Input of heavy metals to the food chain

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Summary

Problems of soil and plant contaminations were experimentally studied at 16 localities of Central Spiš. Risk metals contents (Hg, Cd, Pb, Cu, Cr, Zn, Co, Ni, Fe and Mn) were determined in soils and plants, together with other soil characteristics (pH, humus content, concentrations of available macronutrients P, K, Ca and Mg). Risk metals accumulated in soils during many years from industrial pollutants together with geochemical anomalies contributed to general risk situation in this region. Metals from soil - forming substrate are mainly in immobile forms. Long persistence of observed contaminants – especially Hg, Cu, Cd, As and Zn is presumed. Watch for either total or partial decrease of risk in soil – plant – animal – man system in the described region is needed.

Introduction

Soils in Slovenské Rudohorie belonged (even in the times we did not know about it) and also will belong to pedological anomalies in relation to their higher content of metals and metoloid elements. To this constant natural state were added anthropic imissin anomalies (regarded amounts and composition) from Metalworks Krompachy (KO) and Iron mines (ŽB) Rudňany. Distance between both enterprises is 15 km, so the emissions of SO_2, NO_x, Hg, Zn, Cu, As, Pb, Fe and others many times in interrealtinships negatevly influenced environmental and human life conditions, flora, fauna a all steps of food chain.

Material and methods

To meet the goals of problem solved due to marked emission reduction (KO Krompachy) and disscontinuity of production (ŽB Rudňany) as well as rejection of emission producing enterprises to moderate profit losses of agricultural enterprises, the folloving procedure was selected. Soil and plant samples were collected from the main contaminated microregions.
Risk metals in soils were determined in 2 $mol.dm^{-3}$ extracts of HNO_3 (carbonates contest was taken into account) by atomic absorption spectrofotemeter (AAS). Mercury was determined by TMA – 254 (Trace Mercury Analyzer). The following risk metals were determined in soils and plnts: Hg, Cd, Pb, Zn, Cu, Cr, Co, Ni, Fe and Mn.

Results and discussion

Evaluations of soil risk metals in observed locations were done according recommended standards given in "Decision of Ministry of Agriculture Slovak Republic on the highest admissible values of harmful matters in soils and on appointment of authorized institutions to determine real values of these matters" (N^o – 531/1944 – 540). Evaluation of metals in fodder crops is based on "Intimation of Federal Ministry of Agriculture and Nutrition on

care of animal health " as well as on "Instruction of the Ministry of Agriculture Slovak Republic for requirements determination on production and composition of fodders (fodder mixtures)" N^{o} – 1055/1995 – PV from February 19,1992 and on "Intimation of Ministry of Health of Slovak Republic for enactment of hygienic requirements on heterogeneous matters in eatables". Soil cadmium concentrations only at 7 sites did not exceed the HACV. At 8 sites (Kluknava and Spišské Vlachy) HACV values were exceeded by 1.003 to 80.5 times. The same high concentration values were determined in plants. Origin of Pb from KO Krompachy is doubtless. Risks of Pb, Cd and Hg are warning. Copper and copper compounds concentrations in soils are high. From observed 16 sites only at 4 are Cu contents lower than HACV. 75 percent of sites have HCAV for Cu exceedde by 1.007 to 29.7 times, but concentrations of Cu in plants only at 2 sites exceeded admissable values.

