PCDD/Fs IN SEDIMENT SAMPLES FROM CHINESE SCHISTOSOMIASIS AREAS AND POTENTIAL HUMAN HEALTH EFFECTS*

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INTRODUCTION

Being a powerful molluscacide, Na-PCP is an effective and cheap chemical to control schistosomiasis(1), an epidemiological disease caused by parasite. A large amount of Na-PCP has been spread over vast areas since 1960's in China, especially in the middle and lower valleys of Yangtze River. China produced about 6000 tons of Na-PCP annually. Dioxin which were released into the environment as by-products of technical Na-PCP, could contribute to human exposure in China.

It is a concern that soil or sediment may be a pathway of human exposure through dermal contact, ingestion or food chain. In this study, sediment samples were collected and analyzed for PCDD/Fs from regions where Na-PCP had been sprayed. The background level of PCDDs and PCDFs in soils from non-schistosomiasis areas was also provided for comparison.

To further evaluate human exposure to Na-PCP, a comparison between the pattern of PCDD/Fs congeners in Na-PCP and that in human blood and milk from schistosomiasis areas(1)(2) was conducted.

EXPERIMENTAL

Materials and Sampling

Sodium pentachlorophenate was made in the Dagu chemical factory in Tianjin in 1990. Trace level PCDD/Fs have been detected(3)(4)(5).

^{13}C-labelled 2,3,7,8-substituted PCDD/F congener surrogates were provided by Chemistry Division,Environment Canada.

The sampling region is located in Jiangxi Province. The top 5cm sediment samples from a lake were collected from four different sites where Na-PCP had been sprayed. Background samples were collected from non-schistosomiasis areas.

Sample Pretreatment and Analysis

The sediment samples were pretreated according to the Reference Method EPS 1/RM/19 by Environment Canada[6] which involved Soxhlet extraction, liq-liq extraction and column clean-up. Quantification is based on the use of surrogates(isotopically-labelled compounds added before sample workup) as internal standards. $^{13}C_{12}$-1,2,3,4-TCDD and $^{13}C_{12}$-1,2,3,7,8,9-H_6CDD were added to sample extracts immediately before HRGC/HRMS analysis for the calculation of surrogate recovery.

The Na-PCP sample was dissolved in de-ionized water, spiked with ^{13}C-labelled PCDD/Fs congeners, followed by liq-liq extraction with dichloromethane. The organic extract was passed through an acid/base/silver nitrate/silica column and a basic alumina column. The fraction containing PCDD/Fs eluted with 50% dichloromethane/50% hexane was collected and concentrated for HRGC/HRMS analysis.

RESULTS AND DISCUSSION

Quantitative results of the seventeen 2,3,7,8-substituted PCDD/F congeners and toxic equivalent(TEQ) values in the Chinese Na-PCP, sediments, and human blood and milk samples from schistosomiasis areas are provided in Table 1.

Apart from the high concentration of OCDD and OCDF, Chinese Na-PCP contains significant amounts of 1,2,3,4,7,8-H_xCDD, 1,2,3,4,6,7,8-H_pCDD, 1,2,3,4,7,8-H_xCDF, 1,2,3,4,6,7,8-H_pCDF. These congeners might be used as fingerprint for the assessment of Chinese Na-PCP exposure. In addition, the content of total PCDDs is significantly greater than total PCDFs.

As shown in Table 1, levels of PCDD/F congeners in the sediment samples from the schistosomiasis areas are much higher in comparison with the control soil sample collected from non-schistosomiasis areas. The PCDDs levels were markedly higher than PCDFs in all four sediment samples. Furthermore, the high level of 1,2,3,4,7,8-H_xCDD/F, 1,2,3,4,6,7,8-H_pCDD/F and OCDD/F is in good agreement with the pattern of the fingerprint compounds for Na-PCP(as shown in Figure 1).

Elevated levels of these fingerprint compounds are observed in human blood and milk samples from the schistosomiasis areas. This fingerprint is not evident in the control samples. Results in Table 1 also demonstrate that PCDD/F levels and TEQ values in humans from schistosomiasis areas are several times higher than those of control regions.

The above observations suggested a relationship between the large amount of Na-PCP sprayed and elevated PCDD/F levels in sediments and human bodies in the schistosomiasis area. Therefore, we conclude that the use of Na-PCP may cause elevated PCDD/F levels in both sediment and human blood and milk. Comparing with other more industrialized countries, China has characteristic low background levels of dioxins and furans[2]. The levels of PCDD/Fs in the contaminated sediments are well below the guideline value 1ppb of TEQ in soil[7]. Further study is needed to investigate the possible relationship between the use of Na-PCP and eco-environmental and human health effect.

