Bull. Environm. Contam. Toxicol. 26, 407-412 (1981)

Oxychlordane, *trans*-Nonachlor and *cis*-Nonachlor Residues in Adipose Tissues of Dogs and Cats Collected in the Tokyo Area

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In previous papers, we reported that cis- and trans-chlordane, cis- and trans-nonachlor and oxychlordane were found in aquatic fauna, Tapes philippinarum, Acanthogobius flavimanus, and Zacco playtypus collected from the Tokyo Bay and discharging rivers (MIYAZAKI et al. 1979, 1980a, YAMAGISHI 1981). These data suggested that the marine environmental pollution with chlordane is widespread in Japan. Technical chlordane in Japan is mainly used for controlling termites in wooden structure and products. Current annual consumption is estimated at 500 tons. However, little is known about terrestial pollution by chlordane in Japan. An attempt was made to investigate chlordane residues in adipose tissue of dogs and cats as an indicator of this pollution. This paper indicates that oxychlordane, a metabolite formed cis and trans isomers of chlordane and nonachlor, has been found in these samples at relatively high levels.

MATERIALS AND METHOD

Samples. A total of 51 adipose tissue samples from 15 female and 26 male dogs and 5 female and 5 male cats, was obtained from the Setagaya Dog Pound of the Metropolis of Tokyo. Dogs were 3 months to 10 years old, and were sampled during July and August, 1979. Cats were collected in November. 1979. All samples were kept in the deep-freeze until analysis.

Chlordane Determination. Adipose tissues were extracted with hexane, and the hexane was partitioned with acetonitrile using a modified Mills-Olney-Gaither Method (MILLS et al. 1963). After extraction and cleanup, chlordane determination was conducted according to the method described by MIYAZAKI et al. (1980 b): the extract was chromatographed on a Florisil column for the separation from fat. p,p'-DDT, and PCBs; the cleaned-up solution was analyzed using gaschromatography with a ^{63}Ni detector, and 1.5 % OV-17 + 1.95 % QF-1 and 3 % OV-1 columns.

GC-MS analysis was performed on a JEOL JMS-D300 JMS 2000 Disc System; EI; 70 eV; column; OV-1; 3 % on

0007-4861/81/0026-0407 $01.20

TABLE 1. Concentrations (ppb on wet basis) of Oxychlordane and *trans*-Nonachlor Residues in Dog Adipose Tissues by Sex.

Sex	No. of Samples	Oxy-chlordane	*trans*-Nonachlor	Total Chlordane
M	26	76 ± 110	19 ± 63	95
F	15	63 ± 88	14 ± 25	77
Total	41	71 ± 104	17 ± 52	88

Data represent means ± standard deviations.

Chromosorb W AW DMCS 100- 120 mesh, at 200°C, 2 mm x 1.8 m, He 30 mL/min, injection and separator temperature; 250°C.

RESULTS AND DISCUSSION

Tables 1 and 2 show the concentrations of oxychlordane and *trans*-nonachlor in dog adipose tissues, and Table 3 gives the levels of oxychlordane, *trans*-nonachlor, and *cis*-nonachlor in cat adipose tissues. These two or three componets of the residues were detected in all the samples of dog or cat, respectively. However, no detectable levels of other chlordane components were found. Any regularities in the levels of each species were not observed between sex, ages or body weights. The average level of total chlordanes in cat samples was 160 ppb, twice as high as that in dogs. The ratios of the levels of oxychlordane, *trans*-nonachlor, and *cis*-chlordane were 1:1:1 in cats, and 4:1:0 in dogs. The differences in the levels and component patterns between cat and dog samples may reflect the differences in feeding habit, food-chain, and metabolic behavior. The levels in dog adipose tissues found in the present study are 3-6 times higher than those in human milk (fat basis) from our previous study (MIYAZAKI et al. 1980c), though the component patterns of the both are similar (Fig. 1).

Although there are no reports on dogs in field environments, residues of both oxychlordane and *trans*-nonachlor have sometimes been detected in human adipose tissues from the general populace as the major chlordane residues (BIROS & ENOS 1973, KUTZ et al. 1976). Oxychlordane in aquatic fauna had far less percentage in chlordane residues. The metabolism of technical chlordane, *cis*- and *trans*-chlordane, and *trans*-nonachlor in rat were reported: oxidized metabolites, oxychlordane and hydroxy compounds, were described together with the unchanged materials (STREET & BLAU 1972, BARNETT & DOROUGH 1974, TASHIRO & MATSUMURA 1977, 1978),

TABLE 2. Concentrations (ppb on wet basis) of Oxychlordane and <u>trans</u>-Nonachlor Residues in Dog Adipose Tissues by Age.

Age	No. of Samples	Oxychlordane	<u>trans</u>-Nonachlor	Total Chlordane
1	12	65 ± 81	13 ± 22	78
2	4	110 ± 120	23 ± 32	130
3	4	37 ± 25	2 ± 1	39
4	5	130 ± 210	69 ± 131	200
5	4	66 ± 48	9 ± 2	75
6	4	49 ± 6	5 ± 3	54
7	2	40 ± 5	5 ± 2	44
8	2	27 ± 2	6 ± 5	34
9	1	10	6	16
10	3	96 ± 79	6 ± 3	102
Total	41	72 ± 102	17 ± 52	88

Data represent means ± standard deviations.

