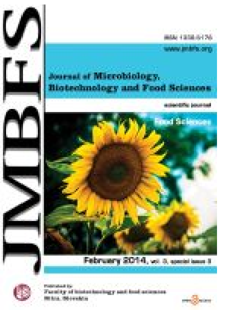

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CADMIUM AND NICKEL CONTENT IN FROZEN SPINACH FROM SLOVAKIA SALES NETWORK

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ABSTRACT

In the present work, we focused on monitoring the content of hazardous elements in retail packs Spinach (*Spinacia oleracea*, L.). Among the most hazardous substances that can get into the spinach are nitrates, pesticide residues. The heavy metals as cadmium, mercury, cobalt, nickel, lead and copper. Into productive parts of plants may get land through the atmosphere or contaminated water. Spinach is among reigns supreme wheatgrass. It is a rich source of minerals, vitamins and folic acid. For this article we have chosen to risk elements cadmium and nickel, which we compared with the maximum level defined by the Codex Alimentarius Commission of the Slovak Republic and the values that are set out in Commission Regulation EU No. 420/2011 and no. No 1881/2006 setting maximum levels for contaminants in foods. The results obtained suggest that in either case there was no exceeded of monitored contaminants. The average levels observed risk elements were in the following intervals: Cd 0:03 to 0:10 mg.kg^{-1}, Ni 0697-1218 mg.kg^{-1}. The results will show that in the case of cadmium, we had exceeded the limit value in six samples and nickel was not exceeding the limit value.

Keywords: spinach, heavy metals, cadmium, nickel, pollution

INTRODUCTION

Heavy metals are ubiquitous part of the environment as a result of mutual natural and anthropogenic activities causing increased exposure of human populations to their effects through various channels **(Wilson - Pyatt, 2007, Poty et al., 2012)**. Increasing concentrations of certain trace elements, especially their mobile forms can cause serious environmental concern about contamination and accumulation in soil, vegetation, animals, respectively, surface and ground waters **(Chopin - Alloway, 2007)**.
The primary source of environmental contamination is mainly metals, whose main part is particularly lead, zinc or copper, in addition, antimony, arsenic, mercury, cadmium, thallium, gallium, and others. In addition to the production of metals is a very important source of environmental contamination by metals and burning of fossil fuels, especially coal. Fly ash from the incineration of atmospheric leakage through contaminated soil. Increasingly important source of environmental pollution with heavy metals is becoming a burning municipal waste streams and pollution effluents containing elevated levels of toxic metals **(Bencko et al., 1995)**. Fresh vegetables and fruits are rich sources of a range of essential trace elements, biologically active substances and the amount of other health-promoting substances, which increases their value and role in the human food chain **(Tamimi et al., 2005)**. Vegetables had a generally high antioxidant capacity, which, for example, heavy metals significantly reduced **(Havlikova, 2006)**. Among the elements that contribute significantly to the development of oxidative stress products include Cd, Hg, Pb, Ni and others **(Szabóová, 2009)**. If the plant is exposed to increased intake of heavy metals from the environment, thus leading to increased production of certain antioxidants, which had a negative impact on their biological value **(Han, Weng, Bi 2008)**. The aim of this paper is the determination of cadmium and nickel in retail packs of different kinds of frozen spinach and compare the measured value with the limit values set out legislation for the maximum quantity of hazardous elements in spinach - resp. leafy vegetables (according to the Food Code of the Slovak Republic and the EU Commission Regulation no. 420/2011 and no. 1881/2006 setting maximum levels for contaminants in foods.

MATERIAL AND METHODS

For the determination of risk elements in samples of frozen spinach samples we used commonly available commercially in Slovakia. Seven samples were analyzed frozen spinach retail packaging (325-450 g). Description and characteristics of the samples are listed in Table 1.

Table 1 Simple characteristic of analyzed spinach

Samples	Product name	Weight (g)	Producer	Country of origin
1	MOCHOV Spinach paste	450	Ardo Austria frost	Austria
2	VITA STAR Spinach paste	450	Kaufland	Slovakia
3	DIONE Spinach paste	450	Agrimex	Czek Republic
4	AGRO Foliar spinach	400	Agro Jesenice	Czek Republic
5	FINDUS Cutted spinach	325	Findus	Slovakia
6	CLASSIC Foliar spinach	450	Kaufland	Belgium
7	BONDUELLE Foliar spinach	450	Bonduelle	Spain

Buying of analyzed samples was performed in 2013. Determination of Cd and Ni was carried out at the Department of Chemistry, FBP, SUA in Laboratory of environmental and food analysis. We spinach samples after thawing and homogenization digested "wet" environment in nitric acid using microwave decomposition pressure on the system MARS X-press made by CEM (USA), according to the methodology XprAG-1 (2004). Then we digest filtered into volumetric flasks 50 cm^3 and supplemented by the exact amount of risk. Thus prepared samples were then measured by atomic absorption spectrophotometry on a Varian 240FS.
The measured values are then compared with the following legislative standards that define the above standards applicable in the Slovak Republic and in the EU.

RESULTS AND DISCUSSION

The cadmium content in all samples ranged from 0.03 to 0.10 mg.kg^{-1} (see Tab. 2). Codex Allimentarius SR is the maximum amount of cadmium for food for infants and young children 0.04 mg.kg^{-1}. In terms of this assessment it can be concluded that all the samples of analyzed spinach are not suitable as food for infants and young children. The results of **Szabóová et al., 2009** showed that in Slovakia grown leafy vegetables poses no risk of possible contamination of the food chain. Except for the sample no. 4, where the HPL for Cd was not exceeded.

