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PCDDs/PCDFs AND OTHER ORGANOCHLORINES IN ADIPOSE TISSUE OF KOREAN WOMEN

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INTRODUCTION

Investigators have reported that 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TeCDD) and its congeners produce a variety of toxic effects, such as teratogenicity, carcinogenicity, immunotoxicity and lethality [1-4], in some species of experimental animals. Futhermore, these compounds are detected in high concentrations in human tissues from some developed and industrialized countries [5-8]. Thus, these compounds, namely polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDDs/DFs) have attracted considerable attention regarding public health. However, in Korea the contamination of PCDDs/DFs and other organochlorine compounds is not clear in the general population. The purpose of the present study is to measure the contamination levels and investigate the accumulation profiles adipose tissue from women in different districts in Korea. This is the first study that has been measured the levels of organochlorine pesticides (HCHs, DDTs, HCB), PCBs and PCDDs/DFs in adipose tissue of Korean women.

MATERIALS AND METHODS

Sample collection

As shown in Table 1, the samples analysed in this study have been collected at hospitals located in Seoul (a large city with many types of PCDDs/DFs emission), Masan (a town located in an industrialized area) and Jinju (a rural agriculture area). Whole adipose tissue samples were frozen after collection and kept at -20℃ until the analysis.

Sample treatment and quantification

PCDDs/DFs and other organochlorine compounds (HCHs, DDTs, HCB and PCBs) were analyzed following the method described by Nakamura et al [9, 10]. About 10g of human adipose tissue was homogenized with anhydrous sodium sulfate. Extraction was carried out by a Soxhlet

apparatus with dichloromethane and the extract was cleaned up with concentrated sulfuric acid. Fractionation was carried out with activated silica-gel column, alumina, and charcoal impregnated silica-gel mixture columns.

Organochlorine pesticides and PCBs were determined by a GC-ECD (Hewlett Packard 5890 Series II). Identification and quantification of PCDDs/DFs was performed using a HRGC (Hewlett Packard 5890 Series II) - HRMS (Jeol SX-102A MS).

Table 1. Details of human adipose samples collected in Korea.

Sampling area	Sex	n	Sampled Year	Age Median (min.~max.)
Seoul	Female	17	1994. 4~1995. 1	25 (19~49)
Masan	Female	5	1995.11~1996. 2	55 (48~63)
Jinju	Female	14	1994. 8~1995. 5	53 (34~64)

RESULTS AND DISCUSSION

Residue levels and composition of PCDDs/DFs and other organochlorines

The concentrations of organochlorine pesticides and PCBs in human adipose samples from the three different areas are shown in Table 2 and Figure 1.

Table 2. Concentrations (ng/g on lipid weight basis) of organochlorine pesticides and PCBs in human adipose tissues from Korea.

Compounds		Seoul (n=17) Mean (min~max)	Masan (n=5) Mean (min~max)	Jinju (n=14) Mean (min~max)
HCHs	α-HCH	0.7 (0.4~1.3)	1.2 (0.9~1.8)	1.7 (0.5~7.6)
	β-HCH	76 (42~150)	100 (50~150)	160 (50~380)
	γ-HCH	0.5 (0.1~1.5)	2.1 (0.3~3.2)	0.3 (ND~1.7)
DDTs	*p,p'*-DDE	340 (101~1056)	530 (190~1000)	590 (160~1460)
	p,p'-DDD	2.8 (1.1~11.4)	4.5 (3.4~6.9)	4.2 (2.2~10.5)
	p,p'-DDT	30 (12~65)	52 (33~81)	54 (23~180)
HCB		12 (7.3~31)	18 (12~24)	18 (9~37)
PCBs		200 (61~510)	250 (170~450)	260 (70~750)

Among organochlorines, DDTs concentrations were found to be the highest in the range of 120 to 1700 ng/g, with a mean value of 540 ng/g on a lipid weight basis. Regarding DDTs, *p,p'*-DDE

was the major component in human adipose tissues, accounting for more than 90%. On the other hand *p,p'*-DDT and *p,p'*-DDE amounted to 8.3% and 0.7%, respectively. Furthermore, the ratio of *p,p'*-DDE to *p,p'*-DDT was calculated as 11. The mean concentration of HCHs was 120 ng/g (43～380 ng/g). β-HCH was the most predominant isomer with a composition of 98% of total HCHs. α- and γ-HCH occupied only 1.1% and 0.9% of total HCHs, respectively. Average concentration of HCB was 16 ng/g (7.3～37 ng/g). PCBs concentrations varied between 61 and 750 ng.g^{-1}, with an average of 230 ng.g^{-1} on a lipid weight basis. On the other hand, a statistically siginificant correlation (r=0.5, P<0.01) was shown between the concentrations of PCBs and PCDFs. It appears that PCDFs intake in Koreans follow the same pathways as PCBs, because the most significant potential source of PCDFs is PCBs [11], namely the former is an impurity of the latter.

