PCDD/PCDF in Mexican Food

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Abstract

Five Mexican-style dishes from a local restaurant in southern Mississippi were analyzed for PCDD/PCDF. Whereas 2,3,7,8-substituted congeners could be quantified in all samples, non-2,3,7,8-substituted were only detected in one dish containing shellfish. Based on our results, preparing food by either frying or baking does not result in the formation of additional PCDD/PCDF. In addition, eating of Mexican-style dishes does not result in a dioxin intake above the present level of exposure of the general population.

Keywords: Polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans, prepared food, non-2,3,7,8-substituted congeners, daily intake.

1 INTRODUCTION

For the general population, food consumption is the major route of exposure for polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/PCDF), contributing more than 90 % (WHO/IPCS 1989). Many analyses have been performed to determine levels of these compounds in various foodstuffs (Beck *et al.* 1992, Fürst *et al.* 1990, Fürst and Wilmers 1995, Lassek *et al.* 1993, Birmingham *et al.* 1989, Schecter *et al.* 1994, Foxall *et al.* 1995, Fiedler *et al.* 1996). Most studies report levels of PCDD/PCDF in raw foodstuff. To our knowledge, only three publications present PCDD/PCDF concentrations of prepared food (Körner and Hagenmaier 1990, de Wit *et al.* 1990, Schecter *et al.* 1995). Earlier we analysed food items from local grocery stores and seafood markets in southern Mississippi, USA (Cooper *et al.* 1995, Fiedler *et al.* 1996) and found good agreement between the levels in fish, shellfish, dairy and meat products with food items reported for other industrialized countries. In a subsequent phase of our study, we collected five popular dishes from a local restaurant and analysed these for PCDD/PCDF.

2 EXPERIMENTAL

Five dishes were purchased from a local Mexican-style restaurant in southern Mississippi, USA (for identification, see Table 1). The items were transported to the local laboratory, wrapped in pre-cleaned aluminum foil, placed in a heavy-gauge polyethylene bag, frozen, and shipped to the analytical laboratory. Extraction, fractionation, separation, and quantification of all 2,3,7,8-substituted congeners was performed as described by Fiedler *et al.* (1996).

3 RESULTS

The results of the congener-specific analyses and the I-TEQ for each sample are given in Table 1. Non-detectable levels (ND) are reported with the limit of quantification (LOQ) for individual congeners in parentheses. The full LOQ was used to calculate the I-TEQ in cases of ND. All results are lipid-adjusted. In addition, the I-TEQ is given on a g/sample basis (fresh weight).

Table 1: Congener-specific results of Mexican-style food. All concentrations in pg/g fat (except for I-TEQ in last line). For ND, the LOQ is given in parentheses and the LOQ is used to calculate the I-TEQ.

Description	Stuffed Jalapeños [1)]	Chicken Fajita	Cheese-cake	Enchillada Carne al Carbon [2)]	Mexican Hamburger [3)]
% Fat Content	8.8	7.7	22.4	14.5	11.3
2,3,7,8-Cl_4DD	0.04	0.058	0.08	(0.05)	(0.05)
1,2,3,7,8-Cl_5DD	0.093	0.06	0.44	0.17	0.22
1,2,3,4,7,8-Cl_6DD	0.088	(0.072)	0.45	0.15	0.18
1,2,3,6,7,8-Cl_6DD	0.12	(0.065)	2.2	0.74	0.97
1,2,3,7,8,9-Cl_6DD	0.12	(0.078)	0.42	0.16	0.25
1,2,3,4,6,7,8-Cl_7DD	0.88	0.37	5	2.1	3
Cl_8DD	9.1	2.8	4	2.5	3.9
2,3,7,8-Cl_4DF	0.33	0.083	0.14	0.073	0.075
1,2,3,7,8-Cl_5DF	0.031	0.091	0.031	(0.038)	(0.044)
2,3,4,7,8-Cl_5DF	0.074	0.069	0.3	0.13	0.13
1,2,3,4,7,8-Cl_6DF	0.068	(0.066)	0.54	0.25	0.22
1,2,3,6,7,8-Cl_6DF	(0.023)	(0.055)	0.32	0.12	0.11
1,2,3,7,8,9-Cl_6DF	(0.029)	(0.028)	(0.015)	(0.057)	(0.069)
2,3,4,6,7,8-Cl_6DF	(0.020)	(0.015)	0.27	0.093	0.087
1,2,3,4,6,7,8-Cl_7DF	0.17	0.25	0.96	0.71	0.7
1,2,3,4,7,8,9-Cl_7DF	(0.054)	0.064	0.025	(0.085)	(0.081)
Cl_8DF	0.32	0.6	0.26	0.26	0.38
I-TEQ (lipid basis)	**0.239**	**0.183**	**0.95**	**0.393**	**0.469**
I-TEQ (fresh weight)	**0.020**	**0.014**	**0.213**	**0.057**	**0.053**

