LABORATORY STUDY

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Analysis of Trace elements of medicinal plants used for cancer therapy by Flame Atomic Absorption Spectrometer

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ABSTRACT: The elemental analysis was carried out by using model of Thermo Scientific iCE 3000 Series at USIC Department, Gulbarga University, Kalaburgi, Karnataka, India. Flame Atomic Absorption Spectrometer (FAAS) technique is used to analyse 11 elements (Mg, Al, Si, Ca, V, Cr, Mn, Fe, Cu, Zn and Mo) in different medicinal plants, used for cancer treatment. Present study gives the information of the concentrations of trace elements in these samples located in North- Karnataka region of Kalaburgi district. These elements play a crucial role in the development and progression of cancer and recent findings had a significant impact on cancer treatment. These trace elemental concentrations are under the limits of national and international medicinal plants quality control bodies' viz., WHO/FAO.

Key words: Trace elements, medicinal plants, cancer, standard and Flame Atomic Absorption Spectrometer.

Introduction

Cancer is a significant public health issue in both developed and developing countries, arising from various types of cells due to imbalances in the body[1], [2]. Major causes include smoking, diet, and hormone imbalances[3]. Breast and colorectal cancer are the most prevalent in women and men globally. Understanding the type, size, spread, and treatment response is crucial. Digestive track cancers are prevalent aging-related diseases[4]. Preventive measures include dietary changes, while chemotherapy and radiation treatments cause toxicity. Due to high death rates and side effects, patients seek alternative treatments[5].

Micronutrients and trace elements are crucial for maintaining health and preventing diseases, including cancer[6]. Medicinal plants, rich in these elements, have been used for cancer treatment. They also serve as a reliable alternative to chemical drugs, providing 80% of rural residents with a safe alternative[7]. Most studies focus on essential oils, vitamins and glycosides, but little is known about the elemental composition of plants. Medicinal plants contain both organic and inorganic constituents and the human body requires a number of constituents in order to maintain good health[8]. Most of the studies have been done on important constituents and little has been reported about the elemental composition of the plants[9]. Every constituent plays an important role in the formation of these compounds and deficiency of any constituent may lead to abnormal development in the human body[10].

In this present analysis objectively, specific laboratory technique employed, such as Atomic Absorption Spectroscopy (AAS). This technique provides precise and quantitative data about the trace element content in ayurvedic medicinal plants.

Materials and method

Collection of medicinal plants

The images of different families of traditional medicinal plants such as Millettia Pinnata, Cassia tora, Withania somnifera, Xanthium strumarium,

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Table 1
List of medicinal plants selected for the current study

SI.No	Botanical Name	Sample code	Common name	Local name	Family	Parts used
1	Millettia pinnata	HOA	karanja	Honge mara	Fabaceae	seed
2	Cassia tora	CHE	Sickle senna	Chagache	Fabaceae	Leaves
3	Withania somnifera	ASA	Ashwagandha	Ashwagandha	Solanaceae	Leaves
4	Xanthium strumarium	MAI	Common cocklebur	Murullumatti	Asteraceae	Leaves
5	Nerium oleander	KAO	Oleander	Kangalo huvoo	Apocynaceae	Leaves
65	Euphorbia hirta	HAA	Asthma tree	Hachhegida	Euphorbiaceae	Leaves

HOA- Honge mara (*Millettia pinnata*), CHE- Chagache (*Cassia tora*), ASA- Ashwagandha (*Withania somnifera*), MAI- Murullumatti (*Xanthium strumarium*), KAO- Kangalo huvoo (*Nerium oleander*), HAA- Hachhegida (*Euphorbia hirta*)

Figure 1

Cancer Medicinal plants: *A) Millettia pinnata; B) Cassia tora; C) Withania somnifera* D) Xanthium strumariun; E) Nerium oleander; F) Euphorbia hirta.

A). *Millettia pinnata*

B) *Cassia tora*

C) *Withania somnifera*

D) *Xanthium strumarium*

E) *Nerium oleander*

F) *Euphorbia hirta*

Nerium oleander, and Euphorbia hirta, and their selected parts (leaves and seed), which were collected from different places in Kalaburgi district in the North- Karnataka region, India. Table 1 and Figure 1 both provide illustrations of the list of medicinal plants together with their botanical names, common names, family names, and local names etc.

Sample preparation and elemental analysis

These leaves and seed were washed in tap water and rinsed thoroughly with double distilled water in order to remove contamination, dried in shade laboratory at room temperature about 35 days and subsequently powdered by using Electrical Grinder. A quantity of pure 250 grams of each powder sample was weighted.

