

**DISTRIBUTION OF DIOXINS AND DIBENZOFURANS IN BLOOD
FROM JAPAN, ISRAEL, RUSSIA, GUAM, VIETNAM
GERMANY, AND THE U.S.A.**

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INTRODUCTION

Dioxin (PCDD) and dibenzofuran (PCDF) measurement of human blood from various countries provides data concerning global environmental contamination. Such data furnishes vital statistics which are important for public health purposes. Recent studies that link dioxins with certain types of cancer and other serious health effects underscore the urgency of determining the levels of dioxins and dibenzofurans in various populations. Results to date indicate that there are variations in dioxin blood levels by geographical areas, documenting industrial pollution and bioavailability. This paper extends our previous work by including data from several countries not previously studied, and will include analyses of data from other countries such as Laos and Cambodia, at the time of presentation.

METHODS

The dioxin laboratory successfully participated in a World Health Organization Interlaboratory Validation Studies for human blood and milk. Methods were previously reported and will not be repeated.¹ Whole blood was collected, frozen at -20°C and shipped frozen to the analytical laboratory.

RESULTS AND DISCUSSION

Table I presents statistics derived from 102 individual analyses of whole blood from residents of Germany. This data gives an estimation of the variation that one might expect if other pooled analyses had been performed as individual analyses.

In Table II we present results from eight locations in seven countries; results are pending for other countries. Data is presented on a lipid basis and is also converted to "dioxin toxic equivalents" (TEQ) in an attempt to estimate toxicity, using current weighting factors,^{2,3} which may well change as new in vitro, in vivo, and human data becomes available.

Total dioxin and dibenzofuran levels range widely from 151 parts per trillion (ppt) in

Russia to 1816 ppt in Guam. This surprisingly high level in Guam could be due to consumption of imported food from Japan and the U.S.A. In general, less industrialized countries are characterized by lower dioxin levels as can be seen in the results from Russia and northern Vietnam. However, Russia is undergoing rapid industrialization and food PCDD/F levels are not greatly different from food in Germany or the U.S.A.⁴

For total dioxin toxic equivalents, Germany, the U.S.A., and southern Vietnam are the highest with 42, 41, and 36 ppt respectively. Russia, at 17 ppt, is close to northern Vietnam at 15 ppt. Guam, although being high in actual levels of dioxins, is lower in toxic equivalents (29 ppt) than the U.S.A., Germany, Israel and the south of Vietnam.

Pooled blood dioxin analysis provides a convenient and economical way to follow the movement of toxic chemical contamination through the food chain and into humans.⁵ Variations between and within countries document industrial pollution and bioavailability. Recent studies implicating dioxins in certain types of cancer and other health effects stress the urgency of mapping out contamination worldwide to provide data for future reference.⁶

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TABLE I
DIOXINS AND DIBENZOFURANS IN WHOLE BLOOD FROM THE GERMAN ADULT
GENERAL POPULATION N=102, (ppt, lipid)

Congener	Minimum	Maximum	Mean	Std. Dev.	Median
2,3,7,8,-TCDD	.6	9.1	3.6	1.9	3.2
1,2,3,7,8,-PnCDD	2.1	39.0	13.8	6.8	13.0
1,2,3,4,7,8-HxCDD	1.0	33.0	10.9	6.4	9.9
1,2,3,6,7,8-HxCDD	15.0	124.0	54.6	25.1	50.0
1,2,3,7,8,9-HxCDD	0.5	71.0	10.6	9.3	8.2
1,2,3,4,6,7,8-HpCDD	19.0	280.0	92.4	53.7	80.0
OCDD	145	1524.0	610.3	290.9	549.0
2,3,7,8-TCDF	0.5	6.7	2.3	1.6	2.0
1,2,3,7,8-PnCDF	0.5	8.8	2.0	1.8	1.4
2,3,4,7,8-PnCDF	6.3	99.0	37.0	18.2	33.5
1,2,3,4,7,8-HxCDF	3.6	49.0	15.4	10.3	13.0
1,2,3,6,7,8-HxCDF	2.7	53.0	13.3	8.6	11.0
1,2,3,7,8,9-HxCDF	0.5	9.4	1.7	1.3	1.5
2,3,4,6,7,8-HxCDF	0.5	14.0	4.3	3.2	3.5
1,2,3,4,6,7,8-HpCDF	4.8	55.0	23.4	11.6	21.0
1,2,3,4,7,8,9-HpCDF	0.5	4.0	1.5	0.8	1.3
OCDF	1.0	15.0	4.2	3.2	3.1
Total PCDDs	221	1983	798	361	703
Total PCDFs	27	192	97	37	91
Total PCDD/PCDFs	268	2135	895	383	836
Total PCDDs TEQ	4	56	20	10	18
Total PCDFs TEQ	4	59	22	12	19
Total PCDD/Fs TEQ	8	115	42	22	37

