Dietary assessment of human exposure to organohalogen contaminants, legacy and emerging flame retardants in a Norwegian cohort

Joo Hui Tay[1], Fuchao Xu[2], Adrian Covaci[2], Ulla Sellström[1] and Cynthia A. de Wit[1]

[1]Department of Environmental Science and Analytical Chemistry (ACES), Stockholm University, SE-106 91 Stockholm, Sweden
[2]Toxicological Centre, University of Antwerp, Universiteitsplein 1, 2610 Wilrijk, Belgium

INTRODUCTION

- Human exposure to organohalogen chemicals (OHCs) and flame retardants takes place through external (e.g.: dust, diet, air) and internal exposure routes (e.g.: blood)
- Dietary intake is estimated to contribute about 97% of the total PBDE exposure [1]
- Most food analyses focus on uncooked food obtained from market baskets
- Cooking has been reported to be able to decrease the amount of chemicals in food [2]
- This study aimed to estimate the daily dietary intake of different OHCs and emerging FRs using duplicate diet portions.

SAMPLES

- 24-h duplicate food samples and food diaries were collected from 60 participants of a Norwegian cohort between November 2013-April 2014 according to Papadopoulou et al. [3].






ANALYSIS

- Sample extraction, clean-up and analysis was performed according to Xu et al. [4] with some modifications.

Multi-stage clean-up procedure

Organochlorine pesticides (OCPs)
- Oxychlordane (OxC)
- Trans-nonachlor (TN)
- Cis-nonachlor (CN)
- HCB
- *α*-HCH
- *β*-HCH
- *γ*-HCH
- p,p'-DDE
- p,p'-DDT

Polychlorinated biphenyls (PCBs)
- CB 99
- CB 101
- CB 105
- CB 118
- CB 138
- CB 153
- CB 156
- CB 170
- CB 171
- CB 177
- CB 180
- CB 183
- CB 187
- CB 194
- CB 206
- CB 209

ANALYTES

Polybrominated diphenyl ethers (PBDEs)
- BDE 28
- BDE 47
- BDE 66
- BDE 85
- BDE 100
- BDE 153
- BDE 154
- BDE 183
- BDE 209

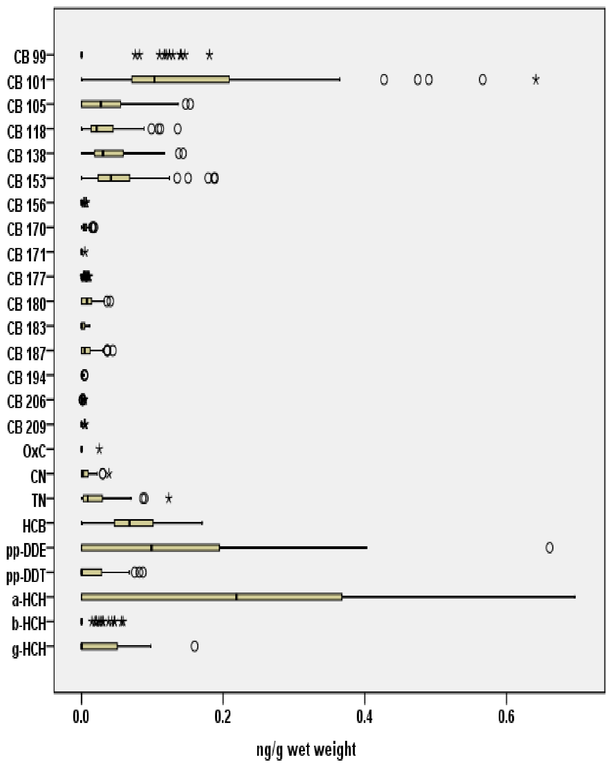
Emerging flame retardants (organophosphorus and halogenated)
- BTBPE
- EH-TBB
- TBPH (BEH-TEBP)
- *s*-DP (*syn*-DDC-CO)
- *a*-DP (*anti*-DDC-CO)
- DBDPE
- EHDPHP
- TCEP
- TPHP
- TDCIPP
- TCPP

ACKNOWLEDGEMENTS

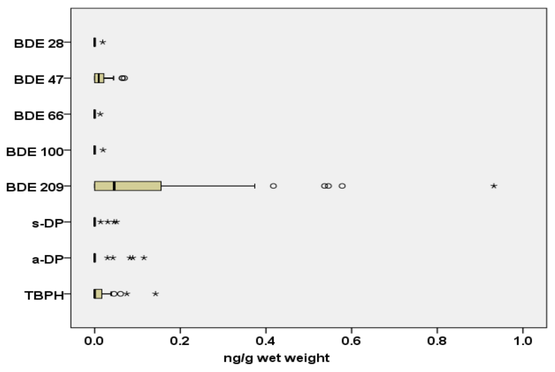
- This research has received funding from the European Union's Seventh Framework Programme FP7/2007-2013 under grant agreement no. 316665 (A-TEAM project).

