



Analysis of *Evolvulus Nummularius* (L.)L. Aerial Part of Plant by ICP-OES, UV-Visible and FTIR Techniques

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KEYWORDS

Evolvulus nummularius(L.)L., ICP-OES technique, nitric acid, elemental contents, medicinal plant.

ABSTRACT:

Evolvulus nummularius(L.)L. used as a wild medicinal plant in India, which commonly known as “dwarf morning glory”. The therapeutic properties of plant were attributed to phyto-chemicals, while mineral elements important for human metabolism and regulation mechanisms. Here, to measure the inorganic mineral elements, aerial parts of *Evolvulus nummularius*(L.)L. were examined. UV-visible spectra of leaves showed that the presence of chlorophyll a and b at 433 nm, 664.5 nm and 465 nm, respectively. FTIR spectra attributed the presence of C-Cl and C-OH stretching at 1086.54 and 608.36 cm⁻¹, respectively. Twenty eight essentials and trace elements were measured through inductively coupled plasma optical emission spectrometry (ICP-OES) technique from aerial parts of plant extract. The elements that were screened included Al, Ca, Fe, K, Mg, Mn, Na, P, Ti, B, Ba, Cd, Co, Cr, Cu, Ga, Ge, Mo, Ni, Pb, V, Zn, As, Hg, Sn, Li, S and Nb. The results of the experiment confirmed that the among the twenty five elements like Al, Ca, Fe, K, Mg, Mn, Na, P, Ti, B, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, V, Zn, As, Hg, Sn, S and Nb present on aerial parts of *Evolvulus nummularius*(L.)L. with different concentrations.

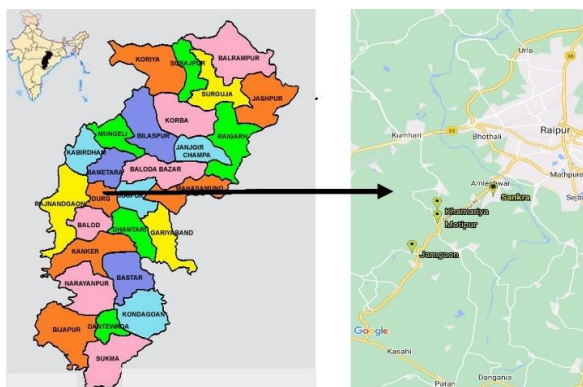
Introduction

The perennial herb *Evolvulus nummularius* (L.) L. syn. *Convolvulus nummularius* L., belonging to the Convolvulaceae family, is found growing in the wastelands of the northeastern regions of India. It has little funnel-shaped blooms. The herb has febrifuge and vermifuge properties[1]. Previous research found that 7,3',4',5'-tetrahydroxyflavone and its 7-*O*-glycosides were present [2, 3]. Medicinally, *Evolvulus nummularius*(L.)L. is highly useful in large quantities; therefore, in vitro cultivation is necessary in the present studies. *Evolvulus nummularius*(L.)L. is commonly called Kidney weed (Miller 1997-in-vitro) and locally known as Bichhamalia, Krishna ankaranti; Jungi-ba, Tandi kodebaha (Kambaska) Lakshmi krantha (Figure 1). *Evolvulus* is a genus of roughly 100 species, nearly all of which are found solely in the Americas. It originated in the tropical regions of Central and South America, and its paste is used to treat scabies in Nepal. The plant is used to treat wound healing, hysteria, convulsions, and poor sedatives. It contains a variety of

phytoconstituents, including alkaloid, saponin, phytosterol, flavonoids, tannins and phenolic compounds, carbohydrates, etc[3]. *E. nummularius*(L.)L. has been pharmacologically reported to possess anti-helminthic activity, to cure burn, fever, cuts, wounds, and scorpion stings. Figure 1. Plant of *Evolvulus nummularius*(L.)L..



