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Dairy Thermodynamics

Module 5: Common Quality and Safety Issues Related to Milk Thermodynamics

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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

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



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)

Food safety issues

- ▶ 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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