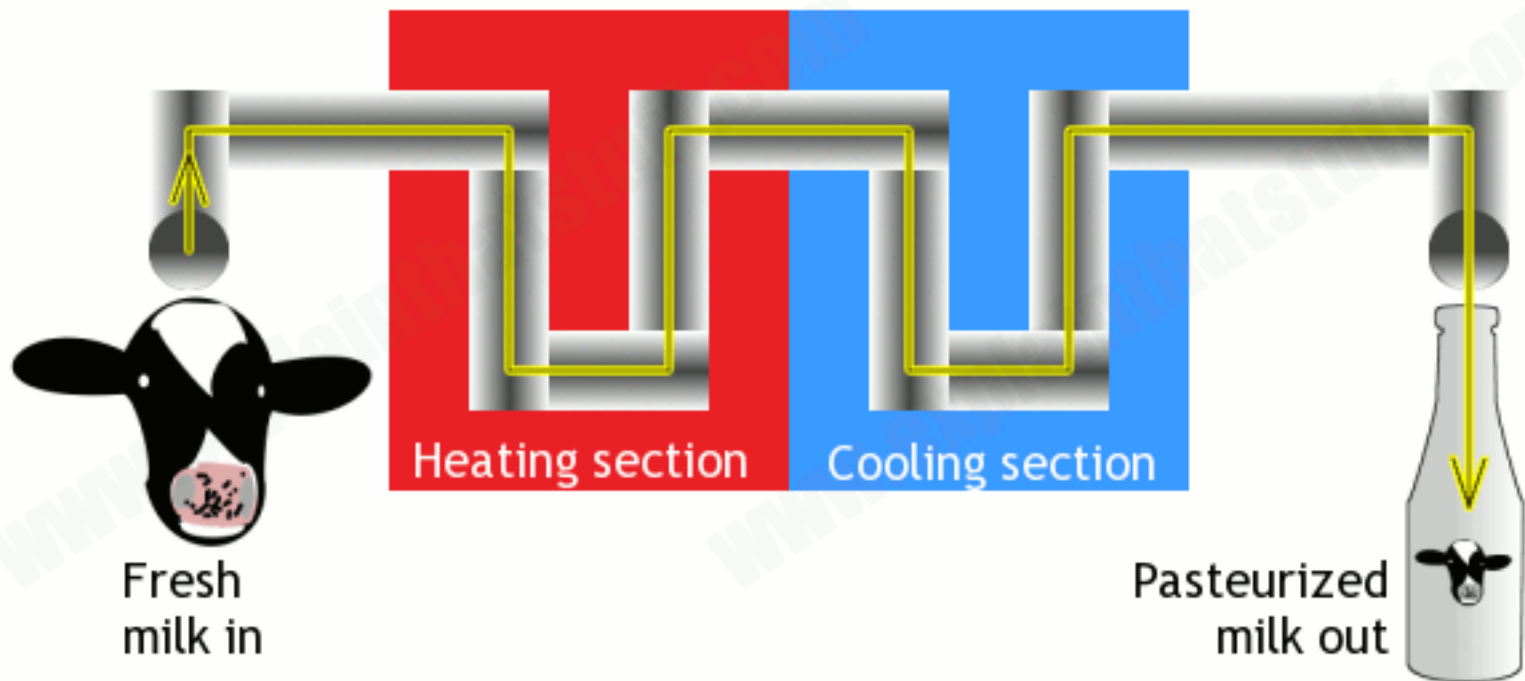


Microbiological Aspects of Heat Treatment



- Microbial load and incidence of the bacterial pathogens in foods are indicators of food quality as well as the sanitary conditions of its production.
- Poor microbiological quality of raw milk is due to bacterial contamination, inadequate packaging system and improper temperature control favour microbial growth and metabolism and brings in undesirable changes and shorten the shelf-life of milk.
- Processing techniques like **thermization, Low Temperature Long Time (LTLT) pasteurization, High Temperature Short Time (HTST) pasteurization, sterilization, ultra high temperature treatment, UV treatment, microwave treatment, membrane processing and microfiltration** can be adopted to treat raw milk to render it safe for human consumption by reducing or eliminating pathogenic microorganisms and to enhance the shelf-life by inactivating spoilage microorganisms.

- **Pasteurization** is widely adopted but not designed to sterilize milk and microbiological quality of pasteurized milk is governed by the initial flora of raw milk, the processing conditions and post-heat treatment contamination.
- Pasteurization ensures completely destruction of all pathogenic and spoilage microorganisms, commonly found in milk and inactivation or reduction of other non-pathogenic spoilage bacteria and certain undesirable enzymes to safeguard the food value of milk.
- **FAO/WHO (2004)** defined pasteurization as “A microbiocidal heat treatment aimed at reducing the number of any pathogenic microorganisms in milk and liquid milk products, if present, to a level at which they do not constitute a significant health hazard.

