

Analysis of macro and micro nutrients in some Indian medicinal herbs grown in Jaunpur (u.p.) soil

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ABSTRACT

Concept of trace elements being “the Inorganic Switches” has evolved during the last several decades. *Ayurveda*, the traditional Indian medicinal system also emphasises the importance of minor and trace elements in human health and disease. To evaluate elemental contents of some commonly used as health promoter and fever, 5 medicine herbs (stems) namely Guduchi, Vach, Mulahati, Joytishmati and Vidhara have been analyzed for four minor (Na, K, Mg and Ca) and eight trace elements (Cr, Mn, Fe, Co, Ni, Cu, Zn and Cd) by atomic absorption spectrometry and flame photometry. Their accuracy was measured by replicate analyses. In general, elemental contents were found in varying amounts with large range. It is observed that many of medicinal herbs are enriched in one or more elements. Since these elements are bioavailable in natural form, probably in combination with organic constituents, these are likely to be easily assimilated by human bodies. Besides them, two toxic elements Ni and Cd were also found in insignificant amounts as these are likely to have originated from environmental contamination.

Keywords: Sample Used as Health Promoter and Fever; Medicinal Herbs in Jaunpur

1. INTRODUCTION

There are ample evidences of herbs being used in the treatment of diseases and for revitalising body system in almost all ancient civilizations [1-5]. Plants were the mainstay of many medicines having mystical and almost super natural healing power. There are many references to the curative properties of several herbs in the ancient

Indian literature, *Rigveda*, though a more detailed amount is found in the *Atharvaveda* from where Ay-

urveda, the Indian traditional health care system (*ayus* = life, *veda* = knowledge, meaning science of life) originated. Fairly comprehensive information about herbs has been recorded [6,7] in two treatises *Charak Samhita* and *Shusruta Samhita*—a base for Ayurvedic system of medicine. Looking to the importance of herbs, A Compendium of Indian Medicinal Plants in six volumes has been published [8]. Herbs play a significant role in modern times, when the damaging effects of food processing and over medication have assumed alarming proportions. These are now being increasingly used in cosmetics, foods as well as alternative medicine [9]. Besides lipids, proteins and carbohydrates required for human growth, supply of optimum quantities of inorganic micronutrients is also essential [10,11]. Several micronutrients such as Cr, Mn, Fe, Cu and Zn etc., constitute a small fraction of our diet and play an important role in metabolic processes. Their excess or deficiency may disturb normal biochemical functions of the body [12]. Two main criteria considered for essentiality of elements are: first, its absence from diet results in departure from normal growth and metabolism; and second, the replacement of an element may suppress pathological symptoms. The composition of biological systems is so complex that the trace elements are totally masked by major constituents, and hence difficult to determine [13]. Some techniques, widely used in trace element analysis [14] are atomic absorption spectrophotometry (AAS), energy dispersive X-ray fluorescence [15] (EDXRF), electro thermal atomic absorption spectrometry [16] (ETAAS), inductively coupled plasma-atomic emission spectrometry (ICP-AES) and mass spectrometry [17] (ICP-MS). Each one of these has one's own advantages and limitations with regard to accuracy, precision, sensitivity and specificity. The advent of ICP-AES and ICP-MS all with multi-element capabilities has slowed the AAS/AES market. However, AAS/AES technology is deeply entrenched in the field of analytical chemistry.

Several workers from different countries have reported the analysis of medicinal herbs of their respective

