

Major steps in milk processing

Milk processing begins with collection from dairy farms under hygienic conditions. The milk is transported to processing units under chilled temperatures to control microbial growth. At the dairy plant, milk undergoes quality testing to determine fat content, solids-not-fat (SNF), and acidity. The next step involves filtration and clarification to remove physical impurities such as dirt or foreign particles. Standardization is then carried out to adjust fat and SNF levels according to product requirements.

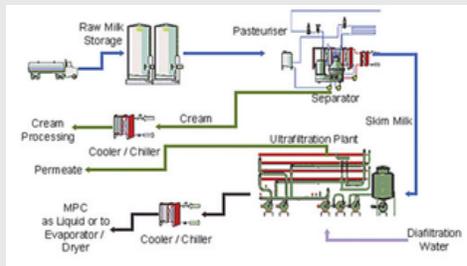


Fig: Milk Production and Processing Flow Chart
(Source: <https://www.sciencedirect.com/>)

Pasteurization follows as the most important step, where milk is heated to a specific temperature for a defined time to destroy harmful microorganisms without significantly affecting nutritional quality. Common methods include Low Temperature Long Time (LTLT) (– 63°C for 30 minutes), High Temperature Short Time (HTST) (– 72°C for 15 seconds), and Ultra High Temperature (UHT) (– 135–150°C for 2–5 seconds) processing.

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INTRODUCTION

Milk is one of the most important and widely consumed animal-derived foods across the world. It is considered a nearly complete food because it contains essential nutrients required for growth, development, and maintenance of human health. Rich in high-quality proteins, calcium, vitamins, and energy-providing fats, milk plays a crucial role in child growth, bone strength, and immune support. However, due to its high moisture content and rich nutrient composition, milk is highly perishable and prone to microbial spoilage. Therefore, scientific milk processing becomes essential to ensure safety, extend shelf life, and deliver high-quality dairy products to consumers.

Composition and nutritional importance of milk

Milk is a complex biological fluid containing approximately 87 percent water, which serves as a medium for dissolved nutrients. The major solid components include proteins such as casein and whey, milk fat, lactose (milk sugar), and essential minerals. Calcium and phosphorus are present in significant amounts and contribute to bone and teeth development. Milk also supplies vitamins such as A, D, riboflavin (B2), and vitamin B12, which support vision, metabolism, and red blood cell formation. Due to this balanced nutritional profile, milk is often described as a protective food suitable for people of all age groups.

Need for milk processing

Freshly drawn milk may contain harmful microorganisms introduced during milking, handling, transportation, or storage. In warm climatic conditions, bacterial growth increases rapidly, leading to souring and spoilage within a few hours. Milk processing is therefore essential to destroy pathogenic microorganisms, reduce spoilage organisms, standardize quality, and enhance storage stability. Proper processing not only ensures consumer safety but also improves market value and allows long-distance transportation.

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Milk and Milk Processing

संकलन

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Homogenization is performed to break down fat globules into smaller sizes, preventing cream separation and providing uniform texture. Finally, milk is rapidly cooled and packed in hygienic containers such as pouches, bottles, or cartons before distribution.

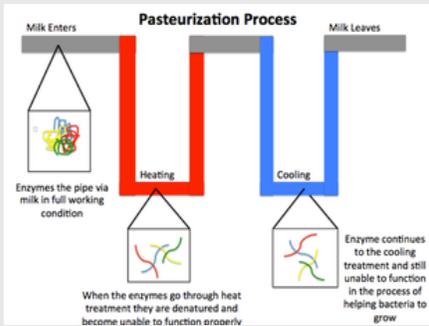


Fig: Schematic Representation of Pasteurization Process
(Source: <https://www.sciencedirect.com/>)

Types of processed milk

Depending on fat content and processing methods, different types of milk are available in the market, including whole milk, standardized milk, toned milk, double-toned milk, skimmed milk, flavoured milk, and fortified milk enriched with vitamins A and D. These variations allow consumers to select products according to nutritional needs and health preferences.

Value addition and dairy products

Milk processing also enables the production of a wide range of value-added dairy products. Fermented products such as curd and yogurt improve digestibility and enhance gut health. Traditional products like butter, ghee, and paneer are widely consumed in households. Industrial processing produces cheese, ice cream, condensed milk, and milk powder with extended shelf life. Value addition not only increases product diversity but also improves profitability for dairy farmers and processors while reducing post-harvest losses.

Hygiene and quality control in milk processing

Maintaining hygiene throughout the milk value chain is essential to ensure product safety. Clean milking practices, sanitized equipment, cold chain maintenance, and proper packaging play vital roles in preventing contamination. Quality control measures such as fat testing, lactometer readings, acidity determination, and microbial tests are regularly conducted to ensure compliance with safety standards. Strict adherence to food safety regulations helps build consumer trust and sustain dairy industry growth.

Packaging and storage

Proper packaging protects milk from contamination and environmental exposure. Modern packaging materials such as polyethylene pouches and aseptic cartons enhance shelf life and convenience. Refrigerated storage at around 4°C is necessary for pasteurized milk, while UHT milk can be stored at room temperature until opened. Maintaining appropriate storage conditions is essential to preserve freshness and quality.

Future prospects in milk processing

The dairy industry is undergoing rapid technological advancements, including automated milking systems, improved cold chain logistics, digital quality monitoring, and production of functional dairy products. Increasing demand for probiotic, lactose-free, organic, and fortified milk products is expanding market opportunities. Sustainable dairy practices and value-added innovations are expected to strengthen rural livelihoods and contribute to national nutritional security.

CONCLUSION

Milk processing is a critical component of the dairy value chain that ensures safety, quality, and economic viability. Through scientific processing, hygienic handling, and value addition, milk can be transformed into a wide variety of nutritious and safe products. Strengthening milk processing infrastructure and quality control systems will play a significant role in supporting dairy farmers, enhancing consumer health, and promoting sustainable food systems.