DIOXIN AND RELATED CHMICALS CONCENTRATION IN HUMAN MILK

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Introduction

Dioxin and related chemicals are known as endocrine disrupters and widespread environmental contaminants. They bioaccumulate in the human body through the food chain and are present in human milk. The effects of dioxin and related chemicals present in human milk have been of great concerns in field of public health. We have reported the concentrations of dioxin and related chemicals in human milk collected from 1994 to 1996 in Japan[1]. The concentrations of dioxin and related chemicals in the environment have decreased over the past few decades as a result of the regulation of incinerators and other dioxin sources.
In this study, we determined the concentrations of dioxins (PCDDs, PCDFs and Non-ortho PCBs) in the human milk collected from 60 mothers in Hokkaido in 2004. We investigated the recent levels of dioxins in human milk of Japanese primiparous and multiparuos mothers. We also investigated the decrease of dioxins levels in human milk by delivery time.

Materials and Methods

The human milk samples were collected from 60 mothers who had given their informed consent in the 2004 fiscal year. The maternal milk specimens were collected one month after delivery. The mother's ages ranged from 21 to 40 in primiparous (n=30, mean:30.1) and from 21 to 47 in multiparous (n=30, mean:32.2). Two grams of breast milk were freeze-dried and added following internal standards. The details of the method for lipid extraction, purification and mass-spectrometric measurements have been described elsewhere[2].

Results and Discussion

Table 1 shows the concentrations of PCDDs, PCDFs and Non-ortho-PCBs in the breast milk. The average concentrations of PCDDs, PCDFs, Non-ortho PCBs and total dioxins (PCDDs/Fs+Non-ortho-PCBs) in the breast milk samples were 4.58, 2.89, 3.77 and 11.23 pg - TEQ/g lipid, respectively. Total dioxins concentrations are about 1/2 of the concentrations previously reported (20-28 pg - TEQ /g lipid[1]). The decrease of total dioxins concentration in human milk was probably due to the reduction of dioxins both in environments and in food during the last ten years. We calculated the amount of total dioxins ingested per day by newborns in the lactation period. Based on the assumption that newborns ingest 120g of maternal milk per kg body weight per day, the amount was 50.8 pg TEQ /kg/day. These values are still higher than the levels of tolerable daily intake (4 pg TEQ /kg/day) according to the WHO.

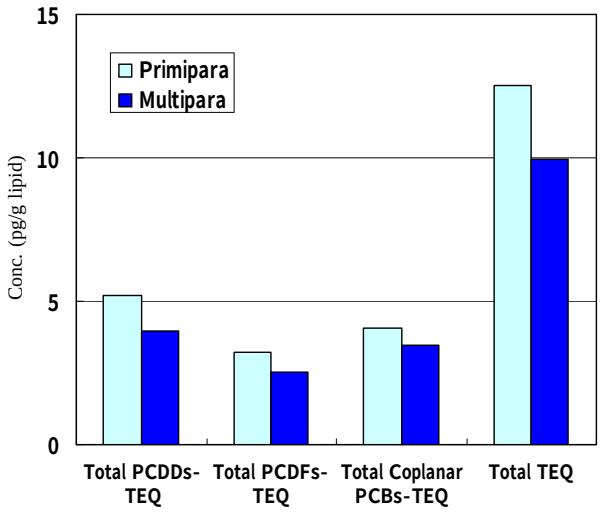

Fig.1 Total TEQs of PCDDs,PCDFs and Non-ortho-PCBs in the breast milk of primiparous and multiparous mothers

