Mercury and methylmercury in plants from differently contaminated sites in Slovakia

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ABSTRACT

Concentrations of methylmercury (MeHg) and total mercury (Hg_{total}) were investigated in green leaves of herbs, deciduous and coniferous trees in 9 sites in Slovakia (the transect Žiar nad Hronom – Vtáčnik, Banská Štiavnica, Rudňany). There was evaluated the relevance of plant uptake and the behaviour of transfer-factors. The MeHg and Hg_{total} in leaves of plants from the contaminated sites in Rudňany (up to 3.21 and 802 ng Hg/g, respectively) were an order of magnitude larger than those from other sites, reflecting the strong Hg contamination in Rudňany's plants. The MeHg and Hg_{total} concentrations in leaves (up to 0.285 and 55 ng Hg/g, respectively) from the transect Žiar nad Hronom – Vtáčnik and Banská Štiavnica may be regarded as uncontaminated. The green leaves from Rudňany showed very low transfer-factors (up to 0.09) compared to the transfer-factors from the transect Žiar nad Hronom – Vtáčnik (up to 1.58), and thus indicated the relevance of Hg translocation from soils to leaves on contaminated sites. Generally, much higher MeHg concentrations in leaves of *Corylus avellana* L., *Quercus polycarpa* Schur. and *Achillea millefolium* L. as compared to the other plant species indicate species specific effects that is also confirmed by increased transfer coefficients for relevant leaves (up to 3.48, 2.51 and 0.35, respectively). The transfer-factors can bring up the species specific differences in the Hg uptake by plants.

Keywords: methylmercury; total mercury; leaf; transfer-factor; Slovakia

Mercury (Hg) is released into environment by both natural sources and human activities, and today it is a ubiquitous pollutant. Human activities like combustion of fossil fuels, artisanal gold mining (Nriagu and Wong 1998) and some industrial, chemical and pharmaceutical applications caused a significant increase of the Hg release into the environment (Allan 1999). Organomercury compounds have usually higher toxic effects than their corresponding inorganic forms. There is a worldwide opinion that the methylmercury (MeHg) in the environment originates from a natural process instead of anthropogenic emission, e.g. *in situ* Hg methylation in wetland soils and aquatic ecosystem (St. Louis et al. 1996) and *in vivo* methylation by organisms (Jereb et al. 2003).

It is suggested that vascular plants accumulate Hg through the root uptake from soils via the transpiration stream, through the stoma from the atmosphere and through foliar adsorption of wet and dry deposited Hg. Various studies indicated that Hg is not taken into roots in significant amounts relative to the amount of Hg available in the root zone. More than 95–99% of Hg that is taken up by the roots remained in them and is not translocated to the leaves (Ericksen and Gustin 2004). Bishop et al. (1998) concluded that xylem sap could only transmit a small amount of Hg in the soil water and might account for ca. 11% of Hg_{total} and 3% MeHg in plant leaves. Schwesig and Krebs (2003) traced the translocation from soils to herb leaves using Hg isotopes and showed that such a translocation was < 0.3% for Hg^{2+} and < 3% for MeHg. The source of foliar Hg appears to be almost exclusively from the atmosphere. However, Higueras et al. (2003) reported Hg concentrations in green leaves of *Marrubium vulgare* L. and *Dittrichia graveolens* W. up to 155 μg Hg/g from Almadén mining district, Spain. They suggested that Hg in highly contaminated soils (up to 2573 μg Hg/g on average) incorporated into plants.

The atmospheric Hg emission in Slovakia amounted to 4.450 t/year in 2000. The atmospheric Hg levels at more than 34% of the tested sites in Slovakia exceeded 5 ng/m^3 (Hladíková et al. 2001), which is the WHO recommended guideline value.

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Kalač et al. (1996) reported the strong accumulation of heavy metals in the plants in Slovakia. The Hg concentration in assimilatory organs of the forest trees from Slovakia ranged up to 1.61 μg Hg/g (Maňkovská 1996). These past studies indicated a potential problem of plant pollution caused by Hg in Slovakia, but little information was available, especially regarding MeHg.

