

DETERMINATION OF HEAVY METALS CONTENTS BY ATOMIC ABSORPTION AND FLAME EMISSION SPECTROSCOPY IN HELIOTROPIUM DAYSICARPUM PLANT OF BALOCHISTAN.

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ABSTRACT

The study survey the elemental arrangement of Heliotropium dasycarpum to understand its fundamental structure and safety, highlight the role of constituent elements in compound bioactive arrangement. Utilizing damp assimilation and spectroscopy methods, Analysis was done on the plant's basic concentrations, which ranged from sodium to cobalt., uncovering heavy metals inside secure range. The inquire about underscores the significance of observing contamination in traditional medicinal plants to confirm therapeutic safety, prevent local populations from exposure to danger, and further conservation application for acceptable use.

INTRODUCTION.

Medicinal plants:

The family of Boraginaceae, mainly distributed, approximately consists of 100 genera and higher up than 2,000 species (Ali, 1977) *Heliotropium*, a critical class inside this family, is widely recognized for its therapeutic applications in, Iranian, African, Brazilian, Indian and Ivorian traditional medicine (Carballo et al., 1992; Nagaraju and Rao, 1990; Barrett, 1994). The fresh powder of *Heliotropium dasycarpum* has been utilized for treating eye disorders. (Tareen et al., 2010). This plant species is commonly found in locales including, Turkmenistan, Brazil, Afghanistan, Pakistan and Iran, also present in Southern Balochistan, Punjab, Waziristan and Gilgit (Ali, 1977; Dasti et al., 2003). Research has confirmed with its phytotoxic and antimicrobial properties, further approval its traditional therapeutic uses (Ghaffari et al., 2013). Continuing research into the health promotinl properties of *Heliotropium* emphasise its character in modern herb therapy and emphasizes the importance of protecting this precious botanical resource. (Sharma et al., 2019). Phytochemical research on *Heliotropium* species has revealed a wide spectrum of bioactive components. including flavonoids, tannins alkaloids, and tannins. These components are linked to the plant's medicinal properties, such as anti-inflammatory and antioxidant. activities, which form the basis of its therapeutic effects. (Patel et al., 2021). It is beneficial to recognized that environmental and geographical factors importantly affect the efficacy of herbs, include the concentration of find elements within them. These trace elements thereby alter both their toxic and therapeutic beneficial. (Fahad, S.M. et al., 2014). Essential trace elements are needed in trace amounts by humans to perform vital metabolic processes. (Soto-Jimenez, M.F et al., 2011). Although some trace elements are necessary for the biological system in trace amounts. (Zhang, J. 2018). Ayurvedic and traditional medicine make considerable use of *Heliotropium indicum*, one of the most studied species. (Mahendra et al., 2016). A species called *Heliotropium bacciferum* is frequently used in African traditional medicine to treat conditions like fever and gastrointestinal issues. (Kumar et al., 2018).

MATERIAL AND METHODS

The extracts were gathered from the Kalat District in Balochistan. Collection of the following herbs were carefully dried in a dark environment to protect

their natural components and safe photodegradation (as shown in Figure 1). Once dried, the herbs were crushed into a fine powder. The resuled powder were then stored and securely in labeled containers to confirm their facilitate and preservation proper processing for further examinations.





Fig.1 Heliotropium dasycarpum plant's dry leaves



Fig.2 Heliotropium dasycarpum plant's fresh leave

2.2. Stock Solution Preparation:

A **1000 ppm analytical grad standard stock solution** was taken as prepared form for all selected elements, including Sb, Se, Mn, Fe, Co, Na, and K. The quantities of heavy metals in the sample were determined using their respective **calibration curves**. These solutions were diluted to **one liter** in a volumetric flask. Standard and blank solutions were already prepared. For **100 ppm solutions**, **10 ml** of the 1000 ppm stock solutions for Mn, Fe, Co, Na, K, Sb, and Se were pipetted into a 100 ml graduated flask and diluted with deionized water. The solutions were thoroughly mixed, and subsequent dilutions were prepared in a similar manner.

2.3. Standard Solution Preparation:

Metal ions analyzed included Se, Sb, Mn, Fe, Co, Na, and K. **Calibration curves** were developed for each element using three to four standard solutions derived from the 1000 ppm stock solution. The standard concentrations were carefully selected to fall within the measurable range of the calibration curves, ensuring accurate quantitative analysis.

2.4. Preparation of Sample

2.4.1. Sample Digestion:

To prepare the sample, **0.5 g** of herb powder was combined with **10 ml of HNO_3** , **2 ml of H_2SO_4** , and **1 ml of HClO_4** in a round-bottom flask connected to a condenser. The mixture was heated until white vapors formed, indicating complete digestion. The digested mixture was then diluted with distilled water and filtered using **Whatman No. 42 filter paper**. The final filtrate volume was adjusted to **50 ml** with deionized water.



