

## Comparison of the Residue Levels of Some Organochlorine Compounds in Breast Milk of the General and Indigenous Canadian Populations

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Numerous studies have shown polychlorinated biphenyls (PCB) and other organochlorine residues to be present in mothers' milk of the general Canadian population (Ritcey et al. 1972; Mes and Davies 1979; Mes et al. 1987), but there has been little work done with respect to Canada's native population. A small survey was therefore undertaken to determine organochlorine residues in breastmilk of Canadian Indian and Inuit mothers as a follow-up to the recent national survey of the general population (Mes et al. 1987).

Analyses were conducted for 14 individual isomers of PCBs, photo-mirex, four hexachlorocyclohexane isomers, heptachlor epoxide, dieldrin, oxychlordane,  $\alpha$ - and  $\gamma$ -chlordane, trans-nonachlor, four analogs of DDT and five isomers of chlorobenzenes. The results were compared to those of the national survey.

### MATERIAL AND METHODS

The milk was manually expressed and pooled over a 24-hr collection period. It was then frozen by Zone Nursing Officers of the Medical Services Branch, Health and Welfare Canada and shipped to this facility. Sample size varied from 5 to 95 g. A total of 18 samples was received from the 5 Nursing Zones participating in the survey (Atlantic, Northern, Moose Factory, Baffin, Keewatin). Samples were stored frozen and only thawed shortly before analysis.

All glassware including that used for sample collection was washed, heat treated, solvent rinsed and air dried (Mes et al. 1987). Solvents used were distilled in glass and free of interference as determined by gas chromatography at a concentration of 250 mL to 1 mL. Sodium sulphate, glasswool and adsorbents were cleaned as previously reported (Mes et al. 1987). Standards used for the gas chromatographic determinations were obtained from Ultra Scientific Co., the United States

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Environmental Protection Agency, Wellington Consultants (Guelph, Ontario) and personal benefactors (Mes et al. 1986).

Each milk sample was centrifuged at 600 x g for 20 min in 50-mL glass-stoppered centrifuge tubes. The aqueous layer was carefully removed and discarded by using a Pasteur pipet and water aspirator. The creamy fat layer was extracted with acetone:benzene (19:1 v/v). After filtering the precipitates by using glass wool, the solvents were evaporated; the residue was dissolved in hexane. The hexane was dried with sodium sulphate. The volume was adjusted to 15 mL with hexane. Lipid content was determined gravimetrically by using 0.5 mL of the total sample. Aliquots for column chromatography did not exceed a total lipid load of 300 mg per column. Three fractions were eluted from the semi-micro florisil-silicic acid column as reported earlier (Mes et al. 1986).

The first fraction, (2% dichloromethane in hexane) eluted compounds such as the PCB isomers, chlorobenzenes, photo-mirex, and most of the DDT metabolites. This fraction was analysed by using a Varian 3700 gas chromatograph fitted with a J&W DB-5 capillary column (30 m x 0.24 mm ID, 0.25  $\mu$ film) and a  $^{63}\text{Ni}$  detector. The column was temperature programmed to run at 130°C for 7 minutes and then increase at 6°C per min to 230°C for the duration of the run. Inlet and detector temperatures were 240° and 301°C, respectively.

The second fraction (20% dichloromethane in hexane) eluted  $\alpha$ -,  $\gamma$ - and partial  $\beta$ -hexachlorocyclohexane (HCH), the rest of the DDT metabolites, chlordanes (CD) and trans-nonachlor (t-NCH). These compounds were analysed on the same instrument as above but by using an isothermal column temperature of 192°C.

The third fraction (60% dichloromethane in hexane) eluted the remaining  $\beta$ -hexachlorocyclohexane, heptachlor epoxide and dieldrin. This fraction was analysed on a similar Varian 3700 GC with a  $^{63}\text{Ni}$  detector, but with a packed column at 218°C (0.6 x 183.0 cm). The packing material was 6% OV-210 and 4% SE-30 on 60/100 mesh Chromosorb W (AW). Inlet and detector temperatures were 232° and 302°C, respectively.

The samples yielded chromatograms similar to those obtained in the national survey (Mes et al. 1987; Mes et al. 1986), and no GC/MS confirmation was considered necessary.

