Animal Science

Dairy Product Technology

Grade 10

Government of Nepal
Ministry of Education, Science and Technology
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Technical and Vocational Stream
Learning Resource Material

Dairy Product Technology

(Grade 10)

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Publisher: Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
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Layout by Santosh Dahal

Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline, self-reliance, creativity and thoughtfulness. It is essential to develop linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills in students. It is also necessary to bring the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values to make them capable of playing the role of responsible citizens with applied technical and vocational knowledge and skills. This learning resource material for Animal Science has been developed in line with the Secondary Level Animal Science Curriculum with an aim to facilitate the students in their study and learning on the subject by incorporating the recommendations and feedback obtained from various schools, workshops, seminars and interaction programs attended by teachers, students and parents.

In bringing out the learning resource material in this form, the contribution of the Director General of CDC Mr. Yubaraj Paudel and members of the subject committee Dr. Manraj Kolakshpati, Madhukumari Tiwari, Lavdev Bhatta is highly acknowledged. The learning resource material is written by Dr. Ganesh Gautam Dr. Shibalal Bhandari and Dr. Asis Mahat the subject matter of the materials, was edited by Mr. Badrinath Timsina and Mr. Khilanath Dhamala and language was edited by Bijaya Kumar Ranabhat. CDC extends sincere thanks to all those who have contributed to developing this material in this form.

This learning resource material contains a wide coverage of subject matters and sample exercises which will help the learners to achieve the competencies and learning outcomes set in the curriculum. Each chapter in the material clearly and concisely deals with the subject matters required for the accomplishment of the learning outcomes. The Curriculum Development Centre always welcomes constructive feedback for the betterment of the material.

2082 BS

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Curriculum Development Centre

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Guidelines to Teachers

A. Facilitation Methods

The goal of this course is to combine the theoretical and practical aspects of the contents needed for the subject. The nature of contents included in this course demands the use of practical or learner focused facilitation processes. Therefore, the practical side of the facilitation process has been focused much. The instructor is expected to design and conduct a variety of practical methods, strategies or techniques which encourage students engage in the process of reflection, sharing, collaboration, exploration and innovation new ideas or learning. For this, the following teaching methods, strategies or techniques are suggested to adopt as per the course content nature and context.

Brainstorming

Brainstorming is a technique of teaching which is creative thinking process. In this technique, students freely speak or share their ideas on a given topic. The instructor does not judge students' ideas as being right or wrong, but rather encourages them to think and speak creatively and innovatively. In brainstorming time, the instructor expects students to generate their tentative and rough ideas on a given topic which are not judgmental. It is, therefore, brainstorming is free-wheeling, non-judgmental and unstructured in nature. Students or participants are encouraged to freely express their ideas throughout the brainstorming time. Whiteboard and other visual aids can be used to help organize the ideas as they are developed. Following the brainstorming session, concepts are examined and ranked in order of importance, opening the door for more development and execution. Brainstorming is an effective technique for problem-solving, invention, and decision-making because it taps into the group's combined knowledge and creative ideas.

Demonstration

Demonstration is a practical method of teaching in which the instructor shows

or demonstrates the actions, materials, or processes. While demonstrating something the students in the class see, observe, discuss and share ideas on a given topic. Most importantly, abstract and complicated concepts can be presented into visible form through demonstration. Visualization bridges the gap between abstract ideas and concrete manifestations by utilizing the innate human ability to think visually. This enables students to make better decisions, develop their creative potential, and obtain deeper insights across a variety of subject areas.

Peer Discussion

Peer conversation is a cooperative process where students converse with their peers to exchange viewpoints, share ideas, and jointly investigate subjects that are relevant or of mutual interest. Peer discussion is an effective teaching strategy used in the classroom to encourage critical thinking, active learning, and knowledge development. Peer discussions encourage students to express their ideas clearly, listen to opposing points of view, and participate in debate or dialogue, all of which contribute to a deeper comprehension and memory of the course material. Peer discussions also help participants develop critical communication and teamwork skills by teaching them how to effectively articulate their views, persuasively defend their positions, and constructively respond to criticism.

Peer conversation is essential for professional growth and community building outside of the classroom because it allows practitioners to share best practices, work together, and solve problems as a group. In addition to expanding their knowledge horizon and deepening their understanding, peer discussions help students build lasting relationships and a feeling of community within their peer networks.

Group Work

Group work is a technique of teaching where more than two students or participants work together to complete a task, solve a problem or discuss on a

given topic collaboratively. Group work is also a cooperative working process where students join and share their perspectives, abilities, and knowledge to take on challenging job or project. Group work in academic contexts promotes active learning, peer teaching, and the development of collaboration and communication skills. Group work helps individuals to do more together than they might individually do or achieve.

Gallery Walk

Gallery walk is a critical thinking strategy. It creates interactive learning environment in the classroom. It offers participants or students a structured way to observe exhibition or presentation and also provides opportunity to share ideas. It promotes peer-to-peer or group-to-group engagement by encouraging participants to observe, evaluate and comment on each other's work or ideas. Students who engage in this process improve their communication and critical thinking abilities in addition to their comprehension of the subject matter, which leads to a deeper and more sophisticated investigation of the subjects at hand.

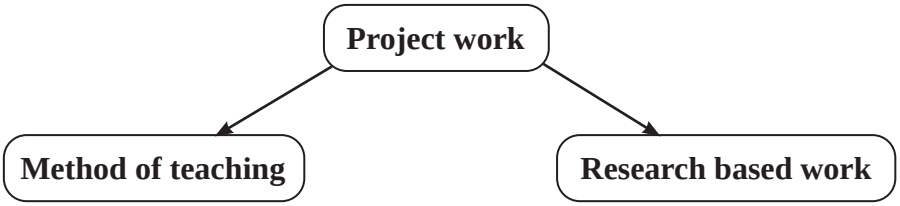
Interaction

The dynamic sharing of ideas, knowledge, and experiences between people or things is referred to as interaction, and it frequently takes place in social, academic, or professional settings. It includes a broad range of activities such as dialogue, collaboration or team work, negotiation, problem solving, etc. Mutual understanding, knowledge sharing, and interpersonal relationships are all facilitated by effective interaction. Interaction is essential for building relationships, encouraging learning, and stimulating creativity in both in-person and virtual contexts. Students can broaden their viewpoints, hone their abilities, and jointly achieve solutions to difficult problems by actively interacting with others.

Project Work

Project work is a special kind of work that consists of a problematic situation which requires systematic investigation to explore innovative ideas and solutions.

Project work can be used in two senses. First, it is a method of teaching in regular class. The next is: it is a research work that requires planned investigation to explore something new. This concept can be presented in the following figure.



Project work entails individuals or teams working together to achieve particular educational objectives. It consists of a number of organized tasks, activities, and deliverables. The end product is important for project work. Generally, project work will be carried out in three stages. They are:

- Planning
- Investigation
- Reporting

B. Instructional Materials

Instructional materials are the tools and resources that teachers use to help students. These resources/materials engage students, strengthen learning, and improve conceptual comprehension while supporting the educational goals of a course or program. Different learning styles and preferences can be accommodated by the variety of instructional resources available. Here are a few examples of typical educational resource types:

- Daily used materials
- Related Pictures
- Reference books
- **Slides and Presentation:** PowerPoint slides, keynote presentations, or other visual aids that help convey information in a visually appealing and organized manner.
- **Audiovisual Materials:** Videos, animations, podcasts, and other

multimedia resources that bring concepts to life and cater to auditory and visual learners.

- **Online Resources:** Websites, online articles, e-books, and other web-based materials that can be accessed for further reading and research.

Maps, Charts, and Graphs: Visual representations that help learners understand relationships, patterns, and trends in different subjects.

Real-life Examples and Case Studies: Stories, examples, or case studies that illustrate the practical application of theoretical concepts and principles.

C. Assessment

Formative Test

Classroom discussions: Engage students in discussions to assess their understanding of concepts.

Quizzes and polls: Use short quizzes or polls to check comprehension during or after a lesson.

Homework exercises: Assign tasks that provide ongoing feedback on individual progress.

Peer review: Have students review and provide feedback on each other's work.

Summative Test

Exams: Conduct comprehensive exams at the end of a unit or semester.

Final projects: Assign projects that demonstrate overall understanding of the subject.

Peer Assessment

Group projects: Evaluate individual contributions within a group project.

Peer feedback forms: Provide structured forms for students to assess their peers.

Classroom presentations: Have students assess each other's presentations.

Objective Test

Multiple-choice tests: Use multiple-choice questions to assess knowledge.
True/False questions: Assess factual understanding with true/false questions.

Matching exercises: Evaluate associations between concepts or terms.

Portfolio Assessment

Compilation of work: Collect and assess a variety of student work samples.

Reflection statements: Ask students to write reflective statements about their work.

Showcase events: Organize events where students present their portfolios to peers or instructors.

Observational Assessment

Classroom observations: Observe students' behavior and engagement during class.

Performance observations: Assess practical skills through direct observation.

Field trips: Evaluate students' ability to apply knowledge in real-world settings.

Dairy Industry in Nepal

Unit 1

1.1 Introduction to History and Importance of Dairy Sector

Nepal has a perfect historical picture of dairy industry as it relies on agricultural support for livestock animals. Dairy animals such as cattle and buffalo are reared for the production of milk and milk products to fulfil the nutrients requirements for humans and baby animals. The following are the different historical landmarks of dairy sector in Nepal.

History of Dairy Sector

1952	Experimental production of Cheese
1953	Establishment of Yak Cheese Factory in Langtang under FAO
1954	Dairy Development Section was established under the Department of
	Agriculture and also a small-scale milk processing plant was started in
	Tusal, Kavrepalanchowk
1956	Dairy Development Commission formed
1956	A central dairy plant with an average milk processing capacity of 500
	liters per hour was established in Lainchour and mini milk processing
	plant was established at Kharipati in Bhaktapur district
1960	Two additional cheese factories were established
1960	Cheese Production and Supply Scheme (CPSS) was launched
1962	Dairy Development Commission was converted to the Dairy
	Development Board
1969	Dairy Development Commission was converted to the Dairy

	Development Coorporation under the Corporation Act of 1964
1970	Involvement of Private sector in Dairy processing
1973	Biratnagar Milk Supply Scheme was established by DDC
1974	Hetauda Supply Scheme was established by DDC
1978	Kathmandu Milk Supply Scheme was established by DDC
1979	Milk Products Production and Supply Scheme (MPPSS) was established
	(Renamed CPSS)
1980	Pokhara Milk supply Scheme was established by DDC
1990	"Ten Year Dairy Development Plan" was designed and approved.
	During this time the private dairies emerged significantly.
1991	First SMP plant in Biratnagar established

1.1.1 Importance of Dairy Sector

The dairy sector holds significant importance in Nepal, both economically and socially. Here is a breakdown of its importance:

A. Economic Importance

i. **Contribution to GDP:** The livestock sector contributes around 12–13% to Nepal's total Gross Domestic Product (GDP), with dairy being a major component.

ii. **Employment and Livelihood:** Over 65% of rural households in Nepal are engaged in livestock farming, with dairy farming providing employment to hundreds of thousands of people, especially smallholder farmers.

iii. **Income Generation:** Milk is a daily income source for farmers. It offers regular cash flow, helping households with daily expenses, education, and healthcare.

iv. **Linkages with Other Sectors:** The dairy sector supports a wide value chain – including feed production, veterinary services, transport, and dairy processing industries – promoting rural entrepreneurship.

B. Nutritional Importance

i. **Source of Nutrition:** Milk and milk products are vital for combating malnutrition. They are rich in calcium, protein, and essential vitamins.

ii. **Dietary Staple:** Dairy is a regular part of Nepali diets, often consumed as milk, yogurt (dahi), ghee, paneer, and traditional sweets.

C. Social and Cultural Importance

i. **Cultural Significance:** Cows are considered sacred in Hindu culture, which influences Nepalese society deeply. Dairy products are used in religious rituals and festivals.

ii. **Women Empowerment:** Many dairy cooperatives are women-led, providing financial independence and leadership opportunities for rural women.

D. Environmental and Agricultural Integration

i. **Integrated Farming Systems:** Dairy farming is often part of mixed farming systems where livestock manure supports crop production, enhancing sustainability.

ii. **Use of Local Breeds:** Indigenous breeds are adapted to local conditions and support biodiversity conservation, though there is growing use of crossbreeds for better productivity.

E. Development and Infrastructure

i. **Dairy Cooperatives:** Nepal has a well-established network of dairy cooperatives, especially under the Dairy Development Corporation (DDC), which plays a key role in collection and distribution.

ii. '**Private Sector Participation:** The rise of private dairies has enhanced competition, leading to better quality products and services for consumers.

F. Other factors

- Help in employment generation
- Help in poverty reduction.

- To contribute to national economic development
- Help to overcome from nutritional deficiencies.

1.2. Introduction of the Dairy Branches and Scope, Importance, Constraints of Dairy Industry

1.2.1 Introduction

Dairy is a branch of agriculture that consists of breeding, raising of dairy animals primarily cattle and buffalo for the production of milk and the various dairy products processed from it. The branches of dairy industry are: milk industry, cheese factory, frozen dairy desert factory, butter and ghee factory, dry milk product factory etc.

The dairy industry in Nepal plays a vital role in the agricultural economy and nutrition of the population. Traditionally rooted in rural livelihoods, dairy farming has evolved significantly over the years, transitioning from small-scale household practices to organized and industrialized production. The sector is essential not only for providing daily nutritional needs through milk and milk products but also for generating employment and supporting rural development.

Nepal's dairy sector can be broadly divided into three main branches:

1. Milk Production (Dairy Farming)

This is the foundational branch of the dairy industry, comprising smallholder farmers and commercial dairy farms. Nepal has a vast number of rural households engaged in dairy farming, primarily raising cows and buffaloes. These farmers supply raw milk to local cooperatives or directly to the market. The government and NGOs provide support through livestock health services, training, and subsidies.

2. Milk Collection and Processing

Milk from farms is collected through a widespread network of milk collection centers and dairy cooperatives, particularly in rural areas. The collected milk is then transported to processing plants where it undergoes pasteurization,

standardization, and packaging. Key players in this branch include:

- Dairy Development Corporation (DDC) – A government-run institution
- Private dairy companies such as Sujal Dairy, Himalaya Dairy, and Shreejana Dairy

These institutions process milk into various dairy products such as yogurt, ghee, butter, cheese, and flavoured milk.

3. Distribution and Retail

After processing, dairy products are distributed through wholesalers, retailers, and supermarkets. Urban centers like Kathmandu, Pokhara, and Biratnagar have well-established supply chains and cold storage facilities that ensure milk and dairy products reach consumers in fresh condition.