The objectives of this study were (i) to determine and to estimate the occurrence of MeHg and Hg_{total} in green leaves of several herbs, deciduous and coniferous trees from both less and strongly contaminated sites in the centre and east of Slovakia, (ii) to evaluate the relevance of plant uptake and to analyse the expedience of transfer-factors for prediction the Hg concentrations in plant assimilatory organs. Transfer-factors, that are represented as the concentrations of Hg compounds in the leaves, are divided by either the forest floors or by root zones contamination. They serve also for estimation of the toxic substances transfer from the soil to plants. Kloke et al. (1984) recorded the transfer-factors for Hg in the soil – plant system in range 0.1–1.0 generally. This great range depends on the plant species and different soil qualities, whereby low factor values show the Hg containment in soil.

MATERIAL AND METHODS

Site description and soil and plant sampling

The investigated transect Žiar nad Hronom – Vtáčnik (abbreviated as the transect Žiar) is located in Žiar basin in the centre of Slovakia (Figure 1) and includes 7 sites (Table 1). The aluminium smelter near Ladomerská Vieska had operated since 1953 and additionally gallium was produced per amalgamation with Hg until 1993. The Hg_{total} in the soils near the factory could be up to 2.46 μg Hg/g, which exceeds the Slovak hygienic standard B (2 μg Hg/g) for Hg in common soils (in sense of Resolution of Ministry of Agriculture of the Slovak Republic No. 531/1994-540). In most cases, it is demonstrated by increasing Hg contents in plants above hygienical limits for food. A brown-coal power plant Zemianske Kostoľany in Hornonitrianska basin is 26 km west from Žiar basin.

The site Rudňany is located in east of Slovakia (Figure 1) and is strongly contaminated by Hg with concentrations in soils up to 130 μg Hg/g (Maňkovská 1996). Mercury was produced together with iron and copper at this site in the past (1332–1992). Geogenic Hg contributes partly to the contamination in Rudňany.

Banská Štiavnica is 21 km southwest from Žiar basin (Figure 1) and is located in the volcanic mountains Štiavnické vrchy. Mining in the past caused the pollution of this area with heavy metals (10^{th}–19^{th} century).

Achillea millefolium L., and *Corylus avellana* L., *Carpinus betulus* L., *Quercus polycarpa* Schur., *Salix fragilis* L., and *Picea abies* (L.) H. Karst. were chosen as representative herbs, deciduous and coniferous trees. Meadow and forest soils and green leaves of plants were taken from transect Žiar, Banská Štiavnica and Rudňany. Soils were sampled in following depths: surface organic layer of forest soils (forest floor) and 0–0.1 m, 0.1–0.2 m, 0.2–0.3 m

Figure 1. Map of sampling locality in Slovakia; grey square is the transect Žiar nad Hronom – Vtáčnik; the altitude of each locality is shown

Table 1. Concentrations of total mercury (Hg_{total}) and methylmercury (MeHg) in green leaves and their corresponding transfer-factors

