POLYCHLORINATED DIBENZO-*p*-DIOXINS (PCDDs) AND DIBENZOFURANS (PCDFs) IN VEGETABLES HARVESTED NEARBY MUNICIPAL WASTE INCINERATORS AREA, KOREA

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Introduction

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF) are formed as by-products of incinerators and many industrial processes and have been detected in almost all environmental matrices: soil, sediment, air, water, animals, vegetation, and humans[1-2]. Food has been recognized as the main source of human intake of PCDD/PCDF more than 90% of the daily exposure[3]. Their high lipophilicity and persistence in the environment, 2,3,7,8-substituted PCDD/PCDF accumulate in the aquatic and terrrestrial food chain. Thus, dairy, meat, poultry, and seafood products typically have much higher concentrations of PCDD/PCDF than vegetables and fruits[4-5]. Although the contribution rate of the vegetable group to total dioxin intake from the total diet was <2.0%, vegetables is highly nutritious in terms of having an abundance of vitamins, minerals and fiber. Some studies have been conducted to determine how plant leaves can accumulate dioxins [6-7]. In those reports, it was shown that the mechanism for the vegetation uptake of organic pollutants is influenced by the chemical and physical properties of the pollutants, environmental conditions, and the plant species.

In Korea, a few studies on the vegetables, fruits, barleys and cereal of PCDD/Fs have been conducted.

From 2010 to 2012, we have determinated the levels of PCDD/Fs in domestic agricultural products harvested nearby municipal waste incinerators area.

Materials and methods

1) Sample collection, extraction and cleanup

From 2010 to 2012, 120 samples of various vegetables, fruits and cereal were collected in different districts of Korea, where there are some potential sources of contamination, including an incinerator(Table 1).

The preparation of samples(Fig. 1) was based on the EPA method 1613 with automated sample cleanup for trace analysis(PowerPrep^{TM}, FMS)

2) Analytical condition

The instrumental analysis was done by JEOL(Akishima, Tokyo, Japan) MStation JMS-700D high resolution mass spectrometer (B/E configuration) equipped with a Agillent (Palo Alto, CA, USA) 6890 Plus gas chromatograph. The capillary GC column 30 m·0.32 mm, coated with a DB-5MS stationary phase (film thickness 0.25um) was used. Samples were injected in splitless mode at an injector temperature of 280 ℃ and at an initial column temperature of 160℃. After 1 min., the temperature was ramped at 20℃/min to 200℃, at 5℃/min up to 235℃, and at 3℃/min up to 310℃. The latter temperature was held for 3 min. The ion source was operated at 260 C, the electron energy was 38 eV. The mass spectrometer was tuned to a mass resolution of 10,000. Quantification was carried out Tetra- through Octa-Chlorinated Dioxins and Furans by the isotopic dilution method.

Results and Discussion

Figure 1 summarizes the results of 2010 on concentrations of PCDD/Fs in the edible portions of samples. In none of samples, lower chlorinated 2,3,7,8-TCDD, were detected. When non-detects were set to zero, the total TEQ levels were in range 0-0.0487 pg TEQ/g. OCDD was detected in 66.7% of the samples. It was showed highest value for lettuce. In green onions, the concentration was the second-highest level because 1,2,3,7,8-PeCDD(the main contributing isomer in TEQ) was detected.

In the results of 2011, there were not detected PCDD/Fs in any samples.

In the results of 2012(Fig. 3), the highest toxic compound TCDD and PCDD were not detected in all samples. the total TEQ levels were in range 0 - 0.0077 pg TEQ/g. The highest level was found in sweet potato shoon. 1,2,3,4,7,8-HxCDF was detected in 22.5% of the samples.

The recoveries of sampling and clean-up standards ranged which were under the required.

Acknowledgements

This work was supported by a grant from The National Agricultural Products Quality Management Service, Republic of Korea.

