

## Comparison of Congener Profiles of Polychlorinated Biphenyls between Yu-cheng Children and a Potential Food Source

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### Introduction

In 1979, about two thousand people in central Taiwan were intoxicated by consumption of the rice oil that was contaminated with polychlorinated biphenyls (PCBs). This “Yu-cheng” incident was one of the two human tragedies which people ingested substantial amounts of PCBs within a short period of time<sup>1</sup>. Some of the follow-up epidemiological studies focused on the children born to the exposed mothers, the Yu-cheng children, since they could be exposed to PCBs via breast-feeding or transplacental transfer. This report presents the results of the serum PCB levels of the 21 Yu-cheng children with a congener-specific analysis.

On the other hand, fish consumption is thought to be the single most important exposure route to PCBs to the general public; thus, it is crucial to understand PCB exposure from fish consumption. In a separated study to assess PCB contamination in fish, PCB congener concentrations in tilapia (*Oreochromis hybrids*), the most popular fish in Taiwan, were evaluated. The consumption quantity of tilapia is the highest throughout the Island<sup>2</sup>. It is mostly farmed in fresh water but can also be bred in saltwater.

This report presents the concentrations and profiles in the serums of the Yu-cheng children. The congener profile is compared with PCB profile in the serum of Yu-cheng women reported previously and that in one of the potentially significant exposure source, tilapia, conducted in a separated work. Remarkable similarity between the profile of Yu-cheng children and that of the tilapia is revealed and discussed.

### Methods and Materials

Serum samples were collected from twenty-one Yu-cheng children in 1999, twenty years after the incident; subjects were from the Yu-cheng registry which was maintained by the government. There were seven boys and fourteen girls, with mean ages of 16.3.

About 1 milliliter of serum samples was used for analysis. Samples added with 2.5 mg of KOH and 20ml of 95% ethanol were saponificated for one hour in a 100°C water bath, followed by three times of hexane extraction in a separatory funnel. Extracts were then concentrated, cleaned-up, concentrated again to nearly dry, added with internal standard (30µl of nonane), and transferred to the GC vials.

Samples were analyzed by a gas chromatograph-electron capture detector (GC-ECD, Varian Star 3600cx) with a 0.25mm×60m×0.25µm DB-5MS capillary column. Sixteen congeners were selected for analysis, namely PCB IUPAC No. 28, 52, 66, 74, 101, 105, 110, 118, 138, 153, 156, 157, 170, 180, 183 and 187. Congener selection was based on preliminary screening of congeners in the serum samples of this cohort<sup>3</sup>.

In the PCBs-in-fish study, approximately 10 fish samples of the tilapia were randomly purchased at the major markets in each of three major cities in Taiwan in 1998: Taipei, Taichung, and Kaohsiung in northern, central, and southern Taiwan, respectively. Approximately 10 g of minced fillets were extracted three times with 80ml acetone/hexane (volume ratio 2:8) mixtures by Tissuemizer. Extracts were then concentrated and cleaned-up, as described in Lung et al<sup>4</sup>. Seventeen congeners were selected for analysis, namely PCB 28/31, 52, 66, 77, 105/153, 118, 126, 128, 138, 156, 157, 167, 170, 180 and 189. PCB analysis was performed on a Perkin Elmer M611-9000 gas chromatograph-electron capture detector, equipped with a 30 m× 0.25 mm ID× 0.25 µm Perkin Elmer PE-5 capillary column.

In this report, concentrations below the method detection limits (MDLs) were taken as 1/2 MDLs when concentrations were presented and discussed. However, to avoid overestimation of non-detectable congeners, PCB levels below MDLs were considered as zero when congener profiles, expressed as percentages, were presented and discussed.

## Results and Discussion

The sum of the sixteen congeners (total PCBs) was 1313±837 ng/g lipid in the serum samples of 21 Yu-cheng children. The median value was 1161 ng/g lipid. The congener profile is shown in Figure 1. PCB 138 was the predominant congener (nearly 60%), followed by PCB105/153 (15-17%).

Guo et al.<sup>2</sup> had analyzed congener concentrations of the serum samples of 56 Yu-cheng women, 14 years after the intoxication. Serum samples were analyzed for thirteen congeners, similar to the congeners analyzed for the 21 Yu-cheng children. Comparing to the congener profile of the Yu-cheng women (Figure 2), which had less than 30% contribution from PCB 138, it was found that PCB 138 accounts for much higher percentage of the total PCBs in the Yu-cheng children.

In the PCBs-in-fish study, the sum of the seventeen congeners (total PCBs) was 19.0 ng/g lipid in the fillet samples of tilapia; the range was 3.96-117.8ng/g lipid. The congener profile is presented in Figure 3. PCB 138 was also the dominant congener, accounting for 65%. And PCB 105/153 accounted for 13% of the total PCBs.

