

Milk Processing

(Raishabh Dangi, Upasna Mishra and *Suhana Puri Goswami)

Medi-caps University, Indore, Madhya Pradesh, India

*Corresponding Author's email: suhana.goswami@medicaps.ac.in

The milk processing and dairy industry are pivotal components of global agriculture and food production, encompassing a multifaceted chain of activities aimed at providing safe and nutritious dairy products to consumers worldwide (FAO, 2018). Beginning with the collection of raw milk from dairy farms, this process involves meticulous quality testing and transportation to processing facilities (Haque *et al.*, 2017).

Upon arrival at the processing plant, raw milk undergoes pasteurization, a crucial step designed to eliminate harmful bacteria and extend the product's shelf life (WHO, 2020). Pasteurization entails heating the milk to a specific temperature for a defined duration, followed by rapid cooling, effectively eradicating pathogens while preserving the majority of its nutritional content (USDA, 2020). This process ensures the safety and quality of dairy products, contributing to consumer confidence and public health.

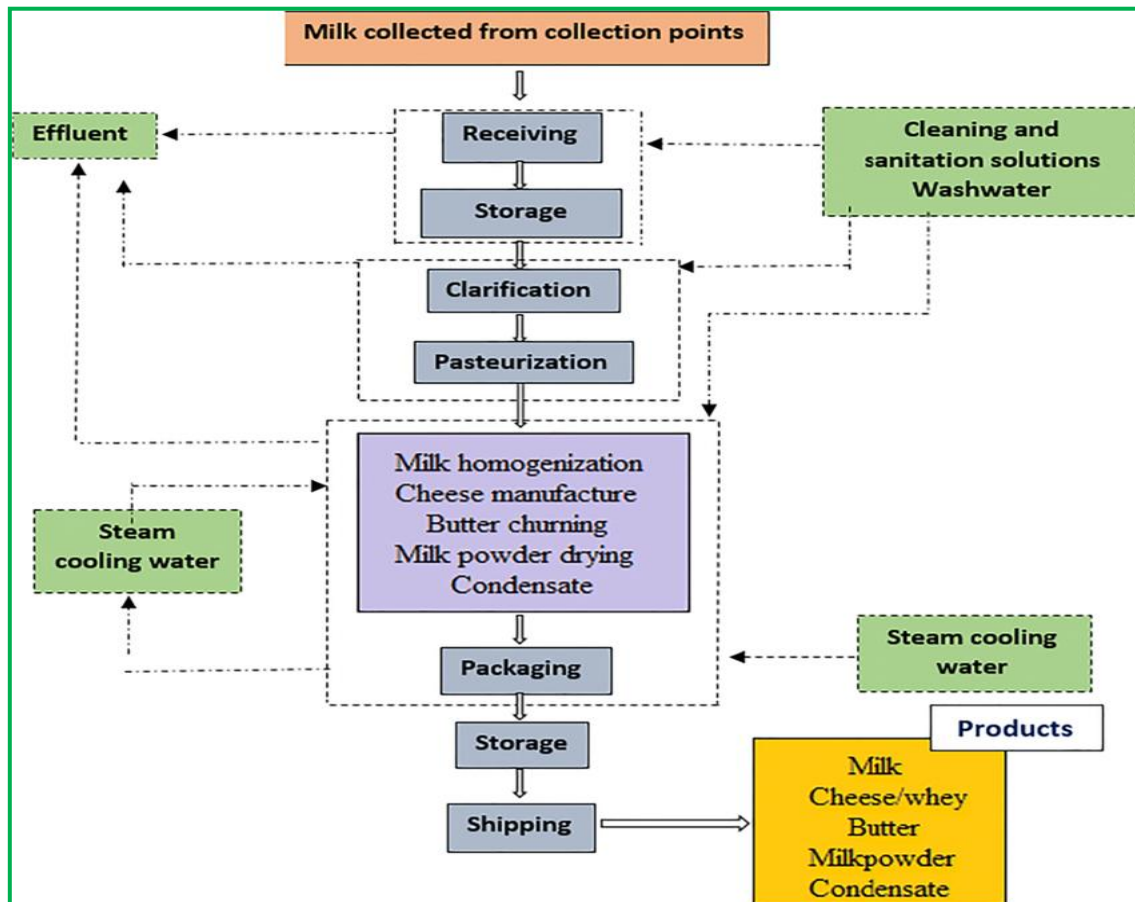
Pasteurization milk may undergo homogenization to break down fat globules and ensure a uniform texture, thereby preventing cream separation (Santillo *et al.*, 2020). Depending on the intended end product, milk can be transformed into a diverse array of dairy items, including but not limited to yogurt, cheese, butter, cream, ice cream, and powdered milk.