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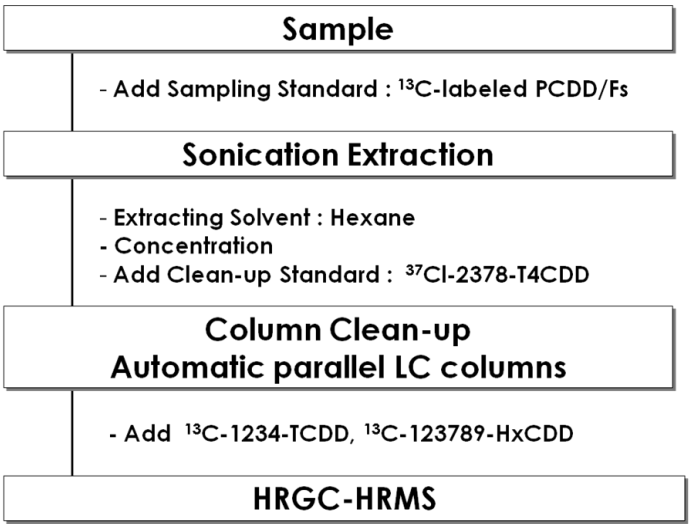

Fig. 1 Schematic diagram for analytical procedure

Table 1. Food items for PCDD/PCDF analysis from 2010 to 2012

(ea)

Food Item	2010	2011	2012	Total
Radish	2	7	-	9
Tangerine	-	-	2	2
Potato	1	-	-	1
Leaf-mustard	-	2	-	2
Sweet potato	-	-	4	4
Sweet potato-soon	-	-	1	1
Green onions	2	2	3	7
Perilla leaf	1	-	1	2
Astringent persimmon	-	-	3	3
Garlic	3	-	-	3
Water parsley	1	-	-	1
Pear	-	-	1	1
Chinese cabbage	7	22	2	31
Barley	1	-	-	1
Chives	-	-	1	1
Apple	-	-	3	3
Lettuce	7	1	-	8
Ginger	-	-	1	1
Spinach	1	-	1	2
Rice	-	2	3	5
Curled mallow	1	-	-	1
Onion	1	-	-	1
Winter plowing	2	2	-	4
Young radish	3	-	-	3
Chicory	1	-	-	1
Kale	2	-	-	2
Grape	-	-	5	5
Green chili	3	2	5	10
Pumpkin		-	2	2
Pumpkin leaf	1	-	-	1
Mashed pepper	-	-	2	2
Total	**40**	**40**	**40**	**120**

