developed and developing countries. Cancer is the second leading cause of death in the United States [3], where one in four deaths are due to cancer. Plants have long been used in the treatment of cancer [4]. The National Cancer Institute collected about

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35,000 plant samples from 20 countries and has screened around 114,000 extracts for anticancer activity [5]. Of the 92 anticancer drugs commercially available prior to 1983 in the US and among worldwide approved anticancer drugs between 1983 and 1994, 60% are of natural origin [6].

Micro elements play a significant role in maintaining health and preventing diseases including cancer, through a wide range of mechanisms, anti-oxidation, anti-proliferation and repair of DNA damage. Direct and indirect relationship between micronutrients and health has been described in experimental, epidemiological and clinical trials. Vitamin deficiencies, specifically of vitamins A, C and E may contribute to the high prevalence of oral cancers in India [7].

Medicinal plant, including Taraxcum officinale leaves, has been used for centuries in indigenous cultures and traditional medicine systems like Ayurveda, Traditional Chinese Medicine, and Native American herbalism. These plants contain bioactive compounds with anti-inflammatory, antimicrobial, analgesic, and antioxidant properties. They are also used as dietary supplements to promote general health and well-being. The leaves, roots, and fruit have various beneficial properties [8].

The study aims to estimate trace elemental concentrations and structural morphology of Taraxcum officinale leaves, a medicinal plant used to treat cancer. The SEM-EDX method was used to analyze the plant's elements, revealing their importance in cancer treatment and its traditional use in traditional medicine.

MATERIALS AND METHODS:

2.1. Collection of medicinal plant

Fresh leaf sample of Taraxcum officinal medicinal plant of image is shown in figure 1, was collected from Bidar, Raichur and Bijayapura districts from, North- East Karnataka, India. Details of medicinal plant as shown in Table1.

Sample preparation and Elemental analysis

These leaves were washed in tap water and rinsed thoroughly with double distilled water in order to remove surface contamination, dried in shade laboratory at room temperature about 35 days and subsequently powdered by using Electrical Grinder. A quantity of each powdered samples 250 grams was weighted. For EDX Technique the dried 10mg leaves fine powder sample was taken and prepared a pallet of 1 cm^2 disks, and the powder sample was coated with 15 nm thick gold layers for contact purposes and these samples were kept for about 30 min one at a time and subjected for elemental analysis.

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2.2 Instrumentation

Energy Dispersive X-ray Spectroscopy (EDX) Analysis

Scanning electron microscopy is a powerful technique which allows evaluating morphological changes on the surface. When SEM is combined with the EDX technique, it can provide valuable input in determining the distribution of various elements on the surface. The plant powder samples were subjected to the elemental analysis using Scanning Electron Microscope (SEM) with an energy dispersive x-ray spectrometer (EDX).

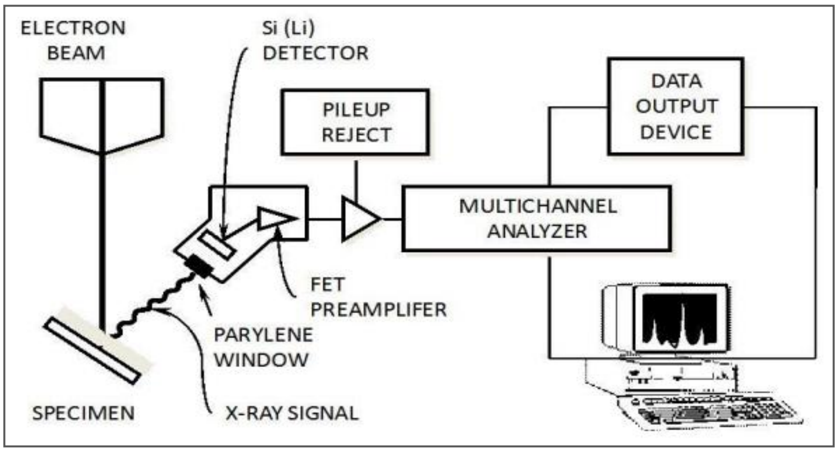

Figure 2: SEM-EDX (Scanning Emission Microscope-Energy Dispersive x-ray)

