Foodborne Illness Outbreaks

Of all fresh produce, leafy green vegetables, including spinach, cause the most illnesses in the United States. In 2006, an outbreak of E.coli from uncooked spinach caused 3 deaths, 31 cases of kidney failure, and 199 cases of dehydration due to diarrhea, across 26 states. In 2012, an outbreak of E.coli 0157:H7 from spinach produced in Massachusetts sickened 33, 2 of whom developed hemolytic uremic syndrome.

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Year</th>
<th>Food Vehicle</th>
<th>Location</th>
<th>States Affected</th>
<th>Illnesses</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.coli O157:H7</td>
<td>2008</td>
<td>Spinach</td>
<td>US</td>
<td>N/A</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Salmonella</td>
<td>2007</td>
<td>Spinach</td>
<td>US</td>
<td>N/A</td>
<td>76</td>
<td>Unknown</td>
</tr>
<tr>
<td>E.coli O157:H7</td>
<td>2006</td>
<td>Spinach</td>
<td>International</td>
<td>14</td>
<td>238</td>
<td>5</td>
</tr>
<tr>
<td>E.coli O157:H7</td>
<td>2003</td>
<td>Spinach</td>
<td>California</td>
<td>1</td>
<td>46</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 1. Selected Foodborne Illness Outbreaks Attributed to Spinach, 2010-Present (Outbreak Database, 2016)

Pathogenic Behavior on Commodity

Like most produce, damaged skin on spinach can lead to greater risk of contamination. Pathogen cells prefer to collect on portions of spinach leaves which are damaged, as pathogens thrive off of nutrients leaked from the interior tissue of the leaf. Additionally, when pathogenic cells have access to damaged portions of leaves, they can spread to the interior of the leaf and render postharvest cleaning procedures ineffective. Water splash, direct soil contact, uncleaned preparation surfaces, and human touch are the greatest contamination risks to spinach. Studies have shown that bacteria multiply on damaged leaves at optimal growing temperatures, but do not grow on undamaged leaves.
Cooling and Storage Conditions for Commodity

Spinach is extremely perishable and will deteriorate quickly in warm conditions, with an accelerated loss of the folate and carotenoid content which contributes to its nutritional value. Spinach is ideally maintained in storage close to 32°F or 0°C, with high humidity levels. Cooling with top ice is permissible.

<table>
<thead>
<tr>
<th>Produce</th>
<th>Optimal Storage Temp., °C</th>
<th>Optimal Humidity (%)</th>
<th>Cooling with top ice acceptable</th>
<th>Cooling with water sprinkle acceptable</th>
<th>Ethylene Production</th>
<th>Ethylene Sensitivity to</th>
<th>Storage Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach</td>
<td>0</td>
<td>95-100</td>
<td>-</td>
<td>-</td>
<td>No</td>
<td>-</td>
<td>10-14 Days</td>
</tr>
</tbody>
</table>

Table 2. Storage and Cooling Conditions for Spinach (Fellow, 2000)

Good Agriculture Practices

- Test water periodically to assure that it is of appropriate microbial quality (e.g., meets U.S. EPA or WHO microbial standards for drinking water).
- Monitor and minimize domestic animal and wildlife activity in lettuce/leafy greens fields.
- Clean and sanitize ice-making equipment routinely
- Sanitize and clean cooling equipment on regular basis.
- Spinach placement and storage should not facilitate cross-contamination.
- Ensure workers follow sanitation protocol and never allow sick workers to handle spinach.
- Inspect all equipment in spinach production to ensure that no biofilm accumulation has occurred.

References


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This food safety factsheet can be downloaded at http://www.wku.edu/agriculture/index.php