Question: Milk Processing
Using what we’ve talked about in class, along with what you may know outside of class, brainstorm what kinds of processes raw milk goes through before it gets to us.

Answer:
1. Cream separation
2. Pasteurization
3. Homogenization
4. Packaging
5. Handling
6. Storing

Student Learning Objectives
1. Describe the composition of milk.
2. Explain the processing of raw milk and the pasteurization process.
3. List and describe bacterial succession in milk and explain the process of milk spoilage.

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

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1. Describe the composition of milk.
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What is the composition of milk?

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

B. Milk composition can vary from the following factors:
   1. Feed
   2. Stage of Lactation
   3. Health of animal
   4. Age of animal
   5. Seasonal conditions
   6. Environmental conditions

C. Milk fat is considered to be the most complex of all common fats.
   1. Whole milk contains about 3.3% fat
   2. Skim milk contains 0.2% fat.
   3. 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.

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

A. Processing operations for fluid milk include a lot of steps:
   1. Cream separation
   2. Centrifugal sediment removal
   3. Pasteurization
   4. Homogenization
   5. Membrane separation (separation of milk components)
   6. Packaging
   7. Handling
   8. Storing

B. Pasteurization is the process of heating milk to a certain temperature to kill the bacteria present in the milk. 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.

C. 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.
D. Homogenization is the process of forcing milk through a small screen to decrease the size of the fat particles, and increase their uniformity.

- Homogenization helps stabilize the emulsion of fat in water that occurs in milk
- This keeps the milk from separating over time.

**WARM-UP**

**Question:** Homogenization

What is the process of homogenization, and what does it do to milk?

**Answer:**
- Homogenization is the process of forcing milk through a small screen to decrease the size of the fat particles, and increase their uniformity.
- It helps stabilize the emulsion, which keeps the milk from separating over time.

**Student Learning Objectives**

- 1. Describe the composition of milk.
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- 3. List and describe bacterial succession in milk and explain the process of milk spoilage.

**What is 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.
- A. Although most bacteria are killed during the pasteurization process, some bacteria survive.
- Ecological succession is a process where the microbial population changes via a new species gradually replacing the original species.
The succession of microbes in pasteurized milk follows the same sequence observed in non-pasteurized milk:

1. Streptococci
2. Lactobacilli
3. Yeasts and molds
4. Bacillus species

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.

1. 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.

2. Lactobacilli: multiply and metabolize remaining lactose into more lactic acid (even lower pH) 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.

3. Yeasts and molds: grow well in this acidic environment and are able to metabolize acid into non-acidic products.

4. 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.

The 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 the 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?

**Milk Review Questions**

Take out a sheet of paper and answer the following questions. (This will be due by the end of class)

1. Cow’s milk is made up of what percentage of water and what percentage of total solids?
2. What are total solids made up of?
3. Name 2 factors that can vary the composition of milk.
4. Whole milk is what percentage of fat? What about skim milk?
5. What is the process of homogenization? What does homogenization help stabilize?
6. What is bacterial succession in milk and how can the process of milk spoilage be explained?