countries. Lin *et al.* [18] detected 32 elements in 16 medicinal herbs by ICP-AES. Zhang *et al.* [19] employing ICP-AES for detecting major, minor and trace elements in 26 Chinese traditional drugs and compare their results with those obtained by AAS and NAA. Fan *et al.* [20] detected Cu, Fe, Mn, Zn, Cr, Mo, Se, B, K, Ca, Mg, F⁻, Cl⁻ in 13 diverse drugs by mean of AAS and HPLC methods. Shuping and Chen [21] detected Zn, Fe, Cu, Cr, Co, Ni, Mo, Sr, Cd and Br in seven medicinal herbs by employing ICP-AES. Yuan [22] detected 16 elements in 6 Traditional Chinese Medicines by AAS. Chen *et al.* [23] and Xu *et al.* [24] determined several elements in TCMs by AAS. Wang *et al.* [25] used ICP-MS for determined metal contents in several TCMs. Zhang [26] employed FAAS for determining Zn, Mn and Cu in chinese medicinal herbs and drugs used in treatment of kidney diseases. Zhang *et al.* [27] determined 21 trace elements in 10 TCM samples by employing flame and graphite furnace AAS techniques. Chen *et al.* [28] determined Ti, Cu, Mn, Cr and Cd in chinese medicines by using fluorination assisted electrothermal vaporisation ICP-AES. Liu *et al.* [29,30] determined Co, Mn, Cu and Ni in TCM and compare their results with those obtained by AAS and spectrophotometry. Dong [31] employed AAS for determining Cu, Cr, Cd, Pb, As, Sb and Sn in donkey hide gelatin. Qiao *et al.* [32] determined 20 elements in TCM by employing XRF method. Yu and Mo employed extraction flame AAS for determining [33] Ge in TCM and foods. Hua *et al.* [34] determined Zn, Cd, Na and K in 11 kidney tonics based on TCM. Chuang *et al.* [35] used graphite furnace AAS for determining Pb and Cd in crude drugs. Lu *et al.* [36] determined As and Pb in TCM by spectrophotometric method. Jain *et al.* [37,38] reported AAS and flame photometric determination of 19 elements in several medicinal plants. Saily *et al.* [39,40] analyzed about 40 medicinal plants for 18 elements. It has been reported that Na, Mg, Ca, Cr, Mn, Fe, Co and Zn contents were common in many medicinal plants used for the treatment of asthma, rheumatism, diarrhoea etc. Further Sondhi *et al.* [41-43] have determined 20 elements in Ayurvedic bhasmas (medicine) used for the treatment of bronchitis, kidney and bladder disorder, skin diseases and Gonorrhoea by employing AAS, ICP- AES and flame photometer.

In the present study we have attempted to analyse specific parts of 5 herbal medicines which are often recommended as health promoter and fever. Nomenclature and uses of medicinal herbs analyzed in this study are listed in **Table 1**.

2. EXPERIMENTAL

2.1. Sampling

All the medicinal herbs were procured from the local

Table 1. Some characteristics of herbal medicines analyzed in this study.

| NAME | BOTANICAL NAME | USES |
|-----------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GUDUCHI GILOYA (Stem) | <i>Tinospora cordifolia</i> | Chronic fever, Jaundice, Stomachic and digestive, milk alleviation, splenomegaly, Astringent, health promotive, Rejuvenator |
| VACH (Stem) | <i>Acorus calamus</i> | Insanity Epilepsy, dry cough, Diarrhoea, Pimples of Puberty, Anti-neuralgic, sharp intellect and sweet voice |
| MULAHATI (Stem) | <i>Glycyrrhiza glabra</i> | Hepatosplenomegaly, Injury, Swelling, Rheumatism Gastric ulcer, Blood disorder, Bronchitis, Cough, Asthma, Dysphonia, Fever, Venereal diseases, T.B., Night fall, Skin diseases, Stomachic |
| JOYTISHMATI (Stem) | <i>Celastrus panniculatus</i> | Brain tonic, Nervine tonic, Analgesic Cardiac problem |
| VIDHARA (Stem) | <i>Pueraria tuberosa</i> | Diuretic, Fever, Splenomegaly, Constipation Cardiac disorder, milk alleviator, Skin deceases |

market in Jaunpur (U.P.) cropped locally through dealers of herbal medicines. These were cleaned and then swiped to remove all the dust. These were further washed with distilled water and then afterwards swiped with tissue paper. The plant material was first dried in an oven and then dried under IR Lamp at temperature <70°C. The dried plant material was grounded to a fine powder (100 mesh) in an agate mortar. The powdered samples were stored in pre-cleaned polyethylene vials and handled with extreme care in a glove box to avoid contamination. Synthetic multielemental standards were prepared by spiking 2 - 5 µg amounts of Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Ca, Mg, Na and K in aqueous solution of their respective AR/high purity grade salts.

