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PROFILING OF TRACE ELEMENTS IN INDIAN VITAL MEDICINAL PLANT MOMIRDICA CHARANTIA USING INDUCTIVE COUPLED PLASMA-MASS SPECTROSCOPY

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Abstract

Momirdica charantia (M. Charantia) is an important medicinal valued plant; the present study was carried out to for the profiling of certain trace elements in the plant. ICP-MS is an efficient and rapid technique which is employed for the present study. The plant contains different trace element with various concentration, those are having vital role in preparing traditional medicines. Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Ag, Cs, Ba and Ti are the trace elements present in the plant extract were investigated. The concentrations of each element are reported in ppm. It is found that Al, Fe, Ba, Sr and Mn were found with higher concentrations and As, Cs, Ag, Tl and Be were present in lower concentrations which have toxic in nature. The individual concentrations of each trace element are in permissible limit as per FAO/WHO. The data obtained in the present investigation may be added up to the trace elemental data base of medicinal plants in the world. The results obtained in this investigation may use to set new criterions for setting the dosage of the herbal drugs.

Keywords: ICP-MS, Trace elements, Medicinal plants, *Momirdica charantia*, Essential metal ions

1. Introduction

Trace elements are found crucial those are essential for the plant and animals healthy growth. As the word trace, they are required in small quantities for healthy functioning of human organs through physiological and biological functions [1]. Trace elements are as well as important for the healthy growth of plants and in formation of chemical constituents those are responsible for medicinal properties [2]. The usage of these medicinal plants has widespread in curing various diseases due to the presence of trace elements. Some medicinal plants are rich in specific trace elements, show good therapeutic action of the medicine [3, 4].

As trace elements are required for the healthy human body, medicinal plants may be used for the same purpose. A number of elements essential to human are gathers minerals essential for the

growth from the environment [5]. In curing skin disease, enhancing immunity system is important which can be done by taking small amounts of trace elements, those are having defensive nature towards pathogens. Fe, Cu, Mn, V and Co [6] is essential and plays important role in many metabolic activities, enzymatic reactions and immunological activities [7, 8]. It is familiar that few trace elements are vital in healthy growth of plants, the intake of some non-essential trace elements also important in some cases [9].

WHO studies predict that, majority of world population depends on traditional medicines as home remedies. The trace elements in the medicinal valued plant play a key role in homemade medicines for treatment of some diseases. Traditional therapy done by commonly used plant extracts [10]. The non-toxicity, fewer side effects on human health made the usage of herbal medicines are gradually increasing day by day [11]. It has been already proved that the trace elements in medicinal plants are potential in curing a disease. This study reveals that traditional plants having trace and major elements shows significant role in battling a variety of human diseases [12]. At the same time, it is toxic if the plant has trace elements in higher concentrations. Due to the reason, the role of medicinal plants on human health shows very good impact, this investigation must be done. Human body absorbs essential trace elements available in medicinal plants by the consumption of herbal medicine. The plants took elements from aquatic and aerial environment to allow plants to be used as bio monitors [13-17]. In the present study, elemental analysis of *M. Charantia* medicinal plants was carried out using inductively coupled plasma mass spectrometry (ICP-MS) technique.

2. MATERIALS AND METHODS

2.1 Experimental Details

2.2 Sampling: The different parts of plants, leaves, roots and fruits of the medicinal plant *M. Charantia* were collected washed with water, ethanol and triple distilled water. All are cut and dried at 40ºC before ground. The extracts were crushed and mechanically ground into a fine powder. The powdered plant materials were kept at room temperature away from direct sunlight in closed dry plastic bags for further analysis. Analytical grade solvents and chemicals were used for analysis purposes. All other solvents, chemicals and reagents were of purified grade (S.D. fine chemicals or E. Merck India). The sample containing roots, leaves and fruits were taken for the analysis with 1:1:1 ratio.

Table 1: Name of the medicinal plant

S.No	Sample with Code	Scientific Name	Parts used	Ratio
1	*M. charantia*	*M. Charantia*	Root, leaves, Fresh fruit	1:1:1

2.3 ICP-MS: The amount of various elements present in the samples determined using a 7700 series ICP-MS (Agilent Technologies, USA). The setup of the ICP-MS is summarized in Table 2.