The dairy industry boasts remarkable diversity, with various sectors specializing in distinct dairy products and production techniques (Ferrand, 2019). Large-scale dairy operations often leverage modern technology and automated systems to optimize efficiency and quality control, whereas smaller, artisanal producers may prioritize traditional methods and high-quality offerings (Sraïri *et al.*, 2018).

Furthermore, sustainability and environmental considerations are gaining prominence within the dairy sector (Vargas-Bello-Pérez *et al.*, 2018). Initiatives aimed at waste reduction,

minimizing greenhouse gas emissions, and enhancing animal welfare practices are driving innovation and shaping the future of dairy production (Herrero *et al.*, 2013).



In milk processing, maintaining the right pH and temperature balance is crucial for ensuring product quality, safety, and shelf life.

pH Balance: The pH of milk typically ranges from around 6.5 to 6.7, making it slightly acidic.

Controlling pH is essential for several reasons:

- It affects the taste, texture, and stability of dairy products.
- It influences the activity of enzymes involved in processing, such as rennet in cheese making.
- It helps inhibit the growth of harmful bacteria.

During processing, pH can change due to various factors, including microbial activity, enzymatic reactions, and the addition of acids or alkalis. Milk processors often adjust pH using food-grade acids or bases to achieve desired characteristics in the final product.

Temperature Balance:

- Temperature plays a critical role in milk processing, affecting microbial growth, enzyme activity, and product stability.
- Heating milk, a process known as pasteurization, is used to kill harmful bacteria while preserving its nutritional value.
- The temperature and duration of pasteurization depend on the specific requirements of the product and regulatory standards.
- Cooling milk promptly after pasteurization helps maintain its freshness and prevents the growth of spoilage bacteria.

- In processes like cheese making, temperature control is vital at various stages to facilitate curd formation, whey separation, and aging.
- Rapid cooling is also essential after certain processes to prevent undesirable reactions and maintain product quality.

Balancing pH and Temperature:

- Achieving the right balance between pH and temperature is essential for optimizing the functionality and sensory properties of dairy products.
- Processors use precise control systems to monitor and adjust pH and temperature throughout processing.
- Factors such as equipment design, mixing techniques, and ingredient selection can influence pH and temperature control.
- Proper sanitation practices are crucial to preventing contamination that could affect pH and temperature balance.
- Monitoring pH and temperature during storage and distribution helps ensure product safety and quality until it reaches consumers.
- In summary, maintaining optimal pH and temperature balance is a fundamental aspect of milk processing, influencing product quality, safety, and shelf life. Processors rely on precise control and monitoring systems to achieve desired characteristics in dairy products while meeting regulatory standards.

Different methods of milk testing

Milk testing is a critical aspect of milk processing, ensuring the quality, safety, and compliance of dairy products. Here's a detailed overview:

Sampling: Sampling is the first step in milk testing. Samples are collected from bulk tanks, farm cans, or individual animals. Proper sampling techniques are crucial to obtaining representative samples.

Physical Testing: Physical testing involves assessing the appearance and properties of milk. This includes evaluating color, odor, and consistency. Any abnormalities may indicate contamination or spoilage.

Chemical Testing: Fat Content: Determining the fat content of milk is essential for categorizing milk for different dairy products such as whole milk, skim milk, or cream. Methods like the Babcock test or Gerber method are commonly used.

Protein Content: Protein content is crucial for determining the nutritional value of milk. The Kjeldahl method is often used to measure protein content.

Lactose Content: Lactose is the primary carbohydrate in milk. Its measurement is essential for lactose-intolerant individuals and for assessing milk quality.

