Physico-Chemical Analysis of Ash of Some Medicinal Plants Growing in Uttarakhand, India

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Abstract: Physio-chemical analysis of ash of *Quercus infectoria*, *Cassia fistula*, *Tinospora cordifolia*, *Butea monosperma* and *Cedrela toona* trees parts were carried out for present study. Atomic Absorption Spectroscopy (AAS) was used for quantitative estimation while chemical methods applied for qualitative estimation of minerals in plants ash. It is found that *C. fistula*, *T. cordifolia*, *Q. infectoria* and *C. toona* showed maximum concentration of potassium while, *B. monosperma* showed maximum results with magnesium. [Nature and Science 2010;8(6):88-91]. (ISSN: 1545-0740).

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1. Introduction

All human beings require a number of complex organic/inorganic compounds in diet to meet the need for their activities. The important constituents of diet are carbohydrates, fats, proteins, vitamins, minerals and water (Indrayan et al., 2005). Every constituent plays an important role and deficiency of any one constituent may lead to abnormal developments in the body. Plants are the rich source of all the elements essential for human beings. There is a relationship between the element content of the plant and its nutritional status. Some elements are essential for growth, for structure formation, reproduction or as components of biologically active molecules while others have some other beneficial affects (New Wall et al., 1996). Qualitative or quantitative determination of mineral elements present in plants is important because the concentration and type of minerals present must often be stipulated on the label of a food. The quality of many foods depends on the concentration and type of minerals what they contains, also play a very significant role against a variety of degenerative diseases and processes, they may also prevent and reduce injury from environmental pollutants and enhance the ability to work and learn, some minerals are essential to a healthy diet (e.g. Calcium, Phosphorus, Potassium and Sodium) where as some can be toxic (e.g. Lead, Mercury, Cadmium and Aluminium). It is clear that mineral nutrition is important to maintain good health and because of that determination of As, Ca, Fe, Mg, Na, K, Zn, Ni, Co etc. have been added to *Ayurvedic Pharmacopoeia of India* (The *Ayurvedic Pharmacopoeia* of India, 1999). From ancient times, *Swarnabhasma* (gold ash) has been used in several clinical manifestations including loss of memory, defective eyesight, infertility, overall body weakness and incidence of early aging. Qualitative analyses indicated that *Swarnabhasma* contained not only gold but also several microelements - Fe, Al, Cu, Zn, Co, Mg, Ca, As, Pb etc (Mitra et al., 2002).

2. Materials And Methods

Butea monosperma (flowers), *Cassia fistula* (pods) and *Tinospora cordifolia* (stems) from B.H.E.L. (Bharat Heavy Electricals Limited, Haridwar) campus, *Quercus infectoria* (galls) from local market of Haridwar and *Cedrela toona* (stem bark) from Dehradun were collected and identified with the help of scientific literature and also by matching with the authentic herbarium specimens deposited at "Botanical Survey of India", Dehradun (U.K.). The glassware used was sterilized in an oven at 150-160^{0}C for 2 hrs. To prepare the sample for mineral analysis, plant material was kept at 150^{0}C to a constant weight. Dried plant material was ground to fine powder and used for dry ashing. Precleaned silica crucible was heated at 600^{0}C until the weight of the crucible became constant. Five gram powdered plant material was taken in the silica crucible and heated in a muffle furnace at 400^{0}C till there was no evolution of smoke. The crucible was cooled at room temperature in a desiccator and ash was moistened with concentrated H_2SO_4 (0.5 ml). Crucible was placed on hot plate and heated until fumes of H_2SO_4 ceased to evolve. The crucible with sulphated ash was then heated in a muffle furnace at 600^{0}C till the weight of the content became constant (Indrayan et al., 2005).

The physico-chemical analysis includes number of parameters such as physical state, colour, taste, percentage of loss on drying as per standard method of (Dupta, 1984 and The *Indian Pharmacopoeia*, 1996),

ash content as per method of (Gupta, 2003 and Indrayan et al., 2005), ash value (water, alcohol and acid soluble or insoluble ash) as per method of (Ahmad and Sharma, 2001), pH value and conductivity (Sharma, and Kaur, 1998), Chloride and Sulphate (Trivedi and Goel, 1986). The eight inorganic elements (Ca, P, Mn, Zn, Ni, Fe, K and Mg) have been detected in *B. monosperma, C. fistula, C. toona, T. cordifolia* and *Q. infectoria* by AAS. The analysis of ash samples was conducted at Wadia Research Institute, Dehradun. The samples (in ten replicates of selected trees) were analyzed.

3. Results and Discussion

The results of physico-chemical analysis of plant ash are given in Table 1. The ash of all the plants was shown as fine powder. Percentage of loss on drying was highest in *C. toona* followed by *C. fistula, T. cordifolia, Q. infectoria* and *B. monosperma*. Percentage of ash content was highest in *C. toona* followed by *T. cordifolia, B. monosperma, C. fistula* and lowest in *Q. infectoria*. Percentage of ash value was highest in acid followed by alcohol and water. All the samples were found alkaline in pH. Conductivity was highest in *C. fistula* followed by *Q. infectoria, B. monosperma, T. cordifolia* and *C. toona*. The chloride concentration was highest in *T. cordifolia* and Sulphate was highest in *B. monosperma*.

