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COMPARATIVE STUDY OF THE ELEMENTAL COMPOSITION OF *SWERTIA CHIRAYITA* FROM TWO DIFFERENT SITES OF GARHWAL IN UTTRAKHAND

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ABSTRACT

Different elemental constituents of the medicinal plant *Swertia chirayita* (whole parts) were estimated from two different sites of Garhwal (Chakrata and Kaddukhal) in Uttrakhand by Inductive Coupled Plasma Mass Spectroscopy against salt standards. 17 Mineral elements (Macro and Trace) Mn, Mg, Fe, Ca, Na, K, AI, B, Zn, Sr, Cu, Ni, Cr, Mo, Co, Cd and Li, have been measured in both samples of *Swertia Chirayita*. It is therefore concluded that, *Swertia chirayta* contains pharmacologically useful active elements, which can play vital roles in health and treatment of diseases.

Key words: *Swertia Chirayita*, Mineral elements (Macro and trace), ICPMS.

INTRODUCTION

Plants have been used as an alternative source of medicine from ancient time, before the advent of synthetic drugs. These plants are widely used to treat many human diseases due to their mild features and low side effects[1]. Medicinal plants are plants that contain substances, which could be used for therapeutic purposes or which are precursor for the synthesis of useful drugs[2]. A variety of medicinal plants are widely used to treat many human diseases for a very long time to cure illness, due to their different medicinal properties and low side effects. Some of the ingredients of allopathic and most of the Ayurvedic and Homeopathy medicines are derived from plants. The traditional medicinal plants used into preparation of various drugs, singly or in combination or even as the principal source of raw material for the other medicine[3].

Herbs, not only provide us chemicals of medicinal value but also nutritional minerals and trace elements[4]. These are chemical elements, which are required by our bodies

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for numerous biological and physiological processes that are necessary for the maintenance of health and proper growth of the body. Those minerals that are required in our diets in amounts greater than 100 mg per day are called "minerals" and those that are required in amounts, less than 100 mg per day, are termed as "trace elements." Major minerals include Ca, Cl, Mg ,P, K, Na, S and trace minerals comprise of I, Fe, Zn, Se, F, Cr, Cu, Mo, and M[5,6]. Though the trace minerals are required in small quantities, but they play a vital role in the maintenance of good health. These mineral elements are presented in different concentrations in plants and their excess or deficiency may lead to various complications and metabolic disorders in the human body. There are basically 17 important elements required for good health, which may be derived from plants. These elements are present in varying concentrations in different parts of the plants, especially in roots, seeds, stems and leaves, which are either used as dietary supplements or as well as the ingredient in the Ayurvedic medicinal preparations. The environmental factors including atmosphere and pollution, season of collection, age of plant (maturity) and soil conditions in which plant grows, affect the concentration of different elements as it varies from plant to plant and from region to region[7].

Swertia chirayita (Family Gentianaceae), is one of the important traditional medicinal plant, an erect annual or perennial herb. It can also be grown in sub- temperate regions between 1500 m.amsl and 2100 m. amsl altitudes[8]. It grows scantily in south facing slope between 1500 m and 3000 m, while on the Northern facing slope, it descends below 1500 m. amsl on shady sites. The plant is a native to temperate Himalayas, found at an altitude of 1200-3000 m. amsl from Kashmir to Bhutan, and in the Khasi Hills at 1200-1500 m.amsl[9,10]. The entire plant is used in medicine; however, the root is mentioned to be the most powerful part. It has been reported to have anti-inflammatory[11], anti-viral[12], antihelmintic[13], anticarcinogenic[14], hepatoprotective[15] hypoglycemic[16,17] wound healing activity as well as antibacterial activity. However, few studies have mentioned the elemental analysis of *Swertia chirayita*. Negi et al.[18] reported the presence of following elements Zn, Cu, Mn, Fe, Co, Na, K, Ca and Li in roots and leaves of *Swertia chirayita*. This study is designed to investigate the comparative difference in elemental constituents of whole part of *Swertia chirayita* from different altitudes.

