J. Mater. Environ. Sci. 4 (2) (2013) 171-176 *Morabad et al.*
ISSN : 2028-2508
CODEN: JMESCN

First series transition elemental analysis in some therapeutically important medicinal plants by AAS method

R.B.Morabad [1], S.J. Patil [2]*, R.R. Tapash [3]

[1]*Department of Post-Graduate Studies and Research in Physics Gulbarga University, Gulbarga-585106, Karnataka, India*
[2]*Department of Post-Graduate Studies and Research in Zoology Gulbarga University, Gulbarga-585106, Karnataka, India*
[3]*Laboratories for Nuclear Research, Institute of Physics,Bhubaneswar -530003, Orissa, India.*

Received 2012, Revised 15 Oct 2012, Accepted 15 Oct 2012
*Corresponding author: Email: shajapatil@gmail.com; Tel. +91-9742069766

Abstract
Medicinal plants are known to have potential value and used them in herbal medicines. The therapeutic effect of medicinal plants for the treatment of various diseases is based on the chemical compounds in them plants. The major components are organic compounds, with biological activity, but none of them act efficiently as and crude fractions have a better efficacy and exhibit synergetic effects. Then medicinal plants contain metal which are useful as well as toxic at higher doses. Hence, ten important medicinal plants are selected from the North Karnataka India literature to study the metal contents by atomic absorption spectrophotometer. The selected traditional and popular medicinal plants are *Ocimum sanctum*L,*Catharanthusroseus* L, *Trigonellafoenum-graecum*L,*Azadirachtaindica*A. Juss and *Aeglemarmelos* Roxb, *Zingiber officinalis* L, *Emblica officinalis* L, *Anacardium occidentale* L, *Momordicacharantia* L and *Syzygiumcumini* L. The metal contents of,Mn, Fe, Cu and Zn was studied by AAS and suggests that the monitoring of trace elements in these medicinal plants does not exceed the limiting values set by World Health Organization values. Hence, these medicinal plants can be safely used for medical purposes.

*Key words:*Medicinal plants; AAS; Estimation; Trace elements

Introduction
Medicinal plants are the basic raw material for many of the transfer of trace elements from soil to man. The level of essential trace elements in the plants varies by the geochemical characteristics of the soil and also by the ability of the plants to select and accommodate some of these elements. Further, the bioavailability of the elements depends on the nature of their association with the constituents of the soil. Plants are readily assimilating elements through their roots. The additional sources of these elements for plants are rainfall, atmospheric dusts, plant protection agents and fertilizers that can be absorbed though the leaf blendes [1].
Traditional medicine is the synthesis of therapeutic experience of generations of practicing physicians of indigenous systems of medicine. Throughout the history of mankind, many infectious diseases have been treated with using herbal plants. The International body WHO [2] recommends that medicinal plant which from the raw material for the finished product must be checked for presence of heavy metals, pesticides, bacterial or fungal contamination.
The elemental composition of medicinal plants is now very often an object of study [3,4].One reason for this is the need to monitor the level of elements, which have a potentially negative effect on human health, such as Hg, Pb and Cd [5].In the present study iron, zinc, magnesium and copper are analyzed,because drugs of plant origin or herbal species are now commonly used, they can be an additional source of macro and microelements in everyday diet. Therefore, in such a sense, certain plant drugs may be treated as food additives [6].
The essential elements are involved in many metabolic processes of human physiology, especially as enzymes activators, e.g., Fe, Zn and Mn [7]. They can also interact with some organic compounds such as flavonoids,

influencing their biological activity [8]. Taking this into consideration, not only the total level of the essential elements in herbs, but also their interactions with the plants constituents should be studied.
This present study has conducted with the objective of assessing the major and trace elements in ten medicinal plants which are used in the treatment of several diseases. Major trace elements play a very important role and often toxic in higher doses.Hence their assessment is essential which could potentially be either dangerous or useful to humans.

