

Dioxins in Russia. I. Sverdlovsk region.

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Introduction

In 1995 a target program "Protection of the Environment and Population from Dioxins and Dioxin-like Toxicants" (1) was initiated. According to this program local authorities were to solve the task of prior examination.

It should be noted that a study of PCDD/Fs contamination of Russian regions is only at its start. Today the Republic of Bashkortostan has been studied in more detail (2,3). There is also data on Arkhangelsk region (4), Irkutsk region (5), the Republic of Komi, Sverdlovsk region, Chuvash Republic (6). There is data on PCDD/Fs content in blood and breast milk for some cities of Russia (7, 8). In other regions (Perm, Volgograd, Tomsk) this work is only beginning.

Sverdlovsk region is a centre of metallurgy, heavy mechanical engineering, chemical and coke chemical industry.

By an order of the Sverdlovsk Centre of Sanitary and Epidemiological Service the first study of several industrial centres in Sverdlovsk region was carried out in 1995. Analytical determination was carried out at the Environmental Research and Protection Centre (ERPC) in the Republic of Bashkortostan. The purpose of the study was to determine the background PCDD/Fs levels for the urban population.

Objects and Methods

In the cities of Nigny Tagil, Kamensk-Uralsky, Ekaterinburg and Kirovgrad representatives of Sanitary and Epidemiological Service selected 4 pool samples of whole blood from 30 permanent inhabitants of these cities. The donors were of approximately equal age. 20 ml of whole blood samples were taken from each of them, except for Ekaterinburg, where the pool sample was presented by blood serum taken from 115 people, 2.5 ml from each. In the city of Nigny Tagil a pool sample of breast milk was taken from 4 women of the same age. Food samples were also taken: chicken from Kirovgrad and butter from Krasnoufimsk.

All samples had been frozen at -18°C and stored in this form up to the moment of

analyzing. PCDD/Fs determination was carried out according to the methods EPA 1613 (9). Lipid extraction from 40 ml of whole blood was made by the mixture of hexane and diethylether (2:1), 3 portions by 40 ml. 50 ml of breast milk (lipid content - 2.8%) were extracted by the mixture of acetone and hexane, 10 g of chicken and 5 g of butter were extracted by the mixture of methylene chloride and hexane.

The extracts were purified by a modified silica gel column, a column with basic alumina. PCDD/Fs were eluted with toluene in the reverse mode from a carbon column.

The measuring system consisted of a chromatograph Carlo Erba 8035 and a mass spectrometer with high resolution Autospec-Ultima.

Experimental conditions: Gas Chromatography. Carlo Erba 8035, column: DB-5 MS, I&W Scientifical, 60m, 0.25 μ m film thickness, GC program: 140°C - 1 min isotherm, 15°C/min to 220°C, 4°C/min to 300°C, 300°C 12 min isotherm. Mass spectrometry. VG Autospec Ultima, resolution 10000, ion energy 36 ev, the MS was operated in a selected ion recording mode, total GC/MS run time 58 min, the detection limit for 2,3,7,8-TCDD is in the range 1 μ g/g lipids and 10-15 fg/ml whole blood respectively.

Results and Discussion

Tables 1 and 2 present the results of PCDD/Fs determination in samples of blood, breast milk and fat-containing food products.

Table 1. PCDD/Fs in pool blood samples from industrial center's donors of Sverdlovsk region, μ g/g lipids.

PCDD/Fs	Nigny Tagil	Kamensk-Uralsky	Ekaterinburg	Kirovgrad
	N=34	N=35	N=115	N=33
	Age=34	Age=30-55	Age=30-35	Age=32
2378-TCDD	7.23	5.991	19.9	8.11
12378-PnCDD	5.54	5.66	ND(5)	6.81
123478-HxCDD	7.82	7.12	11.19	6.22
123678-HxCDD	7.33	5.03	21.29	16.55
123789-HxCDD	4.95	4.5	9.79	7.7
1234678-HpCDD	21.39	15.43	48.8	16.55
OCDD	77.82	62.12	344.5	78.08
2378-TCDF	11.1	6.19	8.55	3.44
12378-PnCDF	4.95	9.63	5.59	6.15
23478-PnCDF	17.72	18.05	46.93	33.51
123478-HxCDF	14.75	12.93	32.32	0.73
123678-HxCDF	9.01	7.72	20.05	31.71
123789-HxCDF	7.32	6.34	4.97	5.82
234678-HxCDF	7.92	7.26	16.16	10.00
1234678-HpCDF	12.18	11.93	36.83	26.46
1234789-HpCDF	3.37	4.46	9.79	5.9
OCDF	14.16	17.88	35.43	14.01
TEQ, PCDDs	12.3	10.62	27.45	15.5
TEQ, PCDFs	14.27	13.73	34.45	22.57
TEQ, PCDD/Fs	26.56	24.35	59.9	38.1

