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Research Article

SOME ELEMENT CONTENTS SCREENING OF ECONOMICALLY IMPORTANT ENDEMIC *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee (Lamiaceae)

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ABSTRACT. Atomic absorption spectrometry and spectrophotometry facilitates the reliable determination of mineral content during pharmaceutical quality control of medicinal plants. In this study, measurable amounts of Fe, Ca, Cu, K, Mg, Na and Zn were detected through flame atomic absorption spectrometry, B was detected by spectrophotometry in *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee. Mean element contents in the herba of *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee was, in descending order, Ca>Mg>K>Fe>Na>Zn>Cu. Ca was present in the highest concentrations (8725.42 ppm) while Cu was present in the lowest concentrations (13.15 ppm) of titled plant. Boron concentration of *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee was determined as 6 mg kg^{-1} dry wt (ppm.).

Keywords: *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee, *Fe, Ca, Cu, K, Mg, Na, Zn, B, flame atomic absorption spectrometry*

INTRODUCTION

The environment in developing countries, pollution in irrigation water, atmosphere, soil, sterilization methods and storage conditions all play an important role in the contamination of medicinal plants by metals. Metals may contaminate a variety of plants causing onsuing serious health hazards such as kidney damage, renal failure and liver damage [1, 2, 3]. Iron, zinc, calcium, magnesium, copper, potassium, manganese, sodium were chosen as representative metals whose levels in the environment represent a reliable index of environmental pollution and human health. Some plants can then be used as biomonitors for the determination of trace element levels [4].

The genus *Stachys* L. is one of the largest genera of the Lamiaceae. This genus consist of more than 270 species in the world, and is also presented as 101 taxa in Turkey. *Stachys* species are found in mild regions of the Mediterranean and in south-west Asia. Of the 101 *Stachys* species reported in the Flora of Turkey, 72 are described, and of these 29 are endemic. The level of endemism of this type is 43.4 % (33/76), while the level of endemic

subspecies is 36.7 % (11/30), and the number of varieties 40 % (6/15) [5]. The rate of endemism for the *Stachys* genus is 40 % [6].

The genus *Stachys* is known in Anatolia as Adacayi and Dag çayı, and used as sage and in popular medicines to treat genital tumours, sclerosis of the spleen, inflammatory tumours, coughs and ulcers. Teas prepared from the whole plant or leaves are used in phytotherapy, possessing sedative, antispasmodic, diuretic and emmenagogue activities [7, 8]. In addition, extracts or components of *Stachys* species exert various pharmacological effects: anti-inflammatory [9, 10], antimicrobial [11], antibacterial [12], anxiolitik [13, 14] and antioxidant [15, 16, 17, 18]. This plant's abundant yield from nature and its resulting high crop, as well as the lack of any dangerous effects has brought about comparison [6].

Boron is a plant nutrient for which there is usually a small window between deficiency and toxicity [19]. Boron (B) is an essential nutrient for normal growth of higher plants, and B availability in soil and irrigation water is an important determinant of agricultural production [20]. The optimum quantity for one species could be either toxic or insufficient for another species [21]. Boron requirements vary among species from 5 to 15 mg kg^{-1} dry wt (ppm.) [22]. Boron is absorbed by plants from the soil solution as undissociated boric acid [23].

Data available on the biological activity of *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee is also many previous reports that have demonstrated their anti-inflammatory, antimicrobial, antibacterial and antioxidant activities [9, 10, 11, 12, 13, 14, 15, 16, 17, 18]. To the best of our knowledge, there is no previous study indicating their some element contents. Hence, the primary aim of this study was to investigate the contents of some element contents of the extracts of *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee to determine through atomic absorption spectrometry and spectrophotometry.

MATERIALS AND METHODS

The species *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee, was collected from Geyve (Adapazarı) and its environs for this study. OUFE 12913, O. Koyuncu, A3 Sakarya: Geyve, Maksudiye Village, road sides, 21.07.2004, N:40°35'45.0"-E 030°22'54.5", 460 m. The plant was identified according to Flora of Turkey and the East Aegan Islands [5].