The ICP-MS was calibrated using MERCK XVII multi-element ICP-MS calibration standards (Merck KGaA, Germany), which was diluted with 3% nitric acid (HNO_3).

Table 2: Setup of the ICP-MS

RF power	1550 W
Plasma gas	Argon, 151 min-1
Peristaltic pump speed	0/3 raps
Auto sampler	ASX-520 (Agilent)
Measuring mode	Helium and NO gas

2.4 Digestion Procedure of Samples:

1gm of each sample (1:1:1 weight ratio of various parts of the plant) was digested in nitric acid/Perchloric acid (6:1) using wet digestion method by heating slowly on a hot plate until white residue was obtained. Residue dissolved in 0.1N Nitric acid and volume was made up to 10 ml. The digested sample were analysed ICP-MS Instrument.

3. Results and Discussion

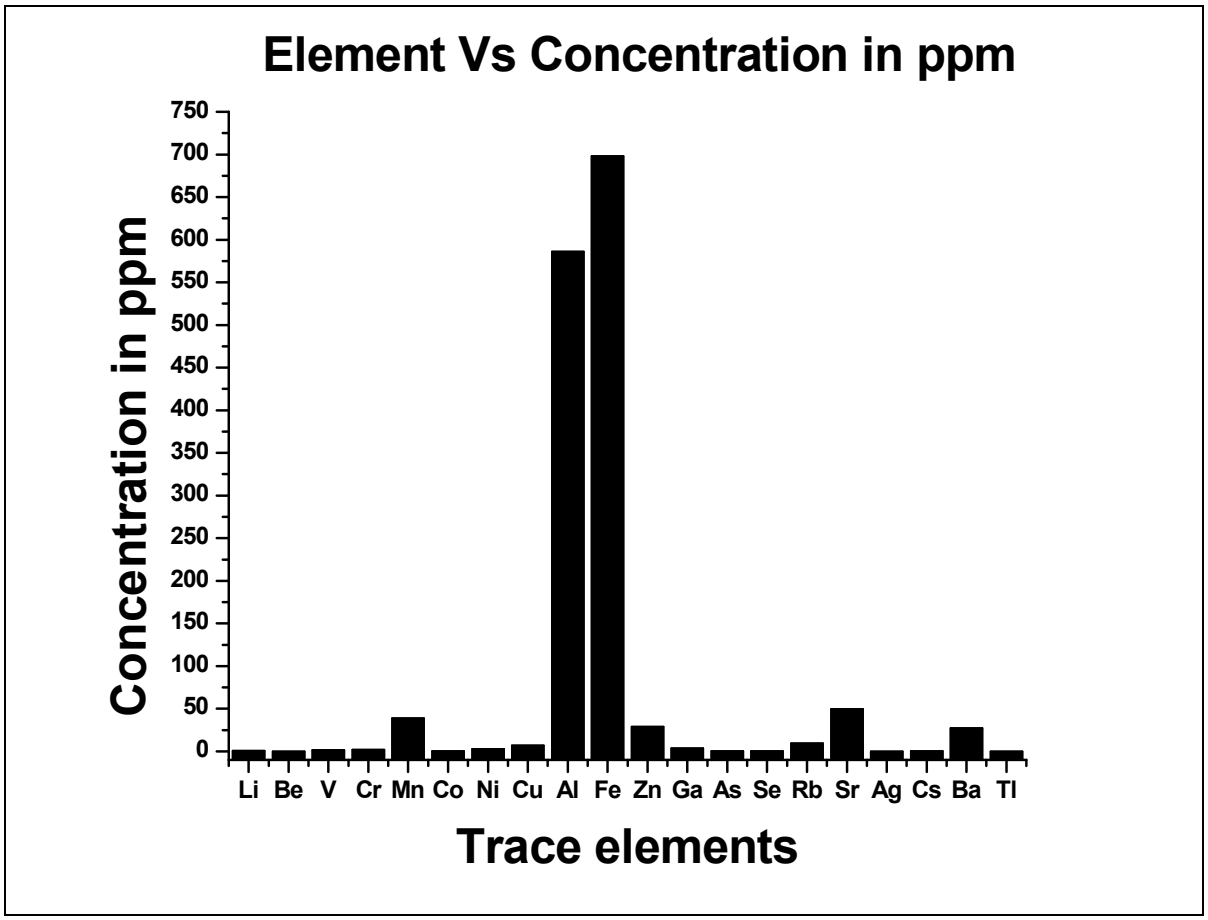
The list of macro- and microelements determined by using ICP-MS technique were given in the Table 3. Totally twenty-elements (Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Ag, Cs, Ba and Tl) were identified in these medicinal plants.

