PASTEURIZATION ROLE IN PACKAGED MILK

Dr. L. Ramesh[1] & Mrs. Poornima.S[2]
[1]*Principal, Bharathiar University Arts and Science College-Gudalur, The Nilgiris*
[2]*Ph. D Research Scholar, Bharathiar University Arts and Science College-Gudalur, The Nilgiris*

Abstract
Pasteurization is a hundred-year-old process that destroys pathogens through simple heat, and is best known for its role in making milk and juices safe for consumption. French chemist and microbiologist Louis Pasteur invented this straightforward food safety technique in 1864. Pasteurization, named for Louis Pasteur who developed the process for other foods, is a moderate but exact heat treatment of milk. Pasteurization kills bacteria that produce disease and retards spoilage in milk. Pasteurization destroys most disease producing organisms and limits fermentation in milk, beer, and other liquids by partial or complete sterilization. The pasteurization process heats milk to 161 degrees Fahrenheit (63 degrees centigrade) for 15 seconds, inactivating or killing organisms that grow rapidly in milk. Pasteurization does not destroy organisms that grow slowly or produce spores. The articles we reviewed, however, clearly suggest that the risk of microbial hazards in raw milk is substantially higher than in pasteurized milk. Further, raw milk is more likely to contain pathogens that are very harmful.
Keywords: Milk, Pasteurization, Pathogens, Micro organisms, Machine used for Milk pasteurization

Introduction

Milk a natural liquid food, is one of our most nutritionally complete foods, adding high-quality protein, fat, milk sugar, essential minerals, and vitamins to our diet. However, milk contains bacteria that--when improperly handled--may create conditions where bacteria can multiply. Most of the bacteria in fresh milk from a healthy animal are either harmless or beneficial. But, rapid changes in the health of an animal, or the milk handler, or contaminants from polluted water, dirt, manure, vermin, air, cuts, and wounds can make raw milk potentially dangerous.

What is pasteurization?

Pasteurization is a process that kills microbes (mainly bacteria) in food and drink, such as milk, juice, canned food, and others.

It was invented by French scientist Louis Pasteur during the nineteenth century. In 1864 Pasteur discovered that heating beer and wine was enough to kill most of the bacteria that caused spoilage, preventing these beverages from turning sour. The process achieves this by eliminating pathogenic microbes and lowering microbial numbers to prolong the quality of the beverage. Today, pasteurization is used widely in the dairy industry and other food processing industries to achieve food and food safety.

Unlike sterilization, pasteurization is not intended to kill all microorganisms in the food. Instead, it aims to reduce the number of viable pathogens so they are unlikely to cause disease (assuming the pasteurized product is stored as indicated and is consumed before its expiration date). Commercial-scale sterilization of food is not common because it adversely affects the taste and quality of the product. Certain foods, such as dairy products, may be superheated to ensure pathogenic microbes are destroyed.

Pasteurization can be done as a batch or a continuous process. A vat pasteurizer consists of a temperature-controlled, closed vat. The milk is pumped into the vat, the milk is heated to the appropriate temperature and held at that temperature for the appropriate time and then cooled. The cooled milk is then pumped out of the vat to the rest of the processing line, for example to the bottling station or cheese vat. Batch pasteurization is still used in some smaller processing plants. The most common process used for fluid milk is the continuous process. The milk is pumped from the raw milk silo to a holding tank that feeds into the continuous pasteurization system. The milk continuously flows from the tank through a series of thin plates that heat up the milk to the appropriate temperature. The milk flow system is set up to make sure that the milk stays at the pasteurization temperature for the appropriate time before it flows through the cooling area of the pasteurizer. The cooled milk then flows to the rest of the processing line, for example to the bottling station. There are several options for temperatures and times available for continuous processing of refrigerated fluid milk. Although processing conditions are defined for temperatures above 200 °F, they are rarely used because they can impart an undesirable cooked flavor to milk.

Pasteurization destroys most disease producing organisms and limits fermentation in milk, beer, and other liquids by partial or complete sterilization. The pasteurization process heats milk to 161 degrees Fahrenheit (63 degrees centigrade) for 15 seconds, inactivating or killing organisms that grow rapidly in milk. Pasteurization does not destroy organisms that grow slowly or produce spores.

