Measuring PCBs in Fish Tissue Using Solid Phase Microextraction (SPME)

Joanne A. Lasrado and Charles R. Santerre
Foods and Nutrition, Purdue University

PURDUE UNIVERSITY

ABSTRACT

Fish collected from Indiana waters were analyzed for PCB-118, PCB-153 and PCB-138 using solid phase microextraction (SPME) coupled to dual column gas chromatography with electron capture detection (GC/ECD) and by gas chromatography/ mass spectrometry (GC/MS). Correlations between the two methods for each congener were 0.94, 0.87 and 0.95, respectively. The data obtained by the two methods were significantly correlated ($p<0.05$). This research demonstrated the effectiveness of SPME for the rapid measurement of selected congeners which can be used to predict the toxicity of fish tissue.

INTRODUCTION

Fish consumption is the main route for exposure to PCBs. Availability of rapid analytical techniques for the measurement of PCB congeners in fish continues to be problematic. PCBs are lipophilic and can be difficult to extract from fatty matrices (Zajicek et al. 2000). Solid phase microextraction (SPME) is an emerging technique that is more rapid then many conventional methods, such as liquid-liquid or solid phase extraction (Pawliszyn 1995). SPME has been used for the extraction of PCBs from various matrices such as water (Potter and Pawliszyn 1994; Yang et al. 1998), ash (Criado et al. 2004), breast milk (Rohrig et al. 1998) and blood (Poon et al. 1999). Three 'indicator' PCBs, i.e., PCB-118, PCB-138 and PCB-153, have been shown to be predictive of toxicity (Lasrado et al. 2005;) and these congeners are often found at concentrations (ppb) that are easier to measure then some of the more toxic PCB congeners (Lasrado et al. 2005; Talloen et al. 2001).

The **objective** was to evaluate an alternative analytical method (i.e., SPME-GC/ECD) for measurement of PCB-118, PCB-138 and PCB-153 in fish tissue.

INTRODUCTION

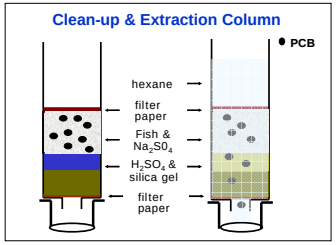
Table 1. Percent contribution of 'indicator' PCBs

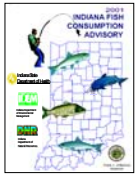
Congener	Mean Concentration (ppb)	% Contribution to [PCB]	
		Mean	Range
PCB-28	0.52	0.82	0.01 – 5.98
PCB-52	0.95	1.26	0.06 – 6.31
PCB-101	2.50	3.80	0.88 – 7.67
PCB-118	3.25	4.96	1.71 – 10.26
PCB-138	6.82	10.23	3.22 – 14.65
PCB-153	8.27	11.64	3.20 – 21.78
PCB-180	4.15	5.91	0.88 – 13.24

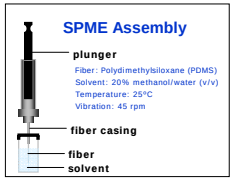
METHODS

Fish samples (n=33), collected from Indiana waters, were analyzed for PCB-118, PCB-153 and PCB-138 using a clean-up and extraction column before SPME-GC/ECD or by a conventional analytical procedure prior to measurement by gas chromatography/mass spectrometry (GC/MS).

Figure 1. Clean-up & extraction column and SPME assembly.







RESULTS

Correlations between SPME-GC/ECD and GC/MS methods for measurement of PCB-118, PCB-153 and PCB-138 were 0.94, 0.87 and 0.95, respectively. The data obtained by the two methods were significantly correlated ($p<0.05$).

Figure 2. Comparison of PCB 118 in fish tissue as analyzed by SPME-GC/ECD or GC/MS.

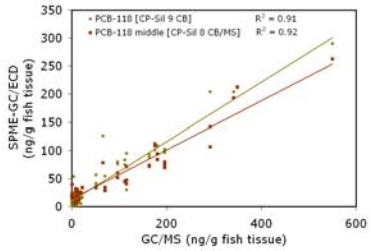


Figure 3. Comparison of PCB 153 in fish tissue as analyzed by SPME-GC/ECD or GC/MS.

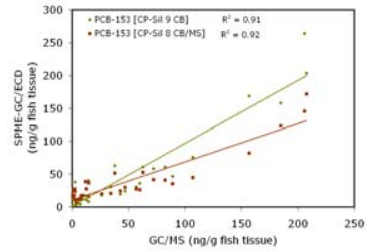
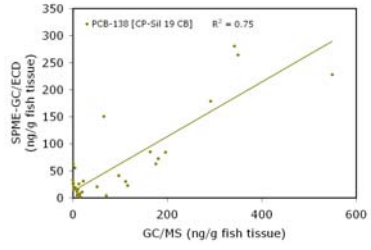


Figure 4. Comparison of PCB 138 in fish tissue as analyzed by SPME-GC/ECD or GC/MS.



CONCLUSIONS

- SPME-GC/ECD can be used to rapidly measure 3 PCB congeners in fish tissue.
- Concentrations of these 3 PCB congeners can be used to predict toxicity of fish tissue.
- This analytical procedure allows for a faster throughput at a significantly lower cost.

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