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Evaluation of Some Element Contents in *Hypericum scabrum* L. from Kükürtlü Village (Erzurum)

Züleyha ASLAN ERGENEKON[1*], Meryem ŞENGÜL KÖSEOĞLU[1]

[1]Department of Biology, Faculty of Science, Atatürk University, Erzurum, Turkey

Abstract

Hypericum scabrum L. is a widely distributed plant in Turkey, known for its significant medicinal properties. This plant has been investigated for its potential as an accumulator in environmental pollution studies. In this study, the elemental contents of *H. scabrum* and surrounding soil samples from Kükürtlü Village, Erzurum, were analyzed to assess its capacity for element accumulation. The samples were processed following standard procedures for elemental analysis, and measurements were made using an ICP-OES device. The results revealed that *H. scabrum* contained high levels of potassium (K) and calcium (Ca), while calcium (Ca), iron (Fe), and magnesium (Mg) were the most concentrated elements in the soil. *H. scabrum* accumulated more potassium (K) than the soil, but other elements, such as copper (Cu), lead (Pb), nickel (Ni), zinc (Zn), and manganese (Mn), were found at lower levels. Although the plant's high uptake of macro-elements like potassium (K) may contribute to environmental nutrient recycling, its limited accumulation of certain heavy metals suggests that it has potential for mitigating environmental pollution, but it cannot be classified as a hyperaccumulator. Further studies should investigate the mechanisms of heavy metal uptake in *H. scabrum* and its potential for bioremediation in more detail.

Key Words: *Hypericum scabrum, element contents, Erzurum,* ICP-OES.

Kükürtlü Köyü (Erzurum)'nden Toplanan *Hypericum scabrum* L.'da Bazı Element İçeriklerinin Değerlendirilmesi

Özet

Hypericum scabrum L. Türkiye'de yaygın olarak bulunan ve önemli tıbbi özellikleri ile bilinen bir bitkidir. Bu bitki, çevre kirliliği çalışmalarında bir akümülatör olarak potansiyeli açısından araştırılmıştır. Bu çalışmada, Erzurum'un Kükürtlü Köyü'nden alınan *H. scabrum* ve çevresindeki toprak örneklerinin element içerikleri, element biriktirme kapasitesini değerlendirmek için analiz edilmiştir. Örnekler element analizi için standart prosedürler izlenerek işlenmiş ve ölçümler bir ICP-OES cihazı kullanılarak yapılmıştır. Sonuçlar, *H. scabrum*'un yüksek düzeyde potasyum (K) ve kalsiyum (Ca) içerdiğini, kalsiyum (Ca), demir (Fe) ve magnezyumun (Mg) ise topraktaki en yoğun elementler olduğunu ortaya koymuştur. *H. scabrum* topraktan daha fazla potasyum (K) biriktirmiş, ancak bakır (Cu), kurşun (Pb), nikel (Ni), çinko (Zn) ve manganez (Mn) gibi diğer elementler daha düşük seviyelerde bulunmuştur. Bitkinin potasyum (K) gibi makro elementleri yüksek oranda alması çevresel besin geri dönüşümüne katkıda bulunabilse de, bazı ağır metalleri sınırlı oranda biriktirmesi çevre kirliliğini azaltma potansiyeline sahip olduğunu, ancak hiperakümülatör olarak sınıflandırılamayacağını göstermektedir. *H. scabrum*'da ağır metal alım mekanizmaları ve biyoremediasyon potansiyeli daha ayrıntılı olarak araştırılmalıdır.

Anahtar Kelimeler: *Hypericum scabrum, element içeriği, Erzurum,* ICP-OES.

Introduction

The genus *Hypericum* Tourn. ex L., the largest genus of the Hypericaceae Juss. family, is represented by over 550 species worldwide (WFO, 2025). In Turkey, more than 100 species of this genus are found, with 48% of these species being endemic (Firat & Eroğlu, 2023). Members of *Hypericum*, which include trees, shrubs, annuals, and perennials, are widely distributed across various habitats, except for polar regions, tropical areas, and deserts (El-Chaghaby et al., 2024).

