

## Concentrations of PCDDs, PCDFs, Co-PCBs and Organochlorine pesticides in the blood and breast milk in Japanese women

Takao Iida\*, Hironori Hirakawa\*, Takahiko Matsueda\*, Reiko Nakagawa\*, Tsuguhide Hori\* and Junya Nagayama\*\*

\*Fukuoka Institute of Health and Environmental Sciences, 39 Mukaizano, Dazaifu Fukuoka, 818-0135 Japan. \*\*Laboratory of Environmental Health Sciences, School of Health Sciences, Kyushu University, Fukuoka 812-8582 Japan.

### Introduction

In our previous studies, we investigated concentrations and distribution of PCDDs, PCDFs and Coplanar PCBs (Co-PCBs) in several human tissues or organs (adipose tissue, liver, blood, spleen, muscle, kidney, lung and brain) obtained from 9 individuals who had died from various kinds of accidents during the period between 1989 and 1990 in Fukuoka metropolitan area, Japan, and found high TEQ levels (pg/g lipid basis) of these compounds in the adipose tissues from young person and in the liver from old person, and low TEQ levels in the brain regardless of the ages. 1-4)

Now we report concentrations of chlorinated Dioxins and related compounds (PCDDs, PCDFs, Co-PCBs and organochlorine pesticides) and TEQs of PCDDs, PCDFs and Co-PCBs in the blood and milk samples obtained from Japanese women.

### Methods

Blood samples were obtained from women before childbirth (n=50), and breast milk samples were obtained from women during lactation (n=125). Their mean ages were  $20.5 \pm 2.5$  and  $29.2 \pm 3.5$  (mean  $\pm$ SD) years old in blood donors and milk donors, respectively. There were no overlap of donors between the two groups.

All samples were stored in a refrigerator (3°C) until analysis. Ten kinds of  $^{13}\text{C}$ -labeled PCDDs/PCDFs and 3 kinds of  $^{13}\text{C}$ -labeled Co-PCBs were added to all samples as internal standards for checking recoveries of PCDDs/PCDFs and Co-PCBs throughout the analytical procedures.

PCDDs/PCDFs and Co-PCBs were analyzed by the HRGC/HRMS technique using a Finnigan MAT-95 mass spectrometer (Finnigan MAT-95, Germany) directly interfaced with a Hewlett Packard 5890 Series II gas chromatograph. All target compounds were measured with an SP-2331 capillary column (0.32 mm X 60m; film thickness, 0.25 mm). The mass resolution (5 % valley) was 7000 to 8000. Details of the sample treatments (extraction and purification) and analyses used in this study have been reported by Matsueda et.al.<sup>5)</sup>

Organochlorine pesticides were analyzed by the technique of ECD gas chromatography after extraction and purification by Nakagawa et.al.<sup>6)</sup>

## Results

Table 1 shows the average concentrations and standard deviations of organochlorine pesticides (8 kinds).

### Organochlorine pesticides (Table 1)

Dieldrin, *p,p'*-DDE, Heptachlor-epoxide and *cis*-Nonachlor in blood samples showed higher average concentrations than in milk samples.  $\beta$ -HCH, *p,p'*-DDT, Oxychlordane and *trans*-Nonachlor in milk samples showed higher average concentrations than in blood samples.

Table 2 shows the average concentrations and standard deviations of PCDDs (7 kinds), PCDFs (10 kinds) and Co-PCBs (3 kinds).

### PCDDs (Table 2)

1,2,3,6,7,8-HxCDD, 1,2,3,4,6,7,8-HpCDD and OCDD in blood samples showed higher average concentrations than in milk samples. 2,3,7,8-TCDD, 1,2,3,7,8-PeCDD and 1,2,3,7,8,9-HxCDD in milk samples showed higher average concentrations than in blood samples. The average concentrations of 1,2,3,4,7,8-HxCDD in blood and milk samples were the same.

### PCDFs (Table 2)

2,3,7,8-TCDF, 1,2,3,7,8-PeCDF, 1,2,3,4,7,8-HxCDF, 1,2,3,6,7,8-HxCDF, 1,2,3,7,8,9-HxCDF, 1,2,3,4,6,7,8-HpCDF and 1,2,3,4,7,8,9-HpCDF in blood samples showed higher average concentrations than in milk samples. 2,3,4,7,8-PeCDF, 2,3,4,6,7,8-HxCDF and OCDF in milk samples showed higher average concentrations than in blood samples.

### Co-PCBs (Table 2)

3,3',4,4'-TeCB, 3,3',4,4',5-PeCB and 3,3',4,4',5,5'-HxCB in milk samples showed higher average concentrations than in blood samples.

