STUDY OF MULTIELEMENT CONCENTRATION OF SOME MEDICINAL PLANTS BY ATOMIC ABSORPTION SPECTROSCOPY AND ENERGY DISPERSIVE X-RAY ANALYSIS

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Abstract

Ayurvedic Medicinal plants are the primary source of the earliest medicines in the traditional ayurvedic system today, and they play an important role in the ayurvedic field. More than 85% of the global population relies solely on folk\traditional ayurvedic plants for plant-based drugs to cure various diseases and their extracts for health care. The current study aims to estimate and compare the levels of trace and heavy metals in several Moracea family Ayurvedic plants, including B, Mg, Al, K, Ca, V, Mn, Fe, Cu, Zn, As, Mo, and Hg. The samples were collected from various locations in North-East Karnataka. Atomic absorption spectrometric (AAS) and Energy dispersive X-ray analysis (EDX) methods were used to estimate trace and heavy elemental concentrations. The average concentrations of B, Mg, Al, K, Ca, and V range from 1 ppm to 20.37 ppm, with potassium (K) having the highest concentration of all. Other elements such as Mn, Cu, Fe Zn, As, Mo, and Cd were also calculated. As a result, these medicinal plants are high in minerals, particularly K, AI, Ca, Cu, Fe, Mn, and Zn, which are very essential for human health.

Keywords: Medicinal plants; AAS, EDX Technique, elemental analysis, and trace elements.

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1. INTRODUCTION

Worldwide, Ayurvedic medicinal plants were a significant source of healing molecules that could treat a wide range of illnesses. Since the beginning of time, medicinal plants used in traditional medicine and as household remedies have played a significant role in society. Metal and microbial contamination of medicinal plants are caused by a number of factors, including environmental pollution, soil contamination, harvesting practises, and handling (3). The number of heavy metals in plants was looked at in order to show the danger that the human body needs a variety of minerals for growth and other processes, which are obtained from plants because they absorb and accumulate the minerals from the environment that are necessary for growth. Because metallic elements are toxic when consumed in large quantities, it is necessary to measure and establish the levels of these elements in herbal plants (4). The World Health Organization also emphasised the need to guarantee the quality of plants and their products using cutting-edge methods and appropriate standards to minimise any negative effects on people and animals who consume them directly or through their original products. AAS is a suitable technique that can accurately detect element concentrations at part per million (ppm) levels and can be used to quickly find trace elements in a variety of sample matrices. By using a deuterium lamp as the background interference, interference brought on by the scattering of light by particles can be easily modified in the AAS technique (7). One of the best methods for micro-level chemical composition analysis is energy dispersive X-ray spectroscopy (EDS or EDX). Samples can be analysed directly in EDX without undergoing any digestion steps or other preparations, presuming that the elements are evenly distributed. Generally speaking, the trace elements technique had been used to identify the elements in medicinal plants because an element in earth metals may not uniformly contain them in nature.

These ideas help herbal and ayurvedic doctors prescribe customised treatments, such as herbal compounds or proprietary ingredients, as well as advice on diet, exercise, and lifestyle (8). Since Ayurveda is far superior to organised ancient systems of medicine, the majority of Indians, particularly villagers, use it for curative purposes. Parts of the Moracea family of traditional medicines were gathered for this study from the districts of Bagalkot, Dharwad, Gadag, Kalaburagi, and Yadagiri. These districts are located between 140 60' and 180' North latitude and 750 30' to 770 70' East altitude.

Fig(1): Karnataka map with North Karnataka region was sample collection (a)Kalaburagi, (b)Bijapur (c)Yadgir, (d)Bagalkot, and (e) Gadag Districts.

2. MATERIALS AND METHODS

2.1 Sample Collection

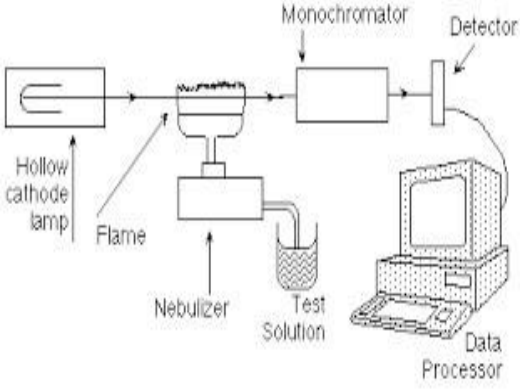
The present investigation, the fresh Bark of Ayurvedic medicinal plants are collected from Bagalkot, Dharwad, Gadag, Kalaburagi, and Yadagiri. This 5 district is situated in northeast Karnataka between 75°.04' and 76°.42 east longitude, and 16°.12' and 17°.56' north latitude, covering an area of 11,451 km². (Table1) shows the details of ayurvedic medicinal plant and their uses. The fresh Bark of the medicinal plant are collected from North -East Karnataka region. Plants Bark part a some amount of plant sample was collected and then collected plant parts were rinsed with distilled water to romove contamination due to dust and environmental pollution. The rinsed bark was dried in a dark room for a month and then ground to a fine powder, sheaved using meshes with 355mm to get fine powder, and kept in an airtight

