

Available online on 15.06.2021 at <http://ajprd.com>

Asian Journal of Pharmaceutical Research and Development

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Research Article

Elemental analysis of *Andrographis echioides* (L.)Nees. leaves, a potential pharmaceutical plant using atomic absorption spectroscopy (AAS).

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ABSTRACT

Andrographis echioides (L.) Nees. is a herbaceous plant belonging to the Acanthaceae family, which is widely used for traditional medicinal purposes. The present study was aimed to analyze the elemental composition in leaves of *Andrographis echioides* (L.) Nees. using atomic absorption spectroscopy (AAS). A total of 12 elements Calcium, Iron, Magnesium, Manganese, Cadmium, Nickel, Sodium, Lead, Chromium, Zinc, Silver, and Copper have been analyzed quantitatively. The results showed that Calcium has the highest concentration among other elements analyzed. It shows the ability of this plant to maintain the proper functioning of cells in our body. It also plays an important role in the functioning of our nervous system. The concentration of iron and magnesium was also significant. Iron is an essential element for blood production and Magnesium plays an important role in human body to maintain cholesterol levels, maintains heart rhythm and also has the capacity to convert blood sugar into energy. *Andrographis echioides* (L.) Nees. plant can be utilized for treating deficiencies of different essential macro and micro-nutrients for maintaining good health. The plant can be utilized for various other pharmaceutical purposes also.

Keywords: Atomic Absorption Spectroscopy, pharmaceutical purpose, *Andrographis echioides*

ARTICLE INFO: Received 10 March 2021; Review Complete; 26 April 2021 Accepted; 31 May 2021 Available online 15 June. 2021



Cite this article as:

Preetha.P.S., Anjana Kartha. A.J, Elemental analysis of *Andrographis echioides* (L.)Nees. leaves, a potential pharmaceutical plant using atomic absorption spectroscopy (AAS)., Asian Journal of Pharmaceutical Research and Development. 2021; 9(3):43-47. DOI: <http://dx.doi.org/10.22270/ajprd.v9i3.974>

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INTRODUCTION

Andrographis echioides (L.)Nees is a herbaceous plant belonging to the family Acanthaceae. The genus *Andrographis* Wall ex Nees. comprises 40 species according to International Plant Name Index (IPNI) These are of potential medicinal value and 26 species of the genus are found in India¹. *Andrographis echioides* (L.)Nees are known for their useful phytochemical components² Several *Andrographis* species have been used in the treatment of dyspepsia, influenza, malaria, respiratory infections and as astringent in the traditional Indian medicine. It is used as an antidote for poisonous stings of some insects^{3,4}. Our present scenario shows good food and medicines are the most important commodities to survive. There is a great interest in using naturally occurring drug as medicines because of their great availability and less side effect

compared to synthetic drugs. *Andrographis echioides* (L.)Nees an annual herb occurring in South India, is listed in the Indian Materia Medica used as a remedy for fevers⁵. The plant shows different biological activities like anti-ulcer⁶, antioxidant⁷, anti-inflammatory, analgesic, antipyretic⁸, antibacterial⁹ and anthelmintic¹⁰ activity. Different chemical constituents like 2',6'-dihydroxyacetophenone 2'-O-β-D-glucopyranoside, echioidinin 5-O-β-D-glucopyranoside, echioidinin, pinostrobin, andrographidine C.dihydroechioidinin, tectochrysin 5-glucoside, methyl salicylate glucoside, 5,7,8-trimethoxyflavone, skullcapflavone I 2'-methyl ether, androechin, skullcapflavone I 2'-O-β-D-glucopyranoside, tectochrysin, 5,7,2'-trimethoxyflavone, echioidin, skullcapflavone, 5,7-dimethoxyflavone, andrographidine¹¹ were reported from the plant. *Andrographis echioides* (L.)Nees. is traditionally used as anti-inflammatory, febrifuge, cooling, alternative for cut

and wounds, the extract of the whole plant is used to cure fever¹². Leaf juice boiled with coconut oil used to control falling and graying of hair¹³.

