COMPARATIVE STUDY OF PCDDS/DFS CONCENTRATION IN SPINACH AND CULTURAL ENVIRONMENT

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Introduction

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofuran(PCDDs/Fs) are groups of global persistent pollutants and well known as emission of municipal solid waste incineration processes [1, 2, 3].

Since the major fraction of the dioxin and furan emissions is emitted directly into the atmosphere and easy to accumulated in soil, they have high possibility to affect the agricultural environment [4, 5]. However, there have been especially few studies about the influences of PCDD/Fs in atmosphere on agricultural crops. The objective of this study is to compare dioxin content in spinach, soil and air and to evaluate the relation of dioxin concentration in cultural environment

We also considered the determination of sample weight for the precise peak detection in dioxin analysis.

Methods and Materials

Two kinds of spinach plants (A, B) were measured in this study. Spinach A was cultured in open field at Saitama and Spinach B was collected from market in Tsukuba city, Japan. 1kg and 2kg of fresh spinach samples were used to determine the sample weight for the dioxin analysis of agricultural crops.

Detection of PCDD/Fs was carried out by HRGC/HRMS method after soxhlet/solvent extraction and gel clean-up procedures. Seventeen native (Wellington Laboratories, Canada) and ^{13}C 2,3,7,8-substituted isomers (Wellington Laboratories, Canada) were used as standard and isotope spike. Concentrations of PCDD/Fs were determined by HRGC (6890, Hewlett Packard, US) with a DB17 column (J&W Scientific, US) and an SP2331 column (Supelco, INC., US), connected to a HRMS (AutoSpec-Ultima, Micromass, UK) operation on a resolution of 10,000 using a posotive electron ionization source and operating in the selected ion monitoring (SIM) mode. Verification of resolution in the working mass range was obtained by measuring perfluorokerosene(PFK) regerence peaks. The current trap was 500mA and the ionization energy was 30eV. Ion source and injector temperatures were 260 °C

Results and Discussion

As the result of dioxin analysis for peak detection, the fragmentogram of HpCDFs, and especially OCDF indicated different pattern from that of TeCDDs/Fs, PeCDDs/Fs and HxCDDs/Fs, which showed the same pattern as shown in Fig. 1.

In case of field culture spinach(wet sample 2 kg), peak of OCDF could be detected clearly, while market spinach(wet sample 1 kg) showed the only baseline detection. The result makes it possible to suppose the fact that production place of market spinach was not contaminated with OCDF, but atmosphere pattern of production place was similar to that of open field sample. So we could decide that the sample of agricultural crops were needed more than 2 kg in wet weight for the evaluation of precise peak.

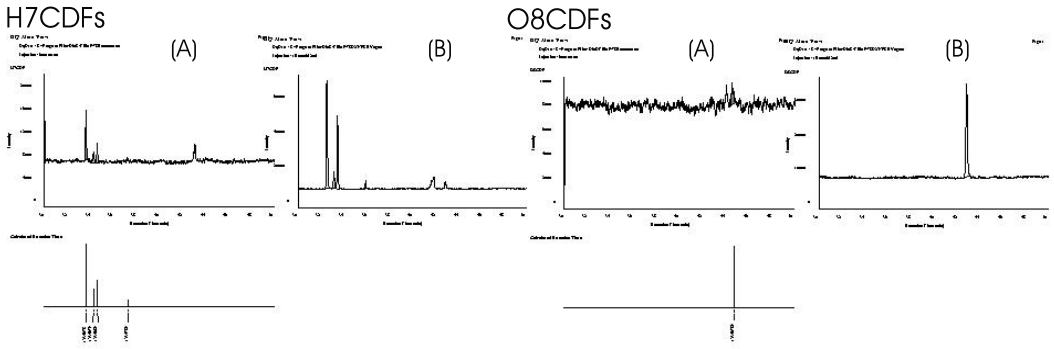

Figure 1. Comparative Mass Fragmentograms of 7,8-Furans in Spinach Samples

Figure 2 illustrates that there was a little concentration difference of PCDDs/Fs between market spinach and field culture spinach. When compared with dioxin content of cultural environment, the total tendency of dioxin concentration levels in field culture spinach may be affected by TCDDs and OCDDs distributed in soil as presented in Fig. 3 and Table 1. However, on the whole the major factor seemed to be the atmospheric deposition.