Table 1. Concentrations of dioxins in human milk of 60 mothers in 2004

Congeners	Mean	SD.	Max.	Min.
2,3,7,8-TCDD	0.69	0.41	2.84	ND
1,2,3,7,8-PeCDD	2.77	1.28	8.93	ND
1,2,3,4,7,8-HxCDD	1.05	0.31	3.21	ND
1,2,3,6,7,8-HxCDD	8.35	4.09	25.34	ND
1,2,3,7,8,9-HxCDD	1.20	0.50	2.97	ND
1,2,3,4,6,7,8-HpCDD	5.44	2.45	13.98	2.17
OCDD	37.86	19.70	105.68	8.16
2,3,7,8-TCDF	0.54	0.23	1.92	ND
1,2,3,7,8-PeCDF	–	–	ND	ND
2,3,4,7,8-PeCDF	4.71	2.56	18.47	ND
1,2,3,4,7,8-HxCDF	1.09	0.43	3.79	ND
1,2,3,6,7,8-HxCDF	1.22	0.69	5.50	ND
2,3,4,6,7,8-HxCDF	1.02	0.19	2.49	ND
1,2,3,7,8,9-HxCDF	–	–	ND	ND
1,2,3,4,6,7,8-HpCDF	1.16	0.68	5.22	ND
1,2,3,4,7,8,9-HpCDF	–	–	ND	ND
OCDF	–	–	ND	ND
344'5-TCB(#81)	–	–	ND	ND
33'44'-TCB(#77)	5.80	3.40	28.95	ND
33'44'5-PenCB(#126)	35.86	23.06	155.59	ND
33'44'55'-HxCB(169)	17.90	10.34	63.97	ND
PCDDs-TEQ	4.58	2.09	15.01	1.32
T PCDFs-TEQ	2.89	1.39	10.75	0.75
T PCDDs/PCDFs-TEQ	7.47	3.43	25.76	2.07
T Non-ortho PCBs-TEQ	3.77	2.39	16.20	0.55
Total TEQ	11.23	5.56	41.96	2.62
Age	31.2	5.45	47	21
Lipid(%)	3.97	1.10	7.05	1.29

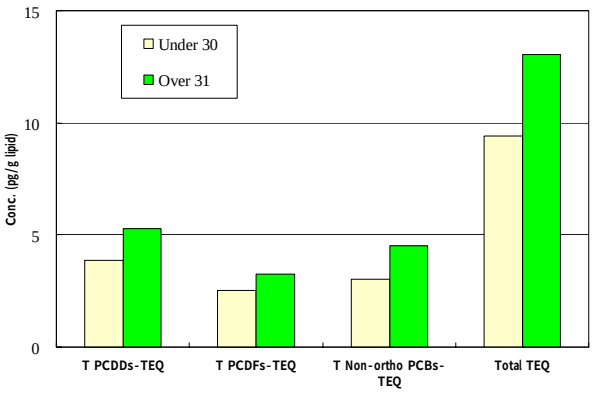

Fig. 2 Total TEQs of PCDDs,PCDFs and Non-ortho-PCBs in the breast milk of under 30 age and over 31 age mothers

Figure 1 shows the mean TEQs of PCDDs, PCDFs and Non-ortho-PCBs in the human milk of primiparous and multiparous mothers. In the case of the primiparous mothers group, the mean TEQ concentrations in the human milk were 5.2, 3.2 and 4.1 pg-TEQ/g lipid, respectively. However, the levels found in the multiparous mothers were 3.9, 2.5 and 3.5 pg-TEQ/g lipid, respectively. The levels of PCDDs, PCDFs and Non-ortho-PCBs in primiparous mothers were about 1.3 times higher than those of the multiparous mothers group, respectively. Figure 2 shows the mean TEQs of PCDDs, PCDFs and Non-ortho-

PCBs in the milk of mothers under 30 years old (n=30, mean: 26.6) and that of mothers over 31 years old (n=30, mean: 35.7). In the case of the over-31-years-old mothers, the mean TEQ concentrations in the human milk were 5.3, 3.3 and 4.5 pg-TEQ/g lipid, respectively. However, those of the under-30-years-old mothers were 3.9, 2.5 and 3.0 pg-TEQ/g lipid, respectively. The levels of PCDDs, PCDFs and Non-ortho-PCBs in over-31-years-old mothers were 1.2-1.5 times higher than those of under-30-years-old mothers. These results suggested the levels of PCDDs, PCDFs and Non-ortho-PCBs were decreased by delivery and increased by aging. The mean age of primiparous mothers was 2.1years younger than that of mutiparous mothers. Then, we compared the concentrations of dioxins in human milk of same-age mothers between primiparous and multiparous women. Figure 3 shows the congeners concentrations in human milk of 28-years-old primiparous and 28-years-old multiparous mothers. The levels of total TEQ in 28-years-old primiparous mothers were about 1.5 times higher than those of the same age multiparous mothers. Significant differences in the breast milk of primiparous and multiparous mothers were exhibited in 1,2,3,6,7,8-HxCDD, OCDD, 3,3',4,4',5-PeCB and 3,3',4,4',5,5'-HxCB.

