Chlorinated dioxin and dibenzofuran levels in food from Bashkortostan Republic, Russia

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1. Introduction

The situation with contamination of environment in the Bashkortostan Republic by dioxins (PCDD) and dibenzofurans (PCDF) is considered in most examples[1-4]. The main sources of environmental contamination by PCDD/PCDF are chemical plants "Khimprom" in Ufa and "Kaustik" in Sterlitamak, which have been manufacturing different chlororganic products for more than 40 years. In the process of operation of installations on thermal burning of chlororganic sludge up to 2.5 ng/m^3 dioxins and dibenzofurans is thrown out into the atmosphere. The high levels of dioxin concentrations are found in gas discharge of installations for toxic waste burning at "Khimprom" and in waste water of this plant. More than 40 years of chlororganic chemistry plants operation have resulted in dioxin contamination of environment in industrial centres of the Bashkortostan Republic and in farm regions not far from chemical plants. In the present paper researches on determination of dioxin and dibenzofuran contents in food products are conducted, as well as daily intake of dioxins by industrial cities inhabitants of the Bashkortostan Republic is evaluated.
The detection of PCDD/PCDF contents was carried out in laboratories of the Institute of Evolution Morphology and Ecology of Animals of Russian Academy of Sciences (Moscow, Dr. N. Kluev), Ecological Centre of Bashkortostan Republic (Ufa, Dr. E. Kruglov) and Russian Research Centre for Emergencies (Moscow, Dr. S. Semenov).

2. Materials and methods

Food was collected and frozen from supermarkets in Ufa and Sterlitamak. Samples were prepared by grinding the samples of the same types (e.g., beef, chicken, milk). Each sample composite was ground and homogenised. Equal amounts of each type of individual food were taken for a composite sample. Food and beverages in proportion to their average daily consumption were purchased and prepared according to normal consumer conditions. The daily diet sample had the following composition: cereals g 360; milk and dairy products g 240; fruits and vegetables g 410; beef, pork , chicken, fish and eggs g 265; fat and oil g 50; beverages and water g 3500.
Before the extraction the samples were spiked with ^{13}C-labelled standards consistent with EPA Method 8290. After extraction with 1:1 dichloromethane/hexane the solvent was removed and the percent extractable lipid was gravimetrically determined. The lipid was re-dissolved in hexane and slurred in acidified silica gel. The extract was then eluted through an acidified silica gel column, a neutral alumina column, a carbon column and analyzed on high-resolution GC-MSs. A 60-m DB-5 GC-MS column was used to provide chromatographic resolution. PCDD/PCDF levels were evaluated

on lipid basis. The results from food samples are presented in the Table on a whole (or wet) weight basis, in order to be more representative of the way food is purchased and consumed.

3. Results

In the Table PCDD/PCDF analysis results from 14 different samples of meat (beef, pork), 10 samples of chicken, 15 samples of milk and 13 samples of fish are presented. In this Table we can find some information concerning dioxin concentrations in water (15 samples). Most of water samples are taken from the Belaja river and the Ufa river. These samples show, that the dioxin concentrations in water do not exceed the norms accepted in Russia (20 ppq). In all cases the dioxin contents in water are not more than 1 ppq. Among food products the highest levels of dioxin contamination has chicken, then follow milk and beef. In fish dioxin concentration is also high. However it does not exceed the allowable norms.

TABLE

PCDD/PCDF LEVELS IN FOOD FROM BASHKORTOSTAN REPUBLIC

Food	*n*	Maximum permissible concentracion, pg/g (lipid basis)	PCDD/PCDF concentration, pg/g					
			2,3,7,8-TCDD			TEQ		
			min	max	mean	min	max	mean
Beef	8	3.3	0.01	0.36	0.12	0.03	0.42	0.20
Pork	6	3.3	0.05	0.40	0.14	0.14	0.87	0.34
Chicken	10	3.3	0.05	10.81	1.02	0.09	46.0	4.54
Milk	15	5.2	0.03	0.61	0.16	0.07	0.74	0.26
Fish	13	88.0	0.01	0.90	0.11	0.03	1.35	0.18
Water*	15	20	0,5	1	0,8	0,5	1	0.8

* pg/l

Fig. 1 illustrates the contribution of food to PCDD/PCDF human exposure in Ufa and Sterlitamak. It is obvious, that with food arrives 97,5 % of dioxins, whereas with water - 0,2 % and with air - 2,3 %. This quantity is close to data for other industrial countries of Europe and Northern America[5]. The main quantity of PCDD / PCDF arrives with chicken and characterises the level of its consumption in Russia (fig. 2).

