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A study on major and trace elements in some traditional medicinal plants using AAS technique

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Abstract
The elemental analysis was carried out for 13 different traditional medicinal plants collected from Gulbarga of North Karnataka region using Atomic Absorption Spectrophotometer (AAS) technique. A total of 12 elements were measured in the collected traditional medicinal plants; out of these 12 elements, the concentration of Ca, K, Mg and V was found to be in the range of Ca[52-80 mg/L], K[6-20 mg/L], Mg[6-7.5 mg/L] and V[1.2-2.3 mg/L], while the other elements such as Al, Mn, Fe, Cu, Zn, Cd, Mo, and Ti were less than 1 mg/L. These results were correlated with multi-elemental analysis technique SEM-EDX.

Keywords: traditional medicinal plants, trace elements, AAS technique and SEM-EDX

1. Introduction
The traditional medicinal plants play an important role in the traditional medicine system. According to the survey reported by World Health Organization (WHO), about 80% of the world's population consumes traditional medicinal plants in direct and indirect ways to treat their diseases. Medicinal plants have been using for curing and preventing of the various diseases. The curing and prevention property of the medicinal plants depends on their chemical composition. The level of the elements in the plants varies by the characteristics of the soil and also environmental conditions [1, 2, 3, 4 and 5]. During the past decade, it has seen a significant increase in the use of traditional medicine due to their minimal side effect, availability and acceptability [6].
Essential major and trace elements in traditional medicinal plants have been investigated by many researchers to strengthen the importance of elemental analysis with respect to human health. The human body requires a number of elements to maintain a good health. Several attempts have been made to determine the elemental compositions of traditional medicinal plants using different elemental analysis techniques from many countries all over the world [7, 8].
In the present study, the different traditional medicinal plants, which are used to prevent and cure various diseases, were selected from Gulbarga of North Karnataka region and the selected plants were investigated for their elemental constituents using AAS technique. This technique measures the concentrations of elements. Atomic absorption is so sensitive that it can measure down to ppb (parts per billion) or ppm (parts per million) of a gram (µg dm-3or 10-6) in a sample. The technique makes use of the wavelengths of light specifically absorbed by an element present in the sample. They correspond to the energies needed to promote electrons from one energy level to another, i.e., higher energy level. Atomic absorption spectroscopy has many uses in different areas such as clinical analysis, Environmental analysis, Pharmaceuticals, Industry, Mining and Agriculture [9, 10]. SEM-EDX, among the various analytical techniques used for elemental analysis, is highly qualified for the identification and the quantification of different elements in various samples of biological and environmental importance [11]. Besides, a powerful tool for such analysis the method is non-destructive and is more advantageous in multi-elementary analysis compared to other existing methods such as ICP-AES, ICP-MS, AAS and INAA.

2. Materials and Methods
2.1 Sample Collection
Table.1 shows the profile of the selected traditional plants collected from Gulbarga of North Karnataka region. About a few kg of each plant material was collected and then collected materials were washed in deionized water to eliminate contamination due to dust and environmental pollution. The washed plant materials were dried in shade for a months and then grinded to a fine powder which was further used for the major and trace elemental analysis.

2.2 Sample Preparation for Elemental Analysis
A 10 gm of powder was taken in a silica crucible and then kept in an oven for 2-3 hours at 250-350° C to get ash. The obtained ash was used for preparation of solution. The solution was prepared by mixing of concentrated HCL, double distilled water and 1gm of ash in the ratio 25: 25:1. The mixed solution was then stirred for few minutes; it was then filtered using watt man filter paper 41. A 950 ml of double distilled water was added to the filtered solution to make it 1000 ml solution. The same procedure was repeated for all other plant material samples [12]. The obtained solutions were finally used for the measurement of trace elemental analysis using AAS technique.

