

MONITORING ON RESIDUE LEVELS OF PCDD/DFS AND DIOXIN-LIKE PCBs IN HUMAN BREAST MILK OF KOREAN POPULATIONS

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Introduction

Polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs) are resistant global pollutants. PCDDs, PCDFs and PCBs are by-products of several processes such as waste incineration, metal production, bleaching of pulp using chlorine, synthesis of halogenated chemicals, etc. On account of their chemical stability and lipophilicity, these contaminants may be retained in the the fatty tissues of the body. Human milk contains many lipid soluble compounds that are also present in mother's adipose tissue. PCDD/DFs and PCBs in breast milk have two issues. One is as an index of mother's exposure levels, and the other is as a exposure source of the chemical to infants.

The aim of this study was to measure the contamination levels and to investigate the residue profiles of PCDD/DFs and dioxin-like PCBs in human breast milk collected from residents of Seoul, Ansan and Jeju area in Korea. Investigation about contamination levels of these compounds in mother's breast milk in Korea has attained from 1999 to present under Korea Food & Drug Administration (KFDA)'s support.

Materials and Methods

Human breast milk samples were collected from 25 donors who had been living in the each other area of Seoul, Ansan and Jeju area for at least five years. Information such as age, height, weight, health, smoking, dietary habit, etc was recorded for all volunteers. Human milk samples were collected in about 50 mL each time on 1 and 30 days after delivery. This samples were immediately frozen in hexane-washed glass bottles and kept frozen at -20°C until analysis.

Approximately 50 g human milk samples were spiked with 25 mL of $^{13}\text{C}_{12}$ -labelled 2,3,7,8-substituted PCDD/DFs and $^{13}\text{C}_{12}$ -labelled dioxin-like PCBs of 20 pg/mL concentration as internal standard. And then 0.5 g sodium oxalate and 20mL ethanol were added and mixed. The mixture were extracted twice, each time with 100mL n-hexane, and then the extracts were dried over anhydrous sodium sulfate and calculated the lipid contents. The amounts of fat determined was used for the calculation of the residue level of PCDD/DFs and dioxin-like PCBs on fat basis. The clean-up of the extracts was performed according to US EPA Method 1613 and CDC (Center for Disease Controls & Prevention). Determination were performed with Agilent 6890 gas chromatograph and Jeol-700D high resolution mass spectrometer at resolution 10,000 using DB5-MS (60m x 0.25mm x 0.25mm) capillary column.

Table 1. Number of human milk samples depends on sampling date and statistics of the donors

Sampling area	Number of breast milk after birth. (days)		Mean age of donors (year \pm SD)	Range
	Colostrum	30th		
Seoul	25	25	32.0 \pm 2.6	27 – 37
Ansan	25	25	32.8 \pm 2.5	28 – 38
Jeju	25	25	31.7 \pm 5.1	23 – 42

Results and Discussion

Results

The human breast milk samples analyzed in this study were collected at maternal clinics in Seoul, Ansan, Jeju area. As donors of human breast milk, mothers in total 65 were chosen 20 mothers from were Seoul (mean age: 32.1 \pm 3.9 years), 25 mothers from Jeju (mean age: 32.3 \pm 3.7 years) and 20 mothers from Ansan (mean age: 30.5 \pm 3.7 years) (Table 1). PCDD/DFs and dioxin-like PCBs were determined in 20 colostrums samples and 20 samples of human breast milk sampled at the 30th day after delivery, all collected from Seoul area. The mean total-TEQ concentrations of PCDD/DFs and dioxin-like PCBs (SPCDD/DFs-TEQ + S Dioxin-like PCBs-TEQ) in colostrums

and samples collected at 30th day after delivery were 7.87 and 5.61 pg WHO-TEQ/g, respectively.