Analysis of eight mineral elements of plant's ash by AAS is presented in Table 2. *C. fistula, T. cordifolia, Q. infectoria* and *C. toona* showed maximum concentration of potassium (K) in comparison to other elements. *B. monosperma* showed maximum results with magnesium. Calcium is present in all plants in good quantity it was highest in *B. monosperma* and lowest in *C. toona*. Iron concentration was found maximum in *Q. infectoria* and minimum in *C. toona*. Phosphorus concentration was found to be highest in *T. cordifolia* and lowest in *C. toona*.

Rasayana drugs of various sources were discovered and applied in ancient Indian medicine since Vedic period. The use of mineral element is found to have been developed and used widely to cure several health problems. In Ayurveda, different plants are mixed-up with *Louha Bhasma* during the process of heating for management of different diseases, with lime juice (*Citrus bergamia*) is used for loss of appetite, with juice of Bala (*Sida cordifolia*) in rheumatism and with cow's urine for treatment of anaemia (Pandit et al., 1999).

The amount and composition of ash remaining after combustion of plant material varies considerably according to the part of the plant, age, treatment etc. The constituents of the ash also vary with time and from organ to organ. Ash usually represents the inorganic part of the plant. The percentage of ash content is highest in *C. toona* stem bark (7.4%) and *T. cordifolia* stem (7.2%), Table 1. It contains inorganic material of the plant because ashing destroys all the organic material present in the sample. Kar *et al.*, (1999) detected 18.53% of organic content and 6.22% of inorganic content in *T. cordifolia* stem that is similar to our results.

Eight elements Ca, P, K, Mg, Fe, Mn, Zn and Ni in all five plants, traditionally used to cure several diseases, have been determined by using Atomic Absorption Spectrophotometer. These inorganic elements play an important role in physiological process involved in human health. The elemental composition of ash is given in Table 2. Barthakur *et al.*, (1995) also reported highest concentration of K in fruit of *C. fistula*. *C. fistula*, is a good source of K so that 100% of the US Recommended Dietary Allowances (RDA) for adults could be met by the consumption of about 100 gm of fresh fruit. K is important as diuretic and it takes part in ionic balance of the human body and maintains tissue excitability. Potassium is the principal intracellular cation and also consider as a very important constituent of the extracellular fluids. Potassium ions are concerned with the transmission of electrical impulse in the nerve cells and in maintaining the fluid balance of the body. Venkataraman and Gopal Krishnan (2002) reported maximum concentration of Ca, Fe and K in nine plants traditionally used for jaundice and concluded that high concentration of K in the medicinal plants could be related to the diuretic action of drugs prepared from these plants.

Calcium imparts strength and rigidity to bones and teeth. Calcium ions are also needed in neuromuscular transmission, in excitability of nerves for normal excitability of heart, in clotting of blood and promoting muscular contraction. It also acts as an activator of the enzymes phospholipase, arginine kinase, adenosine triphosphatase and adenyl kinase. Excess quantity of Calcium ions in the extracellular fluids acts as a mental depressant. At the other extreme, low levels of Calcium causes spontaneous discharge of nerve fibers, resulting in tetany.

Magnesium is the fourth most abundant cation in the body. Much of Magnesium is present in bones in association with Calcium and Phosphate and the rest in soft tissues and body fluids. In muscles and other tissues, intracellular Magnesium ions function as activators for many of the enzymes involved in carbohydrate metabolism and synthesis of nucleic acids (DNA and RNA). Magnesium also acts as an important binding agent of ribosomal particles where protein synthesis takes place. Increased extracellular concentration of magnesium depresses skeletal muscle contraction. On the other hand, low Magnesium concentration causes increased irritability of the

nervous system, peripheral vasodilation and cardia arrhythmias (Singh, and Jain, 2006). Manganese is highest in *B. monosperma* (190 ppm). Manganese is essential for haemoglobin formation but excess is harmful. Zinc is present in sufficient amount in *C. fistula* pods (525 ppm). Zn is an essential component of a number of enzymes present in animal tissue including alcohol dehydrogenase, alkaline phosphatase, carbonic anhydrase and procarboxypeptidase, is also essential for the normal growth and reproduction and helps in the process of tissue repair and wound healing. Zinc deficiency causes growth retardation and skin lesions (Chatterjee and Shinde, 1995). The lower amount of Zn accumulation in the plants is due to its less absorption from the soil.

