

Research

Elemental Study of Some Selected Medicinal Plants in the Gulbarga Region by Flame Atomic Absorption Spectroscopy Technique

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Abstract:

Medicinal plants are extensively used in traditional healthcare systems because of their therapeutic properties and nutritional value. In recent years, they have also gained considerable attention in the green synthesis of nanoparticles for nano-drug development. The formulation of plant-based nanomedicines requires proper understanding and quantitative evaluation of essential elements, as these factors significantly influence safety, therapeutic efficacy, and nanoparticle synthesis. Due to their wide range of medicinal applications, these plants serve as important raw materials for herbal formulations, nutritional supplements, and emerging nano-drug technologies. In the present investigation, leaves of selected medicinal plants, namely Sheesham (*Dalbergia sissoo*), Ajwain (*Trachyspermum ammi*), and Ashwagandha (*Withania somnifera*), were collected from the Gulbarga region of Karnataka, where they are widely used in the traditional Indian Ayurvedic system of medicine. The collected plant samples were authenticated, shade-dried, powdered, and digested following standard procedures. The samples were subsequently analyzed for the quantitative estimation of essential elements using the Flame Atomic Absorption Spectroscopy (FAAS) technique to evaluate their suitability for the preparation of herbal medicines and nano-drugs. FAAS is an effective analytical technique for determining the concentration of essential elements present in medicinal plants. The analyzed elements included Mg, Al, K, Ca, Mn, Fe, Cu, and Zn. The results revealed that essential elements such as Fe, Zn, Cu, Ca, and Mg were present in appreciable quantities, thereby contributing to the medicinal importance of the selected plant species. The study scientifically validates the traditional significance of these medicinal plants and highlights their potential applications in herbal drug formulation and future pharmaceutical research. Furthermore, the study emphasizes the importance of FAAS-based quantitative elemental analysis as a reliable, sensitive, and cost-effective method for quality control, safety assessment, optimization of plant extracts in the development of Ayurvedic medicines and eco-friendly nano-drugs.

Keywords: Medicinal Plants, FAAS (Flame Atomic Absorption Spectroscopy), Elemental Analysis, Nano-drugs, Herbal Medicine.

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Introduction:

Medicinal plants have been used for centuries in managing and treating different kinds of illnesses. In this study, the Flame Atomic Absorption Spectroscopy (FAAS) technique was utilized to examine the elemental composition of

selected medicinal plants and herbs such as Sheesham, Ajwain and Ashwagandha leaves collected from the Gulbarga region. These plants are well known in traditional medicinal therapy because of their broad healing properties and healthcare benefits. They continue to play an important role in

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many indigenous healthcare practices, where they are commonly used for prevention, health promotion and disease treatment. In rural communities especially, traditional herbal remedies still remain one of the primary sources of healthcare support. Numerous studies have been carried out by researchers to evaluate the major, minor and trace elemental compositions of medicinal plants in relation to human health.

In this Investigation we get the trace elements in various human metabolic processes. The Study Area:

essential elemental content in the leaves of medicinal plants and herbs, namely Sheesham, Ajwain and Ashwagandha collected from the Gulbarga region were analysed using the Flame Atomic Absorption Spectroscopy (FAAS) technique. The overall impact of the major, minor and trace elements on human health is also discussed due to increasing industrialization and environmental pollution. The experimental data of the present work will give the importance in the synthesis of new Ayurvedic formulation.

