

Comparison of Polychlorinated Biphenyls in Yusho Patients and Ordinary Persons

by

YOSHITO MASUDA, RIE KAGAWA,
Daiichi College of Pharmaceutical Sciences
Fukuoka, Japan

and

MASANORI KURATSUNE
Department of Public Health, Faculty of Medicine
Kyushu University, Fukuoka, Japan

Since 1966, it has been demonstrated that polychlorinated biphenyls (PCB) are widely distributed in ecosystems of fish, shellfish and birds (RISEBROUGH et al., 1968; JENSEN et al., 1969; ZITKO and CHOI, 1971). PCB in the human body has also been analyzed in the U.S.A. (BIROS et al., 1970; PRICE and WELCH, 1972), Germany (ACKER and SCHULTE, 1970) and Japan (MIZUTANI et al., 1972). During 1968, in western Japan was recorded a mass outbreak of "Yusho" due to a chronic ingestion of rice oil that had been contaminated with PCB (KATSUKI, 1969; HIGUCHI, 1971; TANAKA, 1972). It is therefore desirable to elucidate PCB concentration and components in human adipose tissue and milk of the western Japanese and to compare these values with those of Yusho patients.

EXPERIMENTAL

Samples were collected from hospitals in Fukuoka, Saga and Ishigaki cities. The general analytical procedure employed was essentially the same as the Japanese standard analytical method of PCB (KAWASHIRO et al., 1972). Hexane extract of the sample was refluxed in 1N-sodium hydroxide ethanol solution for 1 hour. The ethanol solution was extracted with n-hexane. The n-hexane solution was washed with purified water, chromatographed on silica gel (Wakogel S-1), concentrated into a small volume and subjected to gas chromatography using Shimadzu GC-5A with a detector of Nickel 63 electron capture. A glass column (3mm X 2m) packed with 5% SE-30 on Chromosorb W AW DMCS was used.

Retention times of many gas chromatographic peaks of all samples were identical to those of Kanechlors, commercial brand of Japanese PCB. Gas chromatographic patterns of these samples were similar to those of Kanechlor-500 (Cl 54%) and/or Kanechlor-600 (Cl 59%). Amounts of PCB were obtained by a calibration curve of PCB concentrations and total peak heights. The total heights were calculated by adding heights of all peaks except the height of the peak corresponding to 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE).

Recovery rates of this experimental method were tested by adding 5µg of Kanechlor-500 and repeating the above mentioned analytical procedure and were estimated to be between 80 and 110%. To check the PCB concen-

tration, a few samples of each group of test materials were chlorinated to decachlorobiphenyl (KAWASHIRO et al, 1972) by heating a glass tube (1 X 25cm) with sealed PCB and antimony pentachloride at 220°C for 1 hour. Amount of decachlorobiphenyl was estimated by gas chromatography and converted to amount of PCB. The PCB concentrations thus obtained were within the range of half and double the corresponding values obtained by standard method.

TABLE 1 PCB in human adipose tissue and milk

	Time of sample collection	Number of samples	PCB concentration Whole basis (Fat basis) ppm		
			Minimal values	Maximal values	Average
Adipose tissue (Saga)	Sept.-Nov. 1970	11	0.3 (0.5)	1.9 (5.3)	0.9 (2.6)
Milk (Fukuoka)	Jan.-March 1972	19	0.01 (0.3)	0.06 (5.6)	0.03 (1.2)
Milk (Ishigaki)	March 1972	12	0.01 (0.1)	0.02 (0.7)	0.014 (0.4)

Gas chromatographic patterns of the PCB were similar to those of Kanechlor-500 (Saga and Fukuoka) or Kanechlor-500 + Kanechlor-600(1:1) (Saga and Ishigaki).

TABLE 2 PCB in tissues of Yusho patients

Case	Age	Sex	Time of death (Time of operation)	PCB concentration Whole basis (Fat basis) ppm	
				Liver	Adipose tissue
Case 1	17	male	July, 1969	0.1 (9.5)	1.3 (3.7)
Case 2	25	male	July, 1969	0.2 (10.4)	2.8 (15.1)
Case 3	73	male	Nov., 1969	0.07 (3.1)	3.8 (8.4)
Case 4	48	female	Dec., 1970	0.07 (1.3)	0.7 (0.9)
Case 5	46	male	May, 1972	0.08 (8.4)	4.3 (6.5)
Case 6	33	female	(Sept., 1972)	-	1.9 (2.9)
Average				0.1 (6.5)	2.5 (6.3)

Values of PCB are calculated as Kanechlor-500 + Kanechlor-600(1:1).

The gas chromatograms of all samples were similar to C or D of Fig. 1 except Case 4.

