DIOXIN LEVELS IN FOOD FROM THE UNITED STATES WITH ESTIMATED DAILY INTAKE

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Objective: Since over 96% of the intake of dioxins in humans is estimated to be from food, congener-specific dioxin analyses were performed on a variety of random food samples from the U.S. In Canada and Germany total daily food intake of dioxin has been estimated at approximately 1.5 picogram of dioxin toxic equivalents (TEqs) per kilogram of body weight.[1-3] We begin to estimate dioxin intake for the U.S. general population using new data from 18 food samples.

Methods: Meat, fish and dairy products were purchased from a supermarket in upstate New York in the early 1990's. Samples were frozen and shipped on dry ice to two dioxin laboratories for analysis. Methods have been previously described.[4,5] Each laboratory has been certified by the World Health Organization for dioxin analysis of human tissue.

Results: The results from 18 U.S. food samples are presented in Tables I, II and III on a whole weight basis, to approximate actual food intake. The fish sampled has lower TEqs in general than the meat, ranging from 0.02 to 0.13 ppt wet weight. For meat, total dioxin TEq ranges from 0.03 to 1.5 ppt on a wet weight basis. Dairy product TEqs range from 0.04 to 0.7 ppt wet weight for these samples.

Conclusion: From initial calculations, we estimate approximately 1 to 10 pg TCDD and 10-100 pg international dioxin toxic equivalents per person per day for Americans, which is similar to estimated intakes from other countries. More precise estimates will be presented at Dioxin '93.

References: 1 Fürst P, Fürst C, Groebel W. Levels of PCDDs and PCDFs in food-stuffs from the Federal Republic of Germany. *Chemosphere* 1990;20:7/9:787-792.
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TABLE I: CONCENTRATION OF CHLORINATED DIOXINS AND DIBENZOFURANS IN AMERICAN FISH (ppt, wet weight)

	TEF	Haddock	Haddock Fillet	Crunchy Haddock	Perch	Cod
2,3,7,8-TCDD	1	ND 0.01	0.008	0.03	0.04	ND 0.01
1,2,3,7,8-PeCDD	0.5	ND 0.01	ND 0.006	0.05	0.05	0.01
1,2,3,4,7,8-HxCDD	0.1	0.01	ND 0.009	0.05	*	ND 0.01
1,2,3,6,7,8-HxCDD	0.1	0.03	0.021	0.1	*0.10	0.02
1,2,3,7,8,9-HxCDD	0.1	0.02	NA	0.1	0.03	ND 0.01
1,2,3,4,6,7,8-HpCDD	0.01	0.12	0.047	0.35	0.18	0.1
OCDD	0.001	0.56	0.268	2.23	1.15	0.67
2,3,7,8-TCDF	0.1	0.04	0.02	0.05	0.73	0.03
2,3,4,7,8-PeCDF	0.5	0.01	0.007	0.04	0.14	ND 0.01
1,2,3,7,8-PeCDF	0.05	0.01	0.008	0.03	0.1	ND 0.01
1,2,3,4,7,8-HxCDF	0.1	0.01	ND 0.008	0.04	0.02	ND 0.01
1,2,3,6,7,8-HxCDF	0.1	0.01	ND 0.007	0.03	0.03	ND 0.01
2,3,4,6,7,8-HxCDF	0.1	0.01	ND 0.006	0.05	0.04	ND 0.01
1,2,3,7,8,9-HxCDF	0.1	ND 0.01	ND 0.01	0.03	ND 0.01	ND 0.01
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.007	0.05	0.03	0.02
1,2,3,4,7,8,9-HpCDF	0.01	ND 0.01	ND 0.01	0.05	ND 0.01	ND 0.01
OCDF	0.001	0.03	ND 0.014	0.14	0.04	ND 0.01
Total PCDDs		0.75	0.35	2.91	1.55	0.815
Total PCDFs		0.14	0.07	0.51	1.14	0.09
PCDDs/Fs		0.89	0.42	3.42	2.69	0.905
Total TEq		0.03	0.02	0.13	0.023	0.023

Analyses by Food Science Laboratory, Norwich England * "Fused" peaks: a small peak not fully resolved from one much larger. The contribution from 1,2,3,4,7,8-HxCDD is small. NA - not available. ND - not detected within detection limits shown. Half of detection limits used in calculation.

TABLE II: CHLORINATED DIOXIN AND DIBENZOFURAN LEVELS IN AMERICAN MEAT PRODUCTS (ppt, wet weight)

