Unit D: Milk Production and Quality

Lesson 2: Pasteurization

Terms

- Caesin
- Coagulation
- Ecological succession
- Fermentation
- Metabolize
- Pasteurization
- pH
- Putrefaction
- Spoilage

What is the composition of milk?

- Cow's milk consists of about 87% water and 13% total solids.
  - This 13% total solids includes both fat and solids-not-fat (SNF).
  - Principal components of SNF include protein, lactose, and minerals.
  - Fat content varies by species and breed (in dairy cattle).
  - ***Caesin***, the principal protein of milk, accounts for about 80% of the milk protein.

What is the composition of milk?

- Milk composition can vary from the following factors:
  - Feed
  - Stage of lactation
  - Health of animal
  - Age of animal
  - Seasonal conditions
  - Environmental conditions

What is the composition of milk?

- Milk fat is considered to be the most complex of all common fats.
- Whole milk contains about 3.3% fat, while skim milk contains .2% fat.
- Milk is an emulsion of fat in water.
- The emulsion is stabilized by phospholipids that are absorbed on the fat globules.
- The emulsion is broken during such treatments as homogenization and churning.

How is raw milk processed and what is the pasteurization process?

- Raw milk must be processed for various reasons after a cow is milked.
  - Processing operations for fluid milk include:
    - Cream separation
    - Centrifugal sediment removal
    - Pasteurization
    - Sterilization
    - Homogenization
    - Membrane separation (separation of milk components)
    - Packaging
    - Handling
    - Storing

How is raw milk processed and what is the pasteurization process?

- ***Pasteurization*** is the process of heating milk to a certain temperature to kill the bacteria present in the milk. Pasteurized milk is milk which has been heat-treated to kill pathogens which cause disease.
  - Not all pathogens are removed during the pasteurization process, so pasteurized milk is not 100% sterile, but many people consider it to be safer to drink than raw milk which has not been pasteurized at all.
  - The bulk of the milk sold in commercial grocery stores is pasteurized, and much of it is also homogenized to prevent the cream from separating.
  - A high number of microorganisms in raw milk suggest that it was produced under unsanitary conditions or that it was not adequately cooled after removal from the cow. If pasteurized products contain excessive numbers of bacteria, then pasteurization contamination occurred or the product was not properly refrigerated.

How is raw milk processed and what is the pasteurization process?

- There are several different pasteurization techniques which can be used to make pasteurized milk. The goal of pasteurization is to render the milk safe to drink without curdling or coagulating it, and without altering the flavor substantially, although people who are accustomed to drinking unpasteurized milk may find that pasteurized milk has an “off” flavor.
  - Raw milk and pasteurized products are examined for microbial growth using the agar plate method or the direct microscopic method. Raw milk may sometimes have lower microbial populations than pasteurized milk, depending on the stage of microbial growth.

How is raw milk processed and what is the pasteurization process?

- In high temperature/short time (HTST) pasteurization, the milk is brought to a temperature of 161 degrees Fahrenheit (71.7 degrees Celsius) and held there for 15 to 30 seconds before being rapidly cooled and packaged.
  - Double pasteurization splits the process up into two segments, and is not recognized as a legal pasteurization method by some governments.
  - Extended shelf life (ESL) milk is pasteurized at a slightly lower temperature and passed through a special filter to remove microbes.
  - Ultra high temperature (UHT) pasteurization involves bringing the milk to 250 degrees Fahrenheit (138 degrees Celsius) for less than a second, while batch pasteurization is performed at a very low temperature, with the milk being held to temperature for 30 minutes before being cooled.

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- Bacterial succession is the main cause of spoilage in pasteurized milk.
  - Although most bacteria are killed during the pasteurization process, some bacteria survive.
  - ***Ecological succession*** is a gradual process whereby the species population in a community changes through establishment of a new species population that may gradually replace the original inhabitants.

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- The succession of microbes in pasteurized milk follows the same sequence observed in unpasteurized milk:
  - Streptococci
  - Lactobacilli
  - Yeasts and molds
  - Bacillus species

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- The sequence of changes in microbial populations is due to the changing chemical environment brought about by the metabolic processes of the microorganisms.
- To ***metabolize*** is to subject to the chemical and physical changes constantly taking place in living matter.

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- Streptococci break down the milk sugar (lactose) to lactic acid in a process called ***fermentation***, the slow decomposition of sugars by microorganisms to form lactic acid.
- ***pH*** is the term used to describe the hydrogen ion activity of a system; a measure of the acidity or alkalinity of a solution.
- As lactic acid is produced, the acidity of the milk increases to a point where further streptococci growth is inhibited and lactobacilli begin to grow.

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- Lactobacilli multiply and metabolize remaining lactose into more lactic acid until lactobacilli growth is also inhibited by the acidity of the milk.
- Lactic acid sours the milk and causes the curdling, or coagulation, of proteins.
- ***Coagulation*** is the formation of noncrystalline solids, especially proteins, from solutions; the act or state of becoming viscous, jelly-like, or solid not by evaporation, but by chemical reaction.
- Yeasts and molds grow well in this acidic environment, metabolizing acid into non-acidic products.

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- Finally, Bacillus species multiply in the environment where proteins are the only nutrient source available.
- Bacillus species metabolize protein into ammonia products, and the pH rises.
- These bacteria also digest the remaining protein through enzymatic action.
- Milk ***spoilage***, any change in a food product that makes it unacceptable for consumption, is evident at this point by the odor of the milk.

What is the bacterial succession in milk and how can the process of milk spoilage be explained?

- pH changes in milk are brought about by microbial activity.
- Fluctuations in pH are due to fermentation and the ***putrefaction***, the chemical decomposition of plants and animals after death, processes.
- Spoiled pasteurized milk usually tastes and smells bitter, sour, rancid, and sometimes putrid.
- After the milk proteins and sugars have been fermented, resulting amino acids and peptides give the milk bitter or putrid flavors.

Review/Summary

- What is the composition of milk?
- How is raw milk processed and what is the pasteurization process?
- What is bacterial succession in milk and how can the process of milk spoilage be explained?