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Levels of PCBs and Organochlorine Pesticides in Human Adipose Tissue Collected in Ehime Prefecture

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Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OC) have received considerable attention in the last decade since studies have shown extreme persistence of these pollutants in the worldwide environment (RISEBROUGH et al. 1968; JENSEN et al. 1970), accumulation in human tissues (SUGIYAMA 1969; BIROS et al. 1970), and toxicity which causes the serious disease exhibited by "Yusho patients" in Japan (TANAKA 1972; MIZUTANI et al. 1972; MASUDA et al. 1974).

The first nation-wide surveys of PCBs and OC in human tissues were conducted by the Ministry of Health and Welfare of Japan in 1973 and 1974. In these surveys, relatively high amounts of PCBs and OC were found in human adipose tissue collected in Ehime prefecture (SHIMAMOTO et al. 1973; MATSUDA et al. 1974; MORI et al. 1977; NIHON KOSYU EISEI KYOKAI 1978).

This paper reports the levels of PCBs and OC in human adipose tissue in Ehime prefecture from 1973 to 1981 in order to determine possible trends of both the disappearance of PCBs and OC, whose use have been restricted about ten years ago in Japan, and the appearance of new environmental pollutants. We think that establishment of levels for these residues could be used to determine these restricted chemical's fate in the future.

MATERIALS AND METHODS

Human adipose tissue samples were obtained from National Hospital Shikoku Cancer Center in Matsuyama City.

Samples were kept frozen (-20°C) until analysed. Samples were subjected to the analyses of PCBs in 1973, OC in 1974, and PCBs and OC in 1976. In 1981, permethrin, the active component of household aerosol was also sought.

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Analytical Methods

PCB : One gram samples were saponified with 1N ethanolic KOH solution on a water bath for 30 min. The fat was extracted with n-hexane, and the sample was cleaned up by column chromatography on Florisil. The eluted PCBs fraction was concentrated to 5 mL and injected to ECD-GC. GC was conducted on a 3% OV-1 glass column. Residue levels of PCBs were calculated by using a total peak heights method (UGAWA et al. 1973) using Kanechlor (300:400:500:600 = 1:1:1:1) as a standard.

OC : One gram samples were ground with anhydrous sodium sulfate and extracted twice with 100 mL portion of n-hexane. The combined n-hexane was evaporated to dryness to determine fat content. The fat was removed by acetonitrile partitioning, and the sample was cleaned up by column chromatography on Florisil. The eluates were concentrated to appropriate volumes and injected to ECD-GC. Glass columns packed with 3% OV-17, 1% OV-210, 1.5% OV-225, 3% QF-1, 3% DC-200 + 3% Bentone 34 and 3% DEGS-H_3PO_4 on Gas-Chrom Q were used for the quantification of the OC levels. The residue levels of OC were calculated by measuring peak heights.

RESULTS AND DISCUSSION

The residue levels of PCBs and OC are shown in Table 1. The mean concentration of PCBs were 5.43, 4.17, and 3.02 ppm in human adipose tissue collected in 1973, 1976, and 1981, respectively. It was shown that the levels of PCBs were almost constant from 1973 to 1976, and tended to decrease gradually from 1976 to 1981. However, it was not statistically significant. We attribute this phenomenon to the chemical stability of PCBs.

The mean concentration of total-HCH in 1974, 1976, and 1981 were 11.3, 4.78, and 3.65 ppm and that of total-DDT were 7.49, 4.46, and 3.84 ppm, respectively. The levels of HCH, DDT, and its analogues showed a significant decrease from 1974 to 1976. These data led us to predict that the majority of OC residues would have been metabolized, excreted, and eliminated from human adipose tissue in 1981. But no significant change in the levels of OC was observed from 1976 to 1981.

The levels of HCB in 1976 and 1981 were 0.13 and 0.07 ppm, respectively. The HCB levels in 1981

Table 1. Organochlorine Compound Residues in Human Adipose Tissue
(mean ± S.D ppm on fat basis)

Year	Sex	Number[1]	PCB	HCH	DDT	HCB	Permethrin
1973	males	13	5.97±3.94				
	females	8	4.50±2.88				
1974	males	20		11.9±5.99	9.25±6.29		
	females	23		10.5±7.68	5.27±3.93		
1976	males	22	5.20±2.93	4.92±2.84	4.79±1.79	0.16±0.10	
	females	23	3.21±2.45	4.84±3.23	4.11±1.72	0.11±0.06	
1981	males	46	3.29±1.48	3.77±2.41	4.04±2.00	0.07±0.04	N.D[2]
	females	46	2.75±1.33	3.52±1.66	3.63±2.36	0.06±0.04	N.D

