

The Levels of PCDFs and PCDDs in Korean Cabbage and Radish from Korean Markets

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Introduction

A comprehensive quality survey for polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDDs/PCDFs) in foods has been studied. This work was the first aimed at monitoring the two kinds of vegetables, which are Korean cabbage and radish. These are mainly consumed everyday in Korea as Kimchi, which are very famous Korean foods. We collected the 3 samples of these vegetables from different supermarkets in 5 big cities. This study reports the concentrations and TEQ levels of PCDDs/PCDFs in these Korean cabbage and radish.

Materials and Methods

Sample: The samples measured in this study have been bought 3 sets of each vegetable from different market in 5 big cities.

Analytical Method: The vegetable samples 50 g were ground, dried at 80 °C in oven and transferred into the prewashed bottle and spiked with fifteen carbon-13 labeled isotope compounds (Cambridge Isotope Laboratories, Woburn, MA, USA). In this bottle, 30 g anhydrous sodium sulfate is added and mixed carefully. Methylene chloride 50 ml, as extracting solvent, was added and ultrasonicated for 20 min. The extraction was done 3 times. Extracts were concentrated to about 10 ml and passed through the activated florisil column and sep-pak cartridge for solid phase extraction (Waters, Milford, MA), with more two times of n-hexane 10 ml. Eluent concentrated to about 20ml by nitrogen stream and washed with conc. sulfuric acid, 5% NaCl and 20% KOH. Washed extracts passed through anhydrous Na₂SO₄ and concentrated to 10 ml for solid phase clean-up; silica, alumina and carbon column by USEPA 1613 method. Eluent to be spiked recovery standards 20 μ l was concentrated to 20 μ l. 2 μ l was injected to HRGC/HRMS.

GC/MS analysis; Determination were performed with HP 5890 series II gas chromatograph and Finnigan MAT 95S mass spectrometer at resolution 10,000 using Ultra 2 capillary column (Hewlett Pacard).

Results and Discussions

The concentrations and TEQ levels of PCDFs in Korean cabbage and radish were 0~0.019 pg/g and 0~0.103 pg/g, respectively (Table 1). And TEQ levels of PCDFs were 0~0.0005 pgTEQ/g and 0~0.001 pgTEQ/g. The total concentration and TEQ level of PCDFs in cabbage (0.024 pg/g and 0.0007 pgTEQ/g) is lower than those in radish (0.106 pg/g and 0.0013 pgTEQ/g). The concentrations of PCDDs in cabbage and radish were 0~0.166 pg/g and 0~0.037 pg/g, respectively. And TEQ levels of PCDDs were 0~0.0808 pgTEQ/g and 0 pgTEQ/g (Table 2). The total concentration and TEQ level of PCDDs in cabbage (0.328 pg/g and 0.0810 pgTEQ/g) is the higher than those in radish (0.037 pg/g and 0 pgTEQ/g). These vegetables are another main food materials with boiled rice in Korea. From these results, we could guess the lower effect for daily intake of PCDFs/PCDDs by kimchi. Figure 1 and Figure 2 show the TEQ levels of PCDFs and PCDDs, respectively, in these vegetables in Korea by bar graph. Figure 3 and Figure 4 show the distributions of TEQ levels of PCDFs and PCDDs, respectively, in these vegetables by spot graph.

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Table 1. The Concentrations and TEQ Values of PCDFs in two Vegetables

Compound	Cabbage (n=5)					
	concentration (pg/g)			pgTEQ/g		
	mean	SD	min-max	mean	SD	min-max
2,3,7,8-TCDF	0.005	0.011	0.000-0.025	0.0005	0.0012	0.000-0.0026
1,2,3,7,8-PeCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
2,3,4,7,8-PeCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,4,7,8-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,6,7,8-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,7,8,9-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
2,3,4,6,7,8-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,4,6,7,8-HpCDF	0.019	0.043	0.000-0.097	0.0002	0.0004	0.000-0.0010
1,2,3,4,7,8,9-HpCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
OCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
Total PCDFs	0.024	0.054		0.0007	0.0016	
Compound	Radish (n=5)					
	concentration (pg/g)			pgTEQ/g		
	mean	SD	min-max	mean	SD	min-max
2,3,7,8-TCDF	0.003	0.007	0.000-0.016	0.0003	0.0007	0.000-0.0016
1,2,3,7,8-PeCDF	0.000	0.000	0.000-0.001	0.0000	0.0000	0.000-0.0000
2,3,4,7,8-PeCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,4,7,8-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,6,7,8-HxCDF	0.000	0.000	0.000-0.001	0.0000	0.0000	0.000-0.0001
1,2,3,7,8,9-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
2,3,4,6,7,8-HxCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,4,6,7,8-HpCDF	0.103	0.135	0.000-0.328	0.0010	0.0013	0.000-0.0032
1,2,3,4,7,8,9-HpCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
OCDF	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
Total PCDFs	0.106	0.142		0.0013	0.0020	

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Table 2. The Concentrations and TEQ Values of PCDDs in two Vegetables

Compound	Cabbage (n=15)					
	concentration (pg/g)			pgTEQ/g		
	mean	SD	min-max	mean	SD	min-max
2,3,7,8-TCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,7,8-PeCDD	0.162	0.315	0.000-0.722	0.0808	0.1577	0.000-0.3610
1,2,3,4,7,8-HxCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,6,7,8-HxCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,7,8,9-HxCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,4,6,7,8-HpCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
OCDD	0.166	0.231	0.000-0.575	0.0002	0.0002	0.000-0.0006
Total PCDDs	0.328	0.546		0.0810	0.1579	
Compound	Radish (n=15)					
	concentration (pg/g)			pgTEQ/g		
	mean	SD	min-max	mean	SD	min-max
2,3,7,8-TCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,7,8-PeCDD	0.000	0.000	0.000-0.001	0.0000	0.0001	0.000-0.0002
1,2,3,4,7,8-HxCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,6,7,8-HxCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,7,8,9-HxCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
1,2,3,4,6,7,8-HpCDD	0.000	0.000	0.000-0.000	0.0000	0.0000	0.000-0.0000
OCDD	0.037	0.024	0.000-0.064	0.0000	0.0000	0.000-0.0001
Total PCDDs	0.037	0.024		0.0000	0.0001	