Cornell CALS
College of Agriculture and Life Sciences

MQIP
Milk Quality Improvement Program

The Laboratory Pasteurization Count: Thermoduric Bacteria in Raw Milk

Background and Overview

Milk Pasteurization was designed to provide a minimum time/temperature combination needed to inactivate the most heat-resistant, non-spore-forming, disease causing organism(s) associated with raw milk. The most common minimum temperatures and times used for the legal pasteurization of milk are:

- 161°F (72°C) for 15 seconds (High Temperature Short Time or HTST)
- 145°F (63°C) for 30 minutes (Batch or Vat Pasteurization

Pasteurization conditions that destroy the "most heat resistant pathogens" ensure that other potential pathogens are killed and have the added benefit of destroying many other types of bacteria, including those that cause spoilage.

While pasteurization is effective in reducing microbial risks, some bacteria survive pasteurization; these are called *thermoduric* bacteria and are mostly associated with contamination.

The Laboratory Pasteurization Count

A test that can determine the number of thermoduric bacteria in milk is the Laboratory Pasteurization Count (LPC). Lab pasteurization mimics batch pasteurization. LPC provides a good benchmark of the relative numbers of organisms that may be present in an HTST pasteurized milk sample. LPCs are generally lower than SPCs of unheated milk. Counts >300/ml are generally indicative of contamination.

High LPCs are often associated with persistent cleaning failures within the milking system. Common causes of high LPCs include:

- leaky pumps
- old and leaky pipe-line gaskets
- cracked inflations or other rubber parts
- milk stone deposits

The bacteria commonly associated with LPCs tend to be more resistant to hot water cleanings but are not generally capable of growth under refrigeration. However, a few strains, especially spore-formers, are capable of cold storage growth and can eventually cause spoilage. LPCs don't differentiate between bacteria that can and can't grow under refrigeration storage.

Thermoduric Bacteria in Pasteurized Milk

Thermoduric Strains: The initial microflora of pasteurized milk usually reflects the Gram-positive thermoduric organisms present in the raw milk. Gram-negative bacteria generally don't survive pasteurization, unless total bacteria in the raw milk exceed the thermal destruction capability. Specific processing parameters used for pasteurization will affect the relative proportions of bacterial types that survive pasteurization. Higher temperatures and/or longer times will tend to select for spore-forming bacteria.

Thermoduric Psychrotrophs: Most strains of thermoduric bacteria are not capable of reproducing in pasteurized milk under refrigeration. However, psychrotrophic strains of thermoduric bacteria have been identified in milk. Some milk defects associated with psychrotrophic are:

- "Sweet curdling" of milk
- "bitty" cream
- Bitter, yeasty, unclean, and rancid flavors
- Coagulation of milk proteins

Psychrotrophic Gram-positive organisms other than *Bacillus* spp. also may be responsible for limiting the shelf-life of pasteurized milk. Most thermoduric psychrotrophs, especially the spore-formers, tend to grow slower and/or later in milk products. Therefore, they generally cause quality concerns later in shelf-life and become predominant in the absence of faster growing post-pasteurization contaminants such as *Pseudomonas* spp.

Bacillus cereus as a Potential Foodborne Pathogen. Although common in milk, *B. cereus*, a potential foodborne pathogen, may not grow as well at lower refrigeration temperatures (<5°C) compared to refrigeration at higher temperatures (7°C). The possibility of foodborne illness caused by *B. cereus* and related organisms cannot be ruled out, especially with longer product sell-by dates and the potential for temperature abuse.

Want more information on Lab Pasteurization or the MQIP? Contact Nicole Martin (nicole.martin@cornell.edu) in the Milk Quality Improvement Program or visit our website https://foodsafety.foodscience.cornell.edu/mqip/

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