While pasteurization destroys many microorganisms in milk, improper handling after pasteurization cans recontamination milk. Many dairy farms use a home-pasteurizing machine to pasteurize small amounts of milk for personal use. Raw milk can also be pasteurized on the stovetop. Microwaving raw milk is not an effective means of pasteurization because of uneven heat distribution. For more information on purchasing and caring for home pasteurization machines, contact your county Extension agent.

Ultra-high temperature (UHT) processing destroys organisms more effectively and the milk is essentially sterilized and can be stored at room temperature for up to 8 weeks without any change in flavor.

What are the requirements for safe handling of milk?

The requirements for proper pasteurization and handling of milk are:

- A potable water supply and proper dispensing system must be available to avoid contamination. A pure hot and cold water supply for the animals' health, and for proper cleaning of the animals, milk handlers and utensils. Regular inspection and maintenance of the system is necessary.

Clean and healthy animals, clean hands, and clean utensils are essential. The animals' hair should be clipped regularly around the flanks and udder to keep it from collecting dirt. Milkers should walk their hands and the udder with clean water or use an approved germicidal solution before milking. Milk from diseased animals or those under antibiotic treatment may not be used. All equipment and utensils should be cleaned immediately after use. Stainless steel utensils are preferred since they are durable and easy to clean.

- Rapid cooling, cold storage, proper pasteurization, and clean cold storage of pasteurized are necessary for the prevention of food borne illness. Milk must be promptly cooled to 40°F (4°C) or less and stored in a closed container before and after pasteurization to maintain the quality and flavor of the milk. Care should be taken not to transfer barnyard dirt from the bottom or sides of the storage container to the countertop or to utensils in the pasteurization and storage areas. Do not mix fresh milk with previously cooked milk unless you plan to pasteurize the entire batch immediately.

How do I pasteurize milk?

Milk must be heated, with agitation, in such a way that every particle of the milk, including the foam, receives a minimum heat treatment of 150°F (66°C) continuously for 30 minutes or 161°F (72°C) for 15 seconds. The temperature should be monitored with an accurate metal or protected glass thermometer. Commercial operations commonly use a high temperature, short-time process in which the milk is heated to 170°F (77°C) for 15 seconds and then cooled immediately to below 40°F (4°C) to increase storage life without any noticeable flavor change in the milk.

Nutritional Components in Milk

Energy

The energy in milk comes from its protein, carbohydrate and fat content, with the exception of skim milk that has virtually no fat. Food provides energy to the body in the form of calories (kcal). There are many components in food that provide nutritional benefits, but only the macronutrients protein, carbohydrate and fat provide energy. The energy value of a food is calculated based on the calories provided by the amount of protein (4 kcal/gram), carbohydrate (4 kcal/gram), and fat (9 kcal/gram) that is present in the milk .

Water

Milk is approximately 87% water, so it is a good source of water in the diet. Water does not provide a nutritional benefit in the same manner as proteins or vitamins, for example. However, water is extremely important in human metabolism. Water is a major component in the body. Water maintains blood volume, transports nutrients like glucose and oxygen to the tissues and organs, and transports waste products away from tissues and organs for elimination by the body. Water helps to lubricate joints and cushions organs during movement. Water maintains body temperature regulation through sweating. Lack of water (dehydration) results in fatigue, mental impairment, cramping, and decreased athletic performance.

Carbohydrate

Milk is approximately 4.9% carbohydrate in the form of lactose. Carbohydrates are the primary source of energy for activity. Glucose is the only form of energy that can be used by the brain. Excess glucose is stored in the form of glycogen in the muscles and liver for later use. Carbohydrates are important in hormonal regulation in the body. Lack of adequate levels of glucose in the blood and carbohydrate stores leads to muscle fatigue and lack of concentration.

Fat

Milk is approximately 3.4% fat. Fats are a structural component of cell membranes and hormones. Fats are a concentrated energy source and are the main energy source used by the body during low intensity activities and prolonged exercise over 90 minutes. Fat is the main storage form of excess energy in the body. Fats cushion organs during movement. The fatty acids in milk fat are approximately 65% saturated, 29% monounsaturated, and 6% polyunsaturated.

