

The PCDD/PCDFs content in foods, the evaluation of daily intake from foods and the body burden levels of these compounds according to the examination results in the Republic Baskortostan

Zarema K. Amirova, Edward A. Kruglov, Elena A. Loshkina, Radik R. Chalilov, Environmental Protection Centre of Bashkortostan, 147 October Av., 450075, Ufa, Bashkortostan, Russia

Introduction

The PCDD/PCDFs occurrence in human blood, adipose tissue and breast milk is established basically in industrial countries as an influence results of a wide variety of sources. The food consumption is considered generally to be the main source of the toxicants contribution to the body burden of man. The different countries in the world have their own dietary trends, even so the main food source of PCDD/PCDFs remain the animal fats.

In a variety of publications on the problems of the food contamination by PCDD/Fs and these toxicants intake through the food chains to the body burden of man was stated that:

- the food accounts for 70-90% of intake;
- the fat-containing products (meat, animal fat, milk, dairy produce, fish and marine products) contribute most of all;
- the vegetable foods except for some vegetables failed to contain the detectable levels of PCDD/PCDFs.

The intake level from food is evaluated on the base of daily diet and the mean values of PCDD/Fs content in the main foods. Beck H.¹⁾ has estimated this level for Germany as 0,3 pg 2,3,7,8-TCDD/kg BW/day and 2 pg I-TEQ/kg BW/d. The contribution of dairy produce, meat and fish to the total toxicity accounts for about 90% (30% for each). The mean daily PCDD/Fs dose in USA according to A. Schecter²⁾ was 0,28-2,96 pg I-TEQ/kg BW/d in 1991-1992 and 0,52-2,57 pg I-TEQ/kg BW/d in 1996. The mean values for Canada, Japan, Netherland, UK account for as 1,4-2,08 I-TEQ/kg BW/d³⁾. A. Schecter had published^{4,5)} some data on the content of PCDD/Fs and also of some organochlorine admixtures in foods from Russia. The main finding was based on the fact, that the content of PCDD/Fs and others toxicants is somewhat below in comparison to the foods from the industrial countries of Europe.

These data were insufficient for the evaluation of daily intake of PCDD/PCDFs, besides the data on some regions cannot be generalized for such great country as Russia.

In the present paper the examination of this kind was performed for a one of the Russia regions-the Republic of Bashkortostan, where the complex investigations on the background levels in various objects including the foods are being carried out. The reason for the work organization served the information about the availability of PCDD/PCDFs sources in Ufa and about the potential contamination of agricultural areas by some components of 2,4-D herbicide.

Dioxin '97, Indianapolis, Indiana, USA

Objects and investigation methods.

In 1996 in various stores of Ufa a set of 17 arbitrarily chosen foods was purchased: chicken, eggs, freshwater and sea fish, beef, duck- and goose fats, pork fat, smoked sausage, vegetable oil, the whole milk from the farmers and the packed milk, cream, sour cream, curds, hard cheese, butter.

In the analyzing the foods along with absolute data of toxicant content we have interested also in the relative contamination levels of foods, produced in Bashkortostan and the imported analogues, sold in Ufa. Formerly we had examined the food of the vegetable nature: corn, groats, vegetables, fruits and failed to find the PCDD/Fs occurrence on the detectable levels except for unwashed cabbage leaves (0,01-0,02 pg TEQ/g wet w.). Subsequently this group of food was not considered in the evaluating the dioxins intake from foods. In present work the results of the examining practically all the main fat-containing foods from the trading network of Ufa are cited.

The fat from samples of animal origin except for cow milk was extracted by methylene-chloride/hexane mixture. The cow milk fat was extracted by hexane/diethyl ether in presence of $K_2C_2O_4$. The extracts were cleaned on the column chromatography with SiO_2 , Al_2O_3 and activated carbon and analyzed by HRGC/HRMS according to US EPA method 1613. Determining results for some foods are listed in Table 1 and 2.

The data on the food consumption in urban and rural regions of the Republic Bashkortostan were obtained from the State Regional Statistical Department. These data are depicted on Figure 1. The data on product groups were available from the sociological questionnaire. The basic results on the PCDD/Fs levels in foods and their daily intake per head in urban regions of Bashkortostan are listed in Table 3.

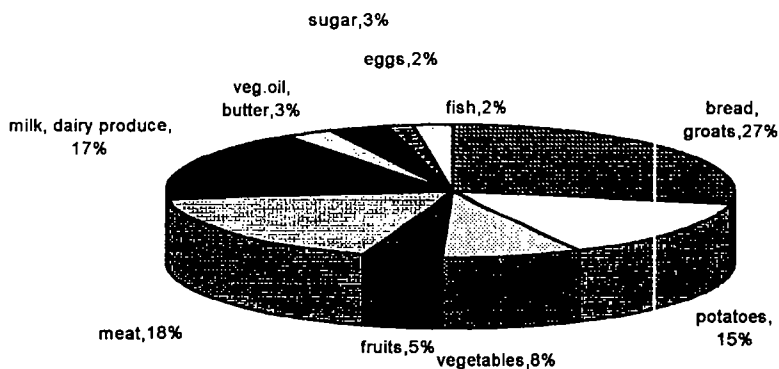


Figure 1. Food consumption in Republic Bashkortostan.

