

Concentrations of non-, mono- and di-*ortho*-chlorobiphenyls (PCBs) in sera from workers with past and present exposure

Luotamo, M.,^{a)} Patterson, D.G., Jr.,^{b)} Needham, L.L.^{b)} and Aitio, A.^{a)}

^{a)} Institute of Occupational Health, Laboratory of Biochemistry, Arinatie 3, SF-00370 Helsinki, Finland.

^{b)} Center for Environmental Health and Injury Control, Centers for Disease Control, Public Health Service, Department of Health and Human Services, Atlanta, Georgia 30333, USA.

INTRODUCTION

Finnish Institute of Occupational Health have done biological monitoring of serum PCBs since 1983 among workers with different occupational exposures. In the present study we analyzed the levels of non-*ortho*-CBs in sera from workers whose earlier results in routine biological monitoring (serum PCB isomers 8, 18, 28, 33, 44, 47, 66, 74 and 101) had indicated occupational exposure^{1,2}.

MATERIALS AND METHODS

PCB containing capacitors have been destroyed in hazardous waste disposal plant in Finland. Blood specimens for the determination of non-*ortho*-chlorinated PCB isomers (IUPAC 77, 81, 126 and 169) in serum were collected from workers in capacitor manufacture (past exposure until 1980's), capacitor paper manufacture (past exposure until 1980's), hazardous waste disposal (continuous exposure) and from controls.

The coplanar PCB's (non-*ortho*-PCBs) were analysed at CDC using a semiautomated sample clean up procedure and isotope-dilution HRGC/HRMS for quantification³.

RESULTS

The concentrations in serum in different exposures were previously reported using HRGC/HRMS⁴ and the results from pooled serum specimens are given in Table 1.

The results on non-*ortho*-chlorinated PCB isomers are given in Table 2. The mean values of 3,3',4,4'-tetraCB (77) were higher in both exposed groups compared to controls. 3,4,4',5-TetraCB (81) was not detected in controls but was found in 2 workers from capacitor manufacture and from 5 workers in hazardous waste disposal. 3,3',4,4',5,-PentaCB (126) and 3,3',4,4',5,5'-hexaCB (169) showed highest mean

values in past exposure (capacitor manufacture). The concentrations in capacitor paper manufacture were analyzed from one worker and were similar to the controls.

Table 1. Previously reported levels of PCBs in pooled serum samples² ($\mu\text{g/L}$).

	Control	Accidental exposure	Occupational exposure
L-PCB ($\mu\text{g/L}$)	0.49	4.32	34.5
TOT-PCB ($\mu\text{g/L}$)	3.41	26.8	73.7
mono-ortho($\mu\text{g/L}$) ¹	0.57	3.30	10.4
di-ortho($\mu\text{g/L}$) ²	2.29	7.50	18.4

¹)IUPAC codes 60, 66, 105, 118, 156, 189

²)IUPAC codes 128, 138, 153, 170+190, 180

Table 2. Non-ortho-chlorinated PCB isomers in sera from controls (a), from workers in capacitor manufacture (b) and from workers in hazardous waste disposal (c) (ppt, w/w) in 1992.

a) CONTROLS

PCB isomers	N/M	Mean	Median	Max
77	5/5	0.087	0.084	0.120
81	5/0	N.D. (< 0.008)	-	-
126	5/5	0.343	0.352	0.487
169	5/5	0.219	0.202	0.395

b) CAPACITOR MANUFACTURE (past exposure)

PCB isomers	N/M	Mean*	Median*	Max
77	4/4	0.325	0.340	0.487
81	4/2	0.169	0.110	0.450
126	4/4	1.604	1.300	3.030
169	4/4	0.545	0.552	0.649

c) HAZARDOUS WASTE DISPOSAL (continuous exposure)

PCB isomers	N/M	Mean*	Median*	Max
77	12/12	0.559	0.118	5.040
81	12/ 5	0.578	0.011	5.160
126	12/12	0.373	0.201	1.760
169	12/12	0.266	0.230	0.494

N = number of workers studied

M = number of positive results exceeding detection limit (D.L.)

* = results below D.L. have been denoted as 0.5 x D.L.

DISCUSSION

The mean concentrations of coplanar PCBs in control serum specimens are very similar to those in Georgia, USA⁴ : 3,3',4,4'-Tetra CB is 0,087 ppt in Finland and 0.251 ppt in USA, 3,3',4,4',5-pentaCB is 0.343 ppt and 0.135 ppt in USA and 3,3',4,4',5,5'-hexaCB is 0.219 ppt in Finland and 0.192 ppt in USA. The overall levels of occupational exposure in Finland are quite low. In capacitor manufacture (past exposure) the PCB concentrations were clearly higher compared to controls^{1,2}. The exposure was also seen in the concentrations of coplanar PCBs: 3,4,4',5-tetraCB (81) was found in 2 workers but not in any of the Finnish controls or from Georgian controls⁴. Levels of all the isomers (77, 81, 126 and 169) were higher compared to Finnish controls (Table 2). Highest was the concentration of 3,3',4,4',5-pentaCB for which the maximum concentration was 3.03 ppt. Exposure of workers in hazardous waste disposal can be observed in concentrations of all PCB isomers except in 3,3',4,4',5,5'-hexaCB (169). 3,4,4',5-TetraCB was found in five workers (max 5.16 ppt). The mean concentration of 3,4,4',5-TetraCB was 6.4 times higher compared to Finnish controls, 3,3',4,4',5-pentaCB did not differ in mean value, but the maximum concentration was 1.76 ppt. The elevated average levels in waste disposal were caused by disproportionately high values observed in some workers, while the majority was not different from the controls. This is most likely due to the fact that the workers came from different parts of the plant, such as waste reception, automated burning section and service functions, laboratory and inorganic waste section.

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