	Concentrations		Transfer-factors (soil → leaf)			
			Hg_{total}		MeHg	
	Hg_{total} (ng Hg/g)[a]	MeHg (ng Hg/g)[a]	b	c	b	c
Ladomerská Vieska						
Achillea millefolium L.	27	0.152		0.28		0.33
Corylus avellana L.	36	0.137	0.14	0.54	0.19	0.39
Carpinus betulus L.	22	0.047	0.08	0.33	0.07	0.13
Picea abies (L.) H. Karst. (1-yr)	22	0.031	0.08	0.33	0.04	0.09
Picea abies (L.) H. Karst. (2-yr)	41	0.035	0.16	0.61	0.05	0.10
Lovča						
Achillea millefolium L.	23	0.042		0.39		0.10
Corylus avellana L.	26	0.048	0.29	0.45	0.10	0.34
Carpinus betulus L.	31	0.062	0.34	0.53	0.14	0.44
Picea abies (L.) H. Karst. (1-yr)	31	0.016	0.34	0.53	0.03	0.09
Picea abies (L.) H. Karst. (2-yr)	53	0.036	0.58	0.91	0.08	0.25
Žiar nad Hronom						
Achillea millefolium L.	55	0.086		1.04		0.10
Corylus avellana L.	46	0.132	0.40	0.96	0.25	3.48
Carpinus betulus L.	22	0.028	0.19	0.46	0.05	0.74
Picea abies (L.) H. Karst. (1-yr)	14	0.013	0.12	0.29	0.02	0.33
Picea abies (L.) H. Karst. (2-yr)	31	0.067	0.27	0.65	0.13	1.76
Dolná Trnávka						
Achillea millefolium L.	19	0.078		0.24		0.09
Corylus avellana L.	52	0.114	0.47	1.58	0.22	0.20
Carpinus betulus L..	48	0.064	0.43	1.45	0.12	0.11
Picea abies (L.) H. Karst. (1-yr)	25	0.021	0.23	0.76	0.04	0.04
Picea abies (L.) H. Karst. (2-yr)	34	0.042	0.31	1.03	0.08	0.08
Prestavlky						
Achillea millefolium L.	50	0.214		0.05		0.15
Corylus avellana L.	31	0.169	0.57	1.19	0.57	1.68
Carpinus betulus L.	26	0.039	0.48	1.00	0.13	0.39
Picea abies (L.) H. Karst. (1-yr)	36	0.042	0.67	1.38	0.14	0.42
Picea abies (L.) H. Karst. (2-yr)	47	0.113	0.87	1.81	0.38	1.13
Prochot						
Artemisia vulgaris L.	19	0.176		0.30		0.35
Corylus avellana L.	43	0.174	0.28	0.30	0.09	0.41
Carpinus betulus L.	34	0.059	0.22	0.24	0.03	0.14
Picea abies (L.) H. Karst. (1-yr)	21	0.024	0.14	0.15	0.01	0.06
Picea abies (L.) H. Karst. (2-yr)	47	0.047	0.30	0.33	0.02	0.11
Vtáčnik						
Achillea millefolium L.	45	0.258		0.28		0.19
Corylus avellana L.	37	0.215	0.14	0.34	0.07	0.11
Carpinus betulus L.	46	0.106	0.17	0.42	0.03	0.06
Picea abies (L.) H. Karst. (1-yr)	24	0.016	0.09	0.22	0.005	0.01
Picea abies (L.) H. Karst. (2-yr)	41	0.056	0.11	0.38	0.02	0.03
Banská Štiavnica						
Achillea millefolium L.	34	0.059		0.26		0.18
Salix fragilis L.	31	0.027	0.23	0.39	0.02	0.03
Quercus polycarpa Schur.	40	0.285	0.30	0.50	0.19	0.30
Picea abies (L.) H. Karst. (1-yr)	16	0.017	0.12	0.20	0.01	0.02
Picea abies (L.) H. Karst. (2-yr)	25	0.019	0.19	0.31	0.02	0.03
Rudňany						
Achillea millefolium L.	528	0.367		0.02		0.04
Salix fragilis L.	802	0.399	0.01	0.09	0.01	0.31
Quercus polycarpa Schur.	668	3.231	0.01	0.07	0.06	2.51
Picea abies (L.) H. Karst. (1-yr)	337	0.238	0.003	0.04	0.004	0.15
Picea abies (L.) H. Karst. (2-yr)	463	0.256	0.005	0.05	0.004	0.16

[a]mean values of duplicate determinations are shown; detection limit (DL) of MeHg in leaves is 10 pg Hg/g; b – related to forest floor; c – related to root zone (10–30 cm deep)

organomineral or mineral layer of soils, where 1–5 soil samples are mixed from 1 plot. Fresh mineral soils and forest floors were passed through a 2-mm sieve and homogenized. Green leaves from herbs and leaves from the upper canopy of deciduous trees (15–20 years old) were collected in summer 2003, needles from the 15–20 years old *Picea abies* (L.) H. Karst in January 2004. Soil and leaf samples were freeze-dried, ground and stored at –20°C in the dark before analysis. Unwashed plants were analysed.

Analysis of methylmercury in the soil and green leaves

For analysis of MeHg in the soil and leaves, 0.3–1.0 g samples were extracted with 4 ml 1M $CaCl_2$, 0.1% tropolone in the glacial acetic acid together with 5 ng internal standard triethyltin. The aliquot merged with 80 ml Milli-Q water was adjusted to pH 4 with acetate buffer and derivatizated by 10 mg $NaBPr_4$ in the glass volumetric flask. Then, the solution was extracted with 1 ml cyclopentane by vigorous shaking for 10 minutes. The cyclopentane extract was centrifuged and analysed with a coupling of a gas chromatograph (HP 6890) to an inductively coupled plasma mass spectrometer (ICP-MS ELAN 5000, Perkin-Elmer SCIEX) (Huang et al. 2003).