LEVELS IN FOOD

The daily consumption for town man accounts for 138,7 pg TEQ/day, this corresponds to 2,31 pg TEQ/kg BW/day (BW=60 kg). For country folk these figures are 69 pgTEQ/day and 1,15 pgTEQkg BW/day, respectively. The decreasing the PCDD/Fs intake in rural regions may be related to the consumption of the whole cow milk instead of packed one (the TEQ value of the whole cow milk is 0,02 pg/g BW) and to the consumption in a lesser degree of the factory-made meat products-sausages and smoked foods.

The diet of the people in Bashkortostan is characterized by comparatively low consumption both of sea and freshwater fish.

So the intake from these three food groups:meat/ milk/fish for Bashkortostan accounts for 48:46:6. In the North America this ratio is 52:23:19, respectively.

Conclusions.

As the contamination level of the main fat-containing foods with PCDD/Fs in the Republic Bashkortostan does not differ from the known published data on background levels in Europe, USA, Canada, then at some difference in diet the daily intake levels represent the values of the same order: 69-139 pg TEQ/day, for Bashkortostan this corresponds to 1,15-2,31 pg TEQ/kg BW/day.

The calculation data obtained are not in contrast with the analyzing results of the background samples of blood and adipose tissue of general population in Ufa and rural regions, that are somewhat lower when compared with the mean European data (Table 4).

Reference.

- (1) Beck, H; Droug, A; Mathar, W. *Chemosphere*, **1993**, 25, 7-10, 1539-1550.
- (2) Scherter, A; Cramer, P; Boggess, K; Stanley, J; Olson, J; Hesser, H; **1996**, *Dioxin'96*, 28, 320-324.
- (3) Exposure of man to dioxins. **1992**, Technical report, 49, ECOTOC, Brussels, Belgium.
- (4) Schecter, A; Furst, P; Furst, C; Grachev, M; Beum, A; Koptug, V. *Chemosphere*, **1992**, 12, 2009-2015.
- (5) Scherter, A; Furst, C; Furst, P. *Organohalogen Compounds*, **1993**, 14, 169-173.

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Table 1. Dioxin and dibenzofuran levels in dairy products and vegetable oil from Ufa, Republic Bashkortostan, Russia (ng/kg lipids).

PCDD/Fs	milk	cheese	curds	sour cream	cream	butter	vegetable oil
2,3,7,8-TCDD	2,13	0,08	0,01	0,22	0,96	0,05	ND(0,02)
1,2,3,7,8-PnCDD	0,52	0,54	ND(0,1)	0,43	1,44	0,09	0,05
1,2,3,4,7,8-HxCDD	ND(0,1)	0,41	0,02	ND(0,1)	0,88	0,06	ND(0,02)
1,2,3,7,8,9-HxCDD	ND(0,1)	ND(0,3)	0,04	0,33	1,15	0,13	ND(0,02)
1,2,3,6,7,8-HxCDD	ND(0,1)	ND(0,3)	0,04	ND(0,1)	0,72	0,08	ND(0,02)
1,2,3,4,6,7,8- HpCDD	0,67	1,13	0,11	1,07	2,12	0,32	0,15
OCDD	1,88	2,66	0,32	2,37	4,2	0,7	0,73
2,3,7,8-TCDF	3,68	1,24	0,02	0,28	3,92	0,28	0,04
1,2,3,7,8-PnCDF	0,41	0,52	0,02	0,55	3,31	0,16	0,09
2,3,4,7,8-PnCDF	0,74	0,84	0,07	1,1	4,74	0,40	0,17
1,2,3,4,7,8-HxCDF	0,33	0,85	0,08	0,78	2,74	0,19	0,09
1,2,3,6,7,8-HxCDF	0,24	0,37	0,04	0,42	0,23	0,08	0,05
1,2,3,7,8,9-HxCDF	0,24	0,46	0,04	0,32	0,96	0,10	0,04
2,3,4,6,7,8-HxCDF	0,36	0,47	0,06	0,73	1,49	0,2	0,08
1,2,3,4,6,7,8- HpCDF	0,44	1,05	0,16	1,03	2,45	0,26	0,12
1,2,3,4,7,8,9- HpCDF	ND(0,1)	0,38	0,04	0,25	0,74	0,19	ND(0,01)
OCDF	1,02	2,47	0,12	0,82	5,11	0,23	0,13
Total PCDD	5,62	5,42	0,55	4,7	11,47	1,43	1,01
Total PCDF	7,57	8,65	0,65	6,26	25,69	2,43	0,82
Total	3,2	14,07	1,2	10,96	37,16	3,86	1,83
PCDD/PCDF							
Total PCDD,TEQ	2,43	0,46	0,03	0,49	1,97	0,13	0,05
Total PCDF,TEQ	0,89	0,67	0,06	0,84	3,48	0,3	0,12
Total PCDD/Fs, TEQ	13,32	1,13	0,09	1,33	5,45	0,43	0,18
% lipids	3,2	24,4	NA	20	20	98	100

LEVELS IN FOOD

Table 2. Dioxin and dibenzofuran levels in meat, fat and fish from Ufa, Republic Bashkortostan, Russia, ng/kg lipids.

