

The exposure of the Croatian population to toxic environmental contaminants – "dioxin-like" PCBs

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INTRODUCTION

Human milk accumulate lipophilic environmental contaminants such as polychlorinated biphenyls (PCBs), which can cause adverse health effects, such as immunotoxicity, reproductive effects, endocrine disruption and carcinogenicity. Contaminant levels found in human milk reflect maternal body burden, can be used as an indicator of the overall exposure of the general population, and provide a means of estimating exposure of breastfed infants.

AIM of this study was to investigate the levels of 11 toxic PCB congeners, known as "dioxin-like" PCBs in human milk samples from multiparae, living in Zadar (previous study (Klinčić et al., 2014) showed that the primiparae from Zadar endured higher exposure to toxic PCBs in comparison with mothers from inland Croatia). In order to quantify very low levels of non-*ortho* PCBs, optimization of GC-MS/MS technique was needed.

RESULTS

- PCB-118 and PCB-126 most frequently detected mono- and non-*ortho* PCB congeners, found in 85% and 58% of the samples, respectively
- mono- and non-*ortho* PCBs were found in the range between <LOD and 4.2, and between <LOD and 0.126 ng g⁻¹ milk fat
- toxic equivalents (TEQ) calculated based on WHO-TEF₂₀₀₅ ranged between 0 and 13.3 pg g⁻¹ milk fat (median 1.3)
- in samples in which non-*ortho* congeners were detected, their contribution to the total TEQ was between 89% and 100%
- mono-*ortho* congeners were found at similar levels in both primiparae (Klinčić et al., 2014) and multiparae

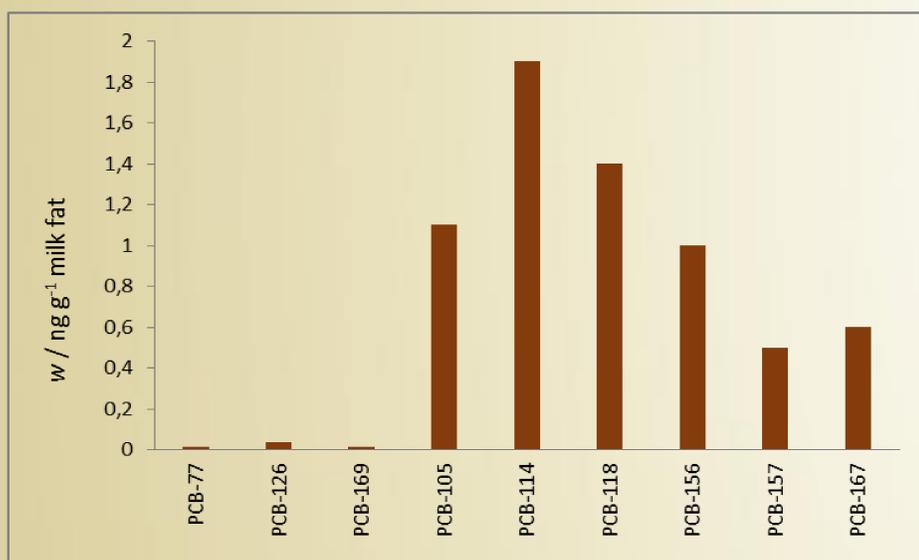
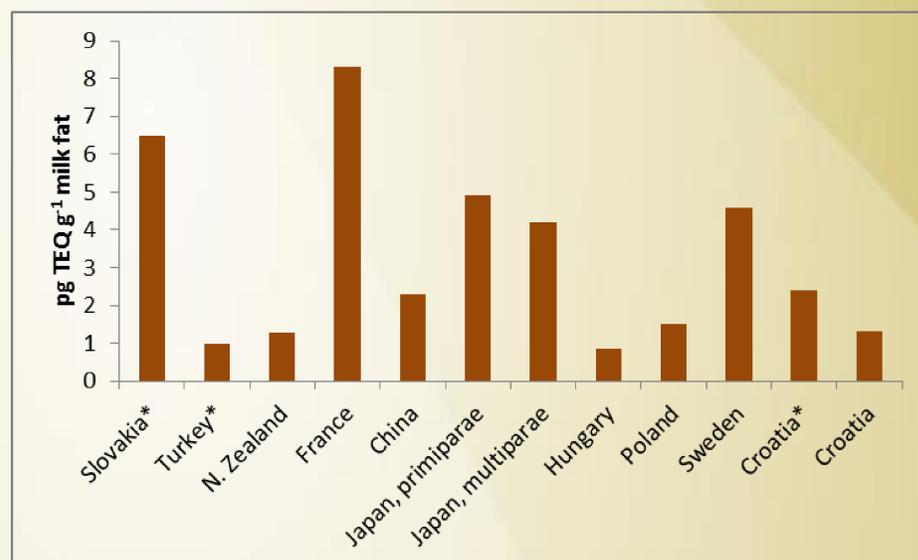