Sample Congener	TEF	Ground Beef	Beef Rib Sirloin Tip	Pork Chops	Lamb Sirloin	Cooked Ham	Beef Rib Steak	Lebanon Bologna	Chicken Drumstick
2,3,7,8-TCDD	1	0.019	0.005	0.013	0.052	ND 0.006	0.028	0.015	0.011
1,2,3,7,8-PeCDD	0.5	0.062	0.01	0.041	0.28	ND 0.009	0.208	0.042	ND 0.011
1,2,3,4,7,8,-HxCDD	0.1	*	*	*	0.295	*	*	0.044	ND 0.017
1,2,3,6,7,8-HxCDD	0.1	0.496	0.03	0.282	0.631	0.055	1.981	0.199	0.04
1,2,3,7,8,9-HxCDD	0.1	0.087	0.011	0.044	0.241	0.007	0.616	0.058	ND 0.014
1,2,3,4,6,7,8-HpCDD	0.01	1.157	0.117	8.197	3.531	0.437	12.065	1.033	0.133
OCDD	0.001	2.262	0.414	50.742	3.916	2.2	15.825	2.271	0.74
2,3,7,8-TCDF	0.1	0.025	0.01	0.065	0.023	0.013	0.051	0.027	0.032
1,2,3,7,8-PeCDF	0.05	ND 0.003	ND 0.001	0.009	0.004	0.003	0.01	ND 0.007	ND 0.006
2,3,4,7,8,-PeCDF	0.5	1.783	0.03	0.039	0.05	0.011	0.065	0.041	0.01
1,2,3,4,7,8-HxCDF	0.1	4.846	0.066	0.108	0.112	0.014	0.187	0.037	0.009
1,2,3,6,7,8-HxCDF	0.1	ND 0.003	0.014	0.031	0.087	0.01	0.199	0.045	0.008
1,2,3,7,8,9-HxCDF	0.1	ND 0.005	ND 0.002	ND 0.007	ND 0.005	ND 0.005	ND 0.01	ND 0.009	ND 0.012
2,3,4,6,7,8-HxCDF	0.1	0.037	0.01	0.029	0.054	0.005	0.177	0.028	ND 0.01
1,2,3,4,6,7,8-HpCDF	0.01	0.274	0.028	1.251	0.359	0.087	2.702	0.136	0.024
1,2,3,4,7,8,9-HpCDF	0.01	0.023	ND 0.003	0.097	0.036	0.008	0.118	ND 0.016	ND 0.01
OCDF	0.001	0.055	0.018	0.821	0.122	0.056	1.073	0.061	0.034
Total PCDD		4.1	0.6	59.3	8.946	2.7	30.7	3.7	0.95
Total PCDF		7.0	0.2	2.5	0.850	0.2	4.6	0.4	0.14
Total PCDD/F		11.1	0.8	61.8	9.796	2.9	35.3	4.1	1.09
Total TEq		1.5	0.04	0.3	0.4	0.03	0.65	0.12	0.03

Analyses by Food Science Laboratory, Norwich England. * "Fused" peaks: a small peak not fully resolved from one much larger. The contribution from 1,2,3,4,7,8-HxCDD is small. ND - not detected within detection limits shown. Half of detection limits used in calculation.

TABLE III: DIOXIN, DIBENZOFURAN LEVELS AND TOXIC EQUIVALENTS IN VARIOUS TYPES OF AMERICAN DAIRY PRODUCTS (ppt, wet weight)

Congener	TEF	Cottage Cheese	Soft Blue Cheese	Heavy Cream	Soft Cream Cheese	American Cheese Slices
2,3,7,8-TCDD	1	ND(.003)	ND(.05)	ND(.04)	0.04	0.07
1,2,3,7,8-PeCDD	0.5	0.01	0.2	0.11	0.11	0.12
1,2,3,4,7,8-HxCDD	0.1	0.02	0.29	0.07	0.14	0.017
1,2,3,6,7,8-HxCDD	0.1	0.07	1.72	0.7	0.58	0.38
1,2,3,7,8,9-HxCDD	0.1	0.02	0.29	0.14	0.14	0.19
1,2,3,4,6,7,8-HpCDD	0.01	0.18	5.88	2.11	1.51	1.13
OCDD	0.001	0.34	5.93	1.54	1.5	1.6
2,3,7,8-TCDF	0.1	0.02	0.15	0.07	0.07	0.1
1,2,3,7,8-PeCDF	0.05	ND(.006)	ND(.05)	ND(.04)	0.04	ND(.05)
2,3,4,7,8-PeCDF	0.5	0.02	0.25	0.14	0.18	0.07
1,2,3,4,7,8-HxCDF	0.1	0.06	0.93	0.47	0.43	0.36
1,2,3,6,7,8-HxCDF	0.1	0.02	0.34	0.14	0.18	0.1
1,2,3,7,8,9-HxCDF	0.1	ND(.006)	ND(.1)	ND(.04)	ND(.04)	ND(.05)
2,3,4,6,7,8-HxCDF	0.1	0.01	0.15	0.11	0.14	0.07
1,2,3,4,6,7,8-HpCDF	0.01	0.1	1.76	0.6	0.58	0.52
1,2,3,4,7,8,9-HpCDF	0.01	ND(.03)	ND(.34)	0.14	ND(.18)	ND(.12)
OCDF	0.001	0.06	1.08	0.29	0.29	0.3
Total PCDDs		0.6	14	5	4	4
Total PCDFs		0.3	5	2	2	2
Total PCDD/Fs		0.9	19	7	6	6
Total PCDD/F TEQ		0.04	0.7	0.4	0.3	0.3

Analyses by ERGO Forschungsgesellschaft mbH, Hamburg, Germany ND - not detected within detection limits shown. Half of detection limits used in calculation