POLYBROMINATED DIPHENYL ETHERS (PBDEs) IN HUMAN BREAST MILK SAMPLES FROM MURMANSK AND ARKHANGELSK, RUSSIA.

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Introduction

Brominated flame retardants (BFRs) and in particular polybrominated diphenyl ethers (PBDEs) are used worldwide in combustible materials, such as plastics, electronic equipment, and textiles, to prevent fire[1]. Since the chemical structures are very similar to those of polychlorinated biphenyls (PCBs), these substances have been transported in similar ways to places far from the production sites and have contaminated different food chains, also in remote areas in the arctic[2,3]. There is still limited knowledge about the toxicity of PBDEs, but nevertheless there is a concern that flame retardants could cause adverse effects in sensitive human populations in the arctic, in fish consumers and in children[2]. Human milk studies in northern Russia showed high levels of organochlorine pesticides (OCPs) but moderate levels of PCBs[4]. The purpose of this study was to examine the level of PBDEs (BDEs) in human milk from northern Russia.

Materials and methods

Sampling and collection: 14 and 25 individual breast milk samples of primiparous mothers were collected within 5 days after delivery in hospitals from Murmansk and Arkhangelsk in the year 2002 and 2000 respectively. Questionnaires with relevant information about mother and child were obtained. The mean age of the mothers was 22.

Determination of BDEs: Determination of the BDEs was performed at the Norwegian School of Veterinary Science. The method used for extraction and clean-up are based on methods described earlier[5], slightly modified[4]. Internal standards were added prior to extraction (BDE-77 for Murmansk and BDE-77, 119 and 181 for Arkhangelsk samples). Details of the analytical method and GC-MS conditions are described elsewhere[3].In this study, concentrations of BDE congeners 47, 99 and 153 in breast milk from Murmansk and Arkhangelsk are presented.

Analitical quality: The laboratory is accredited by Norwegian Accreditation for testing BFRs in biological material according to the requirements of the NS-EN ISO/IEC 17025 (TEST 051). Participation in Quasimeme intercalibration tests on PBDEs in 2002 (Exercise 524, round 28, in human milk) showed good results.

Results and discussion

PBDEs: Relatively low levels of BDEs were detected in human milk from Murmansk and Arkhangelsk (Table 1). BDE-47 was the predominant congener in 13/14 and in 16/25 of the samples from Murmansk and Arkhangelsk and constituted from 37-70 % and 26-71 % of the total of sum BDEs (sum BDE-47, -99, 153), respectively. BDE-153 was predominant in 1/14 and 9/25 of the samples from Murmansk and Arkhangelsk with a contribution of 10-46 % and 24-65 % of the total of sum BDEs respectively. Concentrations of BDE-153 seemed higher in Arkhangelsk than in Murmansk, indicating possible different sources.

Table 1. Concentrations of BDE-47, -99, -153 and sum BDEs (μg/kg milk fat) in human milk from Murmansk and Arkhangelsk.

	Murmansk 2002 *n=14*			**Arkhangelsk 2000** *n=25*		
	mean (std)	*range*	*median*	*mean (std)*	*range*	*median*
Lipid %	2.67 (0.73)	1.40-4.11	2.78	3.42 (1.24)	1.53-7.19	3.17
BDE-47	0.56 (0.22)	0.27-0.94	0.56	0.51 (0.31)	0.23-1.54	0.39
BDE-99	0.17 (0.05)	0.09-0.26	0.17	0.17 (0.09)	0-0.45	0.14
BDE-153	0.23 (0.09)	0.12-0.44	0.20	0.43 (0.32)	0.18-1.63	0.33
Sum BDEs	0.96 (0.26)	0.52-1.35	1.01	1.05 (0.68)	0.51-3.62	0.81

The pattern of the BDEs in the Russian human milk was somewhat different compared to other studies of BDEs in human milk (Figure 1), but the similar trend for most of the studies compared with was that BDE-47 was the dominant congener. In Sweden, BDE-47 contributed 60-70 % to the total of sum BDEs. The sum BDE-47, -99, -153, reported in this human milk study from Sweden in 1997 was 3.22 μg/kg milk fat, thus 3 times higher than mean levels in this study[6]. In Canada, BDE-47 contributed 74 % to the total of sum BDEs. In the Canadian study levels of BDEs were 17 times higher than presented in this study[7]. In Finland a sum BDE-47, -99, -153 of 1.5 μg/kg milk fat was reported in human milk[8], while corresponding levels in Norway were 2.3 μg/kg milk fat[9]. On the Faroe Islands though, BDE-153 was the dominant congener, rather than BDE-47[10]. Interesting is also the difference in BDE pattern between the Russian cities and BDE patterns from Finland, Sweden and Norway, which may indicate possible different sources, or contamination to BDEs from different production origin. Temporal trend studies show that bans on production of certain BDE-mixtures, or replacements with other flame retardants can result in decreasing or increasing trends for the individual congeners within a relatively short time range[11]. Further monitoring will therefore be useful to determine changes of BDE levels and patterns in Russian human milk and in the Russian environment in general.