Protein

Milk is approximately 3.3% protein and contains all of the essential amino acids. Proteins are the fundamental building blocks of muscles, skin, hair, and cellular components. Proteins are needed to help muscles contract and relax, and help repair damaged tissues. They play a critical role in many body functions as enzymes, hormones, and antibodies. Proteins may also be used as an energy source by the body. Milk protein consists of approximately 82% casein and 18% whey (serum) proteins. Both casein and whey proteins are present in milk, yogurt, and ice cream.

Vitamins

Vitamins have many roles in the body including metabolism co-factors, oxygen transport and antioxidants. They help the body use carbohydrates, protein, and fat.

(i) The content of vitamin A in milk

Vitamin A is a fat soluble vitamin involved in vision, gene expression, reproduction, and immune response. Milk contains retinol, retinal esters, and ß-carotene. Dairy products are a good source of vitamin A, although the vitamin A content will vary with the fat content of the product. An 8 oz serving of 2% milk contains approximately 15% of the daily reference intake (DRI) for vitamin A.

(ii) The content of thiamin (vitamin B1) in milk

Thiamin is a water soluble vitamin that is an enzyme cofactor involved in the metabolism of carbohydrates and branched chain amino acids. An 8 oz serving of 2% milk contains approximately 8% of the DRI for thiamin.

(iii) The content of riboflavin (vitamin B2) in milk

Riboflavin is a water soluble vitamin that is an enzyme cofactor involved in electron transport reactions. Milk is a recommended source of riboflavin and an 8 oz serving of 2% milk provides approximately 35% of the DRI for riboflavin.

(iv)The content of niacin (vitamin B3) in milk

Niacin is a water soluble vitamin that is an enzyme cofactor involved in electron transport reactions required for energy metabolism. There is a small amount of niacin in milk, an 8 oz serving of 2% milk contains less than 2% of the DRI for niacin.

(v)The content of Pantothenic acid (vitamin B5) in milk

Pantothenic acid is a water soluble vitamin that is an enzyme cofactor in fatty acid metabolism. Milk is a good source of Pantothenic acid and an 8 oz serving of 2% milk contains approximately 17% of the DRI for Pantothenic acid.

(vi)The content of vitamin B6 (pyridoxine) in milk

Vitamin B6 is a water soluble vitamin involved in the metabolism of proteins and glycogen (energy stored in the liver and muscles), and in the metabolism of sphingolipids in the nervous system. An 8 oz serving of 2% milk contains approximately 7% of the DRI for vitamin B6.

(vii)The content of vitamin B12 (coalmine) in milk

Vitamin B12 is a water soluble vitamin involved in protein metabolism and blood functions. Milk is a recommended source of vitamin B12. An 8 oz serving of 2% milk contains approximately 47% of the DRI for vitamin B12.

(viii)The content of vitamin C in milk

Vitamin C is a water soluble vitamin that is an important antioxidant. It has a role in collagen formation in connective tissue and helps in iron absorption and healing of wounds and injuries. There is a negligible amount of vitamin C in milk, and a serving of milk contains less than 1% of the DRI for Vitamin C.

(ix)The content of vitamin D in milk

Vitamin D is a fat soluble vitamin that is important in maintaining blood calcium and phosphorus balance and assists calcium metabolism. Milk is typically fortified with vitamin D. Fortified milk is a good source of vitamin D, and an 8 oz serving of 2% milk contains over 50% of the DRI for vitamin D.

(x) The content of vitamin E in milk

Vitamin E is a fat soluble vitamin that has antioxidant activity. The compounds with vitamin E activity are the tocopherols and tocotrienols. Milk contains a small amount of vitamin E, which increases with increasing fat content of dairy products. An 8 oz serving of whole milk contains 1% vitamin E, and an 8 oz serving of 2% milk contains only 0.5% of the DRI for vitamin E.

(xi)The content of Folate in milk

Folate is one of the water soluble B vitamins. Folate is an enzyme cofactor important in the metabolism of proteins and nucleic acids and blood functions. There is a small amount of Folate in milk. An 8 oz serving of 2% milk contains 3% of the DRI for Folate.