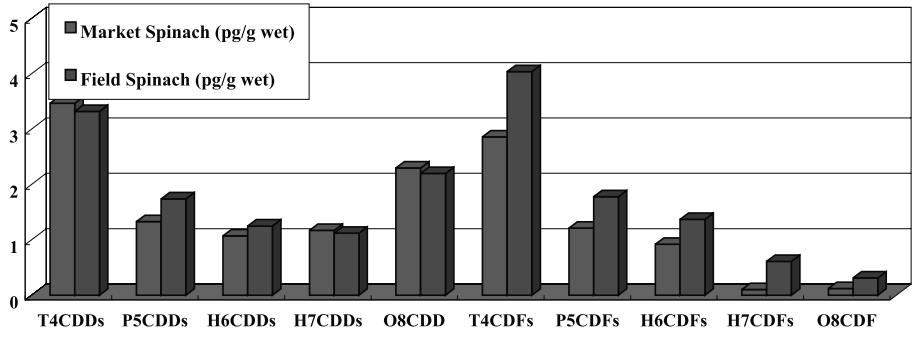

Figure 2. Comparative Results of PCDD/Fs Concentrations in Spinach Samples.

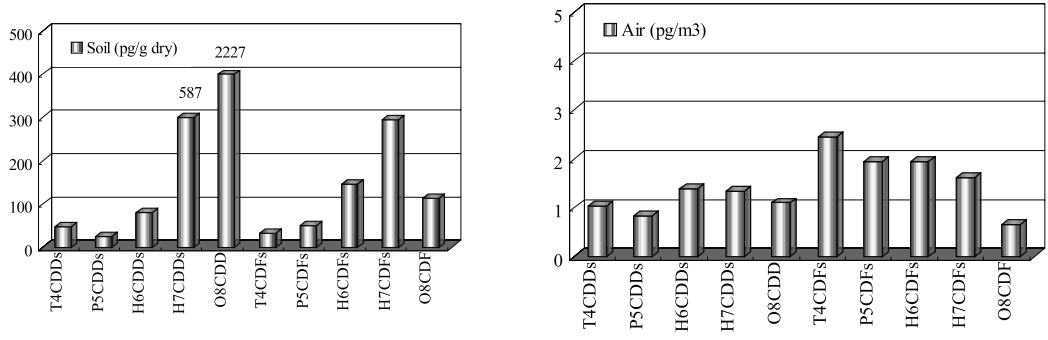

Figure 3. Concentration Levels of PCDD/Fs in Cultural Environment.

Table 1. Comparative Levels of 2,3,7,8-Chlorinated PCDD/Fs in Spinach and Cultural Environment

Congener	Soil (pg/g dry)	Air (pg/m^3)	Market spinach (pg/g wet)	Field spinach (pg/g wet)
2,3,7,8-T4CDD	0.29	ND	ND	ND
1,2,3,7,8-P5CDD	1.89	0.03	0.03	0.04
1,2,3,4,7,8-H6CDD	3.40	0.04	0.03	0.04
1,2,3,6,7,8-H6CDD	9.15	0.08	0.05	0.06
1,2,3,7,8,9-H6CDD	0.78	0.06	0.05	0.05
1,2,3,4,6,7,8-H7CDD	2.36	0.63	0.50	0.49
O8CDD	2,227.44	1.10	2.30	2.20
2,3,7,8-T4CDF	0.86	0.04	0.04	0.08
1,2,3,7,8-P5CDF	1.89	0.13	0.06	0.11
2,3,4,7,8-P5CDF	1.80	0.12	0.05	0.07
1,2,3,4,7,8-H6CDF	5.10	0.19	0.07	0.10
1,2,3,6,7,8-H6CDF	6.20	0.16	0.07	0.11
1,2,3,7,8,9-H6CDF	11.29	-	-	0.13
2,3,4,6,7,8-H6CDF	8.26	0.29	0.12	0.16
1,2,3,4,6,7,8-H7CDF	159.62	0.93	0.06	0.39
1,2,3,4,7,8,9-H7CDF	6.70	0.13	0.04	0.04
O8CDF	114.63	0.67	0.12	0.31