1) Number of sample
2) Not detected

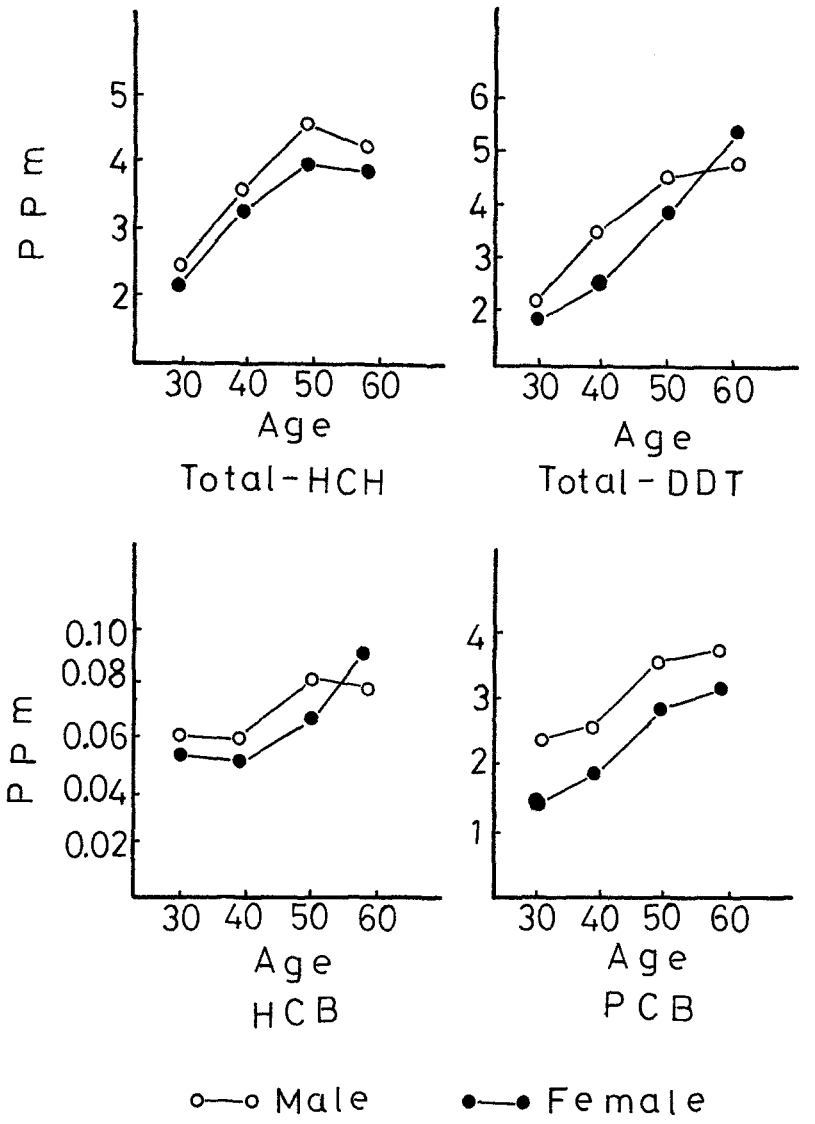

Fig. 1. Organochlorine Compounds in Adipose Tissue by Age.

reduced to about a half the amount of the levels in 1976. This difference was statistically significant.

Residues of permethrin were not found in this survey.

The residue levels of OC and PCBs in human adipose tissue by age are shown in Fig. 1. All organochlorine compound concentration in adipose tissues were increasing with advancing to the age of sixty, and no change therafter.

A slight difference in the levels of OC and PCBs was found between the sexes. The residue levels in males were higher than in females. This fact led us to the presumption that OC and PCBs residues were excreated with mother's milk and menses in females. Further, females have more fat than males.

pp-DDE and β-HCH constituted 99%, 90% of total-DDT and total-HCH, respectively. Samples collected in this investigation had little fat due to diseases such as cancer, and resulted in higher concentration of these pollutants in patients than in healthy persons on a fat basis.

As described above, the OC and PCBs levels are fairly constant and may remain so for many years. Long-term investigation of these chlorinated pollutants deserve more attention.

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