PCBs, Toxaphenes, and other Chlorinated Pesticides in Human Milk from the Archangels district, Russia

Anuschka Polder[1], Siri Føreid[1], Jon Øyvind Odland[2], Anatoly Tkatchev[3] and Janneche Utne Skaare[1,4]

[1]Norwegian College of Veterinary Medicine, Department of Pharmacology, Microbiology and Food Hygiene, Division of Pharmacology and Toxicology, P.O. Box 8146 Dep., N- 0033 Oslo, Norway.
[2]Nordland Central Hospital, 8017 Bodø, Norway.
[3]Archangelsk Branch, Institute of Physiology, Ural Division, Russian Academy of Science, Archangelsk, Russia..
[4]National Veterinary Institute, P.O. Box 8156 Dep., N-0033 OSLO, Norway

Introduction

Studies of the organochlorine (OC) contamination in the Arctic environment [1] have shown the needs for monitoring of OCs in human populations in the Arctic areas. The geographical conditions of the northern areas require a comprehensive import of food from outside of the region. Consumption of beef, fish and dairy products can contribute to the accumulation of OCs in humans [2, 3, 4]. Also settlement in highly industrialised areas is found to increase levels of PCBs (polychlorinated biphenyls) in human milk [5]. Results of PCBs, CHBs (toxaphenes, chlorinated bornanes), HCB (hexachlorobenzene), HCHs (hexachlorocyclohexanes), chlordanes, and DDT with its metabolites, in human milk from four different areas in and nearby the Archangels district are presented. The specifics of the presented areas are: Kargopol (a small inland town), Severodvinsk (harbour), Archangels (paper mill industries), and Naryan Mar (coastal town, along Pechora river).

Materials and methods

Sampling and collection: In February 1996, 100 human milk samples were collected in the City Hospitals of Severovinsk and Archangelsk, and in August 1997, 40 human milk samples were collected in the City Hospitals of Kargopol and Naryan Mar. Questionnaires with details of the mothers health, parity, age, weight, occupation, and dietary habits were filled in., All the mothers were Caucasian, except the mothers from Naryan Mar, who belong to the indigenous group of Nenets. The determination of CHBs was performed on pooled samples from each of the regions studied. Both mothers with their first and second child were participating in this study.

***PCBs and OCs**: Sample extraction, clean-up, and GC analysis*:
Extraction with cyclohexane and acetone and clean-up with sulphuric acid were done according to a method described earlier [6, 7], slightly modified. The milk fat content was determined gravimetrically. PCBs 29, 112 and 207 were used as internal standards. Separation was performed on 60 m SPB-5 and SPB-1701 capillary columns (Supelco, Inc., Bellafonte, Pa). The GC analyses is described in detail elsewhere [8]. The laboratory was accredited on April 11, 1996, by the Norwegian Accreditation as a testing laboratory according to the requirements of NS.EN 45001 (1989) and ISO/EC Guide 25 (1990).

***CHBs**: Sample extraction, clean-up, and GC analysis*:
The extraction of the fat was done as described for PCBs and OCs. Separation of the CHBs from the PCBs was performed on a silica column according to a method of the Boer and Wester [9]. After the silica fractionation, the extracts were cleaned with sulphuric acid in order to improve the purity. PCB-112 was added to the 2nd silica fraction as the internal GC-standard. Three CHB congeners were determined: the nr. 26, 50 and 62. Both silica fractions were analysed on the GC-ECD with a temperature program according to Føreid [10]. The injector temperature was decreased to 230^0 C to minimise decomposition of the toxaphene components.

