PCDD/Fs LEVELS IN BLOOD SAMPLES OF KOREAN RESIDENTS

Byoung-Eog Kim[1], Min-Kyun Kim[1], Jae-Beom Park[2], In-Ho Kim[2], Jung-Ryul Yoo[2], Hwang-Young Yoon[2], Young-Jin Kim[2]

[1]RIST
[2]POSCO

Introduction

Polychlorinated dibenzo-*p*-dioxins and dibenzofurans(PCDD/PCDFs) originate from contamination by chlorinated chemicals and thermal reactions of chlorinated and organic compounds, such as incineration of municipal and industrial waste. Because of their lipophilic properties human exposure occurs mainly via food and can be detected in human blood.

In this work, we report on the results of PCDD/Fs blood measurements, which we have carried out in our laboratory during last 1 year.

Materials and Methods

(1) Sampling

A total of 27 men and women aged 15-64 years were randomly selected among residents in an area of Pohang City (located in southeast of Korea, 0.53 million in habitants). Research nurses drew 50 ml of venous blood at hospitals in the study area.

(2) Extraction and Clean-up

a. After collection whole blood samples were frozen and stored at -20^{o} C until analysis.

b. Homogenized whole blood (40 mL) diluted with deionized water (40 mL) was spiked with standard solution containing 17 $^{13}C_{12}$-labeled PCDD/F isomers and shaken overhead for 30 min.

c. Extraction procedure was as follows:

- Addition of 50mL aqueous saturated ammonium sulfate solution, shaking for 1min.

- Addition of absolute ethanol, shaking for 1min.

- Two-fold extraction with 100mL of hexane

- The hexane layer was dried with anhydrous sodium sulfate and evaporated at 40^{o}C under vacuum to constant weight.

- The residue, which represents the fat content, was weighed and redissolved in hexane for hexane clean-up

d. The clean-up was performed by EPA 1613 standard methods using silica gel and alumina

e. The final sample extract was evaporated under a nitrogen stream to dryness and reconstituted by addition of internal standard containing $^{13}C_{12}$-1,2,3,4-TCDD and $^{13}C_{12}$-1,2,3,7,8,9-HxCDD

(3) HRGC/HRMS analysis

All the samples were analyzed by high-resolution GC-mass spectrometry(SIM mode, resolution:10,000) with a HP6890 GC system(Hewlett- Packard, USA) coupled to an Autospec-ultima(Micromass, Manchester, UK) and a DB5MS capillary column(60m x 0.32mm i.d.). The GC temperature program was 120 ^{o}C(held for 3 min), increased at 20 ^{o}C/min to 220 ^{o}C(held for 5 min), increased at 4 ^{o}C /min to 260 ^{o}C(held for 25 min). Injector temp. was 280 ^{o}C and injection was made on splitless mode(1 min). Helium at a pressure of 25 psi was used as carrier gas.

Results and Discussion

Table 1 displays the concentrations of TEQ from PCDDs and PCDFs in the 27 blood samples. As shown in Table 1, PCDFs and PCDDs accounted for 43% and 57% of total TEQ, respectively. The largest contribution to the total toxicity of PCDD/PCDFs came from 2,3,4,7,8-PeCDF, 1,2,3,7,8-PeCDD and 1,2,3,6,7,8-HxCDD(together about 71%). The concentration was ranged from 6.14 to 33.90 pg TEQ/g lipid.

Fig.1 shows distributions of lipid contents and lipid basis concentrations of PCDD/PCDFs in the blood samples. The average lipid content and TEQ concentration were 0.4 % and 20 pg TEQ/g lipid, respectively.

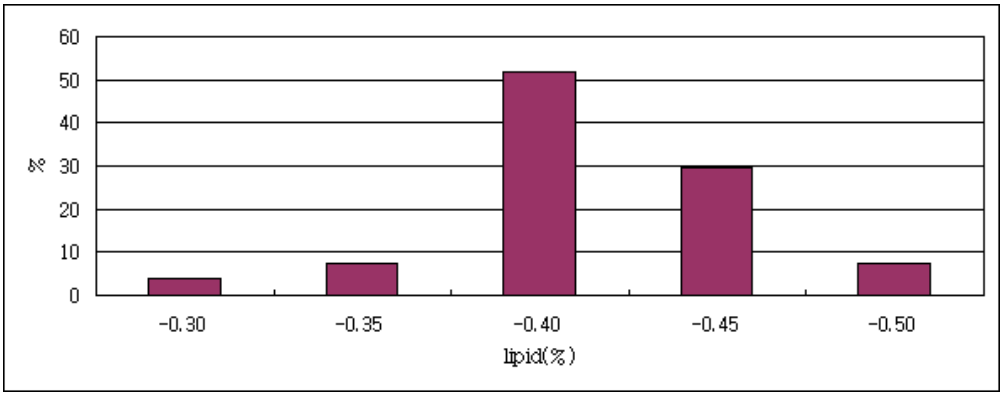
Table 2 lists the TEQ concentrations in the blood of four groups according their ages. Total TEQ concentrations in the older group are about 1.7 times higher than those in the younger group. As shown in Table 2, female group showed slightly higher contents of PCDD/PCDFs in the average than male group. This might be due to the higher fat content of female in the blood.

In conclusion, we found that the levels of TEQ in the blood were positively correlated with age. Average TEQ level was 16.5 pg TEQ/g lipid, and this value was slightly lower than reported in other studies.

