

PCDD and PCDF in Restaurant Food from Southern Mississippi, USA

H. Fiedler¹, K. Cooper², C. Rappe³, S. Bergek³, M. Hjelt³, M. Bonner⁴, and F. Howell⁵

¹ University of Bayreuth, Ecological Chemistry and Geochemistry, D-95440 Bayreuth, Germany

* Present address: Bavarian Institute for Waste Research, BifA GmbH, Am Mittleren Moos 46a, D-86167 Augsburg, Germany

² Rutgers University, Cook College, New Brunswick, NJ 08903, USA

³ Institute of Environmental Chemistry, Umeå University, S-901 87 Umeå, Sweden

⁴ Bonner Analytical Testing Co., Hattiesburg, MS 39402, USA

⁵ University of Southern Mississippi, Department of Biological Sciences, Hattiesburg, MS 39404, USA

ABSTRACT

In 1996, we analyzed seven food dishes from a relatively upscale restaurant in Hattiesburg, Mississippi, for PCDD and PCDF. None of the seven items contained quantifiable concentrations of 2,3,7,8-Cl₄DD. The veal chop had the highest I-TEQ of all food dishes on both a fresh weight basis (0.173 pg/g) and a lipid basis (1.67 pg/g). Based on an assumed average daily PCDD and PCDF intake of 100 pg I-TEQ/person, the veal chop and the pasta dish would contribute 46% and 51%, respectively, if consumed in a regular diet. The PCDD and PCDF levels in these foods are similar to our previously reported findings for food dishes from a Mexican-style restaurant from the same general area.

Key words: Polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans, restaurant food, United States of America

1 INTRODUCTION

Food consumption is considered the major route - greater than 90% - of human exposure to polychlorinated dibenzo-*p*-dioxins (PCDD) and dibenzofurans (PCDF) (1). A number of studies in Europe, the United States and Canada have examined PCDD and PCDF levels in foods (2-13). Very few studies, however, compare the PCDD and PCDF levels in raw and prepared foods (14, 15). We previously reported PCDD and PCDF results for store purchased foods, restaurant foods, and farm-raised catfish from the southeast United States (9-11). Our studies are the most extensive, comprehensive, and congener-specific analysis of food from the United States. The results reported here are a further extension of our previous studies. To put our results into perspective, we calculated the percentage contribution of PCDD and PCDF in these dishes to an assumed daily intake of 100 pg I-TEQ.

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2 EXPERIMENTAL

In 1996, we purchased seven food dishes from the menu of a relatively upscale restaurant in Hattiesburg, Mississippi (USA), and transported them to the local laboratory in Hattiesburg where they were individually wrapped, labeled, and frozen. The seven dishes included: a veal chop, chicken strips and fries, blackened amberjack fish fillet, seafood soup, pasta with cheese and cream sauce, cheese sticks, and cheese cake (Table 1). The samples were shipped on ice to the analytical laboratory in Umeå, Sweden. All samples were prepared and analyzed as previously described (10, 11).

3 RESULTS

The congener-specific results on a lipid basis and the I-TEQs ($\frac{1}{2}$ detection limit) on both a lipid basis and a fresh weight basis are given in Table 1. The limit of quantification (LOQ) for non-detected (ND) congeners are shown in parentheses. 2,3,7,8-Cl₄DD was not quantified in any of the seven food dishes at LOQs ranging from 0.059 to 0.35 pg/g lipid. All other 2,3,7,8-substituted congeners were detected in the veal chop. In most dishes, the major contribution to the I-TEQ is from the penta- and hexachlorinated congeners. In addition, 1,2,3,4,6,7,8-Cl₇DD, 1,2,3,4,6,7,8-Cl₇DF, and Cl₈DD were quantified in all seven dishes.

Table 1: PCDD, PCDF (pg/g lipid) and I-TEQ (pg/g lipid and fresh weight). LOQ for non-quantifiable congeners in parentheses. TEQs are calculated using $\frac{1}{2}$ LOQ for non-detects.

