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Determination of Organochlorine Pesticides in Human Adipose Tissue in Minsk, Republic of Belarus

E. N. Barkatina, A. L. Pertsovsky, V. I. Murokh, N. D. Kolomiets, O. V. Shulyakovskaya, N. D. Veretennikova, O. N. Venger

State Institution "Republican Scientific-Practical Centre for Food-Stuffs Quality and Safety Assessment," 3, P. Brovka Str., 220013, Minsk, Republic of Belarus

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Intensive use of organochlorine pesticides (OCP) in agriculture, medical parasitology and other fields for years has resulted in accumulation in the environment and they have become its global pollutants. Physical and chemical properties that OCP possess provide high stability and let to cumulate themselves in human and animal adipose tissue.
A child gets the first portions of OCP through the mother's placenta and further through food, water, air. OCP possess high toxicity. Being poisoned by OCP the central nervous system, liver and other parenchymatous organs are affected. They cause disturbance of functions of endocrine, cardiovascular systems, blood and so on. Use of OCP, except γ-hexachlorcyclohexane, is prohibited in many countries. Though a number of countries use OCP in medical parasitology nowadays. That adds new portions of poisons to the environment.

In our earlier study (Barkatina et al 1998) it showed that women breast milk in Belarus is polluted with OCP. The content of organochlorine pesticide residues in basic food products consumed in Belarus was also studied and daily OCP intake based on the amount consumed per day was estimated (Barkatina et al 1999). It was of great interest to study organochlorine pesticide residues in human adipose tissue. That data can serve as an additional criteria for estimation of the environmental OCP pollution. In this study we give the results of investigation of the following OCP residues (α-, β- , γ- , δ-hexachlorcyclohexane (HCH), hexachlorobenzene (HCB), heptachlor, heptachlor epoxide, aldrin, dieldrin, p,p'-DDE, p,p'-DDD and p,p'-DDT) in human adipose tissue in Minsk, Belarus. Such study is carried out in the republic for the first time.

MATERIALS AND METHODS

28 samples of human adipose tissue were taken at the general surgery department of the Cardiology Scientific Research Institute, Minsk. 19 samples were of male donors of different age (25-76), and 9 samples - of female donors (19-64 years old).

J. T. Baker standards (P.O. Box 1, Deventer 7400 AA, Holland) were used.

Correspondence to: E. N. Barkatina

The samples collected for analysis were prepared in the following way.

A ground sample (about 2 g) of adipose tissue was rubbed in a mortar with anhydrous sodium sulfate and placed then in an extraction flask. Pesticides were extracted with two 40-50 ml portions of hexane for 1,5 hours each of them. The solvent was evaporated from the united extracts and the fat mass was determined. Then the fat was dissolved in hexane and the sample was cleaned up with concentrated sulfuric acid, flushed in distilled water and in 1% sodium bicarbonate solution till the neutral reaction. The cleaned extract was dried by anhydrous sodium sulfate, filtered into a round-bottom flask, the solvent was evaporated and the residue was dissolved in 1 ml of hexane.

A Perkin Elmer Model 8700 gas chromatograph with electron capture detector and a silica capillary columns (30 m length, 0,32 mm and 0,25 mm id) with silicon liquid phases Ultra-2 and DB-5 were used. The range of programmed temperature was from 170 to 250°C (Ultra-2) and from 200 to 250 °C (DB-5), speed 4 °/min. The injector temperature was 250°, detector temperature - 300°. Quantitative analysis was carried out by an absolute calibration method on peak squares. Each sample was analyzed three times. The mean relative square deviation of OCP determination did not exceed 15%. The recovery of OCP was ranged within 75-90%. Sensitivity of the method made up 0,01-0,05 μg/kg. Control experiences with reagents had been carried out before the analysis. There were no peaks in the pesticide region on the chromatograms.

RESULTS AND DISCUSSION

In the analyzed adipose tissue samples of the population of Minsk residual quantities of β-HCH, HCB, p,p'-DDE (100% of positive samples) and p,p'-DDT (32% of positive samples) were found. α-, γ- , δ-HCH, heptachlor, heptachlor epoxide, aldrin, dieldrin and p,p'-DDD were not found.

Mean concentrations of OCP found in the samples of human adipose tissue are given in the Table 1.

Samples of female donors contain 2,2 times as much β-HCH than those of male donors; HCB - 1,5 times as much. Samples of male donors contain almost the same p,p'-DDE quantities like those of female donors.

Presence of HCB in human adipose tissue some authors connect with possible metabolic relation between HCB and HCH (Gopalaswamy and Alyar 1984). The correlation between HCB and β-HCH in human adipose tissue samples is also mentioned in the study (Gomez-Catalan et al.1995). The level of α- and γ-isomers of HCH in organisms and in ecosystem is found usually low because of transformation to β-isomer and because of the persistent of β-isomer (Çok et al. 1998). HCB is known to be released in the environment due to using it as fungicide and also due to industrial activities. Some studies describe that HCB chlorinated hydrocarbons (Burgaz et al. 1994).

