Dioxin, Dibenzofuran and Coplanar PCB Levels in Human Milk from Ukraine and the United States

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Introduction

After the dissolution of the Union of Soviet Socialist Republics, evidence emerged suggesting high levels of environmental pollution in the former republics and the satellite countries. Studies were initiated to evaluate the health effects on populations thought to be exposed to these pollutants. In Ukraine, the senior author collected samples of human milk for analysis of exogenous chemicals.

To assess the degree of dioxin contamination in human milk from Ukraine, we compare the results of analyses with American samples from 1988 and with American samples from 1995 that show lower dioxin levels compared to the 1988 samples, reported previously (1).

The one previous report of two small samples from Ukraine included only polychlorinated dibenzo-*p*-dioxin (PCDD) and dibenzofuran (PCDF) congeners. In the new Ukrainian data for 199 women, and for 5 American women in 1995, levels of three toxic coplanar polychlorinated biphenyls (PCBs) have been included in the analyses.

Materials and Methods

A sample of women was drawn from the Ukrainian arm of the European Longitudinal Study of Pregnancy and Childhood, a multinational investigation conducted under the auspices of the World Health Organization (2). Two study sites were selected: the Dniprovsky region of Kyiv, which was thought to have moderate industrial pollution and little agricultural pollution, and the city of Dneprodzerzhinsk 400 km to the southeast, which reputedly had both high industrial and agricultural pollution. Study subjects in these sites had delivered a living child during the period November 1993-December 1994. Milk specimens taken on the third day after delivery were combined into four pooled samples stratified by site and by maternal age (under 30 and at least 30 years). The number of specimens in the strata varied between 48 and 52.

The American milk sample from 1988 is the mean of two pooled samples from Binghamton, NY (N=22) and Los Angeles, CA (N=20). The 1995 results are the means for individual analyses of milk of five women in Binghamton, NY. All specimens were stored at -20°C. Analytical methods have been reported previously and will not be repeated here (3).

Results and Discussion

Part A of Table 1 gives measured total levels of PCDDs and PCDFs, and levels of the three coplanar PCBs. Dioxin toxic equivalents (TEQs) are given in Part B. PCDD levels in Ukraine are much lower than American levels. PCDF levels for the American samples are similar to Ukrainian levels. Coplanar PCB levels are markedly elevated among Ukrainian women compared to the 1995 American sample. For all groups, the highest level among coplanar PCBs was PCB 126. Figure 1 presents graphically the differences in levels for total measured PCDDs, PCDFs and PCBs for Ukrainian samples and the 1995 American sample.

Dioxin TEQ for PCDDs and for total PCDD/Fs in Ukrainian milk is lower than in U.S. milk in 1988 but similar to 1995 American milk. The PCDF TEQ levels in Ukraine are similar to 1988 US milk and higher than in 1995 US milk. Dioxin TEQ in American milk is less elevated than measured PCDD levels, because the PCDDs are mostly HpCDD and OCDD (not shown), which have relatively low dioxin toxic equivalency factors.

TEQ levels of coplanar PCBs in the Ukraine, 16 to 24.3 ppt, are higher than the 10.2 ppt in the US in 1995. In Dneprodzerzhinsk PCB TEQ levels are higher than in Kyiv. Because of PCB levels, the total dioxin toxicity of the milk of Ukrainian women is higher than in 1995 US milk.

As is usually the case, older subjects in Kyiv and Dneprodzerzhinsk had higher PCDD/F levels than younger subjects.

Conclusion

Little research yet has been conducted on levels of dioxins, dibenzofurans and PCBs in human tissues in former Soviet Socialist Republics. This paper presents new data on PCDDs, PCDFs, and coplanar PCBs in milk collected from almost 200 Ukrainian women during 1993-94 that indicates a distinctive pattern of dioxin, dibenzofuran and coplanar PCB contamination of human milk.

Acknowledgments

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References

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Table 1. Dioxins, Dibenzofurans and Coplanar PCBs in Human Milk Samples from Ukraine and the United States
pg/g (ppt), Lipid Basis

A. Measured Levels

	UKRAINE 1993-94				UNITED STATES	
	Kyiv		Dneprodzerzhinsk		1988	1995
	age < 30 N = 52*	age 30+ N = 48*	age < 30 N = 49*	age 30+ N = 50*	CA, NY N = 42**	NY N = 5***
Total PCDDs	49.2	43.0	30.8	44.8	327	169
Total PCDFs	30.0	20.8	17.5	24.2	29	20.3
Total PCDD/Fs	79.2	63.8	48.3	68.9	356	189
Coplanar PCBs						
77 3,3',4,4'-TCB	n.a.	n.a	n.a.	n.a.	–	5.9
126 3,3'4,4',6-PeCB	106	118	141	177	–	19.6
169 3,3'4,4',5,5'-HxCB	35	44	32	45	–	5.4
Total Coplanar PCBs	141	162	174	222	–	30.9
Total PCDD/F/PCBs	220	226	222	291	–	220

n.a. not analyzed due to interference
n.d. not detected
*Blood samples pooled for analysis
**Means of two pooled samples
***Means among individuals
Discrepancies in sums due to rounding

B. Dioxin Toxic Equivalent pg/g

	UKRAINE 1993-94				UNITED STATES	
	Kyiv		Dneprodzerzhinsk		1988	1995
	age < 30 N = 52	age 30+ N = 48	age < 30 N = 49	age 30+ N = 50	CA, NY N = 42	NY N = 5
PCDDs	4.4	5.7	4.1	6.1	11.5	5.8
PCDFs	4.1	4.2	3.7	5.2	5.1	2.4
PCDD/Fs	8.5	9.9	7.8	11.3	16.5	8.2
Coplanar PCBs						
77 3,3',4,4'-TCB	–	–	–	–	–	0.0
126 3,3'4,4',6-PeCB	11.2	11.8	14.1	17.7	–	2.0
169 3,3'4,4',5,5'-HxCB	0.4	0.4	0.3	0.5	–	0.1
Total Coplanar PCBs	11.6	12.2	14.5	18.2	–	2.0
Total PCDD/F/PCBs	16.0	17.9	18.6	24.3	–	10.2

Figure 1. Levels of Dioxins, Dibenzofurans, and Coplanar PCBs in Human Milk from Ukraine and the United States
pg/g (ppt), lipid basis