DIETARY INTAKE OF PCDD/DFS AND DIOXIN-LIKE PCBS AMONG THE KOREAN POPULATION

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Introduction

Polychlorinated dibenzo-*p*-dioxins and dibenzofurans(PCDD/Fs) and polychlorinated biphenyls(PCBs) are a highly toxic group of worldwide environmental pollutants which have been classified as persistent organic pollutants(POPs).[1-2] Because of physicochemical properties, PCDD/Fs and PCBs tend to concentrate and magnify in the food chain. Human population is mainly exposure to these compounds through the diet (account for > 90%), foodstuffs of animal origin being one of the main sources. [3-5] Thus, it is important to gather as much information as possible about PCDD/Fs and PCBs concentration in food and human exposure. With the purpose of preventing the health risk derived from the presence of these contaminants in food, Korea recently set maximum levels of PCDD/Fs permitted in meats (beef, pork and chicken). To assess the health risk derived from the exposure to PCDD/Fs and PCBs, estimations of their regular daily intake are periodically carried out and compared with her established daily intake values.[6] This paper presents the results of a congener-specific analysis of PCDD/Fs and PCBs performed on a number of samples of food. An estimation of dietary intake of PCDD/FS and PCBs through the consumption of food has been consequently carried out. Thus we have assessed the health risk derived from the PCDD/Fs and PCBs exposure of the general population in Korea

Materials and methods

(1) Sampling and preparation of samples

All organic solvents were ultra-residue grade for dioxin analysis (Wako, Japan). Samples were acquired from local markets, big supermarkets and traditional markets. For each food category, an aggregate sample (500g) was made by mixing proportional pooled samples. All the composite samples were homogenized. Food samples were stored frozen and lyophilized prior to chemical analysis.

(2) Chemical analysis

The methodology used for PCDD/Fs analysis, based on the US EPA method 1613 has been described in detail elsewhere. For identification and quantification, appropriate C13-labelled internal standard were added to sample prior to extraction. About 10g of the analytical samples were mixed with anhydrous sodium sulphate and extracted using n-hexane : dichloromethane(3:1,v/v) as solvents in soxhlet extractor. The extracts were concentrated to determine the fat contents. Each extract was then purified in a sequence that comprises purification on column with sodium sulphate and sulfuric acid impregnated silica gel. The obtained extract was then transferred to multilayer chromatography clean-up columnin order to further remove the matrix. Finally the organic extract was subjected to a chromatographic filtration on activated alumina to separate the PCDD/Fs from the PCB and from interfering components. The Fraction containing PCDD/Fs was eluted with toluene. The quantification of PCDD/Fs was carried out by the isotopic dilution method and methodology was validated according to US EPA Method 1613 by performing an initial and ongoing precision and recovery studies. Qualitative and quantitative determination of PCDD/Fs and PCBs was done by HRGC/HRMS. HRGC/HRMS analysis were performed with Thermo trace Ultra gas chromatography interfaced to a Finnigan DFS mass spectrometer which were in MID mode operating positive electron ionization at a resolving power of >10,000 at *m/z* 314 of FC43. The detection limits were 0.01ppt for TCDD/Fs, 0.02ppt for PeCDD/Fs, HxCDD/Fs and HpCDD/Fs and 0.04ppt for OCDD/Fs and 0.02ppt for dioxin-like PCBs at S/N >3. To assess the reliability of our results we have participated in interlaboratory studies related to dioxins and PCBs (Interlaboratory Comparison on Dioxins in Food, 2007~2010, Division of Environmental Medicine, Norwegian Institute of Public Health, Folkehelse, Norway). As for PCDD/Fs global concentrations, toxic equivalents (TEQ) were calculated using the toxic equivalent factors (TEFs) reported by the World Health Organization in 2005.

The total concentrations of PCDD/Fs and DL-PCBs have been calculated assuming that non-detected congener concentration is equal to zero.

(3) Dietary intake estimation

PCDD/Fs and DL-PCBs daily dietary exposure through the consumption of food has been calculated multiplying the concentrations of the pollutants found in the food item analyzed by the consumed amount of that item. The average consumption figures taken from the 2007 National Health and Nutrition Examination Survey.[7] The average bodyweight were also obtained from the same survey.

Results and discussion:

(1) PCDD/Fs and DL-PCBs levels in food

The results of the chemical analysis of PCDD/Fs for the food samples analyzed are summarized in Tables 1

Table1. Mean concentration of PCDD/Fs and DL-PCBs in Food samples.

