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Accumulation of Polychlorinated Biphenyl (Phenoclor DP6) by Estuarine Fish

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The polychlorinated biphenyls (PCB) have been found to exert a great environmental impact (PEAKALL 1972). The product is used almost exclusively in industry, and it seems to be more persistent than DDT (JENSEN et al. 1969). PCB occurs in fish and wildlife from whole world (KOEMAN et al. 1969, DUKE et al. 1970, BACHE et al. 1972, LINKO et al. 1974). Many workers have carried out experimental laboratory intoxications in fish from water or from food (DUKE et al. 1970, ZITKO and HUTZINGER 1976, DEQUIDT et al. 1977). The purpose of this study was to measure the concentration coefficient and the tissue distribution of a French PCB (Phenoclor DP6) from water and from food in juvenile grey mullets (Chelon labrosus).

EXPERIMENTAL

Commercial PCB (Phenoclor DP6) was purchased from PRODELEC Company (France).

Exposure from water: 10 mg of DP6 were solubilized in 10 ml dimethyl sulfoxyde (DMSO) and added to tank containing 20 l of sea water (final concentration of DP6: 0,5 ppm).

Five fishes, average weight 51 ± 6 g were added to each tank (two tanks for exposure from water). Water samples were taken after 1, 24 and 48 hr and analysed immediately. The contamined water was renewed after 48 hr. Fish were sacrified after 30 days. Excised livers, samples of muscle and remaining carcass were stored frozen until analysis.

Exposure from food: dry fish food (AQUALIM Mullet chow) was contaminated to 50 µg/g of Phenoclor DP6 and fed to grey Mullets (average weight 56 ± 9 g) over a period of 30 days. Ten fish in two 20 l tanks were used. Following sacrifice, tissues samples and carcass were stored frozen until analysis.

Analysis: water samples containing Phenoclor DP6 were analysed as described by ZITKO and HUTZINGER (1976). Tissues samples were extracted according with ERNEY (1974), and the clean up was performed according with MURPHY (1972). Lipids and PCB were removed from carcass as described by ABRAHAM et al. (1964). DP6 extraction and gas chromatography were described previously (GILLET 1977). The multiple-peaked Phenoclor DP6 was quantitated

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by averaging the heights of six major peaks. All samples analysis are arithmetic means of concentrations determined by individually analyzing ten fish.

RESULTS AND DISCUSSION

Concentration in water: The concentration of DP6 decreased markedly between 24 and 48^{hr} (Table 1). These results agreed with ZITKO (1977).

Concentration in fish: Table 2 shows that DP6 was accumulated from water in all measured samples. The concentration of DP6 found at time of sacrifice were in the following order: liver, carcass and muscle. The accumulation coefficient from water calculated for whole body was 190. In 1974 CAMP et al. studied the accumulation of Aroclor 1254 in the liver of Ictalurus punctatus. These authors show that the accumulation coefficient from water (2 ppm) was 148 after a 8^{hr} exposure. ZITKO (1977) shows that for 0.5 ppm of Aroclor 1254 in water the accumulation coefficient in Salmo solar was 282 after a 48^{hr} exposure. These results suggest that the DP6 accumulation in mullets was comparable with the accumulation of Aroclor 1254 in other fish species. Moreover, these accumulation seems to be independent to time exposure for periods exceeding 24^{hr}.

Accumulation from food: The recovery of DP6 from contamined food was 71%. Table 2 shows that the highest concentration of DP6 in fish tissues was found in liver. The accumulation coefficient from food for whole body was 0,12. DEQUIDT et al. (1977) indicate an accumulation coefficient of 0.14 in trout fed a diet containing 1000 ppm of Pyralene 3010 for 30 days. It's the same coefficient found by ZITKO (1977) in juvenile Atlantic Salmon (Salmo solar) fed a diet containing 100 ppm of Aroclor 1254 for 28 days.

DP6 metabolism: Table 3 shows that all peaks were recovered in DP6 residues extracted from fish contamined from water or from food. The difference of recovery in some peaks may be due to variations in chromatographic analysis conditions. These results indicate that Phenoclor DP6 was not metabolized in Mullets. HUTZINGER et al. (1972) found very little evidence of PCB metabolism in brook trout as compared to that of the rat. MELANCON and LECH (1976) showed that tetrachlorobiphenyl treated rainbow trout were able to eliminate small amonts of conjugated metabolites in the bile. The results indicate that fish have low metabolic capabilities compared to mammalian species (NARBONNE and GILLET 1978).

CONCLUSION

Fish intoxicated for 30 days by Phenoclor DP6 added either to water or food revealed an accumulation of PCB in all tissues measured. The highest concentration was found in the liver. There was a higher accumulation of PCB from water than from food. Little or no Phenoclor DP6 was metabolized by these fish. The results provide important data on the PCB accumulation in food chains.

TABLE 1

Concentration of DP6 in water

	DP6 µg/l	% recovery
Nominal concentration	500	-
time h 1	420	84
24	195	39
48	105	21

TABLE 2

Accumulation of Phenoclor DP6 from water and from food in grey Mullets

Nominal concentration	Samples		
	liver	Muscle	Carcass
in water			
0,5 ppm DP6 (ppm)[a]	135 ± 23	79 ± 9	87 ± 17
A.C.[b]	270	158	174
in food			
50 ppm DP6 (ppm)	19 ± 4	1.2 ± 0.3	5.3 ± 0.7
A.C. [c]	0.38	0.024	0.11

a DP6 in µg/g fresh weight : mean ± SE

b Accumulation coefficient from water $\frac{\text{µg DP6/g fish sample}}{\text{µg DP6/ml water}}$

c Accumulation coefficient from food $\frac{\text{µg DP6/g fish sample}}{\text{µg DP6/g food}}$

TABLE 3

Peak recovery in chromatograms of extracts from fish exposed to Phenoclor DP6 from water and from food

Peak number	1	2	3	4	5	6	7	8	9	10	11	12	13
Contamination from water													
Peak recovery %[a]	103	104	85	96	114	126	103	127	91	84	87	97	78
Significance [b]	NS	NS	$P < 0.05$	NS	$P < 0.02$	$P < 0.001$	NS	$P < 0.02$	NS	$P < 0.02$	NS	NS	$P < 0.01$
Contamination from food													
Peak recovery %	154	81	122	101	96	89	99	99	94	99	115	94	104
Significance	$P < 0.001$	$P < 0.02$	NS	NS	NS	$P < 0.001$	NS	NS	NS	NS	NS	NS	NS

a In each chromatogram the peak amount was calculated as per cent of total residue

Peak recovery was calculated by comparative between peaks amounts (%) in extracted residues with the standard DP6 one's $\frac{\text{peak amount in fish residue} \times 100}{\text{peak amount in standard DP6}}$

b Significance was estimated by Student t test

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