The variability coefficient of cadmium was higher in the products from import, in intervals from 48,61% to 72,88 % at yoghurts and from 51,48% to 76,18 % at cheese. The higher variability of dairy product from import is given too thereby, that products derived from 6 different countries. While variability coefficient for lead was from 47,82% to 50,71% at yoghurts and from 50,77% to 69,25% at cheese.
At evaluated of differences among contents of cadmium in yoghurts from import and from domestic production by T-test were found, that differences between averages are statistically significant. It involve, that between contents of cadmium in yoghurts from import and from domestic production are statistically significant differences ($T_{0,01}$ = 2,831^{+}).
On the other hand differences in contents of cadmium in the cheese from import and from domestic production weren't statistically significant ($T_{0,01}$ = 2,787^{+}). From presented of results showed, that contents of cadmium in the cheese from import approached to values of cadmium, which occurred in domestic cheese.
It was found significant differences between contents of lead at yoghurt from import and of domestic production at used of T-test ($T_{0,01}$= 2,0623^{+}). The values of correlation coefficients weren't statistically significant.
To similar results arrived too Husain et al. (1996) and Wilplinger et al. (1995), which found important differences between followed dairy products.

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MONITORING OF HEAVY METALS IN FRUITS AND VEGETABLES WITHIN THE NETWORK OF SHOPS AND LOCAL MARKETS

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Summary

There were investigated the contens of lead, zinc, copper, nickel, chromium and cadmium in the samples of apples, pears, carot and parsley. These contents where compared with the content limits of heavy metals. On the basis of the results which indicates exceeding of permissible limits of heavy metals contents in analysed commodities, there is a need to devote a considerable attention to hygienic convenience of these foods for health consumption of these items by human population.There were not determined over-limit contens of zinc and copper in samples of apples, pears, carrot and parsley. The highest overstepping of permisible amounts of lead and nickel was analysed in parsley (60 % of samples). The similar situation was with chromium and cadmium, when 30 % of parsley samples showed exceeded concentrations.The best results were achieved with pears, which exceeded limit content only with nickel (28,57 % of total number of samples) and all other element concentrations were below the limit values.

Key words: heavy metals, vegetables, fruits, content limits, contamination, the highest permissible contents

Introduction

Consuption of health foods is an inevitable precondition for health of human population. Food chain can be contamined with heavy metals by agricultural production or by pollution from other sources, mainly from industrial production. Soil contamination with heavy metals can be caused also by activity of metallurgical factories, for instance in Orava and Spiš region (5). The samples of apples, pears, carrot and parsley which are commonly available for consumers in network of shops as well as the samples coming from producers were analysed for content of lead, zinc, copper nickel, chromium and cadmium. To find out the state of contamination of investgated agricultural products was the prime objective of this work.

Material and methods

The samples of fruits and vegetables were gained by incidental shopping within the network of shops and local markets as well as directly from the large-scale producers. Mineralization of taken samples was performed by wet method with HNO_3. Heavy metals content was determined by means of PEY UNICAMPS-9 device by AAS method.

Results and discussion

The contens of heavy metals in apples, pears, carrot and parsley are stated in tables 1-4.
The highest permissible content of lead in fruits and vegetables (0,7 $mg.kg^{-1}$ of fresh matter) was exceed by as much as 60 % of samples of parsley, 22,72 % of carrot samples and 17,50 % of samples of apples. There were not found out an exceeding of content limit with pear samples.
The highest permissible content for nickel represents 0,5 $mg.kg^{-1}$ of fresh matter of fruit or vegetables. This limit content was overstepped by 60 % of parsley samples and 28,57 %, 10,00 % and 9,09 % of samples of pears, apples and carrot, respectively.
As far as the chromium content is concerned, its highest permissible content in fruit and vegetables can be maximally 0,5 $mg.kg^{-1}$ of fresh matter. Within investigated samples, 30 % of parsley ones, 15 % of apples and 13,64 % of carrot samples showed excessive content of this element.
For cadmium the limit represents 0,1 $mg.kg^{-1}$ of fresh matter. This limit value was exceeded by 30 %, 27,72 % and 20 % samples of parsley, carrot and apples, respectively.
It is interesting that the samples of pears did not excees the limits neither with chromium or cadmium.
The highest permissible limits for zinc (10 $mg.kg^{-1}$ of fresh matter) and copper (10 $mg.kg^{-1}$ of fresh matter) were not exceeded in any of analysed commodities.
The theme of heavy metals in food products is delt with many authors including (1), (2), (3), (4), (7). Šalgovičová et al. (8) found that 14,7 % of analysed samples of plant material had excessive content of heavy metals.

