

Occurrence of organophosphate flame retardants in food and dietary intake estimation by the Belgian adult population

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Due to evidence of brominated flame retardants (BFR) toxicity and persistency and to the related increasing health and environmental concerns, the main BFRs (PBDEs and HBCD) were gradually banned worldwide, leading to the increased usage of organophosphate flame retardants (PFRs) as alternatives¹. However, knowledge about PFR environmental persistence, human exposure and toxicity is still limited, as well as information on their presence in foodstuff².

In this study, we investigated the occurrence of 14 PFRs (namely, tris(1,3-dichloro-2-propyl) phosphate (TDCIPP), tris(1-chloro-2-propyl) phosphate (TCIPP), tris(2-chloroethyl) phosphate (TCEP), tri-n-butyl phosphate (TNBP), tri-n-propyl phosphate (TNPP), tris(2-ethylhexyl) phosphate (TEHP), triphenyl phosphate (TPHP), 2-ethylhexyl diphenyl phosphate (EHDPHP), tritolyl phosphates (TOTP, TMTP, TPTP), tris(2-isopropylphenyl) phosphate (T2IPPP), tris(3,5-dimethylphenyl) phosphate (T35DMPP), tris(p-t-butylphenyl) phosphate (TBPP)) in 165 composite food samples belonging to several food categories (including fish/seafood, dairy products, oil/fats, eggs, grain and potatoes, meat, and food for infants) recently purchased from Belgian supermarkets. A modified QuEChERS protocol was used for the sample extraction, while two consecutive clean-up steps (using Florisil and APS cartridges) were performed to purify the samples from interferences. The quantification of the target compounds was achieved by gas chromatography coupled to tandem mass spectrometry (GC-MS/MS) operating in electron ionization (EI) mode.

Out of all considered PFRs, seven compounds (TnBP, TCEP, TCIPP, TDCIPP, TPHP, EHDPHP, TEHP) were measured in most of the food categories, while the other target analytes were always < LOQ. Overall, the food categories with the highest number of detects were potatoes (82 %), grains (67 %), and fish/seafood (48 %), while the food for infants showed the lowest number of detects (12 %). Among the detected PFRs, the lowest mean level was measured for TCEP (3 pg/g ww, in the vegetable group), while TCIPP had the highest mean concentration (39 ng/g ww in fats/oil group). TPHP showed the highest contribution to the total level of PFRs in the composite food samples (accounting for 27 %), followed by TCIPP (25 %) and EHDPHP (20 %). Among the analyzed food groups, the category fat/oil was the most contaminated by PFRs (40 %), followed by grains (17 %), food stocks and cheese (both 9 %).

For the average adult population (15-64 years), the calculated total daily PFR intake from food ranged from 207 ng/day (2.8 ng/kg bw/day, TCEP) to 3396 ng/day (46.6 ng/kg bw/day, TPHP). The major contributors to the total intake were in the order of TPHP (45 %) > TCIPP (18 %) > EHDPHP (15%) > TDCIPP (9%) > TEHP and TnBP (5 %) > TCEP (3 %), whereas the food categories contributing most to the total PFR intake were grains (39 %) and fats/oils (21 %).

References:

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