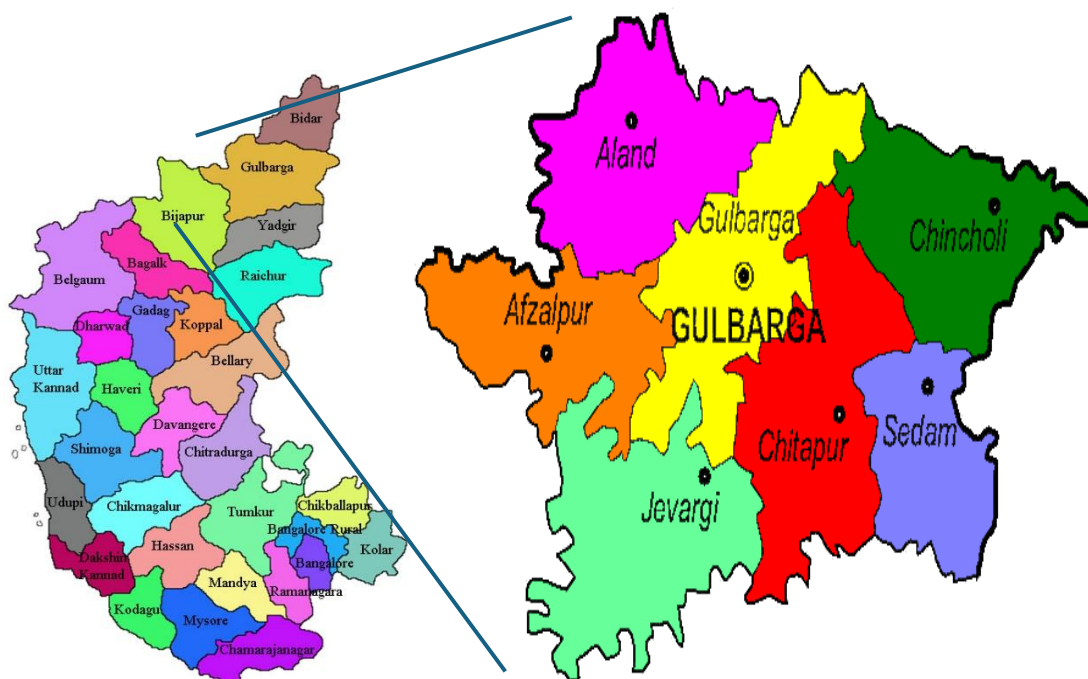


Fig. 1. Study area selected for the present study (Location Map)

Experimental Materials and Methods:

Medicinal plants leaves collection:

Medicinal plant and herb were collected from Gulbarga district of Karnataka. The medicinal plants and herbs in the form of leaves collected, cleaned the surface for removal of contaminants of the plants samples by washing firstly with running tap water thoroughly 2-3 times then in a deionizer water twice finally with double distilled water. Then soaked leaves were dried in a clean drying chamber keeping in a shade for 30-45 days. The dried leaves in silica crucible were heated in a oven at 350 degree Celsius for 2-3 hours to get ash of the samples. The annealed samples were powdered using agate mortar and passed through 100-mesh sieve (aperture~

0.15mm) for further investigations of samples AAS analysis to determine the elements using a standard method.

Sample preparation for elemental analysis:

The medicinal plant samples fine powder of 10g were taken for the analysis of major, minor and trace elements. The weighed powdered material was transferred into a thoroughly cleaned silica crucible and subjected to heating in an oven maintained at 300-400°C for nearly 2-3 hours. Once the heating process was completed, the crucible was cooled to room temperature inside a desiccator to avoid moisture absorption. The ash obtained after this process was further utilized for preparing the

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analytical solution. Precisely 1 g of ash was weighed and mixed with 25 ml of concentrated HCl and 25 ml of double-distilled deionized water (1 g ash + 25 ml conc. HCl + 25 ml deionized H₂O). The mixture was stirred for a few minutes until a clear solution was formed and then filtered using Whatman filter paper No. 41. To the filtered solution, 950 ml of double-distilled deionized water was added to make the total volume up to 1000 ml. The same procedure was repeated for all other medicinal plant samples. The prepared solutions were finally analysed for the quantitative estimation of minerals and trace elements using Atomic Absorption Spectroscopy (AAS).