(a)



(b)

Figure 1. (a) Map of Chhattisgarh; (b) plant of *Evolvulus nummularius(L.)L.* in Durg Chhattisgarh. Mineral elements, which are inorganic substances present in all parts of the body and fluids, constitute a smaller percentage of the diet than major nutrients. Despite not producing energy, they were required for a number of biological processes that were vital of life.

The relevance of mineral elements well recognised in human, animal, and plant nutrition. As well as their deficiencies

could induce a variety of distinctive diseases/disorders. Plant materials comprise a substantial component of diet and their nutritional value is high [4-7]. These elements also necessary for human growth and health in specific concentrations; several trace elements are important for the production of active plant ingredients that give plants their therapeutic qualities [8]. Understanding the nutraceutical worth of fruits, vegetables, and their products requires a thorough analysis of their basic composition. Numerous sophisticated techniques, such as inductively coupled plasma mass spectrometry (ICP-MS), inductively coupled plasma optical emission spectrometry (ICP-OES), X-ray fluorescence (XRF), anodic stripping voltammetry (ASV), neutron activation analysis (NAA), and flame atomic absorption spectrometry (FAAS), can be used for quantitative element estimation. The utilisation of Atomic Absorption and Emission Spectroscopy (AAS/AES) techniques has been demonstrated to be highly reliable for the examination of a wide spectrum of heavy metals, as well as demonstrating good precision and accuracy at the trace level [9]. Compared to standard analytical procedures, these methods are more quick, accurate, and

reproducible. Thus, here in this paper, we focus on assessing the amount of 28 essential and trace elements (Al, Ca, Fe, K, Mg, Mn, Na, P, Ti, B, Ba, Cd, Co, Cr, Cu, Ga, Ge, Mo, Ni, Pb, V, Zn, As, Hg, Sn, Li, S, Nb) in the aerial parts of *Evolvulus nummularius(L.)L.*, with nitric acid digestion procedure with the ICP-OES technique [7]. And resultant will provide important information regarding the presence of heavy elements along with vital mineral nutrients of the plant. As well as it also provide the information that amounts of elements and minerals could be either health or harmful at normal dose consumed through vegetables or fruits. Here, we also characterized the leaf extract of *Evolvulus nummularius*, through UV-visible spectroscopy.

Materials and methods

Sample collection

Firstly, aerial parts of *Evolvulus nummularius(L.)L.* were collected from grass land, waste land, and play ground of dist- durg, Chhattisgarh India. Area of District Durg is 2238.36 Sq. Km and lies between 20°54' and 21°32' north latitude & 81°10' and 81°36' east longitude. District Durg is 317 meters above mean sea level (<https://durg.gov.in/about-district/>). After that the leaves of plant were carefully put under shelter and dried in an airy place. Then crushed those dried leaves, converted into powder and stored in a dry sealed glass container. The plant material was identified and authenticated by plant identification cell department of botany, Guru Ghasidas Vishwavidyalaya (A central university) Koni-(Bilaspur), Chhattisgarh, India. Identification report is provided in appendix I.

Instrumentation

Nitric acid used to hydrolyse the plant sample, which was then examined through ICP-OES 5110. The software was smart analyser version 5.01.0921, utilised for spectrometric measurements was Arcos from M/S Spectro Germany, and the detector also used a Charge Couple Device (CCD). In the absorbance mode, UV-Visible spectra were acquired using a UV-1900i Double beam spectrophotometer. The vibration spectra were recorded using an Avtar 370, Thermo Nicolet, Fourier transform infrared (FT-IR) spectrophotometer equipped with a DTGS detector with 4 cm⁻¹ resolution, and samples prepared with KBr discs for this study. For ICP-



OES, operational parameters and instrumental characteristics were as follows:

Table 1: Operation conditions of ICP-OES as follows.

