Dioxin in environmental, blood, breast milk, cow milk in Chapaevsk town

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The town of Chapaevsk is the most dioxin contaminated places in the world. Investigation of dioxins in the environment and indices of public health in this town began in 1991. The town is situated in the distance of 43 km from Samara to the south-west, on the bank of the Chapaevka river, which flows into Volga river. The number of population of Chapaevsk is 83,6 thousand persons. One of the worst environment pollutants in Chapaevsk is the Middle Volga Chemical plant. Before 1949 the plant produced combat poisonous gases: mustard gas, luisit; from 1967 up to 1987 - hexachloran and its derivatives; nowadays it produces crop protection chemicals (liquid chlorine, acids, metylchloroform, vinilidenchloride, and some other chemicals). Previously it was considered that hexachloran production was responsible for dioxins in the city environment. Tests seemed to confirm it. But after the production was closed in 1987, one can still observe "fresh" dioxins inflow. The study of the present day chemical plant technologies revealed that dioxins and similar compounds could be formed in the production of methyl chloroform, vinilidenchloride, dichlor propionic acid, hexachlorethane, sodium pentachlorfenolat and polychlorkamfen.

Methods. Sampling. Breast milk. Sampling of breast milk was made in December of 1997-June of 1998 in accordance with directions of WHO. 40 samples of breast milk are united into 6 combined samples. The average age of mothers was 22,0 years. All interrogated mothers classified their nourishment as mixed one. 90% of women eat fish once a week or rarely, 80% of women eat meat more often than 2 times a week, and milk and dairy products every day. Blood. Blood samples were taken from 14 persons, blood was centrifuged , frozen and transported in dry ice. 90% of women lived in Chapaevsk more than 3 years and 75%- more than 5 years.

Income for one member of a family in these three groups was nearly the same. Women inquiry on peculiarities of nutrition did not find great differences between the groups. Cow milk samples were taken in private households of inhabitants of Chapaevsk. Inhabitants use free from construction territory of the town for pasturing, including grounds nearby the chemical plant.

Methods of dioxin detection.

The new easy rapid technique for simultaneous determination PCDDs and PCDFs in complex lipophylic matrices generally consists of efficient extraction involving salting out procedure followed by clean-up on the carbon microcolumn that permits to separate fats and lipids

without many-stages liquid-liquid extraction, then the final purification using alumna column and GC–MSHR determination of PCDDs/PCDFs.

Results. Dioxin in environmental. In 1994 the average concentration of dioxins in the air was 0,116 pg/m^3. The observations were carried out when the plant worked at 20 % capacity, so one can guess that previously dioxin air pollution had been higher. A great amount of dioxins is registered in the city soils, what's more important these are the soils of gardens and agricultural fields. Moving away from the plant one would see the dioxin content reduction-up to 36,8 ng/kg in downtown (2,7 km); to 3,9 ng/kg in the city southern part; to 0,9 nano gr/kg at the distance 10-15 km. Private house owners (18.000 in Chapaevsk) grow practically all vegetables and fruit for their own use in the gardens, thus getting an additional dioxin load.

Sources of the town water supply are underground waters in which OXDD 26-78 ng/l is consisted in the highest quantities at comparatively small concentration of other congeners. TEQ dioxins in the water there are within 38,5 - 102,4 ng/l. It could be suppose that such situation was caused by influence of waste from chemical production of pentachlorphenol.

Dioxin in cow and human milk, blood. Dioxins were found in all samples of cow milk: 2,3,7,8-TXDD /17,32 pg/g or 17,32 pg/TEQ/g fat/, 1,2,3,7,8-PeCDD/6 1 or 61, in most samples there were 1,2,3,4,7,8-, 1,2,3,6,7,8- and 1,2,3,7,8,9-HxCDD, 1,2,3,4,6,7,8-HxCDD and furans 1,2,3,4,6,7,8-, 1,2,3,6,7,8,- and 1,2,3,7,8,9 -HxCDF. The rest congeners were found at the edge of the detecting area. Dioxin and furan content in the cow milk is significantly higher of norm accepted in Russia - 5,2 pg TEQ/g fat. *Human milk*. The definition of the dioxins in 7 collected trials of human milk (40 individual trials) has been conducted. The selection of the human milk's trials has been conducted in accordance with the instructions of the WHO./ tabl.1/

Blood. The results of the dioxin determination in the blood plasma have confirmed the fact of the surplus dioxin accumulation detected at the breast milk inspection. The comparison of the dioxin contents in the blood of the different population group shows the considerably higher level of dioxins especially of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD in female workers' blood (table 2). The differences in the content of dioxin in women residing in two different regions of the city are very distinct. Moreover the comparison of the obtained results with the data for the USA shows that the women residing near chemical plant the content of dioxins have much higher than the level of American data and women residing in the district 6-8 Km have the same level.

