DECREASE IN HUMAN TISSUE LEVELS OF DIOXINS AND DIBENZOFURANS OVER NINE YEARS AFTER EXPOSURE IN ONE MALE PATIENT

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ABSTRACT:

This paper presents 8 serial dioxin and dibenzofuran measurements in one male subject followed for 9 years after exposure. 2,3,4,7,8-PnCDF, 1,2,3,4,7,8-HxCDF, 1,2,3,6,7,8-HxCDF and 1,2,3,4,6,7,8-HpCDF especially were shown to decrease from 1983 to 1990. Some of these dibenzofurans have been implicated in the Yusho rice oil poisoning in Japan so are of particular interest because of their known human toxicity. The decrease in tissue levels of these dibenzofurans is considerably more rapid than would be predicted for 2,3,7,8-TCDD, with a currently estimated half-life between 5 and 10 years in humans. Thus, the potential for finding elevations of these compounds long after exposure is less than for TCDD.

INTRODUCTION

There are very few publications documenting decrease in human tissue levels of dibenzofurans which would allow estimates of half-life or decrease in tissue levels. One patient, exposed over a 6 month period in 1981 to the chemicals found in the Binghamton State Office Building after a PCB transformer fire, had 4 serial adipose tissue biopsies followed by 4 blood donations for measurement of PCDD/Fs between 1983 and 1990. The data suggested, from previous results, that a bottoming out or plateau might have been reached by 5 years after the exposure. This paper addresses that question and the question of half-lives for these compounds by extending the times of measurement to nine years after exposure.

METHODS

The fat tissue was taken by biopsy using local anesthesia from subcutaneous adipose tissue in the buttock or abdomen and frozen until analysis. Blood was taken in the usual fashion from an arm vein and frozen. Dioxin measurements were done in the fashion previous described, by a laboratory which successfully participated in the US EPA-NIH interlaboratory study on human adipose tissue and the two WHO interlaboratory studies on human milk and/or blood.

RESULTS

The results are presented in one table and five figures. All analyses, up to the 1990 analysis which is not yet complete, are presented. Certain elevated Binghamton State Office Building contaminants, as reported originally by Rappe and Buser, are noted as "BSOB" congeners. 2,3,7,8-TCDD and 2,3,7,8-TCDF were also found in soot, in lower amounts, but are not noted to decrease over time in this person. Of interest is the continued elevated level of 2,3,7,8-TCDD as compared to the general population, reported between 12 and 17 ppt rather than the usual mean of 5 to 7 ppt, suggesting possible increased exposure from a different source for TCDD or slower elimination than might be expected. By 1987, there appears to be a plateau for most of the BSOB PCDFs. Total dioxin toxic equivalents still remains somewhat above the usual levels for the US population, at 64 or 65 PPT "International" toxic equivalents, between 1987 and 1989, consistent with either another exposure or slow elimination of PCDD/Fs.

CONCLUSIONS AND DISCUSSION

The data is presented documenting decrease of four PCDFs over nine years after exposure in one male subject. If one assumes first order kinetics and a one compartment model it is possible to calculate shorter half-lives for these dibenzofurans than is believed to be the case for 2,3,7,8-TCDD, which is currently believed to have a half-life between 5 and 10 years in humans. The data suggests that the penta-, hexa- and hepta-dibenzofurans studied here may not remain elevated as long as TCDD, at least under the conditions of exposure in this patient. Thus, measurement of PCDD/Fs in blood or adipose tissue may not be useful as an indicator of exposure as long as for TCDD, which has been found elevated as much as 32 years after exposure.

