PROJECT TOCOEN

The Fate of Selected Organic Compounds in the Environment Part XXVI. The Contents of PCBs and PCDDs/Fs in Human Fat in Czech and Slovak Republics

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1. Introduction

One of the most significant and problematic groups of persistent organic pollutants (POPs) is a group of Poly-Chlorinated Aromatic Compounds (PCACs). Polychlorinated bibenzo-p-dioxins (PCDDs) and bibenzofurans (PCDFs) are structurally similar compounds which present significant factors for today's environment. PCDDs/Fs are practically ubiquitous, we can find them in every part of environment - in air, water, sediments, soils, various species of biota, and also in food like meat, milk, and vegetable.

Although the world is engaged in professional discussion about the sources of PCDDs/Fs, their fate in the environment and their influences and risks to various organisms, in the Czech Republic concrete information about contamination of human tissues practically does not exist.

This study is designed to obtain the first information concerning the contamination of human tissues by chlorinated aromatics, and is based on a previous determination of the presence of these compounds in environmental samples and various types of human food in the Czech Republic.

This article evaluates the results for the determination of PCDDs/Fs in samples of human adipose tissues from two different sites of the former Czechoslovak Federal Republic.

2. Materials and methods

2.1. The preparation of human adipose tissue for chemical analysis
Adipose tissue was sampled from dead people from Prague (3 men, Czech Republic) and Michalovce (2 men, Slovak Republic). The samples of adipose tissue were homogenized and extracted with a mixture of acetone - hexane (1:1) in a shaker. The extracts were filtrated through anhydrous sodium sulphate and concentrated by using a rotary evaporator.

2.2. Determination of PCBs and residues of chlorinated pesticides in human adipose tissue
The chemical analyses were made by standard procedures using GC/ECD validated by the laboratory of Department of Food Chemistry and Analysis, Chemical University, Prague.

2.3. Determination of PCDDs/Fs and coplanar PCBs in human adipose tissue
Seven samples of human adipose tissue were analyzed for PCDDs/Fs by the US National Center for Environmental Health (Atlanta, U.S.A.). The extracts of adipose tissues (ch. 2.1.) were diluted in 5 ml of n-hexane and carbon-13 labeled internal standards for each of the PCDDs/Fs and coplanar PCBs were added. The sample cleanup was a modified Smith, Stalling Johnson procedure using "isotope-dilution mass spectrometry" for the quantification of individual congeners[1)].
The method can be described in four steps:
1) the preparation of homogenated sample and the addition of 19 carbon-13 labeled internal standards of the PCDDs/Fs and coplanar PCBs congeners
2) the cleanup and fractionation with silica and active acid Al_2O_3 columns
3) the selective adsorption on active carbon, and the elution from the column by toluene
4) the analysis of concentrated extracts by HRGC/HRMS.

The analyses were made on a mass spectrometer VG 70SE with detection limit of 0,1 - 0,2 $pg.g^{-1}$ of isolated adipose tissue.

3. Results and discussion

The man **A**, middle age. The adipose tissue contains low concentrations of pesticides (which are not currently used in the Czech Republic), relatively high concentrations of PCBs, especially congeners 138 and 180.
The man **B**, senior age. The total concentrations of HCB, HCH, and PCBs are low while the concentrations of metabolite of DDT and HCB are relatively high.
The man **C**, middle age. In comparison with man A, the contamination of adipose tissue is higher, near contamination of twenty-year-older man B.
The man **D**, middle age. The concentrations of observed compounds did not extend beyond average level.
The man **E**, senior age. The contamination of adipose tissue by DDT and HCB is very high, probably due to agricultural exposure.

The results of HRGC/HRMS method (Tab. 3.) show that this method provides sufficient sensitivity for the determination of toxicologically significant congeners of PCDDs/Fs and coplanar

PCBs. The detection limits of individual congeners are in the range from 0,1 to 0,2 ng.kg^{-1} of sample and therefore the HRGC/HRMS method is suitable for analysis of biological samples.

We found only 2,3,7,8-substituted congeners of PCDDs and PCDFs, especially hepta and octa-chlorinated, in adipose tissues which is in agreement with previous studies[2]. While there are some differences in congeners patterns from some countries[3], in general the patterns and levels are similar to previous studies[4]. The I-TEQ values for the coplanar PCBs (Tab. 3) make a major contribution to the total TEQs in these samples which is similar to reports from Japan and Sweden[4]. The percent contribution of the PCDFs to the total TEQ in these samples is 2 to 3 times higher than the PCDDs which is very different from data from other countries[4]. The high I-TEQ values for the PCDFs in these samples from Czech and Slovak Republics are due to the relatively high levels of 2,3,4,7,8-pentaCDF (range of 21 to 44 ppt). The average concentration of 2,3,7,8-TCDD is 1.9 ng.kg^{-1} which is low compared to other industrialized countries[5),6)]. Relatively high concentration of octa-CDD (100 to 460 ppt) were found in the human tissues considering that this isomer was found in low concentration in pork and beef. This suggest another source of contamination for this congeners.

4. References

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Tab. 1. Specification of individual samples of human adipose tissue.

Person	Sample No.	Age	City	type of adipose tissue
man A	1	38	Michalovce	mesenteric
man B	2	59	Prague	mesenteric
man B	3			subcutaneous
man C	4	38	Prague	mesenteric
man D	5	38	Prague	subcutaneous
man E	6	58	Michalovce	mesenteric
man E	7			subcutaneous

Tab. 2. The concentrations of some chlorinated persistent compounds in human adipose tissue obtained by GC/ECD.

Sample No.	Σ HCH $mg.kg^{-1}$	Σ HCB $mg.kg^{-1}$	Σ DDT $mg.kg^{-1}$	HpCE $mg.kg^{-1}$	Σ PCB $mg.kg^{-1}$
1	0.039	0.253	1.291	0.011	3.525
2	0.235	1.475	0.628	0.030	1.552
3	0.251	0.735	0.565	0.031	1.616
4	0.225	2.005	2.094	0.020	1.870
5	0.078	0.935	1.310	0.016	1.416
6	0.226	3.363	9.966	0.013	1.408
7	0.197	3.395	8.404	0.011	1.157

Σ HCH - sum of isomers α-HCH, β-HCH, γ-HCH
Σ DDT - sum of isomers and metabolites of DDT (o-, p-DDT, p-, p-DDE, o-, p-DDD, p-, p-DDD)
HpCE - heptachloroepoxide

Tab. 3. The results from chemical analysis by CDC Atlanta

Sample No.	I - TEQ $ng.kg^{-1}$			Total I - TEQ $ng.kg^{-1}$
	PCDD	PCDF	planar-PCB	
1	6.9	18.4	6.0	31.3
2	10.7	25.2	22.3	58.2
3	10.0	24.9	21.2	56.1
4	7.5	24.0	27.9	59.4
5	7.2	12.0	13.1	32.3
6	6.4	18.6	31.4	56.4
7	6.7	18.9	32.6	58.2

PCDD - sum of all detectable dioxins
PCDF - sum of all detectable furans
planar-PCB - planar congeners of polychlorinated biphenyls