

HUMAN EXPOSURE TO POLYCHLORINATED BIPHENYLS THROUGH THE AQUATIC FOOD CHAIN IN THE ARCTIC

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The contamination of the arctic aquatic food chain by polychlorinated biphenyls (PCBs) have been brought to light through the last decade¹. Once released into the environment at mid- and lower latitudes, PCBs reach the Arctic via long-range atmospheric transport, waterways and ocean currents². High lipophilicity and resistance to biodegradation allow for to their bioconcentration in fatty tissues of organisms. Biomagnification takes place, resulting in relatively high levels of PCBs being found in long-lived predator species located at the top of the food chain (polar bear, beluga)¹. Concentrations of PCBs in sea mammal blubber from the Canadian Arctic are generally between 1 and 5 µg/g (lipid basis)¹. In polar bear fat, PCB concentrations ranging from 3 to 8 µg/g (lipid basis) have been reported¹.

For cultural and economical reasons, the Inuit from Arctic Québec rely heavily on country foods for their subsistence. Based on data pertaining to harvested marine species collected in 1982 and 1988³, their daily consumption of ringed seal, bearded seal, muktuk (beluga skin) and walrus amounts to approximately 300 g per day. Knowing the contamination levels reported in the edible tissues of sea mammals and their estimated daily consumptions, one would anticipate a relatively high body burden of PCBs for native people living in Arctic Québec. Indeed, we reported in 1989 preliminary data which showed that the breast milk of Inuit women from the east coast of Hudson Bay contained an average PCB (Aroclor 1260) concentration of 3.6 µg/g (fat), an unusually high concentration compared

PCB

to the average value of 0.77 µg/g for a control group of Caucasian women living in southern Québec⁴.

In order to expand our database on the organochlorine body burden of natives from Arctic Québec, and to investigate its relationship with their dietary habits, we initiated in 1989 a one-year survey in the regions of Ungava and Hudson Bay. Between mid-July 1989 and mid-July 1990, 224 births occurred in Kuujjuaq and Povungnituk hospitals; among the 125 breast-feeding mothers, 107 provided a 60-ml breast milk sample within three days from delivery. These samples were sent frozen to the laboratory for organochlorine analysis. Ten PCB congeners (IUPAC No. 28, 52, 101, 118, 138, 153, 170, 180, 183, 187) were measured in milk fat extracts by high resolution gas chromatography using an electron capture detector, as described in Dewailly et al.⁵. In order to effect comparisons, we used the concentrations measured in 16 pools made of six 40-ml milk samples collected during a provincial survey⁵.

Tissue samples from polar bear (*Ursus maritimus*), ringed seal (*Phoca hispida*), beluga (*Delphinapterus leucas*) and arctic char (*Salvelinus alpinus*) were collected during the same period in Hudson Bay (HB) or Hudson Strait (HS). Blubber (marine mammals), fat (polar bear) or muscle (arctic char) samples were analyzed for the same ten PCB congeners as described previously⁶.

Total PCB concentration in the milk fat of Inuit women is similar to that found in beluga blubber (Table 1). Both are seven times greater than that found in the arctic char. In the adipose tissue of the polar bear, a predator located on top of the arctic food chain, total PCB concentration is seven times greater than that measured in Inuit milk fat.

The persistent PCB congeners 153, 170 and 180⁷ show biomagnification in this food web. The percentage of total PCB concentration in polar bear fat represented by congener 153 is three times greater than that in the lipid extract from arctic char muscle. In contrast, for PCB congeners 28, 52, 101, which display relatively short half-lives in rats⁷, a "bio-elimination" process is observed throughout the food web. The percentage of total PCB concentration in polar bear fat occupied by PCB 28 is at least 692 times smaller than that in arctic char. Globally, the PCB congener profile observed in Inuit women is similar to that found in the polar bear, a highly-ranked predator of this food web. Total PCB concentration in the milk fat of Inuit women was seven times greater than that measured in milk fat samples from southern Québec women.

The mean PCB concentration in the milk fat of Inuit women is greater than those recently reported for the general women populations of various countries⁸. Epidemiologic studies are presently underway to examine the putative effects of

this exposure on the development and the immune status of Inuit newborns in Arctic Québec.

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Table 1. PCB congener concentration in fat tissues (ng/g, lipid basis) of species from the Arctic Québec aquatic food web.

Species	N	PCB congeners (no. IUPAC)										Σ PCB*
		28	52	101	118	138	153	170	180	183	187	
Polar Bear	35	<1	<1	<1	52† ±6	882 ±155	3767 ±652	720 ±146	1656 ±333	88 ±18	43 ±9	7002 ±1276
Human (Arctic)	107	<1	7 ±1	7 ±1	59‡ ±20	233 ±37	400 ±67	46‡ ±12	194 ±38	19 ±3	55‡ ±13	1052 ±148
Beluga	16	26 ±10	115 ±58	139 ±71	98 ±48	184 ±92	226 ±113	27 ±12	70 ±31	41 ±18	78 ±34	1002 ±469
Seal	16	8 ±4	34 ±36	71 ±83	43 ±39	104 ±148	156 ±225	12 ±19	39 ±60	22 ±35	38 ±53	527 ±692
Arctic char	9	10 ±5	19 ±6	30 ±7	24 ±6	20 ±6	26 ±8	1 ±0.3	6 ±2	5 ±1	11 ±3	152 ±42
Human (South)	16§	13 ±2	<6.8	<2.6	17 ±4	39 ±10	37 ±12	10 ±2	20 ±5	3 ±1	7 ±2	157 ±37

* Sum of the ten PCB congeners

† Arithmetic mean and confidence limit interval - 95 %; when more than one sample contained a non detectable concentration, the arithmetic mean and the confidence interval were computed by log-probit regression*

‡ Only 35 milk samples analyzed

§ 16 pools of milk 6 samples each