(xii) The content of vitamin K in milk

Vitamin K is a fat soluble vitamin involved in blood clotting, bone metabolism, and protein synthesis. Milk contains a small amount of vitamin K, which increases with the fat content in dairy products. An 8 oz serving of milk contains less than 1% of the DRI for vitamin K.

Minerals

Minerals have many roles in the body including enzyme functions, bone formation, water balance maintenance, and oxygen transport. They help the body use carbohydrates, protein, and fat. The content of calcium in milk is shown in the Nutrient Content Tables. Calcium plays an essential role in bone formation and metabolism, muscle contraction, nerve transmission and blood clotting. Dairy products are a significant source of calcium in the diet. Milk is a recommended source of calcium, and an 8 oz serving contains almost 30% of the DRI for calcium.

(i) The content of copper in milk

Copper is a component of enzymes used in iron metabolism. Milk contains a small amount of copper. An 8 oz serving of 2% milk contains approximately 3% of the DRI for copper.

(ii) The content of iron in milk

Iron is a component of blood and many enzymes. It is involved in blood metabolism and oxygen transport. Milk contains a small amount of iron, and an 8 oz serving of milk contains less than 1% of the DRI for iron.

(iii) The content of magnesium in milk

Magnesium is an enzyme cofactor and is important in bone metabolism. Milk is a recommended source of magnesium, and an 8 oz serving of 2% milk contains approximately 7% of the DRI for magnesium.

(iv) The content of manganese in milk

Manganese is involved in bone formation, and in enzymes involved in amino acid, cholesterol, and carbohydrate metabolism. There is a small amount of manganese in milk. An 8 oz serving contains less than 1% of the DRI.

(v) The content of phosphorus in milk

Phosphorus is involved in maintaining body pH, in storage and transfer of energy, and in nucleotide synthesis. Milk is a recommended source of phosphorus, and an 8 oz serving of milk contains over 30% of the DRI for phosphorus.

(vi)The content of potassium in milk

Potassium is an electrolyte that is important in the maintenance of water balance, blood volume and blood pressure. Dairy products are a recommended source of potassium, and an 8 oz serving of milk contains approximately 8% of the DRI for potassium.

(vii) The content of selenium in milk

Selenium is important in oxidative stress response, electron transport, and regulation of thyroid hormone. Milk is a good source of selenium, and an 8 oz serving of 2% milk contains approximately 11% of the DRI for selenium.

(viii) The content of sodium in milk

Sodium is an electrolyte that is important in the maintenance of water balance and blood volume. An 8 oz serving of milk contains approximately 7% of the DRI for sodium.

(x) The content of zinc in milk

Zinc is a component of many enzymes and proteins, and is involved in gene regulation. Milk is a good source of zinc, and an 8 oz serving contains approximately 10% of the DRI for zinc.

Minor Biological Proteins & Enzymes

Other minor proteins and enzymes in milk that are of nutritional interest include lactoferrin and lactoperoxidase.

Lactoferrin is an iron binding protein that plays a role in iron absorption and immune response. Many other functions of lactoferrin have been proposed, but their confirmation is still under study, including protection against bacterial and viral infections, and it's role in inflammatory response and enzyme activity.

Lactoperoxidase is an enzyme that, in the presence of hydrogen peroxide and thiocyanate, has antibacterial properties. The use of lactoperoxidase as an antimicrobial agent is discussed in the section on Antibacterial Properties of Milk in this website.

Lactoperoxidase does not provide antimicrobial protection to fresh milk because hydrogen peroxide is not normally present in milk .

Lipases, a group of enzymes that break down fats, are present in milk but are inactivated by pasteurization, which increases the shelf life of milk. A popular belief among raw milk consumers is that the native lipase in milk plays an important role in the digestion of fat. Fat digestion begins in the stomach with gastric lipase, and the majority of fat digestion occurs in the small intestine, using enzymes secreted by the pancreas. The relative importance of the native milk lipase in digestion compared to the pancreatic lipases is not clear.

