Can food processing influence the level of contamination with organophosphorus flame retardants and plasticizers (PFRs) in Belgian foodstuffs?

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Introduction and Objectives

✓ The worldwide ban of the main brominated flame retardants (bFRs), such as PBDEs and HBCDs, led to the increased usage of organophosphorus flame retardants (PFRs) as alternatives1.

✓ PFRs have been already measured in environmental abiotic matrices (air, dust, surface water, and sediments) all over the world1 but data on the human exposure to PFRs from food are still scarce1-3.

✓ In this study, we analyzed 14 PFRs in 165 composite food samples belonging to different categories (fish, meat, grains, eggs, milk, cheese, vegetables, food for infants, oils) and purchased from the Belgian food market.

✓ Based on the results obtained and using recent data concerning the Belgian food consumption in 20144, the average PFR per capita intake of the Belgian adult population (15-64 years) was calculated.

Materials and Methods

✓ Out of 14 PFRs, TnBP, TCEP, TCIPP, TDCIPP, TPHP, EHDPHP, TEHP were measured in most of the food categories (detection frequency 10 - 100 %), while the other target analytes were < LOQ. TPHP was the most abundant compound (27%), followed by TCPP (25%) and EDHHP (20%).

✓ Fats > Grains > Cheese were the food categories with the highest levels of PFRs (Fig. 1). The whole data set was divided into “non-processed food” (foodstuffs slightly altered from their natural state, e.g. frozen, freshly cut, or directly packed) and “processed food” (manipulated and industrially altered/processed foodstuffs, e.g. canned, smoked, dried, fried, minced, etc.) (Fig. 2).

✓ The results were obtained and using recent data concerning the Belgian food consumption in 20144, the average PFR per capita intake of the Belgian adult population (15-64 years) was calculated.

✓ Quantification of target analytes was achieved by gas chromatography coupled to tandem mass spectrometry (GC-MS/MS) operating in electron ionization (EI) mode.

✓ The per capita intake was determined by multiplying the per capita consumption of a specific food group with the concentration of the compound found in the considered food sample.

✓ For the average adult population (15-64 years), the total dietary intake of PFRs was estimated to be 7500 ± 1550 ng/day, and no significant differences between the PFR intakes of men and women were observed (Table 1).

✓ The mean dietary intake mainly originated from grains (39%), followed by fats and oils (21%) and dairy products (20%) (Fig. 3).

✓ The major contributors to the total intake were TPHP (45%) > TCIPP (18%) > EDHHP (15%) > TDCIPP (9%) > TEHP and TnBP (5%) > TCEP (3%).

Table 1 Mean daily dietary intake in ng/day and ng/kg bw/day for Belgian adult population (72.9 kg on average)

<table>
<thead>
<tr>
<th>Food groups</th>
<th>TnBP</th>
<th>TCEP</th>
<th>TCIPP</th>
<th>TDCIPP</th>
<th>TPHP</th>
<th>EDHHP</th>
<th>TEHP</th>
<th>Total (ng/day)</th>
<th>Total (ng/kg bw/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fats</td>
<td>126</td>
<td>49</td>
<td>739</td>
<td>383</td>
<td>81</td>
<td>41</td>
<td>144</td>
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<tr>
<td>Eggs</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Gras</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>25</td>
<td>18</td>
<td>56</td>
<td>47</td>
<td>39</td>
<td>101</td>
<td>39</td>
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<tr>
<td>Meat</td>
<td>27</td>
<td>23</td>
<td>33</td>
<td>92</td>
<td>174</td>
<td>82</td>
<td>40</td>
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<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>19</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>15</td>
<td>1</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>50</td>
<td>6</td>
<td>50</td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>404</td>
<td>207</td>
<td>1350</td>
<td>697</td>
<td>3396</td>
<td>1087</td>
<td>155</td>
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<tr>
<td>Total</td>
<td>5.5</td>
<td>2.8</td>
<td>18.5</td>
<td>9.6</td>
<td>46.6</td>
<td>14.9</td>
<td>4.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Acknowledgements

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References