

The Swot Analysis of Cheese Production Technology: Navigating Strengths, Weaknesses, Opportunities and Threats

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Introduction:

Cheese, a dietary staple for centuries, embodies a marriage of traditional craftsmanship and cutting-edge science. Its production entails the intricate transformation of milk into an array of cheese types, each boasting distinct flavors, textures and characteristics. This multifaceted process hinges upon a profound comprehension of microbiology, chemistry and engineering principles.

The fundamental steps in cheese production include milk collection, pasteurization, coagulation, curd formation, whey separation, salting, shaping and aging. Each stage contributes to the development of specific flavors and textures in the final product. While traditional methods are still employed in many artisanal cheese dairies, technological advancements have introduced automation, precision control and innovative techniques to enhance efficiency and consistency.

Microorganisms, primarily bacteria and molds, are key in cheese production, fermenting milk and developing unique cheese varieties. Starter cultures and rennet initiate coagulation, leading to the separation of curds and whey, which determine cheese types like cheddar, mozzarella or blue cheese. Modern cheese production facilities use advanced equipment for milk processing, temperature control and hygiene to ensure product quality and safety, meeting regulatory standards and consumer expectations.

The global demand for high-quality cheeses has spurred research in cheese production technology, aiming to improve yield, reduce production time and enhance flavor profiles while maintaining traditional authenticity. This dynamic field blends tradition with innovation to meet global consumer demands.

History of Cheese:

Cheese's history spans thousands of years, possibly accidental due to milk fermentation and its presence in human civilization for over 7,000 years, though exact discovery details remain unclear. Cheese, one of mankind's oldest foods, was a prominent part of the Greek and Roman diets 2500 years ago. It was likely made accidentally in animal stomachs. Cheese was made in farmhouses until 1850, then the factory system was introduced from 1860–80.

Historically, cheese production in India was hindered by Hindus' reluctance to use animal rennet, but the discovery of *Withania coagulans*' seeds, which coagulated milk, led to limited production of Indian cheese or paneer.

Cheddar cheese, originating in Somerset, England, is the world's most recognized cheese, with various variants including American, Australian, New Zealand, Canadian and Indian Cheddar.

Modern cheese-making technology has advanced through the years as shown below:

About 1870 - Commercial rennet preparation was put on the market by Hansen in Denmark.

About 1900 - Use of Titratable acidity measurements to control acidities in cheese making.

- Introduction of pure cultures of lactic streptococci as 'starters'.
- Pasteurization of cheese milk to destroy pathogenic micro-organisms.
- Refrigerated curing of cheese.
- Processed cheese making.

In recent years-Mechanization of cheese making

- New methods of packaging

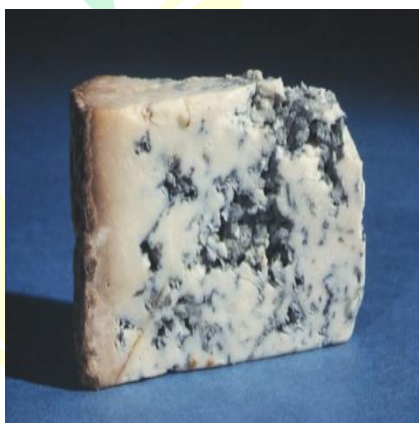
Cheese:

The word cheese comes from Latin caseus, from which the modern word casein is also derived. The earliest source is from the proto-Indo-European root “kwat” which means "to ferment, become sour".

Definition: - Davis defines cheese as a milk-based product made from curd coagulated with rennet and lactic acid, then removed through cutting, cooking, and pressing. Shaped in a mold, it is then ripened by holding it at suitable temperatures and humidity for a period of time.