The PCDD / PCDF isomer structure in milk and meat from Ufa and Sterlitamak corresponds to the isomer structure of dioxin sources. In products from Ufa 2,3,7,8-TCDD and 2,3,7,8-TCDF prevail,

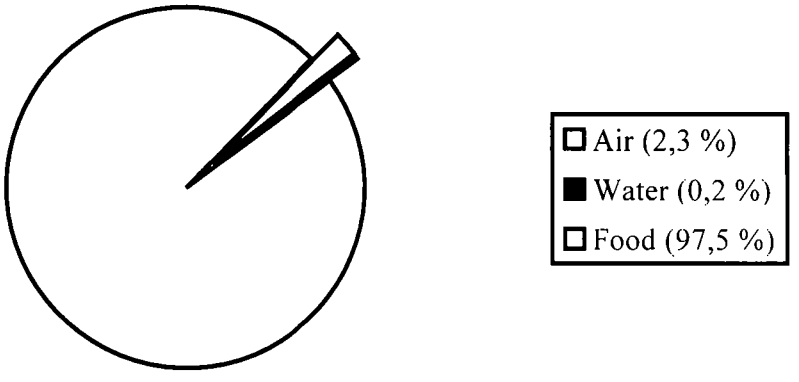

Fig. 1. PCDD/PCDF human exposure in Ufa and Sterlitamak

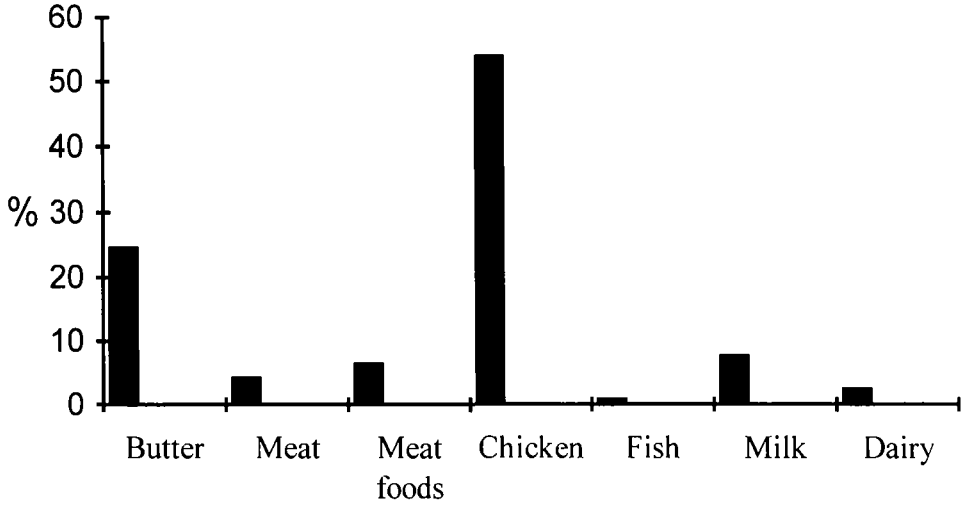

Fig. 2. Relative content of PCDD/PCDF in food

that is connected with their formation in the process of 2,4-D. In Sterlitamak the majority of dioxins Cl_6 - Cl_8-isomers are presented. The PCDD isomer spectrum of human milk from Ufa and Sterlitamak also corresponds to the isomer structure in discharge sources and food. It testifies to the property of PCDD / PCDF accumulation in inhabitants of industrial centres of the Bashkortostan Republic through food. Special attention is required for control of forages while breeding chicken. It is stated, that the forages for chicken contain rather high dioxin concentration and other chlororganic products.

4. References

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