

# Semipermeable Membrane Devices (SPMDs) to Predict Total PCB in Fish Tissue

S.M. Shim<sup>1</sup>; C.R. Santerre<sup>1</sup>; L.E. Dorworth<sup>2</sup>; B.K. Miller<sup>2</sup>; J.R. Stahl<sup>3</sup>; D. Deardorff<sup>4</sup>

<sup>1</sup>Foods and Nutrition, Purdue University; <sup>2</sup>Illinois-Indiana Sea Grant Program, Purdue University;

<sup>3</sup>Indiana Department of Environmental Management; <sup>4</sup>Strategic Diagnostics, Inc.



## ABSTRACT

Triolein-filled semipermeable membrane devices (SPMD) were immersed at 3 locations along the St. Joseph River in northern Indiana for 30 days to see if the PCB content of fish from the same location could be predicted with this model device. Triolein from the SPMDs was analyzed for PCB using enzyme-linked immunosorbent assay (ELISA) and compared to residues detected in fish collected from the same locations. There was a significant difference ( $p < 0.05$ ) in total PCB concentrations between SPMD samples from the 3 locations. However, due to variability in PCB residues between species and low PCB residues in SPMDs, a direct correlation between PCBs in fish and SPMDs could not be determined.

## INTRODUCTION

Fish consumption advisories warn the public of high concentrations of PCBs in fish from local waters. Defining the concentrations of contaminants in waters for fish consumption advisories is made even more difficult by having to collect and process fish.

Development and application of SPMDs provides an alternative approach for determining bioavailable contaminants.

For measuring total PCB in fish extracts, ELISA provides improved sensitivity and selectivity over traditional methods.

The objectives of this study were to analyze PCBs in triolein-filled SPMDs by ELISA in order to demonstrate whether this device can be used to predict total PCBs in fish from Indiana waters.

## METHODS

### Fish Sampling

The Indiana Department of Environmental Management (IDEM) collected fish from 3 locations along the St. Joseph River, where SPMDs were deployed. En Chem, Inc. determined total PCB concentrations for the fish tissues using GC/ECD.

### Deployment of SPMDs

Low density polyethylene tubings filled with 1 g of triolein were fastened by galvanized wire to the inside of cylindrical cages. Cages were deployed at 3 sites in the St. Joseph River (Figure 1). A total of 45 SPMDs were deployed at the 3 locations.

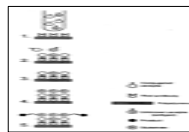


Figure 1. Map of St. Joseph River, IN, U.S.A. showing location of study sites; (1) Bristol; (2) Baugo Bay; (3) d/s South Bend St. Patrick Park. (inserts) Students deploying SPMDs in wire cages. An SPMD.

### Extraction



### ELISA



ELISA - Equation used to calculate PCB concentration:

$$\text{Logit } B/B_0 = \text{Slope} \cdot \text{Ln} [\text{PCBs}] + \text{Intercept}$$

Where:  $B$  = sample absorbance  
 $B_0$  = blank absorbance @450 nm

## RESULTS

Table 1. Total PCB concentration in fish tissue and semipermeable membrane devices (SPMD) from 3 locations along the St. Joseph River, Indiana, U.S.A.

Fish <sup>1)</sup>	Location 1 (Bristol)		Location 2 (Baugo Bay)		Location 3 (downstream of South Bend, St. Patrick Park)	
	PCB (ppb) Fresh basis	PCB (ppb) Lipid basis	PCB (ppb) Fresh basis	PCB (ppb) Lipid basis	PCB (ppb) Fresh basis	PCB (ppb) Lipid basis
Carp	720	17821.7	630	10277.3	4300	35833.3
Rock Bass	ND <sup>3)</sup>	ND	ND	ND	98	11461.9
Smallmouth Bass	ND	ND	ND	ND	93	12916.6
Largemouth Bass	-	-	ND	ND	150	22556.3
Northern Hogsucker	61	5446.4	-	-	150	27272.7
Yellow Bullhead	ND	ND	-	-	-	-
Black Redhorse	-	-	78	2965.7	380	11309.5
Spotted Sucker	-	-	ND	ND	85	3846.1
Channel Catfish	-	-	280	8615.3	-	-
SPMD <sup>2)</sup>	PCB (ng/g triolein) 97.62 ± 4.4 <sup>a</sup> n=13		PCB (ng/g triolein) 120.03 ± 17.7 <sup>b</sup> n=13		PCB (ng/g triolein) 120.75 ± 24.3 <sup>b</sup> n=14	

<sup>1)</sup> Yellow Bullhead and Channel Catfish were skin-off fillets, and all other fish tissues were skin-on fillets and scales. <sup>2)</sup> Different letters signify statistical difference at the  $p < 0.05$  level. <sup>3)</sup> ND = not detected at the lower limit of detection (i.e., 50 ppb in fish tissue)

### Measurement of total PCB concentration in SPMDs

Total PCB concentration in SPMDs was not significantly different ( $\alpha = 0.05$ ) between location 2 (Baugo Bay) and location 3 (downstream of South Bend St. Patrick Park). However, PCB concentration was significantly different between location 1 (Bristol) and the other locations.

### Comparison of SPMDs data to fish tissue data

Total PCB concentration in fish tissue generally varied across species especially when compared on a fresh basis. Less variation was observed in total PCB concentration between each SPMD sample from the same location.

PCB levels in fish tissue did not parallel PCB levels in SPMDs from the same location except when carp and smallmouth bass were compared on a fresh or lipid basis. Our findings indicate that prediction of PCB levels in fish using SPMDs is complicated by other factors (e.g., fish species and dietary intake).

## CONCLUSIONS

- Dietary intake of PCBs by fish is likely to contribute more than exposure to PCBs in water.

- Residues in SPMDs may be a good predictor of contaminants, like PCBs, that are present in the water but do not appear to be a good predictor of PCBs in fish tissue.

- On a lipid basis, PCB levels in carp and smallmouth bass were higher at one location but this was not reflected by PCB residues measured in SPMDs.

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## ACKNOWLEDGMENTS

The authors wish to thank the Illinois-Indiana Sea Grant College Program and Purdue University Agricultural Research Program for partially funding this research. This research was supported through a cooperative agreement with the USDA, Agricultural Research Service Program project number 1935-42000-035. We would also like to thank Strategic Diagnostics, Inc for providing ELISA kits and Cheryl Schaul, Aaron Priebe, and Brady Miller for their assistance.