0.20g each of the powdered plant seeds and leaves samples digested in 7 ml of acid solution (HNO_3, H_2SO_4, $HClO_4$ in the ratio of 5:1:1). The corresponding solution was heated until white fumes had appeared. The clear solution was diluted up to 100 ml with distilled water and filtered with Whatman filter paper no.42, for the elemental analysis using FAAS technique.

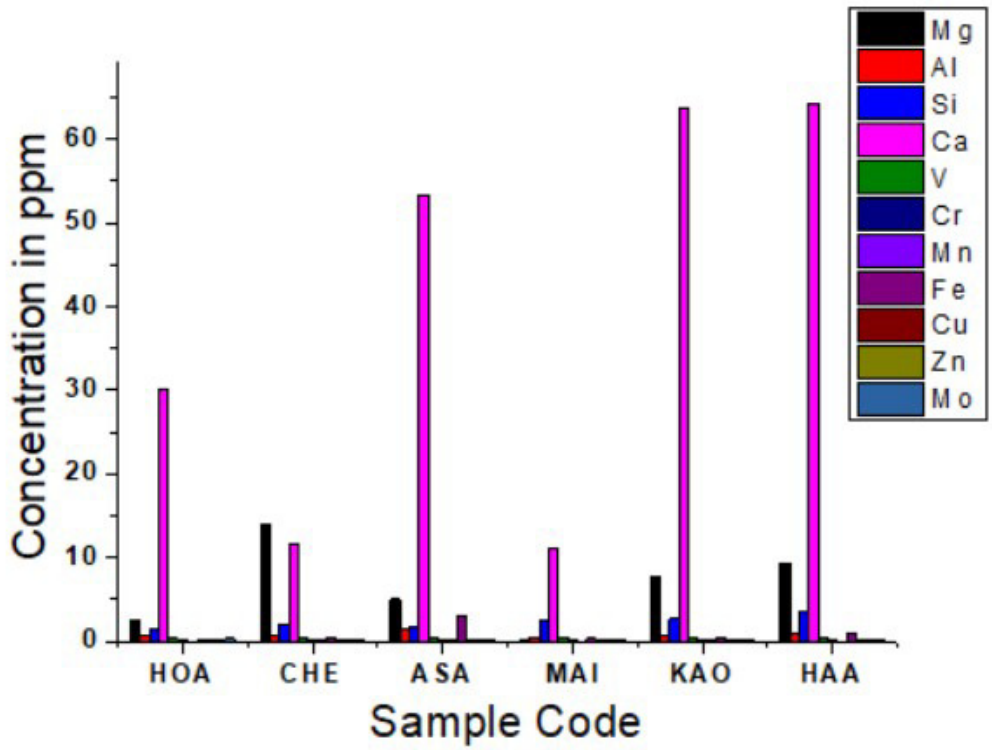
Instrument

The "iCE 3000 series Atomic Absorption Spectrometer from Thermo Scientific" is the device used and is fully automatic for element identification. C_2 H_2 and $N_2OC_2H_2$ flames are used with the AAS Spectrometer in this work.

Results & discussion

The result of the current study is analyzing the 11 different trace elements namely Mg, Al, Si, Ca, V, Cr, Mn, Fe, Cu, Zn and Mo in 6 different families ayurvedic medicinal plants. The below Table 2 shows the data of the trace elements in various

Figure 2
Concentration of elements in medicinal plants
HOA- Honge mara, CHE- Chagache, ASA- Ashwagandha, MAI- Murullumatti, KAO- Kangalo huvoo, HAA- Hachhegida, Mg-Magnesium, Al-Aluminium, Si- Silicon, Ca-Calcium



proportions and the resultant variation of trace elemental concentrations in ayurvedic medicinal plants is mainly associate to the differences in botanical structure, as well as in the mineral composition of the soil in which the plants are cultivated.

Magnesium (Mg): High concentration of Mg found in *Cassia tora* (CHE), while low concentration of Mg found in *Millettia pinnata* (HOA) as shown Figures 2 and 3. Magnesium is essential for hundreds of biochemical reactions in the body, including DNA and RNA synthesis[11].

Table 2
The concentration of trace elements (ppm) in medicinal plants collected from Kalaburgi

SL. No.	Sample Code	Mg	Al	Si	Ca	V	Cr	Mn	Fe	Cu	Zn	Mo
1	HOA	2.49	0.5917	1.4233	30.13	0.2994	0.0277	0.0061	0.0119	0.1085	0.2524	0.3465
2	CHE	13.95	0.7099	1.9580	11.54	0.3390	0.0344	0.2050	0.4210	0.1338	0.1669	0.2066
3	ASA	5.03	1.4174	1.8051	53.33	0.4624	0.0310	0.0352	2.9506	0.1476	0.1779	0.1762
4	MAI	0.11	0.4639	2.6093	11.08	0.4939	0.0278	0.0121	0.3369	0.1729	0.1241	0.1076
5	KAO	7.70	0.7912	2.6661	63.74	0.4806	0.0256	0.0386	0.4551	0.1781	0.1136	0.0690
6	HAA	9.39	0.9612	3.6195	64.22	0.3411	0.0288	0.0242	0.9963	0.2273	0.1948	0.0783

HOA- Honge mara, CHE- Chagache, ASA- Ashwagandha, MAI- Murullumatti, KAO- Kangalo huvoo, HAA- Hachhegida.