Table 1Contents of heavy metals in apples (mg.kg^{-1} of fresh matter)

Num.	Shop/Market	Dry matter %	Pb	Zn	Cu	Ni	Cr	Cd
1.	Jablká letné	13,30	2,47	0,97	0,53	0,32	0,24	0,13
2.	Jablká letné	14,75	2,87	1,02	0,32	0,08	0,24	0,11
3.	Jablká letné	14,07	0,27	0,00	0,97	0,28	0,38	0,00
4.	Agrokomplex	15,20	0,59	0,98	1,22	0,38	0,67	0,03
5.	Tržnica	14,30	0,93	0,87	1,01	0,42	0,20	0,03
6.	OZ Výstavná	18,15	0,18	0,29	1,55	0,28	0,08	0,00
7.	Tržnica	13,62	0	0,04	0,30	0,13	0,09	0,03
8.	OZ Výstavná	14,02	0,18	1,92	0,79	0,09	0,45	0,28
9.	OZ Výstavná	15,27	0,37	1,56	0,56	0,26	0,29	0,02
10.	Tržnica	15,90	0,73	2,83	1,74	0,38	0,30	0,04
11.	OZ Výstavná	14,52	0,44	1,58	0,71	0,41	0,41	0,05
12.	PD Dolná Krupa	13,95	0,04	1,31	0,73	0,39	0,70	0,04
13.	GD Potraviny Výstavná	17,87	0,00	0,98	0,42	0,35	0,14	0,04
14.	GD Tržnica	15,85	0,12	1,07	0,66	0,42	0,15	0,04
15.	Melorous Pukanec	17,55	0,23	0,89	0,66	0,36	0,35	0,02
16.	OZ Progres	15,62	0,18	0,67	0,25	0,29	0,23	0,03
17.	GD Čermáň	18,10	0,12	0,70	0,37	0,51	0,13	0,03
18.	OZ Mostná	14,17	1,22	0,38	0,81	0,15	0,45	0,04
19.	Pukanec	16,25	0,36	1,94	0,51	0,50	0,09	0,06
20.	IVP Tržnica	13,67	0,50	1,30	0,45	0,47	0,05	0,03
21.	OZ Farská GD	15,10	0,92	2,14	1,16	0,81	0,13	0,13
22.	OZ Farská	14,65	0,89	1,91	0,69	0,68	0,08	0,11
23.	D.Z. Helehaven	16,40	0,10	1,15	0,98	0,40	0,00	0,08
24.	D.Z. Redhavev	12,40	0,06	1,24	0,64	0,47	0,09	0,03
25.	D.Z. priesvitné letné	14,00	0,03	1,60	0,81	0,22	0,25	0,27
26.	D.Z. Šampión	17,30	0,00	2,07	0,98	0,30	0,58	0,33
27.	Dv. n/Žitavou Gala	19,07	0,12	0,71	0,55	0,34	0,38	0,04
28.	Dv. n/Žitavou Jonatan	14,47	0,56	0,03	0,30	0,03	0,30	0,11
29.	Dv. n/Žitavou GD	18,16	0,59	0,00	0,29	0,00	0,26	0,09
30.	Dv. n/Žitavou Glostel	16,92	0,38	0,00	0,14	0,00	0,28	0,02
31.	Dv. n/Žitavou Starkinen	17,47	0,53	0,68	0,28	0,05	0,24	0,06
32.	Topoľníky	16,60	0,26	0,05	0,30	0,01	0,24	0,03
33.	Topoľníky	17,35	0,00	0,00	0,44	0,15	0,39	0,07
34.	DZ Golden delicius	15,35	0,14	0,57	0,11	0,08	0,28	0,06
35.	D.Z. Spartan	17,47	0,11	0,15	0,35	0,15	0,09	0,07
36.	D.Z. Jonathan	16,57	0,01	0,19	0,38	0,18	0,25	0,04
37.	DZ Idared	15,50	0,07	3,74	0,65	0,03	0,20	0,07
38.	DZ Glostel	20,32	0,08	3,43	0,55	0,03	0,08	0,03
39.	DZ Melorose	15,60	0,17	0,61	0,56	0,00	0,36	0,06
40.	DZ Lord Lamborne	23,67	0,19	0,14	0,56	0,01	0,36	0,06

Table 2 Contents of heavy metals in pears (mg.kg^{-1} of fresh matter)