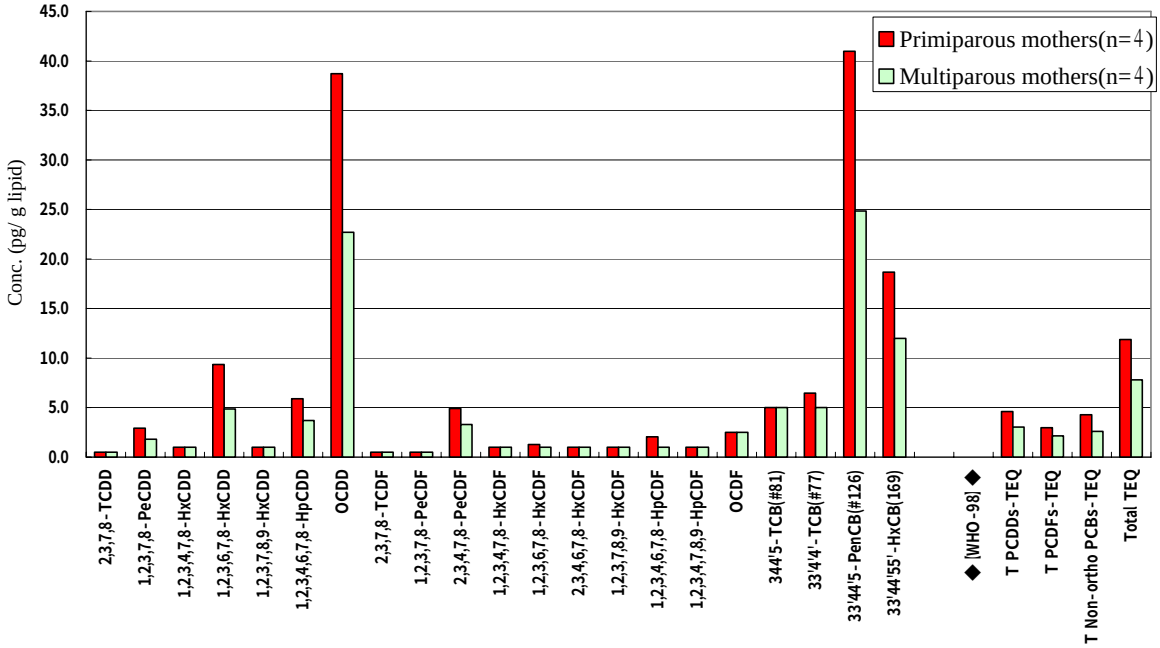

Fig.3 Comparison of congeners concentrations in human milk between 28-years-old primiparous(n=4) and 28-years-old multiprous(n=4) mothers.

The levels of dioxins in human milk may be decreasing in Japan, but the amount of total dioxins ingested per day by newborns is still higher than the levels of tolerable daily intake according to the WHO. Comprehensive regulation of incinerators and/or other dioxin sources is necessary to decrease the levels of dioxins both in environments and in food.

Acknowledgements
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References
1. Iida, T., Hirakawa, H., Matsueda, T., Takenaka S., and Nagayama J. (1999) Polychlorinated Dibenzo-p-dioxin and related compounds in breast milk of Japanese primiparas and multiparas.
2. Todaka, T., Hirakawa, H., Tobiishi, K. and Iida, T. (2003) Fukuoka Igaku Zasshi 94 148–157.