

Intake of PCDDs, PCDFs and Co-PCBs in Breast-Fed Infants of Japan

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It is well recongnized that humans have been contaminated with a variety of dioxins such as PCDDs,PCDFs, and Co-PCBs. Breast milk enriched with fat may also contain these compounds. Recently in Japan, possible undesirable effects of dioxins in mother's milk on breast-fed infants became major concern. In order to clarify the effects of these chemicals on infants, it is necessary to assess the precise amount of dioxins transferred via mother's milk in breast-fed infants. We measured concentrations of various PCDD, PCDF and Co-PCB congeners in mother's milk and calculated the infant's intake of dioxins by breast-feeding.

Subjects and Methods:

Breast milk was serially collected at 5th, 30th, 150th and 300th day after delivery in 80 same lactating primipara women from 4 provinces, Tokyo, Osaka, Saitama and Ishikawa, of Japan. In each province 20 mothers were selected from two different cities according to the distances from the incinerators. Each groups were further divided into two groups by mother's age(26 to 30 and 31 to 35 years old). Daily intake of breast milk was also measured in 121 healthy infants livnig

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around Tokyo areas by weighing their body weights immediately before and after breast feeding.

Seven PCDDs(2,3,7,8-T₄CDD, 1,2,3,7,8-P₅CDD, 1,2,3,4,7,8-H₆CDD, 1,2,3,6,7,8-H₆CDD, 1,2,3,7,8,9-H₆CDD, 1,2,3,4,6,7,8-H₇CDD and O₈CDD), ten PCDFs(2,3,7,8-T₄CDF, 1,2,3,7,8-P₅CDF, 2,3,4,7,8-P₅CDF, 1,2,3,4,7,8-H₆CDF, 1,2,3,6,7,8-H₆CDF, 1,2,3,7,8,9-H₆CDF, 2,3,4,6,7,8-H₆CDF, 1,2,3,4,6,7,8-H₇CDF, 1,2,3,4,7,8,9-H₇CDF and O₈CDF) and three Co-PCB(3,3',4,4'-T₄CB, 3,3',4,4',5-P₅CB and 3,3',4,4',5,5'-H₆CB) were measured using 50 ml of breast milk sample by GC-MS method. The toxicity equivalency(TEq) were calculated using the international equivalent factors(TEF) for PCDDs and PCDFs, while the TEFs for Co-PCB by WHO/IPCS.

Results:

1) There were no significant differences of breast milk dioxin concentrations among mothers in four provinces and between two age groups. In addition, there were no correlation of milk dioxin levels with the distances between mother's residents and the incinerators.

2) Serially measured dioxin concentrations in breast milk after birth are shown in table 1. The dioxin level of breast milk decreased after delivery. The PCDD and PCDF concentrations at the 300th postpartum day was 11.88 pgTEq/g fat and 68.7% of that in the 5th day.

Table 1. Mean dioxin levels in breast milk.

Days after delivery	5d	30d	150d
300d			

Number of mothers	80	72	45
25			
Fat(%)	3.0(1.4)	3.8(1.2)	3.8(1.9)
3.7(1.5)			
PCDDs+PCDFs*	17.3(7.7)	14.8(6.1)	14.0(4.2)
11.9(4.3)			
CoPCBs*	11.1(7.3)	9.9(5.2)	7.0(3.9)
6.2(3.6)			

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PCDDs+PCDFs**	49.7(25.1)	54.5(21.7)	51.6(29.1)
43.4(21.7)			
PCDDs+PCDFs+CoPCBs**	80.7(43.5)	91.7(39.3)	77.2(47.7)
63.2(33.6)			

*pgTEq / 1g fat, **pgTEq / 100g of
breast milk, (SD)

3) Dairy intake of breast milk by infants increased after birth and reached to maximum value(190.5 ml /kg/day) at one month, then gradually decreased to 61ml at 9 months of age(table 2). The average volume of daily milk intake was calculated to be 100 ml/kg during one year after birth .

Table 2 Average daily intake of breast milk

Age weight (ml/kg/day)	Number of infants	No of feeding per day	Tot. Intake (ml/day)	Vol. per weight
3 d	9	7.1(0.8)	322.2(170.4)	97.7(49.6)
3~ 6	19	7.4(1.0)	499.3(126.7)	152.7(33.0)
7~14	19	8.2(1.4)	645.6(150.9)	184.1(37.2)
15~30	26	8.7(1.4)	790.8(152.9)	190.5(34.0)
1 mo~1 mo6d	36	8.5(1.5)	837.3(178.1)	180.0(34.1)
1 m0~1 mo14d	26	9.0(2.0)	886.3(168.0)	184.5(33.7)

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1 mo15d~	13	8.6(1.9)	805.8(113.4)
157.8(22.7)			
3 mo	32	6.8(2.3)	826.3(145.6)
124.5(21.2)			
6 mo	20	6.6(1.6)	697.5(142.4)
88.6(19.5)			
9 mo	11	5.2(2.3)	543.6(245.0)
61.0(25.6)			

(SD)

4) The total amount of dioxins in infants transferred from maternal milk by breast-feeding was calculated in table 3. The accumulated amount of dioxins were estimated to be 12.9 at 6 months, 16.3 at 9 months and 18.3 ng TEq/kg at one year after birth.

Table 3. Estimated dioxin accumulation by breast-feeding

Age Accumulated volume (month) dioxins kg body weight)	Daily intake of breast milk (ml/kg/day)	Dioxin conc. (pg TEq/100g milk)	of (ng TEq/
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0	164.2	49.7
2.45		
1	168.5	54.5
5.23		
2	146.5	53.8
7.57		
3	124.5	53.1
<u>9.55</u>		
4	112.5	52.3
11.32		
5	100.6	51.6
12.87		
6	88.6	50.0
14.20		
7	79.4	48.3
15.35		
8	70.2	46.7
16.34		
9	61.0	45.0
17.16		
10	51.8	43.4
17.83		
11	42.6	41.8
18.36		

Discussion:

No significant difference in dioxin levels of breast milk among several different areas in Japan suggest that the degree of contamination with dioxins might be influenced by daily foods intake. The concentration of dioxins excreted in breast milk of postpartum women decreased after birth and this finding is consistent with previous reports. With our results on average values of daily milk intake in

healthy breast-fed infants, it is possible to calculate easily the accumulated dioxin volume in breast-fed infants by measuring the dioxin concentrations in maternal milk. Further studies on body burden data of dioxin are necessary.

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