2.2. AAS Measurements

For the analysis of Mg, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn and Cd by AAS method, about 2 g of each sample were accurately weighed and digested in 5:1 mixture of nitric acid and perchloric acid [44]. After digestion, two to three drops of HCl was added and the solution was made up to 25 mL., Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni and Zn were determined by Atomic Absorption Spectrophotometer (GBC Avanta, Australia) using a mixture acetylene-air flame. The wavelength and sensitivities for these elements were 422.7 nm and 4 µg/g; 228.8 nm and 1.5 µg/g, 240.7 nm and 7 µg/g; 357.9 nm and 4 µg/g; 324.8 nm and 4 µg/g; 248.3 nm and 5 µg/g; 285.2 nm and 0.3 µg/g; 279.5 nm and 2.5 µg/g; 232.0 nm and 7.0 µg/g and 213.9 nm and 1.0 µg/g respectively. The in-

strument was precalibrated using high purity grade salts of respective elements.

3. RESULTS AND DISCUSSION

Elemental concentrations in 5 medicinal herbs (stems) were measured by relative method of AAS by using RMs and multielemental standards as comparators. Only if the values for elemental concentrations in RMs matched well within $\pm 10\%$ of the certified values, the values for sample were considered. These are listed in **Tables 2**. Also included in the same tables are our data for participation in the analysis of depleted Pine Needle (SRM 1575a). In each case triplicate analyses were made using 100 mg each. It was observed that standard deviations for most elements were small suggesting a good precision. On the basis of good agreement, it is presumed that our values are listed in **Tables 2** should be accurate and precise within $\pm 10\%$. In order to compare the mean elemental concentrations of 5 medicinal herbs (stems) for Na, K, Ca, Mg, Fe, Cu, Mn, Cr, Zn and Co are plotted in **Figure 1**. The herbs of Jaunpur origin are found to contain some rare elements in amounts larger than other places.

A perusal of data in **Table 2** shows that no single herb is enriched in all the elements. The electrolytic elements Na and K responsible for maintaining normal fluid balance inside and outside cells are generally found at minor and major concentration levels respectively. All the samples have shown much higher concentration of K by up to an order of magnitude compared to that of Na.

The analysis of selected herbs leads to the following results:

1) **Guduchi**: The stem of this herb contains Na (0.120), K (0.50), Ca (16.0), Mg (3.1) in mg/g and Fe (1300), Cr (2.5), Mn (130), Co (1.50), Cu (2.0), Zn (8.6), Ni (41) and Cd (1.3) $\mu\text{g/g}$. Other plant organs were not analysed as they have negligible medicinal significance.

2) **Vach**: The stem of this herb contains Na (0.370), K (2.50), Ca (11.0), Mg (5.7) in mg/g and Fe (700), Cr (2.5), Mn (100), Co (4.0), Cu (4.0), Zn (9.0), Ni (40) and Cd (0.4) $\mu\text{g/g}$. Other plant organs were not analysed as they have negligible medicinal significance.

3) **Mulahati**: The stem of this herb contains Na (0.370), K (0.50), Ca (15.6), Mg (3.6) in mg/g and Fe (3500), Cr (1.0), Mn (67), Co (4.20), Cu (1.0), Zn (8.6), Ni (26) and Cd (1.2) $\mu\text{g/g}$. Other plant organs were not analysed as they have negligible medicinal significance.

4) **Joytishmati**: The stem of this herb contains Na (0.120), K (0.005), Ca (19.2), Mg (4.1) in mg/g and Fe (1750), Cr (4.0), Mn (13), Co (2.2), Cu (5.6), Zn (7.1), Ni (42) and Cd (0.4) $\mu\text{g/g}$. Other plant organs were not analysed as they have negligible medicinal significance.

5) **Vidhara**: The stem of this herb contains Na (0.125),

Table 2. Elemental concentrations in stems of medicinal plants.

