NEW DATA ON PCDDs and PCDFs LEVELS IN SOUTH VIETNAMESE ADIPOSE TISSUES

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Introduction

Considerable amounts of herbicides have been sprayed between 1961 and 1971 over Southern Vietnam during the second Vietnamese War. One one these was Agent Orange, a 1:1 mixture of n-butylic esters of 2,4,5-T and 2,4-D, which was reported to be heavily contaminated by 2,3,7,8-TCDD (1-2). Therefore, millions of vietnamese persons may have been exposed to elevated amounts of 2,3,7,8-TCDD. Due to the extreme stability and lipophilic character of 2,3,7,8-TCDD, elevated fat tissues levels could still be found in people from Southern Vietnam (3).

In this paper, we report PCDDs and PCDFs isomer specific analyses performed on a set of 27 fat tissue samples from Southern Vietnamese.

This work was a part of studies bearing on health consequences of Agent Orange spraying, undergone from January 1989 in Vietnam (1)

Sampling

27 adipose tissue samples were taken from male Southern Vietnamese patients undergoing abdominal surgery while anaesthesized. All patients were born before January 1st, 1953. Five to ten gram samples were collected in sterilized polypropylene vials and kept frozen at -20°C until analyzed.

Analytical

Samples were defrosted, weighted and spiked with a mixture containing ten $^{13}C_{12}$ labelled PCDDs and PCDFs isomers. Labelled compounds were purchased from Cambridge Isotope Laboratories. Adipose tissues were torn or cut up into small pieces with a scalpel blade, extracted with a mixture of acetone and hexane, then transferred in an extraction ampoule containing distilled water. Solvent extraction was continued. The water phase was discarded and the organic fraction was dried, then dissolved in hexane. The deproteinization was carried out under concentrated sulfuric acid. The hexane extract was washed, dried on sodium sulfate and cleaned up on neutral alumina (BIORAD AG7).

All phases underwent preliminary extraction with organic solvents, were dried and conditioned at 220°C. Solvents were pesticide grade, glass distilled solvents from Burdick and Jackson.

GC/MS was performed on a VG 70-250 SQ system. The column used was a 50m long, 0.25mm i.d. DB5 column (J&W). 2µl of extract were injected in the splitless mode. The column outlet was directly introduced in the MS source. The mass spectrometer was equipped with a Electron Impact ion source. Acceleration voltage was 70eV. The mass resolution was set at 10 000. Chromatographic windows, chromatographic resolution and mass spectrometry sensitivity were periodically checked. The observed absolute sensitivity was of the order of 10^{-14} g for 2,3,7,8-TCDD. 2,3,7,8 isomers were identified by the retention time of the peaks obtained from the analysis of the "dirty dozen" mixture.

Table 1. Isomer specific analysis of adipose tissue from Southern Vietnam (n= 27, fat basis)

Isomers	N° of positive	Range (pg/g)	Mean (pg/g)	sd (pg/g)
2,3,7,8 -T_4CDF	20	0,8 - 3,9	1,9	1,0
other T_4CDFs	10	2,4 - 29,9	9,9	8,9
2,3,7,8-T_4CDD	24	1,5 - 129	16,2	26,7
other T_4CDDs	2	4,2 - 13,2	8,7	6,4
1,2,3,7,8 P_5CF	10	1,0 - 16,8	4,1	4,6
2,3,4,7,8 P_5CDF	21	6,5 - 67,8	25,0	16,7
other P_5CDFs	14	3,4 - 67,6	29,3	22,2
1,2,3,7,8-P_5CDD	4	9,7 - 34,6	17,5	11,5
other P_5CDDs	0			
1,2,3,4,7,8-H_6CDF	22	1,4 - 121	26,2	27,2
1,2,3,6,7,8-H_6CDF	22	4,0 - 121	26,2	27,1
1,2,3,7,8,9-H_6CDF	14	2,0 - 38,9	8,9	9,6
2,3,4,6,7,8-H_6CDF	2	8,6 - 9,8	9,2	0,9
other H_6CDFs	16	4,3 - 73,1	26,7	20,5
1,2,3,4,7,8-H_6CDD	16	4,5 - 23,5	11,7	6,0
1,2,3,6,7,8-H_6CDD	23	9,5 - 157	56,1	38,9
1,2,3,7,8,9-H_6CDD	22	2,4 - 48,5	12,7	10,4
other H_6CDDs	0			
1,2,3,4,6,7,8-H_7CDF	17	9,5 - 238	47,3	59,4
1,2,3,4,7,8,9-H_7CDF	1		40,4	
other H_7CDFs	26	14,2 - 1528	391	376
1,2,3,4,6,7,8-H_7CDD	23	8,4 - 303	95,5	82,3
other H_7CDD	19	4,0 - 229	63,1	54,6
O_8CDF	0			
O_8CDD	25	35,2 - 2113	569	489

Results

Bulk results are presented in Table 1. On average, our results are in rather good agreement with those previously reported (4). Specially, 2,3,7,8-TCDD has been detected in all but 3 subjects. 2,3,7,8 TCDD was the only tetra isomer detected in all samples studied. The 16.2 pg/g average value obtained for 2,3,7,8-TCDD is abnormally high compared to the values observed in adipose tissue samples from industrialized countries. This seems to confirm the hypothesis that Agent Orange spraying has brought up 2,3,7,8-TCDD in the Southern Vietnam ecosystem.

Relatively high levels of hexachlorodibenzofurans have also been noted, and were also reported by others (4,5). These authors attributed this high H_6CDF content to the use of pentachlorophenols in agriculture. Our opinion is that it could be more likely originating, like 2,3,7,8-TCDD, from the synthesis of 2,4,5-T (2). Indeed, it has been demonstrated (6) that photolysis of chloro-2-phenoxyphenol, an impurity of pentachlorophenol, does not lead to H_6CDF formation but only to the formation of a single dichlorobenzofuran isomer. Furthermore, no high levels of H_6CDF isomers were found in mother milk samples from Thailand (4), although industrialization achievements in Thailand in the early '70s could be compared to that of Southern Vietnam.

It thus seems that further investigations would be necessary to confirm the origin of the abnormally H_6CDF high levels in Southern Vietnam adipose tissues to Agent Orange spraying.

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