container. which was further taken for the trace elemental analysis.

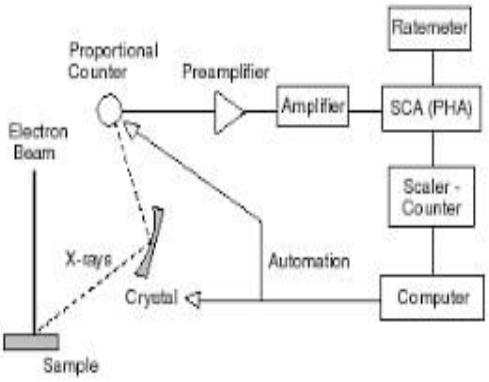
2.2 Instrumentation

The instrument used is an iCE 3000 Series Atomic Absorption Spectrometer from Thermo Scientific, which is unique among atomic absorption instruments. The identification of all elements is fully automatic in every iCE 3000 Series spectrometer. It is computer controlled by a data station running Windows® operating system-based SOLAAR software. Graphite furnace and vapour modes can be added to flame absorption/emission systems by using the proper accessories.

An evolution of the electron microscope is the SEM-EDX. With the help of the Gemini column and new field emitter technology, it is now possible to image electrons with an ultra-high resolution of more than x10,000,000 (>1nm at 15kv). The GEMINI In-lens SE detector for clear topographic imaging and the EsB detector for compositional contrast imaging are both featured in the Carl Zeiss ULTRA Series, allowing for simultaneous real-time imaging and mixing of both signals. High-resolution energy selective backscattered electron (BSE) imaging at low voltages revealing hitherto unobserved image details is made possible by the filtering technology built into the EsB detector.



Fig(2) Schamatic diagram of flame AAS Technique



Fig(3) Schamatic diagram of EDX Technique

Determination of Elements

The trace elements in the plant sample, including B, Al, Mg, Ca, K, V, Fe, Mn, As, Cu, Zn, Hg, and Mo, were analysed using AAS. Themo Scientific produces it under the model's name iCE-3000series, and it has a dedicated flame, furnace, or combined flame. Using an air-C2H2 and N2O2 flame, the elemental content was determined. The equipment used to determine the elemental content had its linear working range and correction coefficient calibrated, and its absorption wavelength was used to determine each trace element.

TABLE 1. Working elements of operating parameter

Elements Flow	Wavelength in (nm)	Slit Width in (nm)	Current Lamp	Type of Flame	Fuel Flow in (L\MIN)	Characteristic in con C. mg\L	Burner Height (mm)
B	249.8	0.5	100%	N_2O_2-C_2H_2	4.3	33.6413	11
Mg	285.3	0.5	75%	C_2H_2	0.9	0.0173	7
Al	309.4	0.5	100%	N_2O_2-C_2H_2	4.1	6.8614	11
K	766.6	0.5	100%	N_2O_2-C_2H_2	0.9	0.1366	7
Ca	422.7	0.5	100%	N_2O_2-C_2H_2	4	0.1.20	11
V	318.6	0.5	75%	N_2O_2-C_2H_2	4.5	6.2860	11
Cr	357.9	0.5	100%	N_2O_2-C_2H_2	4	0.1498	7
Mn	279.6	0.5	75%	C_2H_2	1	0.1074	7
Fe	248.4	0.5	75%	C_2H_2	0.8	0.3608	7
Cu	324.8	0.5	75%	C_2H_2	0.8	0.2163	7
Zn	213.8	0.5	75%	C_2H_2	0.9	0.0784	7
As	193.7	0.5	75%	C_2H_2	4.2	2.0575	11
Mo	309.3	0.5	100%	N2O2C2H2	4.1	6.8614	11
Cd	228.8	0.5	50%	C_2H_2	1	0.0997	7
Hg	253.7	0.5	75%	C_2H_2	1.1	9.6037	7
Pb	217	0.5	75%	C_2H_2	7	0.7544	11