EXPERIMENTAL

Materials and methods

Collection of plant material

The plant specimen of *Swertia chirayita* were collected in the end of September 2011 from two different locations, the first being from the Kauntalani Nursery, which is located at

N-30^{o} 45’123” Latitude and E- 077^{o} 53’00: and is 2580 m.amsl. [Fortrex 201 GPS]. Kauntalani Nursery belongs to the Chakrata (CK,site) Forest Division, District Dehra Dun, Uttarakhand and being jointly managed by the Aushdheeya Vanaspati Van Sanstha, Uttaranchal (under the auspices of Uttarakhand Forest Development Corporation). It is located approximately 9 (nine) kilometers from the Janglat Chauki on the forest road to Mundali at the bifurcation of road to the Deoban Forest Rest House and the second site for the collection of plant material is Kaddukhal (KK,site) of Saklana Forest range in Narendranagar Forest Division located at N- 30°27´804’’, Latitude and E- 079°14´ 120” and is 2241 m.amsl.

Identification of plant

The plant was first identified and authenticated by the plant taxonomist of Department of Botany, Forest Research Institute, Dehra Dun. The accession number 16430 has been assigned to the specimen submitted to FRI herbarium for identification and is identified as *Swertia chirayita* (Roxb.Ex Flem) Karst.

Chemicals

Nitric acid (HNO_3), sulphuric acid (H_2SO_4) and perchloric acid ($HClO_4$) (Renkem Fine Chemicals Limited, Okhla Delhi) were used. All these chemicals were of analytical grade.

Method

An air dried dust free sample was taken and milled into a fine powder, using a stainless steel miller, 5 g of the resultant powder was digested in 25 mL conc. nitric acid in a hot plate until the volume of the sample reduced to about 5 mL. The digested residues were dissolved in 40 mL acid mixture (250 mL HNO_3 + 25 mL conc. H_2SO_4 + 10 mL $HClO_4$) and heated on hot plate until the reddish brown fumes disappeared. This residue was dissolved in dilute HNO_3, and the volume was made up to 100 mL in a volumetric flask. The filtrate was used for the determination of elements by Inductive coupled plasma optical mass spectroscopy (ICPMS, Perkin Elmer SCIEX ELAN DRCe). In this method, the instrument was calibrated with standard reference solution of known concentration, to plot the standard curve, after which the clear digested sample was aspired into the machine to determine the mineral components[19].

RESULTS AND DISCUSSION

The results of mineral elements (Macro and Trace) of *Swertia chirayita* from both the sites KK and CK, as obtained by Inductive Coupled Plasma Mass Spectroscopy, are

depicted in Tables 1 and 2. The values are in ppm and ppb, respectively.

The results of elemental analysis indicated the presence of 17 macro and trace mineral elements. These elements (Mn, Mg, Fe, Ca, Na, K, AI, B, Zn, Sr, Cu, Ni, Cr, Mo, Co, Cd, and Li) have been measured in different concentrations in both sites, KK and CK. It has also been observed that K, Ca, Mg, Al, Mn, Fe, and Na are the chief constituents of the plant in both the regions. Mo, Co, Cd, and Li elements are present in less quantities as shown in Tables 1 and 2. The concentration of potassium (20275 ppm) is highest and cadmium (19 ppb) is least in both the plant samples.

The elements play both; curative and preventive role in combating diseases[19]. There is a vast scope to exploit the preventive medicinal aspects of various elements[20]. The presence of seventeen elements Mn, Mg, Fe, Ca, Na, K, AI, B, Zn, Sr, Cu, Ni, Cr, Mo, Co, Cd, and Li, have been verified by in both the sites (CK and KK) samples of *Swertia chirayita* in the present study, which are traditionally used to cure several diseases. The elemental composition of *Swertia chirayita* is given in Tables 1 and 2.

