

## POSTNATAL EXPOSURE OF POLYCHLORINATED BIPHENYLS (PCBs) FROM BREAST MILK BY THREE SWEDISH INFANTS, TWO RESPECTIVELY THREE MONTHS POST PARTUM

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### ABSTRACT

We have monitored the isomer specific exposure of PCBs via breast milk for three infants at two different time points, 2 months and 3 months post partum. The exposure of 54 PCBs, including PCB #77, #126 and #169, was estimated based on determination of PCB levels in the mother's milk and the infant's daily intake of milk. The chemical analyses were done at a MDL of 0.1-1 ppt by HRGC-HRMS, which also facilitated determination of dioxin levels. The absolute amounts of PCBs and dioxins in the mothers' milk were considerably lower at 3 months post partum. The levels of the congeners likely to accumulate in the body, i.e. #s118, 138, 153 and 180 were lower after three months of breast feeding compared to the levels one month earlier. A decrease of the readily metabolised and excreted congeners, i.e. generally lower chlorinated PCBs, #s18, 52 and 101, was not seen. The daily intake of PCBs and dioxins, expressed in TEQs, by the three Swedish infants dropped between the age of two months and three months. This resulted partly from an up to 15% decrease in the total TEQ levels in the milk of the mothers, i.e. from 39 to 34, 19 to 16 and 27 to 23 pg TEQs per gram milk.

### KEYWORDS

PCB, dioxins, intake, exposure, human milk, breast milk, lactation, infant

### INTRODUCTION

The objective of this study is to monitor levels of PCBs isomer specifically in human milk in order to determine the intake of PCBs from mothers milk during lactation. A decrease in levels can be expected since the mother transfers PCBs, and other lipophilic persistent compounds originating in her body burden, to the baby during lactation. Lactational exposure to PCBs and dioxins and other persistent organochlorine compounds put nursing infants in the high-risk group for adverse effects resulting from the mothers' relatively high body burden of these compounds<sup>1</sup>. European field studies and studies conducted by the World Health Organisation Regional Office for Europe (WHO/EUROPE), on levels of PCBs, PCDDs and PCDFs in breast milk from different industrialised countries, show similar background levels and thus similar exposures<sup>2</sup>. The tolerable intake, 10 pg TCDD or TEQ per kilo body weight and day (WHO), is still exceeded in all Western countries despite recent reports on decreasing levels of organochlorines in the environment. There have also been reports on populations

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with higher than background exposure, i.e. Inuit women with high fish consumption transfer ten times more PCBs to their babies than women in Southern parts of Canada<sup>3</sup>.

Table 1. The absolute intake from mothers milk of 51 PCB congeners by three babies, A, B and C, at the age of 2 and 3 months. The intake is expressed in ng/day (24 hours).

PCB#	Intake A2	Intake A3	Intake B2	Intake B3	Intake C2	Intake C3
16	1.4	1.6	0.6	0.4	1.3	1.2
17	0.7	0.7	0.1	0.3	0.4	0.5
18	2.8	3.4	1.2	1.2	1.6	1.6
22	10	1.6	0.1	nd	0.5	0.7
28	720	261	95	52	149	79
33	30	7.0	1.4	0.5	5.0	4.5
44	11	14	3.0	4.2	3.9	1.9
47	15	7.0	4.5	3.0	3.3	1.6
49	11	15	3.1	3.2	3.4	1.5
52	33	42	12	14	11	4
60	100	39	8.0	5.5	16	6.5
66	295	117	42	25	68	33
70	na	63	8.5	12	34	20
71	4.9	4.9	1.1	2.5	2.4	0.3
74	1050	327	124	72	341	170
83	8.0	10	2.6	1.3	1.4	1.0
89	10	8.5	5.5	4.6	4.0	1.2
99	285	122	228	139	135	64
101	59	70	28	28	18	4.4
105	134	56	102	56	64	29
110	51	69	24	26	9	1.4
114	26	5.5	19	9.0	14	7.5
118	620	265	491	303	301	150
121	38	40	16	17	7.5	0.3
123	13	4.5	7.0	4.3	5.0	1.9
128	150	65	127	81	77	44
130	36	17	37	26	27	15
131	44	16	34	19	22	14
137	24	21	40	20	28	16
138	2610	965	2145	1290	1190	665
144	21	11	15	7.5	5.7	1.8
146	310	122	209	126	153	510
149	31	33	20	16	10	1.8
153	4180	1500	3435	2015	1890	1030
156	387	137	283	184	193	103
157	61	17	47	28	32	17
159	15	3.9	13	8.0	6.0	3.5
170	880	324	710	440	450	242
171	138	49	115	57	66	36
172	108	36	77	47	51	28
177	129	46	93	57	72	39
180	2305	790	1810	1090	1135	615
183	197	72	206	129	101	54
189	43	12	34	20	21	12
193	41	na	33	53	21	12
194	170	58	137	19	63	34
195	56	12	53	69	19	11
196	222	77	185	69	84	48
200	5.5	na	5.0	1.4	1.6	0.9
201	200	65	129	46	71	39
202	84	20	52	19	30	17

Levels of PCBs and related compounds in the milk of mothers have been found to decrease with the number of births and time of lactation. The exposure to these compounds is therefore highest for the neonate and decreases with increasing age of the baby.