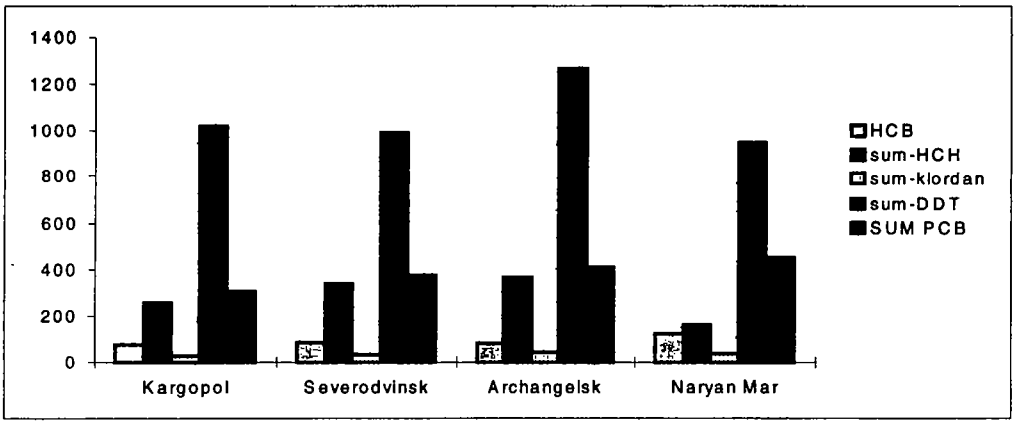

Figure 1. Levels (µg/kg fw) of HCB, sum-HCH, sum-Chlordanes, sum-DDT and sum-PCB in four areas in the northern Russia

Results and discussion
PCBs: The levels of PCB in the human milk in the selected areas were in general low and corresponded well with PCB levels presented in an earlier study from the Kola Peninsula [11]. and corresponding levels in Norway [8, 12]. The highest sum-PCB level was found in Naryan Mar with a higher contribution of the higher chlorinated PCBs to the sum, compared to the other areas. This was opposite to the finding in Monchegorsk in the previous study [11], where the lower chlorinated PCBs contributed relatively more to the sum-PCB. The transport of PCBs by air and water is described by many authors [1] and will influence the congener pattern as the PCB is transported through the food chain. Also the distance between the sampling areas and the industrial sources of PCBs will of course influence both the level and congener pattern of the PCBs in humans [4]. Many indigenous populations consume a higher amount of local foods as

fish, reindeer, moose and birds, compared to urbanised populations [2]. Dietary differences can explain the difference in congener pattern between the studied areas.

OCs:

The present mean levels of HCB were moderate, but 2 times higher than the corresponding levels in Norway [8]. The levels of β-HCH were 10 times higher than the corresponding levels in Norway, but 2 times lower than the corresponding levels in the Kola study [11]. β-HCH contributed with 98% to the sum-HCH. The ratios α/β-HCH, and γ/β-HCH were 3 times higher in Naryan Mar compared to the other areas. The sum-chlordanes were corresponding with levels found in Norway [8]. The levels of sum-DDT were of the same magnitude as found in the Kola study [11] but 3 times higher than corresponding levels in Norway [8]. Highest ratio of pp-DDT/pp-DDE was found in Naryan Mar (0.19).

CHBs:

The level of sum-CHBs was highest in Archangels with 13 µg/kg. The CHB 50 congener contributed with 50% to the sum CHB in all areas. The CHB levels in this study were more than 10 times lower than the corresponding levels in fish from the Baerents sea [13], and 2 times lower than corresponding levels found in human milk from Nicaragua collected in 1992 [14]. In Nicaragua toxaphene is still in use as a pesticide whereas the levels of CHBs, presented in this study, reflect the human exposure through long range transport. In human milk samples from inuit women from Canada, toxaphene residues were found to be more than 10 times higher than the results presented here [15]. This can be explained by the comprehensive usage of fish and marine mammals in the Inuit diet. Other earlier studies present the toxaphene levels as total CHBs, based on technical toxaphene standards instead of single congeners and are therefore not comparable with the presented results.

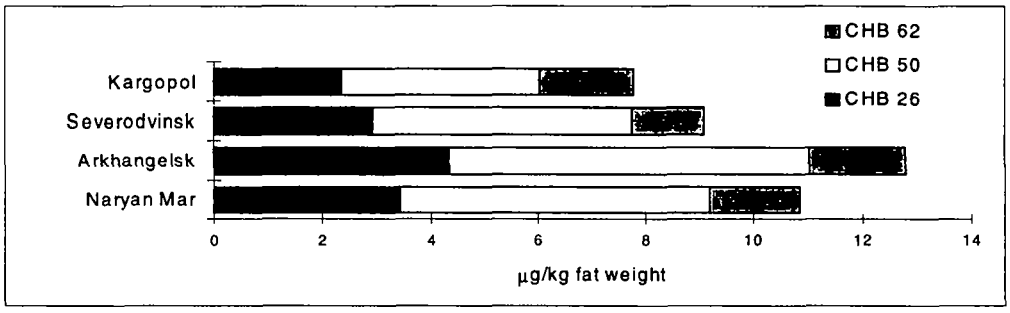

Figure 2. *Levels of CHB congeners: 26, 50 and 62 (µg/kg fw) in four areas in the northern Russia*

Acknowledgements

The authors thank the participating mothers, the Hospitals in Kargopol, Severodvinsk, Archangelsk, and Naryan Mar. Also, we would like to thank Elisabeth Lie and Signe Haugen for their assistanse with making this abstract.