Figure 1 Levels of dl-PCBs in human milk samples collected in 2011 from multiparae living in Zadar



* TEQ based on WHO-TEF₁₉₉₈

Figure 2 Comparison of TEQ values obtained in this work with literature reports

CONCLUSIONS

- GC-MS/MS technique was optimized for determination of non-*ortho* PCB congeners
- the general population in Croatia is not at high risk from exposure to toxic PCB congeners
- in comparison to other countries, TEQ values found in this study are in the lower part of the TEQ range
- the TEQ values in some of the individual human milk samples are of concern because newborns consuming these breast milks could have had a high intake of the studied toxic contaminants, especially considering their low body weight and extremely sensitive life stage
- positive effects of breastfeeding are much greater than any possible adverse effects caused by investigated contaminants



Experimental

Samples: human milk samples from 34 mothers (second or third delivery; age: 24-45) living in Zadar (one sample was excluded from further discussion due to possible contamination), collected in 2011

Analyzed PCBs: PCB-77, PCB-126, PCB-169 (three non-*ortho* congeners), PCB-105, PCB-114, PCB-118, PCB-123, PCB-156, PCB-157, PCB-167, PCB-189 (eight mono-*ortho* congeners)

Chemical analysis: extraction with a chloroform/methanol mixture, purification with sulfuric acid, fractionation on ENVI-Carb SPE tubes pre-packed with carbon (3 mL, 0.25 g, Supelco) in order to achieve separation of non-*ortho* PCBs

Instrumental analysis:

mono-*ortho* PCBs on **HRGC-ECD** - Clarus 500 gas chromatograph (Perkin Elmer) using two capillary columns (Rtx-5 and Rtx-1701, Restek) simultaneously (details in Klinčić et al., 2014)

non-*ortho* PCBs on **GC-MS/MS** - Trace 1300 gas chromatograph - ITQ 700 ion trap mass spectrometer (Thermo Scientific); column: TG-5MS (30 m x 0.25 mm, 0.25 μm; Thermo Scientific)

Temperature programme: 60 °C (2 min) → 200 °C (20 °C min⁻¹) → 280 °C (8 °C min⁻¹) (2 min)

Carrier gas: Helium, 1 mL min⁻¹; Injector PTV (splitless mode): 100 °C (0.05 min) → 300 °C (12 °C s⁻¹); Transfer line: 280 °C; Injection volume: 3 μL

MS-MS operating conditions: Ionization mode: EI; Ion source: 200 °C; Detection: Selected Reaction Monitoring (SRM)

Transitions: PCB-77 (292 > 220/222; CE 1.15V); PCB-126 (326 > 254/256; CE 1.18 V); PCB-169 (360 > 288/290; CE 1.21 V)

Limits of determination (LOD): mono-*ortho* PCBs: 0.5 ng g⁻¹ milk fat ; PCB-77: 7.5 pg g⁻¹ milk fat, PCB-126: 6.2 pg g⁻¹ milk fat, PCB-169: 8.8 pg g⁻¹ milk fat

Recovery: 58% -86%