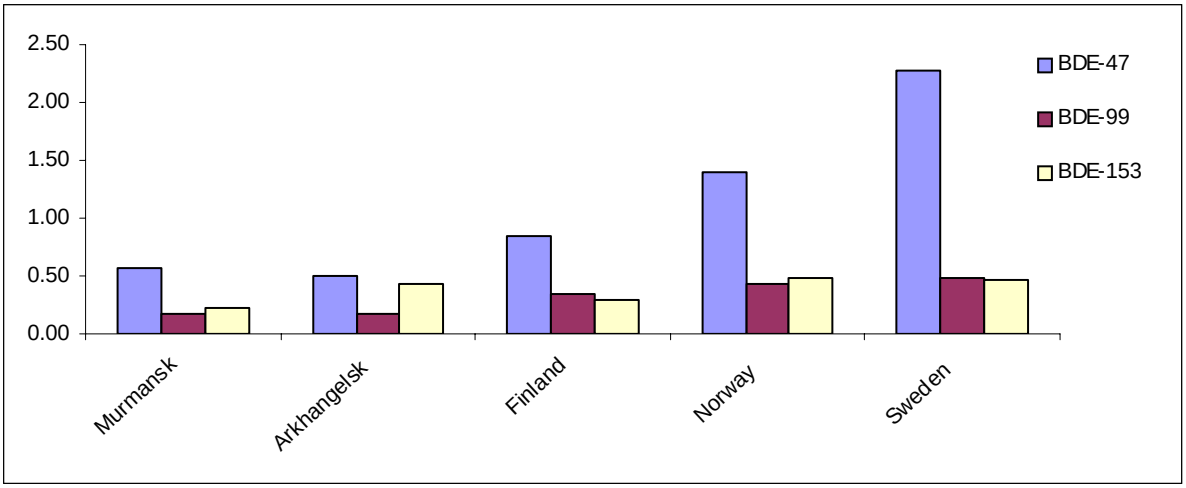

Figure 1. Mean concentrations of BDE-47, -99, -153 (μg/kg milk fat) in human milk from Murmansk, Arkhangelsk, Finland, Norway and Sweden.

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References

1. World Health Organization. 1997. Flame retardants: A general introduction. *Environmental Health Criteria 192*. Geneva: WHO.
2. de Wit CA. *Chemosphere* 2002;46:583-624.
3. Sørmo EG, Salmer MP, Jenssen MB, Hop H, Bæk K, Kovacs KM, Lydersen C, Falk-Petersen S, Gabrielsen GW, Lie E, Skaare JU. *Environ Toxicol Chem* 2006;25: *in press*.
4. Polder A, Odland JO, Tkachev A, Føreid S, Savinova TN, Skaare JU. *Sci. Total Environ.* 2003. 306: 179-195.
5. Brevik E.M.,. *Bull Environ Contam Toxicol.* 1978. 19:281-286.
6. Meironyté D, Norén K, Bergman A, *J Toxicol Environ Health* 1999. A. 58, 329-341.*Chemosphere* 2000, 40: 1111-1123.
7. Ryan JJ, Patry B, Mills P, Beaudoin NG. *Organohalogen Compounds* 2002. 58: 173-176.
8. Strandman T, Koistinen J, Vartianen T. *Organohalogen Compounds* 2000. 47: 61-64.
9. Thomsen C., Frøshaug M., Leknes H., Becher G. *Organohalogen Componds*. 2003. 64, 33.
10. Fängström B, Strid A, Athanassiadis I, Grandjean P, Weihe P, Bergman Å. *Organohalogen Compounds.* 2004. 66: 2829-2833.
11. Lind Y, Darnerud PO, Atuma S, Aune M, Becker W, Bjerselius R, Cnattingius S, Glynn A. *Environ Research*. 2002. 93: 186-194