Totals are rounded

TABLE II
DIOXINS AND DIBENZOFURANS IN HUMAN BLOOD FROM VARIOUS COUNTRIES
1980-91 (ppt, lipid)

Congener	JAPAN	ISRAEL	RUSSIA	GUAM	VIETNAM		GERMANY	U.S.A.
	Pool N=50-100	Pool N=100	Mean N=68	Pool N=100	North* N=82	South* N=383	Mean N=102	Pool N=100
2,3,7,8,-TCDD	3.2	5.5	4.4	4.5	2.2	14.8	3.6	5.2
1,2,3,7,8,-PnCDD	11.7	12.3	8.8	11	4.1	9.1	13.8	21.0
1,2,3,4,7,8-HxCDD	5.3	18	2.4	9.2	3.7	7.5	10.9	13.0
1,2,3,6,7,8-HxCDD	45.9	59.3	8.24	68.8	13.4	33.8	54.6	84.0
1,2,3,7,8,9-HxCDD	9.3	12.8	2.4	14.8	4.8	9.4	10.6	15.0
1,2,3,4,6,7,8-HpCDD	58.8	78.3	13.5	147	25.5	87.3	92.4	187
OCDD	1404	511	85.2	1479	132.3	696.4	610.3	1174
2,3,7,8-TCDF	5.1	<1	2.3	1.9	4.6	2.4	2.3	3.1
1,2,3,7,8-PnCDF	<1.5	<1.0	ND(1.09)	<1.0	1.7	2	2.0	2.8
2,3,4,7,8-PnCDF	20.6	14.2	9.88	7.6	7.6	9.3	37.0	13.0
1,2,3,4,7,8-HxCDF	12	12.3	8.7	17.4	20.6	23.9	15.4	15.0
1,2,3,6,7,8-HxCDF	10.3	10.1	4.24	7.7	11.1	14.7	13.3	14.0
1,2,3,7,8,9-HxCDF	ND(0.9)	<2.4	ND(1.1)	<2.0	0.5	0.8	1.7	ND(1.2)
2,3,4,6,7,8-HxCDF	2.1	3.0	1.3	2.6	2.2	2.6	4.3	3.6
1,2,3,4,6,7,8-HpCDF	11.5	22.1	6.1	37.7	46.7	42.7	23.4	36.0
1,2,3,4,7,8,9-HpCDF	ND(2.4)	<1.8	ND(2.05)	<3.5	1.9	3.8	1.5	ND(1.8)
OCDF	ND(6.2)	<5.8	<8**	<7.8	4.2	4.4	4.2	4.2
Total PCDDs	1538	697	125	1734	186	858	798	1499
Total PCDFs	67	68	39	82	101	107	97	92
Total PCDD/PCDFs	1605	765	164	1816	283	965	895	1591
Total PCDDs TEQ	18	22	10	22	7	26	20	30
Total PCDFs TEQ	13	10	7	7	8	10	22	11
Total PCDD/Fs TEQ	31	32	17	29	15	36	42	41

U.S.A. blood is plasma, all others are whole blood. Totals are rounded. NA= not available. For non-detects and >, half of detection limits were used for calculation of TEQs. * North and South Vietnam are means of several pooled analyses: North is from two analyses with a total of 82 persons, South is from 9 analyses totaling 383 persons. Data for U.S., see reference #6. German data is from individual analyses; all others are from pooled blood. **= N=8