2. Material and methods

Medicinal plants were collected from different area of Karnataka (Table 1) and were identified with the literature data available and also from experts of this region. Each medicinal plant was collected from three different places i.e., Gulbarga,Sandur andKappathagudda; thecollected samples were cleaned with the help of distilled water and Acetone then shade dried. One gram of the each plant sample was ashed with (10:1:4) HNO_3+HCl+H_2SO_4 acid mixture in a Teflon Beaker. A 0.5 ml HCl acid was added in curved beaker placed on sand bath. The sample mixture was heated until a clear solution was obtained. After removing the cover, the mixture was evaporated until drying. The residue was extracted by 50 ml 2N HCl and the extract was diluted by slightly with water and filtered through Whatman filter paper No.1. The filtered acid extract was diluted with deionised water and measured by using GBC 932 AA Unicom Flame Atomic Absorption Spectrometer (AAS) with digital and direct readout concentration and air-acetylene burnersingle element hollow cathode lamps (Pye Unicom) for Fe, Zn,Mnand Cu were used at the recommended currents for each studied element.
Atomic absorption spectrophotometer makes use of the fact that neutral or ground state atoms of an element can absorb electromagnetic radiation over a series of very narrow, sharply defined wavelengths. The sample, in solution, is aspirated as a fine mist into a flame where it is converted to an atomic vapour. Most of the atoms remain in the ground state and are therefore capable of absorbing radiation of a suitable wavelength. This discrete radiation is usually supplied by a hollow cathode lamp, which a sharp line source consisting of a cathode is containing the element to be determined along with a tungsten anode. When a sufficient voltage is impressed across the electrodes, the filters gas is ionized and the ions are accelerated towards the cathode. As these ions bombard the cathodes, they cause the cathode material to “Sputter” and from an atomic vapor in which atoms exist in an excited electronic state. In returning to the ground state, the lines characteristic of the element are emitted and pass through the flame where they may be absorbed by the atomic vapor since generally only the test element can absorb this radiation the method becomes very specific in addition to being sensitive up.
In atomic emission spectroscopy, the metal is exited from the energy imparted to it thermally by the flame and then as it returns to the ground state it emits radiation at a characteristic wavelength. This radiation is then isolated by a monochromatic and subsequently its intensity is directly proportional to the concentration of the element present. The parameters for determining elements by the AAS method are presented in (Table-1).

*2.1. Data analysis:*The results were analyzed statistically for each plant the experiment were repeated thrice mean values, standard error (mean $\pm$ SD) and correlation significance calculated using SPSS package 12 version [9].

3. Results and Discussion

Selection of the plants used for this study was based on their extensive use in traditional medicinal system ofIndia.The botanical as well as common name of the plant, part used, place of collection, major metallic constituents and medicinal uses are listed in Table 2. As it is evident from the literature, efforts were made to collect the samples from different ecological zones of Gulbarga,Sandur and Kappathagudda, North Karnataka,the medicinal uses of these plants in Ayurveda cures a number of ailments including hypertension, neurological disorders, asthma, immuno-stimulants, antibacterial, menstrual disorders, rheumatism and urinary tract infection etc. Since the major elements are either direct or indirect involvement in biological activity, analysis of four major elements namely Fe, Zn,Mn and Cu was performed in a total of 10 plant samples collected from different ecological regions.

Table 1: Medicinal plants collected from Gulbarga, Sandur and Kappattgudda and their medicinal uses