S.No.	Parameter	Value
1.	Power	1.2 kW
2.	Plasma flow	15.0 L/min.
3.	Auxiliary flow	1.50 L/min.
4.	Nebulizer flow	0.75 L/min.
5.	Sample flow rate	1.5 L/min.
6.	Replicate read time	3.00 s
7.	Instrument Stabilization delay	15.0 s
8.	Sample uptake delay	10.0 s
9.	Pump rate	15.0 rpm
10.	Rinse time	10.0 s
11.	Spray chamber	Cyclonic type

Experiment: Element estimation

In a microwave digester, 1.0 g of aerial part of plant powder was dissolved in 100 mL of metal-free nitric acid; which diluted with 25 mL distilled water. The Inductively Coupled Plasma with Optical Emission Spectroscopy (ICP-OES) was used to estimate the elements. To estimate the macro elements and microelements like aluminium (Al), calcium (Ca), potassium (K), sodium (Na), magnesium (Mg), manganese (Mn), iron (Fe), phosphorous (P), titanium (Ti), boron (B), barium (Ba), cadmium (Cd), cobalt (Co), zinc (Zn), nickel (Ni), chromium (Cr), gallium (Ga), germanium (Ge), molybdenum (Mo), lead (Pb), vanadium (V), arsenic (As), mercury (Hg), tin (Sn), lithium (Li), copper (Cu), sulfur (S) and niobium (Nb) the microwave-digested sample was inhaled into an ICP-OES. Nitric acid used to dilute the stock multi-elemental standard solution (1 g/100 ml) in order to create the calibration standards [7].

Result and discussion

Characterization

UV-visible spectroscopy

UV-visible spectroscopy could be used for quantitative analysis of *Evolvulus nummularius*(L.)L.aerial part of

plant extract. It showed, the presence of chromophores (aromatic molecules) in UV-visible range.

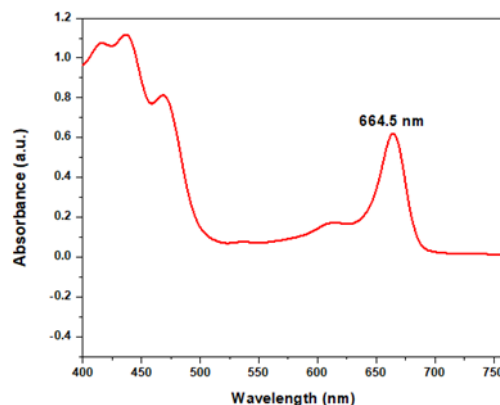


Figure 2. UV-visible spectra of *Evolvulus nummularius*(L.)L. aerial part of plant extract.

Phenolic complexes including tannins, dyes, anthocyanins and phenol complexes with iron etc also detected by UV-visible spectroscopy[10]. It also used to determine the UV absorption value of chlorophyll a and b.

According to Figure 2 the absorption peak observed at 433 nm and a sharp peak at 664.5 nm, which determine the chlorophyll a. A peak also observed at 465 nm, it attributed as chlorophyll b.

FTIR

In FTIR analysis show many organic compound present in *Evolvulus nummularius* (L.)L. plant. According to Figure 3, Transmittance spectra peak at 3233.98cm⁻¹ showed the presence of hydroxyl group, 2106.71cm⁻¹ showed the

presence of $\equiv C$ stretch, 1638.98cm⁻¹ showed the presence of weak C=C stretch, 1448.06cm⁻¹ showed the presence of bending of CH₂, 1086.54 cm⁻¹ showed the presence of C-OH stretch, 608.36 cm⁻¹ presence of C-Cl.

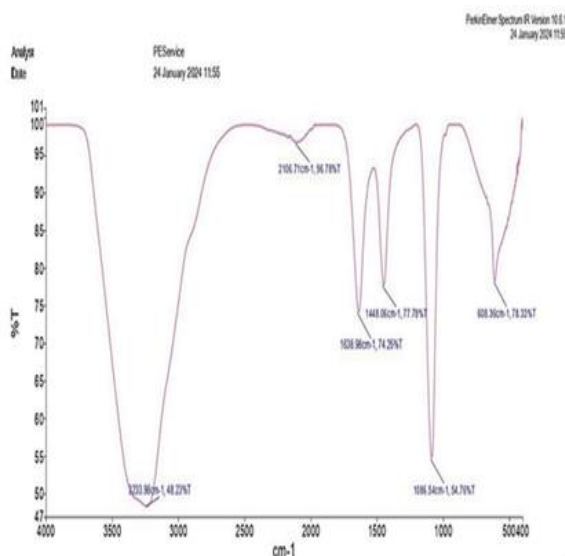


Figure 3. FTIR spectra of *Evolvulus nummularis*(L.)L. aerial part of plant extract.