Furthermore, the total concentrations of PCDD/DFs and dioxin-like PCBs congeners were determined in 20 colostrums samples and 20 samples of human milk sampled at the 30th day after delivery, all collected from Jeju area. The mean total-TEQ concentrations in colostrums and samples collected at 30th day after delivery human milk samples were 12.0 and 8.76 pg WHO-TEQ/g, respectively. In the case of Ansan area, the TEQ concentration of colostrums and samples collected at 30th day after delivery were recorded 20.4 and 10.2 pg WHO-TEQ/g, respectively.

It agrees with the result of 2003 that the contamination levels of dioxins of Ansan area appear some higher than Seoul. Analysis result of Seoul, Ansan and Jeju area is displayed in table 2.

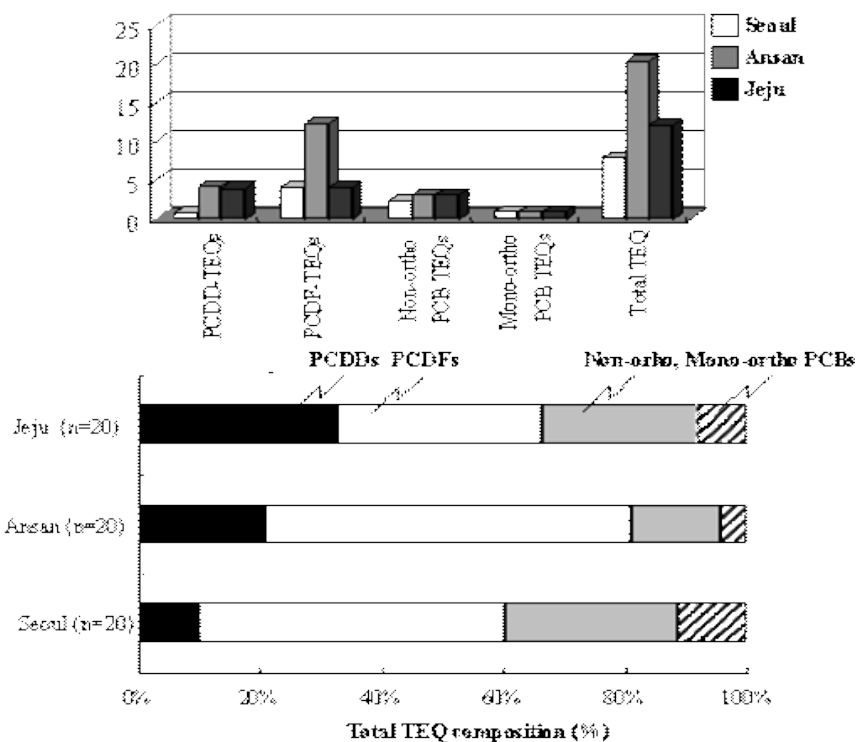
Table 2. Average concentration of PCDD/DFs and dioxin-like PCBs (pg/g lipid weight basis) in human breast milk samples