2.3 Determination of Elements
The elements such as Mg, Al, K, Mn, Fe, Cr, Ca, Cu, Zn, Cd, Si, Mo, V and Ti in the plant samples were analyzed using

atomic absorption spectrophotometer. It is manufactured by Thermo Scientific™ with a model No. iCETM-3000 series and it is equipped with dedicated flame, furnace or combined flame and furnace option. Air – C2H2 and N2O- C2H2 flame was used for determination elemental content. The instrument was operated with the conditions shown in Table. 2. The absorption wavelength for the determination of each element with its linear working range and correlation coefficient were calibrated for the analysis.

3. Results & Discussion

The images of leaves of the traditional medicinal plants are shown in Fig. 1. The botanical as well as local name of the plant, part used, coding of the samples and medicinal uses are listed in Table. 1. Table. 3 show the measured elemental concentration of the traditional medicinal plant collected from Gulbarga of North Karnataka region.

Calcium (Ca)

The concentration of Ca is found in all the collected medicinal plants and the concentration of calcium is highest when compared to all other elements. The presence of high amount of the calcium concentration in medicinal plants could be due to the fact that the soil of this region, Gulbarga, North Karnataka region contains maximum amount of calcium and the same one is reflected in the medicinal plants. The level of calcium is varied from 52 – 80 mg/l in all samples. It helps in preventing and curing all bone related issues. It also helps to repair worn out cells, strong teethe in humans, building of RBCs and body mechanism. Therefore it has been extensively used for treatment of various diseases.

Potassium (K)

The concentration of potassium (K) is found in all collected medicinal plants and it is the second dominant element when compared to all other elements. The presence of high amount of the K concentration in medicinal plants could be due to botanical structure as well as the mineral composition of the soil and also other factors like use of fertilizers, water irrigation and geological conditions of the region. The level of K is varied from 6 – 20 mg/L in all samples.

Magnesium (Mg)

The concentration of Magnesium (Mg) is found in all collected medicinal plants and it is the third dominant element when compared to all other elements. The level of Mg is varied from 6 – 7.5 mg/L in all samples. Magnesium works with calcium to help transmitting nerve impulse in the brain. Magnesium has calming effect and works on the nervous system of those peoples, suffering from depression. In blood its quantity is 2-4mg/100ml. Magnesium has an important role in the phosphorylation reactions of glucose and its metabolism. Its deficiency has been implicated in insulin resistance, carbohydrate intolerance, dyslipidemia and complications of diabetes.

Vanadium (V)

The concentration of Vanadium (V) is found in all collected medicinal plants and it varied from 1.2 – 2.3 mg/l in all collected samples. Vanadium affects carbohydrate metabolism including glucose transport, glycolysis, glucose oxidation, and glycogen synthesis [13]. At a dose of 100 mg/day vanadyl sulfate improves insulin sensitivity [14]. Its possible mechanism of action in glycemic control is thought to be primarily insulin mimetic with up regulation of insulin receptors.

The other elements such as Al, Mn, Fe, Cu, Zn, Cd, Mo, and Ti were also determined in the present study but the concentration of these elements is found are comparatively less. It depends on the botanical structure of the medicinal plant or soil. These elements also help to prevent and cure various diseases and are very essential for the human health.