	Food	AVERAGE	MIN.	MAX.	STDEV
		(pg TEQ/g ww)			(%)
Cereal Products	Rice	0.027	0.000	0.064	0.03
Meat	Beef	0.131	0.048	0.207	0.06
	Chicken	0.054	0.026	0.082	0.02
	Pork	0.029	0.002	0.060	0.03
Egg	Egg(york)	0.732	0.086	2.606	1.06
Dairy Products	Milk	0.018	0.012	0.028	0.01
	Cheese	0.079	0.008	0.129	0.05
Fish and Shellfish	Alaska pollack	0.046	0.018	0.084	0.03
	Eel	0.759	0.060	1.879	0.81
	Hairtail	3.933	1.641	7.265	2.63
	Pacific saury	0.904	0.160	1.634	0.68
	Mackerel	2.167	0.836	3.616	1.05
	Salmon	0.653	0.143	1.317	0.44
	Spanish mackerel	1.654	0.299	2.525	0.84
	Yellow croaker	0.366	0.064	0.583	0.25
	Crab	0.255	0.114	0.448	0.14
	Oyster	0.178	0.049	0.281	0.09

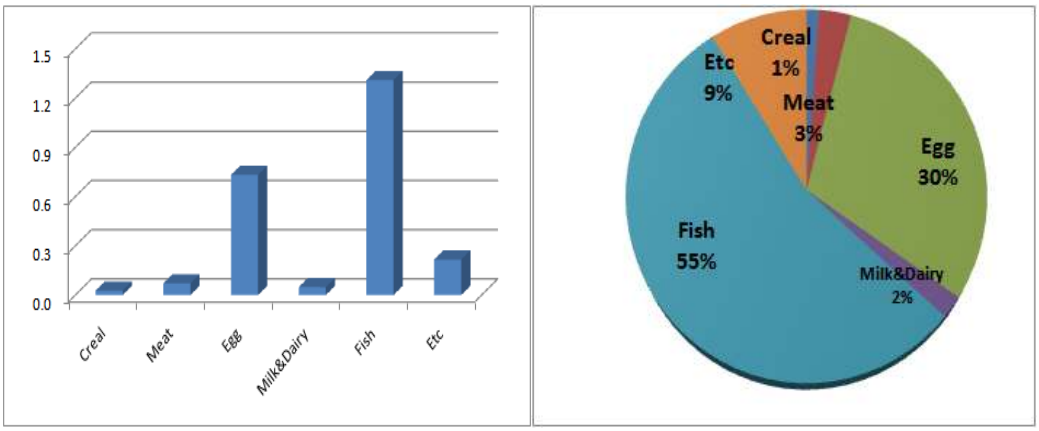

Fig.1 Distribution of the PCDD/Fs & DL-PCBs levels and Relative ratio in food.

(2) Dietary intake to PCDD/Fs and DL-PCBs

We estimated the lower bounded exposure of Korean population to dioxins at 0.53 pg TEQ/kg bw/day(Table 2) based on the TEFs from 2006. The estimated dietary intakes were blow the tolerable daily intake(TDI) proposed by Korea Food and Drug Administration of 4 pg TEQ/kg bw/day. As a conclusion, the dietary consumption of food does not represent a risk for Korean population health, although the ingestion of some food may be of significance importance for consumer health. That fact implies that continuous monitoring of these contaminants is still strongly recommended.

Table2. Estimated daily intakes(pg TEQ/kg bw/day) Dioxins and comparison with TDI.

Food		Estimated Dioxins intake (pg-TEQ/kg bw/day)	Comparison with TDI % of TDI (4pg TEQ ng/kg bw/day)
Cereal Products	Rice	0.07	1.8
Meat	Beef	0.03	0.8
	Chicken	0.01	0.3
	Pork	0.01	0.3
Egg	Egg(york)	0.03	0.8
Dairy Products	Milk	0.00	0.00
	Cheese	0.00	0.004
Fish and Shellfish	Alaska pollack	0.00	0.1
	Eel	0.00	0.0
	Hairtail	0.08	2.0
	Pacific saury	0.02	0.5
	Mackerel	0.22	5.5
	Salmon	0.00	0.0
	Spanish mackerel	0.02	0.5
	Yellow croaker	0.04	1.0
	Crab	0.00	0.0
	Oyster	0.00	0.0
Total		**0.53**	**13.3**

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