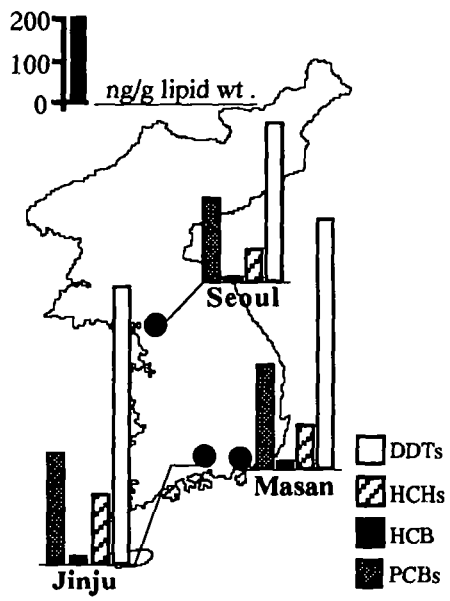

Fig. 1. Mean concentrations of organochlorine pesticides and PCBs in human adipose tissues from different regions of Korea.

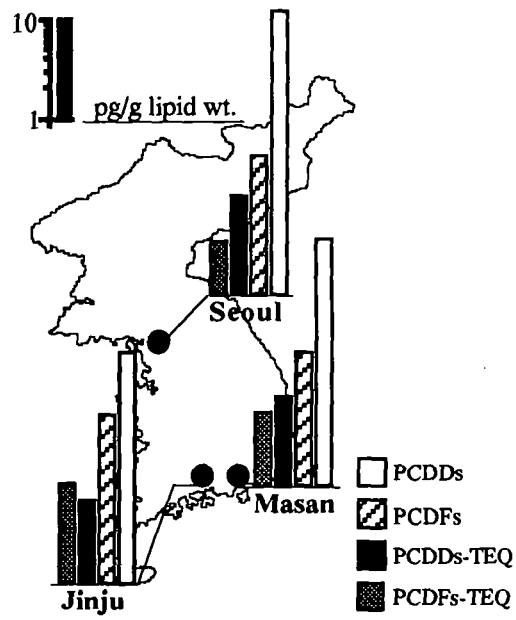

Fig. 2. Mean concentrations of PCDDs/PCDFs and I-TEQ of PCDDs/PCDFs in human adipose tissues from different regions of Korea.

The levels of individual congeners and isomers of PCDDs/DFs in human adipose samples from three different regions in Korea are given in Table 3. The mean concentrations on a lipid weight basis of PCDDs and PCDFs in human adipose samples from Seoul, Masan and Jinju were 480 pg/g (range ; 61～6400 pg/g) and 32 pg/g (3.1～150 pg/g), respectively (Fig. 2). The mean values of International Dioxin Toxic Equivalents (I-TEQ) of PCDDs and PCDFs detected in these samples from the three regions were calculated as 8.7 pg TEQ/g (0.2～30 pg TEQ/g) and 7 pg TEQ/g (0.8～25 pg TEQ/g), respectively (Fig.2). The residue levels of organochlorine

compounds including PCDDs/DFs in adipose tissues from Korean women were generally lower than those of other countries [5-8, 12-14].

A pie graph presentation by individual congener contribution to the total 2,3,7,8-TeCDD toxic equivalents of PCDDs and PCDFs is shown in Figure 3. The percent contribution of TeCDD to total PCDDs-TEQs was 34% followed by 31% for PeCDD, 27% for HxCDD, 4% for HpCDD and OCDD. We found PeCDF occupies 80%, with 15.4% for HxCDF, 3.76% for TeCDF, 0.3% HpCDF and 0.04% for OCDF of total PCDFs-TEQs. Especially, TEQ of 2,3,4,7,8-PeCDF at 35% most greatly contributed to the total dioxin-TEQ, among the analyzed 2,3,7,8-chlorine substituted compounds.

Table 3. Concentrations (pg/g on a lipid weight basis) of PCDDs and PCDFs in human adipose tissues from Korea.