2.3 Sample Preparation For Elemental Analysis Medicinal plants

For AAS Technique

1g of dry bark powder sample was placed into a 100ml of long-necked volumetric flask, the solution was prepared by mixing of 10 ml of conc .HCL, after adding acid heat it gently until the initial reaction subsides, then continue to heat for 15 minutes, then cool and then dilute to add 90 ml double distilled water. after that protect the flask with the help of silver foil, the total dilution time will be 24 hours then it was filtered using watt man filter paper41. The same procedure was carried out for all district plant samples. The obtained extract was finally used for the measurement of elemental analysis using the AAS technique.

For EDX Technique

The dried 10mg bark 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.

3. RESULT AND DISCUSSION

In the present study, the concentration of 13 elements was determined in the Moraceae family using the AAS method as shown in(Table 2). The first column shows the district's name in coded form and from the column elemental concentration is expressed. The result showed different concentrations of micro and trace elements. it is observed from the table3) the concentration of Ca B, and K is highest when compared to all other essential elements. The level of these elements ranging from [19.75-6.57] in all districts its Ca helps in preventing and curing all orthopedic problems. It's also essential to the strengthening of RBCs and mechanisms. The elemental concentration of potassium found in all collected leaves [17.9214.55]] is very high could be due to physiological, and botanical structure as well as the mineral composition of the soil and also other factors like the use of fertilizers, water flooding, and topographical condition of the region. the concentration of boron is found in all districts and its varies from [11.23-2.86] due to contaminated soil n soil pollution. The Dharwad districts have more elemental concentration as compared to other districts.

The other elements such as Mg, Al, V, Mn, Fe, Cu, Zn, As, Mo, Cd, and Hg were also determined in this study but the concentration of these trace elements is found are comparatively less due to botanical plants and soil. These elements also help to cure different health issues and very essential and helpfull for the human health.

Table 2. Information about medicinal plants

Sl. no	Medicinal plants	Biological Name	Family	Image	Vernacular	Parts Used	Treatment/Uses
1	Nyagrodha	Ficus benghalensis Lin	Moraceae		E: Banayan Tree K: Aladmara H: Bargad	Bark	• In order strength the uterine muscles during pregnancy

Table3. Concentration of elements (in mg\L) in the medicinal plants by AAS

Coding/ elements	B	Mg	Al	K	Ca	V	Mn	Fe	Cu	Zn	As	Mo	Hg
Babe1	5.47	1.14	3.23	16.83	6.57	2.30	0.20	0.50	0.16	0.14	2.98	0.34	0.12
Dhbe1	6.44	3.66	3.63	16.63	19.75	2.93	0.20	0.80	0.34	0.14	6.12	0.70	0.23
Gabe1	10.70	1.09	2.68	15.75	14.70	3.03	0.23	0.10	0.18	0.32	6.50	0.57	0.18
Kabe1	2.86	1.07	0.75	17.92	11.92	2.50	0.01	0.30	0.20	0.6	5.14	0.60	0.10
Yabe1	11.23	1.83	1.20	14.55	15.84	2.4	0.11	0.60	0.12	0.12	0.32	0.44	0.45

4. CONCLUSION

From the study, it is concluded that the concentration of various elements depends on the composition of soil, water, and fertilizers. Hence the concentration of the trace elements such as B, Ca, K and Al is found to be significantly high. The other elements such as Mg, Al, V, Mn, Fe, Cu, Zn, As, Mo, and Hg were determined in the this study but the concentration of these trace elements is found to be comparatively less. This data is helpful in the create modern drugs with various combinations of ayurvedic plants which cure many diseases. from this study, it is concluded that the Dharwad districts (fig4) have more permissibility, selectivity, and absorbability of plants for the selected elements as compared to the remaining 4 districts. in this percentage contribution fig(5) in

Dharwad district Ca-32.08%, K-27.01% and B-10.46% have more as compared to other.

The present EDX study of elemental analysis of the medicinal plant reveals the presence of various elements but the concentration of the elements such as Ca and K is found to be significantly high in Dharwad and Gadag Districts. This is attributed to the presence of the said elements in the soil, surrounding of the nature and the different botanical structures of the medicinal plant. This study also verified the trace elemental concentration of copper and zinc along with major and other trace elements. The other elements such as Al, Mn, Fe, Mo, and Cr were determined in the present study but the concentration of these elements is found to be comparatively less (fig6). The data obtained in present study will be helpful in the synthesis of new modern drugs with various combinations of plants which can be used to cure many diseases.