1.2.2 Scope of Dairy

- The barren land of the mountain and hill areas which are accessible for transport and unfit for cultivation can be used for dairy enterprises.
- Better nutrition and health care management and the adoption of disease/ stress resistance and high milk producing breeds can increase productivity of cattle and buffalo.
- Dairying is an important source of subsidiary income to small/ marginal farmers and agricultural labor.
- The manure from animals provide a good source of organic matter for improving soil fertility and crop yields the surplus fodder and agricultural by-products can be utilized for feeding the animals.
- Dairy farming is taken up as a main occupation where demand for milk is high.
- Livestock are widely distributed with even distribution of cattle and buffalo throughout the country.
- Market opportunities and demand of milk and milk products have increased particularly in the densely populated urban areas.

1.2.3 Major Constraints of the Dairy Production Industry

To unlock the full potential of Nepal's dairy industry, the following constraints need to be addressed through better infrastructure, training, policy support, and investment in technology. Strengthening the value chain and empowering farmers with resources and knowledge will be key to long-term sustainability.

Despite its importance, the dairy industry in Nepal faces several obstacles that hinder productivity, quality, and sustainability. The constraints which affect all stages of the value chain—from production to processing and marketing are as discussed below.

1. **Low Productivity of Dairy Animals**
    - Indigenous breeds have low milk yield compared to improved or hybrid breeds.
    - Limited access to genetic improvement programs and artificial insemination services.
    - Poor nutrition and feeding practices affect the health and output of animals.

2. **Inadequate Animal Health Services**
    - Lack of timely access to veterinary care and vaccination programs.
    - Shortage of trained veterinary professionals in rural areas.
    - Disease outbreaks (like foot-and-mouth disease) can severely impact milk production.

3. **Poor Feeding and Fodder Management**
    - Seasonal shortages of green fodder and quality feed.
    - Farmers rely on traditional feeding methods, often lacking balanced rations.
    - Limited knowledge of nutritional needs of dairy animals.

4. **Inefficient Milk Collection and Transportation**
   - In remote and hilly regions, infrastructure is poor, leading to delays in milk transport.
   - Lack of cold chain facilities results in spoilage and wastage.
   - Many rural areas still do not have access to organized milk collection centers.

5. **Limited Processing Facilities**
   - Most processing plants operate below capacity due to inconsistent milk supply.
   - Traditional processing methods dominate, reducing product quality and shelf life.
   - Limited innovation in product diversification (cheese, flavoured milk, etc.).

6. **Market Fluctuations and Price Instability**
   - Farmers often face low and unstable milk prices, especially during peak seasons.
   - Middlemen and lack of strong cooperatives reduce farmer bargaining power.
   - Inadequate government price regulation policy.

7. **Lack of Technical Knowledge and Training**
   - Many farmers lack formal training in modern dairy practices.
   - Limited extension services and demonstration programs at the grassroots level.

8. **Financial Constraints**
   - Difficulty in accessing loans or subsidies to invest in better breeds, feed, or infrastructure.
   - Insurance schemes for dairy animals are underdeveloped.

9. Policy and Institutional Gaps

- Weak implementation of dairy development policy.
- Limited coordination between government, cooperatives, and private sectors.

Overview of Constraints

- High feed costs
- Feed shortage and unavailability in time,
- Lack of proper technical support
- Lack of skilled manpower
- High prevalence of pests and diseases
- Lack of dairy related technologies were the major constraints in dairy production.

1.3 Status of Milk Production, Collection, Processing and Marketing

In earlier days when there were no organized dairies, demand for milk was fulfilled by the direct supply from the milk producers. These producers used to go house by house and deliver the required quantity of milk to the households. Dahi (yoghurt) filled in clay containers were produced by some traditional dahi makers and milk-based sweets were prepared by traditional sweet makers. But now, the scenario began to gradually change with the increasing supply of pasteurized milk and modern dairy products such as cheese, butter, ice cream etc by different dairies. Many new sweet shops also started to emerge. Besides, different dairy products are also imported to fulfill the consumers' demand.

Processed liquid milk is the prominent product of the dairy industry as almost 80 percent of milk collection in the formal sector is used to produce processed milk.

Various brands of the locally produced as well as imported milk products of varying categories are sold in the urban market. Milk products from more than 20 countries from Asia, Europe, Australia and North America compete in the Nepali market.

Milk products being available in the local urban markets indicate that there is ample demand for the modern as well as traditional dairy products. The demand for dairy products in the urban markets is expected to grow in the future mainly due to the increasing population and rise in income. Additionally, exposures to outer world mainly through the TV have particularly attracted the educated younger generation to consume the modern dairy products. Moreover, their demand is also expected to rise due to the increasing establishment of hotels and restaurants.

1.4 Importance of Milk and Milk Products

Milk and milk products are the important source of various nutrition's such as vitamins, minerals where calcium and protein are the major component.

- Calcium helps to maintain strong bones and teeth.
- Protein (for growth and repair), carbohydrates and fat (for energy) as well as many important vitamins (vitamin A and Vitamin B12) and minerals (zinc).
- Consumption of curd has been found useful in the treatment of dyspepsia, dysentery and other intestinal disorders.
- Cheese is rich in protein, energy, calcium, phosphorus and fat-soluble vitamin and easily digestible.
- Milk powder can be used as a substitute for mother's milk in baby food and used for preparing chocolate, ice cream and making bakery items.
- Paneer used to prepare different dishes
- Milk powder can be used in animal feed.
- Ghee is used in the manufacture of ice cream, bakery products, and confectioneries

1.5 Statistics of Dairy Animal

As of Krishi Diary 2080 BS (2023 AD), the statistics regarding dairy animals in Nepal reflect the ongoing trends and challenges in the country's dairy sector.

The Krishi Diary is an official publication from the Ministry of Agriculture and Livestock Development (MOALD) of Nepal, providing detailed statistics on agricultural practices, including dairy farming. Nepal has a total of around 14.3 million dairy animals, which include both cattle and buffaloes.

- Cattle: Approximately 7.6 million cattle are reared for milk production. This includes both indigenous and crossbred cattle.
- Buffaloes: About 6.7 million buffaloes are used for dairy purposes. Buffaloes are the primary milk-producing animals in Nepal, especially in the Terai and lowland regions.

1.6 Organizations Working in Dairy Sector and their Roles

There are various organizations working in dairy industries. The major organizations involved in dairy development are as follows:

1. Dairy cooperatives
2. Dairy Development Dorporation
3. National Dairy Development Board (NDDB)
4. Department of Livestock Services (DLS)
5. Department of Food Technology and Quality Control (DFTQC)
6. Department of Co-operatives
7. National Cooperatives Development Board (NCDB)
8. Private sector(Nepal Dairy, Himalaya Dairy, Sitaram Dairy,Anmol Dairy, Kathmandu Dairy, Adhunik Dairy etc. in Kathmandu valley; Sujal Dairy in Pokhara Valley and Kamdhenu dairy in Sunsari)

The roles of Orginazation Working in Dairy Sector:

- The dairies produce pasteurized milk and other dairy products such as yoghurt, ice-cream, butter, ghee etc. Similarly, some private entrepreneurs have also involved in producing cheese in the mid and high mountain regions from cow and nak milk.

- Help in operating milk chilling vats.
- Help in increasing production and processing of milk and milk products and to contribute to the financial and social upliftment of the rural milk producers.
- To provide a guaranteed market for milk to the rural farmers with fair price.
- To supply pasteurized milk and milk products to urban consumers.
- To develop organized milk collection system to meet increasing demand for pasteurized milk and milk products.
- To develop an organized marketing system for milk and milk products in urban areas.
- Formulation and recommendation of milk pricing policy to the Government of Nepal.
- Recommendation to Government of Nepal on well-being of dairy processors and consumers, Development of cooperative sector dairies, Registration of dairy industries.
- Management and mobilization of national and foreign grant and loan for dairy industries.
- To promote entrepreneurship by developing and disseminating appropriate technologies and improve the nutritional status of people through food based approaches.
- Registration of cooperatives, making recommendations for improvement of cooperatives and dissolving such cooperatives which acts are against its objectives.

1.6. Major Dairy Industries in Nepal and their Roles

Nepal's dairy industry has seen significant growth in recent years, with both government-run and private companies playing crucial roles in the development of the sector. These dairy industries are involved in the production, processing, and distribution of a wide variety of dairy products such as milk, yogurt, ghee, cheese, and butter. Below are some of the major dairy industries in Nepal and their roles in shaping the dairy sector:

Nepal Dairy Development Corporation (NDDC)

The Nepal Dairy Development Corporation (NDDC), established in 1968, is one of the oldest and most prominent state-owned dairy organizations in Nepal. Its primary role is to improve the dairy industry by collecting, processing, and marketing milk and dairy products.

Key Roles

- Milk Collection & Processing: NDDC collects milk from dairy farmers across the country, particularly in rural areas, and processes it into various dairy products like pasteurized milk, yogurt, ghee, and butter.
- Promotion of Dairy Farming: NDDC provides technical assistance, veterinary services, and training to local farmers to improve milk yield and livestock health.
- Government Initiatives: It plays a pivotal role in implementing government policies related to dairy farming and often acts as a bridge between the government and dairy farmers.
- Quality Control: NDDC maintains high standards of quality in dairy production and helps ensure that products are safe for consumption.

Impact

- It serves as a crucial player in rural development, providing a steady market for smallholder farmers' milk and improving their economic stability.
- The NDDC helps stabilize the price of milk in the market, providing fair prices to both producers and consumers.

Dairy Development Corporation (DDC)

The Dairy Development Corporation (DDC), another government-owned entity, has been a key player in Nepal’s dairy industry since its establishment in 1972. The corporation focuses on improving milk production and processing by offering a variety of dairy products to consumers.

Key Roles

- Milk Collection and Processing: DDC operates milk collection centers across Nepal and processes raw milk into packaged milk, ghee, butter, cheese, and other products.
- Farmer Support: DDC assists farmers with animal health, provides high-quality feed, and educates them on best dairy farming practices. It plays a crucial role in enhancing the productivity of small-scale dairy farms.
- Market Stabilization: DDC ensures that there is a regular supply of milk and dairy products in the market, playing a stabilizing role in milk prices, particularly during lean seasons.
- Product Distribution: It distributes its products across major cities and regions of Nepal, ensuring wide availability of dairy items in the market.

Impact

- DDC's involvement in dairy farming supports thousands of smallholder farmers, creating employment and improving livelihoods, especially in rural areas.
- The organization is also instrumental in the government's efforts to increase domestic milk production and reduce reliance on imported dairy products.

Himalayan Dairy Pvt. Ltd.

Himalayan Dairy Pvt. Ltd. is a leading private-sector dairy company in Nepal, known for producing high-quality milk and dairy products. Established in the early 2000s, the company aims to provide nutritious and hygienic dairy products to consumers.

Key Roles

- Modern Dairy Processing: Himalayan Dairy operates state-of-the-art processing plants that ensure the production of premium milk, yogurt, and other dairy products.
- Product Range: The Company offers a wide range of dairy products including

fresh milk, flavoured milk, butter, cheese, and various types of yogurt.

- Market Expansion: It has expanded its market reach across urban and rural areas, ensuring that consumers from all segments of society have access to good-quality dairy products.
- Focus on Hygiene and Quality: Himalayan Dairy is known for its stringent quality control measures, ensuring that the milk and other products meet both local and international safety standards.

Impact

- The company's growth has contributed to raising the standards of milk processing in Nepal and has increased consumer awareness about the importance of high-quality dairy products.
- It has also created employment opportunities in dairy farming, processing, and distribution.

Siddhartha Dairy Pvt. Ltd.

Siddhartha Dairy Pvt. Ltd. is a well-established dairy company in Nepal that operates in the processing and marketing of a wide variety of dairy products. The company is known for producing pure and hygienic milk and dairy products in both urban and rural markets.

Key Roles

- Milk Collection and Supply Chain Management: Siddhartha Dairy has an extensive network of milk collection centers across the country, ensuring a steady supply of raw milk for its processing plants.
- Product Innovation: The company has pioneered the development of several dairy products, including flavoured milk, different types of cheese, and health-oriented products such as probiotic yogurt.
- Local and International Market: Siddhartha Dairy supplies products to domestic markets and has also started exploring export opportunities in regional markets, particularly in India and other South Asian countries.
- Farmer Support Programs: The company works closely with local dairy

farmers, offering them veterinary care, animal feed, and technical advice to enhance milk production and improve the health of livestock.

Impact

- Siddhartha Dairy's innovative products and focus on quality have helped it establish a loyal customer base in Nepal, contributing to the modernization of the dairy sector.
- It has provided a reliable income source for thousands of farmers in Nepal, particularly through its milk collection network.

Chaudhary Group (CG) Foods - Dairy Division

The Chaudhary Group (CG) is one of Nepal's largest and most diversified conglomerates, with a strong presence in the dairy sector through its CG Foods division. The company is known for producing a range of dairy products, particularly milk and yogurt, under its brand Milkmandu.

Key Roles

- Milk Production and Processing: CG Foods operates a modern dairy processing plant and manufactures high-quality milk, yogurt, butter, and other dairy products.
- Branding and Market Expansion: Milkmandu is one of the most recognized dairy brands in Nepal. The brand focuses on product innovation, ensuring the availability of fresh, nutritious, and affordable dairy products to consumers.
- Quality Control and Hygiene: The company's advanced processing facilities maintain high standards of hygiene and product quality, contributing to consumer trust in the brand.

Impact

- As one of Nepal's leading private-sector dairy companies, CG Foods has played a significant role in the expansion of the local dairy market and has contributed to the improvement of milk supply chains.
- The company's market reach and distribution network have helped promote dairy consumption across Nepal.

Laxmi Dairy Industries Pvt. Ltd.

Laxmi Dairy Industries Pvt. Ltd. is a rapidly growing dairy company in Nepal that specializes in processing and distributing a wide range of dairy products, including milk, yogurt, and ghee.

Key Roles

- Dairy Processing: Laxmi Dairy operates dairy processing plants that adhere to international quality standards, producing fresh milk, flavoured milk, yogurt, and other value-added dairy products.
- Farmer Collaboration: Laxmi Dairy works closely with local dairy farmers, providing them with the resources and knowledge necessary to improve milk production and quality.
- Product Distribution: The company has developed a strong distribution network that ensures the availability of its products in both urban and rural markets.

Impact

- Laxmi Dairy contributes to the strengthening of the local dairy industry by supporting smallholder farmers and improving the overall quality of dairy products in Nepal.