RESULTS AND DISCUSSION

PCB concentration of human adipose tissue and milk in Saga, Fukuoka and Ishigaki are listed in Table 1. The values of Yusho patients are shown in Table 2. By the additional experiments of recovery test and deca-chlorobiphenyl method, the values in Table 1 and 2 were supposed to be quite precise, though the quantitative analysis of PCB is rather difficult due to the complex nature of these compounds.

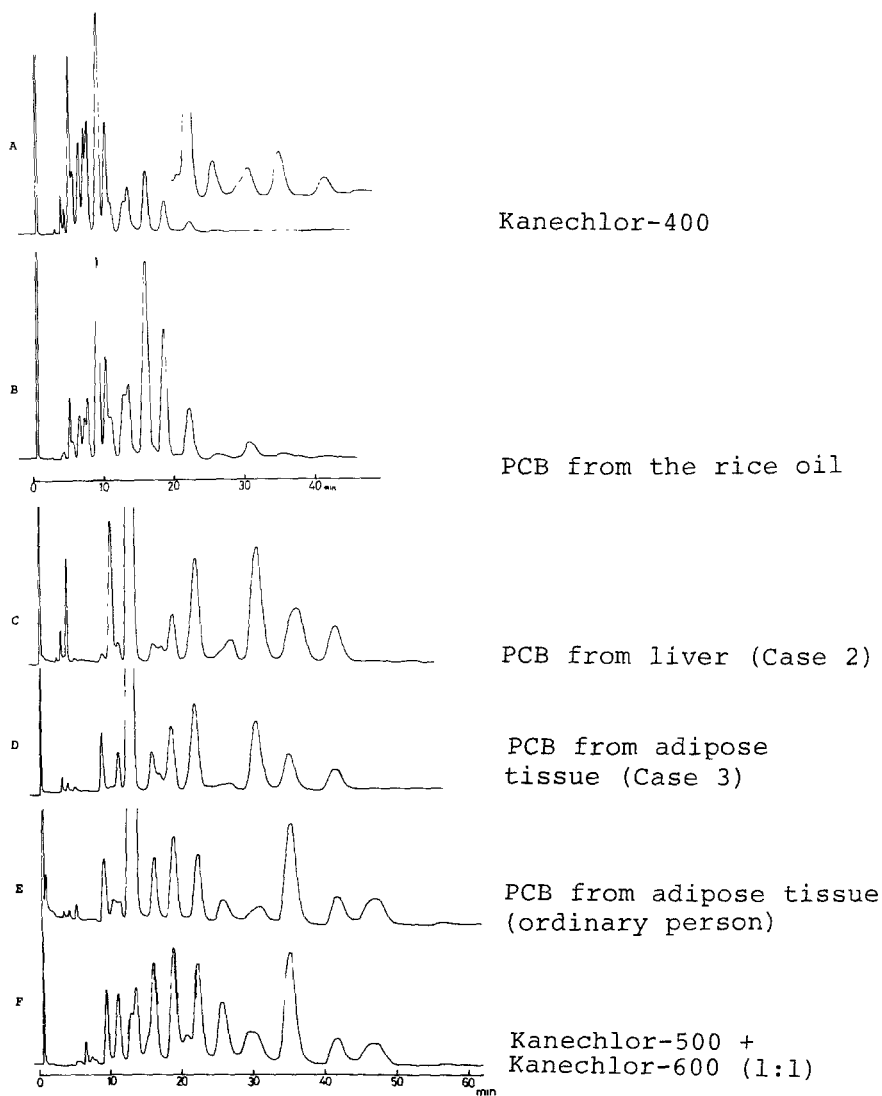


Figure 1. Gas chromatographic patterns of PCB

PCB concentration in adipose tissue of Yusho patients seemed to be a little higher than those of ordinary persons on the average. In the gas chromatograms of all samples, the early peaks corresponding to tetrachlorobiphenyls were seen very low in comparison with the later peaks (Fig. 1). This pattern suggests that the amounts of PCB in the body of Yusho patients were much decreased in a year after the accident.

When the gas chromatograms of Yusho patients and ordinary persons were carefully compared, it was discovered that the peak at retention time 31 min. was very high in the gas chromatograms of Yusho patients and low in those of ordinary persons as shown in Fig. 1. The same peak, probably due to hexa- or hepta-chloro-biphenyl, was noted in the rice oil which was contaminated with Kanechlor-400 (Cl 49%) and was taken by Yusho patients. It is therefore evident that this component of Kanechlor-400 still remains in the body more than 4 years after the accident.

Only one sample of milk from Yusho patient could be examined. The milk contained 0.06ppm of PCB and showed more similar gas chromatographic pattern to C or D than to E of Fig. 1.

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