A certified sediment IAEA-356 was used for quality control. Additionally, 0.5–1 g of the soil or leave sample was spiked with 5 ng MeHg and stored in the dark at room temperature overnight. Recoveries of spiked MeHg were over 80% for soil samples and ranged from 35% to 65% for green leaves.

Analysis of the total mercury in the soil and green leaves

Analysis of the Hg_{total} in the soil and leaves was conducted by digested 0.5 g of the sample with 3 ml HNO_3 (65%) + 0.5 ml HCl (30%) by High Pressure Accelerated Solvent (HPA-S, Anton Paar, Austria). Then, the supernatant was filtered with membrane filter, diluted to 25 ml with Milli-Q water for further analysis with ICP-MS (Agilent 7500c, Japan).

The quality control was achieved with certified materials, 7002 light sandy soils, 7003 silty clay loam (Analytika Co., Czech Republic), SO-3 soil (Canda Centre for Mineral and Energy Technology) with recoveries from 93% to 119%. Recovery of Hg_{total} from certificated materials of plant materials, 1573a tomato leaves (NIST), 1575a pine needles (NBS), and V10 hay powder (IAEA), ranged from 96 % to 126%.

RESULTS

Methylmercury and total mercury in the green leaves

In the transect Žiar and Banská Štiavnica, the MeHg contents were between 0.04 and 0.26 ng Hg/g in herb leaves (*Achillea millefolium* L.), between 0.03 and 0.28 ng Hg/g in deciduous leaves broadleaves (*Corylus avellana* L., *Carpinus betulus* L., *Salix fragilis* L. and *Quercus polycarpa* Schur.) and between 0.01 and 0.11 ng Hg/g in coniferous leaves [*Picea abies* (L.) H. Karst.] (Table 1). The Hg_{total} contents in all leaves ranged from 19 to 55 ng Hg/g in the case of herbs, from 22 to 52 ng Hg/g in broadleaves and from 14 to 53 ng Hg/g in the needles (Table 1). Methylmercury and Hg_{total} in all leaves from Rudňany showed higher contents, up to 3.23 and 802 ng Hg/g, respectively, compared to those from the transect Žiar. The MeHg and Hg_{total} had higher contents in the 2-year-old needles [*Picea abies* (L.) H. Karst.] than 1-year-old ones (Table 1).

Generally, the MeHg and Hg_{total} contents in leaves depend more on the sampling site than on the plant species.

The MeHg contents in leaves at different sites in the transect Žiar were in the order: Vtáčnik > Prochot = Prestavlky > Ladomerská Vieska = Žiar nad Hronom = Dolná Trnávka > Lovča. The Hg_{total} contents in leaves were in the order: Vtáčnik > Prochot = Prestavlky = Žiar nad Hronom > Ladomerská Vieska = Dolná Trnávka = Lovča.

Relation of the methylmercury and total mercury in soils and in the green leaves

Values of the MeHg and Hg_{total} contents in the meadow and forest soils at the transect Žiar, Banská Štiavnica and Rudňany which were used for counting the transfer-factors are presented in Table 2.

The transfer-factors were usually less than 1 (Table 1). The transfer-factors of Hg_{total} from Rudňany reached a level of magnitude lower than those from the other sites. The transfer-factors calculated on the basis of the Hg compounds contents in the root zones were generally higher than those calculated according to the Hg compounds contents in forest floors. In the case of $Hg_{total,}$ the transfer-factors were higher that in the case of MeHg. In some cases transfer-factors for MeHg were very high.

The transfer-factors in the different green leaves from the transect Žiar for Hg_{total} were in the order: *Corylus avellana* L. = *Picea abies* (L.) H. Karst. (2-year) > *Carpinus betulus* L. > *Achillea millefolium* L. > *Picea abies* (L.) H. Karst. (1-year). The transfer-

Table 2. Concentrations of total mercury (Hg_{total}) and methylmercury (MeHg) in soils and type (FAO) of soils

