

A survey of PCDD/Fs and dioxin-like PCBs in Korea retail food from 2002-2004

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Introduction

The surveillance program on PCDD/Fs and dioxin-like PCBs in retail food, especially animal food, have been conducted by Korea food and Drug Administration (KFDA) since dioxin food crisis in 1999. ¹ This periodic survey of dioxin levels is a useful tool to measure the trends of contamination in environment and evaluate the risk assessment of PCDD/Fs and dioxin-like PCBs through food. This study was conducted to measure the levels of PCDD/Fs and dioxin-like compounds of retail food in Korea, investigate the trends in environmental contamination, and assess the health risks potentially associated with the PCDD/Fs and dioxin-like compounds dietary intake over a three year period.

Materials and Methods

Sampling: 159 food samples of animal origin were investigated. Three samples were selected for each item. Sample collection was conducted in three large Korean cities (Seoul, Pusan and Kwangju). The food samples used in the study included meat (beef, pork, chicken), fish (pacific mackerel, hairtail, eel, spanish mackerel, yellow croaker, pacific saury, alaska pollack, oyster, crab) eggs, milk and dairy products (milk, cheese).

Analysis: The sample preparation was carried out as described below. All the samples were homogenized by meat mincer three times in order to make a composite sample out of three samples collected from different regions. Samples were kept at -20°C until they were processed. About 20g of sample was placed into a pre-extracted cellulose thimble (43x123mm) and grounded with 80g of anhydrous sodium sulfate. The samples were then fortified with the ^{13}C -labelled standards and extracted for 18 hours using Soxhlet extraction with hexane/methylene chloride (1:3). After extraction, the solvent was removed and the lipid content were determined gravimetrically. The extracts were cleaned up using sulfuric acid impregnated silica gel and purified on a series of silica gel, alumina and carbon column prior to analysis by HRGC/HRMS.

Instrumental analysis: HRGC/HRMS analysis were performed with HP 6890 gas chromatography interfaced to a Finnigan MAT 95XL mass spectrometer which were in MID mode operating positive electron ionization at a resolving power of $>10,000$ at m/z 314 of PFTBA. The source and transfer line temperature were set at 250C and 280C, respectively. Samples were injected into DB-5MS fused-silica capillary column (30m, 0.25mmid, 0.1um film thickness) in the splitless-injection mode at 280C. The oven temperature was initially 100C (1min) and raised to 150C at 15C/min and raised to 210C at 3C/min, then to a final temperature of 290C at 5C/min for the separation of PCDD/Fs. The oven temperature was initially 100C (1min) and raised to 150C at 15C/min and raised to 210C at 3C/min, then to a final temperature of 250C at 5C/min for the separation of dioxin-like PCBs. The carrier gas was helium at the flow rate of 1.0 ml/min.^{1,2} 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 .

Results and Discussion

This survey was conducted to compare collected results over a three year period in order to assess changes over this time in the levels of dietary PCDD/Fs and dioxin-like PCBs in Korea. In total, 159 samples were collected and analyzed for this survey. These food samples represent the main exposure items of PCDD/Fs, furan and dioxin-like PCBs consumed in Korea. The concentration of PCDD/Fs and dioxin-like PCBs were shown for 5 groups of food samples in table 1 which presented the food samples and food consumption obtained from the report on 2001 National Health and Nutrition Survey-Dietary Intake Survey performed by Ministry of Health and Welfare, Korea in 2002. The lipid content are shown in table 2. The contamination level of the 29 congeners were determined as the TEQ values by multiplying the concentration with the corresponding WHO-TEFs for each congener.³ And the TEQ values were assumed 0.0 for non-detects. As shown in Fig 1 and Fig 2, the trends of level of PCDD/Fs and dioxin-

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like PCBs were decreased annually for most samples except for pacific mackerel whose level of dioxins were increased slightly. Also, the eel sample was represented the highest level of PCDD/Fs TEQ in 2002 and hair tail sample was shown the highest levels of dioxin-like PCBs in 2002. These results were considered as that might be due to influences from high lipid content and habitat such as estuaries and open sea over mud. Another objective of this survey was to assess the health risk potentially associated with the PCDD/Fs and dioxin-like compounds intake annually. Total food consumption was 1,312.5g/day for average Korean and the average amount of animal food consumption was 261.1g and the average amount of plant food consumption was 1051.4g. The level of average consumption for the foods included in the target sample was about 14-15% for animal food excluded the plant food. The daily intake of PCDD/Fs and dioxin-like PCBs through food was estimated to be about 0.8 pgTEQ/kg b.w. in 2002, 0.2 pgTEQ/kg b.w. in 2003, 0.5 pgTEQ/kg b.w. in 2004, respectively under consideration of 55 kg for body weight. It is only about 5-20% of TDI (4 pgTEQ/kg bw/day). In conclusion, with respect to risk assessment for PCDD/Fs and dioxin-like PCBs for retail food in Korea, there is an indication that levels in 2004 have decreased slightly since 2002, however the data is limited.