4. Tables and Figures

Table 1: Profile of the traditional medicinal plants and their medicinal uses

S. No	Botanical name	Local name	Coding	Part	Medicinal use
1	*Abutilon indicum* (L)	*Tutti Vibutigida*	TU	Leaf	Diuretic, infected skin and dysentery.
2	*Murraya koenigii* (L.) Sprenge	*Karibevu*	KA	Leaf	Anti-diabetic, antioxidant, antimicrobial, anti-inflammatory and hair treatments
3	*Tinospora cordifolia*	*Amrita balli*	AM	Leaf	Immune booster, general tonic, Chronic fevers, Upper respiratory,
4	*Lawsonia inermis* L (Lythraceae),	*Madarangi*,	MA	Leaf	Jaundice, amoebic dysentery and sore throats.
5	*Datura metal* L. (Solanaceae),	*Unmatta*	UN	Leaf	Rheumatism, Asthma, control of dandruff.
6	*Adathoda vasica* Nees. (Acanthaceae),	*Adusoge*	AD	Leaf	Cough,Spiny outgrowths of piles to control bleeding.
7	*Acalypha indica* L. (Euphorbiaceae)	*Kuppigida*	KU	Leaf	Constipation, Scabies, Eczema, asthma and Urinary problems.
8	*Plumbago zeylanica* L (Plumbaginaceae),	*Bili chitramula*	BI	Root	Pile, elephantiasis and rheumatic pain.
9	*Balanites roxburghii* Planch. (Simarubaceae)	*Ingudi*	IN	Leaf	Jaundice, intestinal worm infections, leukoderma, psychiatric disorders.
10	*Barleria prionites* L. (Acanthaceae),	*Mullugoranti*	MU	Leaf	Scabies, respiratory diseases, tooth ache and joint pains.
11	*Mirabilis jalapa* L. (Nyctaginaceae),	*Sanjemallige*	SA	Leaf	Wound healing, abscesses and inflammation.
12	*Gymnema sylvestre (*Asclepiadaceae)	*Kodapatri*	KO	Leaf	Diabetes, metabolic syndrome, weight loss and cough.
13	*Tylophora indica (Asclepiadaceae)*	*Aadu muttada balli*	AA	Root & Leaf	Cough, asthma, bronchitis, dysentery, diarrhea, wounds, ulcer, hemorrhoids, malignant tumor, and leukemia

Table 2: Operating parameter for working elements

Elements Flow	Wavelength (nm)	Slit width (nm)	Lamp Current	Flame Type	Fuel Flow (L/min)	Characteristic Conc. mg/L	Burner Height (mm)
Mg	285.2	0.5	75%	Air-C_2H_2	1.2	0.0170	7
Al	309.3	0.5	100%	N_2O- C_2H_2	4.3	12.0442	11
K	766.5	0.5	100%	Air-C_2H_2	1.2	0.0567	7
Mn	279.5	0.2	75%	Air-C_2H_2	1.0	0.0860	7
Fe	248.3	0.5	75%	Air-C_2H_2	0.9	0.2344	7
Ca	422.7	0.5	100%	N_2O- C_2H_2	4.2	0.2340	11
Cu	324.8	0.5	75%	Air-C_2H_2	1.1	0.1119	7
Zn	213.9	0.2	75%	Air-C_2H_2	1.2	0.0333	7
Cd	228.8	0.5	50%	Air-C_2H_2	1.2	0.0344	7
Mo	313.3	0.5	75%	N_2O- C_2H_2	4.7	3.6551	11
V	318.5	0.5	75%	N_2O- C_2H_2	4.7	4.2067	11
Ti	365.4	0.5	75%	N_2O- C_2H_2	4.7	45.6638	11

Table 3: Concentration of elements (in mg/L) in the traditional medicinal plants collected from Gulbarga