	Vegetation, soil type (FAO)	Hg_{total} (ng Hg/g)[a]		MeHg (ng Hg/g)[a]	
		meadow	forest	meadow	forest
Ladomerská Vieska					
Forest floor	oak forest Cambisol (typical)		264		0.719
0–10 cm		95	196	0.457	0.452
10–20 cm		70	54	0.370	0.198
20–30 cm		48	67	0.316	0.354
Lovča					
Forest floor	oak forest Gleysol (typical)		91		0.456
0–10 cm		59	85	0.439	1.196
10–20 cm		62	124	0.469	0.276
20–30 cm		51	58	0.221	0.141
Žiar nad Hronom					
Forest floor	oak forest Cambisol (luvisol)		115		0.521
0–10 cm		53	64	0.838	0.607
10–20 cm		47	46	0.175	0.200
20–30 cm		42	48	0.467	0.038
Dolná Trnávka					
Forest floor	oak forest Gleysol (typical)		111		0.515
0–10 cm		80	58	0.815	0.500
10–20 cm		86	36	0.490	0.978
20–30 cm		77	33	0.434	0.565
Prestavlky					
Forest floor	oak and beech forest Gleysol (typical)		54		0.295
0–10 cm		916	31	1.452	0.202
10–20 cm		138	36	0.286	0.214
20–30 cm		317	26	0.703	0.100
Prochot					
Forest floor	oak and beech forest Cambisol (typical)		155		1.953
0–10 cm		64	160	0.506	2.078
10–20 cm		60	132	0.543	1.682
20–30 cm		57	141	0.243	0.412
Vtáčnik					
Forest floor	beech forest Andosol (typical)		273		3.107
0–10 cm		159	148	1.326	4.241
10–20 cm		160	117	0.492	3.044
20–30 cm		151	109	1.058	1.912
Banská Štiavnica					
Forest floor	oak forest Cambisol (dystric)		133		1.491
0–10 cm		132	57	0,329	0.908
10–20 cm		165	68	0.597	0.281
20–30 cm		289	80	0.325	0.942
Rudňany					
Forest floor	oak forest Ranker		104000		47.03
0–10 cm		25501	102000	9.643	42.61
10–20 cm		24952	30200	7.725	6.640
20–30 cm		6627	9091	3.033	1.286

[a]mean values of duplicate determinations are shown; detection limit (DL) of MeHg in soils is 10 pg Hg/g

factors for MeHg were in the order: *Corylus avellana* L. = *Picea abies* (L.) H. Karst. (2-year) > *Carpinus betulus* L. ≥ *Achillea millefolium* L. > *Picea abies* (L.) H. Karst. (1-year).

DISCUSSION

The Hg_{total} concentration in all green leaves at the transect Žiar and Banská Štiavnica (up to 55 ng Hg/g) were generally below 120 ng Hg/g, which Maňkovská (1996) consider as normal values of the Hg_{total} in plants. So far, legislation has not defined values for the MeHg, so no comparison with critical data is available. The corresponding MeHg contents in green leaves from transect Žiar and Banská Štiavnica (up to 0.285 ng Hg/g) were at similar level to those reported in the uncontaminated sites (e.g. Moore et al. 1995, Liu et al. 2003, Schwesig and Krebs 2003).

The enhanced MeHg concentration in the leaves in Ladomerská Vieska and on sites from Prestavlky to Vtáčnik suggests the influence of atmospheric pollution, because the sites are near to the aluminium smelter and the brown-coal power plant, respectively.

However, the MeHg and Hg_{total} in the leaves from the contaminated sites Rudňany showed apparently much higher concentrations (up to 3.231 and 802 ng Hg/g, respectively) and were an order of magnitude higher than those from uncontaminated sites, reflecting the strong Hg contamination in Rudňany plants.

The source of the foliar Hg appears to be almost exclusively from the atmosphere (Ericksen and Gustin 2004). Therefore, the concentrations of Hg compounds in the green leaves may represent more likely the Hg compounds in the atmosphere than in soils. This was reflected in the case when the 2-year-old needles of *Picea abies* (L.) H. Karst. contained significantly higher MeHg and Hg_{total} concentrations than 1-year-old needles because the 2-year-old needles were exposed longer to the atmosphere than the 1-year-old ones.