Botanical name	Common names	Part used	Major elements	Medicinal uses
Ocimum sanctum L.	Holy Basil	Leaves	Fe, Cu, Mn and Zn (Sing and Garg, 1996)	Bad coughs, skin diseases, gastric disorders children, hepatic disorders, piles, eye drops and fevers.
Catharanthusroseus (L.) G. Don.	Vinca	Leaves	Al, Cd, Fe, Co, Cu, Ni, Ld, K, Mn and Zn (Magadi, 2004)	Diabetic, cancer, human pathogenic strains anddiarrhea
*Trigonellafoenum-graecum*L.	Methi	Seeds	Fe, Mn, Zn and Cu (Ekinci and Rekinci, 2004)	Neuralgia or pneumonia, facial fever, infection of the sciatic pain at back, skin irritations and mouth ulcers
Azadirachtaindica A. Juss.	Neem	Leaves	Na, Zn Cu, Mn, Fe (Sing and Garg, 1996; Magadi, 2004)	Asthma, fever, jaundice, depressed unhappy emotional state heart problem, stomach, dysentery andindigestion.
Aeglemarmelos Roxb.	Bael	Leaves	Ca,P,Na, K, Zn, Cu, Mn andFe (Magadi, 2004).	Anemia, sinusitis, indigestion, fever, cough, teeth, mouth problems andear pain problems
Zingiberofficinalis L.	Zinger	Rhizome	Ca, P, Na, Zn, Cu andMn (Ekinci and Rekinci, 2004)	Stomach disorders, jaundice, liver diseases andrheumatism
Emblicaofficinalis L.	Emblica	Fruit	Fe, P, Cu andCa (Samudralwar and Garg, 1996)	Diabetes, fever, cough, stomach andheart problems
Anacardiumoccidentale L.	Cashew	Leaves	Zn, Fe and Cu (Reddy and Reddy, 1997).	Diabetes and teeth problems
Momordicacharantia L.	Karla	Seeds	Cu, Fe, Ca, Mg, Mn, P and Na (Magadi, 2004)	Teeth, diabetes, leprosy, piles and jaundice
Syzygiumcumini L.	Jambo	Fruits	Zn, Na, Fe and Cu (Ross, 2003; Magadi, 2004)	Diabetes, gastro-intestinal disorder and stomach ulcers

Table2: Elemental determination using AAS method

Elements	Wavelength (nm)	Slit width (nm)	Lamp Current (mA)	Pyrolysis (°C)	Atomization (°C)
Zn	213.9	0.2	8	1000	1800
Mn	279.5	0.5	5	1000	1800
Cu	324.7	0.5	3	800	2100
Fe	248.3	0.2	10	800	2300

3.1. Iron

The average content of Fe range between 0032.10 ± 5.56–1370.37 ± 1.17ppm/100g (Table 3) in the estimated 10 medicinal plants. The highest amount of Fe is recorded in the*Catharanthusroseus* (1370.37 ± 1.17ppm) and least amount was recorded in*Syzygiumcumini*(0032.10± 5.56). It is also observed that the variation of iron content plants collected from different geographical regions. The results clearly indicated that the plants collected from Sandur and Kappadagudda samples contains higher amount of iron content, Due to the soil contains high amount of Mn and Fe contents, while plants collected from Gulbarga samples indicated lesser amount of Fe. The variation due to climatic variability and presence of mining activities in both areas. It is an important hemoglobin component responsible for oxygen transport in human body [10]. The normal tolerable range of iron is 15-120 mg/day. Iron is undoubtedly the most important nutrient and its deficiency causes of several disorders [11]. The concentration of Fe in tulsi*Ocimum sanctum*and neem*Azadirachtaindica*were 129 and 355 mg/g^{-1} respectively by [12,13] reported that the highestFe is estimated in *Pergulariatomentosa* 292 mg/g^{-1} among the estimated seven medicinal plants.

Table 3: Estimation of Iron from medicinal plants collected from Gulbarga, Sandur and Kappathagudda (ppm/ 100g)

Plants name	Iron (in ppm)			Average mean of Iron
	Gulbarga	Kappathagudda	Sandur	
Ocimum sanctum	0974.00 ± 3.36	0815.83 ± 2.58	0195.00 ± 0.57	0661.61 ± 2.73
Catharanthusroseus	1099.20 ± 0.35	1437.83 ± 0.59	1574.10 ± 3.25	1370.37 ± 1.17
Trigonellafoenum-graecum	1495.20 ± 3.80	1097.53 ± 0.54	0315.43 ± 2.45	0969.38 ± 3.54
Azadirachtaindica	1095.80 ± 3.47	1093.40 ± 3.28	1855.40 ± 2.85	1348.20 ± 2.60
Aeglemarmelos	0636.63 ± 3.38	0675.90 ± 0.45	1087.10 ± 0.52	0799.87 ± 1.05
Zingiberofficinalis	1429.10 ± 0.28	0675.90 ± 0.45	1647.93 ± 0.52	1258.90 ± 2.39
Emblicaofficinalis	0350.50 ± 8.50	0007.00 ± 0.57	0792.30 ± 3.35	0383.26 ± 2.28
Anacardiumoccidentale	0798.00 ± 0.63	0924.73 ± 0.63	1775.00 ± 1.99	1165.91 ± 3.70
Momordicacharantia	0018.00 ± 0.57	0637.60 ± 0.88	1093.76 ± 3.59	0583.12 ± 3.73
Syzygiumcumini	0025.30 ± 1.88	0043.00 ± 0.57	0028.00 ± 0.57	0032.10 ± 5.56

