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RISK OF ENHANCED HEAVY METAL CONTENTS IN FRESH FABABEAN USED IN TRADITIONAL FOOD PREPARATION IN IRAQ

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Abstract: In this work the level of risk of enhanced heavy metal contents in young fababeans cultivated in model conditions of the pot trial after different Zn doses addition was evaluated. Four variants of the experiments A: control (without Zn addition), B: 40 mg $Zn.kg^{-1}$, C: 250 mg $Zn.kg^{-1}$, D: 500 mg $Zn.kg^{-1}$ of soil were realised. For the experiment two fababean cultivars Saturn and Zobor were used. Fababeans were harvested at milk ripeness. The flame AAS (AAS Varian AA Spectr DUO 240 FS/240Z/UltrAA) was used for the determination of heavy metal contents in soil and plant materials. The soil used in the pot trial was uncontaminated. Only determined Cd content was on the level of limit value given for the soil extract by *aqua regia* as well as Pb content on the level of critical value given for the relationship between soil and plant. Fababean Saturn acummulated in seeds in control variant high amounts of Ni, Pb and Cd (higher than maximal allowed amount given by the legislative). Fababean Zobor acummulated in seeds in control variant extremely high amounts of Ni, Pb and Cd (higher than those in Saturn by 9%, 44% and 250% respectively). Only in variant with Zn addition the Ni content was decreased, but still the value was higher than the hygienic limit. All determined Pb and Cd contents were extremely higher than maximal allowed amounts given by the Food Codex of the Slovak Republic. Our results confirmed the high ability of cultivar Zobor to acummulate large amounts of risky metals.
Key words: heavy metals, fababean, acummulation

INTRODUCTION

Faba bean is a good sourse of protein, oil, crude fiber, ditary fiber, starch, sugars, vitamins and minerals. Dry beans are widely known for their fiber, mineral and protein contents; however, its nutraceutical value is yet to gain as much attention in the prevention of chronic diseases **(Dinelli *et al.*, 2006)**. The protective effects of dry beans in disease prevention such as cancer may not be entirely associated to dietary fiber, but to phenolic and other non-nutritive compounds **(Oomah *et al.*, 2006)**. Faba bean is the best source of vegetable protein legumes **(Molina *et al.*, 2002).** Pulses have shown numerous health benefits, e.g. lower glycemic index for people with diabetes, increased satiation and cancer prevention as well as protection against cardiovascular diseases due to their dietary fiber content **(Chillo *et al.*, 2008)**. Fababeans are can be eaten while still young, enabling harvesting to begin as early as the middle of spring for plants started under glass or over wintered in a protected location. The young leaves of the plant can also be eaten either raw or cooked like spinach. Broad beans are eaten in a stew combined with artichokes, while they are still fresh in their pods. In Nepal, fava beans are called bakulla. They are eaten as a green vegetable when the pods are young, generally stir fried with garlic, in Iraq Faba Bean and tomatoes uses for preparing soup, or a popular snack eaten on boiled and roasted in oil with egg or onion.

The aim of the work was to evaluate the level of risk of enhanced heavy metal contents in young fababeans cultivated in model conditions of the pot trial after different Zn doses addition. Zinc was added to the soil to reduce the intake of other heavy metals especially of Cd as well as to increase the antioxidant activity of the legume.

MATERIAL AND METHODS

The experiment was realised as the pot trial in the vegetation cage of the Department of Chemistry of FBFS SUA in Nitra. In the pot trial the soil from the locality Čakajovce near of Nitra was used. In the soil the exchangeable reaction (pH/KCl), the contents of available nutrients (K, Mg, P) and mobile forms of Ca according Mehlich II., content of humus by Tjurin method and content of N were determined. Pseudototal content of risk metals including all of the forms besides residual metal fraction was assessed in solution of aqua regia and content of mobile forms of selected heavy metals in soil extract of NH_4NO_3 (c = 1 $mol.dm^{-3}$). Gained results were evaluated according Law 220/2004. For the experiment two fababean cultivars Saturn and Zobor were used. Four variants of the experiments were realised: A: control (without Zn addition), B: 40 mg $Zn.kg^{-1}$ of soil, C: 250 mg $Zn.kg^{-1}$ of soil, D: 500 mg $Zn.kg^{-1}$ of soil. Fababeans were harvested at milk ripeness. Risky element contents in young fresh fababean seeds were determined after mineralization by wet way using the atomic absorption spectrometry, too. The flame AAS (AAS Varian AA Spectr DUO 240 FS/240Z/UltrAA) was used for the determination of heavy metal contents in soil and plant materials. The content of risky elements (Cd, Pb, Cu, Cr, Ni) in fababean seeds were evaluated according to Food codex of the Slovak Republic.

RESULTS AND DISCUSSION

The soil is characterized by low supply of humus and the neutral soil reaction suitable for the legume cultivation (Table 1).

Table 1 Agrochemical characteristics of the soil from locality Čakajovce

Agrochemical characteristics	pH (H_2O)	pH (KCl)	Cox (%)	Humus (%)
	8.53	7.23	1.53	1.44

The used soil is characterized also by high content of potassium and phosphorus as well as by a very high content of magnesium (Table 2).

