Black Sea Journal of Engineering and Science
doi: 10.34248/bsengineering.1600119

Open Access Journal
e-ISSN: 2619 – 8991

Research Article
Volume 8 - Issue 2: 462-465 / March 2025

DETERMINATION OF ELEMENTAL CONTENT OF *Allium pervariensis* PLANT USING ICP-OES (INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROSCOPY) METHOD

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Abstract: In this study, the elemental composition of the endemic *Allium pervariensis* plant was determined using the ICP-OES method. The analysis revealed that calcium (Ca) and potassium (K) had the highest concentrations, with Ca at 6.2278±0.547 ppm and K at 5.5283±0.482 ppm. Additionally, sodium (Na) was measured at 1.0325±0.061 ppm. Furthermore, silver (Ag), arsenic (As), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), manganese (Mn), nickel (Ni), selenium (Se), silicon (Si), strontium (Sr), and vanadium (V) were also analyzed. These findings suggest that *A. pervariensis* is nutritionally rich and may offer potential health benefits. However, as the study is limited to samples from a specific geographical region, caution is needed when generalizing the results. Further comprehensive biochemical and clinical studies are recommended.

Keywords: *Allium pervariensis*, Calcium, Elemental analysis, ICP-OES, Potassium

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Received: December 11, 2024
Accepted: February 14, 2025
Published: March 15, 2025

Cite as: Yolbaş İ. 2025. Determination of elemental content of *Allium pervariensis* plant using ICP-OES (Inductively coupled plasma optical emission spectroscopy) method. BSJ Eng Sci, 8(2): 462-465.

1. Introduction

Ethnobotanical knowledge plays a critical role in preserving traditional cultures, maintaining biodiversity, and contributing to public health and drug development (Khan et al., 2011; Saraçoğlu, 2024; Uslu, 2024; Yolbaş, 2024a, 2024c, 2024d). *Allium pervariensis* is an endemic plant species identified in the Southeastern Anatolia region of Türkiye, particularly in Siirt province (Fırat et al., 2018). It has close relatives such as *A. pustulosum* Boiss. & Hausskn and *A. karyeteini* Post, although it exhibits morphological differences.

Türkiye has a rich diversity of Allium species, attracting global attention. Of approximately 750 Allium species, about 170 are endemic to Türkiye (Rice-Evans et al., 1997). Allium species have been widely used in culinary and medicinal applications (Altunkanat and Tasan, 2023), playing a significant role in health and nutrition (Gürel, 2014).

Minerals are essential inorganic substances that support various biological functions. Their deficiency or excess can negatively impact physiological processes (Soetan et al., 2010). Determining the elemental content in plants is therefore crucial for understanding both plant physiology and human health (Yolbaş, 2024b).

This study aimed to determine the elemental composition of *A. pervariensis* and provide a comprehensive understanding of its biological properties and medicinal potential. For this purpose, ICP-OES was used for detailed elemental analysis.

ICP-OES is widely employed for trace element analysis, allowing simultaneous determination of multiple elements with high accuracy using small sample volumes (Donati et al., 2017; Diğdem and Arslan, 2019).

Trace elements, typically found in low concentrations, play essential roles in biological systems (Narin, 2002). Their determination is critical for plant health and human nutrition (Baytak, 2003). The findings of this study will enhance knowledge of *A. pervariensis*'s elemental composition and potential medicinal uses, inspiring future research.

This study represents the first elemental analysis of *A. pervariensis*. The use of ICP-OES enabled precise identification of its elemental content, providing a valuable reference for future studies.

2. Materials an Methods

2.1. Sample Collection

The *A. pervariensis* plant, naturally growing and commonly used by the local population for cheese-making, was collected in mid-April 2024 from Pervari, Siirt. The above-ground parts were dried in a dark room at 24°C for 30 days, then ground into a fine powder. The powdered plant was stored in a desiccator at the same temperature until analysis.

