IMPACT OF CHANGES IN WHO TEF VALUES ON MEASUREMENTS OF SOIL CONCENTRATIONS OF PCDDS, PCDFS AND PCBS IN A COMMUNITY IN MICHIGAN, USA

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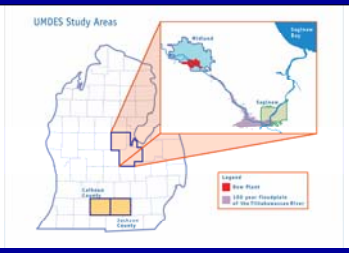
INTRODUCTION & OBJECTIVES

As part of the University of Michigan Dioxin Exposure Study, soil samples were collected from 766 residential properties from five populations in Michigan (Figure 1). When the toxic equivalents (TEQs) measured in this study were first reported (Adriaens et al., 2006), they were based on the toxicity equivalency factors (TEFs) issued by the World Health Organization (WHO) in 1998 (Van den Berg et al., 1998). In 2005, the TEFs were changed for 14 of the 29 congeners (Van den Berg et al., 2006). **The objective of this presentation is to discuss the impact of the changed TEF values on the soil TEQ concentrations.**

Figure 1. Geographic Areas

Floodplain: Within the 100-year floodplain of the Tittabawassee River
Near Floodplain: Within the census block of the Floodplain, but outside the Floodplain
Midland Plume: Down wind of Dow Chemical
Other Midland/Saginaw: Within these counties but outside the other areas
Jackson/Calhoun: Within these counties, located about 100 miles south of Dow Chemical



METHODS

Soil Sampling: Four sampling stations were located around the house (Figure 2). If a respondent indicated soil contact activities, samples were also taken at those locations. For properties in the Tittabawassee River flood plain, a location near the river was sampled. Individual soil cores were composited, yielding the composites shown in Table 1. Samples were analyzed by Vista Analytical Laboratories (California, USA) using HRGC/HRMS. The measured concentrations were then adjusted using population sampling weights to reflect the fact that the samples were obtained from a probabilistic subset of the areas' households.

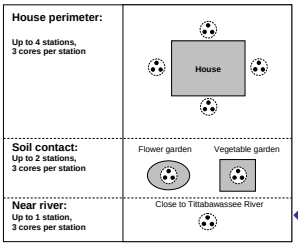


Figure 2. Location of Soil Samples Around a Residence

Table 1. Types of Soil Composites

- House perimeter 0-1 inch composite (HP 0-1 inch)
- House perimeter 1-6 inch composite (HP 1-6 inch)
- Soil contact 0-6 inch composite (Garden)
- Near river 0-1 inch composite (NR 0-1 inch)
- Near river 1-6 inch composite (NR 1-6 inch)

RESULTS

Table 2 presents the arithmetic means for the five types of composite samples for the populations. **In the Floodplain, the average reduction in TEQ from 1998 to 2005 is about 21%, whereas in the Plume and in Jackson/Calhoun, it is 9% and 14% respectively.**

The difference is attributable to the different congener profiles for these populations. Figure 3 shows the contribution to the total TEQ for the PCDDs (dioxins), PCDFs (furans) and PCBs. The TEQ is dominated by the PCDFs in the Floodplain, predominantly 2,3,4,7,8-PeCDF. Thus, the reduction in TEF for this compound from 0.5 to 0.3 (Table 3) results in the median contribution of the PCDFs to the TEQ dropping from about 60% to 55%.

In contrast, the median contribution to the TEQ in the Plume is greater for the PCDDs than for the PCDFs. With the 2005 TEFs, the contribution to the TEQ increases for the PCDDs in the Plume, driven by the increase in the TEF for OCDD and the reduction for 2,3,4,7,8-PeCDF (Table 3).

In Jackson/Calhoun, the changes in congener contributions to the TEQ are similar to those observed in the Plume: the median contribution of the PCDDs increases, while that of the PCDFs decreases.

Despite the changes in the TEFs for the PCBs, the contribution of this group stays relatively the same in all the populations due to the fact that the TEF for the dominant PCB in these samples, PCB 126, did not change (Table 3).