Cheese is a type of dairy product made from milk that can have a variety of flavors, textures, and shapes due to the casein protein in milk coagulating. It is made out of fat and proteins from milk, typically from sheep, goats, cows or buffalo. The milk is often acidified

during manufacture and the rennet enzyme is added to cause coagulation. After being divided into solids, they are pressed into shape. Certain cheeses have mold throughout, on the rind or on the outer layer. There are hundreds of varieties of cheese manufactured in different nations. Their origins, including the diet of the animal, the degree of pasteurization, the amount of butterfat, the presence of bacteria and mold, the processing and aging process and other factors, all affect their styles, textures and flavors. Herbs, spices and wood smoke can all be employed as flavorings. Many cheeses, including Red Leicester, are colored yellow-to-red by the use of annatto. Certain cheeses may also contain other ingredients like cranberries, black pepper, garlic, or chives. Certain cheeses require the addition of acids, like vinegar or lemon juice, to curdle the milk. Bacteria convert milk sugars into lactic acid, which acidifies most cheeses to a lesser extent. Rennet is then added to finish the curdling process.



Market Insights of Cheese:

Market Size and Growth:

- Revenue in the Cheese market: INR 88.9 billion in 2023.
- Expected annual growth rate of 20.9% during 2024-2032.

Market Forecast:

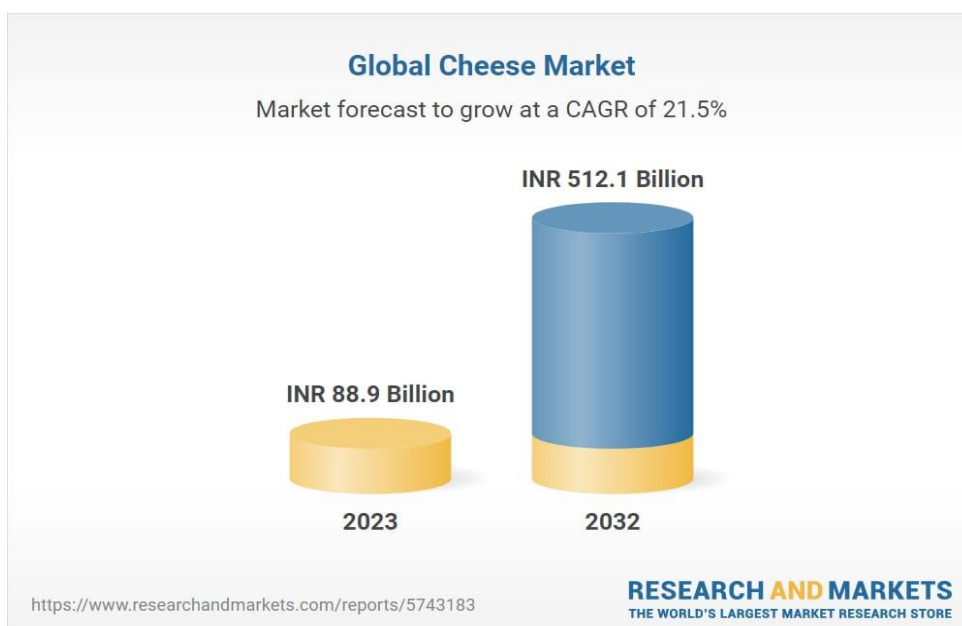
- INR 512.1 billion in 2032.

Per Capita Consumption:

- Per capita consumption in India is a mere 200gm per year.

Market Volume and Growth:

- The market is projected to reach INR 512.1 billion by 2032.
- Exhibiting growth rate (CAGR) of 21.47% during 2023-2032.



Cheese Production:

Lactic acid bacteria (LAB) are essential for cheese making, providing distinct flavor and texture. Mesophilic cultures are essential for various types of fresh, young, medium aged, washed and bloomy rind cheeses like Cheddar, Gouda, Muenster and Camembert. These bacteria work at a temperature range of 16- 38⁰C and are most happy between 28- 30⁰C.

Starter cultures are used early in the cheese making process to assist with coagulation by lowering the pH prior to rennet addition. The metabolism of the starter cultures contributes desirable flavor compounds and help prevent the growth of spoilage organisms and pathogens. Typical starter bacteria include *Lactococcus lactis subsp. lactis or cremoris*, *Streptococcus salivarius subsp. thermophilus*, *Lactobacillus delbruekii subsp. Bulgaricus* and *Lactobacillus helveticus*. Starter cultures use in cheese industry are composed of varieties including Lactococcus, Leuconostoc, Lactobacillus thermophilus and Streptococcus thermophilus which have the role of acid production.