The plant *Andrographis echinoides* (L.) Nees is a herb with tetragonous branches. Leaves entire, oblong or elliptic, sub obtuse. Flowers seen in slender axillary unilateral racemes which are long as or shorter than the leaves, retinacula spoon-shaped. Calyx 5-partite, the lobes very slender. Corolla tube small, white, two-lipped, usually pale but blotched and spotted with brown and purple. Two Stamens; filaments broad, hairy at base; anthers two-celled and slightly bearded. Style slender, stigma bifid. Capsule 0.8-1.2 cm long compressed, broadened towards tip, attenuate at base, sparsely hairy towards tip and usually contains four seeds. The plant body is covered by minute white hairs, greenish quadrangular stem, angles prominent and narrow winged. Fruits are ovoid capsules pointed at above.

Atoms in metallic elements tend to absorb UV light when they are exposed to ultraviolet rays. When the sample is atomized, the metallic element in it is released in the vapour or gas. The gas absorbs UV rays of the particular wavelength in proportion to the number of metallic atoms present in the gas. Atomic absorption spectroscopy (AAS) is a Spectro-analytical procedure of the quantitative determination of chemical elements using the absorption of optical radiation by the free atoms in the gaseous state. The main objective of the present study is to identify and quantify twelve different elements like Calcium, Iron, Magnesium, Manganese, Cadmium, Nickel, Sodium, Lead, Chromium, Zinc, Silver, and Copper in the leaves of the plant *Andrographis echinoides* (L.) Nees using Atomic Absorption Spectroscopy. The study also reveals the pharmacological potential in the plant *Andrographis echinoides* (L.) Nees.

MATERIALS AND METHODS

Plant Materials

Andrographis echinoides (L.) Nees leaves were collected for the present investigation from Attingal, Thiruvananthapuram district. The elements present in the plant was analysed through Atomic Absorption Spectroscopy. The flower, leaf and aerial parts of the *Andrographis echinoides* (L.) Nees were identified and noted their morphological characters. After the collection, the plant was washed and leaves dried in the shade. Test method used was Association of Analytical Chemical International 20th Edition 2016 (3.2.05). Samples are stored in tight sealed pack and analysed. Mix the sample well. Then a portion is blended to fine powder. Calibration is done by aspirating standard metal solutions and noted the absorbance.

Preparation of sample and extraction

Well ground mixed sample of one to three gram is weighed into a pre weighed crucible and heated for overnight at 500°C and let cool. Wet the ash with ten drops of water and one to two millilitre nitric acid is carefully added. Evaporated excess nitric acid on a hot plate set at approximately 100 °C. Returned crucible to furnace and heated for 1 hour at 500 °C. After dissolving

the ash in 10ml HCL, filter it to volumetric flask and made up to 10ml with distilled water. Read the concentration by aspirating sample and reference standard solution in Atomic Absorption Spectroscopy. Perkin Elmer Lambda 45 Atomic Absorption Spectrophotometer was used to record the spectra. The liquid sample is fed into the flame through a nebulizer where the sample is converted into atom at approximately 2300 °C. When the radiation from the cathode lamp passes through the flame, some of the radiation is absorbed by the atomized element and then passes through the monochromator. It is necessary to choose a compatible hollow cathode lamp of the same metal for which the investigation is desired. The radiation that reaches the detector is then measured. The processor then calculates the results obtained by the detector and the amount is seen on the display screen. The characteristic wavelengths are accurate to 0.01-0.1 nm and are element specific. Line source lamps that emit very narrow bands of radiation. The most common source is the hollow cathode lamp (HCL). The lamps are encased in a cylinder made of glass and a quartz end cap. These cylinders are filled with a noble gas like neon or argon to a pressure of 1- 5 torr. A light beam from a lamp whose cathode is made of the element being determined is passed through the flame will provide element specific wavelength. A photon multiplier can detect the amount of reduction of the light intensity due to absorption by the analyte. This is directly related to the amount of the element in the sample analyzed. Necessary settings were made and then the spectral data were recorded finally.