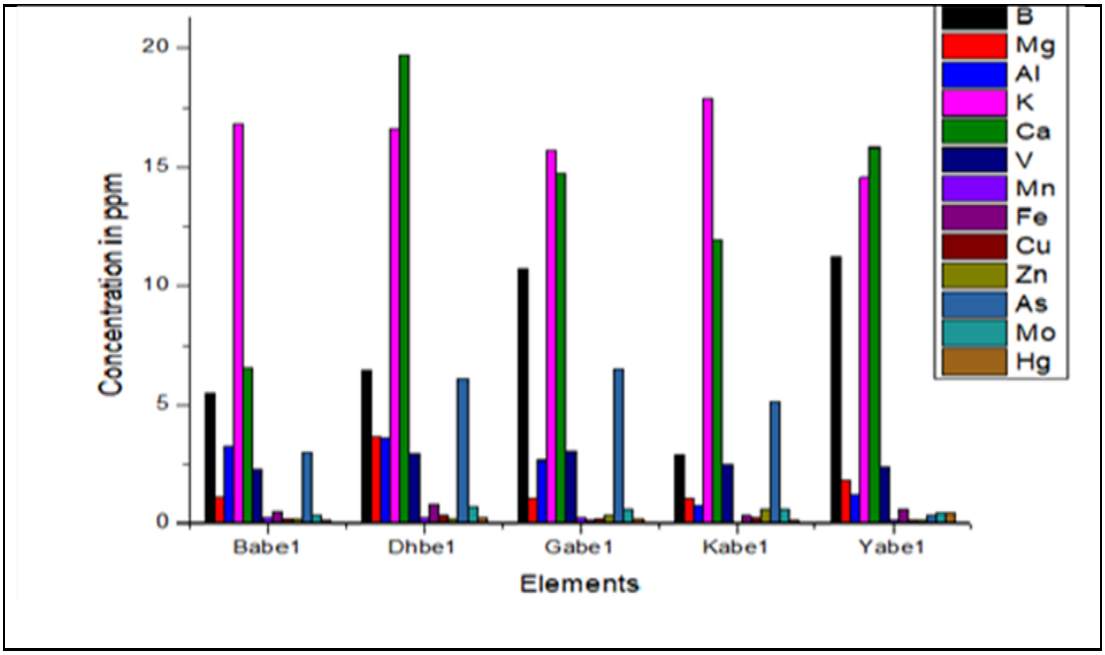


Fig4. Elemental concentration on Ficus benghalensis Lin by AAS Techniqu

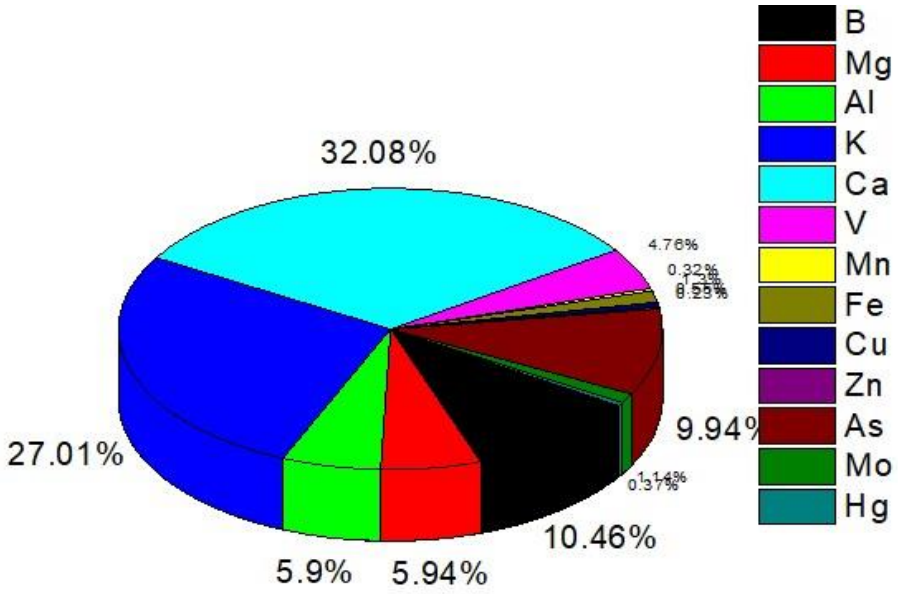


Fig 5. Percentage contribution of elements in Dharwad District

EDX images of Moracea family sum spectrumz

