LEVELS OF ORGANOHALOGEN COMPOUNDS IN HUMAN MILK FROM SEVERAL SETTLEMENTS OF THE IRKUTSK REGION, RUSSIA

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Introduction

Lake Baikal and the Irkutsk Region in eastern Siberia have been shown to be contaminated with PCDDs, PCDFs, and PCBs [1,2,3,4,5,6]. A survey of PCDD/F and PCB levels in soil from the region confirmed that the PCDD/F contamination has been distributed via the atmosphere from a source located in the area of the city of Usol'e-Sibirskoe[4]. Residents of this chemical industrial town were also found to have the highest tissue concentrations of both PCBs and PCDD/Fs in a survey of inhabitants of different towns in the Irkutsk Region [5,6].

The aim of the work presented here was to investigate the influence of dietary habits, the origin of the food consumed, and proximity of residence to Usol'e-Sibirskoe on levels of PCDD/Fs and PCBs in the population of the Irkutsk region. In addition, the levels of PBDEs were studied for the first time in this region.

Material and Methods

In 1998-2003 105 human milk samples were collected in seven pediatric hospitals serving nine towns and small settlements of the Irkutsk Region (see Fig. 1): Irkutsk (city of 588 000), Usol'e-Sibirskoe, Schelekhovo (town with cable (using PVC), aluminum and silicon plants), Ust'-Ilimsk (town on Angara River with pulp & paper mill), Kachug (remote village), Elantsy (remote village), Baikalsk (town on Lake Baikal with pulp & paper mill), Tankoy (village on Lake Baikal), and Ongureny (isolated fishing village on Lake Baikal). The sampling methods are described in[7].

Figure 1. Sampling sites

Three individual samples from Usol'e-Sibirskoe, 2 individual and a pooled sample from Irkutsk, 3 individual samples from Onguren and 2 individual samples from Ust'-Ilimskwere analysed at the ERGO laboratory in Hamburg for PCDD/Fs, dioxin-like (dl) PCBs, and PBDEs (17, 28, 47, 66, 85, 99, 100, 138, 153, 154, 183, 209), while all milk samples were analyzed at the laboratory of the Institute of Geochemistry in Irkutsk for 27 PCBs (IUPAC no. 52, 49, 44, 74, 70, 95/66, 101/90, 99, 97, 87/115, 110, 149/123, 118, 146, 153, 132/105, 138, 158, 187, 183, 180, and 190/170). Published methods were used by all laboratories [8,9]. The toxicity equivalents (TEQ) were calculated using the WHO TEFs from 1998.

Results and Discussion

The levels of PCDD/Fs, dioxin-like PCBs and other PCBs in human milk varied widely between the different towns and villages (Figure 2). The lowest mean PCDD/F and dioxin-like PCB TEQ levels were found in the town of Irkutsk and in the village of Kachug. The highest average levels of PCDD/F TEQ, dioxin-like PCB TEQ, and indicator PCBs were found in the village of Onguren (22 pg/g lipids, 182 pg/g lipids and 2300 ng/g lipids, respectively).

The average of the sum of the indicator PCBs were compared with the results of the 3rd round of the WHO-coordinated exposure study[10]. In accordance with the protocol used in the WHO study, only the primaparous women who donated samples up to 8 weeks after birth were included in this comparison. The average concentrations of PCDD/F and PCB TEQ in milk from Ust'-Ilimsk, Usol'e-Sibirskoe and especially from Onguren were considerably higher than found in the 3rd round of the WHO-coordinated exposure study[10]. Although the women in Onguren cohort were multiparous and had been nursing for a longer period (6 months on average) than the others in the study, they had PCB levels comparable to those found in the milk of women working at the PCB transformer plant in the Russian city of Serpukhov[11] and of inhabitants of the Faroe Islands who consume marine mammals, birds and fish[12]. Strong correlations between fish consumption and the concentrations of SPCB and the higher chlorinated PCB congeners in milk were found for the mothers from Onguren ($R > 0.9$, $p<0.05$). Lake Baikal seals, which have PCB levels comparable with Baltic Sea seals, are a traditional food source for the population on the shore of Lake Baikal. Weaker correlations between fish consumption and PCB levels were found for other villages.