Overview

The dairy industry in Nepal is a dynamic and rapidly growing sector that plays a critical role in the country's economy, particularly in rural development. Government organizations like the NDDC and DDC, along with private companies like Himalayan Dairy, Siddhartha Dairy, Chaudhary Group, and Laxmi Dairy, are instrumental in shaping the industry. These companies not only contribute to the domestic milk supply but also help improve the livelihoods of millions of dairy farmers, promote food security, and improve nutritional standards across the country. Through continuous innovation and collaboration with farmers, the dairy industry in Nepal is well-positioned for further growth and development.

Exercise

Choose the correct answer from the given alternatives.

1. When did organize dairy development begin in Nepal?

   a. 1920 b. 1950

   c. 1956 d. 1965

2. Why is the dairy sector important in Nepal?

   a. It generates foreign revenue

   b. It supports rural livelihoods and nutrition

   c. It is the largest import sector

   d. It is used only for export

3. Which of the following is NOT a major branch of the dairy sector?

   a. Dairy production

   b. Dairy processing

   c. Dairy import regulation

   d. Dairy marketing

4. What is one major constraint of the dairy industry in Nepal?

   a. Overproduction of milk

   b. High quality infrastructure

   c. Poor cold chain facilities

   d. Excessive exports

5. Which of the following describes the scope of the dairy industry?

   a. Limited to Kathmandu valley

   b. Includes production, processing, and distribution

   c. Focuses only on buffalo milk

   d. Involve only government bodies

6. Which region of Nepal produces the highest amount of milk?

a. Terai
b. Hilly region
c. Mountain region
d. Kathmandu Valley

7. What method is commonly used to collect milk in rural Nepal?

a. Cold storage tankers
b. Manual collection at milk collection centers
c. Drone delivery system
d. Centralized online portal

8. Which of the following is a challenge in milk marketing in Nepal?

a. High demand for powdered milk
b. Lack of consumer interest
c. Inadequate transportation and storage
d. Shortage of milk supply

9. Milk is a rich source of which essential nutrient?

A. Vitamin C
b. Iron
c. Calcium
d. Fiber

10. Which milk product helps in improving gut health?

a. Butter
b. Cheese
c. Yogurt
d. Ghee

11. Milk and milk products help in.....

a. Decreasing bone strength
b. Promoting undernutrition
c. Supporting child growth and health
d. Causing dehydration

12. Which dairy animal is found in the largest number in Nepal?

a. Cow b. Buffalo

c. Goat d. Sheep

13. What percentage of total milk production is contributed by buffalo in Nepal (approx.)?

a. 20% b. 40%

c. 65% d. 90%

14. Which is the largest dairy industry in Nepal?

a. Everest Dairy

b. Dairy Development Corporation (DDC)

c. Annapurna Dairy

d. Sita Dairy

15. What is the main role of major dairy industries like DDC in Nepal?

a. Export raw milk

b. Impose milk taxes

c. Support milk collection, processing, and distribution

d. Regulate livestock trade

16. Private dairies in Nepal contribute to.....

a. Importing foreign milk

b. Increasing competition and efficiency

c. Closing down local milk cooperatives

d. Reducing local employment

Write short answer to the following questions.

1. Write in short about history and importance of dairy sector in Nepal.
2. Discuss the status of milk production, collection, Processing and marketing

in Nepal.

3. List the importance of milk and milk products.

4. What are the scope and importance of dairy sector?

Write long answer to the following questions.

1. Introduce major dairy industries in Nepal highlighting their roles in development of dairy sector.

Milk and its Composition

Unit 2

2.1 Definition of Milk and Colostrum

Milk is whitish nutritious fluid produced and secreted by the mammary glands of mature female mammals and used for feeding their own baby until weaned.

Colostrum is a yellowish fluid secreted by the mammary glands of mammals immediately after the delivery lasting for the first two or three days. It is highly nutritious, more concentrated in protein and lower in fats than true breast milk. It is rich in antibodies that protect the newborn against diseases and proceeds the production of true milk, also called foremilk. It also has laxative effect.

2.2 Composition and Nutritive Value of Milk

Milk is mainly composed of water, proteins, fats, lactose, and ash. These are considered as major components of the milk whereas minor components include vitamins, enzymes, pigments and minerals.

Water

- Milk is the only source of water for neonates
- Water provides the suspension of organic component of milk (soluble protein i.e. lactal-albumin, lactalglobulin), lactose,Na, K, vitamin A,D,E.K
- Water provides medium for the milk removal

Lactose

- It is the major carbohydrate in milk
- This acts as the readily digestible source of energy for the neonates

Milk fat

- This is an energy source for neonate
- This is the most variable component of milk (between species and within species). E.g. seal: 53.2%, whale: 34.8%, donkey: 1.2% and horse: 1.6% Protein
- Milk protein consists of casein (80%) and whey (20%)

Composition of milk in different species of animal

Species	H_2o %	Protein %	Fat %	Lactose %	Ash %
Cow	87.0	3.3	4.0	5.0	0.70
Buffalo	82.05	4.0	7.98	5.18	0.79
Sheep	81.23	5.6	7.80	4.4	0.85
Goat	85.71	4.29	4.78	4.46	0.76
Mare	90.18	2.14	1.59	6.73	0.42
Elephant	67.8	3.1	19.6	8.8	0.70
Bitch	75.4	11.2	9.6	3.1	0.70

Nutritive Value of Milk

Milk is an energetic form of fluid which contains different minerals, vitamins and many more. Each volume of milk is subjected to contain certain amount of energy.

For example: Energy content of 100 gram of milk contains:

- Fat: 4.2 gm/100gm milk × 9Kcal/gm= 37.8 Kcal
- Protein: 3.4 gm/ 100gm milk × 4 Kcal/gm= 13.6 Kcal
- Lactose: 4.6 gm/ 100gm milk × 4 Kcal/gm= 18.4 Kcal
- Total = 70 Kcal/ 100 gm of milk

Functions of other form of nutrients

- Protein: helps build and repair body tissues, including muscles and bones and play role in the formation of antibodies

- Calcium: Helps build and maintain strong bones and teeth
- Riboflavin: Supports body growth, red blood cell production and metabolism
- Phosphorus: Strengthens bones
- Vitamin D: Helps promote the absorption of calcium
- Vitamin B: Helps convert food into energy
- Potassium: Regulates fluid balance and helps maintain normal blood pressure
- Vitamin A: Promotes good vision and healthy skin
- Niacin: Promotes proper circulation

2.3 Physical properties of milk

There are various types physical properties of milk which involve to contain their appearance, turbidity, odour and other organoleptic characters.

a. Colour

The colour of the milk ranges from a bluish white to a golden yellow or yellowish white.

White colour: The white colour of the milk is due to the reflection of light by the dispersed fat globules, calcium caseinate and calcium phosphate.

Yellow colour: The yellow colour of the milk is due to the carotene pigment that is found in the green plants. The carotene pigment is a fat soluble yellow pigment and it is considered as a precursor of Vitamin A.

Bluish yellow colour: It is due to riboflavin and lactoflavin.

Green colour: Green colour of whey is due to fewer amounts of fat particles.

Factors affecting the colour of milk

i. Breed of animal: The Jersey breeds produce fat with deepest yellow colour while the Holsteins and Ayrshires produce fat with the lightest colour.

ii. Feeds: Green forage and carrots are rich in carotene so, animals fed with these feed tend to produce milk with deeper yellow colour than that produced by hay, white corn and oats.

iii. Species of animal: Buffaloes have bluish white milk while cows have golden yellow milk.

iv. Flavour and taste

v. Freshly drawn milk tastes slightly sweet and mild aromatic flavour. Sweet taste is due to lactose and salty taste is due to minerals (mastitic milk).It varies according to animal's species, feed and fodder. Sour taste is due to lactic and butyric acid.

b. **Specific gravity:** Milk is heavier than water. The specific gravity of cow milk varies from 1.018 to 1.038. It varies with temperature.

c. **Boiling point:** Boiling point of milk is 100ºC to 100.2ºC in both cow and buffalo milk.

d. **Freezing point:** Freezing point of milk ranges from -0.535ºC to -0.55ºC.

e. **Surface tension:** The surface tension of milk at 20ºC is 54.5 dynes per cm. It decreases as the temperature is raised or fat percent is increased.

f. **Viscosity:** The viscosity of milk varies from 1.5 to 2 centipoises. The viscosity of milk is always higher than viscosity of water due to the presence of dissolved solids in milk.

2.4 Factors Affecting the Composition of Milk

i. Species

Milk fat is the most variable component of milk. It ranges from a little over 1% to greater than 50%. Aquatic mammals typically have high milk fat percentage. Lactose ranges from only a trace to less than 7%. Some species such as bear, kangaroo have very little lactose in milk. Milk protein concentration ranges from 1% to about 14%. Generally, milk protein percentage is positively correlated with milk fat percentage.

ii. Breed

The composition of milk varies within a breed. Lactose content is fairly constant among breeds, milk fat varies extensively (Jersey and Guernsey are highest and Holstein is lowest), and protein varies somewhat among breeds.

iii. Change Occurring During a Normal Lactation

Composition of milk varies considerably during a lactation, with the major changes usually occurring soon after the start of lactation. The first secretion to be collected from the gland is called colostrum. The composition of the secretion gradually changes to that of mature milk.

iv. Day to day Variation

There is day to day variation of milk due to following factors:

- Excitement
- Estrous
- Incomplete milking

Milk fat is the lowest in the fore milk and gradually increases in percentage as the milk is removed. The last milk out of the gland is highest in milk fat content.

v. Age of Cow

As the age increases there is gradual decline in protein, fat and SNF level of the milk.

vi. Pregnancy

In late lactation there is increase in SNF and protein level of the milk.

vii. Temperature

This is inversely proportional with the protein and SNF level. With the increase in temperature beyond 21ºC and below 1.1 ºC, there is increase in fat content of milk.

viii. Exercise

Slight exercise will contribute in the increment of the fat level by 0.2 to 0.3% without change in quantity. Whereas moderate to heavy exercise will decrease in milk secretion and there will be substantial increment of the fat percentage. However, there will be no effect of exercise over the SNF.

ix. Disease

Mastitis will lead to decrease in fat, SNF, protein and lactose. However, there will be increment of the Cl, Na, Cu, Fe, Zn, Mg and a decrease in Ca, P, Mb, K. but ketosis will lead in elevation of fat level.

x. Feeds

Diet favoring acetic acid production during fermentation in rumen will contribute in milk fat percentage. So, for these diets should be provided in pelleted form. Also heat-treated feed and finely grained hay will contribute in fat percentage of the milk.

xi. Dry Period and Body Condition

This period is essential to generate milk secretory tissue and to replenish body supplies.

xii. Season

During winter there will be greater percentage of fat in comparison to the summer season.

Excrise

Choose the correct answer from the given alternatives.

1. What is the correct definition of milk?
   a. A clear liquid secreted by mammary glands
   b. A white fluid rich in protein, fat, lactose, and minerals secreted by the mammary glands of mammals
   c. A synthetic nutritional liquid
   d. A by-product of digestion in ruminants

2. What is colostrum?
   a. Regular milk after two weeks of calving
   b. The milk produced during the mid-lactation period
   c. The first milk secreted after parturition, rich in antibodies
   d. Milk produced by crossbred cows only

3. What is the major biological importance of colostrum?
   a. It enhances fat production
   b. It strengthens the calf's immune system
   c. It increases milk shelf life
   d. It reduces milk protein

4. Which of the following components is found in the highest amount in milk?
   a. Protein b. Fat
   c. Water d. Lactose

5. Which sugar is primarily present in milk?
   a. Sucrose b. Glucose
   c. Lactose d. Fructose

6. What is the average protein content in cow milk?

a. 0.5% b. 1.0%

c. 3.2% d. 8.0%

7. Milk is a good source of:

a. Vitamin C b. Vitamin B12 and Calcium

c. Iron and Fiber d. Zinc and Vitamin K

8. What is the normal pH of fresh cow milk?

a. 4.5 – 5.0 b. 6.4 – 6.6

c. 7.0 – 8.0 d. 8.5 – 9.0

9. The color of milk is primarily due to the presence of.....

a. Hemoglobin b. Casein and fat globules

c. Lactic acid d. Lactose

10. The specific gravity of milk is approximately.....

a. 0.95 b. 1.025 – 1.035

c. 1.50 d. 2.00

11. Which physical property is used in lactometers to check milk quality?

a. Viscosity b. Color

c. Specific gravity d. Surface tension

12. Which of the following factors does not affect the composition of milk?

a. Breed b. Stage of lactation

c. Feeding d. Milking method only

13. Milk from buffalo generally has.....

a. Lower fat content than cow milk

b. Similar fat content to cow milk

c. Higher fat content than cow milk

d. No fat

14. How does stage of lactation affect milk composition?
    a. Milk composition remains constant throughout
    b. Early lactation milk has more fat and protein
    c. Milk becomes waterier in late lactation
    d. Milk stops being nutritious in late lactation

15. Which feeding condition can increase milk fat content?
    a. High grain and low fiber diet
    b. High fiber, balanced energy diet
    c. Water-only diet
    d. Vitamin D-rich diet

Write short answer to the following questions.

1. Define colostrum and write its importance.
2. Explain about composition and nutritive value of milk

Write long answer to the following questions.