Although there were some differences in congener selection among three studies, however, it is shown in the graphs that there is remarkable similarity between the congener profile of Yu-cheng children and that of a potentially significant PCB source, tilapia--a highly popular local cultured fish. Traditionally, eating fish has been thought as one way to enhance childrens' intelligence. Thus, some parents would particularly purchase fish just for the children. The consumption quantity of tilapia is the highest throughout Taiwan and the cultivation areas are all over the Island<sup>2</sup>. Since it is cheaper than a lot of other fish and its wider availability than other fish species, it is a preferable fish choice for the low socioeconomic class, as in the case of the Yu-cheng children<sup>1</sup>.

Nevertheless, fish is only part of the daily food intake and tilapia is only one kind of fish. It is not our intention to stress that tilapia is the main contributing factor for Yu-cheng children's PCB profile. On the contrary, this report merely points out the fact that the PCB congener profile in the serum of the 21 Yu-cheng children is rather similar to the profile found in one of the potential food intake than the profile in the serum of the Yu-cheng women. The different transfer efficiency among different congeners from mother to babies might be one of the possibilities; the metabolism occurred in the Yu-cheng children might be another. However, it cannot be ruled out the importance of other potential PCB exposure routes such as food intake.

There have been few studies focusing on food analysis for PCB congeners in Taiwan. Most of the works have been done only analyzing for coplanar PCBs. Since different PCB congeners have different toxicities and specific congeners may be responsible for some specific health outcomes other than those synergic effects exerted by the similar structured pollutants such as polychlorinated dibenzo-p-dioxins<sup>5</sup>, researches shall not be focused on coplanar PCBs only. Comprehensive assessment of other potential exposure sources for those abundant PCB congeners, occurring both in human tissues and in the biotic compartments, should be conducted to facilitates essential countermeasures against further exacerbation on this group of victims.

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## References

- 1 Hsu C-C, Yu M-LM, Chen Y-CJ, Guo Y-LL, Rogan WJ. (1994) In: Dioxin and Health (Schechter A, ed), Plenum Press, 661-683.
- 2 Fisheries Administration. Fisheries Statistical Year book-1999, Taiwan Area. (2000) Fisheries Administration, Council of Agriculture, Executive Yuan: Taipei, Taiwan, R.O.C, pp 150-189.
- 3 Guo YL, Ryan JJ, Lau BPY, Yu ML, Hsu CC. (1997) Arch Environ Contam Toxicol 33:104-108.
- 4 Lung SCC, Chen CF, Hu SC, Bau YP. (2003) Environ Sci Technol 37:4579-4585.
- 5 Guo YL, Yu M-LM, Ryan JJ. (1996) Neurotoxicol and Teratol 18:255-256.

Figure 1 PCB congener profile in the serum samples of 21 Yu-cheng children.

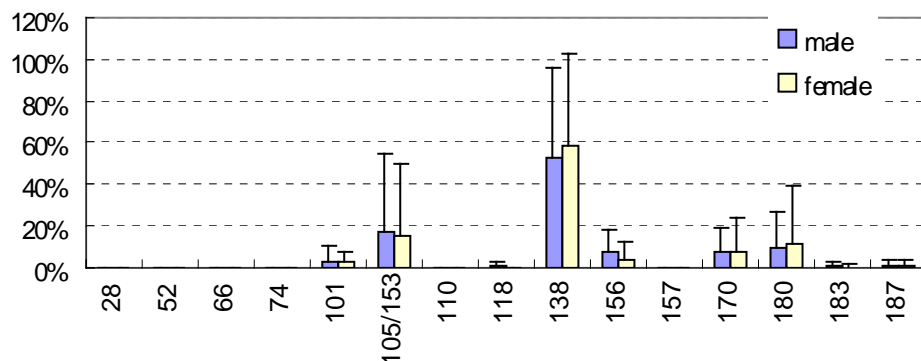
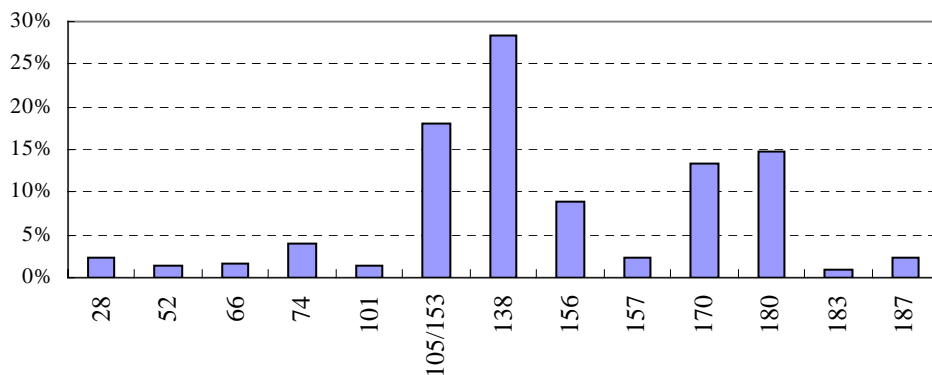
Figure 2 PCB congener profile in the serum samples of 56 Yu-cheng women, from Guo et al.<sup>3</sup>

Figure 3 PCB congener profile in the tilapia samples, a highly popular local cultured fish.