RESULTS AND DISCUSSION

Andrographis echinoides (L.) Nees is an indigenous plant used for medicinal purpose. Nowadays, increasing number of people has been choosing herbal medicines or products to improve their health conditions. They use it as alone or in combination with others. According to World Health Organization, 75% of the world's population using herbs for basic healthcare needs. Our nature is a rich source of medicinally valuable plants. Leaves of *Andrographis echinoides* (L.) Nees is the important part of plant which is used as a traditional medicine. It is commonly used for fever and as hair tonic. Leaf juice of *Andrographis echinoides* (L.) Nees is used to cure fevers; hence it is listed in the Indian Materia Medica as a remedy for the treatment of illnesses⁵. Even pills were prepared from leaf extracts in combination with other ingredients and used as a drug for the treatment of fever¹⁴. In the present study, quantification of major elements present in *Andrographis echinoides* (L.) Nees was studied with the help of Atomic Absorption Spectrophotometer. We identified twelve major different elements present in the leaf. These elements present in varying concentration in the specimen studied.

Heavy metal content in plant *Andrographis echinoides* (L.) Nees shows large variation. They are involved in regulating the formation of secondary metabolites which are responsible for pharmacological actions of vegetal species¹⁵. Trace elements are also essential to all cells and deficiencies of essential elements may cause several diseases in humans. The present study indicates the presence of Calcium greater than that of other metals. It is

2203 mg/ 100 g. The Dietary Value for Calcium is 1,300 mg for adults and children aged four years and older¹⁶. Each and every cell in our body needs calcium for their proper functioning and play an important role in the functioning of our nervous system. It help muscles to contract, our heart to beat and it enables our blood to clot. In addition of providing support to our bodies, bones store calcium. Deficiency of calcium leads to tingling Fingers, muscle cramps, lethargy, poor appetite, weak or brittle fingernails, difficulty swallowing, fainting etc.

Iron content in *Andrographis echinoides* (L.) Nees. Is 97.0mg/100g. It is an important element for blood production and has a wide variety of metabolic processes like oxygen transport, deoxyribonucleic acid synthesis and electron transport. Iron requirements increase to a level above the average iron requirements in menstruating women¹⁷. The established Recommended Dietary Allowance for Iron in normal healthy adults is 8 mg/day for men and post-menopausal women and 18 mg/day for menstruating women¹⁸. In the human body, iron mainly exists in complex form bound to protein (hemoprotein) as heme compounds, heme enzymes, or nonheme compounds. Iron is also required for the formation of heme enzymes involved in electron transfer and oxidation-reductions¹⁹. Iron also involves the transfer of oxygen from the lungs to tissues. Deficiency of iron can cause fatigue, heart palpitations, pale skin, and breathlessness.

The amounts of magnesium present in the study material, *Andrographis echinoides* (L.) Nees. is 55.5mg/100g. Magnesium is the major part of chlorophyll which play an important role in human body in maintaining of cholesterol levels, maintains heart rhythm. Magnesium helps to convert blood sugar into energy. It also prevents headaches and attention deficit hypersensitivity disorder. Magnesium is one of the ten essential minerals with a Recommended Dietary Allowances (RDA) of 400 mg/day for healthy adult males and 320 mg/day for healthy females²⁰.

Sodium presents in *Andrographis echinoides* (L.) Nees. leaves is 28.2mg/100g. Sodium help to keep the water and electrolyte balance of the body. The WHO suggests consuming 2,000 mg of sodium per day. 7.8mg/100g zinc is present in *Andrographis echinoides* (L.) Nees. leaves. It is the second-most-abundant trace mineral in human body after iron and is present in every cell. The established recommended daily amount of Recommended Dietary Allowance for Zinc is 8 mg/day for women and 11 mg/day for men²¹. Zinc is necessary for the activity of over 300 enzymes. It helps in metabolism, digestion, nerve function and many other processes. It plays an important role in the development and function of immune cells. It is necessary to skin health, DNA synthesis and protein production. It is also needed for our senses of taste and smell. It was reported that nearly two billion people in the developing world are deficient in Zinc²².

Concentration of manganese in *Andrographis echinoides* (L.) Nees. is 3.1mg/100g. Manganese contributes too many bodily functions. Manganese is an essential nutrient which is needed in trace amount. It is used for a variety

of metabolic functions including those involved in normal human development, activation of certain enzymes, energy metabolism, immunological system function, nervous system function, reproductive hormone function, and in antioxidant enzymes that protect cells from damage due to free radicals²³. Mammalian brain, small amounts of manganese are required for brain development, cellular homeostasis, and for the activity of multiple enzymes^{24,25}. Manganese deficiencies have been reported in humans, with symptoms including dermatitis, slowed growth of hair and nails, decreased serum, calcium and phosphorus concentrations, and increased alkaline phosphatase activity^{26,27}. Several human diseases have been reported to be associated to low blood manganese concentrations²⁸. The Recommended Dietary Allowances for Manganese is 2.3 mg per day for adult males and 1.8 mg per day for adult females¹⁸.