1. Explain the factors affecting composition of milk in detail
2. Explain the physical properties of milk.

Unit 3 Identify Dairy Equipment it's Cleaning and Sanitization

3.1 Equipment Used in Dairy Farm

Various equipment is required to enhance the performance and production of dairy animals and their products to convert it into the value of money. The picture about the dairy farm will be very clear after the visit to the farm. Following is the list of equipment's in dairy farm.

a. **Milking Equipment**

- Milking machines (automated or semi-automated)
- Milk cans or milk tanks
- Bulk milk cooling tank
- Milk pipeline system
- Vacuum pump
- Teat cups
- Milking parlor (rotary, herringbone, parallel, etc.)

b. **Cleaning & Sanitation**

- Teat dip cups
- Udder washers
- Sanitizers and disinfectants
- Milk line cleaners
- Hot water systems
- Brushes and scrapers

c. **Animal Housing & Handling**

- Cow cubicles/stalls
- Feed troughs
- Water troughs or automatic waterers
- Manure scraper or vacuum
- Cow brushes
- Footbath
- Ventilation fans
- Bedding materials (like sand, straw, or sawdust)

d. **Health & Breeding**

- Artificial Insemination (AI) kit
- Pregnancy testing kits
- Veterinary tools (thermometer, syringes, etc.)
- Tagging system or RFID
- Cattle chute or head gate

e. **Feeding Equipment**

- Total Mixed Ration (TMR) mixer
- Silage cutter
- Hay baler and unroller
- Grain crusher or mill
- Feed bins or silos

f. **Monitoring & Management**

- Herd management software
- Cow activity monitors (wearable sensors)
- Milk meters or yield recorders
- CCTV or surveillance systems

3.2 Dairy Equipment Used in Chilling Center

For the production of quality milk and milk products various factors and machineries are necessary to maintain the system of milk storage, milk products.

a. Milk Reception & Pre-Cooling

- Weighing scale or milk weigh bowl
- Milk receiving vat
- Strainer or filter (to remove physical impurities)
- Milk pump

b. Chilling & Storage

- Bulk milk cooler (BMC) – core equipment for chilling milk to 4°C
- Plate heat exchanger – for instant cooling using chilled water
- Milk storage tanks – insulated and hygienic tanks

c. Cooling & Refrigeration System

- Refrigeration compressor
- Chiller unit
- Condenser and evaporator
- Coolant (refrigerant gas)

d. Cleaning & Hygiene

- CIP (Clean-In-Place) system
- Sanitizing equipment and chemicals
- Hot water generator

e. Power Supply & Backup

- Diesel generator or backup power unit
- Voltage stabilizer or inverter
- Control panels

f. Testing & Quality Control

- Lactometer – for checking milk density
- Milk analyzer – for fat, SNF, and adulteration
- pH meter
- Thermometer
- Alcohol test kit

g. Logistics & Packaging (if applicable)

- Can washers
- Milk cans or crates
- Milk tanker (for bulk transport)

3.3 Dairy Equipment Used in Dairy Plant

Dairy plants use a wide range of specialized equipment for processing, storing, and packaging milk and dairy products. Here is a list of common dairy equipment used in such plants:

a. Milk Reception & Storage

- Milk Reception Tanks – For receiving milk from collection tankers.
- Weighing Scales – For measuring the quantity of milk.
- Chillers / Plate Heat Exchangers – For quickly cooling milk to storage temperature (around 4°C).
- Storage Silos – Large stainless steel tanks for storing milk.

b. Milk Processing

- Pasteurizer – Heats milk to kill pathogens (e.g., HTST pasteurizers).
- Homogenizer – Breaks down fat molecules for even distribution.
- Cream Separator – Separates cream from milk using centrifugal force.
- Standardization Equipment – Adjusts fat content in milk.
- CIP (Clean-In-Place) System – Automatically cleans tanks and pipes without disassembly.

c. Product-Specific Equipment

- Cheese Vats / Cheese Presses – Used in cheese production.
- Yogurt Fermentation Tanks – For culturing milk into yogurt.
- Butter Churns / Continuous Butter Machines – For making butter.
- Ice Cream Freezers / Mixers – For blending and freezing ice cream.

d. Filling & Packaging

- Bottle Filling Machines – For packaging milk and liquid dairy products.
- Carton Filling Machines – For products like milk, cream, and yogurt.
- Sealing & Capping Machines – For securing containers.
- Labeling Machines – Apply product labels automatically.

e. Quality Control & Utilities

- Milk Analyzers – For fat, protein, SNF, and water content testing.
- Boilers & Steam Generators – Provide heat for processing.
- Water Treatment Plant – Ensures clean water for production.
- Air Compressors – Used in pneumatic operations (valves, packing, etc.).
- Refrigeration Units – Maintain proper cold chain storage.

3.4 Milk Utensil on Farm

The essential steps that must be taken during cleaning and sanitation of milk utensils and milking equipment on farms are:

1. Pre-rinsing with Water: Pre-rinsing with cold or lukewarm water should always be carried out immediately upon emptying the vessels. Otherwise, the milk residues will dry and stick to the surfaces, making them harder to clean. If there are dried milk residues on the surface, it may be advantageous to soak the equipment, to soften the dirt and making cleaning more efficient.
2. After rinsing, scrub utensils/pails thoroughly with a suitable brush, using hot water and efficient dairy detergents like, washing soda, tri-sodium

phosphate, sodium hydroxide and sodium metasilicate.

3. Then washing is done with hot water. The temperature of water should be more than 50°C.
4. Wash the utensil again with enough cold water to remove traces of detergent.
5. Sanitize the cleaned utensils with acceptable sanitizing agent (iodophors/ chlorine solutions (50-200ppm of active compound)) to kill/disinfect the utensils.
6. Properly cleaned vessels should be placed in inverted position for the complete drainage of water, so as to avoid contamination from air, insects, rodents, reptiles etc.
7. Dry cleaned utensils should be stored in dust, dirt and other contamination protected area.
8. Hot water sterilization- the temperature should be as near the boiling point as possible and never below 85°C. The utensils should be immersed for 20 min, but where it is not possible, boiling water should be poured over the milk-contact surfaces till they are too hot to touch.

3.5 Milk Plant Line in Place: Cleaning in Place (CIP)

Cleaning in Place (CIP) can be defined as circulating cleaning liquids or detergent solution through machines, tanks, pipes, process lines and other equipment without the equipment moving from its place. This techniques is used for permanently installed equipments like pipes and tanks, which are practically impossible to clean by other means.

Cleaning and sanitization of milk plant line in place comprise the following stages

1. Rinsing with warm water for 3 minutes
2. Circulating of a 0.5-1.5% alkaline detergent at 75ºC for about 10 minutes
3. Rinsing with warm water for about 3 minutes

4. Sanitization with hot water 90-95ºC for 5 minutes
5. Gradual cooling with cold tap water for about 10 minutes

3.6 Sanitizing Utensil and Equipment

It is an attempt to kill most or all of the microorganisms on utensil and equipment surface. Hot water (90-100ºC), flowing steam, steam under pressure, halogens (chlorine or iodine) and quaternary ammonium compound etc. can be used for sanitization of utensils and equipment. Following chlorine concentration is used for the following sanitization purpose:

Bottle: 50-100ppm for 2 minutes

Vat/ plate chiller: 100-200ppm for 2-3 minute

Vat/ tanker spray: 205 ppm for 2-3 minute

Butter churn, ice cream freezer: 50-250ppm for 1-2 minute

3.7 Chemical Sanitizers in Dairy

Chemical sanitizers are the substances used to destroy or reduce harmful microorganisms on surfaces, equipment, and utensils in dairy processing. Their use is critical to:

- Prevent milk contamination
- Ensure milk safety and quality
- Comply with food safety regulations

Chemical sanitizers used in the dairy industry, focusing on their role, types, and importance are as follows:

Types of Chemical Sanitizers in Dairy

1. **Chlorine Compounds**

   Common forms: Sodium hypochlorite (liquid bleach), calcium hypochlorite

   How they work: Strong oxidizing agents that destroy a wide range of microorganisms.

Example: Sodium hypochlorite (bleach)

Action: Oxidizes microbial cell components

Pros: Cheap, fast-acting, effective

Cons: Corrosive to metals, loses power in organic matter

2. **Iodophors (Iodine-based)**

Common forms: Iodine mixed with surfactants or solubilizing agents

How they work: Iodine penetrates microbial cells and disrupts protein and nucleic acid structure.

Example: Iodine with surfactants

Action: Penetrates and kills microbes by breaking proteins

Pros: Stable, visible (brown color), effective

Cons: Can stain surfaces, more costly

3. **Quaternary Ammonium Compounds (Quats)**

Common forms: Benzalkonium chloride, cetylpyridinium chloride

How they work: Disrupt microbial membranes and proteins.

Example: Benzalkonium chloride

Action: Disrupts microbial membranes

Pros: Non-corrosive, leaves a residual kill layer

Cons: Not effective against all bacteria, residue issues

4. **Peracetic Acid (PAA)**

How it works: Strong oxidizer, similar to hydrogen peroxide.

Example: Mixture of acetic acid and hydrogen peroxide

Action: Strong oxidizer; kills bacteria, viruses, fungi

Pros: Biodegradable, no toxic residue

Cons: Strong smell, skin/eye irritant

5. Hydrogen Peroxide

How it works: Produces reactive oxygen species that damage cell components

Action: Releases oxygen to destroy cells

Pros: Environmentally safe, breaks into water and oxygen

Cons: Less stable, can be slow-acting

Precautions while Using Chemicals

- Use the correct concentration (too weak = ineffective; too strong = damage/health risk)
- Allow proper contact time (usually 30 seconds to 2 minutes)
- Surfaces must be cleaned before sanitizing (sanitizers don't work well on dirty surfaces)
- Use food-grade approved sanitizers only
- Always rinse milk contact surfaces before sanitizing.
- Ensure proper dilution and contact time (as per manufacturer's instructions).
- Avoid mixing different sanitizers – it can be dangerous or ineffective.
- Rotate sanitizers occasionally to avoid microbial resistance.

Importance of Chemical Sanitizer in Dairy

- Milk is highly perishable and a good medium for bacteria.
- Unsanitary conditions can cause spoilage, souring, or diseases like tuberculosis, brucellosis.
- Proper sanitization ensures milk stays safe from farm to table.

3.8 Dairy Detergents and Method of Cleaning

Dairy detergent is a specialized cleaning agent used in the dairy industry to clean equipment that comes into contact with milk or dairy products, like milking machines, bulk tanks, pipelines, and pasteurizers. These detergents are

formulated to remove milk residues—especially **fats, proteins, and minerals** (like calcium and magnesium)—which can lead to bacterial growth or equipment malfunction if not cleaned properly.

The milk secreted from cow's udder is usually sterile. It becomes contaminated during and after milking by the milker, milking equipment's, utensils, cooling, storage and while processing. The contamination of milk from improperly cleaned utensils/ cans is about 60%. Good quality milk is essential for production of good quality dairy products. The detergents used for cleaning dairy equipments and utensils are discussed below.

a. Alkaline Detergents

- Caustic soda (NaOH)- 1 % solution of this can be used
- Sodium bicarbonate (NaHCO3)-1-3% solution
- Trisodium phosphate (Na3Po4) and sodium metasilicate are mixed and used as 1-3% solution for corrosive utensil
- Sodium carbonate and bicarbonate: 1% solution

b. Acid Detergents

Acids detergents are used to remove milk stone in dairy utensils and equipments. Nitric acid (0.1%), phosphoric acid (1%), hydroacetic acid and citric acid solution are some of acid detergents used to remove milk stone.

3.9 Clean-in-Place (CIP)

Clean-in-Place (CIP) is an essential process used to clean milking machines, pipelines, storage tanks, pasteurizers, and other dairy processing equipment without dismantling them. It ensures hygiene, product safety, and compliance with strict food safety standards like 3-A Sanitary Standards, FDA, and HACCP.

Importance of CIP

- Milk residues (like fats, proteins, and sugars) quickly become breeding grounds for bacteria.

- Manual cleaning would be inefficient, inconsistent, and risk contamination.
- Dairy systems often run continuously, So, fast turnaround is key.

CIP Cycle

1. **Pre-Rinse (Warm Water)**
   - Flushes out milk residues and loosens soil.
   - Helps prevent protein baking onto hot surfaces later.
2. **Alkaline Wash (Caustic Soda - NaOH)**
   - Removes organic material (fats, proteins).
   - Usually circulated at 70–80°C for 10–20 minutes.
3. **Intermediate Rinse (Water):** Flushes out alkali and remaining soil.
4. **Acid Wash (Nitric/Phosphoric Acid)**
   - Removes milkstone (calcium deposits) and scales.
   - Maintains equipment surfaces and prevents corrosion.
5. **Final Rinse (Potable or Deionized Water):** Ensures no cleaning agent residues remain.
6. **Sanitization (Optional, Pre-Production)**
   - A chemical or heat-based treatment just before restarting processing.
   - Often done using peracetic acid or hot water.

Precautions and consideration

- Milkstone (calcium and protein buildup) is a unique challenge.
- Heat exchangers and pasteurizers need frequent CIP to prevent fouling.
- Systems must be validated and monitored for temperature, flow rate, and concentration.

Exercise

Choose the correct answer from the given alternatives.

1. Which of the following is a common equipment used for milking cows?

   a. Pasteurizer
   b. Milking machine
   c. Centrifuge
   d. Cream separator

2. What is the purpose of a teat dip cup in a dairy farm?

   a. Milk measurement
   b. Sanitation of teats before/after milking
   c. Feeding animals
   d. Measuring milk temperature

3. What equipment is used to immediately reduce the temperature of milk at a chilling center?

   a. Homogenizer
   b. Milk chiller
   c. Cream separator
   d. Vacuum pump

4. Which of the following maintains milk temperature at 4°C in chilling centers?

   a. Plate heat exchanger
   b. Ice cream maker
   c. Storage tank
   d. Cold storage tank

5. What equipment is used to destroy harmful microorganisms in milk?

   a. Homogenizer
   b. Chiller
   c. Pasteurizer
   d. Separator

6. Which machine helps in uniform fat distribution in milk?

   a. Separator
   b. Homogenizer
   c. Boiler
   d. Clarifier

7. Which of the following is not a common milk utensil on a dairy farm?

a. Milk pail
b. Sieve
c. Milk churn
d. Inkjet printer

8. The purpose of using a milk strainer is to.....

a. Cool the milk
b. Heat the milk
c. Filter foreign materials from milk
d. Measure fat content

9. "Line in place" refers to.....

a. Disassembling equipment for cleaning
b. Moving dairy cattle in line
c. Fixed pipeline system for milk flow and cleaning
d. Manual transport of milk

10. What is one benefit of line-in-place (LIP) systems in dairy plants?

a. Reduces need for electricity
b. Eliminates the need for milk cooling
c. Saves time in cleaning and milk transfer
d. Replace pasteurization

11. Why is sanitizing dairy utensils important?

a. To reduce detergent cost
b. To remove visible dirt only
c. To kill bacteria and prevent milk spoilage
d. To cool the milk

12. Utensils should be sanitized.....

a. Once a week
b. After every month
c. After every use
d. Only when visibly dirty

13. Which of the following is commonly used as a dairy sanitizer?

a. Sodium bicarbonate
b. Sodium hypochlorite
c. Glucose
d. Calcium carbonate

14. Iodophors used in dairy sanitation contain.....

a. Fluoride
b. Iodine
c. Zinc
a. Iron

15. What is the main function of alkaline detergents in dairy cleaning?

a. Kill microorganisms
b. Remove mineral deposits
c. Remove organic matter like fat and protein
d. Neutralize acidity

16. What should be the temperature of water used in hot water cleaning of dairy equipment?

a. Below 20°C
b. 25°C – 30°C
c. 40°C – 50°C
d. 70°C – 80°C

17. What is the meaning of Clean-In-Place (CIP)?

a. Manual disassembly and washing
b. Cleaning done in external tanks
c. Automatic cleaning of fixed dairy equipment without disassembly
d. Using only water for cleaning

18. The first step in a typical CIP process is.....

a. Acid wash
b. Hot water rinse
c. Cold water rinse
d. Sanitizer application

19. Which of the following is NOT a benefit of CIP systems?

a. Labor saving
b. Inconsistent cleaning
c. Time saving
d. High efficiency

Write short answer to the following questions.