## RESULTS AND DISCUSSION

It has been a general assumption that the dietary intake of fish by the Canadian Indian and Inuit populations would be higher per capita than the general Canadian population. However, the results of our questionnaires accompanying the sample kits seem to indicate that there is little or no difference in fish consumption between the native and general populations, at least for the limited number of participants (18) in this study. Seventy-eight

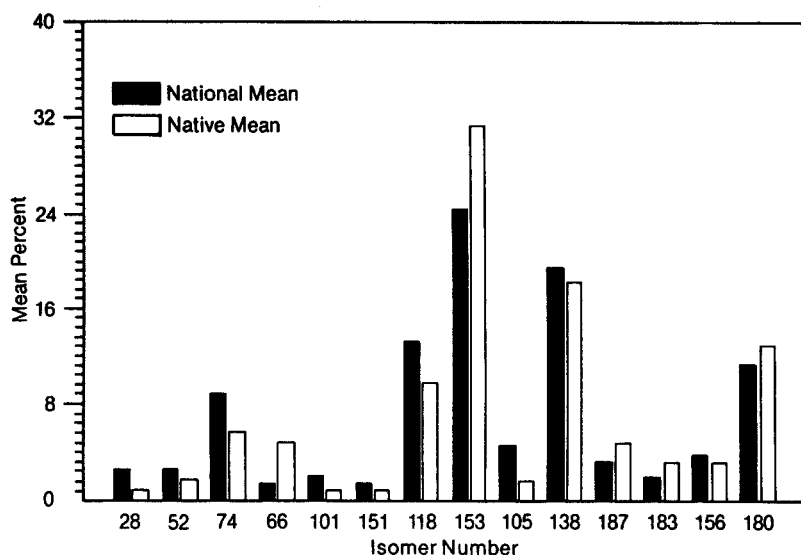


Figure 1. PCB isomers as a percentage of the total.

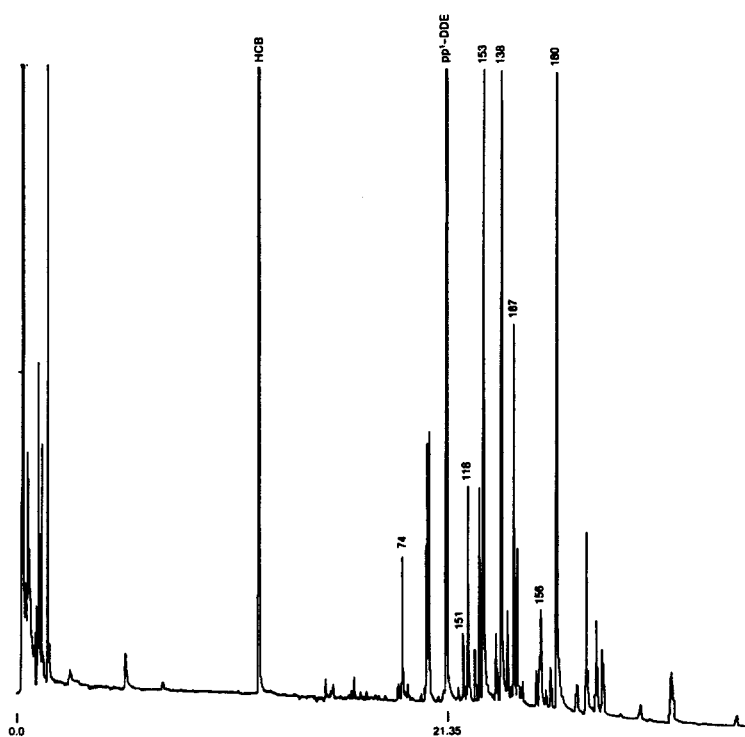


Figure 2. Typical 1st-fraction chromatogram showing PCB isomers.



Figure 3. Typical 2nd-fraction chromatogram showing some of the organochlorine residues.

percent of the native women reported eating one meal of fish or less per week while 88% of the women from the general population eat 0.5 pounds or less per week. This similarity, along with the geographical habitat, away from the highly agricultural and industrialized areas of the south, would tend to suggest that levels of pesticides and environmental chemicals in the breast milk samples of this study might be lower than those found in the general population. From Table 1, however, it is apparent that on a whole milk basis the organochlorine residues in both indigenous and general populations are similar with a few exceptions such as 1,3- and 1,4-dichlorobenzene,  $\beta$ HCH and pp'-DDE, whose levels are higher in the general population. A similar observation can be made for residue levels based on milk fat only.