2.2. Elemental Analysis

2.2.1. Sample preparation

For the analyses to be performed using ICP-OES, *A. pervariensis* plant samples (each 1 g) were first ground into a fine powder. Each sample was then placed in separate Teflon vessels (CEM brand MARS 6 One Touch microwave oven, Matthews, NC, USA). A 10 mL portion of 65% concentrated nitric acid solution (Merck, Darmstadt, Germany) was added to the samples, and a blank sample containing only 10 mL of 65% nitric acid was also prepared. The vessels were sealed and placed in a microwave oven for digestion. The temperature was increased from room temperature (22-24°C) to 210°C over 25 minutes and was held at this temperature for 15 minutes. After cooling the samples to 22-24°C, they were transferred to volumetric flasks (50 mL), and ultrapure water was added to obtain the final volume.

2.2.2. ICP-OES analysis

The elements analyzed in the serum samples were as follows: Copper (Cu), Silver (Ag), Arsenic (As), Calcium (Ca), Cobalt (Co), Chromium (Cr), Iron (Fe), Potassium (K), Manganese (Mn), Sodium (Na), Nickel (Ni), Selenium (Se), Silicon (Si), Strontium (Sr), and Vanadium (V). The levels of these elements were determined using the Thermo iCAP 6000 series (ICP-OES) instrument parameters provided in table 1. Each element was measured using the appropriate wavelengths specified in table 2.

Table 1. ICP-OES device parameters

Parameters	Determined values
Plasma gas flow rate	15 L/min
Argon flow rate	0.5 L/min
Sample flow rate	1.51 L/min
Peristaltic pump speed	100 rpm
RF Power	1150 W

Table 2. ICP-OES elemental wavelengths

Element	Wavelength (nm)
Copper (Cu)	324.754
Silver (Ag)	328.068
Arsenic (As)	189.042
Calcium (Ca)	393.366
Cobalt (Co)	228.616
Chromium (Cr)	283.563
Iron (Fe)	259.940
Potassium (K)	766.490
Manganese (Mn)	257.610
Sodium (Na)	588.995
Nickel (Ni)	221.647
Selenium (Se)	196.090
Silicon (Si)	251.611
Strontium (Sr)	407.771
Vanadium (V)	309.311

Each element to be measured was prepared by creating working standard solutions from standard stock solutions (1000 µg/dL) (Chem-Lab NV). Calibration curves for each element were plotted and evaluated using these standard solutions and deionized water as the blank solution before conducting the measurements. The concentrations of the elements in the serum samples, prepared in this way for measurement, were determined using the ICP-OES device by referring to these standard curves.

2.3. Statistical Analysis

The statistical comparison of the results was performed using descriptive analysis. The data are presented as means and standard deviations (X±SD). All analyses were conducted using SPSS (v23.0).

3. Results and Discussion

In this study, the mineral content of *A. pervariensis* was analyzed using ICP-OES, table 3. The results indicate a significant mineral richness, with calcium (Ca) and potassium (K) detected at the highest concentrations. Calcium was the most abundant element at 6.2278±0.547 ppm, followed by potassium at 5.5283±0.482 ppm. Sodium (Na) ranked third at 1.0325±0.061 ppm. In contrast, cobalt (Co), nickel (Ni), vanadium (V), and arsenic (As) were present at the lowest levels, measuring 0.0035±0.011 ppm, 0.0078±0.012 ppm, 0.0079±0.014 ppm, and 0.0106±0.012 ppm, respectively. These findings suggest that calcium and potassium dominate the mineral composition, while trace elements are present in minimal amounts.

The results highlight the potential health contributions of *A. pervariensis*. Calcium plays a critical role in muscle and nerve function, hemostasis, and intracellular signaling (Duyff, 2006). Given its importance for bone health, this plant may help reduce the risk of osteoporosis. Potassium, essential for lowering hypertension and regulating heart rhythm, suggests potential cardiovascular benefits (Ekinci et al., 2004). Sodium is vital for energy production and intercellular transport, but excessive intake increases the risk of hypertension and cardiovascular disease. Therefore, controlled consumption of *A. pervariensis* is advisable.