3.2. Zinc:

The average content of Zn ranged between 012.00 ± 6.11 –240.69 ± 2.29ppm/100g (Table4) in the estimated 10 medicinal plants. The highest amount of Zn is recorded in the *Trigonellafoenum-graecum*(240.69 ± 2.29ppm) and least amount was recorded in*Syzygiumcumini*(12.00 ± 6.11). It is also observed that the plant collected from different ecological area i.e., Gulbarga,Sandur and Kappathagudda, the deposition of mineral elements varies from place to place. However, the plants obtained from Sandur and Kappathaguddacontains high amount of Zn content. While, Gulbarga plants samples contains lesser amount of Zn content (Table-4). It is clear from the above results accumulation of high amount of Zn content in Sandur and Kappathagudda, the soil contains rich amount of minerals due to mining area and it is a second abundant element in estimated 10 medicinal plants. The physiological activities of the plant influence the Zn absorption and the interaction with many elements like Fe, Mn and Cu, affects Zn uptake [14]. Zn is the component of more than 270 enzymes [15] and its deficiency causes many physiological disorders. Besides, it is responsible for stimulating growth of epidermal and epithelial cells [16]. The normal per day intake of Zn level is 12-15 mg/day. The similar kind of reports in medicinal plants has been reported by [12, 13&7].

Table 4: Estimation of Zinc from medicinal plants collected from Gulbarga, Sandur and Kappathagudda

Plants name	Zinc (in ppm)			Average mean of Zinc
	Gulbarga	Kappathagudda	Sandur	
Ocimum sanctum	212.10 ± 0.57	216.50 ± 2.20	201.16 ± 0.31	209.92±4.56
Catharanthus roseus	111.56 ± 0.12	202.96 ± 0.54	216.86 ± 3.36	177.12±3.02
Trigonellafoenum-graecum	274.50 ± 1.85	251.56 ± 0.28	196.03 ± 1.63	240.69±2.29
Azadirachta indica	123.60 ± 2.40	076.60 ± 0.30	009.46 ± 0.28	069.89±3.12
Aegle marmelos	036.33 ± 2.18	034.73 ± 0.12	127.90 ± 0.32	066.32±3.79
Zingiber officinalis	215.00 ± 0.57	124.16 ± 0.38	150.22 ± 0.18	163.13±2.00
Emblica officinalis	011.30 ± 0.02	083.43 ± 0.89	025.13 ± 0.68	039.95±2.10
Anacardiumoccidentale	117.03 ± 0.39	125.83 ± 0.57	124.40 ± 1.21	122.42±2.72
Momordicacharantia	007.66 ± 0.08	148.10 ± 3.40	039.00 ± 0.20	064.92±2.56
Syzygium cumini	008.00 ± 0.57	024.00 ± 0.47	004.00 ± 1.15	012.00±6.11

3.3. Manganese:

The average content of Mn arranged between 030.10±5.66 -352.63±3.81ppm/ 100g (Table5) in the estimated 10 medicinal plants.The highest amount of Mn is recorded in the*Anacardiumoccidentale*(352.63±3.81ppm) and the lowest amount was recorded in*Aeglemarmelos* (030.10±5.66). From the results it is clear that variation among the different area samples the highest content of Mn was detected in plants collected fromKappathagudda followed by Sandur, due to soil contains high amount of Mn. Similarly the least amount of Mn was recorded in the plants samples estimated from the Gulbarga. Mn is an important electrolyte also responsible for proper bones and liver function. It also works as co-factor in more than 300 metabolic reactions [17].Normal daily intake of Mn is 2-8 mg/day.Shedede*t al.*,[13) estimated the manganese from seven medicinal plants, in *Acacia ehrenbergiana*339 mg/kg^{-1} highest amount were detected. According to Reddy and Reddy [18] most of the plants examined plants are safe.

