# Exposure of infants to polychlorinated biphenyls and organochlorine pesticides from mother's milk

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## Introduction

Organochlorine compounds are capable of bioaccumulating in individual food chain links and biomagnifying in the environment. Besides facilitating accumulation in the animal adipose tissue, the high fat solubility of these compounds makes them penetrate into human milk. Lactation is one of the means of excreting those compounds from the mother's organism.

Man becomes chronically exposed to organochlorine compounds mainly through food. Bioavailability of the compounds in breast-fed infants is higher than that in formula-fed infants (1, 2). It is therefore critical that one determines whether these compounds are hazardous to the health of infants and small children in the high risk category and identifies the safety margin between the current concentrations of the compounds in human milk and the limit beyond which health hazard is no longer acceptable.

## Material and Methods

The study material was human milk. Samples were collected in lactarium and maternity clinic in Warsaw and from donors in different regions of Poland. 462 human milk samples were analyzed using gas chromatograph with electron capture detector for the existence of HCB, HCH isomers, DDT and its metabolites and total PCBs (3). To assure the quality of results, the laboratory simultaneously used the same analytical method in the international proficiency testing organized by FAPAS (Food Analysis Performance Assessment Scheme) by the UK Ministry of Agriculture, Food, and Fisheries. In addition, the certified reference materials and own fortified samples were analyzed as part of a routine, internal analytical quality assurance procedure.

To assess the exposure of breast-fed children to the above mentioned compounds, data was gathered on the Acceptable Daily Intake (ADI) and FAO guidelines used to calculate the Theoretical Maximum Daily Intake (TMDI) and Estimated Daily Intake (EDI) for the tested

compounds. The calculation was based on FAO/WHO data (4) and, thus, assumed that an infant intakes on average 150 ml of milk /kg b.w. × $day^{-1}$ between month 0 and 2, and 120 ml of milk /kg b.w. × $day^{-1}$ from month 3 on. The TMDI estimates for the organochlorine pesticides examined were based on Polish regulations indicating the maximum pesticide residue limits in food products (5). TMDI for PCBs was identified based on the Maximum Residue Limits of these compounds in milk and processed milk, using FAO/WAO Codex Alimentarius (6).

**Results and Discussion**

Average concentrations of the compounds examined are shown in Table 1.

Table 1. Average concentrations of organochlorine compounds in human milk in Poland [mg/l of milk ± Standard Deviation].

| HCB | α-HCH | β-HCH | γ-HCH | p,p'-DDT | p,p'-DDD | p,p'-DDE | PCBs |
|---|---|---|---|---|---|---|---|
| Milk collected on 4th day | | | | | | | |
| 0.0013 ± 0,0008 | 0,0002 ± 0,0002 | 0.0014 ± 0.0008 | 0.0002 ± 0.0001 | 0.0050 ± 0.0024 | 0.0009 ± 0.0003 | 0.0211 ± 0.0140 | 0.0076 ± 0.0041 |
| Mature milk | | | | | | | |
| 0.0020 ± 0.0025 | 0.0005 ± 0.0017 | 0.0033 ± 0.0068 | 0.0004 ± 0.0014 | 0.0034 ± 0.0093 | 0.0004 ± 0.0025 | 0.0282 ± 0.0250 | 0.0544 ± 0.0814 |

It is worth noting that higher concentrations of PCBs and β-HCH are reported for mature milk than for that collected on the 4th day (statistically significant, $p \leq 0,05$). In Poland, ΣDDT and

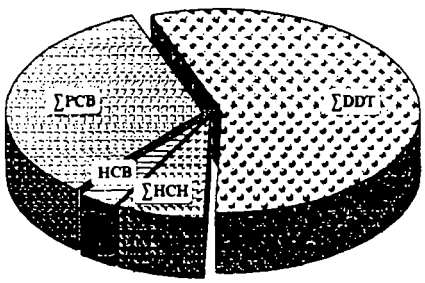


Figure 1. Estimated Daily Intake of organochlorine compounds by infants with human milk.

PCBs had the highest share in the Estimated Daily Intake by breast-fed infants (Figure 1). The relation among ADI, TMDI and EDI was calculated only for ΣDDT and ΣHCH as these were the only compounds for which ADI was identified (7, 8). The above mentioned calculations were then used to estimate the safety margins for ΣDDT and ΣHCH. These amounted to: 4,2 (ADI for ΣDDT = 20 μg/kg b.w. × $day^{-1}$) and 13,3 (ADI for γ-HCH = 8 μg/kg b.w. × $day^{-1}$), respectively. The estimated EDIs for ΣDDT and ΣHCH did not exceed the values assumed to be safe, i.e., ADI and TMDI.

While the PCB intake in the initial period of lactation (4th day) was relatively low and did not exceed the TMDI calculated using FAO/WAO guidelines, the EDI for polychlorinated biphenyls in the mature milk exceeded the relevant TMDI in some regions of Poland. Nevertheless, the concentration of PCB in human milk in Poland was lower than that found in highly developed countries and amounting to, on average, 1 mg PCBs/kg of fat (9, 10). According to the literature sources, the infants' average PCB intake from human milk is 4,4 μg/kg b.w. × $day^{-1}$ (4, 9). The EDI for polychlorinated biphenyls estimated in this study averages 2,8 μg/kg b.w. × $day^{-1}$.

The above mentioned estimated daily PCB intakes in human milk exceed reference values of 1 μg/kg b.w. × $day^{-1}$ as proposed in the USA (Food and Drug Administration) and 0,6 μg/kg b.w. × $day^{-1}$ as proposed in Denmark (National Food Agency of Denmark). However, in the light of the recent toxicological research, there is no reason why the levels of organochlorine compounds detected in human milk should be grounds for altering the children breast-feeding recommendations (11). The benefits of breast feeding for the child far outweigh the possible negative impact of compounds found in the mother's milk.

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