However, the atmospheric deposition cannot explain the fairly high concentrations of both the

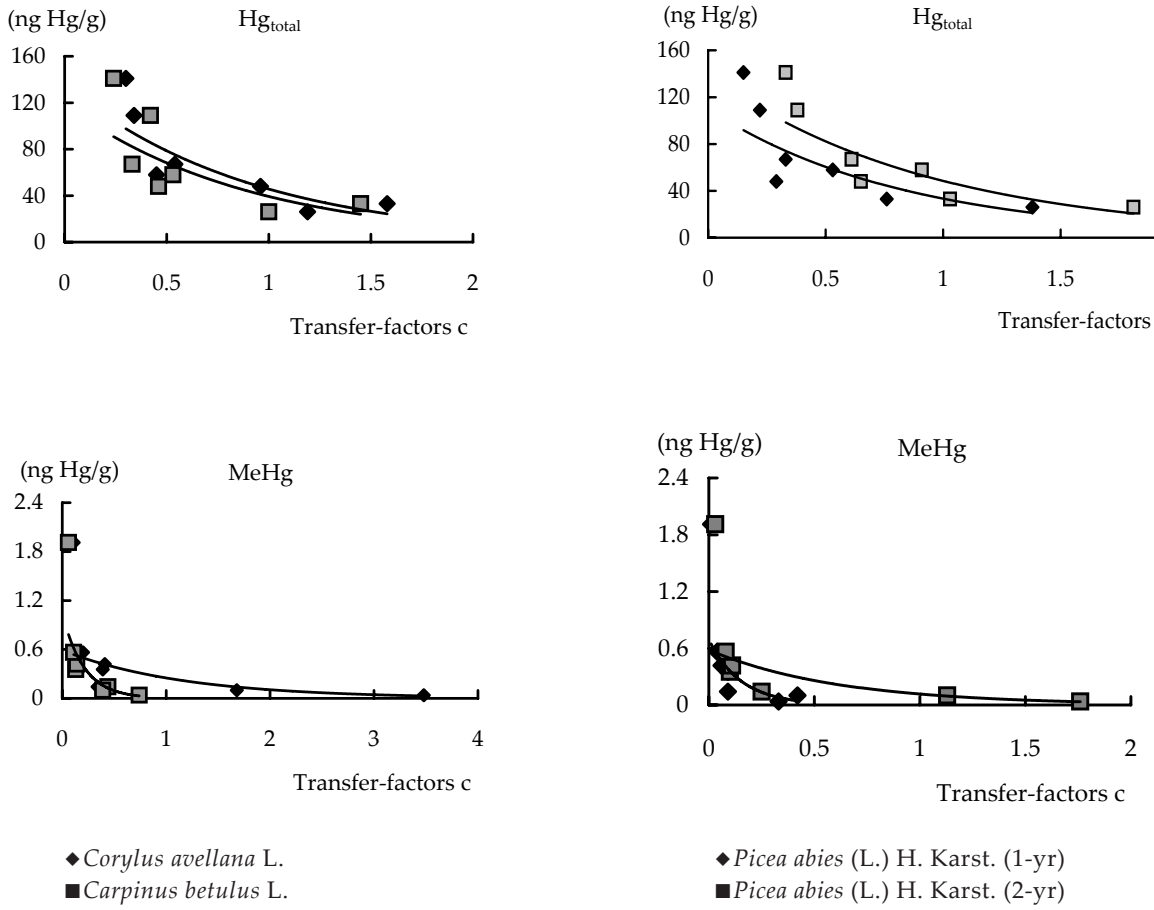

Figure 2. Converting course of transfer-factors ($y = a.e^{-bx}$) in relation to the Hg_{total} and MeHg concentrations in soils (transect Žiar); c – related to root zone (10–30 cm deep)

MeHg and the Hg_{total} in the green leaves from Rudňany, because Hg mining in Rudňany terminated more than 12 years ago (Maňkovská 1996). At this site, Hg seems to originate from soil either through the root uptake and translocation or from the soil-air-foliar exchange processes. Plants on soils with elevated Hg_{total} concentrations may be receiving the Hg from the soil and emit it to the atmosphere, whereas this effect is minimal if Hg_{total} content in the soil is low (Ericksen and Gustin 2004). Additionally, emission of MeHg and Hg_{total} from contaminated soils may result in elevated concentrations in the near level atmosphere (Schroeder and Munthe 1998). Subsequently, the net deposition of MeHg and Hg_{total} to foliar may be enhanced. The soil-air-foliar exchange should be more important for MeHg and Hg_{total} in herb leaves near the soil surface. However, contents of MeHg and Hg_{total} in the herbs in Rudňany gave no evidence of such a process. Thus, high contents in leaves at the site Rudňany seem most likely to be caused by root uptake and translocation.

