Research Note

Detection of Deoxynivalenol Contamination in Wheat Products in Thailand

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MS 08-053: Received 28 January 2008/Accepted 11 April 2008

ABSTRACT

A total of ninety samples in three kinds of wheat products (30 noodle, 30 bread, and 30 cereal samples) were collected from the supermarkets in Bangkok, Thailand, from February to April 2007. The occurrence of deoxynivalenol (DON) contamination in wheat products was investigated using high-performance liquid chromatography equipped with a UV light detector. The extraction method was performed using a multifunctional cleanup column. The limit of quantification was 0.10 µg·g⁻¹ from the range obtained in a linear calibration. The survey found almost 94% of the DON-contaminated samples below 1 µg·g⁻¹, which corresponds to the U.S. Food and Drug Administration advisory level. DON was detected in 18.9% (17 of 90) of all samples, in 6.67% (2 of 30) and 16.67% (5 of 30) of noodle and bread samples at levels from 0.17 to 0.35 and 0.14 to 1.13 µg·g⁻¹, respectively, while it was in 33.33% (10 of 30) of cereal samples at levels from 0.13 to 0.39 µg·g⁻¹. The results suggest that the exposure to DON from the consumption of wheat products, especially noodles, bread, and cereal, is at a very low risk level.

Deoxynivalenol (DON) is a trichothecene mycotoxin produced by several plant pathogenic fungi, of which Fusarium graminearum and Fusarium culmorum are the most important sources. It is known to frequently contaminate a variety of foodstuffs, including wheat, maize, barley, oats, and rice (1, 2, 4, 6, 9, 10, 12, 13, 18, 21–23). DON is the most abundant of the trichothecenes and has been found in high concentrations in cereal crops in the United States and Europe (7). DON contamination has been associated with various adverse effects such as feed refusal, vomiting, and immunotoxic effects in animals and humans (11, 18, 19). Human food poisoning has been reported to be caused by ingestion of DON (18). Symptoms described include abdominal pain or a feeling of fullness in the abdomen, dizziness, headache, throat irritation, nausea, vomiting, diarrhea, and blood in the stool (3, 15). The consumption of wheat products by the human population raises the risk of exposure to DON; studies on exposure to mycotoxins via the diet have been limited, particularly in Thailand.

The Joint FAO–WHO Expert Committee on Food Additives has established the provisional maximum tolerable daily intake for humans at 1 µg of DON per kg of body weight per day. The U.S. Food and Drug Administration has established its advisory level for DON in finished wheat products for human consumption at 1 µg·g⁻¹.

In order to investigate the situation of DON contamination in foods in Thailand in relation to the recommended guidelines for assuring food safety, we surveyed DON contamination in noodles, bread, and cerealsretailed in Thailand.

MATERIALS AND METHODS

Standard and reagents. DON standard was purchased from Wako Pure Chemical Industries, Ltd. (Osaka, Japan). Acetonitrile and methanol were high-performance liquid chromatography (HPLC) grade. Purified water was produced using a Milli-Q water purification system from Millipore (Bedford, Mass.). The multifunctional columns were MultiSep 227 columns (Romer Labs, Inc., Union, Mo.).

Sample extraction and cleanup. A total of 90 samples (30 instant noodles, 30 crackers or breads, and 30 cereals), mainly composed of wheat, were randomly collected from five supermarkets in Bangkok from February to April 2007, a season of relatively high humidity and temperature. The extraction and cleanup methods of DON in wheat products were carried out in accordance with previous publications (3, 14, 17, 20). In short, 50 g of homogenized sample was extracted with 200 ml of acetonitrile-water (85:15 [vol/vol]) by shaking for 30 min. After filtration with a glass microfiber filter (Whatman GF/B, Whatman International, Ltd., Maidstone, Kent, UK), 10 ml of the filtrate was applied to a multifunctional cleanup column, without preconditioning. The first 3 ml of the eluate was discarded, and the next 4 ml was collected and then evaporated to dryness under a nitrogen stream. The dry residue was re dissolved in 1 ml of acetonitrile-methanol-water (5:5:90 [vol/vol/vol]). After passing through...
TABLE 1. The levels of DON contamination in noodles, bread, and cereals in Bangkok, Thailand

