DIOXIN, FURAN AND PCB LEVELS IN PLANT-ORIGIN FOOD

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Introduction

Because of toxicity, wide spread presence and persistence in the environment, dioxins, furans and PCBs accumulated in living organisms may indicate the greatest public health risk.[1-2] Food consumption is the important route of human exposure to these contaminants from a variety of sources, however, contamination levels are depending on species.[3] Species with a higher fat content may have higher contamination levels so that detectable levels are found in fatty food such as meats, eggs, dairy products and fishes. Moreover, food contributing most to the daily intake of dioxins, furans and PCBs differ from region and region due to regional variation in food supply and food consumption pattern.[4-5] In case of Korea, plant-origin foods (1042.5g/day) are significant contributors to the per capita consumption of food (1290.0g/day) based on the National Food Consumption Survey in 1998.[6] In other words, plant-origin foods are considered representative of the diet of the Korean population. The aim of this study is focused on the accumulation pattern and concentration of dioxins, furans and PCBs in specific types of foods such as cereals, legumes, roots, vegetables and fruits. There are two possible pathways accumulating dioxins, furans and PCBs in plant.[1,7] One is uptake from soil and the other is deposition from the atmosphere. Levels of dioxins, furans and PCBs in food of plant origin are usually very low. However, this report can suggest the overview to assess contamination levels of Korean foods as a further extension of previous studies.[8-10]

Methods and Materials

Determination was performed on raw foods. To obtain a representative sample, foods were collected at three major cities in Korea such as Seoul, Daejon and Busan. All samples were prepared as previously described.[8-9] The levels of seventeen 2,3,7,8-substituted dioxins and furans, and four co-planar PCBs (#77, #81, #126 and #169) in food were measured by HRGC/HRMS using the isotopic dilution/internal standard method. The contamination levels were normalized by multiplying their measured concentration by the appropriate WHO TEFs.[11]

Results and Discussion

Food consumption levels for the foods included in the analysis were compiled from Ministry of Health and Welfare’s continuing Survey of Food Intakes by Individuals as illustrated in Fig. 1 and Table 1. Seventy-two food samples including rice, barly, bean, red bean, potato, sweet potato, cabbage, radish root, onion, apple, citrus fruit and pear were analyzed for dioxins, furans and PCBs. Levels of targets converted to toxic equivalents are given in Table 1. It assumes that non-detects (nd) equal 0. Analyses were performed on raw foods, resulting in possible overestimation of total exposure. Dioxins, furans and PCBs were detected in every sample, however, all foods analyzed in this study contribute small amounts to national average contaminant exposures for these chemicals. The levels were lower than 0.1 pgWHO-TEQ/g whole weight. A wide range of concentration levels was observed. A range of targets were detected in 0.001~0.026 pgWHO-TEQ/g. The highest level was found in bean sample for 0.026 pgWHO-TEQ/g mainly because of the TEF of 2,3,7,8-TCDD which is 1.0. Profiles of dioxin congeners in food are shown in Fig. 2. As expected, the food items belong to the same food group exhibit similar congener patterns. Thus, the samples could be categorized into 5 sets such as cereals, legumes, roots, vegetables and fruits. In all other species, the dominating congener was PCB #126 due to TEF of PCB #126 which is 0.1. It was found to be the largest source of TEQ in barley, red bean, sweet potato, radish root and pear. Several other congeners such as PCB #77, 1,2,3,4,7,8-, 1,2,3,6,7,8- and 2,3,4,6,7,8-HxCDF were also found in most of cases. In addition, 2,3,4,7,8-PeCDF is a significant contributor to the total TEQ of bean, red bean and citrus fruit. OCDD was detected in barley, pear and citrus fruit. With the exception of onion, furan analytical contributions are greater than those of dioxins. In conclusion, these results provide one of the most comprehensive characterizations of background dioxin, furan and PCB concentration in the plant-origin food.

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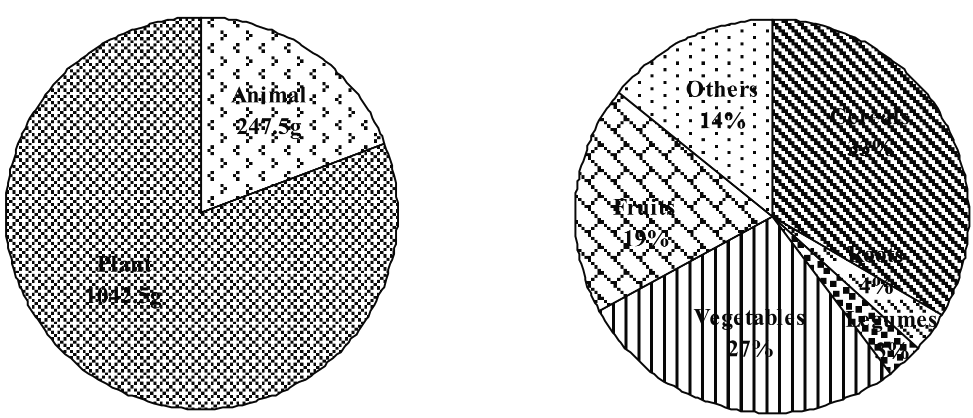