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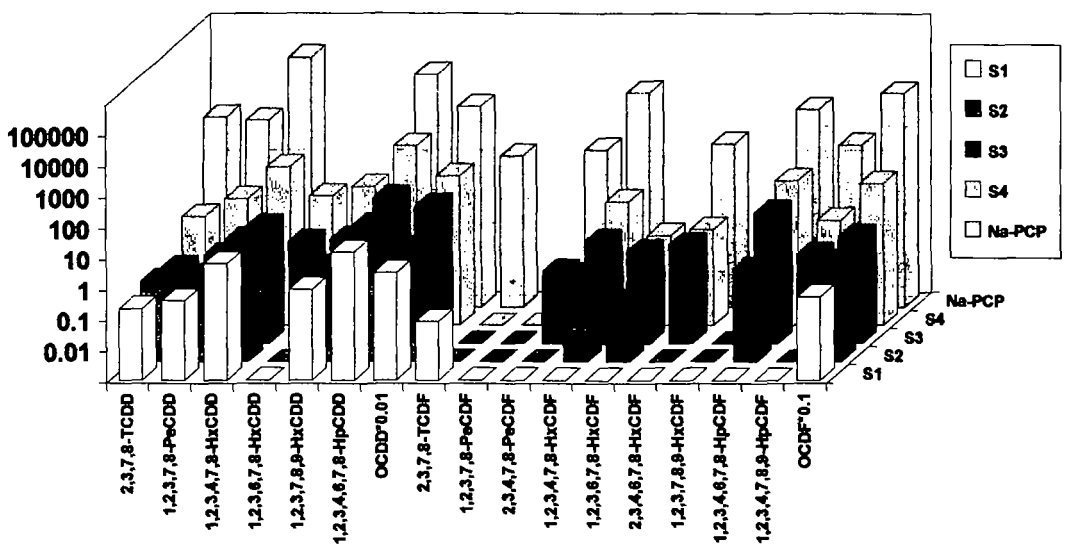

Figure 1 Comparison of PCDD/F congener pattern between Na-PCP and sediment samples from Chinese schistosomiasis areas

Table 1, Levels of PCDD/Fs Congeners in Chinese Na-PCP, Sediment Samples and Human Blood and Breast Milk from Chinese Schistosomiasis Areas and Control Regions

	Na-PCP	Sediment Samples(ppt),pg/g					Human Blood(ppt,lipid)		Breast Milk(ppt,lipid)	
Compound	(ppb),ng/g	S1	S2	S3	S4	Control	Schistosomiasis Areas	Control	Schistosomiasis Areas	Control
2,3,7,8-TCDD	14.1	2.2	4.5	3.1	35.7	ND(0.4)	4.6	ND(1.2)	1.4	0.64
1,2,3,7,8-PeCDD	11	3.9	6.5	7.8	125	ND(0.4)	9.5	3.1	3.4	0.7
1,2,3,4,7,8-HxCDD	1245	63	97.1	64.2	1366	ND(0.8)	27.8	3.8	11.1	0.74
1,2,3,6,7,8-HxCDD	ND	ND(2)	ND(2)	21.4	157	ND(0.8)	8.9	4.9	2.2	1.5
1,2,3,7,8,9-HxCDD	ND	9.1	12.7	26.8	309	ND(0.8)	2.3	2.6	0.79	0.66
1,2,3,4,6,7,8-HpCDD	349	153	284	551	6571	5.7	15.7	17.6	7.1	3.3
OCDD	3094	3210	4997	30457	69200	158	748	117	103	26.8
2,3,7,8-TCDF	0.8	0.81	NDR(1.4)	ND(0.4)	NDR(6.9)	2.3	1.4	2.7	0.47	2
1,2,3,7,8-PeCDF	ND	ND(0.4)	ND(0.4)	ND(0.4)	ND(0.8)	1.7	ND(1.0)	ND(1.0)	0.23	0.37
2,3,4,7,8-PeCDF	1.3	ND(0.4)	ND(0.4)	2.4	ND(0.8)	1.1	1.9	2.7	0.88	1.6
1,2,3,4,7,8-HxCDF	90.3	ND(0.4)	7.1	22.2	108	NDR(1.3)	4.9	4.7	1.5	1
1,2,3,6,7,8-HxCDF	ND	ND(0.4)	1	10.4	9	NDR(0.8)	2.1	3	0.52	0.77
2,3,4,6,7,8-HxCDF	2	ND(0.4)	ND(3)	17.8	13.7	ND(0.8)	2	2.7	0.28	0.33
1,2,3,7,8,9-HxCDF	ND	ND(0.4)	ND(3)	ND(3)	ND(5)	ND(0.8)	ND(1.1)	ND(1.0)	ND	ND
1,2,3,4,6,7,8-HpCDF	25.3	ND(3)	11.3	190	516	2.4	4.1	7.7	0.55	0.71
1,2,3,4,7,8,9-HpCDF	1.8	ND(3)	ND(3)	8.1	27.2	ND(0.8)	ND(2.4)	<2.3	0.04	0.61
OCDF	868	54.2	195	337	4195	7.6	7.5	<5.0	0.37	0.33
Total PCDDs	5062	3753	5968	32799	87629	200	816.8	148.9	128.9	34.34
Total PCDFs	1246	71.4	272	861	6529	44.8	14.6	27.2	4.8	7.17
Total PCDD/Fs	6308	3824.4	6240	33660	94158	244.8	831.4	176.1	133.8	41.51
Total TEQ	161.77	16.24	27.67	62.77	439.01	1.11	16.5	5.7	5.41	2.6

* Value in bracket represent detection limit.

** Human Blood and milk samples were analyzed for pooled values. We chose 50 persons as a group with 4ml blood or milk per person.