Table 1. Congener specific and total TEQ concentrations in the 27 blood samples

	congener	Whole basis (pg-TEQ/g %)				lipid basis (pg-TEQ/g)			
		Average	SD	Min	Max	Average	SD	Min	Max
PCDFs	2,3,7,8-TCDF	2.6	3.6	2.4	3.8	0.43	0.22	0.15	1.3
	1,2,3,7,8-PeCDF	0.4	1.2	0.0	1.1	0.06	0.075	0	0.39
	2,3,4,7,8-PeCDF	28.2	21.4	29.3	20.6	4.65	1.3	1.8	7
	1,2,3,4,7,8-HxCDF	3.4	5.1	2.8	6.2	0.56	0.31	0.17	2.1
	1,2,3,6,7,8-HxCDF	5.2	4.9	5.5	5.6	0.86	0.3	0.34	1.9
	2,3,4,6,7,8-HxCDF	2.5	2.1	2.6	2.1	0.41	0.13	0.16	0.71
	1,2,3,7,8,9-HxCDF	0.4	0.8	0.0	0.6	0.072	0.047	0	0.2
	1,2,3,4,6,7,8-HpCDF	0.6	0.7	0.5	0.6	0.093	0.043	0.03	0.21
	1,2,3,4,7,8,9-HpCDF	0.0	0.1	0.0	0.0	0.004	0.005	0	0.02
	OCDF	0.0	0.0	0.0	0.0	0	0	0	0
PCDDs	2,3,7,8-TCDD	10.9	10.4	12.5	10.0	1.8	0.63	0.77	3.4
	1,2,3,7,8-PeCDD	18.8	17.3	15.5	16.2	3.1	1.05	0.95	5.5
	1,2,3,4,7,8-HxCDD	1.3	1.8	0.0	1.4	0.21	0.11	0	0.48
	1,2,3,6,7,8-HxCDD	18.2	21.4	21.2	22.1	3	1.3	1.3	7.5
	1,2,3,7,8,9-HxCDD	3.8	4.1	3.6	4.1	0.62	0.25	0.22	1.4
	1,2,3,4,6,7,8-HpCDD	2.0	2.1	2.3	2.4	0.33	0.13	0.14	0.8
	OCDD	1.9	2.8	1.8	2.9	0.31	0.17	0.11	1
	PCDFs	43.2	40.0	43.2	40.8	7.14	2.43	2.65	13.82
	PCDDs	56.8	60.0	56.8	59.2	9.37	3.64	3.49	20.08
	Total (PCDDs+PCDFs)	100.0	100.0	100.0	100.0	16.51	6.07	6.14	33.90

Fig. 1. Distribution of lipid content and lipid basis concentrations in the blood samples



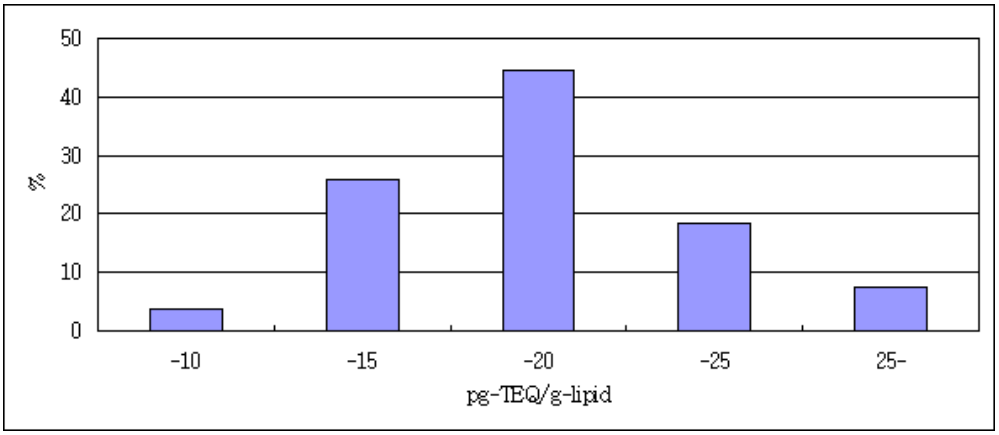


Table 2. Mean (range) of age, lipid content and TEQ values of the blood samples

Age range	No.	Mean age	lipid(%)	pg/g-blood	pg-TEQ/ g-blood	pg/g-lipid	pg-TEQ/ g-lipid
15-24	6	19.3	0.378	0.97	0.053	256.30	13.99
25-34	3	27.3	0.398	1.35	0.074	340.94	18.48
35-49	10	40.6	0.395	1.36	0.075	337.54	18.67
49-64	2	53.5	0.427	1.73	0.089	404.74	20.79
Gender	No.	Mean age	lipid(%)	pg/g-blood	pg-TEQ/ g-blood	pg/g-lipid	pg-TEQ/ g-lipid
male	10	32.4	0.389	1.08	0.064	273.93	16.21
female	12	35.8	0.399	1.45	0.073	361.65	18.26

References

1. Iida T., Hirakawa H. and Hori T. (2003) *Organohalogen Compounds* 64: 211 - 214.

2. Iida, T., Hirakawa H., Matsueda T., Takenaka S., Yu M.-L. and Guo Y.-L.L. (1999) *Chemosphere* 38: 981-993.

3. Masuda Y., Haraguchi K., Kono S., Tsuji H. and Papke O. (2005) *Chemosphere* 58: 329-344.

4. Hu S.-W., Chien, G.-P.C. and Chan H.-C. (2004) *Chemosphere* 55: 611-620.

5. Kumar K.S., Bowerman W.W., Devault T.L., Takasuga T., Rhodes O.E.Jr., Brisbin I.L.Jr. and Masunaga S. (2003) *Chemosphere* 53: 173-182.

6. Kim B.-H., Ikonomou M.G., Lee S.-J., Kim H.-S. and Chang Y.-S. (2005) *Science of the Total Environment* 336: 45-56.