PCDD/Fs	freshwater fish	beef	smoked sausage	chicken meat	pork fat	goose fat	duck fat	chicken fat
2,3,7,8-TCDD	1,89	0,36	0,26	0,26	0,08	0,21	0,26	0,23
1,2,3,7,8-PnCDD	3,43	ND(0,25)	0,41	ND(0,6)	0,20	0,47	ND(0,2)	ND(0,2)
1,2,3,4,7,8-HxCDD	5,71	ND(0,35)	0,44	0,65	0,1	0,19	0,08	ND(0,5)
1,2,3,6,7,8-HxCDD	4,29	ND(0,35)	0,36	ND(1)	0,11	0,24	0,16	0,59
1,2,3,7,8,9-HxCDD	4,29	ND(0,35)	0,71	ND(1)	0,06	0,15	0,08	0,7
1,2,3,4,6,7,8-HpCDD	3,14	0,18	0,75	1,04	0,43	0,71	0,06	0,93
OCDD	5,94	1,58	2,78	2,49	2,6	4,4	3,26	2,63
2,3,7,8-TCDF	9,98	0,35	0,64	1,32	0,3	0,89	0,46	0,25
1,2,3,7,8-PnCDF	2,46	0,31	0,55	1,62	0,27	0,56	0,44	0,98
2,3,4,7,8-PnCDF	3,77	0,48	0,51	0,68	0,39	0,71	0,63	1,3
1,2,3,4,7,8-HxCDF	4,66	ND(0,18)	0,7	1,24	0,28	0,47	0,49	0,74
1,2,3,6,7,8-HxCDF	1,69	ND(0,09)	0,38	0,81	0,17	0,25	0,24	0,51
1,2,3,7,8,9-HxCDF	2,74	ND(0,13)	0,42	0,94	0,16	0,20	0,17	0,44
2,3,4,6,7,8-HxCDF	2,31	ND(0,13)	0,66	1,22	0,19	0,28	0,22	0,62
1,2,3,4,6,7,8-HpCDF	6,74	1,32	0,87	1,92	0,42	0,54	0,47	1,15
1,2,3,4,7,8,9-HpCDF	2,26	ND(0,26)	0,54	0,74	0,13	0,15	0,13	0,48
OCDF	6,63	2,5	1,99	1,57	0,48	0,83	0,52	1,07
Total PCDD	28,68	3,42	5,71	7,02	3,58	6,37	3,9	5,73
Total PCDF	43,28	5,72	7,26	12,06	2,79	4,88	3,77	7,54
Total	71,91	9,17	12,97	19,08	6,37	11,25	7,67	13,27
PCDD/Fs								
Total	5,08	0,61	0,63	0,58	0,15	0,51	0,3	0,49
PCDD,TEQ								
Total	4,12	0,3	0,58	0,96	0,34	0,59	0,5	0,97
PCDF,TEQ								
Total	9,2	0,9	1,21	1,54	0,49	1,1	0,8	1,46
PCDD/ PCDFs,TEQ								
% lipids	3,5	22,8	34,8	14,6	95,9	81,9	94,2	80,83

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Table 3. Daily PCDD/PCDFs intake from foods (Bashkortostan, urban region)

Food products	PCDD/Fs content, pg/ TEQ/g w.w.	Consumption per head, g/day	Daily intake from food, pg/day
beef	0,32	100	32
pork	0,63	30	18,9
mutton	0,12	10	1,2
poultry	0,35	30	10,5
animal fat	0,56	19	10,64
smoked foods	0,44	25,7	11,3
vegetable oil	0,18	19	3,61
butter	0,43	12,7	5,5
eggs	0,03	21,83	0,6
fish	0,26	25,7	6,7
milk	0,21	139,3	29,25
sour cream	0,29	7	2,03
curds	0,09	7	0,63
cream	0,1	3	0,3
sour milk foods	0,1	27	2,7
mayonnaise	0,1	7	0,7
cheese	0,32	6,7	1,14

Total-138,7 pg I-TEQ /day

Table 4. Daily intake of PCDD/Fs (I-TEQ) and their levels in blood and adipose tissue.

Region	Daily intake, pg/kg BW/day (BW=60 kg)	I-TEQ level in blood, pg/g lipids	I-TEQ level in adipose tissue, pg/g lipids
	Present	report	
Bashkortostan			
urban	2,31	17-23	23-26
rural	1,15	5-13	
	Published	data	
USA	0,52-2,57	41	24-28
Germany	2,0	42	69
Japan	1,4	40	38
Canada	2,08	40	36