Table 3: Average elemental concentration in ppm

S. No.	Element in Sample	Concentration in ppm
1	Li	0.8956
2	Be	0.0421
3	Al	721.1230
4	V	2.2123
5	Cr	3.1214
6	Mn	41.2415
7	Fe	695.3541
8	Co	0.8985
9	Ni	3.2856
10	Cu	7.1203
11	Zn	31.2922
12	Ga	7.1245
13	As	0.5421
14	Se	0.7568
15	Rb	18.6245
16	Sr	120.2364
17	Ag	0.1024
18	Cs	0.2159
19	Ba	328.2586
20	Tl	0.05469

The metal concentrations (ppm) in the *M. Charantia* are given in Table 3. The ranges of metal concentrations are 0.0421 (Tl) to 698.2451 (Fe).

Fig. 1: Trace elements concentration in ppm



3.1 Cobalt

Cobalt is also known as vitamin B_{12}; it plays vital role in human health and is a main constituent of cobalamin. The deficiency of it causes the production of lower red blood cells which is also most important in transportation of oxygen to the injured cells helping in quick heal [18]. The presence of considerable amount of Cobalt in all medicinal plants makes the traditional use of medicinal plants in treatment of skin disease and other diseases. It has most important role in both of its organic and inorganic forms. The inorganic form of Cobalt is vital for human body, the excess or deficiency of which causes adverse effects [19-21]. The present study reveals that the plant *M. Charantia* containing 0.8985 ppm. (Table 3 and Figure 1)

3.2 Iron

Iron plays essential role in the production of haemoglobin and in oxygenation of red blood cells in human body. It has vital role in healthy immunity and in energy production [22]. Most of the studies revealed that the role of Iron correlating with bacterial effect of lactoferrin and lysozyme, which can killed gram-negative bacteria [23]. It has important and positive role on immune system in curing skin diseases using tradition way with the use of medicinal plants rich of Iron. The excess intake of Iron leads to tissue damage. The present study reveals that the plant *M. Charantia* containing 695.3541 ppm. (Table 3 and Figure 1)

3.3 Manganese

As like Iron, Manganese also plays very important role in regulating the immune system through breaking down of amino acids in producing energy by regulating metabolism of vitamin B, C, E [24]. Mn is also a component of metalloenzyme manganese superoxide dismutase in the mitochondria is a constituent of the mitochondrial antioxidant defence system which protect the free radical generated from injured cells which is harmful to the skins [25]. Manganese has positive and important role through the enzymes of the antioxidant defence system and immune responses, due to which it has traditional use in treating skin diseases. The present study reveals that the plant *M. Charantia* containing 41.2415 ppm. (Table 3 and Figure 1)

3.4 Zinc

Zinc plays vital role in metabolism of different biochemical reactions, which makes Zinc is an important trace element. The renewal of cells in our body operated by controlling the enzymes in order to maintain a healthy skin [26]. The metalloenzymes containing Zinc plays important role in metabolism, growth and repair of tissues and cell membranes [27]. Due to the reason the medicinal plants containing Zinc in considerable amounts are recommended in traditional methods of treatment. The present study reveals that the plant *M. Charantia* containing 31.2922 ppm. (Table 3 and Figure 1)

3.5 Copper

After Zinc and Iron, Copper is another most important trace element in human body metabolism. Copper stimulates immune system and fight against infection by repairing injured tissues and heals quickly [28]. In addition to this copper is an essential factor for the formation of connective tissues such as the cross of collagen and elastin [29]. As the copper affects our immunity and possess anti-infectant properties [30]. The presence of Copper in considerable amounts is suggested for the treatment of skin diseases. The excess intake of copper is not advisable as it shows adverse effects on human body. The present study reveals that the plant *M. Charantia* containing 7.1203 ppm. (Table 3 and Figure 1)