<table>
<thead>
<tr>
<th>Type of wheat product</th>
<th>Quantifiable samples/total samples (%)</th>
<th>Mean contamination levels of quantifiable samples (µg·g⁻¹)</th>
<th>Range (µg·g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noodles</td>
<td>2/30 (6.67)</td>
<td>0.26</td>
<td>0.17–0.35</td>
</tr>
<tr>
<td>Breads</td>
<td>5/30 (16.67)</td>
<td>0.37</td>
<td>0.14–1.13</td>
</tr>
<tr>
<td>Cereals</td>
<td>10/30 (33.33)</td>
<td>0.24</td>
<td>0.13–0.39</td>
</tr>
</tbody>
</table>

The daily intake (8) and estimated exposure to DON from noodles and bread by the Thai population were calculated by averaging the values of DON concentration in quantifiable samples and the assumed values summarized in Table 2. In upper estimated DON exposure, actual values below the limit of quantification were assumed to be half the limit of quantification (0.05 µg·g⁻¹), whereas the values were assumed to be 0 in lower estimated exposure. The maximal estimated DON exposure by the Thai population in Bangkok (3- to 6-year-olds) was 0.0038 and 0.0111 µg of body weight per day from noodles and bread, respectively. Sugita-Konishi et al. (16) reported that boiling reduced DON concentration and its cytotoxicity by approximately 30%. The average value of estimated exposure to DON in the noodles and bread by the people residing in Bangkok was below the provisional maximum tolerable daily intake value established by the Joint FAO–WHO Expert Committee on Food Additives for humans of 1 µg of DON per kg of body weight per day. This study was conducted in a limited number of samples from Bangkok, but the sample products are distributed widely and consumed by a large population in Thailand.

In conclusion, this study suggests that the risk of DON exposure via wheat products (as food) appears very low in urban areas of Thailand because DON contamination in wheat products, particularly noodles, bread, and cereals, marketed in Bangkok, Thailand, is at a low level.

ACKNOWLEDGMENT

This project was supported by the University of Tokyo, Japan.

REFERENCES

4. Leblanc, J. C., L. Malmauret, D. Delobel, and P. Verger. 2002. Simulation of the exposure to deoxynivalenol of French consumers of

TABLE 2. The daily intake of noodles and bread, and estimated exposure to DON via the noodles and bread, by the Thai population in Bangkok

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>DI (g/person/day)</th>
<th>Lower estimated exposure (µg/kg BW/day)</th>
<th>Upper estimated exposure (µg/kg BW/day)</th>
<th>DI (g/person/day)</th>
<th>Lower estimated exposure (µg/kg BW/day)</th>
<th>Upper estimated exposure (µg/kg BW/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3–6</td>
<td>0.94</td>
<td>0.0010</td>
<td>0.0038</td>
<td>1.73</td>
<td>0.0066</td>
<td>0.0111</td>
</tr>
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<td>6–9</td>
<td>1.17</td>
<td>0.0008</td>
<td>0.0031</td>
<td>2.05</td>
<td>0.0052</td>
<td>0.0088</td>
</tr>
<tr>
<td>9–16</td>
<td>1.61</td>
<td>0.0007</td>
<td>0.0026</td>
<td>2.05</td>
<td>0.0031</td>
<td>0.0052</td>
</tr>
<tr>
<td>16–19</td>
<td>1.81</td>
<td>0.0007</td>
<td>0.0026</td>
<td>1.64</td>
<td>0.0023</td>
<td>0.0038</td>
</tr>
<tr>
<td>19–35</td>
<td>1.90</td>
<td>0.0006</td>
<td>0.0023</td>
<td>1.32</td>
<td>0.0015</td>
<td>0.0025</td>
</tr>
<tr>
<td>35–65</td>
<td>0.96</td>
<td>0.0003</td>
<td>0.0011</td>
<td>1.17</td>
<td>0.0012</td>
<td>0.0021</td>
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<tr>
<td>&gt;65</td>
<td>0.33</td>
<td>0.0001</td>
<td>0.0004</td>
<td>1.01</td>
<td>0.0010</td>
<td>0.0017</td>
</tr>
</tbody>
</table>

*DI, daily intake; BW, body weight.*


