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HEAVY METALS CONTENT IN SOME MEDICINAL AND AROMATIC WILD GROWING PLANTS FROM THE FRUSHKA GORA MOUNTAIN

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ABSTRACT

Investigation showed that soils of selected localities in the Frushka Gora mountain may be considered as non-contaminated whit HM and plants were well-supplied with the essential microelements. Results suggest that examined plant species may be considered as non-toxic and easy accessible natural source of essential microelements, especially Fe, Mn and Zn. Results obtained also confirmed the justification of the use of A. calamus and T. montanus as herbal remedies and for the industrial purposes. Beside organic compounds with biological activity, wild growing plants from the Frushka Gora mountain are also rich in essential microelements and, contrary to some other medicinal plants, they have low toxic HM accumulation ability.

KEYWORDS

heavy metals, frushka gora mountain, medicinal and aromatic wild growing plants

1. INTRODUCTION

Frushka Gora mountain lies on the southern margin of the Pannonian Plain, in Voyvodina province (Serbia), and it represents the transition from mountain to low-land conditions. It extends to an approximative length of 80 km while the average elevation ranges from 300 to 400 m (highest point 539 m). The soils of Frushka Gora were formed mostly on metamorphic rocks and they can be classified into three groups, namely Chernozem with its varieties, Brown forest soils and Brown calcareous soils. Owing to a great diversity of geological, pedologic and climatic conditions, the flora of this region is characterized by a large number of plant species. About 1,500 plant species belonging to different

flora elements and various families have been recorded [1]. For this study, we have chosen three species with medicinal and aromatic properties, benefitial to man: *Acorus calamus* L., *Thymus montanus* L. and *Salvia verticillata* L.

Rhizome of *A. calamus* (*Araceae*) is used a great deal in the making of alcoholic drinks and in perfumery to give a bitter tang to the former and those special nuances to the perfumes; it is also used in toothpaste. The essence, which contains asarone, has tranquillizing action. It showes bitter eupeptic, antithermic and emmenagogic properties [2]. The flowering tops of *T. montanus* (*Lamiaceae*) contain also essential oil which has antiseptic, antispasmodic, carminative, diuretic and expectorant properties. They are widely used both in kitchen as spice, and in the liqour-distilling and perfume industry. The tincture can be used externally as a disinfectant and dried leaves are used as an ingredient of many aromatic infusions [2]. *S. verticillata* (*Lamiaceae*) is the member of the *Salvia* genus which is well known for its medicinal use. Investigations on cultivated and wild growing *Salvia* representatives demonstrate that their antimicrobial activity is not only attributable to essential oils, but also to non-volatile substances. Many members of this genus act as an antiphlogistic, stomachic, antiseptic, antiasthmatic, carminative, antihydrotic, adstrigentia *etc* [3].

Investigation of wild growing plants from the aspect of health safety also requires the determination of presence and concentration of heavy metals (HM) in plant herba. Considering the increased industrial pollution, these investigations are of special importance since it is known that some medicinal plants, such as *Hypericum perforatum*, *Sambucus nigra* and *Achillea milefollium*, could be characterized as HM accumulators [4]. Therefore, in order to evaluate examined plant material from the point of health safety, we determined its mineral composition with special regard to HM content. The concentrations of Pb, Cd, Ni, Cu, Fe, Mn, Co and Zn were determined by AAS, and expressed in ppm in dry matter.

2. MATERIAL AND METHODS

Plant material was collected during full blossoming, from different areas of the Fruška Gora mountain. *A. calamus* is an aquatic plant and grows mainly in the foothills of the mountain, along the river Danube in still or slowly flowing waters. *T. montanus* and *S. verticillata* grow on meadows, on meadow dark type of soil.

3. RESULTS AND DISCUSSION

Results obtained for the mineral content in leaves of *T. montanus* and *S. verticillata*, and rhizome of *A. calamus* are presented in Table 1.

The Pb content was very low and it did not exceed the maximum permissible concentration in any of plants investigated. An average content of lead (Pb) in plant species is 5-10 ppm while the toxic is more then 30 ppm [5]. Compared to our results, in some other wild growing

plants from Serbia, higher, and even toxic Pb content has been established (12-69 ppm) [4, 6]. Cadmium (Cd) is toxic element for plants in higher concentrations, due to its high affinity to –SH groups of enzymes and proteins. High Cd content in plants completely inhibits Fe metabolism causing chlorosis, and thus, affecting photosynthesis. Also, it can inhibit respiration, electron transport and transpiration [4]. An average, and toxic Cd concentrations in plant leaves are 0.05-0.2 ppm, and 3-30 ppm, respectivelly. In our specimen from the Frushka Gora mountain, Cd content ranged from traces to 0.72 ppm, which is bellow toxic level. Recently, there are growing evidence that low concentrations of nickel (Ni) are benefitial to plant growth and development, respiration intensity and photosynthesis, as well as for antioxidant enzymes activity [5].

TABLE 1. - MICROELEMENT CONTENT OF *T. MONTANUS*, *S. VERTICILLATA* AND *A. CALAMUS* (ppm in d.m.)

Element:	*A. calamus*	*T. montanus*	*S. verticillata*
Pb	*	2.32	*
Cd	0.72	*	*
Ni	2.23	3.98	8.68
Fe	159.63	1384.86	219.50
Cu	11.65	13.54	10.86
Zn	92.06	33.00	33.00
Mn	32.48	78.15	181.16
Co	*	*	*

* = below detection limit

An average content of Ni is 0.1-5.0 ppm, while toxic is from 10 to 100 ppm. Highest content of this HM was recorded in *S. verticillata* which is in agreement with the results of other authors obtained for different *Salvia* species [3, 6]. Copper (Cu) is an essential microelement for plants. Average content of Cu in dry plant material is 2-20 ppm [7].

In our specimen Cu concentrations ranged from 10.86 to 13.50 ppm. Zinc (Zn) concentration in plants may vary between 30-150 ppm, usually it is 20-50 ppm. All examined specimen were well-supplied with Zn. Its content ranged from 33.00-92.13 ppm, being highest in *A. calamus* rhizome. The role of iron (Fe) in plant metabolism is essential. It is involved in chlorophyll biosynthesis, photosynthesis, respiration, nitrogen fixation, nitrate and nitrite reduction *etc*. [8]. Usually, Fe concentration in dry plant material may reach up to 1000 ppm, or more. In investigated plant material Fe contents were from 159.63 to 1384.86 ppm.

In some other *Lamiaceae* representatives from Serbia and Montenegro, Fe content ranged from 26.66 up to 2000 ppm [6, 9].

According to these results it seems that both soils and plants in the investigated areas are well-supplied in this essential microelement. The most significant role of manganese (Mn) in life processes is enzyme activation. As a cofactor it activates more then 35 different enzymes. In our specimen, Mn content was ranging from 32.48 to 181.16 ppm. Since

the critical threshold for Mn deficiency in plants is <10 ppm, it is obvious that investigated plants were sufficiently provided with Mn.

4. CONCLUSION

Investigation showed that soils of selected localities in the Frushka Gora mountain may be considered as non-contaminated whit HM and plants were well-supplied with the essential microelements. Results suggest that examined plant species may be considered as non-toxic and easy accessible natural source of essential microelements, especially Fe, Mn and Zn. Results obtained also confirmed the justification of the use of *A. calamus* and *T. montanus* as herbal remedies and for the industrial purposes. Beside organic compounds with biological activity, wild growing plants from the Frushka Gora mountain are also rich in essential microelements and, contrary to some other medicinal plants, they have low toxic HM accumulation ability.

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