Polychlorinated Terphenyls (PCT) in Some British Birds

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INTRODUCTION

The detection of residues of polychlorinated terphenyls (PCT) has been reported in the eggs and tissues of herring gulls (ZITKO et al 1972); in milk (FRIES AND MARROW 1973); in Rhine water, oysters, eel and human fat (FREUDENTHAL and GREVE 1973); in Japanese human fat (DOGUCHI and FUKANO 1975) and blood (DOGUCHI and FUKANO 1975); and in paperboard samples (THOMAS and REYNOLDS 1973). The present paper describes the detection of PCT (and PCB) in the livers of six species of British birds.

EXPERIMENTAL

Some birds which are found dead in the countryside are sent for autopsy examination to the Monks Wood Experimental Station of the Institute of Terrestrial Ecology. Here the livers are excised and sent to the Laboratory of the Government Chemist for analysis to estimate organochlorine pesticide residues and polychlorobiphenyls (PCB). Since polychloroterphenyl(PCT) formulations are used industrially in a similar manner to PCB preparations, it was thought that an additional estimation of the PCT contents of the livers would prove instructive.

The livers were extracted with a mixture of hexane and propan-2-ol (2 + 1). After removal of the propan-2-ol as an azeotrope with hexane, the extracts were cleaned-up by a modification of the method of De FAUBERT MAUNDER et al (1964), involving liquid-liquid partition of the residues between hexane and dimethylformamide, followed by elution through an alumina column with hexane. The cleaned-up extracts were then fractionated on a silica gel column by the technique described by COLLINS et al (1972), which separates PCB and pp'-DDE from other organochlorine pesticides. The first hexane fraction from this column had previously been shown to contain the PCT components in addition to those of PCB and so was reserved for the subsequent examinations.

Under normal conditions for the gas chromatographic estimations of organochlorine pesticide residues and PCB, the components of PCT take several hours to traverse the GLC column and consequently only relatively large amounts can be detected. However, by perchlorinating with antimony pentachloride, using a modification (FARRINGTON) of the method of ARMOUR (1973), and examining the resulting three isomeric tetradecachloroterphenyls by GLC at an elevated temperature, the speed and sensitivity of the analysis

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were very much improved.

A Pye 104 gas chromatograph, fitted with a ^{63}Ni electron-capture detector, was used for all the PCT analyses. A glass column, 1.2 m long x 2 mm int. diam., packed with 1.7% OV17 on Chromosorb G, acid-washed and DMCS-treated, 60-80 mesh, was operated at 270°C; the injection port and detector oven temperatures were 300°C and 275°C respectively. Oxygen-free nitrogen was used as the carrier gas with a flow rate of 50 ml/min.

A standard solution of an industrial PCT (Aroclor 5460), similarly treated at the same time as the sample extracts, was used for the identification and quantification of the PCT found on GLC. Three distinct peaks, corresponding with the fully chlorinated meta-, para- and ortho-isomers of terphenyl were obtained; the GLC trace was broadly similar to that illustrated by DOGUCHI et al. (1974).

RESULTS

TABLE 1 shows the concentrations of PCT detected in the livers of the birds, the majority of which were land predators. The concentrations of PCB found in each liver have also been included for comparative purposes. The amounts of PCB were calculated from the routine GLC traces by the method of COLLINS et al (1972) and confirmed by the same perchlorination technique used for the PCT determinations. The concentrations of PCT were calculated by comparing the total peak area of the three perchlorinated PCT derivatives with that given by the similarly treated PCT standard. All the results are reported as mg/kg in the liver, on a wet weight basis. The limits of detection for PCT and PCB were respectively 0.05 and 0.5 mg/kg.

TABLE 1
PCT and PCB residues (mg/kg) in bird livers

Species	PCT	PCB	Species	PCT	PCB
Kestrel	0.9	30	Barn Owl	0.5	10
"	0.3	13	"	0.3	5
"	0.1	1	"	0.2	5
"	0.1	1	"	0.2	5
"	0.09	2	"	0.2	3
"	0.08	15	"	0.1	5
"	0.08	3	"	0.09	1
"	0.08	2	"	0.09	<1
"	0.08	<0.5	"	0.07	3
"	0.07	3	"	0.07	<0.5
"	0.07	0.5	"	0.06	<1
"	<0.05	2	"	0.05	1
"	<0.05	2	"	0.05	1
"	<0.05	2	"	<0.05	8
"	<0.05	1	"	<0.05	2
8 other samples	<0.05	<0.5	"	<0.05	1
			"	<0.05	1
			14 other samples	<0.05	<0.5

TABLE 1 continued

Species	PCT	PCB	SPECIES	PCT	PCB
Sparrowhawk	1.2	30			
"	0.3	10			
"	0.2	5			
"	0.09	3			
"	0.08	4			
"	0.06	1			
"	0.05	7			
2 other samples	<0.05	<0.5	Long-earned Owl	0.05	<0.5
Heron	0.2	25	Kingfisher	0.08	3
"	0.1	30	"	0.07	2
"	0.05	2	"	0.05	<0.5
"	<0.05	3			

CONCLUSIONS

The samples which contained the highest amounts of PCT also contained the higher amounts of PCB, but the amounts of the latter were 1 to 2 orders of magnitude greater, possibly reflecting the relative usage of the polychlorinated materials.

The relative amounts of the perchlorinated ortho-, meta- and para-isomers of terphenyl are of interest. Three peaks were detected on GLC; the identities of these, in order of increasing retention times, were assigned by DOGUCHI et al (1974) to the ortho-, para- and meta-isomers respectively. Their identity was confirmed during the present work by perchlorination of the respective terphenyl isomers. The ratios of the areas of the perchlorinated isomers in the standard preparation of PCT were ortho:para, 0.8 to 1 and meta:para, 1.4 to 1. With the exception of only one sample - a Barn Owl liver - the ratios for the sample extracts were all lower than those for the standard. DOGUCHI et al (1974) showed a similar result in their chromatogram of a Japanese human fat extract. This may be an indication that the ortho- and meta-isomers may be degraded more rapidly in the environment than the para-isomer; experiments showed that there was no change in the ratio of the isomers when the standard material was put through the complete method. It is hoped that further work with a wider variety of bird species may help to clarify the situation.

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