Table 5: Estimation of Manganese from medicinal plants collected from Gulbarga, Sandur and Kappathagudda (ppm/ 100g)

Plants name	**Manganese (in ppm)**			**Average mean of Manganese**
	Gulbarga	**Kappathagudda**	**Sandur**	
Ocimum sanctum	076.33 ± 0.60	102.80 ± 0.57	124.60 ± 0.35	101.24±1.95
Catharanthusroseus	204.60 ± 0.57	157.43 ± 3.00	242.30 ± 0.33	201.44±2.55
Trigonellafoenum-graecum	048.36 ± 0.88	605.50 ± 2.56	032.93 ± 1.20	228.93±1.30
Azadirachtaindica	098.60 ± 0.57	086.83 ± 0.38	118.00 ± 0.38	101.14±9.08
Aegle marmelos	023.00 ± 0.30	026.00 ± 0.57	041.30 ± 0.57	030.10±5.66
Zingiberofficinalis	417.10 ± 0.35	028.46 ± 1.23	506.10 ± 0.36	317.22±1.60
Emblicaofficinalis	000.00 ± 0.00	094.66 ± 2.40	177.13 ± 0.60	090.59±1.17
Anacardiumoccidentale	357.70 ± 0.45	495.20 ± 2.15	205.00 ± 0.57	352.63±3.81
Momordicacharantia	028.60 ± 0.33	046.53 ± 0.69	047.33 ± 1.49	040.82±6.11
Syzygium cumini	020.33 ± 6.17	035.66 ± 0.88	078.00 ± 0.57	044.66±1.24

3.4.Copper

The average content of Curanged between 43.40±1.46 - 185.06±2.50 ppm/ 100g in the estimated 10 medicinal plants is presented in Table 6.

Table 6: Estimation of Copper from medicinal plants collected from Gulbarga, Sandur and Kappathagudda (ppm/ 100g)

Plants name	**Copper (in ppm)**			**Average mean of Copper**
	Gulbarga	**Kappathagudda**	**Sandur**	
Ocimum sanctum	176.70 ± 1.76	099.06 ± 0.32	273.40 ± 6.00	183.05±0.42
Catharanthusroseus	069.16 ± 0.40	079.46 ± 0.38	087.00 ± 0.49	078.54±5.17
Trigonellafoenum-graecum	211.70 ± 0.15	028.26 ± 0.46	098.30 ± 2.45	112.75±3.44
Azadirachtaindica	059.13 ± 0.39	027.13 ± 0.81	048.10 ± 1.22	044.78± 5.38
Aeglemarmelos	015.00 ± 0.47	037.16 ± 0.91	078.06 ± 0.26	043.40±1.46
Zingiberofficinalis	349.50 ± 0.31	091.00 ± 2.51	114.70 ± 0.26	185.06±2.50
Emblicaofficinalis	007.60 ± 0.25	178.43 ± 0.33	006.36 ± 0.21	064.13±5.15
Anacardiumoccidentale	183.30 ± 0.63	122.36 ± 0.93	122.36 ± 0.93	142.67±2.31
Momordicacharantia	038.20 ± 3.70	063.53 ± 0.59	034.56 ± 1.11	045.43±9.11
Syzygiumcumini	097.60 ± 0.80	016.00 ± 0.57	063.00 ± 0.57	058.86±2.64

The highest amount of Cu is recorded in the *Zingiberofficinalis* (185.06±2.50ppm) and least amount was recorded in*Aeglemarmelos* (43.40±1.46). It is also observed that the plant collected from different ecological area *i.e.*,Gulbarga,Sandur and Kappathagudda, the mineral elements is varies from place to place. However, the Cu content is higher in samples estimated from Sandur and Kappathagudda, while, Gulbarga samples contains least amount were recorded.Cu is the main constituent of the bone, connective tissue, brain, heart, and many other body organs [19]. Normal daily intake of copper is 2-5 mg/day. The Cu is macronutrients, which is essential to human health and nutrition by Reddy and Reddy *et al*., [18]. Sheded *et al*., [13] reported that range of Cu contents in 50 medicinally important leafy materials growing in India.