Distinct differences were observed in the PCB congener pattern in the milk samples. Three different groups were identified. The first group included women from the industrial towns (Usol'e-Sibirskoe, Irkutsk, Ust'-Ilimsk and Schelekhovo), where the pattern was characterized by a dominance of PCB 138 and comparably high levels of the lower chlorinated congeners. The second group included women from Onguren, where PCB-153 was dominant and the levels of the higher (hexa- and hepta-) chlorinated congeners were comparably high. The third group included women from Baikal'sk, Tankhoy, Kachug, and Elantsy, where the pattern was intermediate between the first two groups. This change in pattern may be an indication of different sources of dietary exposure.

Differences in PCDD/F congener patterns were also found (Figure 3). The 2,3,4,7,8-PeCDF and 1,2,3,4,7,8-HxCDF levels were highest in milk from Usol'e-Sibirskoe. The highest 2,3,7,8-TCDD contribution in PCDD/F TEQ was found in milk from Ust'-Ilimsk where a pulp and paper mill is situated. The highest 1,2,3,7,8-PeCDD contribution to the PCDD/F TEQ was found in milk from Onguren where people consume Lake Baikal seal that have high 1,2,3,7,8-PeCDD levels, and in addition the PCDF congener levels in these milk sample were lower than in most other samples from the region. The WHO-PCB TEQs were more than two times higher than PCDD/F TEQ in all investigated milk samples. In Onguren the ratio increased to 8.

PBDE levels were found to be extremely low (0.1 to 0.2 ng/g lipids) relative to levels found in other regions, including the population of Faroe Islands [12,13].

Thus, the population of the Irkutsk region can be classified as uncontaminated with PBDEs and quite highly contaminated with PCDD/Fs and PCBs. The population of Onguren can be classified as extremely highly contaminated with PCDDs/Fs and PCBs.

