

COMPARISON OF DIOXIN AND DIBENZOFURAN LEVELS IN WHOLE BLOOD, BLOOD PLASMA AND ADIPOSE TISSUE, ON A LIPID BASIS

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ABSTRACT

It has become common recently to estimate dioxin body burden or to document dioxin exposures above background levels by reporting dioxin and dibenzofuran congeners in adipose tissue, whole blood or blood plasma (with cells removed) usually on a lipid basis to have a standard base. The question as to whether these three types of specimens yields identical values or whether a ratio exists has just begun to be addressed. This paper compares plasma to adipose tissue and whole blood to adipose tissue in two series of analyses done in two separate laboratories. It suggests that, for higher chlorinated compounds, such as OCDD, plasma lipid values are higher than adipose lipid, but whole blood lipid values for the higher chlorinated as well as lower chlorinated values are about equal. For the lower chlorinated PCDD/Fs, such as TCDD, values are similar.

METHODS

The methods have been described elsewhere and will not be repeated here. The laboratories successfully participated in the 1990 WHO PCDD/F interlaboratory blood study.

FINDINGS

The findings are presented on Table I. Two different series of individuals were analyzed. In the first series of 20 persons, 20 plasma samples were compared to 20 fat samples from the same patients, looking for a potential exposure. In the second series of four, whole blood was compared to fat tissue in the same persons.

For TCDD, plasma mean to adipose tissue mean shows a ratio of 0.83 and for whole blood lipid to adipose lipid the ratio is a quite similar 0.78. For the toxic 2,3,5,7,8-PnCDF, the ratios are 0.90 and 1.0, respectively. For OCDD, on the contrary, a ratio of 2.0 and 1.16 exist, respectively.

For total PCDD/Fs the plasma mean, 1074, is about twice that of the fat tissue, whereas the whole blood mean is 1241 compared to 1082 for fat tissue lipid.

For dioxin toxic equivalents, however, using the 1/1000 value for OCDD, the values are almost the same, 22 vs 23 and 68.5 vs 68.8 for the two series.

CONCLUSIONS AND DISCUSSIONS

There are differences between PCDD/F levels in blood plasma and adipose tissue and also between whole blood and adipose tissue, when reported on a lipid basis.

The difference is most striking between OCDD in plasma as compared to fat tissue, with a ratio of 2 to 1.

Total PCDD/Fs appear higher in plasma than in adipose tissue, if reported by actual measurement, because OCDD is usually the largest value reported. This is not the case when whole blood is compared to fat tissue, where the values are more similar. When toxic equivalents are used, however, using current estimates of toxicity, the values are almost identical, in the two series presented here.

This paper does not take a position on the desirability of using plasma, whole blood or adipose tissue for measurement of dioxins and dibenzofurans in humans. It is clear, however, that differences should be appreciated before interpretations are made.

TABLE I
 PAIRED BLOOD AND ADIPOSE TISSUE DIOXIN AND DIBENZOFURAN LEVELS USING PLASMA OR WHOLE BLOOD

CONGENER	TEQ ²	n=20 ¹					n=4				
		ADIPOSE MEAN	ADIPOSE TEQ	PLASMA MEAN	PLASMA TEQ	RATIO PL/AD ^c	WHOLE BLOOD MEAN	WHOLE BLOOD TEQ	ADIPOSE MEAN	ADIPOSE TEQ	RATIO WHL/AD ^d
2,3,7,8,-TCDF	0.1	1.6	0.16	1.3	0.13	.81	3.0	0.00	3.9	0.39	0.00
2,3,7,8,-TCDD	1	6.9	6.90	5.7	5.70	.83	4.0	4.00	5.1	5.10	0.78
2,3,4,7,8,-PnCDF	0.5	6.8	3.40	6.1	3.05	.90	70.5	35.25	70.8	35.40	1.00
1,2,3,7,8,-PnCDD	0.5	7.7	3.85	7.1	3.55	.92	17.5	8.75	21.5	10.75	0.81
1,2,3,4,7,8,-HxCDF	0.1	5.6	0.56	6.9	0.69	1.2	22.7	0.00	14.5	1.45	0.00
1,2,3,6,7,8,-HxCDF	0.1	3.7	0.37	5.4	0.54	1.5	23.5	0.00	17.8	1.78	0.00
2,3,4,6,7,8,-HxCDF	0.1	1.5	0.15	1.2	0.12	.80	8.2	0.82	5.3	0.53	1.55
Total HxCDF		10.8		13.4			57.4	0.00	38.2		
1,2,3,4,7,8,-HxCDD	0.1	59.3	5.93	56.0	5.60	.94	108.5	10.85	101.3	10.13	1.07
1,2,3,6,7,8,-HxCDD											
1,2,3,7,8,9,-HxCDD	0.1	6.3	0.63	8.5	0.85	1.3	9.8	0.98	8.1	0.81	1.21
Total HxCDD		65.6		64.4			115.8	0.00	109.4		
1,2,3,4,6,7,8,-HpCDF	0.01	16.4	0.16	25.1	0.25	1.5	29	0.29	23.3	0.23	1.24
1,2,3,4,6,7,8,-HpCDD	0.01	82.5	0.83	107.9	1.08	1.3	185	1.85	153	1.53	1.21
OCDF	0.001	ND (1)		ND (1-3)					4.2		
OCDD	0.001	429.0	0.43	843.1	0.84	2.0	760.5	0.76	653	0.65	1.16
Total PCDDs		591.3	18.57	1028.3	17.62		1085.3	27.19	942	28.97	
Total PCDFs		36.0	4.8	45.9	4.78		156.9	41.28	139.8	39.78	
Total PCDD/Fs		627.0	23.37	1,074.20	22.4		1,242.2	68.47	1,081.8	68.75	

¹ After Schecter, Ryan, et al., Partitioning of 2,3,7,8-Chlorinated Dibenzo-P-Dioxins and Dibenzofurans Between Adipose Tissue and Plasma Lipid of 20 Massachusetts Vietnam Veterans. In Press. *Chemosphere*.

² N=1 for this congener

³ N=3 for this congener

^c Plasma to Adipose

^d Whole to Adipose