Conclusion

The trace elements are usefully in human physiological activities. It is therefore concluded that the plants under study are rich in elements may also help in biodiversity function etc. A total four elements have been determined in 10 medicinal plants collected from different ecological regions of North Karnataka; these are commonly used in curing various ailments. From the results it indicated that variations in elemental composition and concentration between the species and different ecological area. There reflecting differences in physiological functioning of the specific plants depending upon the elemental interaction within it. Our preliminary study having baseline information about mineral constituents of medicinal plants of North Karnataka, it will be helpful to develop an approach towards direct link between elemental content and its curative probability having coherence with traditional use.

Acknowledgement

The authors are wishing to express their deep thanks for Financial Assistance Provided by BRNS (Sanction No. 2004/23/23/BRNS)and also acknowledge Dr. Y.N.Seetharam, Professor and Dr. Rajanna L. Research Scholar, Department of Botany, Gulbarga University Gulbarga, Karnataka for the analysis of data.

References

1. Lozak, A., Soltyk, K., Ostapczuk,P.,Fijalek, Z. *The Science of the Total Environment*, 289 (2002) 33.
2. WHO–World Health Organization, Traditional Medicine, (1998) Available at: www.who.int/mediacentre/factsheets.2003/ fs134/en > access in:07/08/2003.
3. Goldman, *Annals of Internal Med.* 135 (2002) 594.
4. Gomez, M.R., Ceruitti, S., Olsina, R.A., Silva, M.F., Martinez, L.D., *J. Pharm. Biomed. Anal.* 34 (2004) 569.
5. Mamani, M.C.V., Alexo, L.M., Abreu,M.F., Rath, S., *J. Pharm. Biomed. Anal.* 37 (2005) 709.
6. Lemberkovics, E., Szentmihalyi, K., Balazs, A., Szoke, E., *Food Chemistry*, 78 (2002) 119.
7. Razic, S., Onjia, A., Dogo, S., Slavkovic, L., Popovic, A., *Talanta*, 67 (2005) 233.
8. Weber, G., Koniecznski, P., *Analyt. Bio-analyt. Chem.* 375 (2003) 1067.
9. SPSS package 12 version (2006)
10. Martin Jr., D.W., Magers, P.A., Rodwell, V.W., Granner, D.K., Harper's Review of Biochemistry, 20th(ed). Lange Medical Publication, California, (1985) p. 651.
11. Chen, K.S., Tseng, C.L., Lin, T.H., *J. Radioanal. Nucl. Chem.* 170 (1993) 266.
12. Samudralwar, D.L.,Garg, A.N., *Biolog. Trac. Elem. Res.* 54 (1996) 113.
13. Sheded, M.G., Pulford, I.D.,Hamed, A.I., *J. Arid Env.* 66 (2006)210.
14. Kandala, J.C., Sharma, D., Rathore, V.S., Iron-manganese and zinc-manganese interactions in maize seedlings. In: Proceeding Use Radioactive Radioisotope Studies Plant Products Symposium, Bhabha Atom Research Centre, Bombay, India, (1974) p. 379.
15. Zinpro Corporation, *Trace Miner. Focus*, 6 (2000) 1.
16. Keplan, L.A., Pesce, A.J., Kazmiereczak, S.C.,Clinical Chemistry-Theory, Analysis, Correlation, Fourth (ed) Mos- by, London (2003).
17. Berdanier, C.D., Advanced Nutrition-Micronutrients CRC Press, York (1994).
18. Reddy, P.R., Reddy, S.J., *Chemosphere*, 34 (1997) 2193.
19. Ekinci, N., Rekinci, *J. Rad. Anal. Nuc. Chem.* 260 (2004) 127.