The effect of biofilm on spore and toxin production for Bacillus cereus

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Abstract

Bacillus cereus (B. cereus) is a well-known foodborne pathogen that causes diarrhea and emesis. Spores, toxins, and biofilm formation are three main features of this bacterium that cause concern to the food industry. The relationship between these three properties is not fully understood. The objective of this project is to try to understand the role of biofilm in sporulation and toxin production of B. cereus, to help us better understand the safety issues related to biofilm formation in food processing.

Introduction

B. cereus is a well-known foodborne pathogen causing diarrhea and emesis. Spores, toxins, and biofilm formation are three main features of this bacterium causing concern to the food industry. The relationship between these three properties is not fully understood. The objective of this project is to try to understand the role of biofilm in sporulation and toxin production of B. cereus, to help us better understand the safety issues related to biofilm formation in food processing.

Spore formation

Tested strains: 3 potato isolates & 3 dairy isolates

Results

- Biofilm is better than planktonic growth for spores;
- Sporulation ability varies between strains.

Conclusions

- Biofilm is a source of spores than planktonic cells and spores harvested from biofilm have a higher heat resistance than those from planktonic cultures;
- The toxin production by stainless steel-grown biofilm was higher than planktonic cultures;
- The toxin production by biofilms depends on substratum.

Toxin production (Hbl, hemolytic toxin)

Tested strains: P5 (potato isolates, strong biofilm former)

Table 1 The interpretation of toxin production based on BCET-RPLA kit. ** means present of toxin, while “-” means absent.

<table>
<thead>
<tr>
<th>Test type</th>
<th>Plates</th>
<th>BCET-RPLA kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planktonic stainless steel wool</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Planktonic stainless steel wool</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Glass wool biofilm</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Glass wool biofilm</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Stainless steel wool</td>
<td>+++</td>
<td>++</td>
</tr>
</tbody>
</table>

Fig. 1 Comparison between biofilms and planktonic populations, in terms of spore formation and toxin production.

Fig. 2 Sporulation percentages in biofilms and planktonic cultures of B. cereus isolates grown in TSB medium after 3 days.

Fig. 3 Spores’ heat resistance grown in TSB, harvested from biofilm or planktonic populations: ** means p < 0.05, *** means p < 0.01, **** means p < 0.0001.

Results

- Spores harvested from biofilm are more heat resistant than those from planktonic culture;
- Heat resistance of spores varies between strains.

Conclusions

- Biofilm is a source of spores than planktonic cells and spores harvested from biofilm have a higher heat resistance than those from planktonic cultures;
- The toxin production by stainless steel-grown biofilm was higher than planktonic cultures;
- The toxin production by biofilms depends on substratum.

References