## EXPERIMENTAL

Three mother-baby pairs (A, B and C) were selected for the study. The excretion of PCBs and dioxins in the milk and the daily uptake by the baby at two (2) respectively three (3) months of age were studied. The milk was collected at the two age points during a 48-hour period, and the baby's intake was determined by weighing it before and after each feeding. The analyses of the milk samples (A2, A3, B2, B3 and C2, C3) were done by HRGC-HRMS at a method detection level of 0.1-1 ppt for the PCBs and the dioxins. Analyses of dioxins<sup>4</sup> and co-planar PCBs were performed using a PX-21 carbon column and the isomer specific PCB analyses were done utilising a basic alumina open column after sulphuric acid treatment of the unretained PX-21 fraction containing the non-planar PCBs<sup>5</sup>.

## RESULTS

The absolute intake (in ng) by the babies of 51 PCBs are reported in Tables 1. The intake of the persistent isomers, #153 and #138 as well as #170 and #180 reach  $\mu\text{g}$  amounts. A significant decrease in the intakes of the persistent congeners can be seen in contrast to the readily metabolised and eliminated ones, such as # 16, #17, #18, #44, #49, #52, #101, #110 and #121.

The levels of Toxic Equivalents (TEQs) in the milk, given in pg/gram milk fat, are listed in Table 2. Included are the TEQs for the co-planar PCBs, the TEQs derived from the PCBs, #105, #114, #118, #123, #156, #157, #167, #170, #180 and #189, suggested by WHO/IPCS<sup>6</sup> and the PCDDs and PCDFs (I-TEF). On a total TEQ bases it is estimated that there is a 12-17% decrease in the PCB and dioxin content of the milk fat between two months and three months post partum. The fact that the fat content of the milk at two months is lower than at three months for all the mothers studied here results in a very high drop in the absolute PCB intake for the babies.

To calculate the PCB levels (ppb) in the milk fat we divided the absolute PCB intake in Table 1 with the amount of fat in the milk consumed. Table 2 reports amounts of milk and it's fat percentage consumed by the babies during the 24-hour period.

## CONCLUSIONS

Isomer specific profiles of PCBs in breast milk reveal a typical pattern. This pattern is most pronounced for the congeners with long half lives being present at relatively high levels. Fast excreted congeners are present at lower levels and are more reflecting of the mothers daily exposure to PCBs.

There is a decrease in levels of bioaccumulating PCBs and dioxins in the milk fat of at least 12% per month resulting from the lactational excretion of these compounds from the body burden of the mother.

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Table 2. Toxic Equivalents, TEQs, in ppt of co-planar PCBs, mono-ortho and di-ortho PCBs and dioxins in human milk fat from three mothers A, B and C, two (2) and three (3) months post partum. The total daily intake of TEQs in pg is shown on the last row.

PCB#	Milk A2	Milk A3	Milk B2	Milk B3	Milk C2	Milk C3
77	3.9	3.5	0.9	0.9	3.4	4.8
126	67	58	30	25	36	43
169	60	55	29	27	38	16
TEQ (ppt)	7.3	6.3	3.3	2.8	7.4	3.8
105	0.58	0.65	0.27	0.21	0.3	0.3
114	0.6	0.3	0.2	0.2	0.3	0.4
118	2.7	3.1	1.3	1.1	1.5	1.5
123	0.054	0.052	0.018	0.016	0.025	0.02
156	8.5	7.9	3.7	3.4	4.9	5.3
157	1.3	1	0.6	0.5	0.8	0.8
167	na	na	na	na	na	na
170	3.9	3.7	1.9	1.6	2.3	2.5
180	1	0.9	0.5	0.4	0.6	0.6
189	0.2	0.1	0.1	0.1	0.1	0.1
TEQ (ppt)	18.8	17.7	8.6	7.5	10.9	11.5
<i>PCDD/F</i>						
TEQ (ppt)	12.4	9.8	7.2	5.4	8.5 <sup>1</sup>	8
Total TEQ	38.6	33.8	19.1	15.7	26.8	23.3

<i>Daily intake of milk (g)</i>	815	760	887	928	840	885
<i>% milk fat</i>	2.8	1.1	4.3	2.9	2.4	1.1

<i>Daily intake of TEQ (pg)</i>	881	283	729	423	541	227
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<sup>1</sup> TEQ calculated using milk sample from 1 month post partum

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