Table 1. OCP levels in human adipose tissue in Minsk (mg/kg extracted fat).

Sex	β-HCH	HCB	p,p`-DDE	p,p`-DDT
females				
min-max	0.040-2.303	0.014-0.224	0.081-2.917	not found-0.029
$\bar{x} \pm SD$	0.505±0.714	0.077±0.083	0.929±0.994	0.005±0.010
males				
min-max	0.047-0.568	0.009-0.119	0.133-7.760	0.005-0.090
$\bar{x} \pm SD$	0.230±0.147	0.053±0.032	1.061±1.683	0.012±0.025

In this study we have found the trend toward increase of OCP quantity in human adipose tissue with the increase of donor's age which is well supported by literary data (Burgaz et al. 1994; Waliszevski et al. 1995).

In Table 2 the levels of OCP in human adipose tissue found in present study are compared with those of other countries. It should be noted that in the literary data given in Table 2 information about content of heptachlor and heptachlor epoxide in human adipose tissue is given only in the following papers (Burgaz et al. 1994; Çok et al. 1998). So in the paper (Burgaz et al. 1994) heptachlor content in human adipose tissue samples makes up 0,021±0,04 mg/kg, heptachlor epoxide content - 0,062±0,06 mg/kg. In the paper (Çok et al. 1998) heptachlor epoxide content in human adipose tissue samples makes up 0,121±0,063 mg/kg.

Mean concentrations of OCP obtained in present study indicate that Belarus can be compared with such countries as Germany, Kanada, USA, where OCP content in human adipose tissue is comparatively not high.

So the carried out study for determination of OCP content in human adipose tissue in Belarus revealed the presence of β-HCH, HCB, p,p`-DDE and p,p`-DDT in it though the quantities are not high. Because the agricultural and medical use of OCP was prohibited long ago. The comparison of the obtained data with those showing OCP content in human adipose tissue in Russia (Bogomolova et al. 1978) confirms decrease of DDT content during these years. Anyway even not high concentrations of highly toxic OCP influence people's health negatively. Especially it is dangerous for young women's health who are still going to have children. Besides it should be taken into account that in bad ecological situation in Belarus unfavourable influence of contaminants of different class upon human organism is aggravated in connection with the Chernobyl disaster. That is why it is necessary to estimate OCP content in women breast milk, food and human adipose tissue from time to time.

Table 2. OCP levels in human adipose tissue in different countries (mg/kg).

Country	HCH					HCB	p,p`-DDE	DDT		
	α-	β-	γ-	δ-	ΣHCHs			o,p`-	p,p`-	ΣDDTs
Germany, 1990[a]	-	0.042	0.038	-	-	-	0.436	0.013	0.093	0.556
Poland, 1990[a]	-	0.002	0.004	-	-	-	15.00	0.009	0.67	15.00
Finland, 1991[a]	-	-	not found	-	-	-	2.60	-	-	2.80
Japan, 1991[a]	-	0.84	not found	-	-	-	2.40	-	-	-
USA, 1991[a]	-	0.163	-	-	-	-	0.679	0.014	0.294	0.987
Canada, 1992[a]	-	0.028	-	-	-	-	0.585	0.006	0.032	0.623
India, 1994[b]	3.63 ±3.39	5.98 ±4.52	3.54 ±3.22	4.77 ±4.42	17.92 ±12.40	-	5.79 ±6.12	-	6.77 ±7.23	13.86 ±12.70
Kenya, 1992[a]	-	0.034	-	-	-	-	3.26	0.15	2.49	5.91
Spain, 1993[a]	-	1.97	0.06	-	-	-	6.00	-	1.18	7.18
Mexico, 1992[a]	-	0.25	0.30	-	-	-	18.91	1.19	4.72	24.82
Mexico, 1997[c]	0.01	0.17	0.02	-	0.18	0.07	4.04	0.05	0.56	4.67
Turkey, 1991-1992[d]	0.014 ±0.06	1.522 ±1.03	0.002 ±0.01	-	1.539 ±1.04	0.164 ±0.22	3.722 ±3.59	-	0.275 ±0.32	4.42 ±4.16
Turkey, 1995-1996[e]	0.102 ±0.067	0.374 ±0.311	0.043 ±0.095	-	0.519 ±0.339	0.033 ±0.036	1.832 ±0.889	-	0.088 ±0.212	2.130 ±1.026
Russia, 1975-1977[f]	-	-	-	-	0.683 ±0.083	-	-	-	-	5.268 ±0.384
Belarus, 2000[g]	not found	0.319 ±0.427	not found	not found	0.319 ±0.427	0.061 ±0.054	1.019 ±1.448	-	0.010 ±0.021	1.029 ±1.430

Sources: a. Waliszevski et al. 1995; b. Dua et al. 1998; c. Waliszevski et al. 1998; d. Burgaz et al. 1994; e. Çok et al. 1998; f. Bogomolova et al. 1978; g. present study.

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