Iron (Fe) deficiency, a global health issue, leads to anemia (Vandecasteele and Block, 1997). The low iron level in *A. pervariensis* (0.1158±0.087 ppm) suggests it is not a significant iron source. However, the presences of other essential trace elements, such as copper (Cu), enhances its nutritional value. Copper is crucial for human health, and its deficiency can cause various disorders (Yaşar et al., 2016).

Selenium (Se) was detected at low levels, indicating safe consumption without an increased risk of cardiomyopathy (Vandecasteele and Block, 1997). However, given selenium's role in cardiovascular health, further research is needed. Similarly, the low cobalt (Co) levels suggest limited health effects. While cobalt is essential in small amounts, excessive intake can be toxic, underscoring the importance of evaluating *A. pervariensis*'s trace element content.

Allium species have been historically used to treat various diseases. The Ebers Papyrus from ancient Egypt mentions their benefits for heart conditions, tumors, and infections (Rahman, 2001). Modern studies confirm that *Allium sativum* (garlic) lowers blood pressure, enhances fibrinolysis, and inhibits platelet aggregation. Given these findings, *A. pervariensis* may exhibit similar pharmacological effects. The anti-atherosclerotic properties of *A. sativum* suggest not only disease prevention but also therapeutic potential (Koscielny et al., 1999). Additionally, *Allium* species possess antidiabetic, antibiotic, hypocholesterolemic, and antimicrobial properties (Augusti, 1996), which may extend to *A. pervariensis*.

Despite the significance of these findings, some limitations should be noted. First, mineral analysis was conducted solely using ICP-OES, preventing comparison with other techniques. Second, samples were collected from a single geographic location, limiting the generalizability of the results. Environmental factors such as soil composition and climate variations can influence mineral content, necessitating broader studies across different regions and seasons.

Furthermore, the bioavailability of *A. pervariensis*—the extent to which its minerals can be absorbed and utilized by the human body—remains unexplored. Investigating bioavailability could clarify its nutritional and pharmacological value. Future studies should assess its mineral composition in diverse populations and conditions, along with toxicological and pharmacokinetic evaluations. Such research could uncover the full potential of *A. pervariensis* in both traditional and modern medicine.

Table 3. Elemental analysis results of *A. pervariensis* plant

Element	Value (X±SD) ppm
Silver (Ag)	0.0297±0.016
Arsenic (As)	0.0106±0.012
Calcium (Ca)	6.2278±0.547
Cobalt (Co)	0.0035±0.011
Chromium (Cr)	0.0111±0.011
Copper (Cu)	0.0157±0.012
Iron (Fe)	0.1158±0.087
Potassium (K)	5.5283±0.482
Manganese (Mn)	0.0155±0.016
Sodium (Na)	1.0325±0.061
Nickel (Ni)	0.0078±0.012
Selenium (Se)	0.0121±0.013
Silicon (Si)	0.2126±0.054
Strontium (Sr)	0.0304±0.014
Vanadium (V)	0.0079±0.014

X= mean, SD= standart devition

4. Conclusion

The ICP-OES analysis results indicate that *A. pervariensis* is nutritionally rich, with the highest concentrations of calcium (Ca) and potassium (K), measured at 6.2278±0.547 ppm and 5.5283±0.482 ppm, respectively. Sodium (Na) was also detected at 1.0325±0.061 ppm, along with other elements such as silver (Ag), arsenic (As), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), manganese (Mn), nickel (Ni), selenium (Se), silicon (Si), strontium (Sr), and vanadium (V). These findings suggest that *A. pervariensis* may have nutritional and potential health benefits. However, as the study is limited to samples from a specific geographical region, caution is needed when generalizing the results. Further comprehensive biochemical, toxicological, and clinical studies involving samples from different regions are necessary to better understand the nutritional and medicinal potential of *A. pervariensis*.

Author Contributions

The percentages of the author' contributions are presented below. The author reviewed and approved the final version of the manuscript.

	İ.Y.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

Acknowledgments

I would like to thank Mr. Mustafa Yavuz for his contributions and support during the plant identification and collection process.

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