Figure 1. The per capita consumption of food in Korea

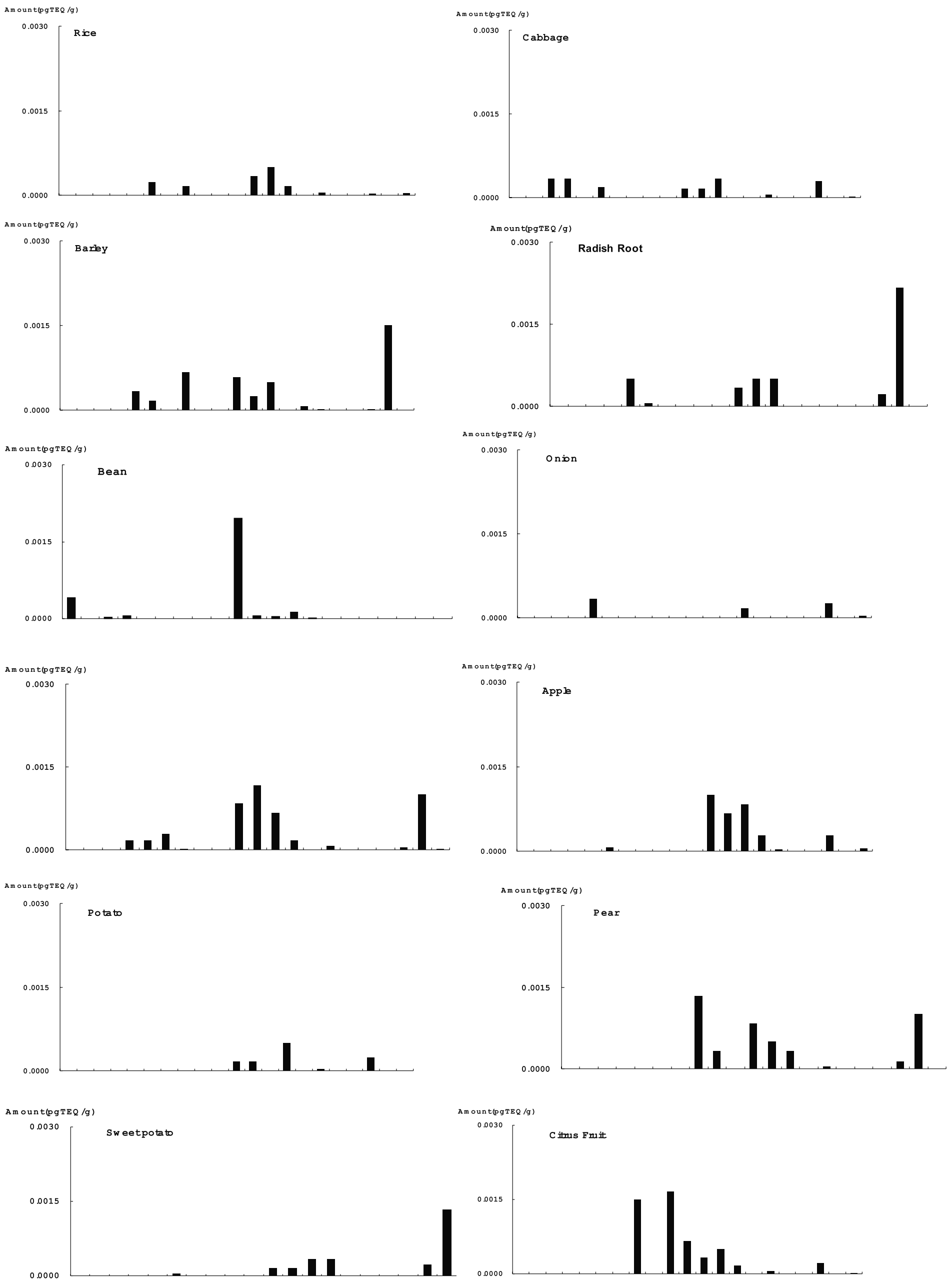

Figure 2. Profiles of dioxin, furan and PCB congeners in plant-origin food

Table 1. Dioxin Levels in the Plant-Origin Food

Food		Consumption	Mean (Range)	
Group	Item	(g/day)	pg/g ww	pg WHO-TEQ/g ww
Cereals	Rice	246	0.271 (0.055~0.704)	0.002 (0.001~0.003)
	Barley	4.3	0.236 (0.110~0.460)	0.003 (0.002~0.003)
Legumes	Bean	3.2	0.016 (0.005~0.026)	0.010 (0.001~0.026)
	Red Bean	0.9	0.656 (0.050~1.579)	0.004 (0.002~0.006)
Roots	Potato	16.5	2.323 (2.214~2.463)	0.001 (0.001~0.002)
	Sweet Potato	16.2	2.402 (2.223~2.519)	0.001 (0.001~0.002)
Vegetables	Cabbage	12.8	2.897 (2.672~3.129)	0.002 (0.001~0.005)
	Radish root	40.5	2.328 (1.294~3.169)	0.002 (0.001~0.005)
	Onion	14.6	2.578 (2.085~3.169)	0.001 (0.001~0.002)
Fruits	Apple	40.1	2.883 (2.555~3.398)	0.003 (0.001~0.007)
	Citrus fruit	73.1	2.195 (1.974~2.423)	0.005 (0.003~0.007)
	Pear	23.4	1.364 (0.065~2.177)	0.004 (0.002~0.005)