RESULTS

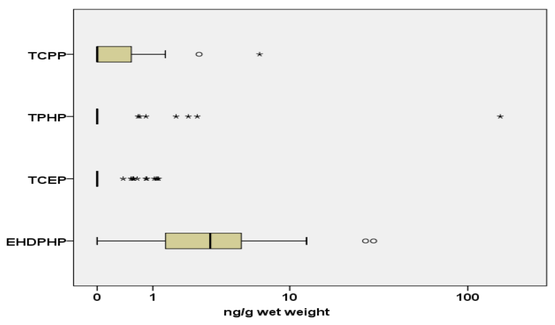
PCBs & OCPs



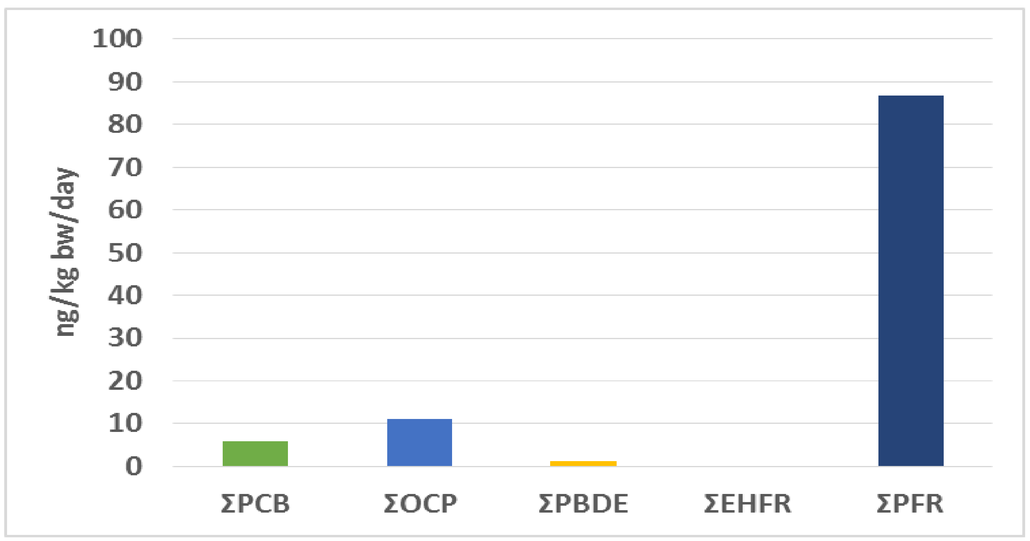
PBDEs & HFRs



PFRs



ESTIMATED DAILY DIETARY EXPOSURE (MEDIAN)



SPEARMAN'S CORRELATION

ng/kg bw/day	Amount consumed (g)		
	Fish	Meat	vegetable + fruit
ΣPCB	0.601**		0.261*
ΣOCP	0.453**		
ΣPBDE	0.266*		
ΣEHFR			
ΣPFR		0.299*	

**correlation is significant at the 0.01 level (2-tailed)
*correlation is significant at the 0.05 level (2-tailed)

CONCLUSIONS

- 24h-duplicate diet studies can provide accurate and detailed information on intake over a short period of time
- However it is only a snapshot of intake and not wholly representative of participants' usual diets
- Our results show that dietary intake is an important pathway for these chemicals in humans, but there is a need to investigate other pathways (e.g.: dust ingestion and air inhalation) and compare the values to biomonitoring data to further understand human exposure to these chemicals

REFERENCES

1. Fromme, H., et al., *Human exposure to polybrominated diphenyl ethers (PBDE), as evidenced by data from a duplicate diet study, indoor air, house dust, and biomonitoring in Germany.* Environment International, 2009. **35**(8): p. 1125-1135.
2. Schecter, A., et al., *Changes in polybrominated diphenyl ether (PBDE) levels in cooked food.* Toxicological & Environmental Chemistry, 2006. **88**(2): p. 207-211.
3. Papadopoulou, E., et al., *Sampling strategy for estimating human exposure pathways to consumer chemicals.* Emerging Contaminants, 2016. **2**(1): p. 26-36.
4. Xu, F., et al., *Multi-contaminant analysis of organophosphate and halogenated flame retardants in food matrices using ultrasonication and vacuum assisted extraction, multi-stage cleanup and gas chromatography-mass spectrometry.* J Chromatogr A, 2015. **1401**(0): p. 33-41.

Contact information: Joo.Hui@aces.su.se