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Levels of perchlorate and chlorate in foods available in Denmark

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Background:
Sources of both perchlorate and chlorate in food may be multiple though chlorinated water used for irrigation/washing/blanching/disfection is meant to be an important and primary source of perchlorate and chlorate in foods, respectively. In Denmark 100% of the water supply is covered by groundwater which is only filtered and aired (thus no chlorination). Consequently the risk of water being a source of perchlorate and chlorate is low. This makes Denmark unique among European countries (Fig. 1).

Results:
High risk commodities were collected and analysed in 2014-2017. A total of 119 (89 domestic, 29 foreign) were analysed for perchlorate (sampling period 2014-2017). Additionally, 77 of the samples from 2016-2017 (48 domestic, 29 foreign) were analysed for chlorate (LOQ 0.01 mg/kg).

Figure 2 illustrates the frequency with which perchlorate and chlorate were found (≥0.01 mg/kg) generally were higher among non-domestic samples than among domestic samples. The number of foreign samples was low but the frequency of positive perchlorate findings are in line with the findings of e.g. Arcella et al. 2017(2) and Vejdovszky et al. 2018(3) (Table 1). Roughly 40% of the foreign samples in the present study were found to contain chlorate (≥0.01 mg/kg) compared to roughly 14% of domestic samples.

Conclusion:
The presented results strongly indicate that the frequency with which perchlorate and chlorate are found in commodities of Danish origin generally is lower than in commodities of foreign origin. This may be related to the fact that the water supply in Denmark is based 100% on non-chlorinated groundwater.

Table 1: Findings of perchlorate in commodities of which more than two samples have been analysed.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>No. samples analysed</th>
<th>Positive findings (≥LOQ (%))</th>
<th>Average of positive findings (mg/kg)</th>
<th>No. samples analysed</th>
<th>Positive findings (≥LOQ (%))</th>
<th>Average of positive findings (mg/kg)</th>
<th>Positive findings reported by others (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber</td>
<td>22</td>
<td>9%</td>
<td>0.03</td>
<td>5</td>
<td>20%</td>
<td>0.03</td>
<td>37%</td>
</tr>
<tr>
<td>Herbs</td>
<td>8</td>
<td>63%</td>
<td>0.05</td>
<td>5</td>
<td>80%</td>
<td>0.06</td>
<td>90%</td>
</tr>
<tr>
<td>Lettuce</td>
<td>23</td>
<td>22%</td>
<td>0.20 (0.06)*</td>
<td>5</td>
<td>60%</td>
<td>0.05</td>
<td>42%(2)</td>
</tr>
<tr>
<td>Spinach</td>
<td>4</td>
<td>0%</td>
<td>0.00</td>
<td>9</td>
<td>67%</td>
<td>0.04</td>
<td>51%(2)</td>
</tr>
<tr>
<td>Tomato</td>
<td>25</td>
<td>0%</td>
<td>0.00</td>
<td>5</td>
<td>0%</td>
<td>0.00</td>
<td>7%(2)</td>
</tr>
</tbody>
</table>