Lactase (ß-galactosidase) is the enzyme responsible for the breakdown of lactose into glucose and galactose for digestion. There is no lactase present in fresh milk. Any lactase present in milk products comes from lactic acid bacteria that are either added to milk on purpose, as in the case of yogurt and cheese, or that enter milk from airborne or other contamination. A popular belief is that people with lactose intolerance are able to drink raw milk but not pasteurized milk because the lactase present in raw milk is inactivated during pasteurization. Because there is no lactase present in fresh milk, this concept is a myth. People with lactose intolerance have, themselves, lower levels of lactase which creates problems when it comes to digesting large amounts of lactose in a timely manner. Naturally occurring lactase used to digest milk is normally secreted by the small intestine. Lactase found in any lactic acid bacteria present will minimally help to digest lactose when it is released as the milk is digested in the small intestine.

Objectives of the Study

- To study the overview of pasteurization of milk
- To analysis the methods and technique used for pasteurization
- To identify the merits and demerits of pasteurization

Review of literature

Almost every article reviewed on the topic of milk-related outbreaks directly stated that pasteurization substantially reduces the risk of microbial contamination and should always be strongly recommended or required (e.g. (Langer et al. 2012) (Lejeune and Rajala-Schultz 2009) (Gould et al. 2014) (David 2012)). Many studies have investigated microbial risks by reviewing outbreaks of infectious intestinal diseases reported to health agencies in the United States and other countries. As infections from pathogenic bacteria and viruses are sporadic, epidemiologists rely 9 on determining causes of outbreaks through retrospective analyses of surveillance data. (Langer et al. 2012) provides one of the most extensive reviews of outbreaks from both nonpasteurized and pasteurized dairy products. This article identified 121 outbreaks from 1993-2006 associated with dairy products through the Centers for Disease Control and Prevention's (CDC) Foodborne Disease Outbreak surveillance system. 60% of these outbreaks were from nonpasteurized dairy products. Only 36% of total cases (i.e. infected individuals) from all the outbreaks were from nonpasteurized dairy products, but among these cases there was a higher proportion hospitalized; 13% as opposed to the 1% hospitalization rate from pasteurized dairy product cases. Individuals affected by nonpasteurized outbreaks were more likely to be young children and to reside in states that permit the sale of nonpasteurized milk. The authors found that half of the pasteurized dairy product outbreaks were caused by norovirus, a pathogen with a human reservoir and therefore likely contaminated products post-pasteurization. This study highlighted the high proportion of nonpasteurized outbreaks, especially considering that consumption rate of nonpasteurized dairy products ranges from 1-3.5% of all dairy products. The authors estimate that the relative risk of individual illness is almost 150 times greater per unit of nonpasteurized dairy product, compared to pasteurize

Similar findings were observed in other reviews of outbreaks. (Lejeune and Rajala-Schultz 2009) mentions numerous additional raw milk outbreaks reported to the CDC since 2006. (Newkirk et al. 2011) looked at U.S. milkborne outbreaks from 1990-2006 and found that 55.4% of the 83 outbreaks were associated with unpasteurized milk. (Oliver et al. 2009) found that from 2000-2008, 8 of 10 U.S. milkborne outbreaks were due to consuming raw milk. (Leedom 2006) mentions a study that reviewed 23 foodborne outbreaks from 1980-1982 caused by Campylobacter species; 14 were associated with raw milk. (Gillespie et al. 2003) reported milkborne outbreaks in England and Wales from 1992-2002. Fifteen of the 27 outbreaks during this time period were from unpasteurized milk, mostly due to Salmonella species, Escherichia coli strain VTEC O157 and Campylobacter jejuni. Finally, (De Buyser et al. 2001) reviewed reported outbreaks from France, U.S., Finland, Netherlands, UK, Germany, and Poland. Of the 22 milkborne outbreaks considered, 10 were from raw milk, and of the 27 cheese-associated outbreaks, 21 were from cheese made from raw milk.