1. List the common equipment used in dairy farm
2. List the equipment used in chilling center
3. What is the equipment used in dairy plant?
4. Define CIP. How do you sanitize milking utensils?

Write long answer to the following questions.

1. List the process of sanitizing equipment in dairy. Describe the process of CIP.

Clean Milk Production

Unit 4

4.1 Milking and Methods of Milking

Milking is the process of draining milk from the mammary glands of cattle, buffalo, goats, and sheep. Milking may be done by hand or by machine. The various methods of milking are as follows:

1. Hand Milking

Hand milking is performed by massaging and pulling down on the teats of the udder, squirting the milk into a bucket. Two main methods of hand milking are:

a. Stripping Technique

In this technique, teat is grabed in each hand by holding it between thumb and forefinger and drawing it down the length of the teat and at the same time pressing it to cause the milk to flow down in a stream.

b. Full Hand Technique

It is done by grasping the teat with all the five fingers and pressing it against the palm. The teat is compressed and relaxed alternately in quick successions, thus the method removes milk much quicker than stripping as there is no loss of time in changing the position of the hand. It is known to be superior to stripping method as it stimulates the natural suckling process by calf.

2. Machine Milking

Milking machine are capable of milking number of cows quickly and efficiently, without injuring the udder, if they are properly installed, maintained in excellent operating conditions, and used properly. It performs in two basic functions:

- It opens the streak canal through the use of a partial vacuum, allowing the milk to flow out of the cistern through a line to a receiving container.
- It massages the teat, which prevents congestion of blood and lymph in the teat.

4.2 Clean Milk Production: Concept and Methods

Milk is biological in origin. Milk containing dirt, dust, foreign materials high bacterial count and with off, flavour is called a contaminated milk. Milk is contaminated by various sources like Udder, Exterior of cow's body, milking barn, flies, milker, utensils etc. On consumption of contaminated milk, one may get a' number of health problems.

As soon as it is drawn from the udder, it is attacked by number of microbes. For retaining the original quality of milk, milk should be protected from microbial fermentation as soon as it is milked. Various post secretary factors are involved for changes in milk. To maintain hygienic quality risk of milk being attacked by microorganisms should be minimized. For this during milking, we should ensure cleanliness. Not only that but also one should avoid contamination of milk during subsequent handling.

For clean milk production we should be careful enough not to draw milk in dusty environment. Milch animal's udder should be free from dirt and dust. Otherwise during the operation of milking it might fall in to the milk. To avoid milk residues left over as a source of microbial contamination it is essential that the vessel used for milking and for storage should be cleaned and rinsed using detergents after each milking.

Methods that should be followed for clean milk production

Clean milk production is of utmost importance to retain its nutritive value and keeping quality. Following methods should be followed for clean milk production:

a. Clean and Healthy Animals

Bacteria present on the animal body may enter in to the milk at the time of milking. Maintenance of, clean skin, washing flank and udder with clean damp cloth before milk reduces the contamination from this source. For this we can use clean brush and detergents or soap solution or potassium per manganite solution. We should also avoid initial stripping of milk. Milk will also develop odour from surroundings and utensils.

b. Milking Barns

Milking barn should be dry, free from dirt,neat flooring and well ventilated to avoid contamination from this source. Washing of milk parlour should be done regularly. Dry feeds or forage should be fed after milking.

c. Healthy Milkmen

Milker is directly responsible in producing good quality milk. Dirty hands and clothing of the milker may be the source of contamination. Several bacterial diseases like T.B, Typhoid fever, diphtheria may be transmit from the milker, or handler to the consumer through milk. Proper dress of milkmen and personnel hygiene should be maintained. Also one should wash their hand properly before milking and avoid wet hand milking to avoid contamination. Similarly, usdesirable habits like smoking, drinking should be avoided.

d. Control of Insects and Fly

They are source of contamination so, should be killed regularly. Insecticides should be sprayed in milk shed.

e. Utensils

Utensils are the containers or equipment in which the milk is handled, processed, stored or transported. Clean sanitized, smooth, copper free and dry utensils may be used for handling milk. First rinse the milk utensils with cold water followed by hand or brush scrubbing with cold water with the aid of washing soda or any detergents.

f. Boiling

Boiling helps to keep milk for longer time. But during reduction of temperature at around 61 degree celsius thermophilic bacteria may grow.

g. Chilling

Cooling below 10 degree celsius will substantially decrease the microbial load. Chilling equipments also should be clean to ensure clean milk after transportation

4.3 Micro-organisms Common to Raw Milk, Pasteurized Milk and Milk Product

As Milk and milk products are very good media for the growth and development of a number of micro-organisms. Some organisms are desirable and some are harmful and pathogenic. When these organisms come in the milk it causes change in taste, odor or appearance of milk. The importance of knowledge of the microorganism of dairy products are:

- Pathogenic bacteria in milk and milk products may spread diseases
- Milk and milk products may be spoiled by the action of micro organisms
- Certain dairy products can be made only by controlled action of specific micro-organisms

The various microorganisms found in milk and milk products are of following types:

a. Acid Producers/Lactose Fermenters

Those bacteria, which are responsible for conversion of lactose to lactic acid, are included in this group

1. Streptococci: These are non-pathogenic and important to dairy industry.

Streptococcus cremoris (S. cremoris): Important member of starter cultures. It produces good flavour of ripened cream.

Streptococcus lactic: They are responsible for normal souring of milk. It is

desirable in milk and milk products.

Streptococcus thermophiles: Important for preparation of yoghurt.

S. citrovorus, S. paracitrovorus, and S. diacetilactis: responsible for production of desirable aroma and flavour in milk products, especially in butter.

2. **Lactobacilli:** They play an important role in ripening of cheese and in preparation of certain types of sour milk. E.g. *Lactobacillus bulgaricus, L. acidophilus, L. casei*

b. Peptonizing Organisms

These organisms decomposes the protein (casein) and responsible for sweet curdling and development of abnormal colors of milk. These are undesirable organisms in milk. These organisms found in milk and milk product can be classified into:

i. Sweet curdling Organisms

Aerobic spore forming: These organisms are common contaminants in milk. E.g. *Bacillus subtilis, B. mesentricus, B. cereus, B. mycoides, B. novus*

Aerobic non spore forming rods: Proteus vulgaris, Pseudomonas fluorescens

ii. Organisms Responsible for the Development of Abnormal Colors in Milk

- Blue colour: *Bacillus cyanogens*
- Yellow colour: *B. synnanthus*
- Red: *B. prodigiosus*

c. Fat Splitting Organisms/Lipolytic Organisms

These organisms are responsible for tallow flavour, rancidity and bitter tastes in milk and cream. Bacteria which causes lipolysis are *Pseudomonas*

fluorescens, P. fragi, Achromobacter lipolyticum and moulds such as: *Oidium lactis* and *Penicillium*.

d. Aroma Producing Bacteria

These bacteria are responsible for the production of desirable aroma and flavour in milk product. E.g.*Streptococcus citrovorus, Streptococcus paracitrovorus, Streptococcus diacetilactic*

e. Gas producing Bacteria

These are undesirable type of bacteria that ferment lactose and produce acid and gas i.e. lactic acid and co2. E.g. *E. coli, Aerobacter acrogens*

f. Toxin Producing Bacteria

Salmonella, Strepylococcus produce poisonous substances which are toxic to man and animals.

g. Yeast: The yeast most frequently encountered in milk and milk products act upon the lactose to produce acid and carbon dioxide. *Torula lactis, Torulus mycoderma, Saccharomyces* are the yeast that can produce acidity which inhibits the activity of organisms and also imparts flavour and aroma in dairy products.

h. Mould: Moulds are multi cellular organism, which are not visible by our naked eye, at maturity they may observe as mycelium. Generally aerobic moulds are significant to dairy products. It is used in mould ripened cheese varieties. It causes discoloring of milk along with producing smell and odors. Common genera are P*enicellium, oospora, Aspergillus, mucor, Monilia* etc.

Some moulds are of significant importance in different types of cheese production while others spoil the dairy products under their favorable conditions.

i. Viruses: The virus are usually not destroyed by normal pasteurization of milk employed for cheese and cultured buttermilk, but they can be

destroyed by higher heat treatment.

j. Pathogenic Organisms: These can be grouped in two classes:

- **Organisms originating from the cow**

  Mycobacterium tuberculosis, Brucella abortus, Streptococcus agalactiae, Staphylococcus aureus, Salmonella spp., Coxiella burneti, Corynebacterium pyogenes

- **Organisms originating from persons handling the milk**

  Salmonella typhi, S. paratyphi, Shigella dysenteriae, Hemolytic streptococci, Escherichia coli, Clostridium perfringes, Corynebacterium diphtheria

4.4 Pasteurization

The process of pasteurization was named after Louis Pasteur, a French chemist/ microbiologist, who discovered that spoilage organisms could be inactivated in wine by applying heat at temperatures below its boiling point. Pasteurization is one of the important processes in the treatment of milk. It is process of heating every particle of milk or milk products to at least 62ºC for 30 minutes or at least 72ºC for 15 seconds in approved and properly operated equipment. Bacteria of TB, typhoid fever, scarlet fever, diphtheria, brucellosis can be killed by the process of pasteurization.

Methods of Pasteurization

1. Low Temperature Long Time (LTLT)

- In this process, the milk is heated at 62ºC for 30 minutes.
- This method is suited for small scale operation upto 900 lts.
- This has low initial cost.
- This can also be hand operated.

2. High Temperature Short Time (HTST)

- In this process, milk is heated at 71ºC to 72ºC for 15 seconds.
- It is also known as continuous flow or flash pasteurizer.

- The entire process is continuous and automated.
- This method is applicable to liquid milk, cream, and other liquid milk products.

4.4.1 Pasteurized Milk

Pasteurized milk is milk that has undergone a heat treatment process called pasteurization, which involves heating the milk to a specific temperature for a certain amount of time to kill harmful bacteria and other microorganisms.

The goal of pasteurization is to make the milk safe to consume while preserving its flavour, nutrients, and overall quality.

Two types of Pasteurization:

1. HTST: High-Temperature Short Time: 161°F (72°C) for 15 seconds
2. LTLT: Low-Temperature Long Time: 62ºC for 30 minutes

In most cases, pasteurization involves heating the milk to about 161°F (72°C) for 15 seconds (known as High-Temperature Short Time or HTST method), but other methods, such as Low-Temperature Long Time (LTLT), may use lower temperatures over a longer period.

Pasteurization helps prevent foodborne illnesses and extends the shelf life of milk without the need for refrigeration.

Exercise

Choose the correct answer from the given alternatives.

1. Which of the following is a major advantage of machine milking over hand milking?

   a. More physical labor required

   b. Increased risk of contamination

   c. Faster and more hygienic milk collection

   d. Requires no electricity

2. In hand milking, the best method to extract milk is.....

   a. Squeezing with nails b. Knuckling method

   c. Stripping method d. Fist method

3. Machine milking is preferred in large farms because.....

   a. It wastes more milk

   b. It increases human contact

   c. It reduces labor and saves time

   d. It increases bacterial load

4. What is the primary goal of clean milk production?

   a. Reduce fat content in milk

   b. Enhance milk color

   c. Ensure milk is free from dirt and pathogens

   d. Add more preservatives to milk

5. Which of the following does NOT help in clean milk production?

   a. Cleaning udder before milking

   b. Using rusty buckets

   c. Milking in a clean environment

   d. Washing hands before milking

6. Clean milk should have.....

a. High microbial count
b. Low microbial count
c. No fat content
d. High pH

7. What is raw milk?

a. Milk that has been boiled
b. Milk that is fermented
c. Milk in its natural state, unpasteurized
d. Powdered milk

8. Which of the following is a risk of consuming raw milk?

a. More calcium content
b. High shelf life
c. Transmission of diseases like TB, brucellosis
d. More color

9. Pasteurization is the process of.....

a. Freezing milk
b. Fermenting milk
c. Heating milk to a specific temperature for a set time to kill harmful microbes
d. Boiling milk at 100°C

10. Standard method of pasteurization is.....

a. 30°C for 10 mins
b. 63°C for 30 mins or 72°C for 15 secs
c. 90°C for 1 hour
d. Boiling and cooling

11. Pasteurized milk is.....

a. Unsafe to drink

b. Free from all nutrients

c. Safe for consumption with most bacteria destroyed

d. Stored without refrigeration

12. The main objective of heat treatment of milk is to.....

a. Increase milk volume b. Remove water from milk

c. Kill pathogenic microorganisms d. Make milk sweet

13. Heat treatment helps to.....

a. Decrease milk shelf life

b. Inactivate enzymes that cause spoilage

c. Reduce lactose content

d. Add artificial flavors

14. Which of the following is not a type of heat treatment?

a. Pasteurization b. Sterilization

c. Freezing d. UHT (Ultra-High Temperature)

Write short answer to the following questions.

1. List and explain methods of milking.
2. Write the process of clean milk production.
3. Define pasteurization. What are the steps of milk pasteurization?
4. Write the objectives of heat treatment.

Write long answer to the following questions.

1. Describe the process of clean milk production with complete process involved.
2. Define pasteurization and its different types with process methods in detail.

Unit 5

Milk Quality and its Test

5.1 Concept of Quality Milk

Good-quality milk has to be free of debris and sediment, free of off-flavours and abnormal colour and odour, low in bacterial count, free of chemicals, and of normal composition and acidity. Good raw milk quality is the basis for the production of high quality dairy products. To achieve this quality, good hygiene practices should be applied throughout the dairy chain.