Role of Mg to maintain adequate magnesium levels can help alleviate muscle cramps, fatigue and neuropathy, which are common side effects of certain cancer treatments[12]. Magnesium (Mg) is the second most abundant intracellular action in the body, involved with numerous biological activities, particularly related to its interaction with Ca[13]. Serum Mg levels, and Ca/Mg ratio have been shown to be associated with high-grade prostate cancer. Mg deficiency is linked to chronic inflammation, possibly due to the concentration Ca levels. Furthermore, it is speculated that Ca may play a key role in the progression of prostate cancer[14],[15].

Calcium (Ca): High concentration of Mg found in *Euphorbia hirta* (HAA) and *Nerium oleander* (KAO) leaf, while low concentration found in *Cassia tora* (CHE) and *Xanthium strumarium* (MAI) as shown in Figures 2 and 3. Calcium, an essential mineral in the human body, has complex and multifaceted roles in various cellular processes, including cell signaling, muscle contraction, and bone health[16]. While calcium itself is not typically used as a primary treatment for cancer, it can indirectly influence cancer risk and may play a role in cancer management in certain contexts[17]. Here are some aspects of calcium significance in relation to cancer. Calcium is crucial for maintaining strong and healthy bones. Many cancers, particularly breast and prostate cancer, can metastasize to the bones[18]. Adequate calcium intake and bone health are essential for preventing cancer-related bone complications, such as fractures and bone pain[19]. A number of studies have shown that dietary calcium intake is associated with a reduced incidence of colon cancer among middle-aged subjects[20]. Other observations suggested that alterations in essential trace elements like Cu, Fe, Zn and Ca may play an important role in the pathogenesis of this kind of cancer[21].

Aluminum (Al): Low concentration of Al in all samples, as shown in Figure 2. Aluminum is a naturally occurring element found in various environmental sources, including soil, water, and certain foods[22]. While aluminum is generally considered safe in small amounts, concerns have been raised about its potential role in cancer development and other health issues, particularly[23] Silicon: High concentration of Si found in *Euphorbia hirta* (HAA), while low concentration found in *Millettia pinnata* (HOA)

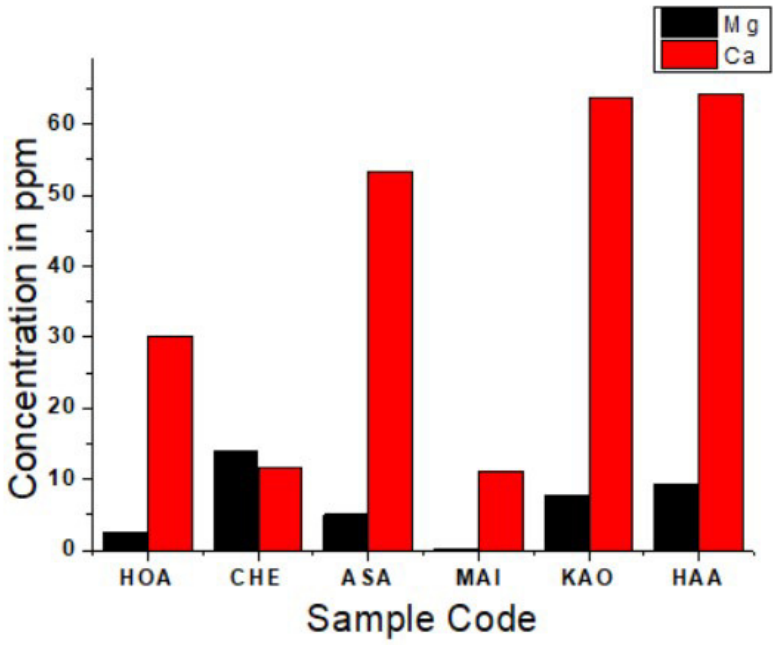
as shown in Figure 2. Silicon does not have a direct role in the treatment of cancer[24]. Silicon is an essential trace element that is naturally present in the human body and plays a role in various physiological processes, such as the formation of connective tissues, bone health, and maintaining the health of skin, hair, and nails. However, it is not used as a primary or specific treatment for cancer[25].

