

Flame retardants residues in commercially important freshwater species from Lake Trasimeno, Italy: preliminary risk characterization and benefit–risk analysis



Roila Rossana¹⁺, Piersanti Arianna², Ranucci David¹, Miraglia Dino¹, Valiani Andrea², Branciarri Raffaella¹

¹ Dipartimento di Medicina Veterinaria, Università degli Studi di Perugia, Via San Costanzo, 4, 06126, Perugia, IT

² Istituto Zooprofilattico Sperimentale Umbria e Marche, Via Gaetano Salvemini, 1, 06126, Perugia, IT

e-mail: rossana.roila@unipg.it

Introduction

Compounds referred to as flame retardants constitute a large group of chemicals which are added to manufactured materials in order to inhibit or delay the spread of fire. Since the early 1970s, the most commonly used flame retardants were polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecanes (HBCDs). These compounds might separate or leach from the products into the environment and due to their potential adverse health effects, their widespread global distribution, and their ability to bioaccumulate and biomagnificate in food chain, some restriction on their use have been introduced since early 2000's. However, extensive and frequently unregulated use of these compounds in the past has resulted in their diffusion in various environmental matrices. Consequently, humans can be exposed to both PBDEs and HBCDs through numerous routes although food consumption appears to be the main one for general population, especially regarding "Fish and other seafood" product category. Chronic exposure to such compounds may lead to several health consequences involving liver functionality, thyroid homeostasis, reproductive, nervous and the immune systems impairments[1]. The study aimed to define the dietary exposure to several specimens of PBDEs and HBCDs for central Italy population in relation to the consumption of freshwater fish species from Lake Trasimeno (Umbria region, central Italy), to characterize the consumers' risk and to assess benefit-risk ratio.

Materials and methods

FRs analytical determination

20 g of samples were weighed in a polypropylene centrifuge tube and submitted to QuEChERS extraction. 10 mL of the upper organic layer were reduced in volume at 35 °C using the Genevac EZ-2 concentrator (SP Scientific, Ipswich, Suffolk, UK). The residue was purified on H₂SO₄ tandem columns assembly and then by gel permeation chromatography (Gilson GPC system, Gilson Wisconsin, USA). Each purified extract was divided into two fractions and carefully reduced to dryness and opportunely resuspended. LC-MS/MS injection performed on a 7890A GC — 7000B triple-quadrupole mass analyser in EI ionization mode (Agilent Technologies, Palo Alto, CA, USA) [2].

Dietary Exposure Assessment

The dietary exposure was determined through the definition of the estimated daily intake (EDI) of PBDEs and HBCDs flame retardants. EDI was obtained by multiplying the average upper bound concentration of such molecules in food by the amount of fish consumed daily by an average adult. Data on freshwater fishes consumption were extrapolated from a questionnaire administered to consumers around lake Trasimeno [3].

Risk Characterization and Benefit-Risk Assessment

The risk characterization of PBDEs and HBCDs was performed by means of the margin of exposure (MOE) approach by comparing the estimated human intake associated with the benchmark dose lower confidence limit (BMDL₁₀) for neurodevelopmental effects in mice. The benefit–risk quotient (BRQ) was applied to integrate benefit and risk assessments for to the simultaneous ingestion of omega-3 fatty acids and contaminants through freshwater fish consumption [3].

	EDI (ng/ kg bw/day)		MOE (x1000)		BRQ	
	∑ PBDE	∑ HBCD	∑ PBDE	∑ HBCD	∑ PBDE	∑ HBCD
<i>Perca fluviatilis</i> (n. 10)	0.0058	0.0022	25800	56400	<1	<1
<i>Tinca tinca</i> (n. 10)	0.0061	0.0014	25080	54835	<1	<1
<i>Procambarus clarkii</i> (n. 10)	0.068	0.045	21300	1734	<1	<1

Results and discussions

Exposure assessment revealed that, among targeted fish species, crawfish (*Procambarus clarkii*) contributes the most to the daily intake of brominated flame retardants in the population consuming freshwater fish products. Risk characterization revealed values of MOE remarkably higher than the threshold level of concern of 10000 attesting a low concern for public health related to the ingestion of PBDEs and HBCDs through the meat of the mentioned fish species. Benefit-risk assessment performed by means of BRQ, resulted in values < 1 for all the targeted species and for both PBDEs and HBCDs.

Conclusions

Both the MOE and BRQs values indicated that the health benefits of consumption of fish from lake Trasimeno outweigh the potential risks attesting a low concern for public health related to the ingestion of FRs residues through the meat of the mentioned fish species. Therefore, these fish species from lake Trasimeno not only can be consumed regularly by the general population without posing significant health risks, but additionally their consumption should be encouraged as they can contribute to the suggested intake of omega-3 fatty acids.

REFERENCES

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