5.2 Characteristics of Quality Milk

The quality milk should have following characteristics:

- Quality milk should be of normal colour
- Good quality milk should be free of off-flavour
- Quality milk should not contain any adulteration like water, preservatives, added solid etc.
- Quality milk should be free of chemicals (e.g. antibiotic residues, detergents)
- Somatic cell count should be less than 100,000 cells/ml in quality milk
- Quality milk has to be free of debris and sediment
- Quality milk should be of normal composition and acidity
- Quality milk should be low in bacterial count

5.3 Factors affecting milk quality

a. Microbiological Quality

- Endogenous source (cow itself)

- Exogenous source
- Environment (soil, water, manure, human contact etc)
- Collection and processing equipments
- Human milk handlers on the farm and in the factory

b. Milk Composition

- Species
- Genetic differences within species
- Breed differences: Milk from holstein cows has a lower milk fat % than milk from Jersey
- Stage of lactation: fat %, vitamin A & D, Ca, Mg, P, Cl is higher in colostrum than in milk.
- Change in milk composition during milking: first drawn milk contain 1-2 % fat whereas at the end of milking fat % may be 5-10%
- Seasonal variation: milk fat and SNF are higher in winter and lowest in summer.
- Diseases : infection of udder (mastitis) greatly influences milk composition

c. Milk Somatic Cell Count

High Somatic Cell Counts (SCC) present in milk are the main indicators of mammary gland infection. Normally, in milk from a healthy mammary gland, the SCC is lower than 100,000 cells/ml. An elevated SCC in milk has a negative influence on the quality of raw milk

d. Antibiotic Residues

Antibiotic residue in milk refers to trace amounts of antibiotics that remain in milk after a treated animal has been milked, often before the end of the withdrawal period (the time required after treatment for antibiotics to clear from the animal's system). These residues pose health risks and are strictly regulated in dairy production.

5.4 Quality Assurance in Milk Collection

The quality of the milk is dependent partly upon its condition on arrival at the receiving platform and partly upon the efficiency of the processing methods. Upon receipt of the milk at the collection center several inspections and test should be carried out at milk collection center before processing for assurance of milk quality.

Milk can be tested for:

- quantity – measured in volume or weight;
- organoleptic characteristics – appearance, taste and smell;
- compositional characteristics – especially fat, solid and protein contents;
- physical and chemical characteristics
- hygienic characteristics – hygienic conditions, cleanliness and quality;
- adulteration – with water, preservatives, added solids, etc. drug residues.

Note: Examples of simple milk testing methods suitable for small-scale dairy producers and processors include taste, smell, and visual observation (organoleptic tests); density meter or lactometer tests to measure the specific density of milk; cloton-boiling testing to determine whether the milk is sour or abnormal; acidity testing to measure the lactic acid in milk; and the Gerber test to measure the amount of fat in the milk.

5.5 Organoleptic Evaluation

The test performed by utilizing the sense of sight, smell and taste is known as organoleptic examination.

The sample of milk is examined and recorded from the observation on following aspect.

1. **Odor/Smell**

- It can be judged within few seconds.
- Remove the lid and inhale the smell.
- Record the odor/ smell as normal or abnormal.
- Milk should be free from any off flavour like feed, fishy, barny etc.

2. **General Appearance**

It should be observed whether the milk is clear or contains any visible dirt or foreign matter.

3. **Colour:**

Observe the colour of milk and record it whether colour of milk is normal or abnormal. Normal colour of milk are white, yellowish, light yellow. Abnormal colours are reddish, bloody, bluish etc.

4. **Consistency**

Record the consistency of milk as normal, watery, thick, ropy and slimy.

5. **Temperature**

Note the temperature of milk at the time of receiving. It should be below 5ºC.

5.6 Alcohol Test

The test is done to detect abnormal milk such as colostrum or mastitis milk. The procedure are as follows:

1. Take 5ml of milk in test tube
2. Add equal quantity of 68% Ethyl alcohol
3. Mix the contents of the test tube by inverting several times
4. Examine the tube and note any coagulation. Presence of flake or curd denotes positive alcohol test. Such milk are rejected.

5.7 Clot on Boiling (COB) Test

If milk is kept as such at room temperature, there will be increased in the acidity. If acidity is increased to more than 0.2 percent, there is coagulation due to heat treatment. Hence, it is essential to know the heat stability of incoming raw milk for further processing.

1. Take 5 ml of milk in the test tube.
2. Put this on boiling water bath or in flame for 5 minute.
3. Remove the tube from water bath without shaking.
4. Note any acid smell or clotting particles on the sides of the test tube.
5. Sample showing clotting particles are recorded as positive COB Test. Such milk is rejected on the platform

5.8 Fat Test (Gerber Method)

Fat is the most important constituent of milk as it is used as a basis for fixing the purchase and sale price of milk. It helps to detect adulteration like watering and skimming of milk. The fat level in milk is determined by Gerber method.

The procedure for fat test is as follows:

10.94 ml. of milk at 20 degrees celsius is added to a butyrometer together with 10ml sulphuric acid and 1ml amyl alcohol. After centrifugation, the sample is put in a 65 degrees celsius water bath and read after 3 minutes. The fat content from this reading should not be less than 3%.

5.9 SNF (Solid Not Fat) Test by Using Lactometer

The test is done to estimate the level of total solid content of milk. The quality of milk is determined on the basis of total and SNF.

SNF is estimated by using lactometer. The specific gravity of milk is measured usually with lactometer. It works on the principles that the body floating in liquid sinks to such a level that it displaces a volume of liquid equal in weight of the floating body.

5.10 The Methylene Blue Reduction Test (MBRT)

The Methylene Blue Reduction Test (MBRT) is a simple laboratory test used to assess the quality and microbial load of milk. It measures the milk's ability to reduce methylene blue dye, which is linked to the presence of bacteria in the milk. Here's how it works:

Principle of the Test

Methylene blue is a dye that is blue in color when oxidized. When milk contains bacteria, especially those that consume oxygen (anaerobic bacteria), the bacteria reduce the methylene blue dye to a colorless form. The quicker this reduction happens, the higher the microbial load in the milk. Thus, the test helps to estimate the milk's freshness and cleanliness.

Procedure

- Preparation of the Milk Sample: A small amount of milk is placed in a test tube or another container.
- Adding Methylene Blue: A few drops of a methylene blue solution (typically 0.5% concentration) are added to the milk.
- Incubation: The milk is incubated at a specific temperature, typically around 37°C (98.6°F), for a certain period, usually 30 minutes.
- Observation: After the incubation period, the milk is observed for color changes.
- If the milk stays blue, it means there are fewer bacteria, and the milk is of good quality.
- If the milk turns colourless or a pale white, it indicates a higher number of bacteria, meaning the milk may be of poorer quality or has been stored improperly.

Interpretation

The time it takes for the milk to lose its blue color is a key indicator of its bacterial content:

- Less than 2 hours: Milk is considered of low quality, with a high bacterial count.
- 2 to 6 hours: Milk is of moderate quality, with an intermediate bacterial load.
- More than 6 hours: Milk is considered of good quality, with a low bacterial count.

The test is primarily used to evaluate raw milk before pasteurization, as pasteurization itself should reduce the bacterial load, making the test less relevant for pasteurized milk.

5.11 The Acidity Test of Milk

The acidity test of milk is a simple method used to determine the level of acidity in milk, which is an important factor for assessing its freshness, quality, and whether it has spoiled. Milk naturally contains lactic acid, and as bacteria in the milk metabolize lactose (the sugar in milk), they produce more lactic acid, causing the milk's acidity to increase. The acidity test measures the amount of acid in the milk, which can be used to estimate its freshness or the extent of spoilage.

Principle of the Test

The acidity of milk is typically measured in terms of lactic acid content. As bacteria ferment the lactose in milk, they produce lactic acid, which lowers the pH of the milk and increases its acidity. A higher acidity level indicates older milk or milk that has begun to sour.

Procedure

- **Prepare a Sample:** A small quantity of milk is taken for testing, typically 10-20 mL.
- **Indicator or Titratable Acidity:** In the most common method, the milk is titrated with a standardized sodium hydroxide (NaOH) solution or sodium carbonate solution of known concentration.
- A few drops of a phenolphthalein indicator are also added to the milk. Phenolphthalein is colorless in acidic solutions and turns pink in basic (alkaline) solutions.

- **Titration Process:** The milk is slowly titrated (dropped) with the base (NaOH solution) until a permanent color change (usually pink) occurs. This color change indicates that the acid has been neutralized, and the milk has reached a certain pH level.
- **Calculation:** The amount of titrant used is measured, and the result is expressed as percentage of lactic acid in the milk. This can be calculated from the volume of sodium hydroxide solution required to neutralize the acid in the milk.

Interpretation of Results

- **Low Acidity (Fresh Milk):** Fresh milk typically has an acidity of around 0.12% to 0.14% lactic acid. This indicates that the milk has a relatively neutral pH and has not undergone significant bacterial fermentation.
- **Increased Acidity (Soured Milk):** As milk spoils and bacteria proliferate, the acidity increases. When the acidity rises above 0.16% to 0.18%, the milk is considered to have started souring. Milk with higher acidity (e.g., 0.2% or more) is often not suitable for consumption.
- **Spoiled Milk:** When acidity reaches levels above 0.22%, the milk is considered spoiled, and the sour taste becomes noticeable.
- **Significance of the Acidity Test:** Freshness Indicator: A higher acidity level is an indicator that milk is not fresh and has started fermenting or souring.
- **Quality Control:** This test is important in dairy production for quality control purposes, ensuring that milk meets certain freshness standards.
- **Storage Conditions:** Milk that has been improperly stored (e.g., at higher temperatures) will show an increase in acidity more quickly due to bacterial growth.

This acidity test is widely used both in dairy farms and in quality control labs to determine the freshness and safety of milk.

5.12 Tests of Processed Milk

1. Tests for Efficiency of Pasteurization

a. Phosphate Test

This test is done for testing the efficiency of pasteurization. The test involves the detection of phosphate enzyme in pasteurized milk. When milk is pasteurized the phosphate enzyme is destroyed. The presence of phosphate enzyme in pasteurized milk either indicates (a) inadequate heat treatment or addition of raw milk to pasteurized milk.

b. Sensory Evaluation

This is the judging of the quality of milk by its taste and smell. Milk is smelled and observed visually to see if there are any defects on appearance such as filling of the milk, colour, visibility purity, presence of foreign matters, spots of mould etc.

c. Test for Developed Rancidity

a. The pH value for fresh milk is normally 6.5-6.7. If there are high number of micro-organisms acidity is increased in pasteurized milk.

2. Microbial Analysis

a. Standard Plate Count (SPC)

The standard for total plate count for pasteurized milk is 20,000/ml and pasteurized cream is 100,000/ml.

b. Coliform Count

All coliform bacteria in milk are killed by pasteurization. Presence of coliforms indicate contamination after pasteurization or unsanitary condition during production, processing or storage.

Standard values for pasteurized milk for coliform count

a. Less than 1 colonies/ ml----------satisfactory

b. 1-10/ ml----------not quite satisfactory

c. More than 30/ml----------unsatisfactory

3. Compositional Test

a. Determination of Fat

It is done to examine the quality of pasteurized milk whether the producer has maintained the standard percentage of fat.

b. Determination of SNF Percentage of Milk

It is done to examine whether manufacturers has maintained the standard for SNF in pasteurized milk by using lactometer.

Ecercise

Choose the correct answer from the given alternatives.

1. Milk quality refers to.....
   a. Color of the milk only
   b. Taste and smell only
   c. Overall hygienic, nutritional, and safety standards of milk
   d. Amount of water in milk

2. Which of the following is a characteristic of good quality milk?
   a. Sour smell
   b. High microbial load
   c. Clean, fresh smell and taste
   d. Dirty appearance

3. Normal pH of fresh quality milk is around.....
   a. 3.0
   b. 5.0
   c. 6.6 – 6.8
   d. 9.0

4. Which of the following does NOT affect milk quality?
   a. Animal health
   b. Milking hygiene
   c. Storage conditions
   d. Weather forecast

5. Mastitis in dairy cows affects milk quality by.....
   a. Increasing fat content
   b. Lowering temperature
   c. Increasing somatic cell count and bacterial load
   d. Improving flavor

6. What is a key practice in assuring milk quality during collection?
   a. Using plastic bags
   b. Using dirty cans
   c. Using stainless steel cans and quick chilling
   d. Delayed transport

7. Milk should be chilled to below what temperature to prevent spoilage.....

a. 15°C b. 10°C

c. 4°C d. 20°C

8. The organoleptic test evaluates milk based on.....

a. pH and alcohol content b. Smell, taste, and appearance

c. Fat content only d. SNF only

9. Which of the following is not evaluated in an organoleptic test?

A. Color b. Smell

c. Fat percentage d. Taste

10. Alcohol test is used to check.....

a. Taste of milk b. pH stability and heat stability

c. Fat content d. Color of milk

11. Coagulation in the alcohol test indicates.....

a. High sugar content b. Good milk quality

c. Poor milk quality or mastitis d. Presence of detergent

12. COB test is done to detect.....

a. Fat in milk

b. Boiling point of milk

c. Stability of milk proteins during heating

d. Water in milk

13. A positive COB test means.....

a. Milk is safe for pasteurization

b. Milk is stable for heat treatment

c. Milk is poor in quality and unsuitable for processing

d. Milk has high SNF

14. The standard method for fat testing in milk is.....

a. Alcohol test
b. Organoleptic test
c. Gerber method
d. Benedict test

15. Fat percentage in cow milk is generally around.....

a. 1%
b. 3.5–4.5%
c. 6–8%
d. 10–12%

16. SNF in milk includes:

a. Only water
b. Fat only
c. Lactose, proteins, minerals, etc.
d. Alcohol and water

17. SNF content in normal cow milk is about.....

a. 1%
b. 4–5%
c. 8–9%
d. 12–13%

18. SNF is calculated using.....

a. COB test only
b. A thermometer
c. Lactometer reading and fat percentage
d. Taste and smell

Write short answer to the following questions.

1. List the characteristics of quality milk.
2. Write short notes on:
   a. Organoleptic test
   b. Alcohol test
   c. COB test
   d. Fat test
   e. SNF test

f. MBR test

g. Tests for processed milk

Write long answer to the following questions.

1. Explain factors affecting quality milk in detail

Unit 6

Dairy Products and Processing

6.1 Importance of Milk and Milk Products

Milk products are important because they are rich in essential nutrients like calcium, protein, and vitamins that support strong bones, teeth, and overall growth. They help in muscle repair, boost immunity, and improve digestion—especially fermented products like yogurt that contain probiotics. Regular consumption of milk products also supports healthy weight management and may reduce the risk of chronic diseases such as osteoporosis and high blood pressure. Some of them are discussed below:

- To increase the nutritive value of milk
- To increase the keeping quality of milk and makes it less susceptible to bacterial growth
- For preservation of milk and nutrient of milk e.g. dry milk
- To increase the delicacy and palatability
- To decrease the economic losses of farmers from milk holiday
- To increase the return above the base price of raw milk

6.2 Methods of Preparation of Different Milk Products From Milk

6.2.1 Preparation of Butter: Methods of Preparation of Butter

Butter is defined as a fat concentrate that is obtained by churning cream, gathering the fat into a compact mass. It may or may not contain salt.