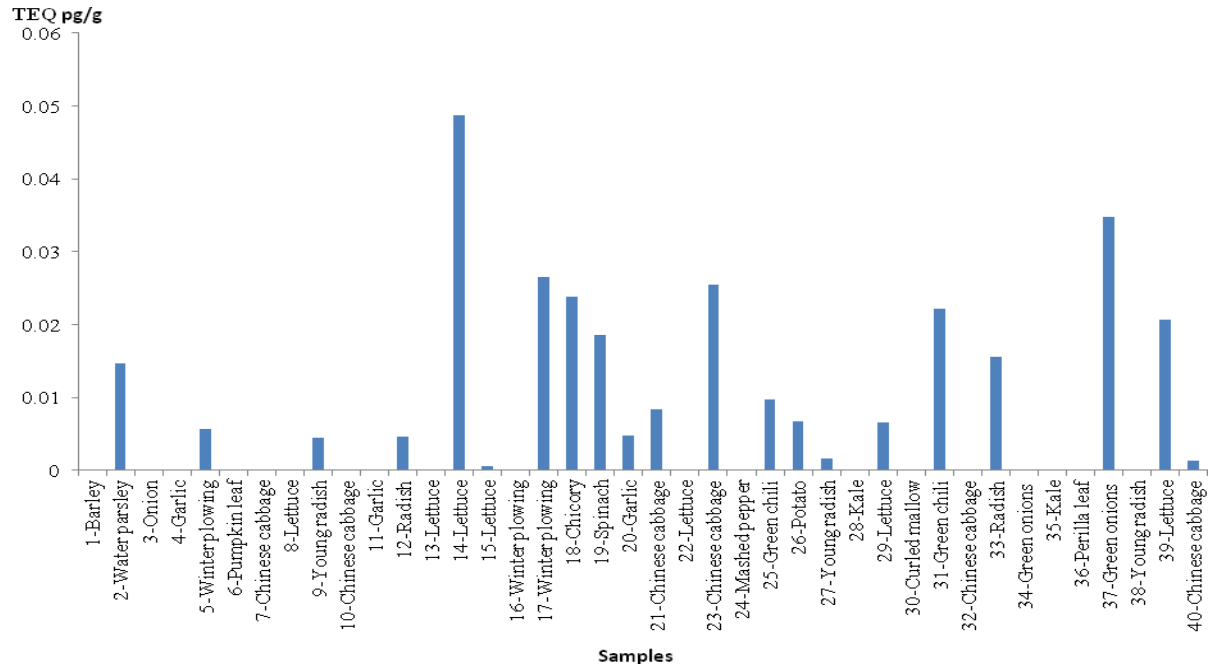

Fig. 2 The WHO-TEQ values concentrations of PCDD/Fs in samples of 2010

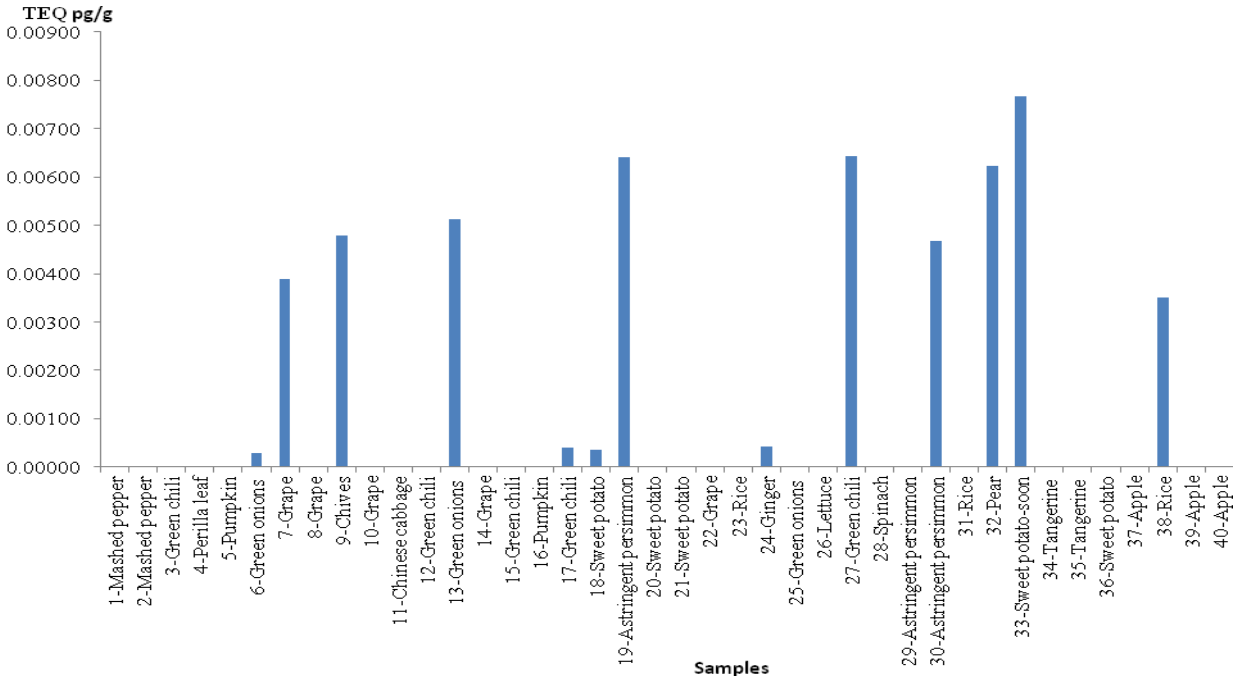

Fig. 3 The WHO-TEQ values concentrations of PCDD/Fs in samples of 2012