Figure 2 show that the Scanning Electron Microscopy (SEM) provides a high resolution, high magnification image of a sample material by emitting a finely focused beam of electrons onto a sample. This beam interacts with the molecular composition of the sample. These interactions produce a series of measurable electron energies that are analyzed by the scanning electron microscope to create a three dimensional image. The beam of electrons emitted on the sample also produces x-rays. The energy dispersive x-ray (EDX) instrument collects the x-rays and converts them into useful information. Each element has a set of characteristic x-ray lines. The energy dispersive x-ray technique is utilized to identify the element and measure the composition of the sample material. The output from the EDX analysis is a spectrum. The EDX spectrum is a plot of how frequently an x-ray is received for each energy level. An EDX spectrum normally displays peaks corresponding to the energy levels (when the most x-rays were received). These peaks are generally unique to an element. Higher peaks in the spectrum indicate higher concentrations in that element. Overlapping peaks from mixtures are deconvolved using special computer Software. Energy dispersive x-ray systems are often attachments to scanning electron microscopy instruments. Typically scanning electron microscopy provides the visual analysis and energy dispersive x-ray provides the elemental analysis. Scanning electron microscopy with energy dispersive x-ray is a powerful tool to classify and discriminate materials because they can simultaneously examine the morphology and the elemental composition of objects. Some of the typical applications of SEM/EDX are

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identification and classification of different material structures, examination of surface morphology, particle contamination identification, structural analysis, and forensic examinations, identification of corrosion and oxidation problems, product and process failure.

RESULTS & DISCUSSION

In the current analysis, Seventeen trace elements C, O, Mg, Al, Si, MO, Cd, K, Sb, Ca, Ti, Cr, Mn, Fe, Co, Ni and Zn were determined as well as measured their concentrations using energy dispersive x-ray (EDX) method. The results of concentrations measured in weight percentage (%) were shown in Table 2 and details of medicinal plant (Taraxcum officinal) were shown in Table 1. These results were compared to all samples' accuracy-certified values, which showed excellent agreement with the standard values.

Table 1: Details of medicinal plant sample

SL. No	**Botanic name**	**Common name**	**Local name**	**Family**	**Sample code**	**Parts used**	**Medicinal uses**	**Image of plant**
1	Taraxcum officinale	Dandelion	Kadushevanthi	Asteraceae	KAI	Leaves	cancer	

Table 2: Concentrations of trace elements in weight percentage (%) of Taraxcum officinale Medicinal plant from three districts of North- East Karnataka region.

SL.NO	Element	B1KAI	RKAI	B2KAI
1	C K	51.35	50.56	49.27
2	O K	40.28	40.38	38.53
3	MgK	0.18	0.12	0.18
4	AlK	0.05	0.04	0.07
5	SiK	0.04	0.01	0.04
6	MoL	0.26	0.12	0.10
7	CdL	0.09	0.00	0.00
8	K K	4.28	5.25	4.79
9	SbL	0.15	0.16	0.69
10	CaK	1.74	0.16	3.50
11	TiK	0.09	2.09	0.07
12	CrK	0.05	0.00	0.25
13	MnK	0.11	0.20	0.18
14	FeK	0.05	0.13	0.10
15	CoK	0.23	0.20	0.19
16	NiK	0.07	0.04	0.26
17	Zn	ND	ND	0.42

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3.1 Surface morphology using SEM-EDX data

Experimental Analysis

Energy Dispersive X-ray Spectroscopy (EDX) Analysis

Scanning electron microscopy is a powerful technique which allows evaluating morphological changes on the surface. When SEM is combined with the EDX technique, it can provide valuable Input in determining the distribution of various elements on the surface in different weight percentage. The plant powder samples were subjected to the elemental analysis using Scanning Electron Microscope (SEM).Figure 3 depicts surface morphological investigations of the current the plant powder samples were subjected to the elemental analysis using Scanning Electron Microscope (SEM). Surface morphology of BIKAI shows granular morphology with thin sheet in the center of spectrograms and crystalline morphology. The morphology of RKAI distinct irregular shapes of the trace medicinal plant powder. Finally, the morphology of B2KAI shows congested small circular groups shown in below figure 3 and table1.