1. Collection of milk
2. Preheating (35-45 ºC)

3. Cream separation
4. Neutralization of cream (with NaOH, NaHCO3, Na2CO3etc)
5. Standardization of cream (35-40% fat)
6. Pasteurization (85 ºC/no hold or 75 ºC/15 sec)
7. Cooling (room temperature)
8. Adding butter culture (1%) and ripening (room temperature for 15-16 hours) it increases flavour
9. Ageing (5-10 ºC for at least 5 hours)
10. Churning: gentle agitation of milk cream at a suitable temperature
11. Washing (removes all loosely adhered butter residue and butter curd. It improves keeping quality and reduce off flavour.)
12. Salting (2%): It acts as preservatives and taste enhancer
13. Packaging and storage (stored at -23 to -29 ºC)

6.2.2. Method of Preparation of GHEE

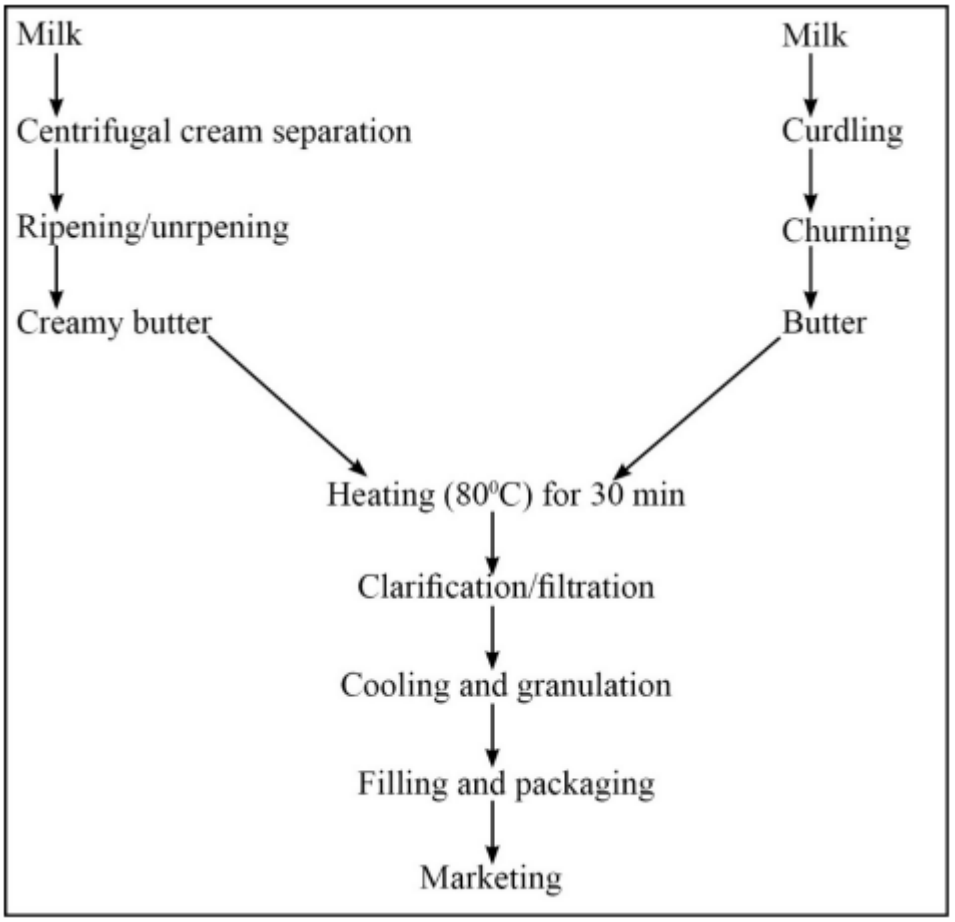
Ghee is a clarified butter fat that is something liquid like consistency by removing unwanted solid matter and impurities.

Manufacturing Process

- Traditional method
- Cream method
- Butter method

In traditional method, milk is first boiled and poured into theki in warm condition for dahi making. Dahi is then churned with household wooden churner (mathani). Nauni is then recovered after churning and butter milk is separated. Warm water may be sprinkled during churning for fast recovery of nauni but the fat content is very low in it. This nauni is then cooked in a vessel. Ghee serum formed on the top layer during cooking is skimmed out. The end point of cooking is determined by sprinkling chilled water on the ghee surface. The cracking sound indicates

the end of cooking time. Ghee is transferred into another vessel. There may be ghee residue on the bottom of the vessel after cooking. Then, ghee is kept in a cool place.



6.2.3 Preparation of Yoghurt and Lassi

Yoghurt Preparation

Yoghurt is a lactic acid fermented milk product with lactobacillus bulgaicus and streptococcus thermophiles (1:1 or 2:1 ratio)growing together symbiotically. The pleasant aroma of the yoghurt is obtained through the production of lactic acid by the fermentation of lactose content of milk.

Materials required

- Starter culture
- Cow milk/ buffalo mik or mixed milk
- Incubator
- Milk container
- Refrigerator
- Plastic cups/ stainless steel containers

Methods of preparation of Yoghurt

1. Take fresh milk.
2. Clarification (removal of dust, dirt, hair follicles, cow dung particles, insects etc.).
3. Standardization (fat≤ 5%, SNF 12-20%).
4. Preheating (60 ºC).
5. Homogenization (it increases body texture and taste of the product).
6. Boil the milk at 80-90 ºC for 15-30 min.
7. Bring down the temperature of the heat treated milk to 45ºC.
8. Inoculate the milk with the starter culture @ 1.0 % (1 % mother culture containing lactobacillus bulgaricus and streptococcus thermophiles(1:1 or 2:1ratio).
9. Distribute the milk in container (plastic cups/stainless steel containers) of desired capacity and close with the suitable lids.
10. Incubate at 42-45 ºC for 4 hours.
11. Take out the dahi containers from the incubator and keep them in refrigerator at 4-5 ºC until use.

6.2.4 Lassi Preparation

The set curd (dahi) is used for the preparation of lassi. The curd is broken either manually (using mathani) or with the help of an agitator and then desired amount

of sugar, salt, water and essence is added to get the delicious “lassi” prepared.

Required Materials are

1. Curd (dahi)
2. Homogenizer
3. Sugar
4. Common salt
5. Container (plastic or glass)
6. Agitator (mathani)
7. Pot (stainless steel)
8. Essence
9. Incubator

Method for Preparation of Lassi

1. Take clean raw milk and standardize its fat % to 3.5 to 4.0 %.
2. Heat the milk at 80 ºC for 5 minute in the vessel.
3. Bring down the temperature of heated milk to 30 ºC.
4. Inoculate with an active starter culture of dahi @ 1% taking all septic precautions.
5. Incubate the inoculated milk at 30 ºC for 12-15 hour after mixing.
6. Take the curd so prepared and break it either manually (with mathani) or mechanically (agitator).
7. Add water to get the desired texture of the preparation.
8. Add sugar and salt to taste and essence to the desired flavour.
9. Mix thoroughly the content with the help of a homogenizer.
10. Fill the preparation in the container (plastic or glass) and store in the refrigerator (4-5 ºC) till use.

6.2.5 Method of Preparation of Chhena and Paneer

Chhena

Chhena is defined as the solid product obtained by the acid coagulation of milk at its boiling point followed by subsequent drainage of whey. The commonly used coagulants are lactic acid or citric acid and or juices of citrus fruits.

Method of Chhena preparation

- Receiving milk
- Clarification/filtering
- Boiling with stirring
- Transfer to coagulating vessel
- Addition of coagulants (lactic or citric)at pH 5.4
- Stirring
- Straining (removal of whey)
- Cooling of chhena

Paneer

Method of Paneer Preparation

- Take whole milk.
- Heating in a stainless steel pot till the milk begins to boil. Stir regularly to prevent burning.
- Remove from heat.
- Add 1 tablespoon of lemon juice or vinegar/liter of milk.
- Stir briefly. Curd should begin to form.
- Remove the whey by straining through cheese cloth.
- Tie the curd in the cheese cloth in to a bundle.
- Place a bundle on a plate.
- Press the bundle from above with some weight for 4-6 hrs.
- Unite the bundle and refrigerate Paneer.

6.2.6 Method of Preparation of Khoa, Cheese, Condensed Milk

Khoa

Khoa is defined as partially dehydrated whole milk product prepared by the continuous heating of milk in a Karahi over a direct fire.

Method of Preparation of Khoa

- Milk receiving
- Filtering/clarification
- Pour into the karahi
- Put over the fire
- Dehydration and stirring by Dabilo(scraper) continuously
- Preparation of Khute (condensed milk)
- Dehydration
- Semi-solid
- Off fire
- Stirring
- Fill in clean and dry container (packaging)
- Labelling
- Store in cool and dry place

Cheese

Cheese is a product obtained by coagulating the milk in presence of lactic acid produced by lactic acid bacteria with the help of rennet or similar coagulating agents.

Types of Cheese

1. Soft chees
2. Semi soft/semi hard cheese
3. Hard cheese

4. Very hard cheese
5. Whey cheese

Method of Preparation of Cheese

- Pasteurized skim milk with SNF 9%
- Adding 1 ml saturated solution of CaCl per 100 liter of milk
- Adding lactic starter (5-6%)
- Adding rennet (1.5gm/100litre)
- Incubate at 30-32ºC for curd formation
- Cutting with curd knife when whey acidity developed to 0.5% (pH 4.6-4.7)
- Cooking (59 ºC for 2 hours) with gentle agitation so that curd develops elasticity
- Drainage of whey
- Washing the curd with water

  1st wash: 27 ºC for 10 min

  2nd wash: 17 ºC for 10 min

  3rd wash: 8 ºC for 10 min
- Salting (1% of final mass)
- Packaging in wax coated paper or cheese paper
- Storage (5-10 ºC)

6.2.7 Method of Preparation of Milk Powder

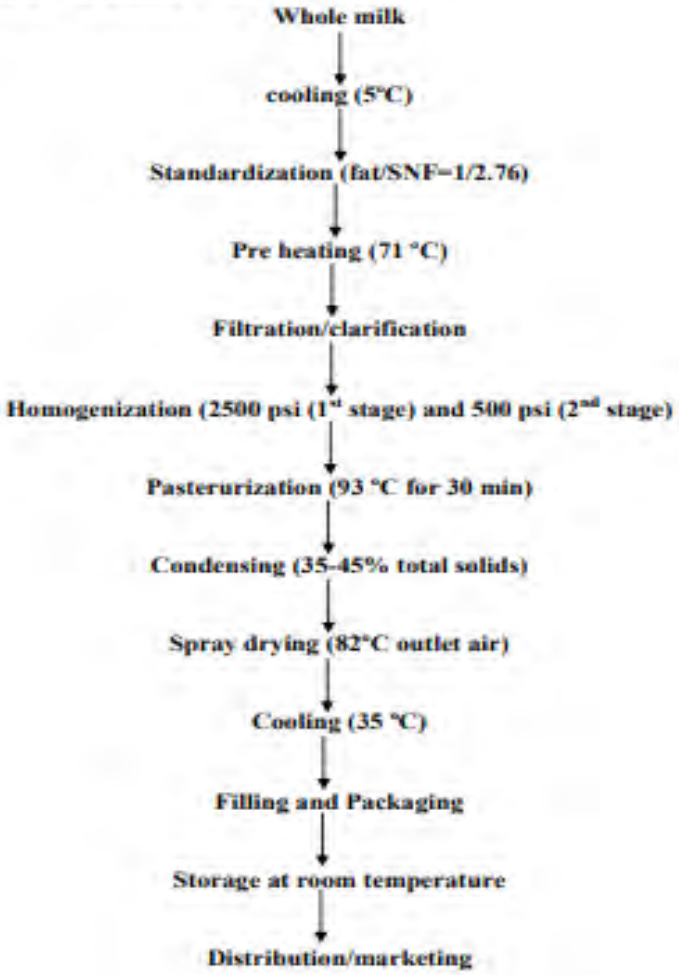
Milk product prepared by removal of all the free water from milk by heating or by any other methods is called milk powder or dried milk.

Types of Milk Powder

- Whole milk powder
- Partially skimmed milk powder

- Skimmed milk powder

Method of preparation of Whole Milk Powder



Composition

Milk powder	Moisture (%)	Fat (%)	Protein (%)	Lactose (%)	Ash (%)
Whole milk powder	2.0	27.5	26.4	38.2	5.9
Skimmed milk powder	3.0	0.8	35.9	52.3	8.0

6.2.8 Method of Preparation of Ice Cream and Churpi

Preparation of Ice Cream

Ice cream is defined as a frozen dairy product made by suitable blending and processing of cream and other milk products together with sugar and flavour, with or without stabilizer or colour and with incorporation of air during the freezing process.

Materials Required

a. **Ingredients** : For manufacturing 1kg ice cream

1. Milk: 650-700ml
2. Cream/ butter: 100gm/50gm
3. Skim milk powder: 50-100 gm
4. Sugar: 150 gm
5. Sodium alginate :3-4 gm
6. Glycerol mono stearate (GSM): 2-4 gm
7. Flavours: vanilla, chocolate, strawberry, pine apple, coca powder etc
8. Edible colour (yellow/green/pink)

b. **Equipment:** Ice cream plant

Method

1. Selection of ingredients (skim milk powder, whole milk, GMS, sodium alginate, cream etc.)
2. Figuring and making the mix (mixing of dry ingredients with milk and cream separately)
3. Pasteurize the so prepared ice cream mix at 71 ºC for 20 min and then cool rapidly it to below 5 ºC.
4. Homogenize the ice cream mix first at 2500 psi and then at 500 psi keeping temperature between 63 to 77 ºC.
5. Cool the mix immediately after homogenization to 0-5 ºC (sodium

alginate requires no ageing).

6. Transfer the ice cream mix to the freezer (-4to -5 ºC).
7. Add the proper amount of edible colour and flavouring materials (vanilla essence) to the mix in the freezer where continuous agitation of the mix is in operation in order to incorporate air and quick freezing of the mix.
8. Take out the partially frozen ice-cream from the freezer, transfer in to package (desired containers) and then quickly place in to the cold storage (-23 to -29 ºC) further freezing and hardening without agitation.)

Preparation of Churpi

Durkha or Chhurpi is a milk-based food usually made in the mountain region of Nepal. Yak milk is usually preferred to make Dhurkha.