Sampling Area		Seoul		Ansan		Jeju	
Comp.	Congener	Colostrum	30th	Colostrum	30th	Colostrum	30th
PCDDs	2378-TeCDD	0.15	ND	ND	0.28	0.06	0.17
	12378-PeCDD	0.46	0.91	2.82	1.72	3.12	1.60
	123478-HxCDD	0.42	0.64	2.78	1.57	1.08	0.96
	123678-HxCDD	1.12	2.74	5.43	5.31	4.64	3.48
	123789-HxCDD	ND	0.52	3.68	1.19	1.10	0.73
	1234678-HpCDD	3.11	2.92	23.12	5.85	6.26	3.15
	OCDD	40.24	21.51	56.29	36.03	86.35	37.43
PCDFs	2378-TeCDF	3.22	0.34	20.98	0.22	ND	ND
	12378-PeCDF	0.25	1.19	8.21	2.51	2.24	1.54
	23478-PeCDF	5.87	3.43	13.55	5.04	5.72	4.00
	123478-HxCDF	3.59	2.23	11.11	4.81	3.51	3.05
	123678-HxCDF	2.91	1.67	7.54	4.05	2.95	2.61
	123789-HxCDF	0.00	0.22	3.01	1.71	0.99	0.80
	234678-HxCDF	ND	1.30	5.00	4.00	2.79	2.67
	1234678-HpCDF	3.04	2.71	29.10	9.10	6.57	6.02
	1234789-HpCDF	ND	0.63	5.85	2.17	0.84	1.34
	OCDF	ND	1.96	2.20	5.53	4.24	4.03
Total PCDD/DFs		64.36	44.91	200.51	91.09	132.47	73.58
PCDD/DF WHO-TEQ		4.75	3.71	16.53	7.11	8.00	5.38
Non-ortho	344'5(81)	3.77	3.02	19.22	6.67	6.13	3.49
	33'44'(77)	31.46	25.48	50.14	44.76	59.68	32.36
PCBs	33'44'5(126)	21.78	13.13	28.74	21.11	28.95	23.22
	33'44'55'(169)	4.12	7.83	11.90	13.32	17.44	12.46
	2'344'5(123)	132.56	81.45	342.20	151.71	190.84	156.22
	23'44'5(118)	2457.71	1308.99	2231.99	2195.90	2447.51	2439.01

Mono-ortho PCBs	2344'5(114)	136.70	92.53	145.59	146.56	189.78	160.47
	233'44'(105)	687.30	419.04	688.86	727.08	680.19	696.20
	23'44'55'(167)	255.82	155.52	232.83	249.20	378.23	300.47
	233'44'5(156)	797.45	420.36	743.23	679.88	769.46	818.23
	233'44'5'(157)	188.74	117.17	176.07	192.85	268.35	207.66
	233'44'55'(189)	76.54	43.93	84.42	69.01	127.82	81.21
Total Dioxin-like PCBs		4793.95	2688.46	4755.19	4498.04	5164.38	4931.01
Dioxin-like PCBs-TEQ		3.12	1.90	3.87	3.08	4.04	3.38

ND : Not Detected

Figure 1. Composition of individual compounds of PCDD/DFs and dioxin-like PCBs on the total 2,3,7,8-TeCDD toxic equivalents in human milk samples collected from different regions of Korea



Discussion

Information about mean value of the toxic equivalents (TEQ) for human milk from Seoul, Ansan and Jeju area appears in Figure 1. The total TEQ concentration is dominated by PCDF (48.1%). TEQ value for dioxin-like PCBs is lower than PCDD/DFs, but the human body residual levels are much higher than PCDD/DFs, so that toxicity contribution of dioxin-like PCBs is high at about 40%.

A detailed study about exposure levels to dioxin-like PCBs is reported in this paper. We confirm that the contamination level of Koreans is lower than in European countries such as Belgium, Germany and Italy, etc. Though exposure levels are relatively low, all possible actions should be taken in order to decrease mother's exposure by identifying and reducing source of environmental input for PCDD/DFs and dioxin-like PCBs. Moreover continuous surveillance of contamination levels and residue profiles of these pollutants remain necessary.

Acknowledgements

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References

1. Environmental Research Section A 83, 293-297, 2000
2. World Health Organization European Centre for Environment and Health, vol. 5, 2000
3. Malisch R and van Leeuwen FXR (2002), Third round of WHO-coordinated exposure study :
Analysis of PCDD/DFs and PCBs in human milk, *Organohalogen Compounds*, vol. 56, 317-320
4. Alawi M.A., H. Wichmann, W.Lorenz and M.Bahadir (1996) Dioxins and Furans in the Jordanian Environment, part 2 : Levels of PCDDs and PCDFs in human milk samples from Jordan, *Chemosphere*, vol. 33, 2469-2474
5. Rappe C., Fresenius J. Anal. Chem. Vol. 348, 63, 1994
6. Alder L., H. Beck, W.Mathar and R. Palvinskas (1994) PCDD/DFs, PCBs and other organochlorine compounds in human milk levels and their dynamics in Germany.