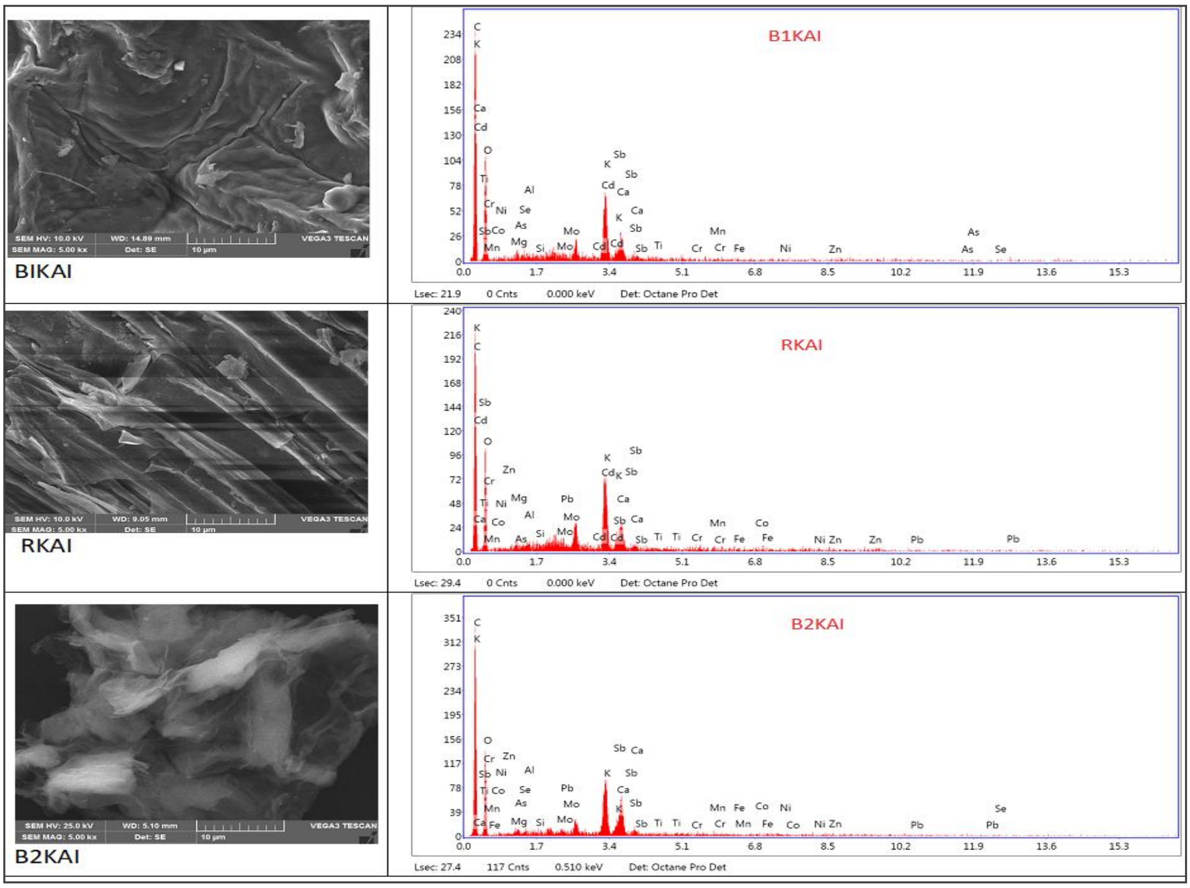

Figure 3: Structural Morphology and EDX spectrum of Taraxcum officinale medicinal plant Leaves; A) BIKAI; B) RKAI; C) B2KAI.