Description	Veal Chop	Chicken Strips & Fries	Fish Fillet	Seafood Soup	Pasta with Cream Sauce	Cheese Sticks	Cheese Cake
% Fat Content	10.29	15.74	3.92	4.57	10.46	19.65	24.42
2,3,7,8-Cl ₄ DD	ND (0.059)	ND (0.066)	ND (0.35)	ND (0.092)	ND (0.10)	ND (0.062)	ND (0.070)
1,2,3,7,8-Cl ₅ DD	0.27	ND (0.091)	ND (0.30)	0.17	0.28	0.16	0.27
1,2,3,4,7,8-Cl ₆ DD	0.31	ND (0.053)	ND (0.15)	ND (0.069)	0.28	0.14	0.19
1,2,3,6,7,8-Cl ₆ DD	1.1	ND (0.062)	0.70	1.1	1.3	0.75	1.2
1,2,3,7,8,9-Cl ₆ DD	0.41	ND (0.11)	ND (0.25)	0.31	0.27	0.11	0.27
1,2,3,4,6,7,8-Cl ₇ DD	4.7	0.60	1.6	3.5	5.6	1.9	2.5
Cl ₈ DD	6.9	8.0	3.7	5.1	16	5.2	1.8
2,3,7,8-Cl ₄ DF	0.97	0.055	0.35	0.47	0.23	0.046	0.15
1,2,3,7,8-Cl ₅ DF	0.48	ND (0.046)	ND (0.20)	0.15	0.062	ND (0.026)	ND (0.023)
2,3,4,7,8-Cl ₅ DF	1.3	ND (0.056)	ND (0.23)	0.37	0.18	0.13	0.17
1,2,3,4,7,8-Cl ₆ DF	2.3	ND (0.11)	ND (0.20)	0.38	0.41	0.27	0.22
1,2,3,6,7,8-Cl ₆ DF	1.0	ND (0.11)	ND (0.17)	0.23	0.23	0.13	0.13
1,2,3,7,8,9-Cl ₆ DF	0.11	ND (0.12)	ND (0.18)	ND (0.080)	ND (0.077)	ND (0.056)	0.070
2,3,4,6,7,8-Cl ₆ DF	1.2	ND (0.11)	ND (0.17)	0.16	0.18	0.085	0.082
1,2,3,4,6,7,8-Cl ₇ DF	3.8	0.21	0.46	0.88	1.4	0.43	0.46
1,2,3,4,7,8,9-Cl ₇ DF	0.34	ND (0.063)	ND (0.35)	ND (0.098)	ND (0.12)	ND (0.075)	ND (0.075)
Cl ₈ DF	0.97	0.17	ND (0.41)	0.44	0.54	0.18	ND (0.11)
I-TEQ (lipid)	1.67	0.128	0.500	0.646	0.664	0.362	0.519
I-TEQ (fresh wt.)	0.173	0.0199	0.0197	0.0298	0.0691	0.0712	0.128

LEVELS IN FOOD

4 DISCUSSION

The high concentrations for most 2,3,7,8-substituted congeners and the I-TEQ in the veal chop is in agreement with results reported from Europe (2, 5, 6). The pasta dish congener pattern is similar to the pattern of the cheese sticks, indicating a dairy component in the pasta sauce. As expected, the dairy-based food items (pasta with cream sauce, cheese sticks and cheese cake) exhibit similar PCDD and PCDF patterns. For example, the ratios between the three 2,3,7,8-substituted Cl₆DD (1,2,3,4,7,8-, 1,2,3,6,7,8-, 1,2,3,7,8,9-) for these dishes were approximately 1:4:1. Also, 1,2,3,7,8-Cl₅DD and 2,3,4,7,8-Cl₅DF are present in approximately the same concentrations in the dairy-based dishes. Moreover, the patterns of these dairy-based items is similar to the PCDD and PCDF pattern of the veal, indicating a likely dairy diet for the calves. The cheese cake contained comparable PCDD and PCDF levels as the cheese cake from another restaurant from the same geographic area that we reported earlier (9). We were not able to make a correlation between these dairy-based meals and the raw dairy products we analyzed in our earlier study because these dishes contain many other ingredients of various non-dairy origin. In addition, the dairy component of these dishes varied.

The levels in the seafood dishes were lower than those we previously quantified for store purchased seafood items and farm-raised catfish (10, 11). 2,3,7,8-Cl₄DD at an LOQ of 0.35 pg/g lipid was not quantified in the fish fillet from the present study. In our catfish studies, this congener was quantified in all 15 samples, ranging from 2.1 to 32 pg/g lipid. This fish fillet dish had a TEQ lipid of 0.5 pg/g, while the catfish TEQ lipid ranged from 5.5-43 pg/g. Similarly, 2,3,7,8-Cl₄DD was not quantified in the seafood soup in the current study at an LOQ of 0.092 pg/g lipid. In our prior studies, nine of ten crawfish and crab samples analyzed had measurable levels of this congener, ranging from 1.3-6.4 pg/g lipid. Likewise, the seafood soup had a TEQ lipid of 0.646 pg/g, while the crab and crawfish TEQ lipid ranged from 5.23-40.1 pg/g.

The contribution of each food item to the total I-TEQ (fresh wt.) and the percentage of daily intake (assuming 100 pg I-TEQ/day) are summarized in Table 2. Based on this assumption, a meal of either the veal chop or the pasta dish would contribute approximately 50% of the daily intake. Based on this and previous studies, food consumption at home and at restaurants in the United States contributes to the daily intake of PCDD and PCDF.

Table 2: I-TEQ contribution and percent of daily intake.

Food Dish	Total Weight	I-TEQ Fresh Wt.	I-TEQ Lipid	Percent of Daily Intake*
Veal Chop	265	0.173	1.67	46
Chicken Strips	338	0.0199	0.128	6.7
Fish Fillet	378	0.0197	0.500	7.7
Seafood Soup	620	0.0298	0.646	18
Pasta	744	0.0691	0.664	51
Cheese Sticks	184	0.0712	0.362	13
Cheese Cake	114	0.128	0.519	15%

* Assumes a daily intake from food consumption of 100 pg I-TEQ/day.

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