Fluorochemicals used in food packaging inhibit male sex hormone synthesis

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Fluorochemicals used in food packaging inhibit male sex hormone synthesis


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Background & Aim

Polyfluorinated phosphate surfactants (PAPS) are widely used in food contact materials (FCMs) of paper and board and have recently been detected in 57% of investigated materials. Human exposure occurs as PAPS have been measured in blood; however, knowledge is lacking on the toxicology of PAPS. Metabolic products of PAPS, fluorotelomer alcohol (FTOH) and perfluorocarboxylic acids (PFCAs) have shown potential to interfere with the endocrine system and thus the aim of this study was to elucidate the effects of six fluorochemicals on sex hormone synthesis and androgen receptor (AR) activation in vitro. Four PAPS and two metabolites, perfluorooctanoic acid (PFOA) and 8:2 fluorotelomer alcohol (8:2 FTOH) were tested.

Results

Hormone profiles, including eight steroid hormones, generally showed that 8:2 diPAPS, 8:2 FTOH led to decreases in testosterone, dehydroepiandrosterone, and androstenedione in the H295R steroidogenesis assay. Decreases were observed for progesterone and 17-OH-progesterone as well. None of the compounds showed effects in the AR reporter gene assay.

<table>
<thead>
<tr>
<th>Compound</th>
<th>LOEC (µM)</th>
<th>Emax (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:2 triPAPS</td>
<td>n.s.</td>
<td>12.5</td>
</tr>
<tr>
<td>10:2 diPAPS</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>8:2 diPAPS</td>
<td>25</td>
<td>72.7</td>
</tr>
<tr>
<td>8:2 monoPAPS</td>
<td>12.5</td>
<td>3.1</td>
</tr>
<tr>
<td>8:2 FTOH</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>PFOA</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

Conclusion

Overall, the results demonstrate that of the tested endpoints interference with steroidogenesis is the main target of the test compounds. Specifically, fluorochemicals used in food packaging and their metabolites can affect steroidogenesis through decreased Bzrp and increased CYP19 gene expression causing lower androgens and higher estrogen levels.

Materials and Methods

Materials and methods are described in detail in the paper Fluorochemicals used in food packaging inhibit male sex hormone synthesis (Rosenmai et al., 2012). The tested compounds include 8:2 triPAPS, 10:2 diPAPS, 8:2 diPAPS and 8:2 monoPAPS and their metabolites, 8:2 FTOH and PFOA. H295R steroidogenesis assay. The H295R cell line was cultured for 24 h with successive test compound exposure for 48 h. Exposure concentrations ranged from 1.6-50.0 µM. After 48 h exposure the supernatant was sampled for hormone analysis and cell viability was tested. Hormones were extracted from cell supernatants by SPE and were measured both by time-resolved fluoroimmunoassays and HPLC-MS/MS. Effects on gene expression were assessed by qRT-PCR, mRNA isolation and conversion to cDNA were performed with TaqMan® Fast Cells-to-CTTM Kit. cDNA was analyzed on a PCR system using TaqMan® Gene Expression Assays. Androgen receptor reporter gene assay. The assay was performed as previously described by Vinggaard et al. (2002). All plasmids were generous gifts from Dr. Albert Brinkmann (Erasmus University, Rotterdam). Test chemicals were added leading to final exposure concentrations ranging from 0.2 – 50.0 µM on agonist, antagonist and toxicity plates.

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