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Spectrometric Determination of Heavy Metal Accumulation in variety of Plants

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Abstract

Five plant varieties (Cocculus Pendulus, Artemisia Persica Martima, Tribulus Terristris, Ephedra Intermedia and Solanum Nigrum) were collected from five distinct locations in Balochistan. The Current study was undertaken for evaluate the heavy metal analysis, antioxidant activity, and antibacterial activity of five plants, as well as to analyze seven types of metals, namely Cd, Fe, Ni, Co, Mn, K, and Na, using an atomic absorption spectrophotometer. The Frequent use of therapeutic plants to recover health in the context of existing pollution necessitates specific caution, as they may contain heavy metals in their structure, posing hazards and threats to human health. Certain plants possess various medicinal properties, including antioxidant and antibacterial activities. Natural antioxidants, which are abundant in food and medicinal plants, have been shown to display a series of biological effects, as well as anti-inflammatory, anti-aging, and anticancer properties. Moreover, bacterial infections of the skin and wounds can significantly impair the quality of life and even lead to fatal consequences in some cases.

Keywords: *Cocculus Pendulus, Tribulus Terristris*, AAS, K, Na

INTRODUCTION

Natural products, which are chemical compounds derived from living organisms, have been a vital source of medicines for centuries. In fact, around 50% of modern medicines are derived from natural sources, offering a diverse range of structures and biological activities. These medicinal plants have served as the basis for developing new drugs, with modifications to minimize side effects and enhance bioavailability (de la Torre & Sierra, 2004). Medicinal plants, in particular, have played a crucial role in humanoid health, exhibiting antibacterial properties and serving as a valuable resource for maintaining well-being (Zaika, 1988). Plants are essential for supply drugs and perform a key position in global fitness (Roy et al., 2022). Herbal plants have long been

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extensive been recognized as a major source of healing and medicinal support. Beyond their role in treating ailments, they also offer a natural means of promoting overall wellness. In fact, many countries around the world - approximately two-thirds of nations rely heavily on medicinal plants as a primary source of healthcare due to their cultural significance, ease of access, portability, and minimal side effects. This highlights the importance of medicinal plants in maintaining human health and well-being. Some notable examples of drugs derived from plants include tropine, artemisinin, digoxin, and morphine, among others (Han, K. T., 2022).

Prolonged exposure to low levels of heavy metals can have devastating properties on human and animal health, as the body lacks an effective mechanism to eliminate them. Metals like lead, mercury, cadmium, and copper are mostly risky as they store in the body over time, leading chronic toxicity. These metals not only pose significant environmental risks but are also extremely toxic, making them a serious concern for public health and ecosystems (Ellen, Loon, & Tolsma, 1990). Plants have the ability to absorb important heavy metals like iron, zinc, copper, and manganese from the soil through a process driven by selective uptake and Concentration gradients. Plants require metal ions in limited amounts, but an overabundance can have harmful effects, including, inhibited growth, Disrupted function and metabolism, Damage to plant structure and function and reduced productivity of enzyme action (Luo, 2021).

The goal of this research was to examine and relate the ranges of heavy metals, antioxidant activity, and antibacterial properties in plant samples collected from three different districts in Balochistan, specifically: Khuzdar (Moola Chotok), Kalat (Harboi) and Quetta. This study sought to determine the level of heavy metal concentrations, antioxidant potential, and antibacterial effects across these different regions in different types of plants.

MATERIAL AND METHOD

Sample collection

Areas from where the sampling of the medicinal plant was carried out, the mountainous area of the Balochistan specifically Kalat and Khuzdar District where famous for Harboi and Moola Chottok , which are famous for their natural beauty and yield more than thousands of medicinal plants. The herbal product which is found on the tops of the mountains in Harboi from Kalat district and the other herbal medicinal plant from district Khuzdar, the mountainous area of Moola chottok where thousands of other medicinally used plants grow naturally. However, another plant easily accessible, which may be found in every street of Balochistan province but especially in Sarawan Range, like Kalat, Mastung and Quetta. A thorn that is sign of comfort.

Sample preparation for metal analysis

The plant samples were carefully cleaned with the help of deionized water to eliminate any impurities and contaminants. The plants were then chopped into smaller pieces, dried out in the oven at 50°C for several periods to take out excess moisture. The dried samples were subsequently pulverized using a crucible to produce a fine, homogeneous powder. Each sample was labeled and stored in polyethylene bags for future analysis, ensuring easy identification and preservation of the samples (Kebbekus, 2003).

Digestion

Accurately weighed samples were carefully heated in a water bath on 80°C for three hours in a 20 ml blend of Nitric Acid and Hydrochloric Acid in a 3:1 ratio. (concentrated acids) to obtain a pure solution. After that the solution cooled out than it was diluted with distilled water to attain the wanted. Then filtered all the samples by whatman filter paper which removes impurities and kept in acid-washed polyethylene flasks for more examination of heavy metals present in medicinal plants.