Table 2 The cadmium content in spinach samples (mg.kg^{-1})

Samples	Product name	Producer	Country of origin	Cd content (mg.kg^{-1})
1	MOCHOV Spinach paste	Ardo Austria frost	Austria	0.083
2	VITA STAR Spinach paste	Kaufland	Slovakia	0.100
3	DIONE Spinach paste	Agrimex	Czech Republic	0.086
4	AGRO Foliar spinach	Agro Jesenice	Czech Republic	0.030
5	FINDUS Cutted spinach	Findus	Slovakia	0.069
6	CLASSIC Foliar spinach	Kaufland	Belgium	0.057
7	BONDUELLE Foliar spinach	Bonduelle	Spain	0.087

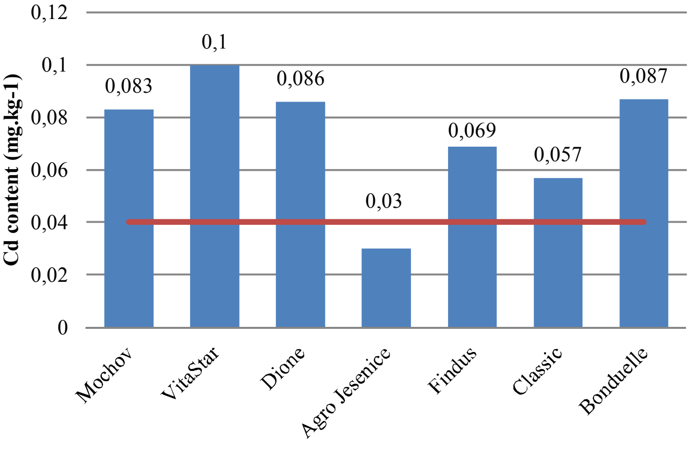

Figure 2 Comparison of cadmium content in spinach samples with limit value (0.04 mg.kg^{-1})

Table 3 Statistical parameters of cadmium content in spinach samples

Cd	Average	LV*	MIN	MAX
n = 7	0.081	0.04	0.030	0.100

*Limit value

The second reference element in this work is nickel. The nickel content in the analyzed samples of spinach ranged from 0.697 to 1.218 mg.kg^{-1}. Nickel content in each sample is given in Table 4 Codex Alimentarius SR NPM nickel in leafy vegetables 2.50 mg.kg^{-1}. Based on the identified content it can be concluded that the analyzed frozen spinach is a good food, because no sample exceeded the maximum specified amount. In the sample no. 3 maximum nickel content was 1.218 mg.kg^{-1}. Similar results were also recorded **Cabálková, 2007**, which followed the Cd content in samples of fresh spinach.

Table 4 The cadmium content in spinach samples (mg.kg^{-1})

Samples	Product name	Producer	Country of origin	Ni content (mg.kg^{-1})
1	MOCHOV Spinach paste	Ardo Austria frost	Austria	0.967
2	VITA STAR Spinach paste	Kaufland	Slovakia	0.994
3	DIONE Spinach paste	Agrimex	Czech Republic	1.218
4	AGRO Foliar spinach	Agro Jesenice	Czech Republic	0.697
5	FINDUS Cutted spinach	Findus	Slovakia	0.816
6	CLASSIC Foliar spinach	Kaufland	Belgium	0.809
7	BONDUELLE Foliar spinach	Bonduelle	Spain	0.831

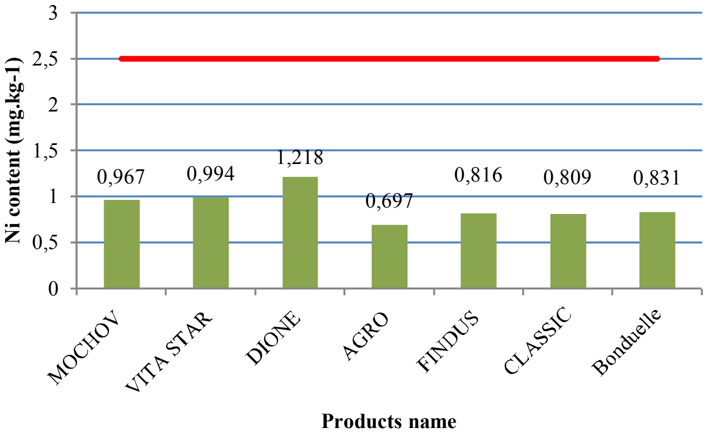

Figure 3 Comparison of nickel content in spinach samples with limit value (2.50 mg.kg^{-1})

Table 5 Statistical parameters of nickel content in spinach samples

Ni	Average	LV*	MIN	MAX
n = 7	0.904	2.50	0.697	1.218

*Limit value

CONCLUSION

In the present work we aimed to assess the level of hygienic quality retail packaging spinach monitored in terms of content of heavy metals (Cd and Ni). The results show a satisfactory hygienic quality in all samples of spinach. In the case of cadmium, we had exceeded the maximum level for this element only in one sample (4) also when compared with the limit value specified for food for infants and children (0.04 mg.kg^{-1}). Other samples do not exceed the limit value for this element. For nickel we did not exceed the prescribed limit of 2.50 mg.kg^{-1} in either case. In conclusion, the analyzed samples retail packaging spinach meet legislative standards, which defines the Food Code of the Slovak Republic and the EU for adults.

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