Table 1: Elemental composition of *Swertia chirayita* in ppm

Element	Unit	KK	CK
Mn	ppm	77	45
Mg	ppm	2562	1910
Fe	ppm	224	329
Ca	ppm	3229	4141
Na	ppm	94	58
K	ppm	20275	17923
Al	ppm	166	276
B	ppm	14	20
Zn	ppm	17	23
Sr	ppm	10	5
Cu	ppm	2	46
Ni	ppm	12	26
Cr	ppm	22	26

Table 2: Elemental composition of *Swertia chirayita* in ppb

Element	Unit	KK	CK
Mo	ppb	267	189
Co	ppb	252	265
Cd	ppb	104	19
Li	ppb	252	416

The analysis of various elements in the whole plant sample of *Swertia chirayita* indicated that the plant of both sites contains same types of elements but having difference in their concentrations. The presence and concentrations of various elements, in plant, depend on the locality factors viz. soil composition, moisture contents, topography aspects, solubility of minerals diffusion and osmosis traits of the plants. Hence, the observed variations in concentration of the elements are attributed to the nature of the plant as well as its locality factors. Furthermore, this difference can also be attributed to the edaphic factors along with the forest management practices, as site KK is totally protected as buffer zone to the forest nursery and site CK does possess certain biotic pressure. The difference of the quantities of different elements under the present physical conditions of both sites are not in consonance with each other and hence, the justification of difference in the quantities of elements studied in both site. These inorganic elements play an important role in physiological process involved in human health.

Elemental analysis has shown that the plant is a rich source of K, Ca, Mg, Fe, Al, and Na. These mineral elements are very important in human nutrition. Ca, K, and Mg are required for repair of worn out body cells, strong bones and teeth in humans, building of red blood cells and for body mechanisms[21].

Potassium (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 considered 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.

Potassium content was highest in both the sites, which is supported by the earlier results[18]. The plant contained sodium in low amount. Sodium and potassium take part in ionic balance of the human body and maintain tissue excitability, carry normal muscle contraction, help in formation of gastric juice in stomach[23].

Calcium (Ca) imparts strength and rigidity to bones and teeth. Calcium ions are also needed in neuromuscular transmission, excitability of nerves, normal excitability of heart, clotting of blood and promoting muscular contraction.

Sulphur (S) is an important element that is used in small amounts in the construction all parts of human body. Fortunately there is plenty of sulphur in the food products and excess sulphur gained by the body is excreted by the body.

Iron (Fe) has many functions in the body. It is used to make tendons and ligaments. It is also important for maintaining healthy immune system. Iron is essential for blood as it is an essential part of haemoglobin. Its deficiency can cause anemia.

Aluminium (Al) is now thought to be involved in action of a small number of enzymes. The body has hard time ridding itself of excess aluminium.

Magnesium (Mg) prevents some heart disorders and high blood pressure and is associated with improved lung function. It helps in absorbing calcium and phosphorus. It is essential to control insulin levels in blood. It is injected in veins in acute heart or asthma attack situations. Magnesium is effective in treating numerous heart/lung diseases.

Trace elements such as Mn, Fe, and Zn are essential in enzymes metabolism. The concentrations of these elements in plants are quite important.

Zinc (Zn) maintain various reactions of the body, which help to construct and maintain DNA, required for growth and repair of body tissues, important element of ligaments and tendons[24].

Lithium (Li) was found in the range of 416 ppb in *Swertia chirayita*. It is recommended as blood purifier. This may be attributed due to the presence of higher Fe content 329 ppm. Hemoglobin contains the greatest amount of body iron (67%) and this is largely in the red blood cells[25].

The appreciable concentrations of minerals such as sodium, potassium, calcium and magnesium obtained in the plant are interesting. It showed that the plant holds tremendous promise in providing the variable secondary metabolites and mineral supply that could enhance the curative process of ill health. These findings provide quantitative estimation of the phytochemicals as well as mineral element analysis, which are important in understanding the pharmacological and/or toxicological actions of medicinal plants. This plant is suitable to meet the human body requirement as an important supplement.

CONCLUSION

The elemental analysis by ICPMS indicates the presence of 17 elements in *Swertia chirayita* in different concentration. All these elements have vital importance in human's metabolism and that they are required for growth, prevention, and treatment of various diseases. 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 in the cure of many diseases ethno medicinally. Therefore the plant can be used in the treatment of various diseases. However, more detailed analysis of chemical composition of these medicinal plants is required to be done.

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