Phosphorus is present in highest amount in *T. cordifolia*. *C. fistula* and *Q. infectoria* also contain sufficient amount of Phosphorus. Phosphate ions are the major anions of intracellular fluids, phospholipids and the coenzyme NAD and NADP and especially of ATP and other high energy compounds. It helps in the process of ossification of bones by getting deposited in the form of Calcium Phosphate (Indrayan et al., 2005). Kar *et al*. (1999) reported that the inorganic parts (containing K, Zn, Ca traces of chromium etc) of *T. cordifolia* (stem) showed more pronounced action of glucose-tolerance factor than their corresponding organic parts. Nickel is present highest in *Q. infectoria* (213 ppm) and lowest in *C. toona* (24 ppm). Ni aids the synthesis of haemoglobin in the bone marrow.

Iron is the most well known in biological system. It performs a wide range of biological functions. Many of these functions are connected with oxidation-reduction and processes by which energy is conserved in the body. It forms an integral part of cytochromes, haemoglobin, myoglobin, metallo-flavoproteins and certain enzymes such as catalase and peroxidases. Thus, Iron is absolutely essential for transport of oxygen to the tissue and for operation of oxidation systems within the tissue cells, without which life would cease within a few seconds. Iron deficiency causes anaemia. In present study, Iron content is highest in *Q. infectoria* galls (3587 ppm). Omolo *et al*. (1997) reported the Iron content in different parts of eight plants, *Adenia gummifera, Allophylus rubifolius, Brackenridgea zanguebarica, Bridelia eathartica, Albizia versicolor, Commiphora africana, Lannea stuhlmannii* and *Triumfelta rhomboidea* traditionally used to treat anaemia in Eastern Africa, was determined using AAS. The values obtained for the root bark had higher Iron content than the leaves and stem bark.

Table 1: - Physicochemical analysis of plants ash

Plants	Physical State	Colour of ash	Taste of Ash	% of loss on drying	% of ash cont-ent	% of ash value						pH of Ash sol.	Condu-ctivity of ash sol. (µS/cm)	Chloride mg/l	Sulphate mg/l
						Alcohol		Water		Acid					
						Sol.	Insol.	Sol.	Insol.	Sol.	Insol.				
Butea monosperma	Fine Powder	White	Alkaline	0.148 ±0.01	6.5 ±0.21	31.18 ±1.05	68.82 ±9.63	21.20 ±3.89	78.80 ±12.23	98.17 ±14.56	1.83 ±0.12	10.62 ±1.36	786 ±36.69	18.22 ±2.26	13.20 ±1.89
Cassia fistula	Fine Powder	Light Brown	Alkaline	0.468 ±0.01	5.3 ±0.22	32.58 ±1.09	67.42 ±9.36	29.43 ±6.87	70.57 ±11.36	99.00 ±14.26	1.00 ±0.11	10.08 ±1.32	809 ±54.47	17.43 ±2.69	11.36 ±1.12
Quercus infectoria	Fine Powder	Light Pink	Alkaline	0.334 ±0.01	2.0 ±0.12	39.4 ±1.14	60.59 ±8.52	24.20 ±5.77	75.80 ±14.36	99.22 ±15.36	0.78 ±0.14	10.74 ±1.38	802 ±63.21	16.32 ±3.12	10.52 ±1.25
Tinospora cordifolia	Fine Powder	Grayish	Alkaline	0.382 ±0.01	7.2 ±0.21	29.74 ±1.08	70.26 ±8.87	25.42 ±4.36	74.58 ±12.87	97.59 ±14.44	2.41 ±0.16	11.01 ±1.01	741 ±54.58	18.38 ±3.36	12.47 ±1.36
Cedrela Toona	Fine Powder	White	Alkaline	0.473 ±0.01	7.4 ±0.19	26.60 ±1.44	73.30 ±5.56	23.21 ±3.32	76.58 ±11.36	94.41 ±13.39	5.59 ±0.74	10.32 ±1.12	714 ±45.54	16.41 ±3.65	10.33 ±1.09

Table 2: - Elemental composition of plants by using Atomic Absorption Spectrophotometer

S. No.	Elements	Plants (in 5% HCl				
		B. monosperma	*C. fistula*	*Q. infectoria*	*T. cordifolia*	*C. toona*
1.	Calcium (Ca) (ppm)	38600	18000	12700	26200	10700
2.	Phosphorus (P) (ppm)	3400	15100	11100	19300	820
3.	Potassium (K) (ppm)	10516	256833	223633	228851	22538
4.	Magnesium (Mg) (ppm)	83928	27600	20933	49998	5205
5.	Iron (Fe) (ppm)	657	1896	3587	1226	206
6.	Manganese (Mn) (ppm)	190	100	100	70	1
7.	Zinc (Zn) (ppm)	179	525	329	290	104
8.	Nickel (Ni) (ppm)	55	199	213	51	24

4. Conclusions

All these plants may be a good source of minerals to treat number of diseases that are mainly caused due to the deficiency of those minerals and can be utilized in Ayrvedic system to cure disease. Ayurveda can be termed as India's monumental heritage and vibrant tradition. In Kerala Ayurveda has withstood the test of time for the past 2000 years.

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