The material for this study, *Hypericum scabrum* L., has a wide distribution in Turkey and is naturally found in many regions, including Denizli, Kastamonu, Ankara, Erzurum, and Van (TÜBİVES, 2025). *H. scabrum* is a perennial plant that typically grows in dry and rocky slopes, open woodlands, and steppe habitats, at altitudes ranging from 750 to 3200 meters, and blooms between May and August (Peşin, 2007; Şerbetçi, 2002). A plant of significant medicinal value, *H. scabrum* has been used in traditional medicine to treat conditions such as heart, bladder, and intestinal disorders, rheumatism, jaundice, ulcers, gastritis, hemorrhoids, and constipation (Baytop, 1984). Its flowering branches are consumed in decoction form, while its fruits are used in infusions for stomach disorders (Kültür et al., 2018). In Turkey, it has been reported to be sold in markets for the treatment of eye diseases (styes) (Kocabaş et al., 2016). Recent studies have revealed that *H. scabrum* exhibits anti-inflammatory,

antioxidant, antifungal, and antidepressant effects, highlighting its potential for medicinal use (Abdollahi et al., 2012; Eslamı et al., 2011; Heshmati et al., 2018; Nalkıran Ergin et al., 2022; Şeker Karatoprak et al., 2019).
Industrial facilities are major sources of environmental pollution. As a result of production processes, heavy metals are released into the environment, with elements such as Pb, Ni, and Zn mixing into the atmosphere and soil, leading to severe environmental contamination. The accumulation of heavy metals in the soil can have toxic effects on organisms in the soil ecosystem, posing a threat to human health through the food chain. Heavy metal concentrations in soil typically range from 1 to 100,000 mg/kg, and when present at high levels, they disrupt the biological balance of the soil ecosystem, leading to reduced agricultural productivity and damage to ecosystems (Hayta & Avcil, 2019).

Previous studies have suggested that certain *Hypericum* species may exhibit potential accumulator properties with respect to heavy metal accumulation (Ayan et al., 2010; Colak et al., 2020). In one study, the heavy metal contents of soil samples around the Bitlis Solid Waste Integrated Disposal Facility were analyzed, revealing a high accumulation of metals, particularly Zn, Pb, Fe, and Cu. As a result, it was indicated that *H. scabrum* could potentially act as an accumulator for specific heavy metals (Hayta & Avcil, 2019). However, further research is needed to understand the tolerance mechanisms of this species to heavy metals and to determine whether it qualifies as a hyperaccumulator. This study aims to evaluate the elemental content of *H. scabrum* by analysing the concentrations of various elements in plants collected from an area near a cement factory and in soil samples taken from the same area.

Materials and Methods

Plant and soil samples were collected from Kükürtlü Village (Aşkale, Erzurum) (Table 1, Figure 1).

Table 1. Locality Information of Collected Plant and Soil Samples

Locality	Altitude	Coordinate
Kükürtlü Village, Aşkale, Erzurum	2006 m	39º51'34"N-40º36'11"E

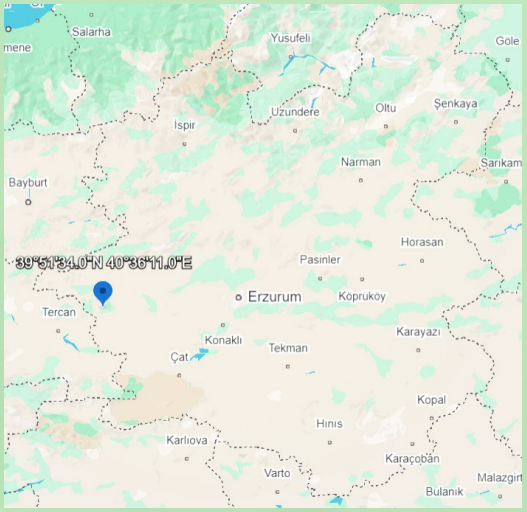

Figure 1. Location of the Plant and Soil Sample Collection Area (Google Earth)

The plant samples were carefully placed in polyethylene bags for preservation. Additionally, soil samples were also collected from the areas where the plants were gathered (Figure 1). To prevent microbial degradation of the plant material and to establish a fixed reference value based on dry weight, all samples were dried in an oven at 80 °C for 24 hours. To ensure the homogeneous distribution of metal content in the samples, plant samples were ground using a micro mill and passed through sieves of specific sizes to prepare them for analysis. The soil samples were collected using a stainless steel auger, air-dried, and then sieved through a 2 mm mesh. The homogenized soil samples were placed in transparent paper bags for preservation during the analysis process. Heavy metal analyses were carried out according to the method described by Aksoy et al. (2005), and the measurements were performed using a Varian Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). The accuracy and measurement stability of the device were evaluated by controlling internal standard contamination during digestion and analytical procedures for each sample.
Data for various parameters were subjected to one-way analysis of variance (ANOVA) using SPSS version 22.