For the solid samples with a nitric acid (Merck, Darmstadt, Germany) – perchloric acid (Merck, Darmstadt, Germany) digestion was used for mineralizing. The samples were extracted for the solution phase as described previously (Que Hee and Boyle 1988) and analyzed for Fe, Zn, Ca, Mg, Cu, K, Na (Merck AAS standard solutions), using Hitachi (180-70) Polorized Zeeman flame atomic absorption spectrometry [24]. All precautions were taken to prevent metal contamination, i.e. samples were cleaned with 2% HNO_3, rinsed in distilled water and baked at 600°C. All samples were analyzed in triplicate and the mean values were calculated. In order to increase the reliability of the measurements during the study, the instrument was calibrated at every 10 readings.

The flame atomic absorption spectrometry (FAAS) instrumental and operating conditions that provided the best sensitivity for the determination of metal content are detailed in Table 1.

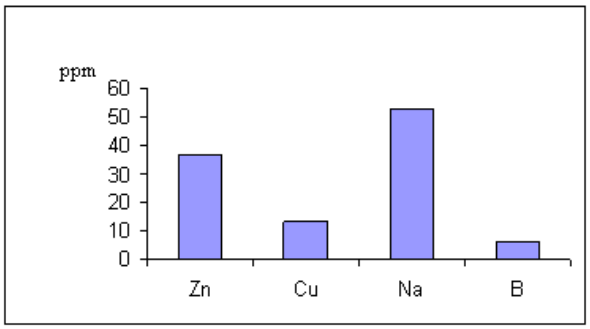
Table 1. *FAAS instrumental parameters employed to determine metals*

Elements	Flame type	Burner height (mm)	Wavelength (nm)	Slit width (nm)	Lamp Current (mA)	Fuel gas (1 min^{-1})
Fe	Air-C_2H_2	7.5	248.3	0.2	10	2.3
Zn	Air-C_2H_2	7.5	213.8	1.3	10	2.0
Ca	Air-C_2H_2	12.5	422.7	2.6	7.5	2.6
Mg	Air-C_2H_2	7.5	285.2	2.6	7.5	1.6
Cu	Air-C_2H_2	7.5	324.8	1.3	7.5	2.3
K	Air-C_2H_2	7.5	766.5	2.6	10	2.3
Na	Air-C_2H_2	7.5	589.0	0.4	10	2.2

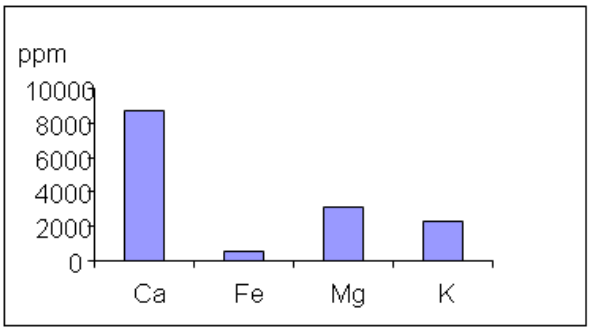
To measure B concentration, the curcumin method was used, and absorbance was read by spectrophotometry (Jasco V-530 UV/VIS) at 540 nm [25].

RESULTS AND DISCUSSION

In this study, some element contents of *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee was investigated. These levels were obtained through flame atomic absorption spectrometry. Metal concentrations of *Stachys iberica* were found to be 582.82, 8725.42, 13.15, 2271.13, 3078.38, 52.64, 36.90 and 6.00 ppm; for iron, calcium, copper, potassium, magnesium, sodium, zinc, boron respectively (Table 2, Fig. 1). Mean element contents in the herba of *Stachys iberica* Bieb. subsp. *iberica* var. *densipilosa* Bhattacharjee was, in descending order, Ca>Mg>K>Fe>Na>Zn>Cu>B. Ca was present in the highest concentrations (8725.42ppm) while boron was present in the lowest concentrations (6.00 ppm) of titled plant. (Fig. 1, Table 2).



A



B

Fig. 1. *A-B. Relationships element concentrations of Stachys iberica Bieb.* subsp. *iberica* var. *densipilosa* Bhattacharjee

Table 2. *Element concentrations of Stachys iberica (ppm)*

Elements	*Stachys iberica*
Fe	36,9 ± 0,10
Cu	13,15 ± 8,13
Ca	8725,42 ± 2,19
K	582,82 ± 1,18
Mg	3078,38 ± 2,75
Na	52,64 ± 0,12
Zn	2271,13 ± 3,29
B	6±0.04

Vrbnıčanın et al. investigated Zn, Cu concentrations in 9 plant species. They found concentrations as 11.50-44.99,4.50-13.99 ppm, respectively. This study is show close relationship with our study. Cu concentrations was show paralellness, but Zn concentrations was higher than that study [26].