Pasteurization conditions are designed effectively destroy the organisms *Mycobacterium tuberculosis* and *Coxiella burnetii*. Initially, pasteurization conditions were devised to inactivate *M. tuberculosis* but subsequently, *C. burnetii* appeared as the most heat-resistant organism present in the milk and therefore, pasteurization was redesigned to achieve at least a 5-log reduction of *C. burnetii* in whole milk.

Efficiency of Pasteurization:

- **Pasteurization efficiency can be determined by Phosphatase test. Alkaline phosphatase, an enzyme naturally present in milk of all mammals have a thermal resistance greater than that of the most heat resistant non-spore-forming pathogens commonly found in milk and hence, its destruction confirms proper pasteurization. Positive Phosphatase activity is the indicative of inadequate pasteurization or contamination of pasteurized milk with raw milk or post-process bacterial contamination.**

Factors Affecting Microbiological Quality Of Pasteurized Milk

- **Type of milk:** Type of milk influences the shelf-life of milk due to diverse chemical composition and enzyme activity. Shelf-life of skim milk is lower than whole milk during storage at 4.5°C which may be attributed to relatively higher protease activity in the skim milk.
- **Microbiological quality of raw milk:** Depends on the microbial load as well as the type of organisms present in the raw milk. Raw milk may contain heat-resistant bacterial spores of different genera such as *Bacillus* spp. and *Paenibacillus* spp. and serve as the major source of *B. cereus* spores in pasteurized milk. Amongst psychrophilic, thermoduric and thermophilic organisms, psychrotrophs are the major contributor of total microbial flora in raw milk. Pasteurization will actually induce spore germination by eliminating competing flora and psychrotrophic spores will thus germinate and grow during refrigerated storage

- **Heat treatment employed:** Milk is generally subjected to High Temperature Short Time (HTST) pasteurization at 72°C/15 sec or the Low Temperature Long Time (LTLT) pasteurization at 63°C/30 min. Selection criteria should be based on the type and initial bacterial concentration in milk. It has been seen that both HTST and LTLT pasteurization of milk were efficacious in destroying *L. monocytogenes*, when present in lower concentration (10^2 CFU/mL) but not at higher concentration (10^7 CFU/mL).
- **Storage conditions:** Pasteurized milk has a shelf-life of 2-20 days and is dependent on quality of raw milk, processing method, hygienic conditions during filling and maintenance of temperature during the entire cold chain. Storage temperature has a greater influence on microbiological shelf-life of pasteurized milk and refrigerated pasteurized milk has a shelf-life of approximately 10-20 days when stored at 6.1°C.

It has been seen that a decrement in shelf-life of full cream pasteurized milk (31-11 days) and skimmed pasteurized milk with an elevation in storage temperature from 4-10°C due to more enhanced proteolytic and lipolytic activities of psychrotrophic microorganisms after 2-3 days at 10 C in contrast to 4-6 days at 4 C.

Post-pasteurization contaminants: Microbial spoilage of processed fluid milk is due to Gram (+) ve organisms surviving pasteurization temperatures or post-pasteurization contamination from Gram (-) ve bacteria. Detection of *L. monocytogenes*, *E. coli* *M. avium subsp paratuberculosis*, *Pseudomonas* spp. and bacterial phosphatase is attributed to a faulty pasteurization process, post-pasteurization contamination or improper post-pasteurization storage. Mesophilic aerobic counts of pasteurized milk (7×10^5 CFU/mL) enhanced 2-4 fold increase as it left the pasteurizing unit due to contamination with **utensils** used for holding and the **plastic sheets used for packaging of pasteurized milk**. Post-pasteurization contaminations of milk products are mainly due to the **filling machines and gaskets with biofilms**.

HTST pasteurization is ineffective in destroying spore-forming bacteria. Spores from milk can be removed employing Bactofugation or Microfiltration. Greater removal of aerobic spores from milk is employing Microfiltration (99.1-99.9%) than Bactofugation (94-98%). Microfiltration of milk for 10 min employing 0.8 μm membrane, capable of removing 5.91 ± 0.05 log 10 spores/mL prior to HTST pasteurization (72°C/18.6 sec) is recommended and the pasteurized milk obtained showed no growth of spore-forming bacteria up to 7 days when stored at 4°C.

THE DEBATE OVER PASTEURIZATION



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