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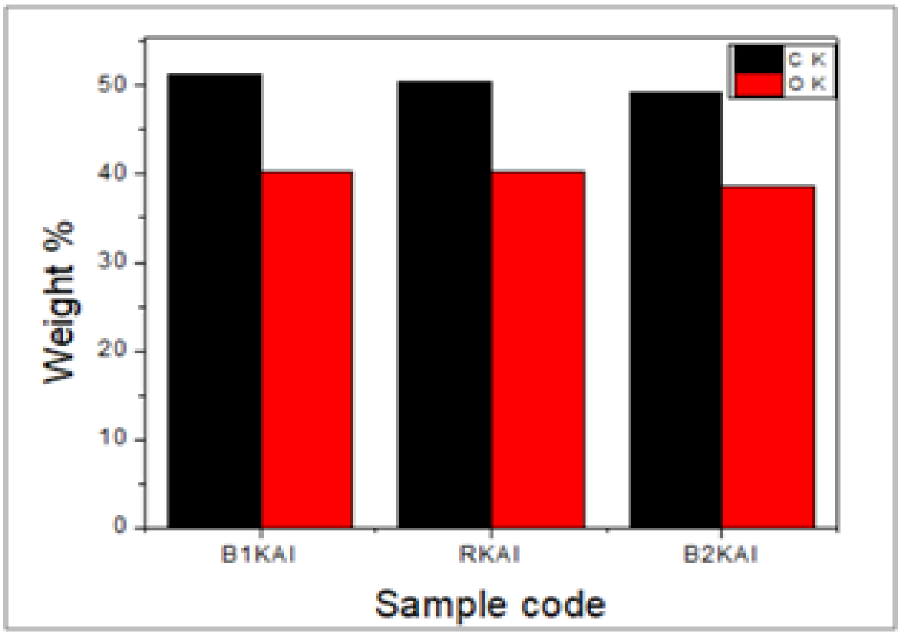

Figure 4: Variation of C and O in Taraxcum officinale leaves

The seventeen trace elements namely C, O, Mg, Al, Si, Mo, Cd, K, Sb, Ca, Ti, Cr, Mn, Fe, Co, Ni and Zn were done in the present plant samples by using energy dispersive x-ray spectrometer (EDX). Table 2 shows the measured concentration values of the present study. The results of energy dispersive x-ray spectrometer (EDX) measurements are among all the trace elements it is clear that calcium (Ca) and Magnesium (Mg) are the most abundant detected elements (major elements) which are quantified in percentage level whereas other elements are found to be in percentage level (%). The essential elemental concentrations of C, O, Mg, Al, Mo, Cd, K, Sb, Ca, Ti, Cr, Mn, Fe, Co, Ni and Zn are present in these plant samples. The weight percentage of carbon (C) varied from (49.27% to 51.35%) in Taraxcum officinale leaves of Bidar Raichur and Bijayapura I North- West Karnataka as shown in figure 4. The oxygen (O) varied from (38.53% to 40.38%) in Taraxcum officinale leaves of Bidar Raichur and Bijayapura I North-West Karnataka as shown in figure 4.

This gives a wide variation in their elemental concentration values of essential trace elements shown in figure 5. The maximum concentration of K is observed in Raichur district (5.25%) and minimum concentration is observed in case of Bidar district (4.28%) as shown in figure 5. Potassium (K) is an important part in regulation of water balance of the body, it is extremely important to cell and without it we could not survive [9]. The concentration of Mg range varied from (0.12 % to 0.18 %) in Taraxcum officinale leaves as shown in figure 5. Magnesium (Mg) is an essential mineral that plays various roles in the human body, but it is not typically used as a primary treatment for cancer. Cancer treatment generally involves surgery, radiation therapy, chemotherapy, targeted therapy, immunotherapy, or a combination of these approaches, depending on the type and stage of cancer [10].

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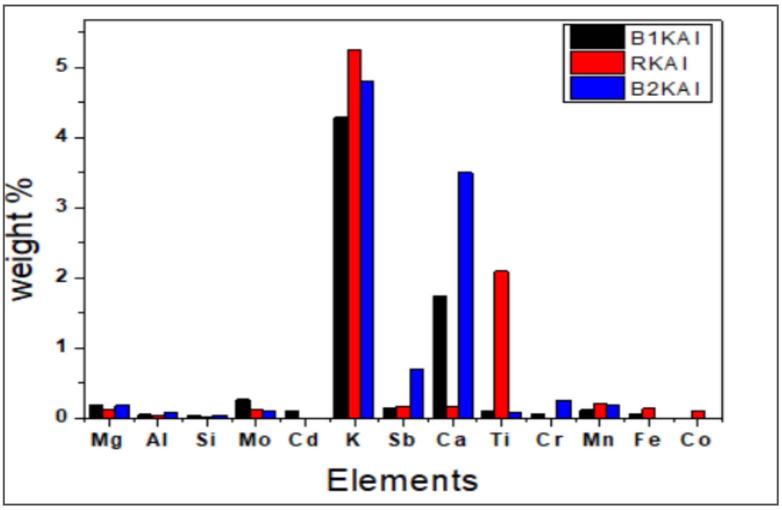

