

PROFILES OF DIOXINS IN FISH LIVERS AND BRANCHIA FROM DONGTING LAKE, CHINA

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Introduction

Dongting Lake located in Hunan Province of China is the second-largest freshwater lake and is also an endemic region of schistosomiasis. *Oncomelania hupensis* *gredler* is the only lodging host of schistosome and plays a vital role in schistosomiasis spread. To kill *oncomelania hupensis gredler*, large amounts of sodium pentachlorophenate (Na-PCP) which was found containing polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) impurities had been sprayed for over 30 years¹. PCDD/Fs are chemically stable and persistent hydrophobic organic chemicals and are thought to be biomagnified via food chain. Although Na-PCP has been prohibited sprayed in the region since 1996, recent studies have indicated that the sediments^{2,3}, soils, and breast milk⁴ around Dongting Lake area are contaminated by PCDD/Fs.

Fish is usually used as bioindicator for environmental medium and foodweb and can reflect the PCDD/Fs pollution status. As do most organic contaminants, PCDD/Fs accumulate in certain organs with the highest proportions found in the fish liver⁵. This paper describes the levels and bioaccumulation profiles of PCDD/Fs in different fish species organs from Dongting Lake region.

Materials and Methods

Fish tissues were taken from Dongting Lake in China in September 2004. Samples were wrapped in aluminum foil, stored at -20°C until analyzed.

After thawed, fish tissues were freeze-dried, ground and mixed with anhydrous sodium sulfate (Na₂SO₄). The PCDD/Fs analysis was performed using the isotope dilution technique based on U.S. EPA Method 1613. Before extraction, samples were spiked with ¹³C₁₂-labeled 2,3,7,8-substituted PCDD/F internal standards. Extraction was carried out by Soxhlet using 250 mL n-hexane/dichloromethane (1:1) for 24 h. The extract volumes were reduced by rotary evaporation. Lipid contents were calculated with residues of the extracts. Then lipids were dissolved with n-hexane and subjected to sulfuric acid wash. The volumes of eluates were reduced by rotary evaporation, and a multistep-cleanup was performed with adsorption chromatography. Prior to analysis, ¹³C₁₂-labeled injection standards were added for calculating recovery. The PCDD/Fs were analyzed by high-resolution gas chromatograph (Agilent 6890 GC with a 60 m DB-5MS column) coupled with high-resolution mass spectrometry (Waters Micromass Autospec Ultima with a resolution >10,000). Additionally QA/QC measures included running a procedural blank, replicate, and a certified reference material.

Levels in biota

Results and discussion

The recovery for the PCDD/Fs analyzed in this study was in the range of 53.2-104.7%.

The levels of PCDD/Fs congeners from fish tissues are given in Table 1. The limit of detection (LOD) for PCDD/Fs in a given sample was defined by a signal to noise ratio greater than 3 times the average baseline variation. The different levels and patterns of PCDD/Fs could be due to different fish species and fish internal organs. TEQs for 2,3,7,8-PCDD/F congeners were calculated for each sample using the WHO TEFs. When the value of PCDD/Fs congener was less than LOD, total WHO-TEQ was calculated with 1/2 LOD. Total WHO-TEQ values for the samples analyzed ranged from 1.38 to 23.60 pg TEQ/g lipid. Ratios of total 2,3,7,8-substituted PCDF congeners against total 2,3,7,8-substituted PCDD congeners were less than 1, excluding that of pomfret liver sample with 1.21. OCDD is preponderant among 17 PCDD/Fs congeners. The PCDD/Fs patterns of fish tissues indicated Na-PCP originated. The character of accumulation between the different fish species tissues was probably due to differences in feeding habits and metabolic capability toward PCDD/Fs.

Table 1 Levels of PCDD/Fs in livers and branchia from different fish species in Dongting Lake (pg/g lipid)

	carp liver(1)	carp liver(2)	catfish liver	pomfret liver	carp branchia	Catfish branchia
Lipid (%)	3.32	3.22	3.55	33.53	2.97	2.17
2,3,7,8-TCDF	21.10	7.85	12.10	7.34	<6.56	17.51
12378-PeCDF	3.01	<2.27	<2.87	<0.55	<6.26	<5.99
23478-PeCDF	4.54	<2.36	6.47	<0.50	<6.56	<6.08
1,2,3,4,7,8-HxCDF	<5.12	<1.65	<2.62	0.36	<4.2	<3.91
1,2,3,6,7,8-HxCDF	<6.19	<1.68	<2.81	<0.24	<4.07	<3.64
2,3,4,6,7,8-HxCDF	<4.25	<1.63	<2.45	<0.27	<3.87	5.07
1,2,3,7,8,9-HxCDF	<7.02	<2.72	<3.94	<0.48	<7.47	<6.96
1,2,3,4,6,7,8-HpCDF	11.76	1.68	1.68	0.78	1.35	12.44
1,2,3,4,7,8,9-HpCDF	1.21	<1.12	<1.27	<0.28	<3.23	<4.42
OCDF	3.62	<0.95	1.97	0.15	<4.67	<2.99
2,3,7,8-TCDD	<2.52	<2.16	2.81	0.42	<6.69	<6.77
1,2,3,7,8-PeCDD	<7.14	<3.65	4.78	<0.60	<13.72	<10.18
1,2,3,4,7,8-HxCDD	<1.72	1.12	11.53	<0.22	4.04	22.11
1,2,3,6,7,8-HxCDD	2.41	<1.18	<1.18	<0.21	<3.50	7.37
1,2,3,7,8,9-HxCDD	<1.48	<1.24	1.41	<0.22	<3.67	2.30
1,2,3,4,6,7,8-HpCDD	22.91	8.69	16.88	1.85	42.04	39.16
OCDD	141.39	22.72	77.64	4.06	579.14	155.72
Ratio PCDFs/PCDDs	0.20	0.28	0.28	1.21	0.08	0.19
∑WHO-TEQ	10.06	4.93	17.97	1.38	15.28	23.60

Acknowledgments

This study was supported by National Natural Science Foundation of China (40332023) and National Basic Research Program of China (2003CB415006).

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