Table 1. Average levels of PCDD/Fs and dioxin-like PCBs.

(unit:pgWHO-TEQ/g ww, nd=0)

Group	Item	2002			2003			2004		
		Dioxin	PCBs	total	Dioxin	PCBs	total	Dioxin	PCBs	total
Meat	Beef	0.036	0.006	0.042	0.045	0.084	0.129	0.090	0.080	0.170
	(n=5)	+/-0.08	+/-0.003	+/-0.08	+/-0.072	+/-0.097	+/-0.168	+/-0.091	+/-0.042	+/-0.093
	Pork	0.114	0.251	0.365	0.000	0.004	0.004	0.001	0.008	0.009
	(n=5)	+/-0.196	+/-0.458	+/-0.648		+/-0.002	+/-0.002	+/-0.002	+/-0.002	+/-0.002
	Chicken	0.006	0.000	0.006	0.002	0.001	0.003	0.000	0.002	0.002
	(n=3)	+/-0.003		+/-0.003	+/-0.003	+/-0.001	+/-0.003		+/-0.001	+/-0.001
Eggs	Egg	0.000	0.013	0.013	0.002	0.015	0.017	0.041	0.162	0.203
	(york only) (n=3)	+/-0.001	+/-0.007	+/-0.007	+/-0.002	+/-0.016	+/-0.016	+/-0.041	+/-0.171	+/-0.158
Milk and milk product	Cheese	0.011	0.034	0.045	0.009	0.018	0.031	0.032	0.053	0.085
	(n=5)	+/-0.01	+/-0.028	+/-0.037	+/-0.025	+/-0.027	+/-0.037	+/-0.023	+/-0.068	+/-0.072
	Milk	0.001	0.001	0.002	0.000	0.006	0.006	0.000	0.000	0.000
	(n=3)	+/-0.002	+/-0.001	+/-0.003		+/-0.010	+/-0.010			
Fishes and Shellfishes	Pacific mackerel	0.171	0.734	0.905	0.318	0.641	0.959	0.891	1.836	2.727
	(n=3)	+/-0.247	+/-0.294	+/-0.536	+/-0.247	+/-0.294	+/-0.536	+/-0.475	+/-0.213	+/-0.655
	Hairtail	0.224	9.886	10.110	0.116	0.395	0.511	0.151	0.328	0.479
	(n=3)	+/-0.185	+/-8.715	+/-8.898	+/-0.185	+/-8.928	+/-9.110	+/-0.121	+/-0.237	+/-0.347
	Oyster	0.014	0.050	0.064	0.000	0.009	0.009	0.004	0.115	0.119
	(n=3)	+/-0.011	+/-0.008	+/-0.018		+/-0.007	+/-0.007	+/-0.053	+/-0.173	+/-0.226

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Crab	0.154	0.421	0.575	0.002	0.175	0.177	0.122	0.177	0.299
(n=3)	+/- 0.142	+/- 0.406	+/- 0.494	+/- 0.001	+/- 0.106	+/- 0.106	+/- 0.003	+/- 0.140	+/- 0.143
Spanish mackerel	0.002	2.475	2.477	0.124	0.045	0.169	0.004	0.87	0.874
(n=3)	+/- 0.003	+/- 1.420	+/- 1.423	+/- 0.150	+/- 0.062	+/- 0.211	+/- 0.00/	+/- 0.857	+/- 0.855
Eel	2.436	1.845	4.281	0.05	1.088	1.138	0.229	0.859	1.088
(n=3)	+/- 4.164	+/- 1.714	+/- 5.869	+/- 4.164	+/- 1.714	+/- 5.869	+/- 0.096	+/- 0.412	+/- 0.495
Pacific Saury	0.357	0.680	1.037	0.000	0.191	0.191	0.023	0.116	0.139
(n=3)	+/- 0.310	+/- 0.578	+/- 0.888		+/- 0.058	+/- 0.058	+/- 0.020	+/- 0.139	+/- 0.119
Yellow croaker	0.000	0.484	0.484	-			0.086	0.072	0.158
(n=3)		+/- 0.059	+/- 0.059				+/- 0.105	+/- 0.028	+/- 0.129
Alaska Pollack	0.019	0.082	0.101				0.001	0.03	0.031
(n=3)	+/- 0.012	+/- 0.013	+/- 0.023				+/- 0.002	+/- 0.036	+/- 0.038

