Chapter 10: Bacillus Cereus

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Potential Food Safety Hazard

Food poisoning caused by Bacillus cereus may occur when foods are prepared and held without adequate refrigeration for several h before serving. B. cereus is an aerobic spore forming bacterium that is commonly found in soil, on vegetables, and in many raw and processed foods. Consumption of foods that contain ≥ 10⁶ B. cereus/g may result in food poisoning. Foods incriminated in past outbreaks include cooked meat and vegetables, boiled or fried rice, vanilla sauce, custards, soups, and raw vegetable sprouts. Two types of illness have been attributed to the consumption of foods contaminated with B. cereus. The first and better known is characterized by abdominal pain and diarrhea; it has an incubation period of 4-16 h and symptoms that last for 12-24 h. The second, which is characterized by an acute attack of nausea and vomiting, occurs within 1-5 h after consumption of contaminated food; diarrhea is not a common feature in this type of illness (Rhodehamel and Harmon, 1998).

Control Measures

B. cereus is a common food contaminant. Effective control measures depend on destruction by a heat process and temperature control to prevent spore germination and multiplication of vegetative cells in cooked, ready-to-eat foods. Measures to reduce or eliminate the threat of food poisoning by B. cereus include: 1) Avoid preparing food too far in advance of planned service, 2) Avoid holding cooked foods at room temperature, 3) Use quick chill methods to cool foods below 7.2 °C (45°F) within 4 h of preparation; store in shallow pans/small quantities with the food less than 4 inches (10.2 cm) deep; if food is especially thick (e.g., refried beans), store no
more than 3 inches [7.6 cm] deep). Hold/store hot foods above 60ºC (140ºF) until served, and 5) Reheat foods rapidly to 74ºC (165ºF) or above (Kramer and Gilbert, 1989; Reed, 1994).

**FDA Guidelines**

FDA to assess situations on a case by case basis.

**Growth**

**Table A-1.** Limiting conditions for pathogen growth.

**Heat Resistance**

*B. cereus* spore heat resistance.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Temperature (°F)</th>
<th>D-Values (min.)</th>
<th>Medium</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>194</td>
<td>21-137</td>
<td>Water</td>
<td>Gilbert et al., 1974</td>
</tr>
<tr>
<td>95</td>
<td>203</td>
<td>5-36</td>
<td>Water</td>
<td>Gilbert et al., 1974</td>
</tr>
<tr>
<td>100</td>
<td>212</td>
<td>6.7-8.3</td>
<td>Water</td>
<td>Gilbert et al., 1974</td>
</tr>
</tbody>
</table>

**Analytical Procedures**

Food sampling and preparation of sample homogenate (USFDA)

Definition of Terms (HC Appendix A); Collection of samples (HC Appendix B); Supplement to All Methods in the HC Compendium: General Microbiological Guidance (HC Appendix I) General Microbiological guidance on Pre-warming of Broths in All Qualitative Methods in the [HC] Compendium (HC Supplement to Appendix I)

*Bacillus cereus* (USFDA)

Isolation and enumeration of *Bacillus cereus* in foods (HC MFLP-42)

*Bacillus cereus* diarrheal enterotoxin (USFDA)

Other analytical procedures

- *Bacillus cereus* in foods: Enumeration and confirmation microbiological methods (AOAC, 1995a).
- Differentiation of members of *Bacillus cereus* group: Microbiological method (AOAC, 1995b).
Commercial Test Products

Commercial test products for \textit{B. cereus}.

<table>
<thead>
<tr>
<th>Test Kit</th>
<th>Analytical Technique</th>
<th>Approx. Total Test Time(^1)</th>
<th>Supplier</th>
</tr>
</thead>
</table>
| \textit{Bacillus cereus} Test [A presumptive test for \textit{Bacillus cereus}.] | Uses prepared traditional media | 24 h | Biomedix  
Contact: Claver Bundac  
1105 #F North Golden Springs Dr.  
Diamond Bar, CA 91765  
Phone: 800/674-8648 #4282;  
909/396-0244  
E-mail: cb4biomedx@aol.com |
| BCET-RPLA TD950 [Used to identify \textit{B. cereus} diarrheal enterotoxin] | Reversed passive latex agglutination | 24 h (food) 48 h (bacterial culture) | Oxoid, Inc.  
Contact: Jim Bell  
217 Colonnade Rd.  
Nepean, Ontario K2E 7K3 Canada  
Phone: 613/226-1318  
E-mail: jbell@oxoid.ca |
| CRA Bacillus diarrheal Enterotoxin VIA [Used to detect GDE toxin and \textit{Bacillus} spp. capable of producing enterotoxin] | ELISA | 4-24 h | InternationalBioProducts  
Contact: Mike Yeager  
14780 NE 95th St. Redmond, WA 98052  
Phone: 425/861-4918  
E-mail: mveyager@intlbioproducts.com  
Web: intlbioproducts.com |

\(^1\)Includes enrichment

References


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