Dairy Thermodurics

Module 6: Control of Thermodurics in Dairy Processing Plants

Content

- Control of thermodurics in processing plants

Control of thermoduric sporeformers

- Control in processing plant
  - Physical removal
  - Control biofilm formation
  - Inactivation

Spore reduction in plants

- Spore removal by centrifugation (Bactofuge)
  - Spores have higher density (1.2 to 1.3 gr/l) than vegetative cells
    - Anaerobic spores reduce by 98%
    - Aerobic spores reduce by 95%
  - Inclusion of bactofuge may extend the shelf life of pasteurized milk by up to 3 days
  - However, waste from this process may be as high as 5% of the raw material

(Kilcast and Subramaniam, 2000)

Spore removal by microfiltration (Bactocatch)

- Cross flow microfiltration using a 1.0 micron ceramic membrane can reduce spore by 4-5 log cycles
  - High retention levels (> 99.98%) have been observed for spore-formers, such as *Bacillus cereus,* using double layer MF membranes
- Combined microfiltration and pasteurization can reduce spores by 5-6 log cycles

(Olesen and Jensen, 1989; Saboya and Maubois, 2000)

Thermal inactivation of spores

- High heating UHT (150 - 200°C/ 302 - 392°F) for a fraction of second can inactivate most of the heat resistant spores
- Thermal shock and activation process
  - Heat shock is also the most likely mechanism of thermophilic spore activation and subsequent germination
  - Germination may result in enzyme and acid production and consequential development of off-flavors in the product

(Scott, 2007; Burgess, 2010)

Pressure assisted thermal processing (PATP)

- Intermittent high pressure treatment at 400 MPa is more effective than single treatment
  - High pressure induces spore germination
  - 500-700 MPa combined with 121°C/ 250°F for 1-2 min can reduce aerobic/anaerobic bacterial spores by 7-8 logs

(Johnson and Balasubramaniam, 2010)

Ultrasoniocation

- Low frequency ultrasound, which operates at 20 to 100kHz of frequency, produces vibrations of the molecules in liquid medium, thereby generating disruptive physical effects for inactivation of bacteria
- The phenomenon of such a violent implosion is known as ‘cavitation’.
- During cavitation, temperature and pressure are assumed to rise inside the bubble up to 5,500°C/ 9,932°F and 50MPa respectively, which are supposed to cause microbial inactivation
- The bactericidal effect of ultrasonication has been reported to depend on static pressure, amplitude of ultrasonic waves, and treatment temperature

(Raso et al., 1998; Villamiel et al., 2009; Bermúdez-Aguirre and Barbosa-Cánovas, 2011; Khanal and Anand 2013)

Other potential methods

- Natural antimicrobials (Nisin, Lysozymes, and Lactoferrin) in combination with heat and high pressure
- Pulsed Electric field
- Non thermal plasma processes
  - For inactivating spores embedded in biofilms

Credits

- Conceptualization, content, and analysis : Sanjeev Anand, Ph.D., Associate Professor, Dairy Science Department, South Dakota State University, SD 57007.
  Email: Sanjeev.anand@sdstate.edu. Phone: (605) 688-6648.

- Contributions from my M.S. students form some parts of the overall content of the Modules (I-VI): Mallika Avadhanula, Diwakar Singh, Som Nath Khanal, Sowmya Marka, and Kim Buehner, Dairy Science Department, South Dakota State University, SD 57007.
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