Results and Discussion

In this study, the element contents of *H. scabrum* collected from Kükürtlü Village (Aşkale, Erzurum) and the soil samples from the same site were analyzed. The obtained results are presented in Table 2.

Table 2. Detected Element Concentrations in Plant and Soil Samples

Elements	Plant (mg/kg)	Soil (mg/kg)
Ca	4123.2 (±201.53)	72200 (±2633.27)
Cu	4.05 (±0.09)	36,248 (±31.94)
Fe	18.22 (±4.14)	126448.5 (±45497.37)
K	9725.05 (±13.47)	5253.15 (±96.95)
Mg	725.04 (±208.95)	21710.5 (±5974.345)
Mn	7.27 (±0.07)	3749.25 (±137.67)
Na	94.70 (±48.81)	3299.4 (±82.73)
Ni	1.14 (±0.05)	156.70 (±82.73)
Pb	4.10 (±4.16)	203.02
Zn	20.99	362.47

Element Concentrations in *Hypericum scabrum* and Soil

The analyses revealed that the elements found at the highest concentrations in *H. scabrum* were potassium (K: 9725.05 mg/kg), calcium (Ca: 4123.2 mg/kg), and magnesium (Mg: 725.04 mg/kg). In contrast, soil samples showed the highest levels of Ca (72,200 mg/kg), iron (Fe: 126,448.5 mg/kg), and Mg (14,761.13 mg/kg). These findings offer important insights into the uptake and bioavailability of elements from soil to plant tissues.

When comparing *H. scabrum* and soil samples, it was observed that K was present at a higher concentration in the plant (9725.05 mg/kg) than in the soil (5253.15 mg/kg). Although K is a macronutrient and not classified as a heavy metal, this suggests that *H. scabrum* has a strong ability to absorb K, which may contribute to nutrient cycling within the ecosystem. In contrast, the accumulation of other elements such as Ca, Cu, Fe, Mg, Mn, Na, Ni, Pb, and Zn in the plant was relatively limited.

Accumulation of Potentially Toxic Elements

From an environmental perspective, the plant samples contained low levels of potentially toxic metals such as Cu (4.05 mg/kg), Pb (4.10 mg/kg), and Ni (1.14 mg/kg). However, the soil samples showed relatively high concentrations of Pb (203.02 mg/kg) and Ni (156.70 mg/kg), suggesting that these elements have accumulated in the area.

These results point to the limited ability of *H. scabrum* to uptake and store potentially hazardous metals, despite their elevated presence in the soil.

Hyperaccumulation Potential of *Hypericum scabrum*

Hyperaccumulator plants are defined by their ability to accumulate certain heavy metals in their tissues at 10–100 times the concentration found in the surrounding soil. According to the literature, threshold values for hyperaccumulation vary by metal. For example, Cu, Ni, and Pb must exceed 1,000 mg/kg to qualify as hyperaccumulators (Farooqi et al., 2022), while Zn and Mn require levels above 10,000 mg/kg.

The low accumulation levels of Cu, Ni, Pb, Zn, and Mn in *H. scabrum* indicate that it does not meet the criteria to be classified as a hyperaccumulator for these elements.

Ecological Implications and Future Research

Despite its limited uptake of heavy metals, *H. scabrum* showed a notably high uptake of potassium (K), an essential macronutrient. Although K is not considered a heavy metal, its elevated concentration in plant tissue compared to soil suggests that *H. scabrum* may play a role in nutrient cycling and ecosystem function.

Overall, the findings of this study suggest that *H. scabrum* absorbs certain elements in limited amounts and cannot be considered a hyperaccumulator. Further research is recommended to better understand its elemental uptake mechanisms, evaluate its potential role in environmental monitoring or phytoremediation, and examine its responses under varying ecological conditions.

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