[1)] contains crabmeat and Monterrey Jack cheese; [2)] contains steak, enchillada sauce and cheese; [3)] contains cheese and ground beef.

As can be seen from Table 1, almost all 2,3,7,8-substituted congeners could be quantified in the foodstuffs. At a LOQ of approximately 0.003 pg/g sample fresh weight, 1,2,3,7,8,9-Cl_6DF could not be quantified in any sample. The highest concentration in I-TEQ - on a lipid and a fresh weight basis - was in cheesecake (0.95 pg I-TEQ/g fat or 0.21 pg I-TEQ/g sample). As expected, samples that contain larger amounts of "dioxin-free" ingredients, *e.g.* flour-based, had relatively low PCDD/PCDF levels (jalapeños, chicken fajita).

In general, high contributions to the I-TEQ in all items are from 1,2,3,7,8-Cl_5DD (16-23 %) and 2,3,4,7,8-Cl_5DF (14-18 %). We also observed that 1,2,3,6,7,8-Cl_6DD is a major contributor (18-23 %) for beef- and dairy-based products (cheesecake, enchillada, and hamburger), whereas this congener contributes less than 5 % in the chicken and the shellfish products (fajita and jalapeños). In addition, 2,3,7,8-Cl_4DD was found to be relatively dominant in the chicken fajita (32 % to the I-TEQ), and was quantified in the cheesecake and the jalapeños.

Non-2,3,7,8-substituted PCDD and PCDF were only found in the stuffed jalapeños (see Figure 1 for fragmentograms of Cl_5DD, Cl_6DD, and Cl_4DF). This is in agreement with studies that reported the presence of these congeners in shellfish (Fiedler *et al.* 1996, Rappe 1993). The fragmentograms of the four other food items did not show traces of non-2,3,7,8-substituted congeners. This result is in agreement with a Swedish study (de Wit *et al.* 1990), when herring was analyzed before and after frying and no difference was observed in the congener profiles of the two samples. In addition, the concentrations in the two herrings were almost identical (210 and 220 pg TEQ/g lipid). However, Körner and Hagenmaier (1990) detected non-2,3,7,8-substituted congeners in samples of smoked and charcoal-fried meat and fish. The presence of these congeners may be due to adsorption from the smoke.

4 DISCUSSION

Some results of our earlier southern Mississippi food survey are given in Table 2. As can be seen, PCDD/PCDF concentrations in the various raw foodstuffs are in the same range as in the prepared (finished) Mexican foods. Because milk is the primary ingredient for cheesecake and this food item does not have many "dioxin-free" additives, the presence of PCDD/PCDF is due to the milk itself.

In addition, a comparison of the 1995 study and the present study indicates that preparing food by either cooking or frying does not seem to change the PCDD/PCDF content of a given item. In other words, the origin of a meal and its main ingredients primarily determines the final dioxin concentration and not the way it is prepared.

Table 2: PCDD/PCDF concentrations in foodstuffs from southern Mississippi (Fiedler *et al.* 1996). Concentrations in pg/g fat.

Foodstuff	I-TEQ		
Blue crab, Body	31.4	35.9	40.1
Blue crab, Claw	19.7	17.0	18.4
Chicken, Meat	0.782	0.708	0.610
Ground Beef	0.626	1.10	0.528
Milk, Whole	0.805	0.805	0.416
Cheese, Cheddar	0.863	0.756	0.740
Eggs	0.195	0.326	0.176

To put our results into perspective, the contribution of consuming Mexican food to the daily dietary PCDD/PCDF exposure was estimated. For this assessment, we assumed that the general population is presently exposed to 100 pg I-TEQ/day from food consumption. From the results in Table 3, it can be concluded that eating a normal-sized dish of a Mexican-style meal is at most one quarter of the daily intake. However, in terms of dioxin exposure, consumption of a desert like cheesecake will contribute approximately another one-fourth of the total daily intake *via* food.