Table 2 Macroelement contents in the soil from locality Čakajovce ($mg.kg^{-1}$)

Macroelements	N	K	Ca	Mg	P
	1225	291	5210	380	90,8

The soil used in the pot trial was uncontaminated. Only determined Cd content was on the level of limit value given for the soil extract by *aqua regi*a as well as Pb content on the level of critical value given for the relationship between soil and plant (Table 3).

Table 3 Heavy metal contents in the soil from locality Čakajovce ($mg.kg^{-1}$)

Heavy metals	Cu	Cd	Pb	Cr	Ni
Aqua regia		0.72	18.3	27.4	29.2
limit value*	***60***	***0.7***	***70***	***70***	***50***
NH_4NO_3 (c=1$mol.dm^{-3}$)	0.085	0.026	0.11	0.06	0.16
critical value*	***1***	***0.1***	***0.1***	**-**	***1.5***

**Law 220/2004*

Fababean Saturn (Table 4) accumulated in seeds in control variant high amounts of Ni, Pb and Cd (higher than maximal allowed amount given by the legislative by 50%, 2050% and 60% respectively). In variants with Zn addition the Ni content was decreased under hygienic limit.

The determined Pb content was in variants with addition of 40 mg. Zn.kg^{-1} of soil as well as 500 mg Zn.kg^{-1} of soil higher and Cd content was only in D variant with addition of 500 mg Zn.kg^{-1} of soil higher that those in the control variant.

Table 4 Heavy metal contents ($\overline{x}$ ± S.D.) in the fababean Saturn (milk ripeness in mg.kg^{-1} DM)

Variant	Cu	Ni	Cr	Pb	Cd
A	11.70±0.14	4.50±0.41	2.03±0.05	4.30±0.08	0.16±0.03
B	9.13±0.09	2.10±0.08	2.00±0.16	4.87±0.25	0.10±0.02
C	7.54±0.75	2.30±0.44	1.28±0.14	4.15±0.45	0.15±0.06
D	8.26±1.08	2.77±0.28	1.25±0.24	4.50±0.63	0.21±0.05
Limit	***15.0***	***3.0***	***4.0***	***0.2***	***0.1***

***Limit value for legumes according the Food Codex of the Slovak Republic*

Also fababean Zobor (Table 5) accumulated in seeds in control variant extremely high amounts of Ni, Pb and Cd (higher than maximal allowed amount given by the legislative by 63%, 3000% and 460% respectively). In variant with Zn addition the Ni content was decreased, but still the value was higher than the hygienic limit. The determined Pb content was in variants with addition of 250 mg. Zn.kg^{-1} of soil as well as 500 mg Zn.kg^{-1} of soil lower and Cd content was only in D variant with addition of 500 mg Zn.kg^{-1} of soil lower that those in the control variant, but all determined Pb and Cd contents were extremely higher than maximal allowed amounts given by the Food Codex of the Slovak Republic.

Table 5 Heavy metal contents ($\overline{x}$ ± S.D.) in the fababean Zobor (milk ripeness in mg.kg^{-1} DM)

Variant	Cu	Ni	Cr	Pb	Cd
A	8.03±0.05	4.90±0.08	1.80±0.16	6.20±0.16	0.56±0.05
B	8.10±0.08	5.00±0.16	1.43±0.05	6.77±0.45	0.68±0.03
C	6.86±0.77	4.09±0.39	1.40±0.26	5.04±0.25	0.57±0.05
D	7.02±0.45	3.07±0.59	1.52±0.12	4.50±0.50	0.43±0.09
Limit	***15.0***	***3.0***	***4.0***	***0.2***	***0.1***

***Food Codex of the Slovak Republic*

The determined contents of Cr, Cu and Pb (0.1 mg.kg^{-1}, 0.7 mg.kg^{-1} and 0.1 mg.kg^{-1} respectively) by **Hicsonmez et al., (2012**) in fababea seeds were many times lower than those determined in our fababean cultivars, only Ni content determined by these authors was similar to that in our samples (3.4 mg.kg^{-1} DM). On other hand, **Haciseferoğullari et al. (2003)** determined higher amounts of Cr, Cu (11.25 mg.kg^{-1} and 18 mg.kg^{-1} respectively), a lower Pb content (1.5 mg.kg^{-1}) and a similar Ni content (3.83 mg.kg^{-1}) in comparison to our results.

(Gadd, G.M., 1992) and **(Giller et al., 1998**) postulated that some metals such as Zn, Cu, Ni and Cr are essential or beneficial micronutrients for plants, animals and microorganisms, whereas others, such as Cd, Hg, and Pb have no known biological and/ or physiological functions. However, all these metals could be toxic at relative low concentrations. These metals are taken up from soils and bioaccumulated in crops, causing damage to plants when reach high levels and under certain conditions becoming toxic to human and animals fed on these metal enriched plants **(EL-Sokkary and Sharaf, 1996).** Heavy metal accumulation in plants depends upon plant species, and effeciency of different plants in absorbing metals in evaluated by either plant uptake or soil to plant transfer factors of the metals **(Rattan et al., 2005).**

CONCLUSION

Our results confirmed the high ability of both of investigated fababean to accumulate large amounts of risky metals. The presented results indicate the serious risk heavy metal intake by human organism due the consumption of foodstuffs based on fababean. It is permanently necessary to monitor the content of risky heavy metals and to apply measures for the minimalization of risky metal input into the human food chain.

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