Analysis

Heavy metal concentration in herbal plants were determined through Atomic absorption spectrophotometer in combination with wet digestion process. This instrument working was a double beam spectrophotometer along with deuterium related correction, working hollow cathode definite to every metal (K, Na, Cd, Fe, Cu, Ni, and Mn) with definite wavelengths.it permitted accurate amounts of heavy metal absorption in the medicinal plant samples (Leventeli, 2021).

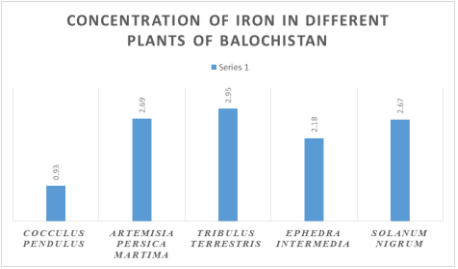
RESULT AND DISCUSSION

Medicinal plants containing heavy metals arranged from numerous regions of Balochistan unveiled substantial variations. These changes in metal content are influenced by the chemical and physical properties of the soil, as well as the unique absorption abilities of each metal by the herbal plant. As these contaminants accumulate in the soil and are absorbed by plants, they can build up in the food chain, leading to serious health issues, and warranting further discussion and attention (Ullah, R., 2020).

S. No	Local Name	Scientific Name	Collection Area
1	Zamor	Cocculus pendulus	Moola Chotok District Khuzdar
2	Gorhdil	Artemisia persica martima	Ferozabad District Khuzdar
3	Gorgondok	Tribulus terristris	Quetta
4	Naromb	Ephedra intermedia	Harboi of District kalat
5	Tola angoor	Solanum nigrum	

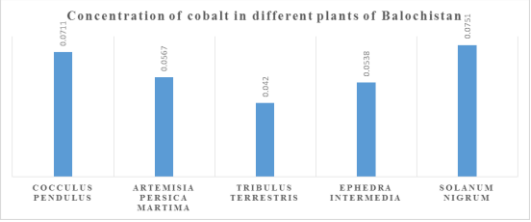
Iron

Iron is an essential trace element crucial for various cellular functions in the body. The concentration of iron (Fe) in the analyzed medicinal plants ranged from 0.9338 to 2.9 mg·kg−1, exceeding the Permissible limit of 15 mg·kg-1 in all samples. The human body, specifically an adult male, contains approximately 4 grams of iron, primarily stored in hemoglobin and myoglobin. Iron deficiency can lead to various diseases, with anemia being the most common. However, excessive iron levels can have detrimental effects on metabolic functions, cardiovascular health, and gastrointestinal systems, causing disorders such as cramps, bleeding, and other adverse effects (Dghaim, R., 2017).



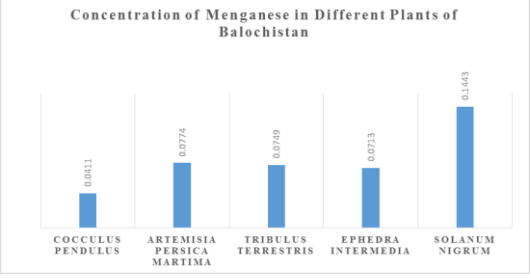
Cobalt

Cobalt is a naturally occurring element in the environment and its presence in soil can impact plant growth. Plants grown in cobalt-deficient soil can lead to cobalt deficiency in animals that consume them, while soil near mining and melting facilities can contain high concentrations of cobalt, potentially causing health problems in animals and contaminating the food chain. On the other hand, cobalt is essential for humans as a component of vitamin B12, and it has been used to treat pneumonia in pregnant women . (.Konieczynski, P., 2021). However, excessive cobalt intake can have adverse health effects. The concentration of cobalt in various medicinal plants arrays 0.0420 to 0.075 mg/g, below the WHO Permissible limit of 0.48 mg/g. Cobalt overdose can lead to respiratory problems, Hyperglycemia, Cardiomyopathy, Dermatitis, and Pulmonary disorders, although shortage can result in Anemia, Weight loss, and stunted development. (Ahmed, M 2008).



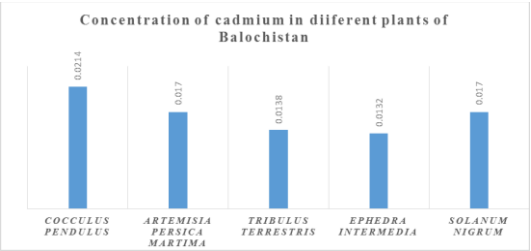
Manganese

Manganese is an essential mineral found in a variety of foods, Including Legumes, Nuts, Tea, whole grains, and green root vegetable. While it considered a crucial nutrient, the body functions properly if Manganese requirement is fulfilled. Manganese is used for the treatment of weak bones (Ghani, A., 2012). The concentration of manganese in several herbal plants ranges 0.0041 to 0.1443 mg/g, which less than WHO Permissible limit of above 15 mg/g for medicinal plants (Mutaftchiev K., 2003).