Figure 5: variation of trace elemental concentrations in Taraxcum officinale leaves

The concentration of Ca is high in Bidar district (1.74%) is compared to certified values of other two districts in Taraxcum officinale leaves. This gives a wide variation in their elemental concentration values of essential trace elements shown in figure 5. Mn present at minor levels in all the districts in medicinal plant. The maximum concentration (in this minor level of concentration) of Mn is observed in Bijayapura district in Taraxcum officinale and minimum concentration is observed in Bidar district Taraxcum officinale as shown in figure 5 . Mn is an important mineral in maintaining the body immune system since it is responsible for several metabolic and enzymatic processes [11]. The excess of Mn can cause toxic; in brain it can cause a Parkinson type syndrome [12]. Manganese is required for the formation of connective tissues, bone health, and the metabolism of amino acids, carbohydrates, and cholesterol. Iron is found to be high concentration in Raichur district (0.13%), which compared to other two districts in Taraxcum officinale. Fe plays an important role in the formation of hemoglobin and certain enzymes. Iron deficiency [13]. Iron is vital for the formation of hemoglobin, the protein in red blood cells that carries oxygen throughout the body. It also plays a role in energy metabolism. The maximum concentration of Mo (Molybdenum) is observed in Bidar district (0.26%) and minimum in Raichur and Bijayapura districts (0.12% and 0.10%) as shown in figure 5. Molybdenum is a cofactor for enzymes involved in the metabolism of amino acids and the detoxification of certain compounds [14]. Cu is an important enzymes involved in a number of vital processes. Excessive dietary of Zn can cause Cu deficiency; chronic Cu toxicity is rare in humans and mostly associated with liver damage [15]. The concentration of Zn is found in the range of (0.46%) in Bijayapura district as shown in figure 5. Zn is involved in the activity of about 100 enzymes example RNA polymerase and Carbonic anhydrate. It is also essential for the creation, release and use of hormones in the body. Zn deficiency is common in under developed countries and is mainly associated with malnutrition, affecting the immune system [16 17]. In the present study we have discussed with their highest and lowest concentrations of selected cancer medicinal plant samples and also discussed their significances of the trace elements.

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Other elements like Al, Si, Cd, Sb, Ti, Cr, Co, Ni, and Zn are the concentrations are very less. The concentrations of elements such as Aluminum (Al), Silicon (Si), Cadmium (Cd), Antimony (Sb), Titanium (Ti), Chromium (Cr), Cobalt (Co), Nickel (Ni), and Zinc (Zn) in Taraxcum officinale are well within the permissible limits set by the World Health Organization (WHO). This indicates that the plant does not contain excessive or potentially harmful levels of these elements, making it safe for consumption or other uses as a medicinal plant.

CONCLUSION:

The current investigation provides the information on the trace elemental concentrations of Taraxcum officinale leaves Ayurvedic medicinal plant in North – East Karnataka regions of Bidar, Raichur and Bijayapura districts. Taraxcum officinale leaves Ayurvedic medicinal plant collected and examined by using high efficient fluorescence methods such that SEM-EDX (Scanning Electron Microscope - energy dispersive x-ray spectrometer). Moreover, the present analysis represents that all detected elements are shown within the permissible limits of WHO/FAO. Present studied data it is useful to the new researchers, medicinal practitioners to prepare new health drugs and promote the society. The analyzed elemental concentrations' viz., Mg, Al, Si, Mo, Cd, K, Sb, Ca, Ti, Cr, Mn, Fe, Co, Ni and Zn are under the limits of national and international medicinal plants quality control bodies' viz., WHO/FAO and to studied structural morphology of Taraxcum officinale leaves. These are trace elements most significant role in treatment of cancer.

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