Methods of pasteurization

Temperature	Time Pasteurization	Type
63°C (145°F)*	30 minutes	Vat Pasteurization
72°C (161°	15 seconds	High temperature short time Pasteurization (HTST)
89°C (191°F)	1.0 seconds	Higher-Heat Shorter Time (HHST)
90°C (194°F)	0.5 seconds	Higher-Heat Shorter Time (HHST)
94°C (201°F)	0.1 seconds	Higher-Heat Shorter Time (HHST)
96°C (204°F)	0.05 seconds	Higher-Heat Shorter Time (HHST)
100°C (212°F)	0.01 seconds	Higher-Heat Shorter Time (HHST)
138°C (280°F)	2.0 seconds	Ultra Pasteurization (UP)

If the fat content of the milk product is ten percent (10%) or more, or if it contains added sweeteners, or if it is concentrated (condensed), the specified temperature shall be increased by 3ºC (5ºF). Provided that, eggnog shall be heated to at least the following temperature and time specifications:

Temperature	Time Pasteurization	Type
69ºC (155ºF)	30 minutes	Vat Pasteurization
80ºC (175ºF)	25 seconds	High temperature short time Pasteurization (HTST)
83ºC (180ºF)	15 seconds	High temperature short time Pasteurization (HTST)

The original method of pasteurization was vat pasteurization, which heat milk or other liquid ingredients in a large tank for a at least 30 minutes. It is now used primarily in the dairy industry for preparing milk for making starter cultures in the processing of cheese, yogurt, and buttermilk and for pasteurizing some ice cream mixes.

The most common method of pasteurization in the United States today is High Temperature Short Time (HTST) pasteurization, which uses metal plates and hot water to raise milk temperatures to at least 161° F for not less than 15 seconds, followed by rapid cooling. Higher Heat Shorter Time (HHST) is a process similar to HTST pasteurization, but it uses slightly different equipment and higher temperatures for a shorter time. For a product to be considered Ultra Pasteurized (UP), it must be heated to not less than 280° for two seconds. UP pasteurization results in a product with longer shelf life but still requiring refrigeration.

Another method, aseptic processing, which is also known as Ultra High Temperature (UHT), involves heating the milk using commercially sterile equipment and filling it under aseptic conditions into hermetically sealed packaging. The product is termed "shelf stable" and does not need refrigeration until opened. All aseptic operations are required to file their processes with the Food and Drug Administration's (FDA) "Process Authority." There is no set time or temperature for aseptic processing; the Process Authority establishes and validates the proper time and temperature based on the equipment used and the products being processed.

Important of Pasteurization:

Pasteurization is important because it kills harmful bacteria. Raw milk and dairy products can contain microorganisms such as Salmonella, E. coli and Listeria that cause food-borne illnesses.

Many health problems result from unpasteurized milk, such as tuberculosis, listeriosis, typhoid fever, diphtheria and brucellosis. Symptoms of illnesses caused by unpasteurized milk are vomiting, diarrhea, abdominal pain, fever, headaches and body aches. Women who contract the Listeria bacteria from unpasteurized milk while pregnant can have miscarriages.

The pasteurization process occurs when milk is heated to just below boiling temperatures. This process was invented by Louis Pasteur in the 1800s as a way to keep milk fresher longer. Two types of pasteurization are in use today. In the high-temperature, short-time treatment process, milk is run between metal plates and heated pipes for 15 seconds. Pasteurized milk, contrary to some claims, does not cause lactose intolerance or milk allergies and does not lessen nutritional value. It also does not last when stored outside of the refrigerator.

Although most milk and dairy products in the United States undergo pasteurization, there are some exceptions. Some soft cheeses use unpasteurized milk in the crafting process and can be harmful. These raw milk cheeses include Brie, Camembert, queso fresco, queso panela, asadero and queso blanco.

Comparison between Pasteurized milk and Raw Milk:

Raw Milk

Raw (unpasteurized): “raw” or “unpasteurized” refers to a dairy product that has received no heat treatment to destroy pathogens or spoilage organisms. WAPF promotes a more refined definition for raw milk, termed “real milk,” that also includes organic, non-homogenized, “grass fed,” and produced from certain breeds of cattle as criteria.