Ingredients

Yak Milk, Lime, butter milk, lemon or anything containing lactic acid

Method

- Boil Milk
- Add key lime, fitkiri (Alum), Mohi (buttermilk) or any other sour fruits juice as lactic acid to the milk.
- Stir the boiling milk continuously with strong wooden stirrer Kelu.
- As the milk start boiling a thick layer of butter starts to form in the milk. Extract the butters and it keep aside (it is not used to make durkha) while let the milk boiling continuously.
- After 2 to 3 hours of boiling the milk, white cheese starts forming. Separate this white cheese with the help of large bamboo sieve called Chergang and spread in the separate piece of cotton cloth.
- Tie the cloth and press hard to drain excess water out. (few hours of draining makes the cheese hard)

- Cut the cheese into small pieces and dry under the sun or in shade or over a wood fire oven.
- When it get dried, the product is Durkha or chhurpi.
- This type of Chhurpi becomes very hard and having low moisture content.
- These durkha or churpi can be stored for a number of years.

S.No.	Product	Price (Rs.)	S.No.	Product	Price (Rs.)
1.	Pasteurized Milk	75/lt	2.	Nestle Milk Powder	400/ 400gm
3.	DDC Yak Cheese	565/500gm	4.	Local Cheese	578/500gm
5.	Ghee (Local)	750/lt	6.	Ghee (Dairies)	900 / lt
7.	Yoghurt	180/lt			

Cost of Different Dairy Product

Legal Standardization of Different Dairy Products in Nepal:

Types of dairy product	% Fat (min)	% SNF (min)
Cow milk (whole)	3.5	7.5
Buffalo milk (whole)	5.0	8.0
Processed milk	3.0	8.0
Evaporated milk	7.8	25.9
Evaporated skimmed milk	-	20.0
Sweeten condensed milk	8.0	28.0
Skimmed sweetened condensed milk	-	24.0
Partly skimmed sweetened condensed milk	3-9.0	28.0

Source: The Nepal Gazette 2057 (no. 42) part 3

The Nepali legal standards of dairy products are given below in tables:

6.3 Traditional Process of Making Haluwa

In Nepal, haluwa (or halwa) refers to a variety of traditional sweets that are made from different ingredients like flour, lentils, fruits, or vegetables, and are often flavoured with ghee, sugar, and cardamom. The process of making haluwa can vary depending on the specific type (such as gajar halwa made from carrots

or suji halwa made from semolina), but the general steps for making haluwa in Nepal involve slow-cooking ingredients and adding sugar, ghee, and spices to create a rich, flavourful dessert.

Here is an explanation of the traditional process of making haluwa in Nepal, focusing on a popular version like suji halwa (semolina halwa) and gajar halwa (carrot halwa):

Ingredients

- Suji Haluwa (Semolina Halwa)
- Semolina (suji)
- Ghee (clarified butter)
- Sugar
- Water or milk
- Cardamom powder
- Nuts (like cashews, almonds, or raisins)
- Saffron (optional)
- Gajar Haluwa (Carrot Halwa):
- Grated carrots
- Milk
- Sugar
- Ghee
- Cardamom powder
- Nuts and dry fruits
- Saffron (optional)

Traditional Preparation Method

- Roasting the Base Ingredient (Suji or Carrots):
- For Suji Haluwa: Begin by heating a pan or kadhai (wok) over medium

heat and adding ghee. Once the ghee melts, add the semolina (suji) and roast it gently. Stir continuously to ensure that the semolina does not burn. This process can take around 5 to 10 minutes, and the semolina should turn golden brown and release a nutty aroma.

- For Gajar Haluwa: Grate fresh carrots and set them aside. In a heavy-bottomed pan, add ghee and sauté the grated carrots. Cook for a few minutes until the carrots begin to soften and absorb the ghee.
- Adding Liquid (Water or Milk):
- For Suji Haluwa: Once the semolina is roasted, add water or milk to the pan (about 2 cups of liquid per cup of semolina). Stir well to combine and avoid lumps. The mixture should be cooked on low heat so that the semolina absorbs the liquid and thickens into a pudding-like consistency.
- For Gajar Haluwa: Once the carrots are softened, add milk (usually about 1-2 cups, depending on the amount of carrots). Let the milk cook down and evaporate, leaving a rich, thick mixture. This process takes longer, often around 30 to 40 minutes, and the milk should reduce to a creamy texture.

Sweetening the Halwa

For Suji Haluwa: Add sugar (around ½ to 1 cup) to the mixture. Stir until the sugar dissolves completely. The mixture will become slightly more liquid again before it thickens up.

For Gajar Haluwa: Add sugar (about ½ to 1 cup, depending on preference) once the milk has reduced. Stir well to combine, and continue cooking the mixture until it reaches a pudding-like consistency.

Flavouring and Finishing Touches

Both versions of haluwa are flavoured with cardamom powder (a pinch or ½ teaspoon) for an aromatic touch.

Nuts (such as cashews, almonds, or raisins) are often fried in ghee and added to the halwa for crunch and flavour. These can be sprinkled on top or mixed in.

Saffron can be soaked in warm milk and added for a vibrant color and exotic flavour (optional).

Cooking to the Desired Consistency

Continue cooking the halwa on low heat, stirring occasionally, until it thickens to the desired consistency. For suji halwa, it should be a thick, creamy consistency, while gajar halwa should have a soft, pudding-like texture with the carrots well-cooked and infused with milk and sugar.

Serving

Traditionally, haluwa is served warm or at room temperature. It may be garnished with extra nuts or dried fruits for added texture and visual appeal.

Cultural Significance

Haluwa is a beloved sweet dish often served during festivals, special occasions, or family gatherings in Nepal. It is particularly common during Dashain and Tihar (Nepali festivals) when sweets play a significant role in the celebrations.

The process of making haluwa, especially with family, is often a ritual passed down through generations, and many families have their own variations of the recipe.

Key Points

- The essential ingredient of ghee adds a rich flavour and texture to haluwa.
- The slow-cooking process allows the flavours to meld together, creating a deeply aromatic and flavourful dessert.
- Suji halwa tends to be quicker to make, while gajar halwa requires more time due to the reduction of milk.
- This traditional method reflects the essence of Nepali sweets: using

simple ingredients and slow-cooking them to bring out rich flavours, making haluwa a comforting and indulgent treat.

6.4 Packaging, Storage and Distribution

6.4.1. Overview of Packaging, Storage and Distribution of Milk Products

After the milk products are prepared it is processed, preserved stored and packed to distribute world-wide to reach to the taste of people need. The following processes are done for safe use to humans.

1. Packing of Milk Products

Proper packaging ensures milk products remain fresh, safe, and hygienic, that ensures ready to eat.

- **Liquid Milk:** Usually packed in plastic pouches (polyethylene), tetra packs, or glass bottles. Tetra packs are UHT (ultra-heat treated) and can be stored without refrigeration before opening.
- **Butter and Cheese:** Packed in wax-coated paper, foil, or plastic containers to prevent moisture loss and contamination.
- **Yogurt and Curd:** Often packed in sealed plastic cups or tubs to maintain freshness and prevent bacterial contamination.
- **Milk Powder:** Packed in moisture-proof, airtight tins or sachets to avoid spoilage.

2. Storage of Milk Products

Proper storage is crucial to prevent spoilage and maintain quality.

- **Refrigeration:** Most milk products (like fresh milk, yogurt, cheese) must be kept at 4°C or below.
- **Freezing:** Some products like butter and certain cheeses can be frozen for long-term storage.
- **Dry Storage:** Milk powder should be stored in a cool, dry place away from moisture and light.

- **Shelf-Life Consideration:** UHT milk has a longer shelf life and can be stored without refrigeration until opened.

3. Distribution of Milk Products

Efficient distribution ensures products reach consumers safely and quickly.

- **Cold Chain Logistics:** Refrigerated trucks and insulated containers are used to transport perishable milk products.
- **Time-Sensitive Delivery:** Since milk is highly perishable, timely delivery is essential—especially for fresh milk and curd.
- **Retail and Vending:** Milk products are sold through supermarkets, local dairy outlets, and automated milk vending machines in some regions.
- **Export Considerations:** Exported dairy products are packed in special containers to preserve quality and meet international standard.

6.4.2 The detail Introduction to Packaging, Processing and Distribution of Milk Products

Milk reception refers to the accepted transfer of raw milk from the farm by dairy. Raw fresh milk is received at the processing plant in cans or tanks directly from a producer or from a collection center. The milk-receiving platform at dairy plant should be elevated to facilitate convenient handling of cans.

Reception area should have weighed machine, a can steaming block, can washer, temporary storage after weighing, and a high-capacity milk pump for pumping milk from this tank to a chiller. This cools the milk on line before it reaches into a storage tank. The reception section should have a small laboratory to conduct platform test and recording of the milk being received. The raw milk is store in storage tank which are usually made of double walled horizontal stainless steel. These are insulated tanks which prevent increase in the temperature of chilled milk.

i. Intake of Milk in Cans or from Tanker

Milk is received in the processing plant from the primary producers or the milk collection centers. Usually, they are transported by cans or bulk containers (milk transport tanks or vans).

ii. Storage of Milk

Usually, milk is held up to a maximum of 72 hours between receptions and processing in the tank. The tanks may be cylindrical or oval. The storage tanks are often kept outdoors with heads extended through the wall into processing room.

Milk temperature is maintained at less than 7°C and tanks must be designed for sanitizing, preferably for CIP. Surfaces must be smooth and easy to clean. All closed type tanks must be equipped with a manhole, either round or oval in shape to permit access to the interior for cleaning and inspection.

iii. Platform sampling and testing

It is a rapid test done for acceptance or rejection of incoming milk. It includes the test for judging the quality of the raw milk. These are:

a. Organoleptic Evaluation
b. Clot on Boiling Test (COP)
c. Alcohol Test (AT)
d. Sediment Test (ST)
e. Resazurin Test (RT)

Pretreatment

1. Clarification

Clarification means separation of non-dairy solids and milk fat content, in order to obtain a clean product with the desired fat content according to the final destination.

2. Cream Separation

Cream separation is a process by which the milk is separated into cream and skim milk by centrifugal and gravitational force. The milk enters the rapidly revolving bowl of the separator. The inflow of milk is channelized to the outer wall of the bowl and fills it from outside towards the center. The centrifugal and gravitational forces keep on continuously and help to separate the skim milk and cream. Skim milk is thrown towards the outer periphery and channelized to skim milk out let, while the cream is channelized to the central core and forced out through cream out let.

3. Homogenization

Homogenization is the process of breaking down the larger fat globules (4-5 microns) in the milk into smaller globules of approximately less than 2 microns to make uniform suspension of the fat. Hence there will be increase in viscosity because milk protein are absorbed on the surfaces or these fat globules. It is done by forcing the liquid through a very small orifice under suitable temperature and pressure.

4. Standardization of Milk

Standardization of milk refers to the adjustment, i.e. raising or lowering, of the fat and/or solids-not-fat percentages of milk to a desired value, so as to conform to the legal or other requirements prescribed. It is commonly done in cases of market milk supply and also in case of manufacture of milk products e.g. condensed milk, milk powder, ice cream and cheese etc. The standardization is mostly done to have uniform milk fat content in the finished dairy product. Milk is standardized by the addition of milk or cream with a higher or lower fat percentage than that of the material to be standardized; sometimes the addition of skim milk will fulfill the purpose.

There are two calculation methods by which we can solve the standardization problems.

a. Pearson's Square Method b. Algebraic Method

Exercise

Choose the correct answer from the given alternatives.

1. Which of the following is not a milk product?

   a. Paneer b. Ghee

   c. Bread d. Cheese

2. One major advantage of processing milk into products is.....

   a. Decreased shelf life

   b. Reduced nutrition

   c. Value addition and longer shelf life

   d. Increased microbial growth

3. Butter is made by .....

   a. Boiling milk directly

   b. Curdling milk

   c. Churning cream or curd

   d. Drying milk

4. Ghee is made by .....

   a. Freezing milk

   b. Heating butter to remove water and solids

   c. Boiling milk with sugar

   d. Fermenting milk

5. Yoghurt is made by.....

   a. Adding sugar to milk

   b. Heating and cooling milk, then adding starter culture

   c. Freezing milk directly

   d. Filtering milk

6. Lassi is a product made by .....

a. Concentrating milk

b. Mixing curd with water, sugar, and sometimes spices

c. Boiling curd

d. Skimming cream

7. Paneer is prepared by .....

a. Adding sugar to boiled milk

b. Boiling milk and adding acid (like lemon juice or vinegar)

c. Drying milk powder

d. Mixing cream and milk

8. Chhena differs from paneer in that .....

a. It is dried and pressed

b. It is not pressed after curdling

c. It is made only from buffalo milk

d. It contains added sugar

9. Khoa is made by .....

a. Adding acid to milk

b. Churning cream

c. Boiling milk to reduce moisture

d. Mixing milk with sugar

10. Cheese is made by.....

a. Coagulating milk with rennet or acid

b. Freezing milk

c. Evaporating milk

d. Mixing curd and cream

11. Condensed milk is .....

a. Milk with removed protein

b. Milk diluted with water

c. Milk thickened by removing water and adding sugar

d. Powdered milk

12. Milk powder is made by .....

a. Fermenting milk

b. Adding sugar and freezing milk

c. Evaporating milk and spray drying it

d. Mixing curd with water

13. Ice cream is a frozen product made from .....

a. Milk, cream, sugar, and flavoring

b. Only water and sugar

c. Only milk

d. Milk and rennet

14. Churpi is.....

a. A frozen dairy product

b. A fermented dairy drink

c. A hard traditional cheese from yak or cow milk

d. A milk-based sweet

15. Haluwa is a traditional sweet prepared mainly from .....

a. Raw milk

b. Flour (wheat or semolina), ghee, and sugar

c. Ice cream

d. Cheese and curd

16. The best packaging material for pasteurized milk is .....

a. Newspaper

b. Glass bottles or food-grade plastic pouches

c. Cloth bag

d. Aluminum foil

17. Milk and milk products should be stored at .....

a. Room temperature b. 37°C

c. Below 4°C d. 50°C

18. Distribution of milk is best done in .....

a. Open containers

b. Dirty cans

c. Chilled and sealed containers

d. Plastic carry bags

Write short answer to the following questions.

1. List the importance of milk products.
2. Explain the procedure for preparation of following milk products:

a. Ghee b. Ice cream c. Lassi d. Milk powder

e. Paneer f. Khoa g. Haluwa

Write long answer to the following questions.

1. Explain in detail about packaging, storage, and preservation of milk products.

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