### Total PCDDs, PCDFs, Co-PCBs (Table 2, Fig. 1)

The total concentrations of PCDDs in blood samples was about 2 times as high as the amount in milk samples. The total concentrations of PCDFs in blood and milk samples were nearly the same. The total concentrations of Co-PCBs in milk samples was about 1.7 times higher than in blood samples.

### TEQ levels (Table 3, Fig. 2)

2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) toxic equivalent (TEQ) levels of PCDDs and PCDFs were calculated using I-TEFs, and those of the Co-PCBs were calculated using the data reported by WHO<sup>7)</sup>.

Table 3 shows the TEQ levels and standard deviations for estimating the toxicity of the PCDDs, PCDFs and Co-PCBs measured. The total PCDDs-TEQ and PCDF-TEQ of both groups showed similar value. The total Co-PCBs-TEQ of milk samples was about 1.8 times higher than that of blood samples.

## Conclusions

Our data show the equivalent levels of concentrations of these compounds analyzed in human blood and milk studied in Japan<sup>5)</sup> and other countries<sup>8)</sup>.

$\beta$ -HCH and Oxychlorane concentrations in milk samples were about 1.6 times and 2.3 times higher than blood samples, respectively. There was a clear difference between the total Co-PCBs-TEQ in blood samples and milk samples, being greater in the latter. The present findings, thus, suggest that Co-PCBs tend to accumulate more prominently in milk samples. Further study is necessary to establish this tendency by comparing concentrations of these compounds in blood and milk samples from the same subjects.

## Reference

- 1) H.Hirakawa, T.Iida, T.Matsueda, H.Tokiwa, T.Nagata, J.Nagayama, Organohalogen Compounds, Vol.10, 1992; 93-96
- 2) H.Hirakawa, T.Iida, T.Matsueda, J.Nagayama, Organohalogen Compounds, Vol. 30, 1996;127-130
- 3) H.Hirakawa, T.Matsueda, T.Iida, M.Nakamura, T.Nagata, J.Nagayama Organohalogen Compounds, Vol. 21, 1994; 419-423
- 4) H.Hirakawa, T.Iida, T.Matsueda, R. Nakagawa, T. Hori, J.Nagayama, Organohalogen Compounds, Vol. 26, 1995;197-200
- 5) T.Matsueda, T.Iida, H.Hirakawa, K.Fukamachi, H.Tokiwa, J.Nagayama, Toxic evaluation of PCDDs, PCDFs and coplanar PCBs in breast-fed babies of Yusho and healthy mothers, *Chemosphere*, Vol. 27, Nos.1-3,187-194, 1993
- 6) R. Nakagawa, H.Hirakawa, T.Iida, T.Matsueda, J.Nagayama, Maternal Body Burden Organochlorine Pesticides and Dioxins, Journal of AOAC International, in press.
- 7) Ahlborg U.G., G.C.becking, L.S. Birnbaum, A.Brouwer, H.J.G.M. Derks, M.Feeley, G.Golor, A. Hanberg, J.C. Larsen, A.K.D.Liem, S.H.Safe, C.Schlatter, F.Wærm, M.Younes and E.Yrjänheikki (1994) : Toxic equivalency factors for dioxin-like PCBs. Report on a WHO-ECEH and IPCS consultation, December 1993 *Chemosphere*, Vol. 28, No. 6, 1049-1067, 1994.
- 8) A.Schechter, P.fuirst, C.fuirst, O.Päpke, M.Ball, L.C.Dai, H.T.Quynh, N.T.N.Phong, Beim, B.Viasov, V.Chongchet, J.D.Constable, K,Charles,: Dioxins, Dibenzofurans and Selected Chlorinated Organic Compounds in human milk and blood from Cambodia, Germany, Thailand, The U.S.A., The U.S.S.R., and Vietnam. *Chemosphere*, Vol. 23, Nos.11-12,1903-1912, 1991.

**Table 1** Concentrations of organochlorine pesticides  
in blood and milk samples in Japanese women ( ng/g lipid basis)

	blood samples		milk samples	
	Average	SD	Average	SD
<i>f</i> -HCH	257.6	229.9	419.6	308.8
Dieldrin	5.8	2.5	3.0	5.0
<i>p,p'</i> -DDE	347.1	213.4	329.5	255.7
<i>p,p'</i> -DDT	14.4	13.1	15.0	11.7
Heptachlor epoxide	6.4	4.5	4.0	4.4
Oxychlorane	14.7	6.5	34.3	52.6
<i>trans</i> -Nonachlor	30.9	17.9	40.5	24.3
<i>cis</i> -Nonachlor	8.0	3.9	5.0	5.0

