

GOT MILK?

Background

Food Processing and Preservation

Food processing is the set of methods and techniques used to transform raw ingredients into food for consumption. Food processing occurs from the farm to the table. Several food processing methods are used to preserve foods. Over the years, these methods have been improved to increase the shelf-life of foods while minimizing changes to the quality and nutritional content. Some methods to preserve food include:

- Refrigeration and freezing
- Canning
- Irradiation
- Dehydration
- Freeze-drying
- Salting
- Pickling
- Pasteurizing
- Fermentation

All of these processes work by slowing down the activity and growth of disease-causing bacteria, or by killing the bacteria all together. They also slow down or stop the action of enzymes which can degrade the quality of the food. How a food is processed can affect its appearance, odor, flavor, and texture.

Milk Processing and Preservation

Most milk sold in grocery stores and markets in the United States undergoes some sort of processing, mainly pasteurization and homogenization. These processes greatly increase the safety and the shelf-life of milk. In fact, in the U.S. it is illegal to sell raw (unpasteurized) milk because of the high risk of foodborne illness.

Pasteurization: Pasteurization is the process of heating liquids to destroy disease-producing bacteria as well as yeasts, molds, viruses, and less harmful bacteria.



High Temperature, Short Time

The most common method used to pasteurize milk is high temperature, short time (HTST) pasteurization. In this process, milk is heated to 161°F for 15 seconds or 145°F for 30 minutes. The pasteurized milk is then immediately cooled to 45°F to minimize the growth of surviving organisms. Milk that is HTST pasteurized must still be refrigerated and has a shelf-life of about 2 to 3 weeks.

Ultra High Temperature

Another method used to pasteurize milk is called ultrapasteurization or ultrahigh temperature (UHT). In this process, milk is heated to 275-300°F for 2-4 seconds. The high temperature kills off more bacteria and gives the product a longer shelf life. The milk is also immediately cooled after ultrapasteurization. If the ultrapasteurized milk is packaged in a sterile environment in aseptic packages, the product can last on the shelf (unrefrigerated) for over 6 months.

Homogenization: Homogenization is the process by which whole pasteurized milk is treated so that the fat globules are decreased in size to the extent that there is no separation of fat from the milk serum (the portion of the milk that contains water, carbohydrates, proteins, and minerals). Most milk purchased in the United States is homogenized; otherwise, the fat portion of the milk would separate from the serum portion.

Whole Milk: Whole milk must contain a minimum of 3.25% milk fat and contain 8.25% milk solids, not fat (mainly carbohydrates, protein, and minerals). Both milkfat and milk solids, not fat, may be added or removed during processing to meet these criteria.

Skim Milk: Skim milk is milk that has had as much of the fat drawn off as possible. It must contain less than 0.5% fat, a minimum of 8.25% milk solids, not fat, and must be fortified with 2,000 IU (International Units) of vitamin A per quart.

Lactose-Free Milk: Lactose-free milk is pasteurized, ultrapasteurized, or UHT-processed milk that has been treated with lactase to reduce the lactose content by 100%. Lactase is an enzyme that converts milk sugar, or lactose, into glucose and galactose. People who are lactose intolerant don't make enough lactase to fully digest lactose themselves. As a result, people who are lactose intolerant may experience mild to severe side effects within 30 minutes to 2 hours of eating dairy; however, the effects are not life threatening. Lactose intolerance should not be confused with cow's milk allergy, in which people experience an allergic reaction to the protein in milk that can be life threatening. Lactose-free milk is sweeter than untreated milk because the sugars glucose and galactose are sweeter than lactose.

Nonfat Dry Milk: Nonfat dry milk is made from pasteurized skim milk that has had the water removed. It contains less than 5% moisture and 1.5% milkfat, unless otherwise labeled. To manufacture nonfat dry milk, first two-thirds of the water is removed under pressure to form concentrated milk. Then the concentrated milk is dried by spraying the concentrated milk into a heated vacuum. This process is called spray-drying. The result is a fine powder that can be dissolved in warm water upon stirring. Nonfat dry milk is most commonly used in areas where there is no access to refrigeration.

Evaporated Milk: Evaporated milk is manufactured by removing about 60% of the water from homogenized whole milk by heating it under a vacuum. The evaporated milk must be sealed in a container and sterilized at 240-245°F for 15 minutes to prevent bacterial spoilage. Evaporated milk is usually light brown in color due to a reaction between the sugar in milk (lactose) and the protein in milk. This reaction is called the Maillard reaction. It also results in changes to the flavor of the milk. According to the United States Food and Drug Administration (FDA), evaporated milk must contain at least 6.5% by weight of milkfat and 23% total milk solids. If evaporated milk is packaged in a can, it may have a metallic flavor.

Sweetened Condensed Milk: Sweetened condensed milk is obtained by evaporating fresh milk sweetened with sucrose or dextrose (or both) to a point where the finished product contains no less than 28% milk solids and 8% milkfat. Sweetened condensed milk does not need to be sterilized like evaporated milk because of the high sugar content, which is sufficient to prevent spoilage. Sweetened condensed milk is often used to make sweetened desserts. If sweetened condensed milk is packaged in a can, it may have a metallic flavor.

References

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.



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Administrator's Guide

Grade levels: 8-12

Estimated Preparation Time: 30 minutes

Estimated Demonstration Time: 30 minutes

Standard Addressed: Content Standard F (Science and Technology in Local, National and Global Challenges)

Individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits, and consideration of who benefits and who suffers, who pays and who gains, and what the risks are and who bears them. Students should understand the appropriateness and value of basic questions—"What can happen?"—"What are the odds?"—and "How do scientists and engineers know what will happen?"