Table 1. Soil and plant risk metals concentrations

No.	Risk elements in (mg.kg^{-1})									
	Hg		Cd		Pb		Cu		Cr	
	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant
1	4,06	0,11	1,20	0,40	104,10	34,52	254,0	66,30	1,95	0,92
2	4,57	0,03	0,79	0,18	69,60	10,65	190,00	28,77	6,00	1,34
3	4,41	0,12	0,85	0,07	66,00	10,77	148,00	27,32	9,65	0,44
4	4,24	0,12	0,70	0,40	101,50	40,49	256,00	71,55	4,95	0,18
5	110,84	0,27	0,73	0,24	56,90	29,22	514,00	45,46	4,40	0,19
6	5,02	0,11	3,20	0,18	232,10	12,48	595,00	35,01	2,90	0,21
7	4,20	0,12	2,60	0,32	241,50	15,68	544,00	36,03	5,00	0,26
8	4,30	0,05	0,35	0,07	30,02	7,95	18,90	26,95	4,95	0,10
9	13,59	0,09	0,26	0,07	19,38	6,17	49,25	24,91	2,45	0,35
10	0,56	0,04	0,11	0,08	11,69	5,56	17,50	28,95	2,25	0,50
11	7,03	0,20	0,09	0,07	11,28	3,75	21,80	28,10	2,35	0,39
12	8,06	0,05	0,10	0,09	11,96	2,64	20,15	25,20	3,35	0,75
13	1,17	0,02	0,09	0,09	15,67	2,86	18,20	27,51	3,65	0,42
14	8,34	0,05	0,31	0,04	16,34	4,78	25,40	24,36	1,75	0,45
15	21,83	0,04	0,30	0,07	17,49	2,32	65,25	27,74	2,75	0,31
16	4,65	0,03	0,07	0,00	9,63	2,75	9,45	22,63	2,85	0,41

Negative pollution effects on agricultural production in the previous periods were corrected with higher energy inputs (mineral fertilizers, pesticides) and with efficient biological materials. The hygienic qality of crop yields was risky mainly related to intake of risk metals. Contamination of agricultural soils historicaly varied depending on wind and rainfall conditions, country relief and height of exhausts industrial polluted gases. We proved main soil contamination with Hg, Pb, Cu, As and Zn. Residual contamination will be continue even if industrial production is reduced and therefore will be continualy influence quality of soils, water, flora and fauna.

Since begining of emission producers (industrial or energetic) transformation continues discussion on old ecological debts, where are included also soil loads with non – degradable contaminants (risk metals). Therefore the soil and plant contaminations of

Central Spiš localities were not significantly decreased during 3 observed years. On the other hand risk of contaminated areas persist in hidden form.

Table.1 Continue

No.	Risk elements in (mg.kg^{-1})									
	Zn		Co		Ni		Fe		Mn	
	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant
1	313,00	177,60	2,20	0,21	1,95	2,18	2248,00	119,30	325,00	19,03
2	195,0	158,20	2,40	0,05	4,20	4,42	4010,00	54,28	617,50	23,72
3	135,00	52,55	3,30	0,08	3,35	2,43	2573,00	54,03	618,00	25,46
4	354,00	207,70	3,60	0,15	4,50	4,30	3930,00	118,40	336,50	16,52
5	84,85	80,30	4,05	0,19	4,80	3,07	5460,00	11,50	564,00	31,72
6	917,00	81,21	2,80	0,05	4,30	0,79	2689,00	72,61	37,00	13,94
7	1011,00	121,10	5,05	0,10	4,65	1,66	3900,00	159,45	207,50	22,92
8	25,15	44,83	2,70	0,19	3,40	1,42	2789,00	88,54	390,00	54,32
9	42,95	35,52	3,30	0,13	6,30	1,49	2154,50	188,80	521,0	30,90
10	24,25	37,92	4,00	0,16	8,15	1,89	2290,00	246,10	563,00	52,78
11	6,60	24,61	2,05	0,03	0,50	1,44	2248,00	138,30	261,00	43,91
12	7,15	28,91	1,80	0,04	0,60	1,52	2744,00	94,72	249,50	34,92
13	17,90	24,19	3,60	0,02	4,75	1,63	3464,00	87,83	1064,50	23,85
14	19,65	39,38	2,60	0,10	3,50	1,47	1401,50	19,70	805,50	101,30
15	27,30	45,77	3,40	0,05	4,50	2,05	2260,00	84,66	749,00	86,09
16	8,25	45,12	2,15	0,11	0,85	1,79	1197,50	150,70	215,00	47,18

Literature

At authors.