Table .1

PCDD/PCDF Contents in Human Milk of Women of Chapaevsk Town

/ ng/l and pg/g fat/

Congeners	*TEF, WHO*	*Contents*			
		ng/l	*TEQ.*	*pg/g fat*	*pg/TEQ/g/fat*
2,3,7,8–TCDD	1,0	0,88	0,88	23,2	23,2
1,2,3,7,8–PeCDD	1,0	0,30	0,30	7,88	7,88
1,2,3,4,7,8–HxCDD	0,1	0,125	0,0125	2,78	0,28
1,2,3,6,7,8–HxCDD	0,1	0,91	0,09	26,5	2,65
1,2,3,7,8,9–HxCDD	0,1	0,08	0,008	4,27	0,43
1,2,3,4,6,7,8–HpCDD	0,01	0,405	0,004	10,3	0,10
OCDD	0,0001	15,75	0,0016	426,4	0,04
2,3,7,8–TCDF	0,1	0,515	0,051	1,87	0,19
1,2,3,7,–PeCDF	0,05	0,37	0,018	9,08	0,45
2,3,4,7,–PeCDF	0,5	0,285	0,143	6,73	3,37
1,2,3,4,,8–HxCDF	0,1	0,64	0,064	16,97	1,70
1,2,3,6,,8–HxCDF	0,1	0,41	0,041	11,35	1,13
1,2,3,7,8,9–HxCDF	0,1	0,08	0,008	7,88	0,79
2,3,4,6,,8–HxCDF	0,1	0,32	0,032	3,02	0,03
1,2,3,4′,6, 7,8–HpCDF	0,01	0,08	0,0008	1,87	0,02
1,2,3,4′,7, 8,9–HpCDF	0,01	0,08	0,0008	1,87	0,0002
OCDF	0,0001	0,08	0,000008	2	0,000008
Total PCDD/PCDF			1,55		42,26

Table 2

PCDD/PCDD in blood (plasma), pg/TEQg/ lipid

Congeners	*TEF, WHO*	*Chapaevsk, 1998*			*USA (A. Schecter, 1997)*		
		Workers n=4	*1 – 3 Km n=6*	*5 – 8 Km n=4*	*1980, n=28.*	*1992, n=44*	*1996, n=100*
2,3,7,8– TCDD	1,0	80,5	46,4	<2,5	3,5	3,8	4,2
1,2,3,7,8–PeCDD	1,0	164,9	8,6	<7,5	7,7	9,3	9,8
1,2,3,4,7,8–HxCDD	0,1	5,8	1,8	<1.0	0,9	1,0	1,06
1,2,3,6,7,8–HxCDD	0,1	15,7	4,8	6,1	6,4	7,2	6,8
1,2,3,7,8,9–HxCDD	0,1	5,2	1,3	<1,0	1,3	1,2	1,1
1,2,3,4,6,7,8–HpCDD	0,01	1,45	0,9	0,49	1,3	1,2	1,16
OCDD	0,0001	0,18	0,14	0,08		-	-
2,3,7,8–TCDF	0,1	3,86	0,78	<0,25	-	0,2	0,2
1,2,3,7,8-PeCDF	0,05	1,84	0,41	<0,12	-	0,06	0.08
2,3,4,7,8–PeCDF	0,5	89,0	<,25	<1,25	4,6	4,4	4,7
1,2,3,4,7,8–HxCDF	0,1	13,6	3,8	<1,0	1,3	1,06	1,4
1,2,3,6,7,8–HxCDF	0,1	27,8	2,86	<1,0	0,7	0,69	0,79
1,2,3,7,8,9–HxCDF	0,1	<1,0	<1,0	<1,0	0,2	0,28	0,41
2,3,4,6,7,8–HxCDF	0,1	1,37	<1,0	<1,0	-	0,28	0,40
1,2,3,4′,6,7,8–HpCDF	0,01	<0,12	0,1	<0,1	0,3	0,19	0,14
1,2,3,4,′7,8,9-HpCDF	0,01	<0,12	<0,12	<0,1	-		-
OCDF	0,0001	0,0025	0,0025	0,0025	-		-
Total PCDD/PCDF		412,4	75,2	24,5	28,2	30,9	32,3

Discussion.

Data analyses on dioxin content in drinkable water, cow milk, human milk and in human blood of Chapaevsk population has shown high level 2,3,7,8, TXDD and okta-dioxins. This data congeners are typical for chlorcontain products which are being produced at the factory now. Dioxin content in human milk for Chapaevsk in comparison with the data of the researches of Netherlands, Germany, Denmark, Belgium and of the other countries the women residing in Chapaevsk display considerably higher contents of 2,3,7,8 TCDD and of other congeners. Dioxin content in human blood of women for Chapaevsk is decreasing dependently on extent from the plant. This phenomena is confirmed in further investigation in coordination with CDC. There is a plan to carry out in Chapaevsk epidemiological works for estimation of dioxin hazards upon cryptorchism frequency among boys, breast cancer and endometriosis among women .

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