Reference:

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

Objectives:

- To introduce food processing and food science to students
- To demonstrate the effects different processing methods have on the sensory properties of food products

Materials:

- Whole milk
- Skim milk
- Lactose-free milk
- Nonfat dry milk
- Sweetened condensed milk
- Shelf-stable ultra high temperature milk
- Water
- Crackers
- Cups (enough for each member of the class to try each sample)
- Trays (enough for each member of the class)



Be aware that some students may have food allergies or sensitivities. Alternatives: This demonstration can also be done with orange juice (from concentrate, not from concentrate, fresh squeezed, canned, orange juice drink, and Tang orange drink mix).

Set-up Procedures:

1. Hydrate powdered milk according to package directions.
2. Label cups with random three-digit codes.
 - For example: Whole milk (753), Skim milk (026).
 - Record the number used for each sample.
3. Pour each type of milk into appropriately labeled cups.
4. Assemble the trays. Put one of each sample (in random order) on a tray along with crackers and a cup of water.
5. Bring samples to room temperature prior to serving.

Demonstration Procedures:

1. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis. Be aware that some students may have food allergies or sensitivities.
 2. Give each student a tray.
 3. Review the tasting guidelines on the student handout:
 - i. Smell the sample by wafting the odor to your nose. Take an open hand with the palm towards your body and move your arm in a rapid clockwise circular manner over the sample so as to lift vapors of the substance towards the nose. Record any odor that you smell.
 - ii. Take a small sip, and with the mouth closed, not swallowing any of the milk, move your tongue moderately five or six times to assure that the rear of the tongue also comes into contact with the sample. At the same time, inhale and exhale slowly through the nose. This forces the aroma through the back of the nose, making it possible to note the aroma. Record any flavors that you perceive.
 - iii. Spit out the sample quickly and notice the aftertaste. Hold the sample in your mouth no longer than about ten seconds. Holding it longer will dull your senses of taste and smell.
 - iv. If necessary, repeat the procedures as a further check on your findings. Sometimes it may be necessary to go on to the next sample, and come back later for a recheck. However, in order to avoid confusion and develop more confidence in your decision, do not recheck a sample any more than is necessary.
 - v. It is advisable to allow a short interval of time between tasting samples. Also, in between samples, take a sip of water and eat a bite of cracker.
 4. Ask students to taste products from left to right and record their observations about color, taste, smell, and mouth-feel on the ballot provided.
 5. Remind students to take a sip of water and eat a bite of cracker between samples.
 6. Ask students to share some of their observations
 7. Discuss how each type of milk is processed and why the processing would affect the flavor (see background).
- Extension:** Discuss standards of identity and labeling. Some information is included in the background. For more detailed information, visit: www.gpo.gov/nara/cfr/waisidx_02/21cfr131_02.html.



Data Sheet:

<i>Sample #</i>						
<i>Attribute</i>						
<i>Appearance</i>						
<i>Odor</i>						
<i>Flavor</i>						
<i>Mouth-feel</i>						

Data Sheet:

<i>Sample #</i>						
<i>Attribute</i>						
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Student Handout

Background: Food processing is the set of methods and techniques used to transform raw ingredients into food for consumption. Several food processing methods are used to preserve foods. Over the years, these methods have been improved to increase the shelf-life of foods while minimizing changes to the quality and nutritional content. Some methods to preserve food include:

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Objectives: To investigate the effects of processing techniques on the sensory properties of food



Instructions: To taste each sample of milk, follow these procedures:

1. Taste samples one at a time from left to right.
2. Look at the first sample and record the sample number and the color of the milk sample on your data sheet.
3. Smell the sample by wafting the odor to your nose. Take an open hand with the palm towards your body and move your arm in a rapid clockwise circular manner over the sample so as to lift vapors of the substance towards the nose. Record any odor that you smell.
4. Take a small sip, and with the mouth closed, not swallowing any of the milk, move your tongue moderately five or six times to assure that the rear of the tongue also comes into contact with the sample. At the same time, inhale and exhale slowly through the nose. This forces the aroma through the back of the nose, making it possible to note the aroma. Record any flavors that you perceive.
5. Spit out the sample quickly and notice the aftertaste. Hold the sample in your mouth no longer than about ten seconds. Holding it longer will dull your senses of taste and smell.
6. If necessary, repeat the procedures as a further check on your findings. Sometimes it may be necessary to go on to the next sample, and come back later for a recheck. However, in order to avoid confusion and develop more confidence in your decision, do not recheck samples any more than is necessary.
7. It is advisable to allow a short interval of time between tasting samples. Also, in between samples, take a sip of water and eat a bite of cracker.

Some Potential Dairy Terms:

<i>Appearance</i>	<i>Odor</i>	<i>Flavor</i>	<i>Mouth-feel</i>
Transparent (can see through it)	Buttery	Buttery	Watery
Opaque (can't see through it)	Feed (grassy)	Feed (grassy)	Thick
Glossy/shiny	Metallic	Metallic	Slick/Smooth
White	Cooked	Cooked	
Blue	Musty	Musty	
Yellow	Rancid (like it's gone bad)	Rancid (like it's gone bad)	
		Bitter	
		Salty	
		Sweet	
		Acidic (sour)	

Conclusion Questions:

1. Did the milk samples taste different?

2. If so, which attributes (appearance, odor, flavor, and/or mouth-feel) were most different?

3. What about the way in which the samples were processed might have influenced these sensory properties?