Figure 3. Digestion of sample

i. Calibration Curves Calibration curves are essential for determining the concentration of metal ions in unknown samples. Here's how they were prepared:

- **Preparation of Standard Solutions.** Stock solutions of each metal ion (Sb, Se, Fe, Mn, Co, K, Na) were diluted to create a series of solutions with known, precise concentrations.
- **Calibration Curve Construction.** Calibration curves were plotted for each metal by measuring absorbance using Atomic Absorption Spectroscopy (AAS). X-axis: Metal ion concentration. Y-axis: Absorbance readings. The calibration curves served to determine the concentrations of the metals in the samples.

ii. Blank Solutions

Blank solutions play a critical role in accurate spectroscopic measurements: They contained only deionized water without any metal ions. Used to correct for background signals and instrumental noise. The absorbance reading of the blank is subtracted from the readings of standards and unknowns, ensuring that only the signal due to the metal ions is analyzed.

2.5. Metal Content Determination:

2.5.1. Methodology with AAS:

- The elemental components (e.g., Co, Fe, Mn, Se and Sb) are analyzed using Atomic Absorption Spectroscopy (AAS).
- Key adjustments: A deuterium corrector compensates for background absorption. The analysis uses the standard air-acetylene flame setup with external calibration curves.
- Instrument optimization: Parameters like burner and lamp settings, slit width, and wavelength are optimized for the instrument's minimum signal strength.
- Repeatability: Each analysis is repeated three times for reliability.
- Hollow Cathode Lamps: These lamps operate at specific wavelengths recommended by the manufacturers to ensure precision.
- Conditions for Analysis: The standard conditions for atomic absorption are summarized in Table .1

2.5.2. Flame Photometric Analysis (FP):

- Target Elements: Sodium (Na) and Potassium (K).
- Sample Preparation: Samples are thoroughly mixed to ensure uniformity. Digestion is performed before analysis to make the samples homogeneous and representative.
- Analysis Approach: The digested samples are analyzed using Flame Photometry. The concentration of Na and K is determined by comparing the absorbance to a standard calibration curve.
- Comparison to Standards: Results are compared with the Provisional Tolerable Weekly Intake (PTWI) values established by FAO/WHO Joint Expert Committee on Food Additives (JECFA). Hussain et al., 2018.

• 2.6. Digest Metal Content Analysis

The metal contented in the digested samples was examined by means of Atomic Absorption Spectroscopy (AAS) in exact circumstances.

• 2.7. Data Analysis

The results were treated by means of Microsoft Excel 365. Expressive data were used, and crucial values were exhibited in the facts for easier clarification.

RESULTS AND DISCUSSION

3.1. FP and AAS

A universal health alarm is the presence of both beneficial and harmful mechanisms in plant treatments. Weak controlling observing and deficient feature control of the plants used to harvest these harvests worsen the difficult in Pakistan. Using Atomic Absorption Spectroscopy (AAS) and Flame Photometry, this study examined the amounts of seven metals in the medicinal herb *Heliotropium daysicarpum* from the Kalat region: iron (Fe), selenium (Se), manganese (Mn), antimony (Sb), cobalt (Co), potassium (K), and sodium (Na). The results highlight how urgently stricter laws and oversight mechanisms are required to guarantee the security of herbal remedies.

3.1.1. Selenium (Se)

The selenium meditation in the leaves in this analysis was 6.9418 ppm, above the 0.05 ppm permissible limit set by the WHO and FAO. This recommends the potential dangers linked with the plant's great selenium content.

An needed vitamin for immunological and endocrine, role is selenium. It has been confirmed that taking complements can elevation blood levels of selenium and minor oxidative injury, while lacks can ache immunological function. On the further indicator, overconsumption of healing floras can be damaging and should be carefully checked.

3.1.2. Antimony (Sb)

The plant under study had antimony levels of 0.4421 ppm, which is far lower than the FAO and WHO-recommended safe limit of 6 ppm sef. While this indicates safe levels of antimony in the plant, long-term exposure to high levels of antimony compounds has been linked to respiratory and gastrointestinal issues, as well as skin conditions like "antimony spots." Its retention and absorption in the body depend on the form and particle size of the compound.

3.1.3. Manganese (Mn)

The manganese concentration in the plant's leaves was measured at **0.1449 ppm**, far below the WHO-recommended limit of **2 ppm** for heavy metals in medicinal plants. This is also substantially lower than values reported in previous studies, such as **44.6 to 339 ppm** in Egyptian plants. Manganese is an essential trace element but can be toxic at high concentrations.

3.1.4. Iron (Fe)

The highest concentration of iron recorded in the plant was **1.0800 ppm**, well within the permissible limit of **20 ppm** set by the FAO and WHO. Iron is an essential element for hemoglobin synthesis and oxygen transport in the blood. Compared to other medicinal plants,



which often exceed this limit, the relatively low iron content in *Heliotropium daysi* suggests a safer profile for this metal.

