Concentrations and distribution of PCDDs, PCDFs and Co-PCBs in various tissues of Japanese

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Introduction

We have already been contaminated with very toxic organochlorine chemicals such as polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and coplanar polychlorinated biphenyls (Co-PCBs)[1)2)]. We have reported their levels in the liver, blood, adipose tissue and brain in the 7 Japanese people in the meeting Dioxin '92, Tampere, Finland[3)]. In this study, we investigated the concentrations and distribution of PCDDs, PCDFs and Co-PCBs in the spleen, muscle, kidney and lung in addition to the above four tissues in the 9 Japanese people including the former ones.

Methods

Samples of human tissues/organs obtained from the 9 Japanese people, who had died in accidents between 1988 and 1990 in Fukuoka Prefecture, were kindly given by an honorary professor T. Nagata, ret., Department of Legal Medicine, Faculty of Medicine, Kyushu University, Fukuoka 812-82 Japan. The 8 tissues/organs (liver, blood, adipose tissue, brain, spleen, muscle, kidney and lung) were extracted with acetone/hexane using a POLYTORON® homogenizer. Each extract was then concentrated to dryness, and the lipid weight was gravimetrically determined.
Ten kinds of ^{13}C-labeled PCDDs/PCDFs and three kinds of ^{13}C-labeled Co-PCBs were added as internal standards for checking the recoveries of the PCDDs/PCDFs and Co-PCBs throughout the entire analytical procedure. The extract was cleaned up on a $AgNO_3$-silica gel column and charcoal column.
The PCDDs/PCDFs and Co-PCBs were analyzed using the HRGC/HRMS technique along with a Finnigan MAT-95 mass spectrometer (Finnigan MAT-95, Germany) directly interfaced with a HP Model 5890 II gas chromatograph. All target compounds were measured using an SP-2331 capillary column (0.32 mm x 60m; film thickness, 0.25μm). The mass resolution (5 % valley) was 7000 to 8000.
The concentrations (pg/g on fat basis) of the PCDDs/DFs and Co-PCBs were converted to the amounts of TEQ of 2,3,7,8-TCDD, which were calculated using the Toxic Equivalency Factor (TEF) values proposed by the NATO Committee on Challenge to Modern Society(1988) for PCDDs/DFs, and those by WHO-ECEH and ICPS (1994) for Co-PCBs.

We divided the 9 Japanese into 4 groups according to their ages, that is, A, B, C and D as indicated in Table 1. Group A consists of only one person and he is the youngest, 2 years old. Their respective mean ages were 2.0, 19.7, 46.7 and 78.0 in groups A, B, C and D, respectively.

Results and discussion

It appears that this is the first study to determine the concentrations of PCDDs/DFs and Co-PCBs in 8 tissues/organs of 9 individual people.

The TEQ levels of the 8 tissues/organs are shown in Table 2. Group D, the eldest group, indicated the highest level, which was expected, because we have already reported the concentrations of these chemicals in human adipose tissue showed an increase with age[4]. Contrary to our expectation, the TEQ level of group A, the 2 year-old boy, was the second highest.

Except for group A, the TEQ levels were the highest in the liver (100—680 pg/g). In group A, the adipose tissue showed the highest level (290 pg/g) while the level in the liver was not very high (82 pg/g). In each group, except for the lung of group C, the TEQ levels in the spleen, muscle, kidney and lung were not very different. In the 4 groups, the TEQ levels were the lowest in the brain ranging from 10 to16 pg/g. In the lung, the TEQ levels of groups A, C and D were almost the same with the lowest in group B.

We also compared the TEQ levels in individual tissues/organs in the 4 groups. As shown in Fig. 1, in the adipose tissue, the level was the highest in group A and the lowest in group B or C. In group A, Co-PCBs showed the largest contribution to the TEQ level and in other groups, the PCDDs or PCDFs were the highest. Similar results were seen in the blood, spleen, muscle and kidney. Quite different TEQ levels were observed in the liver, as indicated in Fig. 2. The level was the lowest in group A and the highest in group D.