TABLE 3. Concentrations (ppb on wet basis) of Oxychlordane, *cis*-Nonachlor, and *trans*-Nonachlor Residues in Cat Adipose Tissues.

Case	Sex	Body Weight(Kg)	Oxy-chlordane	*cis*-Nonachlor	*trans*-Nonachlor	Total Chlordane
1	F	2	340	250	84	670
2	F	3	1	31	23	55
3	F	3.5	3	7	15	25
4	F	3.5	33	60	80	170
5	F	3.5	26	39	58	120
6	M	4	16	67	27	110
7	M	2	15	27	22	63
8	M	2	16	27	53	96
9	M	5	46	90	130	270
10	M	3.5	5	7	10	22
Mean ± S.D.						
	Feamle		81 ± 130	77 ± 87	52 ± 28	210 ± 240
	Male		19 ± 14	43 ± 30	49 ± 44	110 ± 84
	Total		50 ± 98	60 ± 67	51 ± 37	160 ± 190

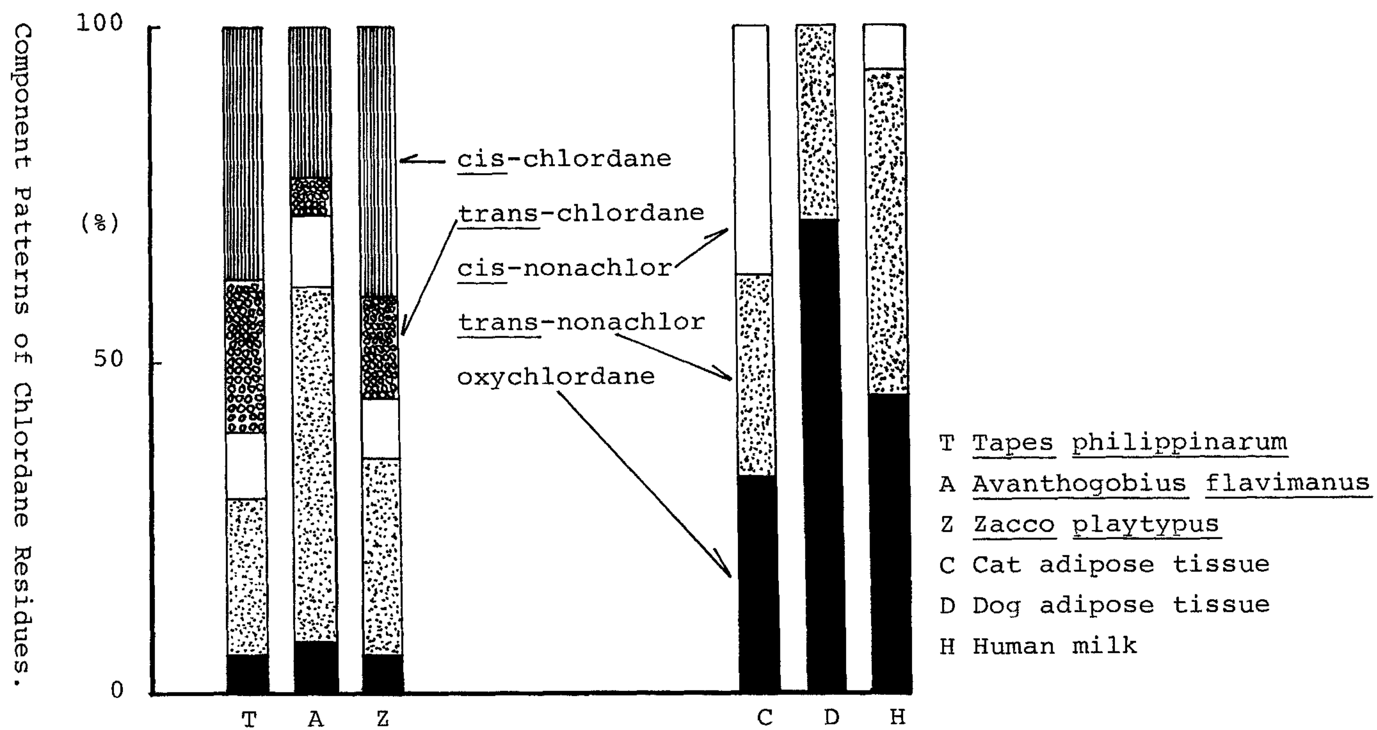

Fig. 1. Component Patterns of Chlordane Residues in Biological Samples.

and human liver was less active than rat liver in metabolizing trans-nonachlor (TASHIRO & MATSUMURA 1978). cis-Chlordane in gold-fish was metabolized less than in rat (FEROZ & KHAN 1979). The component patterns of chlordanes in biota thus reflect varying metabolism in different species.

Although human adipose tissues are sometimes difficult to obtain for monitoring environmental pollution, the dog and cat seem useful biological indicators, because they appear to reflect the distribution and the range of domestic pollutants in the environment.

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