

Studies on variation in elemental composition in wild and cultivated forms of *Andrographis paniculata*

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ABSTRACT

In the present Study, an attempt was made to explore the therapeutic potential of *Andrographis paniculata*. The inorganic elements play an important role in physiological process involved in human health. These are chemical elements, which are required by our bodies for numerous biological and physiological processes that are necessary for the maintenance of health and proper growth of the body. Element (major and trace) present in the leaves were quantitatively investigated by inductive coupled plasma mass spectroscopy against salt standards. The results show that the leaves of *Andrographis paniculata* in wild and cultivated form are rich in chemical constituents. Elemental analysis of *Andrographis paniculata* leaves has shown that the plant is a rich source of K, Ca, Mg, Fe, Al, and Na which can play vital roles in health and treatment of diseases. There is little variation in concentration in both cultivated and wild forms.

Keywords: Minerals (Macro or trace), Phyto chemicals, Herbal medicine, ICPMS.

1. INTRODUCTION

Plants have been used as an alternative source of medicine from ancient times before the advent of synthetic drugs. Medicinal plants have played an important role in treatment of the world health. According to an approximation of World Health Organization, nearly 80% of the populations of developing countries rely on traditional medicine. Therefore such plants should be investigated for better understanding of their therapeutic properties, safety and efficacy [1, 2]. The traditional folk medicinal system uses the plant-products for the treatment of various infectious diseases. Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids [3, 4]. 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 medicines[5]. Herbs, not only provide us chemicals of medicinal value but also nutritional minerals and trace elements [6]. These are chemical elements, which are required by our bodies for numerous biological and physiological processes that are necessary for the

maintenance of health and proper growth of the body.

Andrographis paniculata(Burm. f.) Nees is one of the important medicinal plant, belongs to the family of Acanthaceae. It is plentifully found in south eastern Asia i.e., India, Sri Lanka, Pakistan and Indonesia. It is an annual herbaceous plant, widely cultivated in Southern Asia, India, China and some parts of Europe. It is found in wild through out of plains of India especially in Tamil Nadu, Karnataka, Maharashtra, Orissa, Uttar Pradesh and Uttarakhand. *Andrographis paniculata*, "Kalmegh" of Ayurveda is an erect annual herb extremely bitter in taste in each and every part of the plant body. The plant is known in north-eastern India as 'Maha-tita', literally 'king of bitters'[7]. Mostly leaves and roots have been traditionally used over centuries for different medicinal purposes in Asia and Europe as a folklore remedy for a wide spectrum of ailments or as herbal supplement for health promotion. The leaves and aerial parts of the plant have been used to cure various kinds of ailments. *A. paniculata* contains andrographolide as the major active principle[8]. The aerial parts are most commonly used however, the whole plant or roots are mentioned for certain limited purposes in some

manuscripts. Traditionally, the plant was used as an infusion, decoction, or powder, either alone or in combination with other medicinal plants. In modern times, and in many controlled clinical trials, commercial preparations have tended to be standardized extracts of the whole plant. Since many disease conditions commonly treated with *A. paniculata* in traditional medical systems are considered self-limiting, its purported benefits need critical evaluation^[9]. Extract of *Andrographis paniculata* was found to inhibit formation of oxygen derived free radicals such as superoxide hydroxyl radical lipid peroxidation and nitric oxide in in-vitro system.

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^[10]. The elements play both; curative and preventive role in combating diseases^[11].

However based on plant height, leaf length, leaf width, leaf stem ratio, leaf biomass ratio and dry biomass (herbage) yield/plant and chlorophyll content, morphogenetically diverse genotype have been reported from Bhuvneshwar, Lucknow,, Kakori and Assam. Comparative studies of plants from different localities have shown variation in the total alkaloids content^[12]. Local clones are generally cultivated as there is no named variety available.

Viewing the medicinal potential of *Andrographis paniculata* the present study was undertaken to analyze the elemental content present in wild and cultivated plant species.

2. MATERIALS AND METHODS

2.1. Collection and Identification of Plant Material

The plant samples (wild and cultivated) of *Andrographis paniculata* were collected from the Garhwal region. Both the plant samples were authenticated by Dr. Rajendra Prasad Kala, Head, Department of Forestry, UCTBMS, Dehradun. The voucher specimen was submitted at herbarium.

2.2. Preparation of sample powder

The fresh leaves of the plant were separated from stems and dried in shade at room temperature in the laboratory and then crushed to

make coarse powder. The coarse powder was thoroughly screened through mesh no.18. The dust free dried material was stored in air tight poly bag till further use.