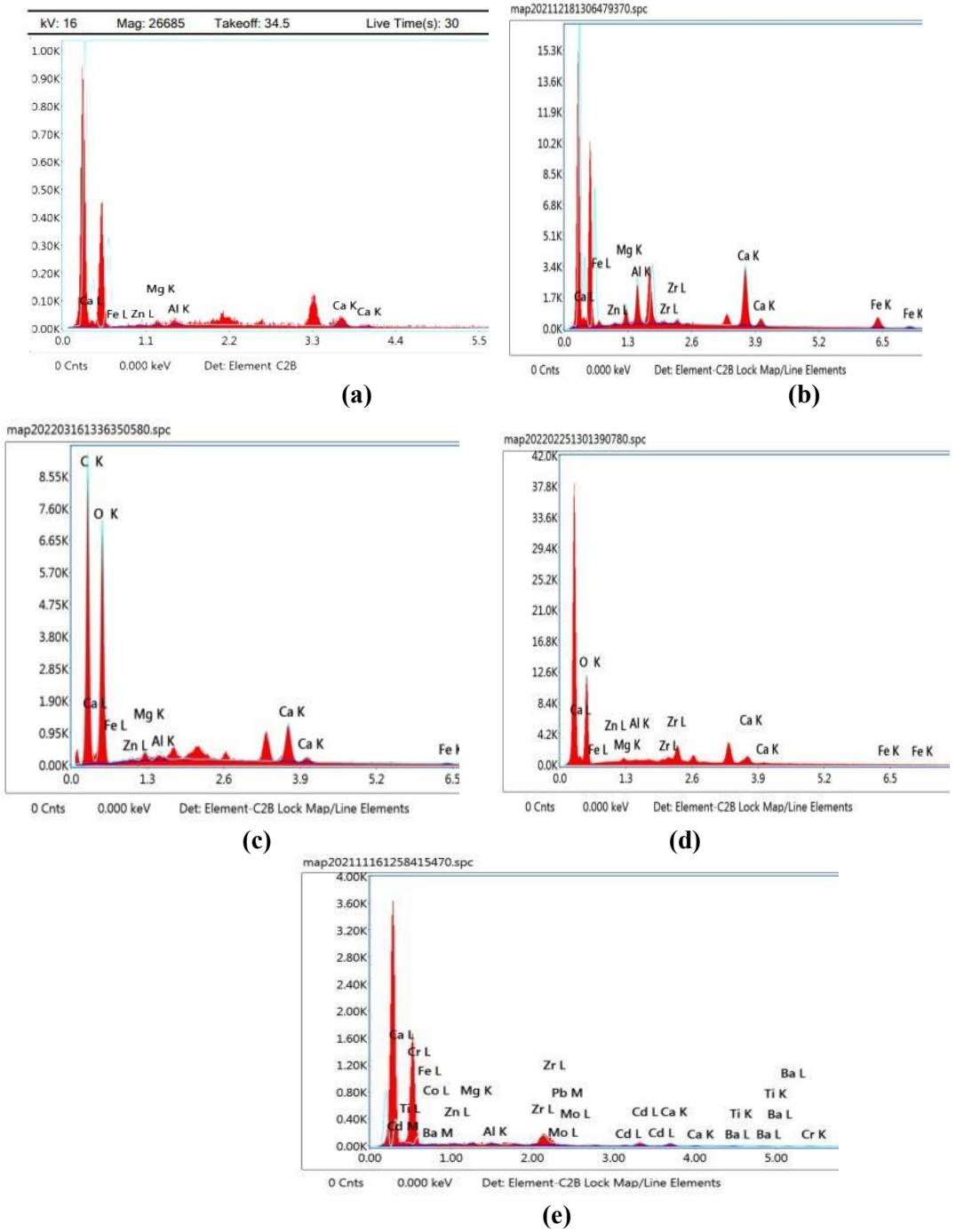


Fig 6. Multi elemental concentration (a) Bagalkot, (b) Dharwad, (c) Gadag,(d) Kalaburagi (e) Yadagiri Districts by EDX spectrum

5. ACKNOWLEDGEMENT

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