Pasteurized Milk

Pasteurization was named after Louis Pasteur, who discovered the process for the preservation of wine. When talking about milk, pasteurization refers to the heating of milk or milk products to a certain temperature for a 2 specific period of time. The purpose of pasteurization is to destroy disease causing and spoilage organisms. The Grade A Pasteurized Milk Ordinance allows for different combinations of time and temperature: • High Temperature Short Time (HTST): uses metal plates and hot water to raise milk temperatures to at least 161° F for not less than 15 seconds following by rapid cooling • High Heat Short Time (HHST): similar to HTST, but uses slightly different equipment and higher temperatures for a shorter time • Ultra Pasteurized (UP): milk is heated to not less than 280° F for two seconds • Ultra High Temperature (UHT): milk is heated until sterile Among these methods, only UHT milk is sterile (shelf stable), and does not require refrigeration. The other methods of pasteurization do not destroy all organisms, thus milk whether raw or pasteurized eventually spoils, and must be refrigerated to prevent the growth of pathogens.

Homogenized Milk

Homogenization is a process that breaks the fat globules in milk into smaller particles, which prevents the cream layer from separating and floating to the top of the milk. Most conventional pasteurized milk is homogenized whereas organic pasteurized milk and raw milk are often non-homogenized.

Raw Bovine Colostrums

Colostrums is the "first milk" produced by the mammary gland of an animal after giving birth. Consumption of raw bovine colostrums appears to be increasing in popularity among raw milk drinkers unlike raw milk, raw bovine colostrums is regulated as a nutritional supplement

General causes of intentional contamination of pasteurized milk:

- Equipment failure: The pasteurization equipment fails and there is raw milk in the product sold as pasteurized. This can happen if the temperature is not high enough, or if the milk is not heated long enough.
- Post-pasteurization contamination: the milk is contaminated after pasteurization, usually through unsanitary handling of the milk.

Effects of pasteurization on the nutritional value of milk

Pasteurization destroys 100% of pathogenic bacteria, yeast and mould and 95% to 99% of other bacteria.

Although the sale of raw milk is prohibited in Canada, some people nevertheless believe in the virtues of this product, claiming that pasteurization destroys important vitamins and that drinking raw milk can prevent or treat allergies, cancer or lactose intolerance. But is this really true?

To find out, researchers in Ontario reviewed and analyzed 40 studies on the effects of pasteurization and the nutritional value of milk. The first finding: pasteurization has a small effect on the vitamins naturally found in milk. And contrary to raw milk, which only contains a small amount of vitamin D, pasteurized milk is fortified with this vitamin, which promotes calcium absorption and plays a key role in bone health. Only levels of riboflavin, or vitamin B2, decrease significantly during the pasteurization process. Nevertheless, pasteurized milk is still an important dietary source of this vitamin.

Benefits of pasteurized milk:

Pasteurization destroys microorganisms that can appear in milk and cause illnesses, such as tuberculosis, typhoid fever, scarlet fever, sore throat, diphtheria and gastrointestinal ailments. It's also meant to counter organisms that lead to the souring of milk. The process involves heating the milk to temperatures between 150 to 300 degrees Fahrenheit and then cooling it. Pasteurization destroys bacteria that cause souring; pasteurized milk has a longer shelf-life than raw milk.

Pasteurization is a simple process in which milk is heated to 161° F for 15 seconds. This safe, well-tested process turns raw milk into the pasteurized milk that you can buy at the grocery store. Currently, with many people turning towards “whole foods” and away from processed foods, some people are questioning the benefits of pasteurized milk and milk products. Is pasteurized milk really safer? Is it just another form of processing that should be eliminated?

Raw milk can be a source of pathogens that cause foodborne illness that can result in sickness, hospitalization and death. This is because milk may be contaminated in a variety of ways. Pathogens can be spread through feces, water, soil that may be on the cow’s udder, sores on the teats, or from the hands of the dairy worker. Microorganisms such as Salmonella, Listeria, Yersinia, Campylobacter, Staphylococcus, Mycobacterium bovis, Coxiella burnetii, Brucella, and E. coli are killed or greatly reduced by pasteurization.