2.3. Quantitative Detection of Elements

A portion of dust free powdered sample were dried and milled into a fine powder, using a stainless steel miller. 5.0 gm of the resultant powder were taken and digested in 25 ml concentrated Nitric acid in a hot plate until the volume reduced to about 5 ml. The digested residues were dissolved in 40 ml acid mixture (250 ml HNO₃ + 25 ml conc. H₂SO₄ + 10 ml perchloric acid) and heat on hot plate until the reddish brown fumes disappears. The above residue is dissolved in dilute nitric acid solution and the volume in each case was made up to 100 ml in a volumetric flask. Filter the solution and filtrate was used for determination of elements by Inductive coupled plasma optical emission spectrum. In this method the instrument was calibrated with standard reference solution of known concentration, to prepare the standard curve, after which the clear digested samples were aspirated into the machine to determine the mineral components.

3. RESULT AND DISCUSSION

The results of mineral elements (Macro and Trace) of *Andrographis paniculata* from both samples (wild & cultivated), as obtained by Inductive Coupled Plasma Mass Spectroscopy, are depicted in Tables 1 and 2. The values are given in part per million (ppm) and part per billion (ppb), respectively. These are the chemical elements, which are required by our bodies 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 Calcium, Chlorine, Magnesium, Phosphorus, Potassium, Sodium, Sulphur and trace minerals comprise Iron, Iodine, Zinc, Selenium, Fluorine, Chromium, Copper, Molybdenum, and Manganese^[13,14].

The present study revealed the presence of medicinally active constituents. Elemental Analysis of plant samples has shown that the both plant sample is a rich source of potassium, calcium, Magnesium, iron, aluminum and sodium. The elements have been measured in different concentrations in both forms. It has also been observed that, potassium, calcium, aluminum, magnesium and manganese are the chief constituents of the both the plant samples.

Potassium is present as 14527 part per million followed by calcium whose concentration is 3229 part per million (Table 1). Potassium is the principal intracellular cation and also considered as a very important constituent of the extracellular fluids. Potassium is an important diuretic and it takes part in ionic balance of the human body and maintains tissue excitability. Potassium ions are concerned in maintaining the fluid balance of the body. Calcium (Ca) imparts strength and rigidity to bones and teeth. Calcium ions are also needed in neuromuscular transmission, excitability of nerves, and normal excitability of heart, clotting of blood and promoting muscular contraction. The concentration of sodium is less in both the plant samples i.e. 94 ppm (in wild), 96.2 (in cultivated). 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 [15]. 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 hemoglobin. Its deficiency can cause anemia. Aluminum (Al) is now thought to be involved in action of a small number of enzymes. The body has hard time ridding itself of excess aluminum. 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 Manganese, Iron and Zinc are essential in enzymes metabolism. The concentration of zinc is found 67 ppm in both the plant sample. Zinc (Zn) help in growth and repair of body tissues. It is an important element of ligaments and tendons [16].

Among the trace elements the concentration of Molybdenum is found 264 parts per billion. The concentration of selenium varies 313 (wild), to 412 (cultivated) ppb. The concentration of other trace elements (Cobalt, Cadmium, Lithium and Iodine) does not show much variation in both the sample (Table 2).

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 mineral elemental 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^[17].

Table - 1: Elemental composition of Major Elements of *Andrographis paniculata*

Element	Wild (ppm)	Cultivated (ppm)
Manganese	92	92
Magnesium	2362	2254
Iron	524	523.8
Calcium	3229	4325
Sodium	94	96.2
Potassium	14527	13082
Aluminum	166	180
Boron	24	24
Zinc	67	67
Strontium	10	10
Copper	22	22
Nickel	42	42
Phosphorus	2501.3	2405

Table - 2: Elemental composition of Trace Elements of *Andrographis paniculata*

Element	Wild (ppb)	Cultivated (ppb)
Molybdenum	264	264
Cobalt	113	112
Cadmium	254	253
Lithium	85	85
Iodine	782	782
Selenium	313	412

The analysis of different elements in the both the plant sample of *Andrographis paniculata* indicates that both the sample possesses same types of elements but in different concentrations.

The variation in concentration can be accounted due to the locality factors viz. soil composition, moisture contents, topography aspects, solubility of minerals diffusion and osmosis traits of the plants. Hence, the difference in concentration of the various elements is 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. The different 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.

4. CONCLUSION

The elemental analysis revealed the presence of 19 elements in both the sample of *Andrographis paniculata* in different concentration. 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. The study has revealed that *Andrographis paniculata* (wild as well as cultivated) is potential sources of nutrients and some essential macro, micronutrients. These can be incorporated in other foods as nutraceuticals for effective and proper metabolism as well as for the maintenance of good physiological state in man and animals.

5. REFERENCES

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