

PCBs IN FISH FROM THE MILWAUKEE REGION¹

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Abstract. The results of this investigation provided spectrochemical confirmations of the presence of chlorobiphenyls (PCBs) and estimates for the composition and concentration of the PCB mixtures in fish from the Milwaukee River and Lake Michigan. The composition of the PCBs in fish varied with location of capture and its relation to PCB sources. Fish from the upper Milwaukee River contained from 2.3 to 15.4 $\mu\text{g}/\text{gm}$ of Aroclor 1260 equivalent. Major sources of Aroclors 1242 and 1248 were found in the city of Milwaukee, and the fish in this region contained 405 $\mu\text{g}/\text{gm}$ Aroclor 1248 equivalent. Lake Michigan fish contain residues resembling Aroclor 1254 at levels of approximately 18.6 to 22.4 $\mu\text{g}/\text{gm}$. (Key words: Aroclors; chlorobiphenyls; chlorinated hydrocarbons; PCBs; Lake Michigan).

INTRODUCTION

The chlorobiphenyls have stimulated considerable research interest since Jensen and Widmark first confirmed the presence of these chlorocarbons five years ago. Although the chlorobiphenyl mixtures (PCBs) were utilized in electrical and heat transfer systems (Hubbard 1964) before the advent of chlorinated pesticides such as DDT, it was not until pesticide research and environmental protection had matured through the use of gas chromatography and mass spectrometry that the PCBs were shown to coexist with pesticides in many organisms. Within the past few years, the PCBs have been found throughout the environment, particularly in organisms associated with natural waters which receive wastes from urban centers. Reviews of the chemical and physiological properties and the occurrences of the PCBs have been presented (Hubbard 1964; Veith and Lee 1970a; Peakall and Lincer 1970; National Swedish Environment Protection Board 1970).

While estimates of the levels of PCBs in environmental systems can rapidly be made with present analytical instrumentation, assessments of the long-term physiological consequences of the exposure of food chain systems to sublethal concentrations of PCBs are more difficult. Table 1 presents a brief summary of the toxicological effects of the PCBs, many of which must be regarded as preliminary identification.

Generally, the acute toxicity of the PCB mixtures to birds are of the same order of magnitude as DDT, although some variations are observed which result from differences in the slope of the feed dose-response curves for PCBs and DDT (Prestit, Jefferies and Moore 1970; Heath et al. 1970). The PCBs produce greater enzyme induction in avian, rat, and dog livers than does DDT (Risebrough et al. 1968; Street et al. 1969). In regard to enzyme induction and acute toxicity to some invertebrates, the PCBs are more active than DDT but less active than some of the oxygenated cyclodiene pesticides such as dieldrin and heptachlor epoxide (Lichtenstein et al. 1969; Street et al. 1969). The comparatively high

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Table 1. Summary of PCB toxicities.

| Organism | PCB Mixture | Dose or concentration | Remarks | Reference |
|---------------------------|------------------|----------------------------------|--|--|
| Rats and dogs | A-1254 | 1,10,100 $\mu\text{g}/\text{gm}$ | no effects after 2 yrs. | Monsanto (1970) |
| Chickens | A-1242 | 200-400 $\mu\text{g}/\text{gm}$ | produced hydropericardial oedema, growth depression | Flick et al. (1965) |
| Bengalese finches | varied | low dose high dose | more toxic than DDT less toxic than DDT | Prestt et al. (1970) |
| Penned birds | A-1254 varied | 25,50 mg/kg 5 day feedings | no effect after 5 days less toxic than DDT | Heath et al. (1970) |
| Avian livers | A-1254 | | increased steroid metabolism | Risebrough et al. (1968) |
| Hepatic enzymes | varied | varied | greater induction than DDT, less than heptachlor epoxide | Street et al. (1969) |
| <i>Daphnia magna</i> | varied | continuous bioassay | 25 $\mu\text{g}/\text{l}$ safe level A-1254 most toxic | Nebeker (1970) |
| <i>Gammarus Oceanicus</i> | A-1254 | 0.001-0.01 mg/l colloidal | lethal threshold in sea sublethal necrosis | Wildish (1970) |
| Juvenile pinfish | A-1254 | 100 $\mu\text{g}/\text{l}$ | no effect after 48 hr | Duke et al. (1970) |
| Oysters | | 100-1.0 $\mu\text{g}/\text{l}$ | 100-19% shell reduction | |
| Juvenile shrimp | | 100 $\mu\text{g}/\text{l}$ | 80% mortality after 24 hr | |
| Juvenile shrimp | A-1254 | 1 $\mu\text{g}/\text{l}$ | some mortality | Duke (personal communication) ¹ |
| Crayfish | A-1254 | continuous -7 day | TL ₅₀ ; 80 $\mu\text{g}/\text{l}$ | |
| Glass-shrimp | | | TL ₅₀ ; 3.0 $\mu\text{g}/\text{l}$ | |
| Damselfly | | -4 day | TL ₅₀ ; 200 $\mu\text{g}/\text{l}$ | Stalling (1970) |
| Rainbow Trout | | -10 day | TL ₅₀ ; 8 $\mu\text{g}/\text{l}$ | |
| Bluegills | | | TL ₅₀ ; 443 $\mu\text{g}/\text{l}$ | |
| Channel catfish | | -15 day | TL ₅₀ ; 741 $\mu\text{g}/\text{l}$ | |
| Bluegills, trout | A-1254 | 1 $\mu\text{g}/\text{l}$ | adverse physiological effects in continuous flow | Stalling (personal communication) ² |
| Channel catfish | | | | |
| Salmon | 54% Cl | 1 $\mu\text{g}/\text{l}$ | egg mortality-16% for 9.2 $\mu\text{g}/\text{gm}$ fat; 100% for 34.0 $\mu\text{g}/\text{gm}$ fat | Johansson et al. (1970) |

¹T. W. Duke, 1970, Bureau of Commercial Fisheries, Pesticide Field Station, Gulf Breeze, Florida, personal communication to G. Fred Lee.

²D. L. Stalling, 1970, Fish-Pesticide Research Laboratory, Route 1, Columbia, Missouri.

mortality and/or adverse physiological effects in aquatic organisms caused by the PCBs at the lower $\mu\text{g}/\text{l}$ levels (Duke, Lowe and Wilson 1970; Johansson, Jensen and Olsson 1970; Stalling 1970) is of interest because $\mu\text{g}/\text{l}$ quantities of PCBs are found in municipal and industrial waste waters (Duke et al. 1970; Veith and Lee 1970b).

The purpose of this study was to examine fish from the Milwaukee River and nearshore (Wisconsin) region of Lake Michigan for the presence of PCBs. The objectives of the study were to relate the composition and quantities of the PCB mixtures to known PCB sources or areas of the river which have been contaminated with PCB-containing wastes.