S. No	Botanical name	Coding	Mg	Al	K	Mn	Fe	Ca	Cu	Zn	Cd	Mo	V	Ti
1	*Abutilon indicum (L)*	TU	7.4817	0	18.0794	0.1074	0.3072	76.5954	0	0.1948	0.0036	2.3730	1.8851	0.4551
2	*Murraya koenigii(L.) Sprenge*	KA	7.0280	0	17.1518	0.2419	3.1464	73.7779	0.0460	0.0744	0.0188	2.2808	2.0665	4.7605
3	*Tinospora cordifolia*	AM	6.9069	0	19.5953	0.4677	0.5291	71.9977	0	0.0374	0.0073	2.5380	2.1404	1.2515
4	*Lawsonia inermis L (Lythraceae),*	MA	7.2817	0	12.2685	0.2539	1.4574	78.2088	0.0135	0.0853	0.0008	2.5437	2.2929	0
5	*Datura metal L. (Solanaceae),*	UN	7.1855	0	20.0802	0.2233	1.0544	80.4063	0.0055	0.0761	0.0132	2.3948	2.2706	0
6	*Adathoda vasica Nees. (Acanthaceae),*	AD	7.0582	0	15.2156	0.2117	1.8310	78.9519	0	0.1354	0.0213	2.5630	2.3034	0
7	*Acalypha indica L. (Euphorbiaceae)*	KU	7.2165	1.3896	17.0668	0.2415	4.0092	78.3728	0.0066	0.1316	0.0086	-0.1084	1.2996	2.5503
8	*Plumbago zeylanica L (Plumbaginaceae),*	BI	7.5361	0.5786	18.1869	0.2481	1.0217	53.1360	0	0.0938	0.0002	0.2650	1.3024	0.6345
9	*Balanites roxburghii Planch. (Simarubaceae)*	IN	6.9488	0.6873	6.1536	0.1606	0.4761	76.8192	0	0.0401	0	0.5987	1.3179	1.8217
10	*Barleria prionites L. (Acanthaceae),*	MU	7.4221	0.2443	18.8229	0.0847	0.9937	79.0460	0	0.0618	0.0143	0.6544	1.3929	3.9378
11	*Mirabilis jalapa L. (Nyctaginaceae),*	SA	7.5132	2.4991	18.2589	0.1931	0.7003	78.5445	0.0054	0.0993	0.0104	0.7266	1.2874	3.4799
12	*Gymnema sylvestre (Retz.) R.Br.ex Schult.(Asclepiadaceae)*	KO	7.1939	3.0792	16.8841	0.5515	1.2741	70.6604	0.0138	0.0729	0.0046	0.6493	1.4762	3.7741
13	*Tylophora indica (Asclepiadaceae)*	AA	6.7428	2.3862	13.2819	0.2265	0.3803	72.4958	0.0397	0.0826	0.0097	0.5273	1.5403	0.7607