This estimation can be proved by the following results: the transfer-factors of the Hg_{total} in green leaves to the Hg_{total} in the corresponding soils from Rudňany (0.003–0.09) were smaller than the translocation rates suggested by some authors (0.003 Schwesig and Krebs 2003; 0.11 Bishop et al. 1998). Hg compounds in soils are then an important source of Hg in green leaves from contaminated sites. The transfer-factors of Hg_{total} for green leaves from the other sites were much higher in most cases (up to 1.58), reflecting the atmospheric Hg as the dominant origin for Hg in leaves.

The transfer-factors are not suitable for estimating the translocation of Hg compounds from soils to leaves, because most Hg in leaves originates exclusively from atmosphere (Ericksen and Gustin 2004). It results also from the using the equation of the e-function (Figure 2). The transfer-factor as the upper-mentioned relation is divided by the hyperbolic way, if the transfer-factors are put on the x-axis, opposite to the soil concentration. For its informative value it means, that the transfer-factor with low Hg contents in soils cannot be used for high Hg contaminated soils. The transfer-factors reliability is decreasing in this case (Filipinski 1989). However, the comparison of transfer-factors between samples from less and highly contaminated sites may support the enhanced importance of the Hg translocation for the content of Hg in leaves at contaminated sites.

At the uncontaminated sites, the MeHg contents in green leaves of *Corylus avellana* L. (0.048–0.215 ng Hg/g), *Quercus polycarpa* Schur. (0.285 ng Hg/g) and *Achillea millefolium* L. (0.042–0.258 ng Hg/g) were higher than those in leaves of the other plants (0.013–0.113 ng Hg/g). In Rudňany, the MeHg contents were remarkably higher in leaves of *Quercus polycarpa* Schur. (3.231 ng Hg/g) compared to those of the other plants (0.238–0.399 ng Hg/g). Generally, much higher MeHg concentrations in green leaves of *Corylus avellana* L., *Quercus polycarpa* Schur. and *Achillea millefolium* L. as compared to the other plant species indicate species specific effects that might result from translocation of soil Hg or from atmospheric uptake. This effect also proves high transfer coefficients for MeHg for relevant leaves (up to 3.48, 2.51 and 0.35, respectively). Moreover, the transfer-factors can bring up the species specific differences in Hg uptake by plants (Table 1).

The distinctions in MeHg contents of different plants are surprising and further research is needed on investigation of potential mechanisms causing these effects.

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ABSTRAKT

Rtuť a metylrtuť v rostlinách na různě kontaminovaných lokalitách Slovenska

V zelených listech bylin a listnatých či jehličnatých stromů byly na 9 lokalitách Slovenska (transekt Žiar nad Hronom – Vtáčnik, Banská Štiavnica, Rudňany) sledovány koncentrace metylrtuti (MeHg) a celkové rtuti (Hg_{total}). Byl hodnocen význam příjmu Hg rostlinami a chování transferových faktorů. Koncentrace MeHg a Hg_{total} (3,21 a 802 ng/g) v listech na kontaminované lokalitě Rudňany byly vyšší než na ostatních místech, což odráží silnou kontaminaci Rudňan rtutí. Na základě koncentrací MeHg a Hg_{total} (0,285 a 55 ng/g) zjištěných v listech transektu Žiar nad Hronom – Vtáčnik a Banská Štiavnica lze lokality hodnotit jako nekontaminované. Zelené listy z lokality Rudňany vykazovaly mnohem nižší transferové faktory (do 0,09) v porovnání s transektem Žiar nad Hronom – Vtáčnik (do 1,58). V kontaminovaných oblastech vystihují intenzitu translokace Hg z půdy do listů. Celkově mnohem vyšší koncentrace MeHg v listech *Corylus avellana* L., *Quercus polycarpa* Schur. a *Achillea millefolium* L. v porovnání s jinými rostlinnými druhy indikují druhově specifický efekt, který potvrzují i vysoké transferové faktory pro příslušné rostliny (do 3,48, 2,51 a 0,35). Transferové faktory mohou zvýraznit druhově specifické rozdíly v příjmu Hg rostlinami.

Klíčová slova: metylrtuť; celková rtuť; list; transferový faktor; Slovensko

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