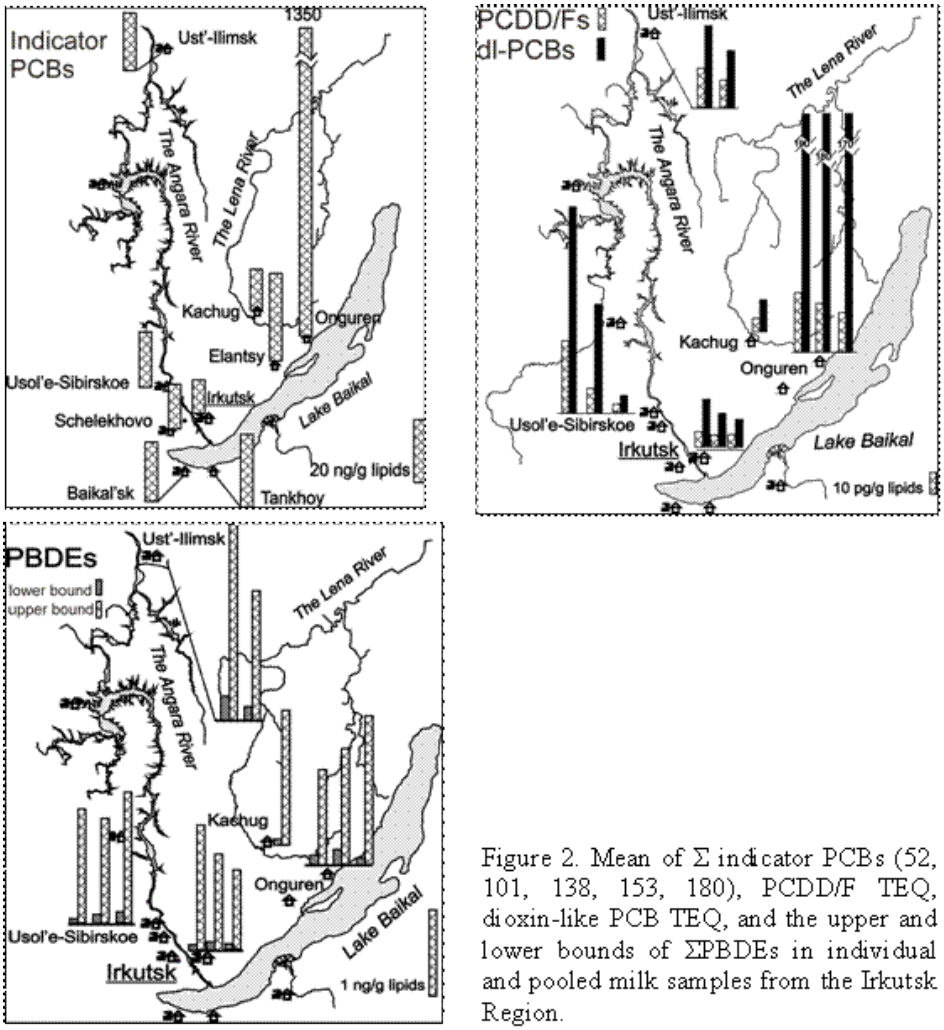

Figure 2. Mean of Σ indicator PCBs (52, 101, 138, 153, 180), PCDD/F TEQ, dioxin-like PCB TEQ, and the upper and lower bounds of ΣPBDEs in individual and pooled milk samples from the Irkutsk Region.

Acknowledgements

We thank the managers and stuff of the Health Departments and hospitals in Irkutsk and in the Irkutsk Region for their assistance in sampling. We thank the volunteers for their willingness to participate in the study and to donate samples. The investigation was supported by INTAS 2000-00140 and partly supported by RFFI 04-05-64870.

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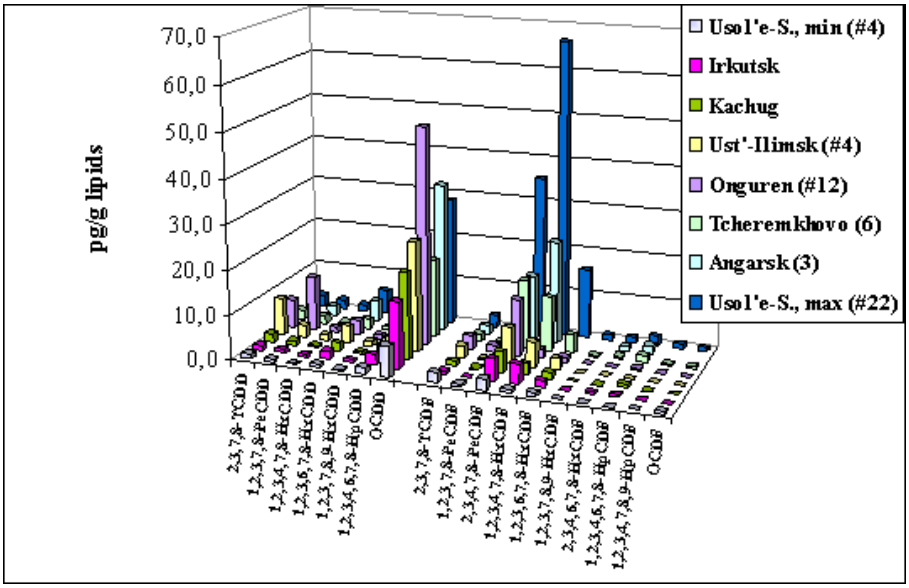

Figure 3. PCDD/F congener patterns in human milk from some towns and villages of the Irkutsk Region.