Fig 1: Leaves of Different traditional medicinal plants

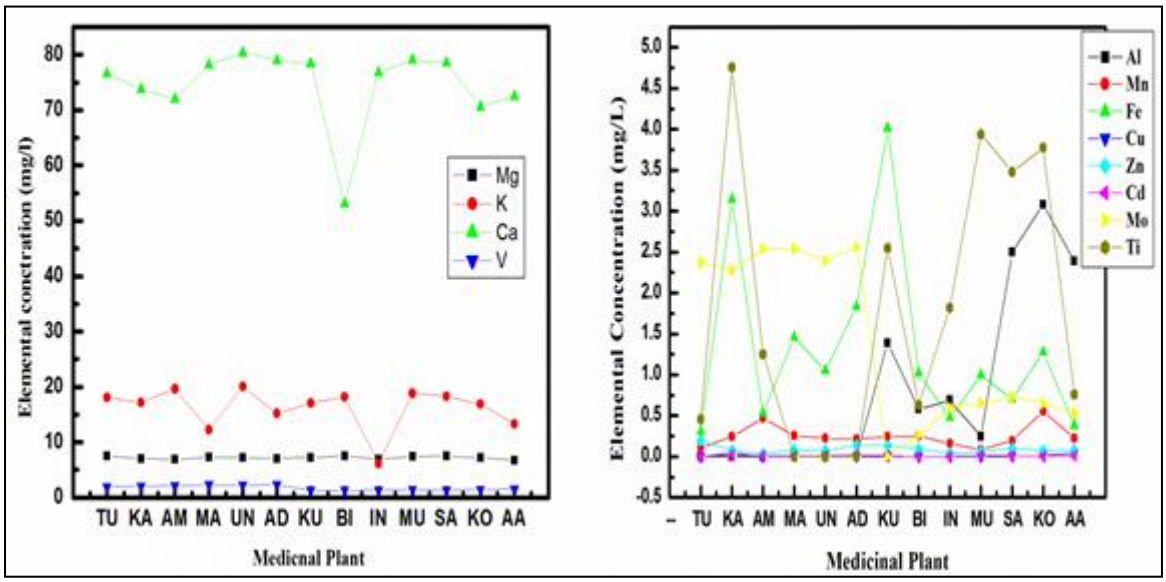

Fig 2: Elemental concentration versus medicinal plants

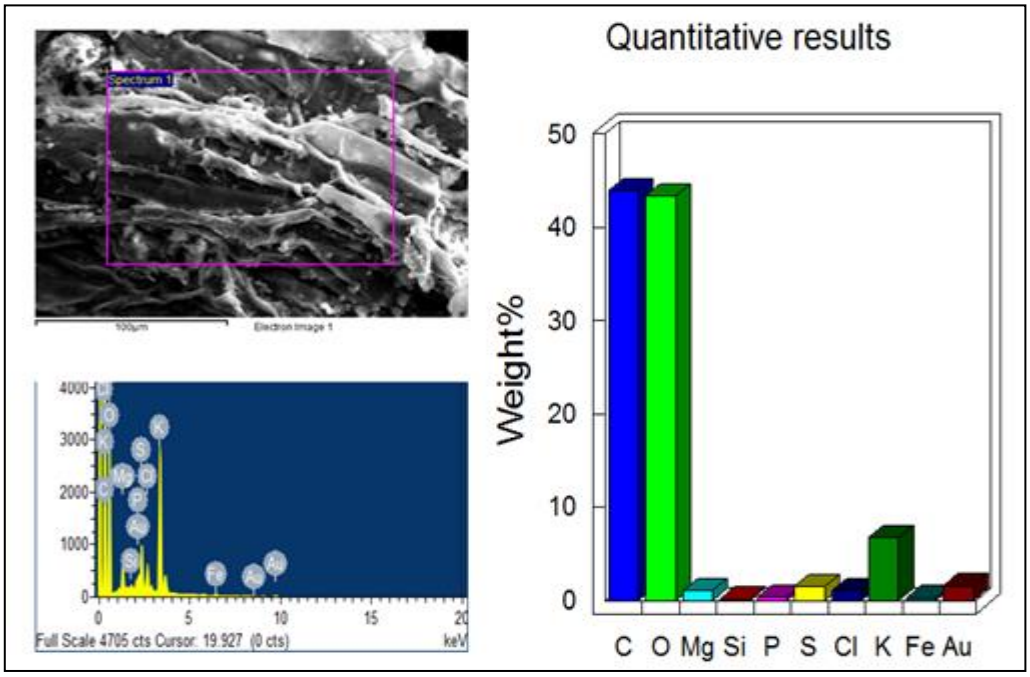

Fig 3: SEM-EDX for Datura metal L. (Solanaceae)

5. Conclusions

The present study of elemental analysis of the medicinal plant reveals the presence of various elements but the concentration of the elements such as Ca, K, Mg and V is found to be significantly high. This is attributed to the presence of the said elements the soil, surrounding of the nature and the different botanical structure of the medicinal plant. From this study it is also verified the medicinal plants viz., Murraya koenigii, Lawsonia inermis, Datura metal, Acalypha indica, Mirabilis jalapa, Gymnema sylvestre and Tylophora indica contains trace elemental concentration of copper and zinc along with major and other trace elements, which are the required nutrients for the metabolism as per the recommendations of WHO [15-17]. The other elements such as Al, Mn, Fe, Cd, Mo, and Ti were determined in the present study but the concentration of these elements is found to be comparatively less. 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. The results were correlated with SEM-EDX and are found be similar as shown in figure 3, for Datura metal L. (Solanaceae). However, more detailed analysis of chemical composition of these traditional medicinal plants is required and work is progressive in this direction.

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