Medicinal Benefits:**1. Sheesham leaves:****Family:** Fabaceae**Common name:** Sheesham**Order:** Fabales**Scientific name:** Dalbergiasissoo**Rank:** Species**Higher classification:** Dalbergia**Kingdom:** Plantae

The leaves are used for treating variety of diseases. The leaves are used for eye pain, swelling, painful urination, gynaecological disorder etc leaves bark are used as astringent in bleeding disorders. The paste of leaves mixed with sweet oils is used topically in skin excoriation (scraping, abrading of skin). The tree is anti-inflammatory antinociceptive/reducing sensitivity to painful stimuli property, antidiabetic, analgesic and antioxidant. It heals ulcers, sheesham leaves can heal fractured bones.

2. Ajwain leaves:**Family:** Apiaceae**Common name:** Ajwain**Scientific name:** Trachyspermumammi**Order:** Apiales**Higher classification:** Trachyspermum**Rank:** Species**Kingdom:** Plantae

Ajwain are used in stomach disorder, Instant remedy for stomach ache, for cold diseases. It is very useful in the asthma, diabetes mellitus, weight loss etc so many diseases treatment ajwain placed important role. Ajwain help to dissolve kidney stones, it reduces gas and flatulence. Ajwain used for acidity and hyperacidity, nutritional facts and nutritional values etc

3. Ashwagandha:**Scientific name:** Withaniasomnifera**Common name:** Ashwagandha**Family:** Solanaceae**Order:** Solanales**Rank:** Species**Higher classification:** Withania**Kingdom:** Plantae

Ashwagandha is widely recognized as an important medicinal plant in Ayurveda, the ancient Indian system of natural healing. It is known for its

numerous health benefits, including helping to regulate blood sugar and cholesterol levels, reducing stress and anxiety, supporting muscle development, stimulating thyroid function, enhancing blood formation, and exhibiting anti-inflammatory as well as antibacterial activities.

Results and discussion:

The elemental study carried out on the leaf samples of the selected medicinal plants and herbs showed the presence of important elements such as Fe, Ca, K, Mg, Mn, Zn, Cu and Al. These elements are believed to contribute to the medicinal value of the plants and may also support the formation of secondary metabolites that are associated with the therapeutic properties of traditional herbal medicines. Ashwagandha used to reduce Aluminium induced toxicity (in brain and liver) rather than contributing to it. Recent investigations have shown that Scientific methodologies use Aluminium chloride in lab tests to induce toxicity to test the protective effects of Ashwagandha Extracts. The Atomic Absorption Spectroscopy (AAS) analysis indicated that the concentration of these elements differed from one plant sample to another.

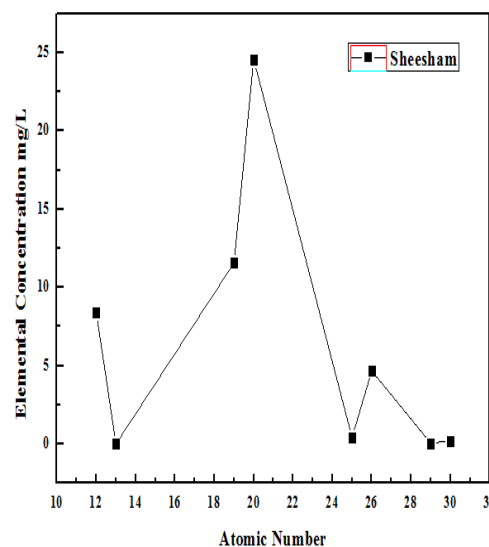
For better comparison, the elemental concentrations observed in Sheesham, Ajwain and Ashwagandha leaves were presented in tabular and graphical form. Among all the elements analyzed, calcium was found in comparatively higher amounts, while aluminium was recorded at the lowest level in most of the collected samples from the Gulbarga region. Since these medicinal plants are commonly used in traditional treatments, the presence of essential major and trace elements may play an important role in both prevention and management of various health disorders.