Although some claim that raw milk has improved nutritional value, cures diseases, and even tastes better, raw milk has no scientifically documented health benefits. It is strongly discouraged for children, those that are pregnant, elderly, and those with weakened immune systems because they have the greatest risk of food borne illness from raw milk and milk products. Pregnant women also run the additional risk of miscarriage. Is pasteurized milk really safer? Yes! Pasteurization is not just another form of processing that should be eliminated. It is not a process that is mandated to save time or money, but rather a process that is designed for the safety of the consumer.

Disadvantages of Pasteurized Milk

Pasteurization kills dangerous germs, but it also destroys beneficial bacteria and other nutritious constituents. Pasteurized milk have lower levels of nutrients compared with raw milk. Pasteurization destroys all microbes in milk, including lactic acid bacilli, which are beneficial to health, enhancing the gastrointestinal and immune systems. Additionally, according to Sally Fallon, a nutritional researcher and author of "Nourishing Traditions," pasteurization alters milk's amino acids; promotes rancidity of fatty acids; destroys vitamins A, D, C and B12; and reduces the minerals calcium, chloride, magnesium, phosphorus, sodium and sulphur, as well as many trace minerals. Furthermore, the heating in pasteurization destroys the enzymes in milk, which otherwise help the body assimilate nutrients, especially calcium. Often, some synthetic vitamins are added back to pasteurized milk, however, without milk's natural enzymes, they are difficult to digest. Pasteurized milk tends to taste inferior to raw milk

Conclusion

The articles we reviewed, however, clearly suggest that the risk of microbial hazards in raw milk is substantially higher than in pasteurized milk. Further, raw milk is more likely to contain pathogens that are harmful to susceptible populations such as young children, the elderly, and individuals with chronic illnesses. Milk purveyed by present methods may contain dirt and pathogenic organisms. Dirt may be tolerated, but pathogenic organisms should be permitted no longer. Cattle infections contaminating milk while in the udder and a variety of organisms introduced to milk later by human handling are to-day causing sickness; the amount of this has not yet been completely estimated, but it has been shown clearly by many workers to be extensive. The eradication of these infections among human beings cannot be left to await a Utopian state where diseased cattle have been eliminated and all milking is mechanically performed in such a manner that external contamination is no longer possible. Universal compulsory pasteurization presents the only method of preventing the spread of cattle infections and the contamination of milk by human handling. In present study by the above observation and finding, it can be concluded that one of the important reason for the milk adulteration. Unhygienic milking, handling of milk, failure in cold chain maintenance during transport, post pasteurization contamination, personal and utensil hygiene and contaminated adulterated ingredients are the main factors responsible for the microbial deterioration of the milk.

References

- Lejeune JT, Rajala-Schultz PJ. 2009. Food safety: Unpasteurized milk: A continued public health threat. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 48:93-100.
- Gao A, Mutharia L, Chen S, Rahn K, Odumeru J. 2002. Effect of pasteurization on survival of mycobacterium paratuberculosis in milk. Journal of dairy science 85:3198-3205.
- Namminga, Kelly, (1999), “Health Risks of Drinking Raw (Unpasteurized) Milk,” http://www.abs.sdstate.edu/flcs/ecoli/milk.htm, South Dakota State University, Brookings, SD (reviewed by E. Kim Cassel, SDSU Extension Dairy Specialist). Smith, P. W., (August 1981), “Milk Pasteurization” Fact Sheet Number 57, U.S. Department of Agriculture Research Service, Washington, D.C.
- Compiled by Cindy Brock, Extension Educator, Food Safety Area of Expertise Team, Cheboygan, Montmorency, and Presque Isle Counties, Michigan State University Extension
- Reviewed by John Partridge, Ph.D., Professor, Food Science and Human Nutrition, Michigan State Universe
- Bradley J, Pickering LK, Jareb J. Advise families against giving children unpasteurized milk. AAP News. 2008:29(12):29.
- Oliver SP, Boor KJ, Murphy SC, Murinda SE. Food safety hazards associated with consumption of raw milk. Foodborne Pathogens and Disease. 2009;6(7):793-806.
- The dangers of raw milk: Unpasteurized milk can pose a serious health risk. Food and Drug Administration Web site. http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm079516.htm. Accessed April 7, 2010.