| Elements | SRM Pine Needle (1575a) | Vidhara | Mulahati | Vach | Guduchi | Joytishmati |
|----------|---------------------------|---------|----------|-------|---------|-------------|
| Na mg/g | 0.40 - | 0.125 | 0.370 | 0.370 | 0.120 | 0.120 |
| K mg/g | 5.0 (3.70 \pm 0.20) | 0.05 | 0.50 | 2.50 | 0.50 | 0.005 |
| Ca mg/g | 4.12 (4.10 \pm 0.20) | 14.4 | 15.6 | 11.0 | 16.0 | 19.2 |
| Mg mg/g | 3.24 - | 4.0 | 3.6 | 5.7 | 2.1 | 4.1 |
| Fe g/g | 210 (200 \pm 10) | 500 | 3500 | 700 | 1300 | 1750 |
| Cr g/g | 3.2 (3.0 \pm 0.3) | 3.0 | 1.0 | 2.5 | 2.5 | 4.0 |
| Mn g/g | 670 (675 \pm 15) | 16 | 67 | 100 | 130 | 13 |
| Co g/g | 0.10 (0.10) | 0.70 | 4.20 | 4.0 | 1.50 | 2.2 |
| Cu g/g | 3.2 (3.0 \pm 0.3) | 2.0 | 1.0 | 4.0 | 2.0 | 5.6 |
| Zn g/g | - - | 1.5 | 8.6 | 9.0 | 8.6 | 7.1 |
| Ni g/g | 3.50 (3.5) | 27 | 26 | 40 | 41 | 42 |
| Cd g/g | 0.50 (<0.5) | 0.8 | 1.2 | 0.4 | 1.3 | 0.4 |

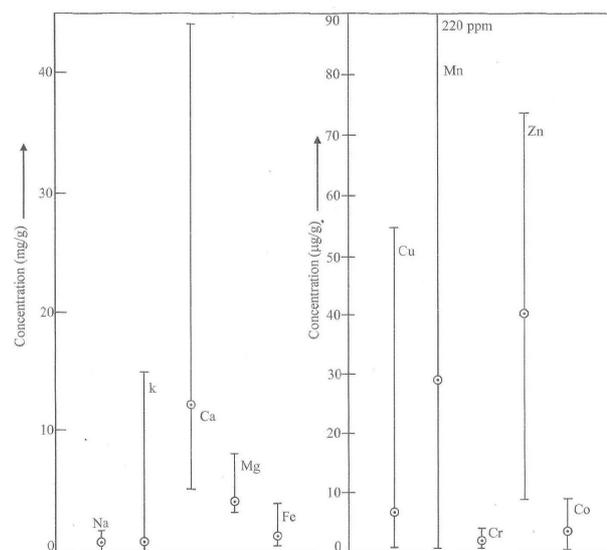


Figure 1. Comparison of elemental contents (range and median values) in medicinal herbs. Note: In Parenthesis are given certified values from literature.

K (0.05), Ca (14.4), Mg (4.0) in mg/g and Fe (500), Cr (3.0), Mn (16), Co (0.70), Cu (2.0), Zn (1.5), Ni (27) and Cd (0.8) $\mu\text{g/g}$. Other plant organs were not analysed as

they have negligible medicinal significance.

Vach has highest contents of Na, K, Mg, Cr, Co, Cu and Zn. It has intellect promoting property and quite often used for removing pimples of puberty as it alleviates an sanity and epilepsy. Its organic constituents are a saryl aldehyde, acorin, caffeine and eugenol. Probably these elements may be associated with these organic constituents making them available in the bioavailable form. Yastimadhu commonly called Mulahati in Hindi has highest contents of Na, Ca, Fe, Mn, Co, Cu and Zn. This is sweet in taste and very often used in hyperacidity, peptic ulcer, anaemia, and cough. Its main constituents are glycyrrhizins and a glycoside called isoliquiritin. Joytishmati has very high contents of Ca, Fe, Cu and Zn. It is quite useful as analgesic and cardiac problem. Guduchi has highest content of Fe, Mn and Zn. It is used in chronic fever, jaundice and milk elevation. Vidhra has very highest content of Fe, Ni, Mn and Ca. It is quite useful in constipation, milk elevation and skin diseases. The accountability of different components for medicinal potency may be a search light for physicians [45] and dieticians [46,47].

4. CONCLUSIONS

Five herbal medicines (stems) commonly used as health promoter and fever have been analyzed for 10 essential nutrients (Na, K, Ca, Mg, Fe, Cr, Mn, Co, Cu and Zn) and 2 toxic elements (Ni and Cd) by flame photometry and AAS. The elemental data should be reliable within $\pm 10\%$. On the basis of elemental data in 5 medicinal herbs commonly used as health promoter and fever following conclusion may be drawn:

(1) Different parts of medicinal plants are enriched in some or other nutrient elements specially for Ca, Fe, Mn, Cu and Zn.

(2) No particular plant is enriched in all the elements.

(3) In general iron is enriched in all the medicinal herbs as there are used as brain tonics.

(4) Elemental contents of environmental contaminants are minimal so as not to cause any harm to our body system.

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