Content

- How do Thermodurics affect the quality and safety of milk and dairy products?
Incidence of spore formers in cheeses

- Aerobic and anaerobic spore formers have been associated with cheese.
- Clostridium species commonly involved in late blowing of cheese included:
  - C. sporogenes
  - C. tyrobutyricum
  - C. butyricum
- Aerobic bacilli have also been reported to be associated with blowing defects in cheese:
  - B. polymyxa in Cremoso and Mozzarella cheeses
  - B. marcerans in mozzarella and Taluhet cheeses

(Klijn et al., 1995; Bintsis and Papademas 2002; Quiberoni et al., 2008; Carmen Martínez-Cuesta et al., 2010)
What are some common cheese and whey spoilages?

- Spoilage of Cheddar cheese during storage
  - Flavor defects, bitterness, unclean flavors characteristic of atypical breakdown of proteins

- Production of biogenic amines in low fat and low salt cheese
  - Catabolism of amino acids involving deamination, decarboxylation, desulphuration, oxidation, and reduction

- Loss of functionality of whey proteins isolated and concentrated by ultrafiltration
  - Gel strength and foaming stability
Cheese defects and their relation to Thermodurics

<table>
<thead>
<tr>
<th>Defect</th>
<th>Organisms responsible</th>
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<tbody>
<tr>
<td>Late blowing of Cheddar</td>
<td>High numbers of citrate fermenting <em>Lactobacillus casei</em>, <em>Clostridium tyrobutyricum</em> from poor silage</td>
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<tr>
<td>Phenolic flavor Cheddar cheese</td>
<td>High numbers of citrate fermenting <em>Lactobacillus casei subsp. rhamnosus</em></td>
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<td>Grey spots in low-salt Cheddar</td>
<td><em>Clostridium butyricum</em> from dirty process equipment</td>
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<td>Cheese flavor</td>
<td>Thermoduric lactic acid bacteria (strains of <em>Streptococcus salivarius</em>, and <em>Lactococcus lactis</em>)</td>
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<td>Biogenic amines in low-salt and low-fat Cheddar style cheese</td>
<td>Fecal streptococci (<em>Enterococcus spp.</em>), strains of <em>Lactobacillus</em></td>
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<tr>
<td>Open texture defect in Cheddar style cheese</td>
<td><em>Clostridium spp.</em></td>
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Incidence of spore formers in milk powders

- The common bacilli constituting 92% of total bacterial population in milk powders include the following
  - *Geobacillus stearothermophilus*
  - *Bacillus licheniformis*
  - *Anoxybacillus flavithermus*

(Ruckert et al., 1992)
Milk powder related issues

- Bacteria present in raw milk are concentrated an estimated 10 times as milk powders are processed.
  - Spore counts of generally less than 50 cfu/mL in raw milk would thus become approximately 500 cfu/g even if no significant growth occurred during powder processing.
- It is thus important to start with high quality raw milk.

(McGuiggan et al., 2002; Rückert et al., 2004, 2006; Kim et al., 2009)
Cross contamination and build-up during powder manufacture

- Cross contamination does occur during manufacture of milk powders
- Favorable growth conditions within segments of the processing line support thermophilic growth during longer manufacturing cycles and formation of resistant biofilms
- Thermal operating conditions (between 45 to 75°C/113 to 167°F) may result in a build up of about 5 logs of thermophiles during processing
  - Bypassing the pre-heater reduced the growth of bacteria in the evaporation stage and ultimately reduced the numbers in milk powder
  - Limiting the production cycle to 12 hours substantially reduced thermophilic counts in the milk powder

(Murphy et al., 1999; Scott et al., 2007)
Aerobic sporeformers such as *Bacillus cereus* have been associated with finished milk products.

Although, not common, but have the potential to multiply to large numbers during milk processing and release enterotoxins causing food safety concerns.
Credits

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