The amount of nickel presents in *Andrographis echinoides* (L.) Nees. is 2.0mg/100g. Nickel is necessary for proper functioning of the human body, as it increases hormonal activity and is involved in lipid metabolism²⁹. It's over dosage cause much side effect on human health such as allergy, cardiovascular and kidney diseases, lung fibrosis, lung and nasal cancer^{30,31}. There is no Recommended Dietary Allowance (RDA) has been established for nickel. But it has been reported that the estimated daily intake of nickel from food and water worldwide is 80-130 µg/day³².

Lead present in *Andrographis echinoides* (L.) Nees. is 1.3mg/100g. Lead is a naturally occurring toxic heavy metal found in earth crust. Other elements such as chromium content is 0.9mg/100g, cadmium content is 0.3mg/100g, copper content is 0.8mg/100g and silver content is 0.01mg/100g is also present in the leaf of *Andrographis echinoides* (L.) Nees. Dietary Reference Intakes of chromium is 35 mg/day for adult males and 25 mg/day for adult females¹⁸. Copper is an essential nutrient for the body. Along with iron, copper enables the body to form red blood cells. Copper helps to maintain healthy bones, blood vessels, nerves, and immune function, and it also contributes to iron absorption. Adequate amount of copper in the diet may help to prevent cardiovascular disease and osteoporosis. The established Recommended Dietary Allowance (RDA) for Copper in healthy adults is 2 mg/day³³.

Table No. 1: Chemical analysis of *Andrographis echinoides* (L.) Nees. leaves by atomic absorption spectroscopy by A.O.A.C. International 20th edition 2016(3.3.05) method

SL NO	PARAMETERS	RESULT	UNIT
1	Silver (Ag)	0.01	mg/100g
2	Iron (Fe)	97.0	mg/100g
3	Copper (Cu)	0.8	mg/100g
4	Calcium (Ca)	2203	mg/100g
5	Chromium (Cr)	0.9	mg/100g
6	Nickel (Ni)	2.0	mg/100g
7	Sodium (Na)	28.2	mg/100g
8	Lead (Pb)	1.3	mg/100g
9	Cadmium (Cd)	0.3	mg/100g
10	Manganese (Mn)	3.1	mg/100g
11	Magnesium (Mg)	55.5	mg/100g
12	Zinc (Zn)	7.8	mg/100g

CONCLUSION

Andrographis echinoides (L.)Nees is one of the most popular herbs which is distributed over India and Srilanka.. The plant *Andrographis echinoides*(L.)Nees belongs to Acanthaceae family which has a wide range of distribution among the altitude of 300-700m. Leaf of the plant is used as a traditional medicine. It is traditionally used as anti-inflammatory, febrifuge, cooling, alternative for cut and wounds. Leaf extract or leaf juice boiled with coconut oil is used to control falling and graying of hairs. Identification and quantification of major elements present in *Andrographis echinoides* (L.) Nees. was studied with the help of Atomic Absorption Spectrophotometer. Twelve different elements present in the leaf were studied. These elements present in varying concentrations. The current study reveals the presence of elements such as Calcium, Iron, Magnesium, Manganese, Cadmium, Nickel, Sodium, Lead, Chromium, Zinc, Silver, and

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- Copper. These elements have been analyzed quantitatively. The result shows high concentration of calcium and low concentration of silver. The toxic metals like lead and cadmium are found at a concentration of 1.3mg and 0.3 mg per 100g respectively. Each element has their own capacities to maintain good health. The scientific data in the present study is also very helpful in pharmaceutical industries and local practioners. It is concluded that *Andrographis echinoides* (L.) Nees.plant can be utilized for pharmaceutical purposes. The data obtained in the present work will be useful in synthesis of new herbal drugs or in replacing them.

ACKNOWLEDGMENT

We express our deep sense of gratitude towards Sree Narayana College, Kollam and CEPICI Laboratory and Research Institute, Kollam for valuable support and providing facility during the work.

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