On the other hand, Figure 4 shows clearly the attached soil particle on the leaf surface of spinach washed with water. This result reveals that in spite of water washing pretreatment, dioxin concentration of spinach leaves stained with soil may be affected by that of soil because of the strongly attached soil.

References

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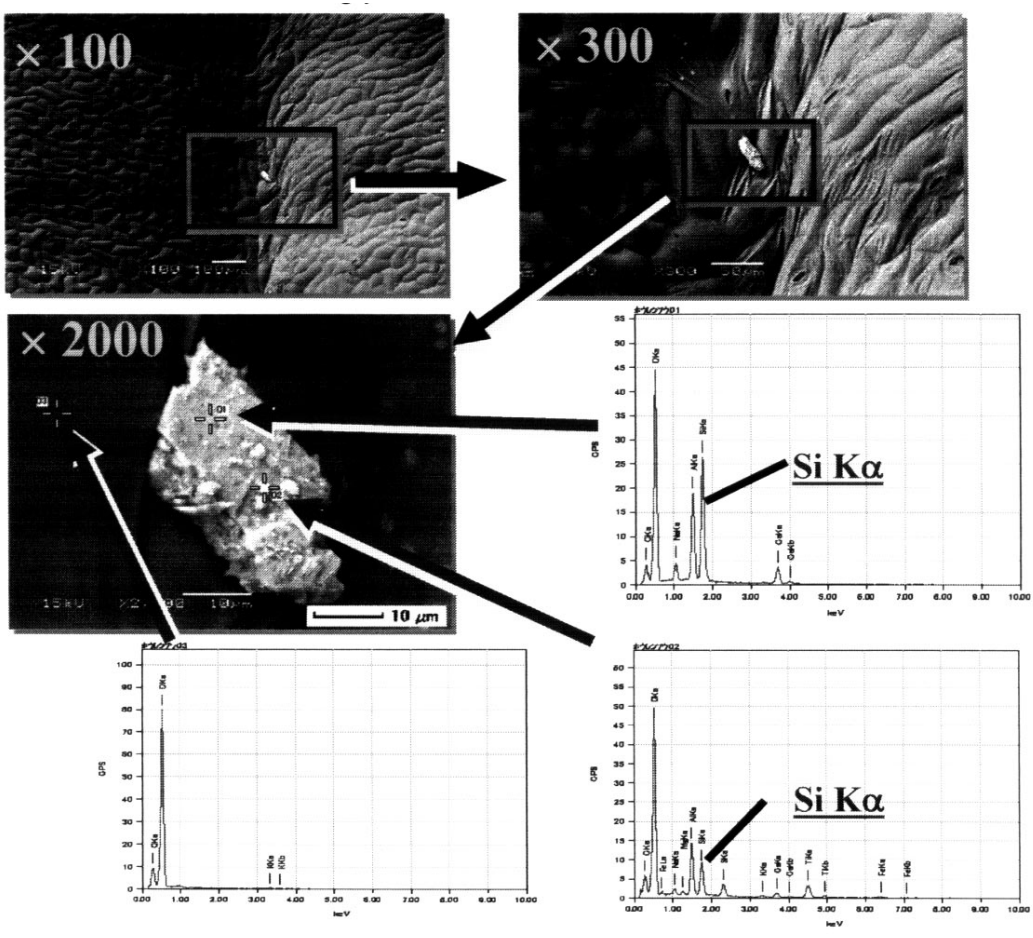

Figure 4. SEM Pictures of Attached Particle on Spinach Leaf Surface Washed with water