Total Solids: Total solids include all the components of milk except water. Measuring total solids helps determine milk quality and processing suitability.

Added Water: Adulteration with water is a common issue in milk. Various tests, such as the cryoscopic method, are used to detect added water.

pH Level: Monitoring the pH level of milk is important for detecting acidity, which can affect the taste and shelf life of dairy products.

Microbiological Testing: Microbiological testing assesses the microbial load in milk, including bacteria, yeast, and mold. High microbial counts can indicate poor hygiene practices or milk contamination.

Mastitis Testing: For milk sourced from dairy animals, testing for mastitis is crucial. Mastitis is an inflammatory condition of the udder caused by bacterial infection. Testing involves examining somatic cell counts (SCC) and conducting bacterial culture tests.

Pathogen Testing: Pathogen testing is essential for ensuring milk safety. Common pathogens tested for include Escherichia coli (E. Coli), Salmonella, Listeria monocytogenes, and Campylobacter.

Quality Assurance and Compliance: Milk testing helps ensure compliance with regulatory standards and quality assurance protocols. Regulatory bodies set standards for milk composition, safety, and labeling requirements.

Data Analysis and Reporting: Test results are analyzed, and reports are generated to communicate findings to dairy processors, farmers, and regulatory agencies. Any deviations from standards are addressed promptly to maintain product quality and safety.

Overall, milk testing plays a vital role in maintaining the integrity of dairy products, safeguarding public health, and upholding industry standards. Advanced technology and stringent testing protocols continue to improve the accuracy and efficiency of milk testing in the dairy industry.

Popular products of dairy industry

The milk industry produces a wide range of products, including:

| | |
|----|---|
| 1 | Liquid milk (whole, skim, low-fat) |
| 2 | Cheese (cheddar, mozzarella, feta, etc.) |
| 3 | Yogurt (plain & flavored) |
| 4 | Butter |
| 5 | Cream (heavy cream, sour cream) |
| 6 | Ice cream and frozen desserts |
| 7 | Milk powder and condensed milk |
| 8 | Whey protein products |
| 9 | Flavoured milk drinks (chocolate milk, strawberry milk) |
| 10 | Dairy-based beverages (smoothies, shakes) |
| 11 | Dairy desserts (puddings, custards) |

These are just a few examples of the diverse range of products that come from the milk industry.

Conclusion

The milk processing and dairy industry are vital for providing a wide range of globally consumed products. Despite challenges like fluctuating prices, environmental impacts, and growing demand for plant-based alternatives, companies must innovate and adopt sustainable practices to meet consumer preferences. Despite obstacles, the industry remains crucial, supplying nutritious and delicious products enjoyed worldwide.

References

- Ferrand, M. (2019). The dairy sector: Structure, economics and policy. In *The dairy sector: Structure, economics and policy* (pp. 1-10). Academic Press.
- Herrero, M., et al. (2013). Biomass use, production, feed efficiencies and greenhouse gas emissions from global livestock systems. *Proceedings of the National Academy of Sciences*, 110(52), 20888-20893.
- Santillo, A., et al. (2020). Effect of Homogenization on Microbiological, Physical, and Chemical Quality of Milk: A Review. *Foods*, 9(2), 191.
- Sraïri, M. T., et al. (2018). Dairy industry in transition: A case study in Morocco. *Sustainability*, 10(12), 4605.
- Vargas-Bello-Pérez, E., et al. (2018). Sustainable dairy production: The journey from farm to table. *Sustainability*, 10(11), 4315.

6. Food and Agriculture Organization of the United Nations (FAO). (2018). Milk and Dairy Products in Human Nutrition. Retrieved from <http://www.fao.org/3/i3396e/i3396e.pdf>
7. Haque, M. A., et al. (2017). Quality of Raw Milk in Bangladesh: Comparison between Three Districts. *Bangladesh Journal of Animal Science*, 46(2), 127-133.
8. World Health Organization (WHO). (2020). Milk Pasteurization. Retrieved from https://www.who.int/foodsafety/areas_work/food-technology/faq-pasteurization/en/