	Seoul (n=17)	Masan (n=5)	Jinju (n=14)
Congeners	Mean (min~max)	Mean (min~max)	Mean (min~max)
2,3,7,8-TeCDD	4.8 (ND~20)	2.5 (1.5~4.7)	1.7 (ND~4.4)
1,2,3,7,8-PeCDD	4.8 (2.6~11)	6.3 (3.9~10)	5.1 (ND~11)
1,2,3,4,7,8-HxCDD	8.3 (ND~13)	ND	0.7 (ND~2.8)
1,2,3,6,7,8-HxCDD	16 (5~31)	17 (7.8~27)	18 (0.9~54)
1,2,3,7,8,9-HxCDD	3.2 (1.2~5.3)	4.6 (ND~8.5)	2.4 (ND~8.5)
1,2,3,4,6,7,8-HpCDD	45 (14~200)	31 (13~53)	26 (5.9~110)
OCDD	680 (102~6130)	240 (80~450)	160 (41~500)
2,3,7,8-TeCDF	1.8 (0.1~6.8)	4 (2.5~5.6)	2.5 (0.8~8.3)
1,2,3,7,8-PeCDF	1.2 (ND~2.1)	3.5 (1.1~5.7)	1.1 (ND~2.8)
2,3,4,7,8-PeCDF	9.5 (4.7~31)	9.3 (5.7~14)	14 (1.4~30)
1,2,3,4,7,8-HxCDF	1.0 (ND~2.3)	ND	11 (ND~43)
1,2,3,6,7,8-HxCDF	0.5 (ND~1.4)	2.3 (ND~3.4)	13 (ND~51)
2,3,4,6,7,8-HxCDF	2.2 (ND~8.9)	1.6 (ND~2.2)	1.6 (ND~6.3)
1,2,3,4,6,7,8-HpCDF	0.9 (ND~2.7)	3.8 (ND~6.2)	7 (ND~37.8)
1,2,3,4,7,8,9-HpCDF	0.8 (ND~1.3)	2.1 (ND~3.4)	0.6 (ND~4.7)
OCDF	5.9 (ND~17)	1.9 (ND~3)	0.3 (ND~1.9)
Total PCDDs	760 (140~6400)	300 (110~510)	214 (61~570)
Total PCDFs	24 (6.9~73)	29 (15~40)	51 (3.1~150)
Total PCDDs TEQ	11 (3.1~30)	8.4 (5~12)	6.7 (0.2~17)
Total PCDFs TEQ	5.4 (2.5~17)	5.7 (3.8~8.2)	9.8 (0.8~25)

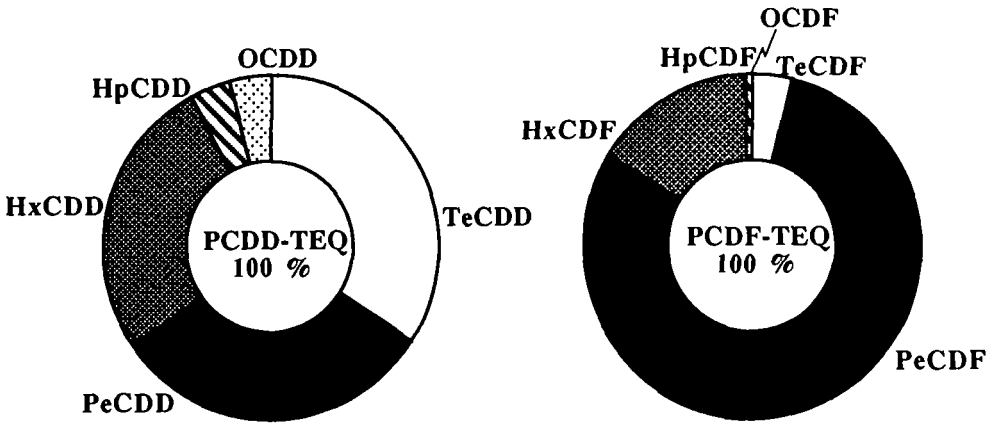

Fig. 3. Composition of individual congeners of PCDDs and PCDFs on 2,3,7,8-TeCDD toxic equivalents in adipose tissues from Korean women.

Regional differences of PCDDs/DFs and other organochlorines

The concentrations of HCHs and DDTs in samples from Jinju were significantly higher (HCHs : $P<0.01$, DDTs : $P<0.05$) than in those from Seoul (Fig. 1). This is probably due to the fact that the latter group was relatively younger than the former. There was however no characteristic difference between HCB and PCB residues in the geographic population.

In the case of the PCDDs/DFs and I-TEQ determined in the present study, we could not find any statistical significant correlation among the figures obtained from the samples collected at the three regions (Fig. 2). Similar results have been reported on human milk [15-17] and human adipose samples [7] from other countries. It was estimated that more than 90% of PCDDs/DFs uptake by humans can be attributed to food consumption [15, 18]. Based on this information, the lock of regional differences of PCDDs/DFs contamination in Korean women was probably due to the uniform food supply. However, the residue levels of PCDDs, especially OCDD, for some donors in Seoul was detected at equal or slightly higher levels than in industrialized countries. Accordingly, it is that the possibility of an increase of PCDDs residues in the Seoul population can not be excluded.

CONCLUSIONS

Based on the results obtained we can make the following remarks :

1. The accumulation levels of organochlorines were detected in the order of DDTs, PCBs, HCHs, HCB and PCDDs/DFs in adipose tissues from Korean women.
2. There were no significant differences between PCDDs/DFs concentrations and residence region.

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