Conclusions

The eldest group indicated the highest TEQ level and the TEQ levels in the liver were the highest among the 8 tissues/organs except for group A. In groups B, C and D, PCDFs was dominant in all the tissues/organs examined. In groups B and C, the TEQ levels in the blood, adipose tissue, spleen, muscle and kidney were almost same. In all the 4 groups, the brain showed the lowest TEQ level. TEQ levels in the adipose tissue, blood, muscle, spleen and kidney of a 2 year-old boy were comparable to those of the eldest group. However, in the liver, brain or lung, the level was not very high.

References

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Table 1. Groups in this study

Group	Sex	Age	Mean Age
A	Male	2	2.0
B	Male	19	19.7
	Male	20	
	Female	20	
C	Male	41	46.7
	Male	47	
	Male	52	
D	Female	74	78.0
	Female	82	

Table 2. Concentrations and distribution of TEQ value in four groups (pg/g on fat basis)

	A	B	C	D
Liver	82	134	100	680
Adipose	290	46	50	160
Blood	149	30	32	143
Muscle	109	33	29	68
Lung	83	34	88	88
Spleen	73	34	29	78
Kidney	65	24	20	62
Brain	16	13	10	16

HUM (po)

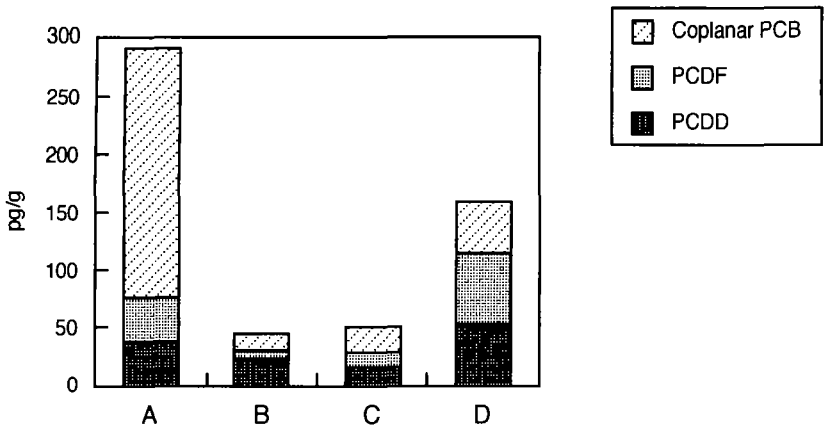

Fig.1 TEQ levels of the adipose tissue

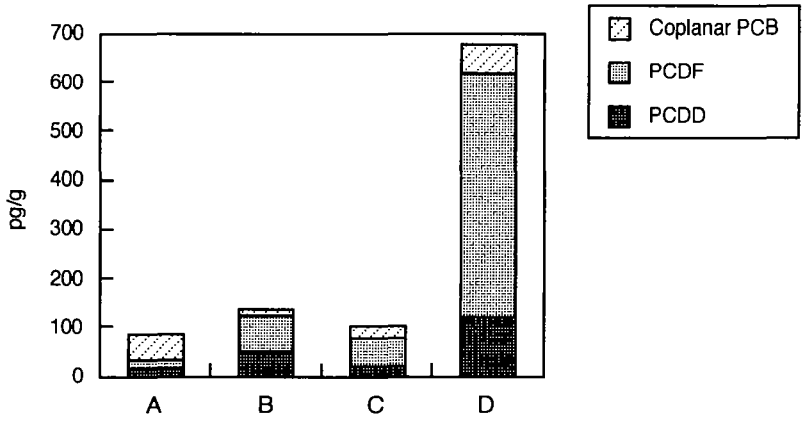

Fig.2 TEQ levels of the liver