References

[1] AMAP. 1997. The Arctic Monitoring and Assessment Programme; Arctic Pollution Issues; A State of the Arctic Environmental Report, Oslo, 1997.

[2] Dewailly, E., Ryan, J.J., Laliberte, C., Bruneau, S., Weber, J-Ph., Gingras, S., and Carrier, G. 1994. Exposure of remote maritime populations to coplanar PCBs. Environ. Health Perspect. 102, Suppl. 1:205-209.

[3] Nordic Risk Assessment of Toxaphene Exposure, Tema Nord 1997:540. (Nordic Council of Ministers, Copenhagen)

[4] Liem, A.K.D.,Theelen, R.M.C. *(Thesis)*, Dioxins: Chemical Analysis, Exposure and Risk Assessment, Utrecht Universitet, 1997, ISBN 90-393-2012-8.

[5] Koopman-Esseboom, C., Huisman, M., Weisglas-Kuperus, N., Boersma, E.R., de Ridder, M.A.J., Van der Paauw, C.G., Tuinstra, L.G.M.T., and Sauer, P.J.J. 1994. Dioxin and PCB levels in blood and human milk in relation to living areas in the Netherlands. Chemosphere 29:2327-2338.

[6] Brevik, E.M., 1978. Gas chromatographic method for the determination of organochlorine pesticides in human milk. Bull. Environ. Contam. Toxicol. 19:281-286.

[7] Skaare, J.U., Tuveng, J.M., and Sande, H.A. 1988. Organochlorine pesticides and polychlorinated biphenyls (PCBs) in maternal tissue, blood, milk and cord blood from mothers and their infants living in Norway. Arch. Environ. Contam. Toxicol. 17:55-63.

[8] Johansen, H.R., Becher, G., Polder, A., and Skaare, J.U. 1994. Congener-specific determination of polychlorinated biphenyls and organochlorine pesticides in human milk from Norwegian mothers living in Oslo. J. Toxicol. Environ. Health 25:1-19.

[9] de Boer, J.and Wester, P.G. 1993. Determination of toxaphene in human milk from Nicaragua and in fish and marine mammals from the Northeastern Atlantic and the North Sea. Chemosphere 27:1879-1890.

[10] Føreid, S, *(Cand. scient. thesis)*, 1997. Bestemmelse av toksafen i fisk og sjøpattedyr., Department of Chemistry, University of Oslo.

[11] Polder, A., Becher, G., Savinova, T.N. and Skaare, J.U. 1998. Dioxins, PCBs and some chlorinated pesticides in human milk from the Kola Peninsula, Russia. Special Chemosphere Issue: Dioxin'96,(in press).

[12] Becher, G. Skaare, J.U., Polder, A., Sletten, B. , Rossland, O.J., Hansen, H.K.,and Ptashekas, J., 1995. PCDDs, PCDFs and PCBs in human milk from different parts of Norway and Lithuania, J. Toxicol. Environ. Health 46:133-148.

[13] Karlsson, H., Oehme, M., Klungsøyr, J. 1997. 4,5-dichloro-chlordene, a new synthetic internal standard for the quantification of toxaphene and chlordane congeners in fish from the Barents Sea and North Atlantic. Application and Experience. Chemosphere 34:951-963.

[14] de Boer, J., de Geus, H-J. 1997. Multidimensional gas chromatographic analysis of toxaphene. Environ Sci. Technol. 31, 873-879.

[15] Stern G.A., Muir D.C.G., Ford C.A., Grift N.P., Dewailly E., Bidleman T.F., Walla M.D. 1992. Isolation and Identification of Two Major Recalcitrant Toxaphene Congeners in Aquatic Biota. Environ sci Techn 26: 1838-1840.