Table 3: Estimated daily dioxin intake from Mexican food

Meal	Fresh Weight (g)/Meal	PCDD/PCDF Intake (pg I-TEQ/meal)
Stuffed Jalapeños	175	3.6
Chicken Fajita	200	2.8
Cheesecake	110	23.4
Enchillada Carne al Carbon	400	22.8
Mexican Hamburger	300	15.9

5 ACKNOWLEDGMENT

This work was sponsored by Georgia-Pacific Corporation, Atlanta, GA (USA).

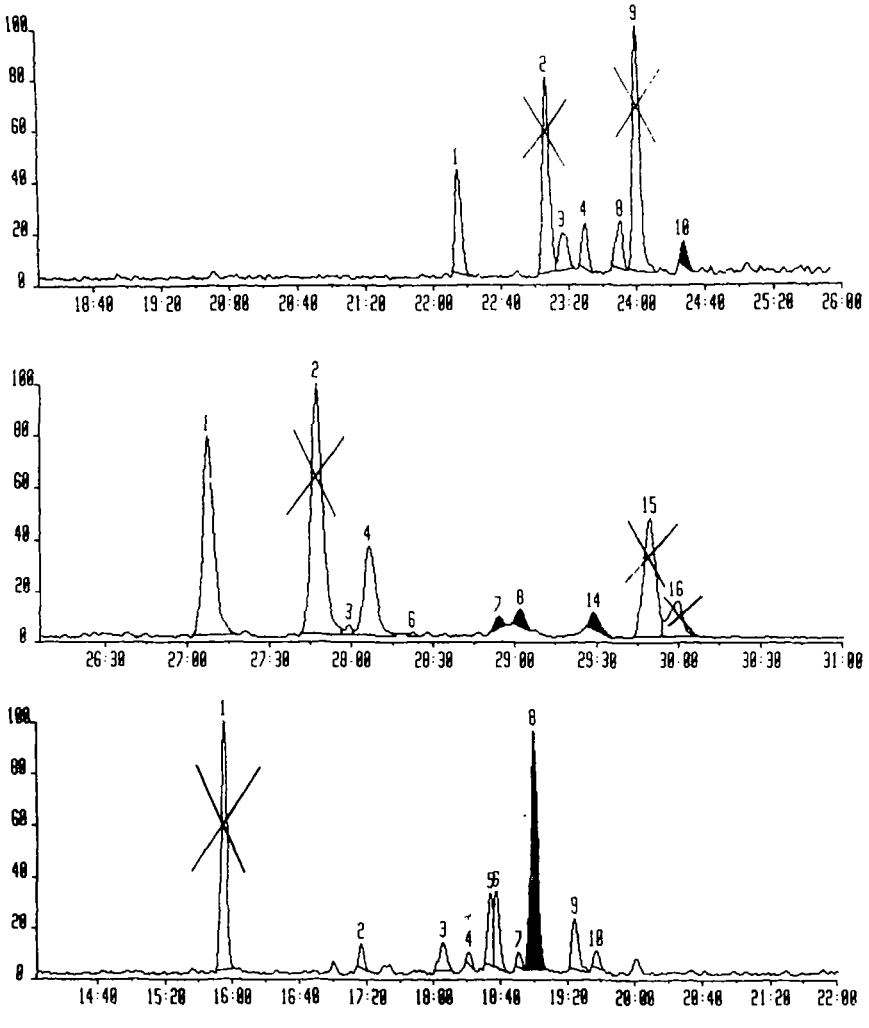

Figure 1: Mass fragmentograms for Cl_5DD (top), Cl_6DD (middle), and Cl_4DF (bottom) in the stuffed jalapeños. 2,3,7,8-Substituted congeners are indicated by shaded peaks (crossed-out peaks are artifacts).

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