The highest level in donor blood (serum) was registered in Ekaterinburg and Kirovgrad (Table 1). PCDD/Fs content in breast milk was at the average level of the known data for Russia (8).

As it follows from Table 2, contamination of food (chicken and butter) is within the norms for Russia – 3.3 ng/kg of fat for meat and 5.2 ng/kg of fat for milk and diary.

Table 2. PCDD/PCDFs in breast-milk and food products.

PCDD/PCDFs	Nigny Tagil	Kirovgrad	Krasnoufimsk
	Breast-milk	Chicken flesh	Butter
	N=4, Age=30-34		
2378-TCDD	3.9	0.33	0.18
12378-PnCDD	4.01	0.97	0.31
123478-HxCDD	4.8	0.57	0.18
123678-HxCDD	2.96	0.48	0.23
123789-HxCDD	1.83	0.4	0.14
1234678-HpCDD	7.28	1.04	0.51
OCDD	43.55	3.88	1.38
2378-TCDF	1.82	1.02	0.71
12378-PnCDF	2.13	1.25	1.2
23478-PnCDF	10.26	1.92	1.4
123478-HxCDF	5.45	1.76	0.83
123678-HxCDF	3.56	0.82	0.43
123789-HxCDF	1.03	0.72	0.2
234678-HxCDF	2.14	0.86	0.43
1234678-HpCDF	3.22	1.33	0.62
1234789-HpCDF	0.92	0.64	0.12
OCDF	2.26	1.46	0.46
TEQ, PCDDs	6.98	0.98	0.4
TEQ, PCDFs	6.68	1.56	1.02
TEQ, PCDD/Fs	13.7	2.54	1.41

Apart from analyzing biological samples the risk assessment of PCDD/Fs contamination of the water system for Ekaterinburg, Nigny Tagil and Turinsk was made. In Ekaterinburg drinking water was sampled and active sludge from municipal water treatment facilities. In drinking water samples PCDD/Fs isomers were present at the detection limit, except for hepta- and octa- isomers (0.7 – 1.8 pg/l). I-TEQ sample was 1.2 p/l (ND=1/2 MDL). I-TEQ sample of active sludge in Ekaterinburg was 16 ng/kg, 2.6 ng/kg for 2,3,7,8-TCDD. Active sludge sample in Nigny Tagil (the first stage of purification of industrial waste water from "Uralchimplast" plant) contained 8.4 ng TEQ/kg 2.6 ng/kg for 2,3,7,8-TCDD. Waste water sample from the paper and pulp factory in Turinsk contained 23 pg TEQ/l. The character of isomer specter corresponded to the processes of pulp bleaching with chlorine.

If we take mean value of TEQ for pool blood samples for the cities of Russia that are known at present, this value will be 27.7 (Table 3).

It is obvious that the country like Russia occupying vast areas with different technogenic impacts, having regions with high concentration of dioxin hazardous production requires more extended research.

Table 3. The PCDD/Fs concentration in whole blood samples of big industrial centres of Ural and Volga regions.

The towns	I-TEQ, pg/g lipids	References
Nigny Tagil	26.6	ERPC, 1997
Kamensk-Uralsky	24.4	ERPC, 1997
Ekaterinburg	59.9	ERPC, 1997
Kirovgrad	38.1	ERPC, 1997
Novocheboksarsk	14.6	ERPC, 1996
Syktyvkar	26.4	ERPC, 1997
Ufa	35.6	ERPC, 1997
Sterlitamak	17	ERPC, 1995
Baikalsk	17	A. Schecter, 1993
S. Petersburg	18	A. Schecter, 1993
Mean	27.7	

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