3.1.5. Cobalt (Co)

The cobalt concentration in the plant was **-0.0338 ppm** (likely reflecting an undetectable or negligible value). The WHO - recommended limit for cobalt in medicinal plants is **0.2 ppm**. While cobalt is essential for vitamin B12 synthesis, its presence in this plant is minimal compared to values reported in other medicinal plants, which range between **0.14 ppm and 0.48 ppm**.

3.1.6. Sodium (Na)

The sodium concentration was recorded at **81 ppm**, significantly below the permissible limit of **2610–51340 ppm** for medicinal plants. Sodium is vital for maintaining fluid balance and normal physiological functions. Deficiency can lead to dehydration, fatigue, and other health issues, but the levels in this study suggest no toxicity risk.

3.1.7. Potassium (K)

Potassium concentration in the plant was measured at 31 ppm, also well within safe limits. Potassium is essential for maintaining electrical and cellular signaling, as well as numerous physiological processes like hormone release and vascular tone regulation. Potassium ranks in all plant constituents observed were considerable, while they were within satisfactory limits, representing that this plant is safe.

Serial No	Metals	Leaves	Permissible Limit (ppm)
1	Sb	0.4421	6
2	Se	6.9418	0.05
3	Fe	1.0800	20
4	Mn	0.1449	2
5	Co	-0.0338	0.2

Serial no	Metals	Leaves (ppm)	Permissible Limit (ppm)
1	Na	81	2610-51340
2	K	31	6380-36,600

Table 1. Concentration (ppm) various elements in selected medicinal plants

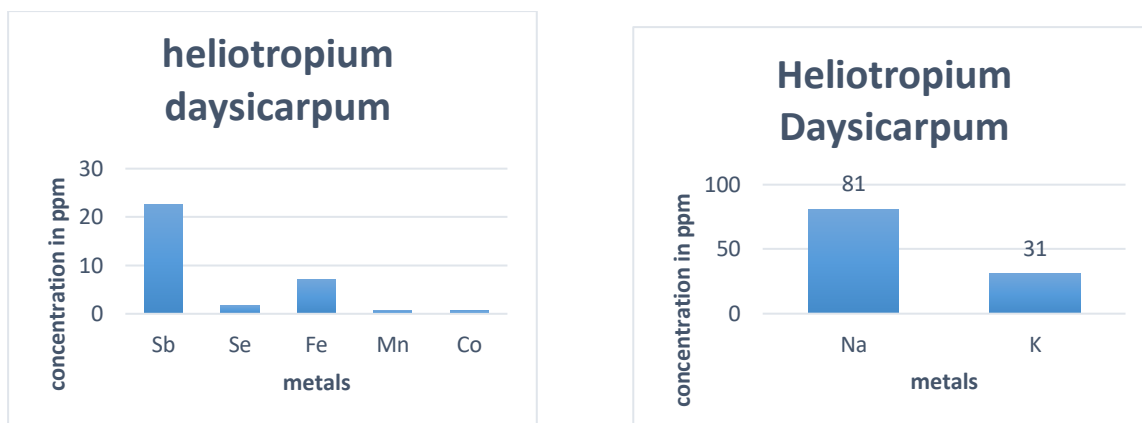


Figure 2: Comparison of the concentrations of various metals in *Heliotropium daysicarpum*

CONCLUSION

With the exclusion of selenium, which remained originate to be overhead the optional level, this training inventions that the quantities of heavyweight metals in *Heliotropium daysicarpum* and other observed plants are under the harmless bounds set by global administrations like the FAO and WHO. Seven elements remained assessed, counting both essential and non-essential metals. The quantities of additional heavy metals were within acceptable bounds, however the quantities of sodium and potassium were comparatively greater. These consequences suggest that there are no important fitness dangers related with the plants' usage in outdated medicine and that they are non-toxic. The study highlights how important accurate and precise heavy metal analysis is to assuring the effectiveness and care of healing plants. The conclusions give the pharmaceutical industry significant material for making medications based on herbs for a variety of diseases. Based on scientific evaluation, the medicinal plants under investigation show great promise and are widely utilized in traditional medicine. Plant components, ambient conditions, and soil makeup all affect changes in metal concentrations. The low heavy metal concentrations imply that there is little to no pollution at the collection locations.

RECOMMENDATIONS

Regularly check the quality of the soil and surroundings. Only gather medicinal herbs in places free of pollution. Standardize extraction techniques to ensure reliable and secure results. Examine the long-term effects of the environment on the buildup of heavy metals. Raise awareness about obtaining plants from hygienic sources. Involve interdisciplinary teams to investigate composition and health impacts. Examine the toxicity hazards associated with emissions, insecticides, and fertilizers. Benefits should be weighed against possible abuse and health hazards. Pay attention to medicinal plants understudied mineral

compositions. For safe use, research the bioavailability of hazardous heavy metals. Inform people about how to use medicinal plants safely. Examine the cultural, sociological, and economic significance of plants.

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