The estimated concentrations of elements in the studied medicinal plants were found to be within the permissible limits recommended by FAO/WHO standards. The results also suggested that all three medicinal plants contain sufficient calcium content when compared with other elements analyzed in the present work. According to FAO/WHO guidelines, the permissible concentration of copper in edible plants is 3.00 mg kg⁻¹, although specific limits for medicinal plants have not been clearly defined by WHO. Overall, the findings of the present investigation indicate that the

medicinal plants collected from the Gulbarga region of Karnataka possess appreciable amounts of major and trace elements, which may support their traditional use in treating different diseases.

Elemental Concentration in the Sheesham Leaves in mg/L

Coding	Atomic Number	Gulbarga
Mg	12	8.4155
Al	13	0.0124
K	19	11.5685
Ca	20	24.5635
Mn	25	0.4255
Fe	26	4.6859
Cu	29	0.0685
Zn	30	0.2101



Elemental Concentration in the Ajwain Leaves in mg/L

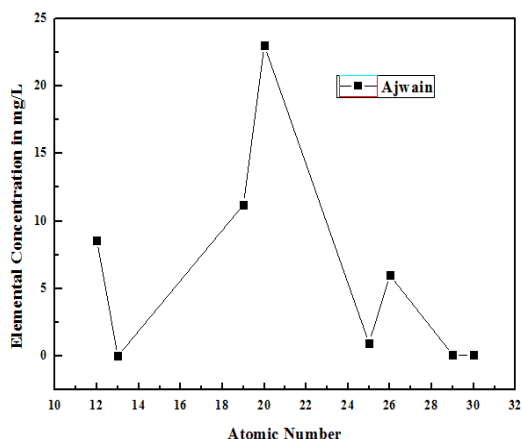
Coding	Atomic Number	Gulbarga
Mg	12	8.5625
Al	13	0.0298
K	19	11.2032
Ca	20	22.9865
Mn	25	0.9856
Fe	26	5.9867
Cu	29	0.1120
Zn	30	0.1254

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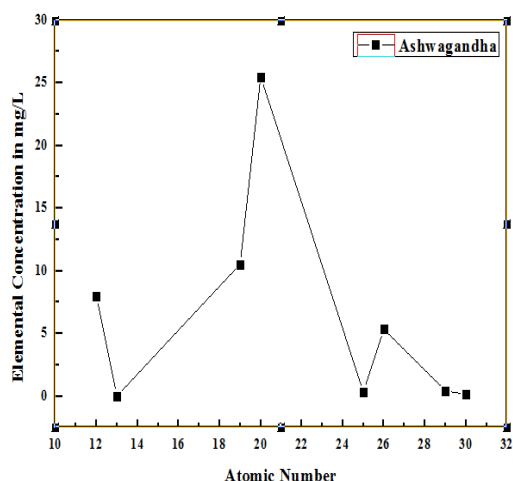
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Elemental Concentration in the Ashwagandha Leaves in mg/L

Coding	Atomic Number	Gulbarga
Mg	12	7.9545
Al	13	0.0258
K	19	10.5362
Ca	20	25.4855
Mn	25	0.3542
Fe	26	5.3562
Cu	29	0.4522
Zn	30	0.1452



Conclusion:

The variation in elemental concentration may be mainly due to differences in the botanical nature of the plants, along with the mineral composition of the soil where the medicinal plants and herbs are grown.

Factors such as climatic conditions and the selective absorption capacity of plants also contribute to the variation in elemental content. The present study indicates that the investigated medicinal plants and herbs used in the treatment of various diseases are rich sources of major, minor, and trace elements. These plants may therefore be beneficial in treating diseases caused by deficiencies of essential elements. The studied medicinal plants and herbs were found to contain appreciable amounts of potassium (K), calcium (Ca), and magnesium (Mg), which are important for human nutrition. Furthermore, the results revealed that the concentrations of major, minor, and trace elements in the analyzed medicinal plant leaves were within the permissible limits prescribed by WHO/FAO standards. Hence, these medicinal plants and herbs may be effectively utilized in the development of new herbal formulations and drugs for the treatment of various diseases.

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