Table 2. Comparison of Arithmetic Mean TEQs (pg/g) for Soil Composites from the Five Populations

Population	Composite	WHO 1998	WHO 2005	Percent Change
Floodplain	HP 0-1 inch	72.2	56.5	-21.7%
	HP 1-6 inch	71.9	56.2	-21.8%
	Garden	64.4	50.7	-21.3%
	NR 0-1 inch	302.1	238.5	-21.0%
	NR 1-6 inch	363.4	286.6	-21.2%
Plume	HP 0-1 inch	127.8	114.8	-10.2%
	HP 1-6 inch	120.5	106.4	-11.7%
	Garden	66.6	62.5	-6.2%
Near Floodplain	HP 0-1 inch	67.8	52.0	-23.3%
	HP 1-6 inch	83.2	64.7	-22.2%
	Garden	25.3	20.4	-19.4%
Other Midland/Saginaw	HP 0-1 inch	16.0	13.9	-13.1%
	HP 1-6 inch	151.4	113.4	-25.1%
	Garden	11.1	10.2	-8.1%
Jackson/Calhoun	HP 0-1 inch	8.3	6.9	-16.9%
	HP 1-6 inch	13.2	11.2	-15.2%
	Garden	5.5	4.9	-10.9%

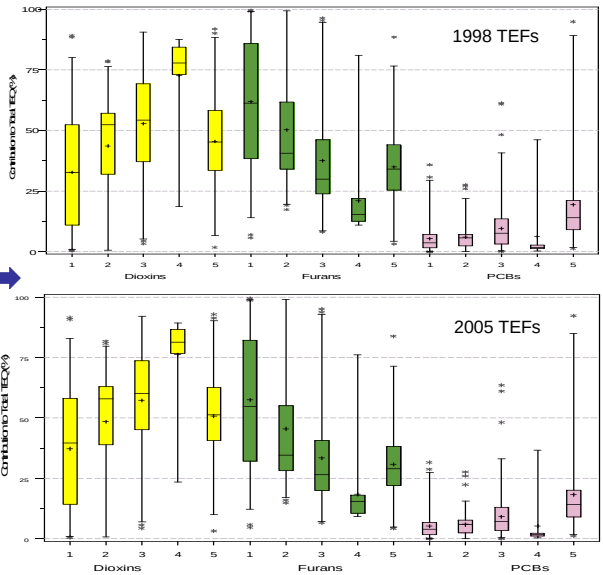


Figure 3. Box Plots Showing Percent Contributions to Total TEQ for the HP 0-1 Inch Composites.

1: Floodplain
2: Near Floodplain
3: Other Midland/Saginaw
4: Plume
5: Jackson/Calhoun

Plus sign is arithmetic mean; horizontal line across box is median; margins of the box are the 75th and 25th percentiles; ticks extend to the 99th and 1st percentiles; stars show values above the 99th percentile or below the 1st percentile.

Table 3. WHO TEF Values

Compound	WHO 1998 TEF	WHO 2005 TEF
chlorinated dibenzo-p-dioxins		
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	1	1
1,2,3,4,7,8-HxCDD	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.01
OCDD	0.0001	**0.0003**
chlorinated dibenzofurans		
2,3,7,8-TCDF	0.1	0.1
1,2,3,7,8-PeCDF	0.05	0.03
2,3,4,7,8-PeCDF	0.5	**0.3**
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,6,7,8,9-HpCDF	0.01	0.01
OCDF	0.0001	**0.0003**
non-ortho substituted PCBs		
PCB 77	0.0001	0.0001
PCB 81	0.0001	**0.0003**
PCB 126	0.1	0.1
PCB 169	0.01	**0.03**
mono-ortho substituted PCBs		
PCB 105	0.0001	**0.00003**
PCB 114	0.0005	**0.00003**
PCB 118	0.0001	**0.00003**
PCB 123	0.0001	**0.00003**
PCB 156	0.0005	**0.00003**
PCB 157	0.0005	**0.00003**
PCB 167	0.00001	**0.00003**
PCB 189	0.0001	**0.00003**

References

Adriaens, P., et al., 2006. Organohalogen Compounds, 68.

Van den Berg, M., et al., 1998. Environmental Health Perspectives, 106.

Van den Berg, M., et al., 2006. Toxicological Sciences, 93.

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