Moreno-Jiménez et al. works metal concentrations in shoots of plants growing in the areas surrounding the Mónica mine (Madrid, Spain). They determined as Cu 6.42-23.5, Zn 59.15-581.1, Fe 39.5-422.1 in the present Works. While this study was compared with us; Cu was same, Fe was higher than us, Zn was lower than us. The metal levels observed in the soils, streams and plants reflect the potential risk still remaining due to the past mining activities at this site. A description of the flora growing in this area is reported. Many of these plants survive in contact with relatively high levels of heavy metals in the soils. Among them, *S. atrocinerea* and *D. thapsi* have not been, to the best of our knowledge, previously reported as Cdor Zn-accumulators. *S. atrocinerea* stands out as a good candidate for Cd- and Zn-phytoextraction [27].

Elemental studies of the plants revealed that they contained large amounts of nutrients and were rich in Mg, Ca, Na and K [3]. The results above indicated that the herbal plants contain large amounts of nutrients and are rich in Mg, Ca and K. The abundance of K, Mg and Ca, demonstrated as a result of this analysis, was in agreement with previous findings that these three metals represent the most abundant metal constituents of many plants. Variations in the metal concentration of plants from different sites are related to their condition. These differences might be due to growth conditions, genetic factors, geographical variations and analytical procedures in the locale from which the samples are collected. Though much is known about the functional role of a number of elements, the best foreseeable benefit for human health, mineral nutrition, lies in obtaining the correct amount of supplementation in the right form at the right time. Deficiency or excess of Cu, Zn, Ca, Mg and K may cause a number of disorders [3]. These elements also play a part in neurochemical transmission, as well as serving as constituents of biological molecules, as a cofactor for various enzymes, and in a variety of different metabolic processes.

High amounts of Ca are expected one way or another, as it is one of the most common minerals of the soil, from where it is readily absorbed into the plants. Iron is an important element for the human body and plays a role in oxygen and electron transfer, as well as being essential for the formation of hemoglobin. Copper and Zinc are required in our diet because they exhibit a wide range of biological functions, such as being components of the enzymatic and redox systems [4]. The results also show that many of these plants contain elements of vital importance to man’s metabolism, and that they are also needed for growth and development, as well as in the prevention and healing of diseases.

Ražić et al. work, micro and macro elements (Cu, Zn, Mn, Fe, Ni, Cd, Pb, Cr, K, Ca and Mg) were determined in herbal drugs, indicated that the Fe, Ca, Cu, K, Mg, Zn respectively 121.1, 9607, 11.05, 5325, 5371, 31.4 ppm concentration in herbal drugs. This situation shows that the Zn concentration of the *Stachys iberica* is higher than that study but K, Fe, Mg concentrations was higher than our study, Ca showed paralellness [28]. Metallic elements are constituent plant compounds demonstrating biological activity as essential or toxic agents in metabolism. Thus, the application of metal monitoring as a pattern recognition method in medicinal herbs is a promising tool for their characterization [28].

Essential elements are important for plant growth, life cycle and as a part of the food chain, while toxic ones have no direct benefit and significant physiological role for plants documented in the literature till nowadays Nevertheless, heavy metals may contaminate different plants causing serious health hazard with symptoms of toxicity, renal failure, liver damage etc. Additional arguments that justify conducted research are the existence of very narrow concentration ranges between the deficiency and toxicity for the human body [28].

Plants vary in their Boron requirment, but the range between deficient and toxic soil solution concentration of Boron is smaller than for any other nutrient [29]. The Boron content of central Anatolian soils in Turkey varies between 0.86 and 4.86 mM. per kg, one of the largest global producers of boron [30]. These results are parallelness with our study. Boron concentration was determined for our taxon as 6 mg kg^{-1} dry wt (ppm.).

CONCLUSION

The classification of biological species in relation to their chemical composition, which of course includes metal species, is also important in the area of chemotaxonomy. Heavy metal levels are important pollutants for soil, water, plant, the environment and human health. Some species can be used as biomonitors in the determination of trace heavy metal levels.

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