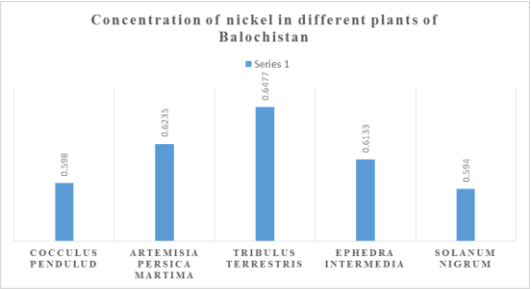
Cadmium

Cadmium is a toxic metal which is found in many products like phosphate fertilizers, petroleum goods and industrial wastelands. The level of cadmium (Cd) in the analyzed herbal plants is of 0.0170 to 0.0214 mg/kg, which is below the Permissible limit, 0.3 mg/kg fixed according to World health organization (WHO) (Ghani, A., 2012).



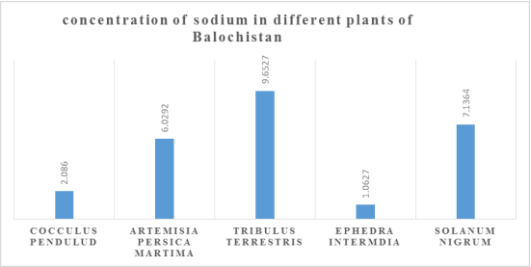
Nickel

Nickel, a trace heavy metal, is an important element established in various enzymes, Microorganisms, plants, and human existences. The concentration of nickel (Ni) in analyzed plants ranges from 0.5940 to 0.6477 mg/kg. While nickel shows a crucial role in iron metabolism, elevated concentrations can be toxic (Ghani, A., 2012). Prolonged contact with nickel has been linked to increased threat of high blood pressure, Neurological defects, Cardiovascular disease, developmental stops in children, and lung cancer. However, nickel toxicity in humans is rare due to low absorption rates. World Health Organization (WHO) has established a permissible limit for nickel of 0.96-1.95 mg/kg.(Konieczynski, P., 2021).



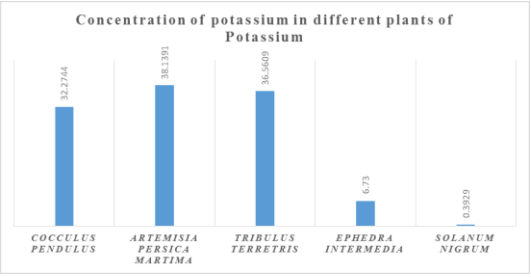
Sodium

Sodium naturally accumulates in soil through various sources, including fertilizers, pesticides, runoff from salt-laden waters, and mineral breakdown. However, excessive sodium in the soil can be taken up by plant roots, leading to severe vitality issues in gardens. Sodium (Na+) has the most detrimental effects on plant growth, disrupting plant metabolism and inhibiting enzyme activities. The level of sodium (Na) in the plant samples ranges from 9.6527 to 1.0627 mg/kg, highlighting the potential risk of sodium toxicity in plants. (Schwartz, J. H. 1982).



Potassium

The production of ATP plays a crucial role in regulating the degree of photosynthesis. Moreover, Potassium helps modulate the opening and closing of stomata, which facilitates the oxygen, CO2 and exchange of water vapor. Adequate potassium is essential for well plant evolution, and deficiencies can lead to stunted growth and reduced yields. The level of potassium in the plant samples from 0.3929-38.1391 mg/kg, highlighting the importance of optimal potassium levels for plant development (Zahedifar, M., 2019).



CONCLUSION

Our research has revealed that various kinds of herbal plants, grown in various localities, accumulate altered concentrations of heavy metals. Notably, the plants collected from Khuzdar (Moola Chotok) and Kalat (Harboi) exhibited heavy metal levels mostly within Permissible limits, but the ranks in plants from further localities were below the permissible limits. These findings highlight the significance of location-specific assessments of the heavy metal accumulation in herbal plants to ensure the safe use (Han, K. T., 2022). Our outcomes additionally indicated that the plants samples used for therapeutic or local purposes the should be obtained from zones not polluted with heavy metals, Therefore it is advised that the heavy metal contents in medicinal plants should be checked the concentration of heavy metals in advance their usage for native and therapeutic. (Kebbekus, 2003).

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