TABLE I

PCDD/Fs IN SAMPLES TAKEN FROM THE SAME DONOR EXPOSED TO A TOXIC SOOT (PPT, LIPID) AND DIOXIN TOXIC EQUIVALENTS

SAMPLE NO.		1		2		3		4		5		6		7		8
SAMPLE TYPE		ADIPOSE		ADIPOSE		ADIPOSE		ADIPOSE		BLOOD		BLOOD		BLOOD		BLOOD
BIOPSY DATE		MARCH 83		DECEMBER 83		JUNE 85		OCTOBER 86		OCTOBER 87		SEPTEMBER 88		APRIL 89		APRIL 90
WT (g) ANALYZED		2.38		2.51		0.49		2.87		484.9		506.6		258.1		
% LIPID		85		83		83		94.3		0.61		0.55		0.41		
	TEF[16,17]		TEQ		TEQ		TEQ		TEQ		TEQ		TEQ		TEQ	TEQ
2378-TCDF	0.1	ND(4)		4.1	0.41	ND(8)		4.2	0.42	4.6	0.46	4.2	0.42	4.6	0.46	*
2378-TCDD	1	16	16	15	15	14	14	17	17	12	12	13	13	17	17	*
23478-PnCDF (BSOB)	0.5	84	42	51	25.5	46	23	34	17	29	14.5	30	15	29	14.5	*
12378-PnCDD	0.5	18	9	16	8	18	9	21	10.5	25	12.5	18	9	17	8.5	*
123478-HxCDF (BSOB)	0.1	143	14.3	101	10.1	65	6.5	54	5.4	46	4.6	47	4.7	48	4.8	*
123678-HxCDF (BSOB)	0.1	97	9.7	85	8.5	79	7.9	45	4.5	46	4.6	44	4.4	45	4.5	*
234678-HxCDF	0.1	NA	NA	NA	NA	NA	NA	2.8	0.28	2.3	0.23	28	2.8	3.9	0.39	*
123478-HxCDD	0.1	NA	NA	NA	NA	NA	NA	18	1.8	16	1.6	15	1.5	15	1.5	*
123678-HxCDD	0.1	168	16.8	209	20.9	125	12.5	109	10.9	95	9.5	92	9.2	93	9.3	*
123789-HxCDD	0.1	8.6	0.86	15	1.5	ND(8)		14	1.4	15	1.5	14	1.4	14	1.4	*
1234678-HpCDF (BSOB)	0.01	55	0.55	29	0.29	39	0.39	28	0.28	24	0.24	26	0.26	24	0.24	*
1234678-HpCDD	0.01	275	2.75	398	3.98	236	2.36	165	1.65	160	1.6	158	1.58	170	1.7	*
OCDD	0.001	991	.991	1098	1.098	950	0.95	844	.844	1068	1.068	1050	1.058	1139	1.139	*
TOTAL PCDDs		1477	46.4	1751	50.5	1343	38.8	1188	44.1	1391	39.8	1360	36.7	1465	40.5	*
TOTAL PCDFs		379	66.6	270	44.8	229	37.8	168	27.9	152	24.6	179	27.6	155	24.9	*
TOTAL PCDD/Fs		1856	113	2021	95	1572	77	1356	72	1543	64	1539	64	1620	65	*

(BSOB) = Chemical detected in soot from the Binghamton State Office Building
ND = element was not detected. Detection limit is in the parentheses.
16,17 = See References
NA = Not available
* = Results are not complete but will be presented at Dioxin '89
Blood = Whole Blood

DECREASE OF SELECTED PCDD/Fs OVER TIME 1983-1990 (PPT, Lipid)

Figure I: 2,3,4,7,8-PnCDF

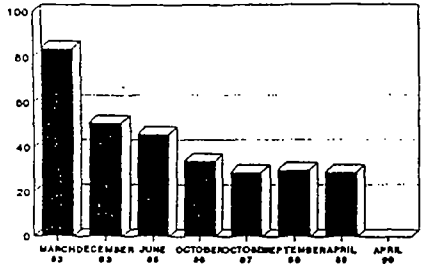


Figure II: 123478-HxCDF

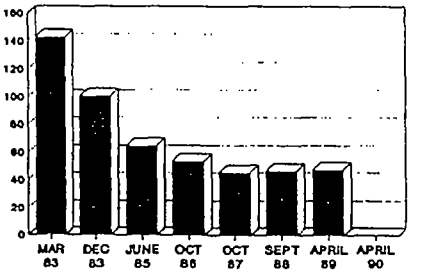


Figure III: 123678-HxCDF

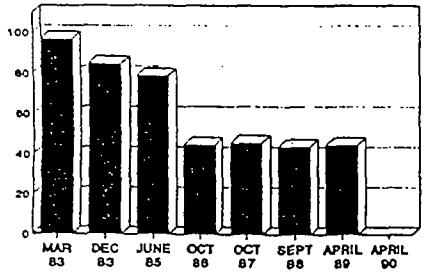
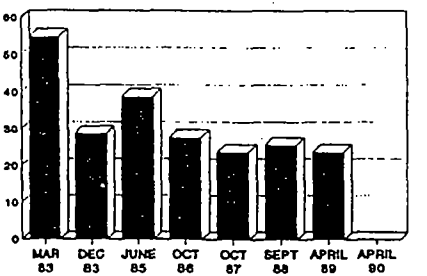


Figure IV: 1234678-HpCDF



DECREASE IN TEQ OVER TIME IN ONE PERSON FOLLOWING EXPOSURE (PPT, LIPID)

Figure V