Table 1. Organochlorine Residues in Breast Milk (ng/g)<sup>a</sup>

Analyte	Wholemilk		Milkfat		Freq. of Residue (Percent)	
	A <sup>b</sup>	B <sup>c</sup>	A	B	A	B
1,2-Dichlorobenzene	8.1	2.9	427	80	50	69
1,3 & 1,4-Dichlorobenzene	-	6.1	-	160	0	86
1,2,3-Trichlorobenzene	0.1	0.3	5	8	89	97
1,2,4-Trichlorobenzene	1.2	0.6	64	16	89	100
1,3,5-Trichlorobenzene	0.4	-	21	-	94	0
Pentachlorobenzene	t <sup>d</sup>	0.1	2	3	17	97
Hexachlorobenzene	1.0	1.8	52	48	94	100
Photomirex	0.2	0.3	13	8	94	100
α-HCH	0.1	0.2	5	5	100	99
β-HCH	0.4	7.7	22	206	100	100
γ-HCH	0.1	0.2	7	5	44	68
Oxychlordane	0.7	1.3	35	35	100	100
γ-Chlordane	0.1	0.3	3	8	17	73
α-Chlordane	0.2	0.7	12	19	50	56
t-Nonachlor	0.7	0.7	36	19	100	99
p,p'-DDE	14.2	34.1	759	911	100	100
p,p'-TDE	0.3	0.7	18	19	72	64
o,p'-DDT	0.4	0.5	19	13	28	26
p,p'-DDT	1.1	3.0	61	80	94	96
Heptachlor epoxide	0.2	0.5	11	13	61	62
Dieldrin	0.4	0.5	21	13	89	95

<sup>a</sup> Mean using positives only<sup>b</sup> A Indigenous Population<sup>c</sup> B National Survey<sup>d</sup> t trace (less than 1 ppb)

Table 2 shows the individual levels of specific PCB isomers found in breast milk of indigenous as compared to the national mean (Mes et al. 1987). The combined total isomer level on a whole milk basis is 15.9 ng/g nationally and 12.4 ng/g for the native population. The contribution of each isomer to their respective total is quite similar especially for the five largest contributors (isomer no. 74, 118, 153, 138 and 180). The total of these five isomers was 78% for the native milk samples and 77% for the national survey. These similarities can be seen graphically in Figure 1. Typical profiles of breastmilk contamination for fractions 1 and 2 from column chromatography are shown in Figures 2 and 3, respectively.

Table 2. A Comparison of Levels (ng PCB Isomer/g) of Specific PCB Isomers

Isomer Bz# <sup>a</sup>	Wholemilk				Milkfat	
	A <sup>b</sup>	% total	B <sup>c</sup>	% total	A	B
28	0.1	0.8	0.4	2.5	6	11
52	0.2	1.6	0.4	2.5	9	11
74	0.7	5.6	1.4	8.8	29	37
66	0.6	4.8	0.2	1.3	19	5
101	0.1	0.8	0.3	1.9	6	8
151	0.1	0.8	0.2	1.3	4	5
118	1.2	9.7	2.1	13.2	48	56
153	3.9	31.5	3.9	24.5	179	103
105	0.2	1.6	0.7	4.4	10	19
138	2.3	18.3	3.1	19.5	97	82
187	0.6	4.8	0.5	3.1	27	13
183	0.4	3.2	0.3	1.9	14	8
156	0.4	3.2	0.6	3.8	16	16
180	1.6	12.9	1.8	11.3	66	48

<sup>a</sup> Ballschmiter and Zell numbering system (Ballschmiter and Zell 1980)

<sup>b</sup> A is Indigenous Population

<sup>c</sup> B is National Survey

It should be noted that the fat content (1.87%) in the breast milk of the indigenous people was approximately 50% of the national average. A more comprehensive study would be required to assess whether this reflects the true situation or whether it can be attributed to the limited number of samples in the present study or indeed to inadequate sampling of the milk itself.

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