Table 2. Average lipid content of samples

Group	Item	Lipid (%) +/-SD	Group	Item	Lipid (%) +/-SD
Meat	Beef	23.01+/- 3.76	Fishes and Shellfishes	Pacific mackerel	14.50+/-1.32
	Pork	32.71+/- 1.56		Hairtail	7.31+/-2.35
	Chicken	12.68+/- 1.04		Oyster	2.46+/-0.43
Eggs	Egg	31.40+/- 3.07		Crab	2.58+/-0.31
Milk and Milk product	Milk	2.82+/-0.63		Spanish mackerel	10.24+/-2.90
	Cheese	26.47+/- 3.01		Eel	10.93+/-0.24
				Pacific saury	19.52+/-3.98
Yellow Croaker			13.03+/-0.44		
			Alaska pollack	1.05+/-0.649	

Figure 1: Trend in the PCDD/Fs WHO-TEQ content of Korea food

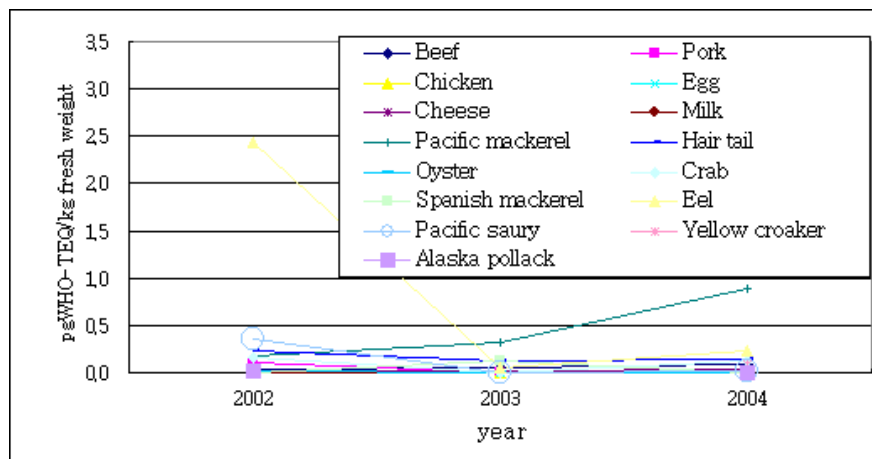
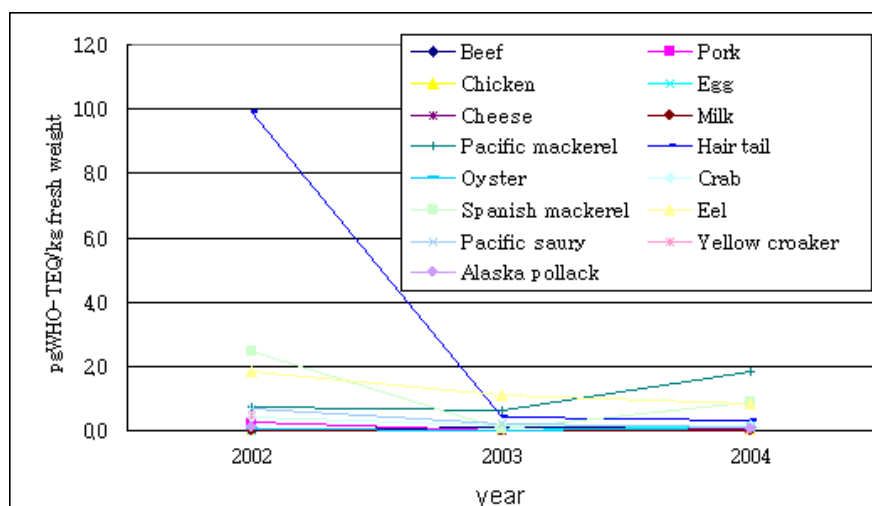


Figure 2: Trend in the dioxin-like PCBs WHO-TEQ content of Korea food



References

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