Discussion

Here, in current study, the major and minor elements found in leaf of *Evolvulus nummularis* were estimated through ICP-OES technique. According to UV-visible spectra it showed that presence of chlorophyll a and b at 433, 664.5 nm and 465 nm, respectively (Figure 2). According to FTIR spectra it attribute the presence of strong $c \equiv c$, $C=C$ and CH_2 hydrocarbons. Including that also presence of $C-OH$ and $C-Cl$ functional groups at 1086.54 cm^{-1} and 608.36 cm^{-1} , respectively (Figure 3).

The most common analytical technique for elemental determination is ICP-OES, which is based on atomic spectrometry with single element detection. Numerous studies have been carried out to validate this method for metal analysis in a wide variety of sample types, including plant samples [7, 11-13]. ICP-OES is advantageous because the technique can estimate many elements at a time. Table 2 showed that the elemental composition in *E. nummularis*(L.)L. as follows:

Table 2: Quantitative element analysis of *Evolvulus nummularis* plant

S.No.	Elements	Concentration (ppm)
1.	Al	6.92
2.	Ca	107.87
3.	Fe	8.19
4.	K	210.57
5.	Mg	35.43
6.	Mn	1.44
7.	Na	4.50
8.	P	19.35
9.	Ti	0.05
10.	B	0.4223
11.	Ba	0.8073
12.	Cd	0.0019
13.	Co	0.0042
14.	Cr	0.2180
15.	Cu	0.6163
16.	Ga	ND
17.	Ge	ND
18.	Mo	0.0001
19.	Ni	0.1205
20.	Pb	0.0452
21.	V	0.0199
22.	Zn	0.7688
23.	As	0.0042
24.	Hg	0.0010
25.	Sn	0.0251
26.	Li	ND
27.	S	136.68
28.	Nb	0.0046

It was discovered that distinct essential and trace elements with biological significance for human metabolism were present in varying amounts. Elemental analysis showed higher concentration of potassium (K), sulfur (S) and calcium (Ca). The concentration of analysed elements were in order of $K > S > Ca > Mg > P > Fe > Al > Na > Mn > Ba > Zn > Cu > B > Cr > Ni > Ti > Pb > Sn > V > Nb > As > Co > Cd > Hg > Mo$. Elements like Ga, Ge and Li were not detected or their concentration less than 0.0001 ppm (Table 2). Variations



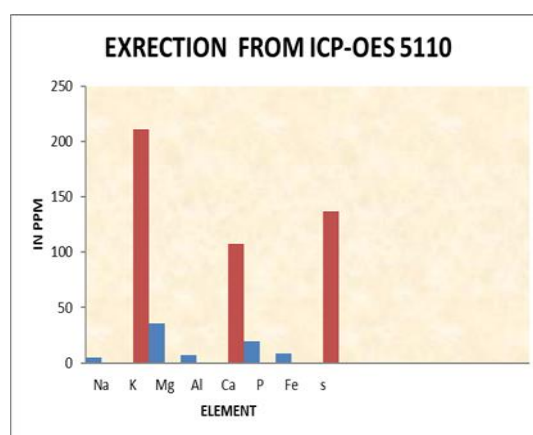
in the concentration of these elements can be attributed to a number of factors, including the age of the plant, the mineral makeup of the soil, the meteorological circumstances, and the plant's preferential absorption of the relevant elements [14].