Vanadium (V): Low concentration of V found in all medicinal plants as shown Figure 2 .Vanadium is a transition metal element that has been studied for its potential role in cancer treatment and prevention. However, its role in cancer therapy remains largely experimental and is not a standard or widely accepted treatment approach[26]. Here is an overview of the significance of vanadium in cancer research. Vanadium compounds, particularly vanadium salts, have been investigated for their potential anticancer properties[27]. Some studies have suggested that certain vanadium compounds can inhibit the growth of cancer cells in laboratory settings[28].

Chromium (Cr): Low concentration of Cr found in all ayurvedic medicinal plants as shown Figure 2. Chromium (Cr) is an essential trace element in the human diet, but its role in cancer treatment is not well-established[29]. Chromium has primarily been studied for its potential role in glucose metabolism, insulin sensitivity and its effects on various metabolic processes in the body. However, the significance of chromium in cancer treatment is limited and it is not considered as a standard or widely recognized cancer therapy[30].

Manganese (Mn): Low concentration of Mn found in all medicinal plants as shown Figure 2. Manganese is involved in antioxidant defense mechanisms and the metabolism of carbohydrates, amino acids and cholesterol[31]. Manganese supports overall health during cancer treatment by assisting in the body antioxidant defenses and maintaining metabolic processes[32].

Figure 3
Comparison of the concentrations of Ca and Mg in medicinal Plants
HOA- Honge mara, CHE- Chagache, ASA- Ashwagandha, MAI- Murullumatti, KAO- Kangalo huvoo, HAA- Hachhegida



Iron (Fe): High concentration of Fe found in *Withania somnifera* (ASA) while low concentration of Fe found in *Millettia pinnata* (HOA) as shown Figure 2. Iron is essential for carrying oxygen in the blood and for various cellular processes. While iron is crucial for normal body function, it can be problematic when it accumulates excessively[33]. Iron supplementation may be necessary for cancer patients who develop anaemia due to the disease or cancer treatments. However, excessive iron levels in the body have been associated with increased cancer risk, so iron balance is critical[34].

Copper (cu): High concentration of Cu is found in *Euphorbia hirta* (HAA), while low concentration found in *Euphorbia hirta* (HAA) Figure 2. It is within the permissible limit (WHO). Copper is involved in angiogenesis (the formation of new blood vessels) and collagen production[35]. While copper is necessary for normal body functions, excessive copper can be harmful. Copper chelation therapy is sometimes used as an adjuvant treatment for certain cancers to inhibit angiogenesis, thereby preventing the growth of new blood vessels that supply tumours[36]. Copper (Cu) appears to play also an important role in the carcinogenic process. Colorectal cancer (CRC) is one of the most common cancers in men and women. The early diagnosis of colorectal cancer is promoted as a means to reduce the burden of the disease in society[37].

Zinc (Zn): High concentration of Zn is found *Millettia pinnata* (HOA), while low concentration of Zn found in *Nerium oleander* (KAO) as shown in Figure 2. It is within the permissible limit (WHO). Zinc is an essential element for cell growth, DNA synthesis and immune function[38]. It is involved in numerous cellular processes including apoptosis (programmed cell death). Zinc supplementation may support the immune system during cancer treatment and aid in wound healing after surgery or radiation therapy. It can also help to prevent or mitigate treatment-related side effects[39]. Zn levels seem to play a protective role also in lung cancer. In addition, it is suggested that low levels of zinc can facilitate the pathogenesis of lung cancer[40].

Molybdenum (Mo): Low concentration of Mo in all ayurvedic medicinal plants as shown in the Figure 2. Molybdenum does not play a direct role in the treatment of cancer[41]. It is an essential trace element required by the body in very small amounts for various biochemical processes, including the metabolism of certain amino acids and the detoxification of harmful compounds. While molybdenum is important for overall health, it is not used as a primary treatment for cancer.

Conclusion

The present investigation provides information on the trace elemental concentrations of ayurvedic medicinal plants in the North-Karnataka regions. A total of six different ayurvedic medicinal plants were collected and examined by using flame atomic absorption spectrometer (FAAS) technique. Moreover, the present analysis shows that all detected elements are within the permissible limits of WHO/FAO and some other standard permissible limits for medicinal plants. The presented studied data is useful to the new researchers and medicinal practitioners to prepare new health drugs and promote society. The secondary metabolites of medicinal plants and the human body also help to study the phytochemical compounds, which have some antimicrobial properties like cancer. The analyzed trace elemental concentrations' viz., Mg, Al, Si, Ca, V, Cr, Mn, Fe, Cu, Zn and Mo are under the limits of national and international medicinal plants quality control bodies' viz., WHO/FAO.

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