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Short communication

Content of Fe and other selected elements in *Chenopodium album* L. and *Chenopodium borty s*L. (Amaranthaceae) from Macedonian flora

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Introduction

According to the World Health Organization, anaemia prevalence is up to 29% in women in reproductive age, and up to 39 %inchildren. Among all the cases, iron deficiency has been pointed out as ~~a~~ leading global health problem. Regarding literature data, some of the plant species can be consideredas natural source of Fe and could be of interest for production of herbal food supplements. Plants take up elements from the soil through their roots and from the air through their leaves. Fourteen of them are essential, and necessary for normal life cycle. Few of them have a building function and represent parts of plant enzymes. Plant nutrients belong to the group of primary macronutrients: N, P and K; secondary macronutrients: Ca, S and Mg or micronutrients/elements in traces: B, Cl, Mn, Fe, Zn, Cu, Mo and Ni (Bunt, 1989). Few elements have beneficial importance such as Si and Co. Besides, there are other trace elements whosebiological role is still insufficiently known (As, Br, F, Li, Se, Ti, V), as well as toxic elements (Pb, Cd, Cr, Al) that plants accumulate in different amounts, depending on environmental conditions (Barker and Pilbeam, 2006). The content of elements can vary a lot depending on many factors. Nevertheless, edible plants represent biological source of these elements for other living organisms including humans and provide one of the ways to prevent its deficiency.

Wild plants from genus *Chenopodium* play an important role in the diet of inhabitants in different parts of the world, providing minerals, fibres, vitamins, essential fatty acids, etc. (Pachauri et al., 2013). Macedonian species have not been an issue of chemical characterisation so far, with the exception of published results of an analysis of essential oil composition of *C. botrys* (Adji Andov et al., 2014). Therefore, the aim of this study was to determine the content of the selected macro- and microelements in the wild growing samples of*C.botrys* and *C. album,* collected from different localities in R. N. M. and their evaluation as novel sources of plant-based iron.

Materials and methods

Plant material

Plant material (25 specimens) consisting of aerial flowering part (*herba*) and dried roots (*radix*) of two *Chenopodium* species (*C. album* and *C.botrys*) were collected as indigenous plants from different localities in Republic of North Macedonia.

Mineralization of the plant material:

Plant samples (0.5 g) were placed in Teflondigestion vessels (OMNI/XP 1500). Then, 7 mL (69%, *m/v*) $HNO_3$and 2 mL H_2O_2 (30%, *m/v*) were added. The vessels

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were capped closed, and after 24 hours, were placed in the rotor of the Mars microwave digestion (CEM, USA).
The digestion was carried out on 180 °C in two steps, first 25 min and then additional 15 min.The digests were filtered throughfilter paper (Munktell, Sweden), quantitatively transferred to 25 mL calibrated flasks, diluted with demineralized water and analyzed for the selected metals.

Instrumentation

All analyzed elements (Ca, K, Mg, P, Na, Cu, Fe, Mn, Zn, Al, Sr,) were determined by the application of inductively coupled plasma atomic emission spectrometer (ICP-AES) (Varian, 715-ES) equipped with an ultrasonic nebulizer CETAC (ICP/U-5000AT+) for better sensitivity. All results were calculated on a dry weight basis (mg/kg DW). Each data represents the mean ± two standard deviations of three samples.

Results and discussion

In total, 11 elements (Ca, K, Mg, P, Na, Cu, Fe, Mn, Zn, Al, Sr) were determined in 25 specimens of aerial flowering parts (*herba*) and dried roots (*radix*) of *C. album* and *C.botrys* by the application of inductively coupled plasma atomic emission spectrometry (ICP-AES).

The content of microelements (Zn, Na, Fe, Mn and Cu) and two related elements (Al and Sr) in *C. album* and *C. botrysherba* ranged from 4.0 mg/kg for Cu to 965.6 mg/kg for Fe. The most abundant element in all investigated specimens of *herba* was Fe (33.3-965.6 mg/kg). The content of Sr was also high, from 13.2-44.1 mg/kg, while the content of Al was in much broader range, from 16.7-1609.0 mg/kg. The content of these elements in *C. album* and *C. botrys radix* were lower than in *herba*, ranging from 4.2 mg/kg for Cu to 566.5 mg/kg for Fe. Iron was dominant in *herbal extracts* of *C. botrys*, while for *C. album* higher amount of these element was determined in *radix*.

The content of seven investigated elements (Fe, Al, Na, Sr, Mn, Zn and Cu) was higher in samples of *C. bortys herba* from Kozuf, Strumica and Zletovo which were characterised by very large amounts of Fe. Large amounts of Fe, Al and Na were found in all investigated samples of *C. album radix* from Dojran, Krivolak and Stip. Finally, *radix* of *C. album* and the whole plant of *C. botrys* could be considered asa natural source of very important elements (Zn, Mn, Cu), especially Fe, but the safety of large content of Al in these plants should be further examined.

The obtained research results fromour study were in accordance with the few references considering mineral content of *C. album* and other related *Chenopodium* species. According to Guerrero et al. (1997) the contents of some elements (Na, K, Ca, Mg, P, Fe, Cu, Zn and Mn) in *C. album, C. murale* and *C. opulifolium* were higher than in other green leafy vegetables (Guerrero et al., 1997). Similarly, the literature data about mineral contents of *C. botrys* is very limited. Malayeri et al. (2008) found *C. botrys* to be very good bio-accumulator of heavy metals, especially for Fe, Mn, Zn and Cu as these elements can rich up to 4145 mg/kg, 175 mg/kg, 276 mg/kg and 56 mg/kg, respectively (Malayeri et al., 2008).

Conclusion

C. album and *C. botrys* from Macedonian flora are rich in K, Ca, Mg and P. *C. album herba* represents a good natural source of macro-elements compared to *C. botrys herba* which could be consideredas biological source of important microelements such as Cu, Zn, Mn, Na, Sr and especially Fe. Differences in the contents of macro- and microelements were evident, depending on the harvesting region, but much more on the biological characteristics of the plants as well as plant organs used in the analysis. Both species, especially *C. botrys* should be considered as a promising source of important elements, but further research is required for analyzing their safety, nutritive value and health benefits.

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