In the human body, the majority of critical components that play an active part in metabolic reactions are present in good concentration [15]. Potassium is most typically used to treat and prevent low potassium levels, treat high blood pressure, and prevent stroke [16, 17]. It also plays a part in the transmission of nerve signals, muscle contractions, fluid balance, and different chemical reactions [18-20]. According to bar diagram 1, potassium concentration in *Evolvulus nummularious* is higher 210.57 ppm. Sulfur is third abundant element in human body [21]. It seems to have antibacterial effects against the bacteria which was cause of acne. It also fix DNA and protect from cancer [22, 23]. The concentration of sulfur in *Evolvulus nummularious* is 136.68 ppm. Calcium is an essential mineral for healthy blood pressure, strong bones, teeth, cell signalling, and blood clotting [24-26]. It also plays a key role in the metabolism of vitamin D and synaptic nerve transmission, which can result in severe conditions like arthritis in the elderly [27, 28]. The concentration of calcium in *Evolvulus nummularious* is 107.87 ppm (bar diagram 1). The concentration of other essential elements like Fe, Mn, Mg, Zn and Cu were recorded as 8.19, 1.44, 35.43, 0.7688 and 0.6163 ppm, respectively.

Trace elements from plant leaves were investigated as aluminium (6.92 ppm). We take in roughly 2 mg (2000ppm) of aluminium per day from our meals, or about 60 gm in our lifetime, that involved in the action of a small number of enzymes. Certain boron compounds were found to be effective in treating arthritis; their estimated concentration in plant was 0.4223 ppm. Barium and all of its water or acid-soluble compounds are toxic [29]. With the highest known application of barium being in the form of barium sulphate, which could be consumed as a medicinal cocktail to outline the stomach and intestines for medical examination. Its concentration in plant was 0.8073 ppm. Lead was recognised to induce hepatotoxicity at higher concentrations, neurological problems, anaemia, renal damage, miscarriage, and reduced sperm count [30]. However, a mean daily consumption of 3.4–4 µg/kg of

body weight was not linked to an increase in blood lead levels or the body burden of lead. Their estimated concentration in plant was 0.0452 ppm.

Results showed that the estimated concentration of heavy metals like Hg, As, Ti, Cr, Cd, Mo, Ni, Co, V, Sn and Nb were 0.0010, 0.0042, 0.05, 0.2180, 0.0019, 0.0001, 0.1205, 0.0042, 0.0199, 0.0251 and 0.0046 ppm, respectively observed. It also showed that other elements like Ga, Ge, Li etc were not detected in plant leaf.



Bar diagram 1: Quantitative element analysis of *Evolvulus nummularious*(L.)L. plant

1. Conclusion

In conclusion, an elemental composition of 28 elements and their estimated concentrations were determined using the ICP-OES technique. It was found that the aerial part of plant had 25 elements in varying amounts. UV-visible spectra also showed the presence of chlorophyll a and b in aerial part of plant. The FTIR spectra attributed the presence of $C \equiv C$, $C=C$ and CH_2 hydrocarbons. It also showed the presence of C-OH and C-Cl functional groups. The plant of *Evolvulus nummularious*(L.)L. under study contained both essential and trace elements, which could be important in the various biochemical and physiological processes in humans and hence considered as a potential source for providing trace elements other than diet. The information observed for this study might be prove to be a valuable asset for future research on the plant's potential as a nutraceutical.



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Appendix I

PLANT IDENTIFICATION CELL
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No: BUCGGV/2024/91

Dr. Ashwini Kumar Dixit
Professor

Date: 11-01-2024

S. No.	Name of the Plant Identified	Family	Test material	Analysis/study	Conclusion
1.	<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae	Live plant & Digital photographs	Digital photographs with already identified herbarium specimens	Authenticated

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Note: Plant identification has been done based on the material given for which population variation has not been considered. Most nomenclature name for the sample submitted has been considered and nomenclature is subjected to change over time with new systems of classification emerging from time to time.