3.6 Chromium

Chromium directly stimulates the insulin and hence effect on metabolism of carbohydrates, proteins and lipids. It helps in treating diabetes [31]. Its main role is maintenance of normal glucose tolerance in the body. The present study reveals that the plant *M. Charantia* containing 3.1214 ppm. (Table 3 and Figure 1)

3.7 Vanadium

Vanadium has limited biological role, it is mostly a part of protecting a system against injury tissues [32]. In addition to Fe, Mn, Zn, and Cu, Vanadium is also shows defence mechanism from pathogens in skin diseases and helps recovering quickly [33]. Vanadium is a potent inhibitor of many enzymes, lower plasma cholesterol levels, directly influence glucose metabolism in vitro, suggesting a role in its regulation and supposedly play a physiological role on levels of the endogenous antioxidant-glutathione indicating its importance with respect to toxic interactions of chemicals. The excessive intake of Vanadium causes serious illness to human health. In medicinal plants those are having anti-cancerous characteristics, Vanadium is mostly available. The present study reveals that the plant *M. Charantia* containing 2.2123 ppm. (Table 3 and Figure 1)

3.8 Aluminium

Aluminium is mostly present in almost all plants and soils. It has been taken into the body in several ways through lungs, skin and etc. The intake of excess aluminium causes neurological disorder [34]. The present study reveals that the plant *M. Charantia* containing 721.1230 ppm. (Table 3 and Figure 1)

3.9 Arsenic

Arsenic is very toxic in its inorganic form, the intake of as it causes poisoning. The present study reveals that the plant *M. Charantia* containing 0.5421 ppm. (Table 3 and Figure 1)

3.10 Selenium

The excess intake of Selenium leads to highly toxic, but in micro levels it is essential trace element for humans and animals. The present study reveals that the plant *M. Charantia* containing 0.7568 ppm. (Table 3 and Figure 1)

3.11 Rubidium

Rubidium is highly present in fruits and vegetables; it is non-toxic and has low toxicity on human body. The present study reveals that the plant *M. Charantia* containing 18.6245 ppm. (Table 3 and Figure 1)

3.12 Strontium

Strontium is chemically similar to Calcium, the intake of which takes place through fruits and vegetables. The excess intake of Sr causes bones weakening and leads to lung cancer. Sr levels in our samples were not high enough to be able to cause these effects. In the present study, the sample contains 120.2364 ppm of Strontium. 140 mg/day after oral exposure in the United States for an average person of 70kg [35]. The present study reveals that the plant *M. Charantia* containing 120.2364 ppm. (Table 3 and Figure 1)

4. Conclusions

The present study concludes that the obtained results in the plant *M. Charantia* containing trace elements in the permissible limits, which can be used to cure skin diseases. The obtained result can be used to set a standard of prescribing the dosage of herbal drugs prepared from the plant materials. The decreasing order of trace elements with respective to their concentration is Al < Fe < Ba < Sr < Mn < Zn < Rb < Ga < Cu < Ni < Cr < V < Co < Li < Se < As < Cs < Ag < Tl < Be. *M. Charantia* plant possesses medicinal properties like antimicrobial, anthelminthic, anti-cancerous, anti-mutagenic, anti-tumorous, abortifacient, antifertility, and antidiabetic. Information about concentrations of trace elements in Momordica charantia plant is presented in this study. The presence of Chromium is essential for glucose tolerance in human body. In this study Iron and Aluminium reported higher values followed by Strontium, Manganese, Zinc and Barium. In view of above fact, the Indian rich medicinal plants Momordica charantia was studied for understanding the role of elements in pharmacological properties. These findings revealed concentrations of heavy and toxic metals below the permissible level as per World Health Organization therefore; it may not be hazardous to human health. The findings in the present study reveal the concentrations of various elements which are helpful in therapeutic activity and curing skin diseases.

Certificate of Conflict of Interest

The author has No conflict of interest.

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