**Table 2** Concentrations of PCDDs, PCDFs and Co-PCBs  
in blood and milk samples in Japanese women ( pg/g lipid basis)

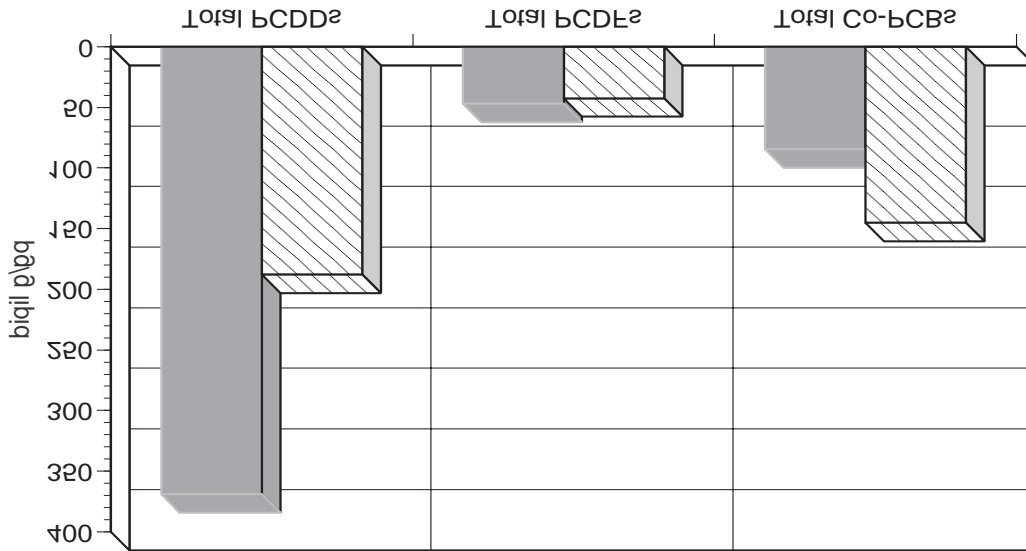
	TEFs	blood samples		milk samples	
		Average	SD	Average	SD
2,3,7,8-TCDD	1	1.7	0.7	1.8	0.8
1,2,3,7,8-PeCDD	0.5	6.1	2.2	6.9	2.8
1,2,3,4,7,8-HxCDD	0.1	2.1	1.1	2.1	1.4
1,2,3,6,7,8-HxCDD	0.1	29.1	13.0	25.4	13.3
1,2,3,7,8,9-HxCDD	0.1	6.1	2.5	6.9	5.9
1,2,3,4,6,7,8-HpCDD	0.01	32.0	13.4	16.4	8.4
OCDD	0.001	300.3	180.3	128.5	115.6
2,3,7,8-TCDF	0.1	4.2	2.2	1.2	0.6
1,2,3,7,8-PeCDF	0.05	1.3	1.5	0.9	0.7
2,3,4,7,8-PeCDF	0.5	9.1	2.8	11.1	5.2
1,2,3,4,7,8-HxCDF	0.1	5.4	3.2	4.6	2.4
1,2,3,6,7,8-HxCDF	0.1	8.3	3.2	3.6	1.5
1,2,3,7,8,9-HxCDF	0.1	3.9	1.4	0.8	0.8
2,3,4,6,7,8-HxCDF	0.1	0.8	0.6	4.5	3.8
1,2,3,4,6,7,8-HpCDF	0.01	9.1	4.5	3.4	3.3
1,2,3,4,7,8,9-HpCDF	0.01	0.4	0.4	0.1	0.1
OCDF	0.001	4.8	13.4	12.4	45.9
3,3',4,4'-TeCB	0.0005	14.4	9.6	20.3	26.0
3,3',4,4',5-PeCB	0.1	46.5	25.1	85.2	39.7
3,3',4,4',5,5'-HxCB	0.01	23.1	8.3	39.9	16.5
Total PCDDs		377.6	200.4	188.0	128.6
Total PCDFs		46.7	24.4	42.6	50.8
Total Co-PCBs		84.0	35.5	145.4	57.2
Total PCDDs/DFs/Co-PCBs		508.3	220.8	375.9	168.5

**Table 3** TEQs of Total PCDDs, PCDFs and Co-PCBs  
in blood and milk samples in Japanese women ( pg/g lipid basis)

	blood samples		milk samples	
	Average	SD	Average	SD
Total PCDDs-TEQ	9.0	3.3	8.9	3.3
Total PCDFs-TEQ	6.9	2.3	7.1	3.1
Total Co-PCBs-TEQ	4.8	2.6	8.9	4.1
TEQ(International)	20.7	7.1	25.0	8.7



in blood and milk samples in Japanese women  
 Fig. 1 Concentrations of PCDDs, PCDFs, Co-PCBs



in blood and milk samples in Japanese women  
 Fig. 2 TEQ levels of PCDDs, PCDFs, Co-PCBs