Num.	Shop	Dry matter %	Pb	Zn	Cu	Ni	Cr	Cd
1.	Čermáň	17,67	0,16	1,25	1,08	0,47	0,28	0,05
2.	Čermáň	19,30	0,28	0,88	0,55	0,13	0,18	0,04
3.	Čermáň	19,02	0,15	1,24	0,78	0,50	0,33	0,04
4.	Čermáň	14,97	0,26	1,18	0,71	0,55	0,29	0,04
5.	Tesco	23,22	0,28	1,81	0,78	0,26	0,21	0,04
6.	Topoľníky konferencia	17,07	0,24	1,24	0,80	0,36	0,25	0,04
7.	Topoľníky konferencia	16,25	0,23	0,67	0,73	0,04	0,32	0,04

Table 3 Contents of heavy metals in carrot (mg.kg^{-1} of fresh matter)

Num.	Shop / Market	Dry matter %	Pb	Zn	Cu	Ni	Cr	Cd
1.	Nitra potr. Výstavná	17,60	2,47	3,06	2,09	0,34	0,18	0,18
2.	Nitra OD Progres	11,72	0,30	0,98	0,37	0,37	0,37	0,20
3.	Tržnica	13,77	0,27	1,77	1,46	0,12	0,52	0,03
4.	Tržnica	10,00	0,86	0,34	0,98	0,33	0,58	0,04
5.	Tesco	11,02	1,02	3,00	1,46	0,12	0,17	0,01
6.	Progres	12,37	0,00	2,51	1,15	0,15	0,06	0,02
7.	OZ Štefániková	10,97	0,19	1,58	0,37	0,00	0,09	0,01
8.	Tesco	12,60	0,38	2,13	1,43	0,43	0,12	0,02
9.	Potr. Úspech	13,65	0,62	3,52	0,76	0,19	0,52	0,03
10.	Výstavná	14,80	0,82	3,33	1,25	0,49	0,49	0,10
11.	Tržnica	14,40	0,14	2,55	0,69	0,31	0,28	0,05
12.	Progres	11,90	0,05	3,30	2,80	0,87	0,18	0,04
13.	Pukanec	13,30	0,30	2,54	0,58	0,26	0,47	0,02
14.	Progres	11,10	0,06	2,88	0,79	0,25	0,07	0,05
15.	Pukanec	13,92	0,47	3,99	0,89	0,62	0,19	0,08
16.	Progres	11,02	0,91	2,36	0,95	0,39	0,07	0,05
17.	DZ Delícia	12,87	0,00	2,85	1,15	0,24	0,00	0,54
18.	DZ Nantes	13,55	0,08	2,40	0,84	0,28	0,12	0,65
19.	DZ Olympia	14,67	0,01	1,80	0,84	0,11	0,37	0,07
20.	DZ Rubína	14,35	0,04	2,16	1,07	0,21	0,36	0,08
21.	DZ Kardamet1	16,65	0,15	5,46	1,14	0,37	0,46	0,08
22.	DZ KarnavitF1	12,37	0,20	0,38	0,76	0,08	0,20	0,08

Table 4 Contents of heavy metals in parsley (mg.kg^{-1} of fresf matter)

Num.	Shop/Market	Dry matter %	Pb	Zn	Cu	Ni	Cr	Cd
1.	Progres	17,91	3,27	5,87	1,52	0,53	0,36	0,18
2.	Nitra Chrenová	25,05	0,56	4,45	2,25	0,35	0,77	0,04
3.	Tržnica	17,65	0,97	0,21	2,26	1,19	0,81	0,06
4.	Tesco	24,32	0,92	5,88	3,76	0,61	0,37	0,01
5.	Štefániková	18,12	0,04	4,90	2,38	0,31	0,12	0,03
6.	Tesco	24,65	1,06	4,61	2,45	0,40	0,37	0,04
7.	Potraviny Úspech	18,42	0,89	5,76	2,45	0,16	0,43	0,15
8.	Tesco	23,60	0,18	5,88	2,76	0,63	0,22	0,05
9.	DZ Olomoucky	22,68	0,18	4,15	2,14	0,61	0,71	0,70
10.	DZ Hanácky	23,72	0,96	3,36	1,28	0,75	0,22	0,07

Table 5 Total content of heavy metals

Num	Material	A	Pb		Zn		Cu		Ni		Cr		Cd	
			B	%	B	%	B	%	B	%	B	%	B	%
1.	Apples	40	7	17,50	0	0	0	0	4	10,00	6	15,00	8	20,00
2.	Pears	7	0	0,00	0	0	0	0	2	28,57	0	0,00	0	0
3.	Carrot	22	5	22,72	0	0	0	0	2	9,09	3	13,64	5	27,72
4.	Parsley	10	6	60,00	0	0	0	0	6	60,00	3	30,00	3	30,00

A – total number of analysed samples
B – number of samples which exceeded the highest permissible content

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