Scientific Basis of Cheese Making:

Davis asserts that all cheeses, regardless of origin or manufacturing methods, share certain common characteristics.

- They are made from the milk of certain mammals.
- The first stage is souring/ripening.
- The second stage is clotting/coagulation by rennet or a similar enzyme preparation.

- The third stage is the cutting or breaking up of the coagulum or junket to release the whey.
- The fourth stage is the consolidation or 'matting' of the curd.
- The fifth stage is the maturing/curing of cheese in some type of container.

SWOT Analysis of Cheese Production Technology:

Strengths

- **Efficiency:** Modern cheese production technology enables high levels of efficiency in terms of processing milk into cheese, leading to higher output with minimal wastage.
- **Consistency:** Advanced technology allows for precise control over the cheese-making process, resulting in consistent quality and flavor profiles.
- **Automation:** Automation in cheese production technology reduces labor costs and human error while ensuring standardization and uniformity in the final product.
- **Quality Assurance:** Technological advancements facilitate rigorous quality control measures, ensuring that cheese meets safety and regulatory standards.
- **Innovation:** Continuous advancements in production technology enable the development of new cheese varieties, flavors and textures, catering to diverse consumer preferences.

Weaknesses

- **Initial Investment:** Implementing advanced production technology requires significant upfront investment in equipment and infrastructure, which may pose a barrier for small-scale producers.
- **Skill Requirements:** Operating complex machinery and automation systems necessitates skilled personnel and training costs can be high.
- **Dependency on Technology:** Reliance on technology makes cheese production vulnerable to disruptions caused by equipment malfunctions, power outages or cyber security threats.
- **Environmental Impact:** Some modern production technologies may have a higher environmental footprint due to energy consumption and waste generation, raising concerns about sustainability.



- **Uniformity vs. Artisanal Quality:** While automation ensures consistency, it may compromise the artisanal quality and uniqueness associated with traditional cheese-making methods, impacting consumer preferences.

Opportunities

- **Market Expansion:** Advanced production technology enables manufacturers to meet growing demand for cheese globally, tapping into new markets and consumer segments.
- **Customization:** Technology allows for customization of cheese products to align with specific dietary preferences, such as lactose-free or vegan options.
- **Health and Wellness Trends:** Innovations in production technology can facilitate the creation of healthier cheese alternatives with reduced fat or salt content, capitalizing on health-conscious consumer trends.
- **Traceability and Transparency:** Block chain and other technologies can be leveraged to enhance traceability and transparency in the cheese supply chain, addressing consumer concerns regarding product origins and quality.
- **Collaboration and Partnerships:** Collaboration between technology providers, dairy industry stakeholders and research institutions can drive innovation in cheese production technology, creating mutually beneficial opportunities.

Threats

- **Competition:** Intense competition in the cheese industry, both domestically and internationally, can pressure producers to continually innovate and optimize production processes to maintain market share.
- **Regulatory Changes:** Evolving regulations related to food safety, labeling and environmental standards may require cheese producers to adapt their technology and practices, increasing compliance costs.
- **Supply Chain Disruptions:** Disruptions in the supply chain, such as fluctuating milk prices, transportation issues or natural disasters, can impact cheese production and distribution, leading to shortages or price volatility.
- **Consumer Preferences:** Shifting consumer preferences towards plant-based alternatives or other dairy products may pose a threat to traditional cheese production technology, necessitating adaptation to changing market demands.



- **Global Challenges:** Economic uncertainties, geopolitical tensions and public health crises (e.g., pandemics) can disrupt cheese production technology supply chains and demand dynamics, affecting profitability and sustainability.

Overall, leveraging strengths, addressing weaknesses, capitalizing on opportunities and mitigating threats through strategic planning and continuous innovation can help cheese producers navigate the dynamic landscape of production technology and maintain competitiveness in the market.

Conclusion:

1. Cheese production technology exhibits strengths in efficiency, consistency and innovation, yet faces challenges like initial investment and environmental impact.
2. To thrive in the cheese industry, producers must seize opportunities for market expansion, customization and collaboration while navigating threats such as competition and regulatory changes.

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