Vocational Higher Secondary Education (VHSE)

Second Year

DAIRY TECHNOLOGY

Reference Book - Teachers' Version

Government of Kerala
Department of Education

State Council of Educational Research and Training (SCERT), KERALA
2016
Dear Teachers

This reference book (Teachers’ Version) is intended to serve as a transactional aid to facilitate classroom transaction and as a ready reference for teachers of Vocational Higher Secondary Schools. It offers some guidelines for the transaction of the course content and for undertaking the practical work listed in the course content. As the curriculum is activity based, process oriented and rooted in constructivism focusing on the realisation of learning outcomes, it demands higher level proficiency and dedication on the part of teachers for effective transaction.

In the context of the Right-based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of the teachers’ version of reference books has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. J. Prasad
Director
SCERT, Kerala
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ABOUT THE COURSE

Agriculture is one of the fields which can absorb a considerable number of unemployed educated youth of the country. In India, agriculture employs about 50% of the total workforce. While income from crop production is seasonal, stable income from dairying provides an important economic incentive for the small farmers to take to dairying.

Animal husbandry and Dairying play an important role in the national economy and in the socio-economic development of country. These sectors also play a significant role in supplementing family incomes and generating gainful employment. The dairy industry with large number of Dairy entrepreneurs in rural areas as made a tremendous impact on agrarian economy of country with present production level of 98 million tons of milk per annum, India ranks first in the world.

Vocationalization in the field of Dairying will definitely change the pace of rural employment. The course ‘Dairy Technology’ is designed to train the youth so that there will be improvement in the present scenario of effective and efficient management of dairy enterprise. Now the course ‘Dairy Technology’ has been revised with latest scientific technologies developed and improved management practices. The course curriculum is designed and presented to mould the students suitable for self employment as well as seek employment with state departments, private/public firms, co-operatives, educational institutes etc.

This course consists of 4 modules, more importance has been given to practicals and On the Job Training, which develop vocational skills in the field.
### JOB ROLES

<table>
<thead>
<tr>
<th>Government/co-operative sector</th>
<th>Private Sector</th>
<th>Self Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Laboratory Technical Assistant/Laboratory Assistant in Dairy industry or educational institutions with dairy courses</td>
<td>● Laboratory Assistant in Quality Control labs of Private dairy plants.</td>
<td>● Dairy farm owner.</td>
</tr>
<tr>
<td>● Food Analyst/Laboratory Assistant in Food industry/departments</td>
<td>● Assistant food analyst in food industry.</td>
<td>● Owner of milk processing and marketing unit (Fluid milk plant).</td>
</tr>
<tr>
<td>● Dairy Farm Instructor</td>
<td>● Dairy Extension Assistant</td>
<td>● Fodder Producer.</td>
</tr>
<tr>
<td>● Fodder Promoter.</td>
<td>● Fodder production Assistant</td>
<td>● Technical staff for research organizations and consultancy services</td>
</tr>
<tr>
<td>● Secretary in dairy co-operative societies.</td>
<td>● Salesman for Feeds and suppliers Purchase and sale of cattle Sale of dairy equipments/Farm implements.</td>
<td>● Marketing of milk and milk products.</td>
</tr>
<tr>
<td>● Milk Tester in dairy co-operative societies.</td>
<td></td>
<td></td>
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<tr>
<td>● Livestock assistant/Artificial Insemination Assistant.</td>
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<tr>
<td>● Dairy plant Assistant/Dairy plant operator</td>
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<tr>
<td>● Milk and milk products sales promotion assistant.</td>
<td></td>
<td></td>
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<tr>
<td>● Dairy Farm supervisor.</td>
<td></td>
<td></td>
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<tr>
<td>● Dairy Extension Assistant</td>
<td></td>
<td></td>
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<tr>
<td>● Vocational Instructor</td>
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</tr>
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</table>
MAJOR SKILLS

Vocational education enables students to acquire skills which are traditionally non-academic and totally related to specific trade, occupation or vocation. Vocational courses are primarily designed in such a way that they impart a thorough application-based study wherein theoretical concepts of a field are not studied independently but are subordinated to the understanding of techno-operational aspects of specific job.

In India Dairying is recognized as an instrument for social and economic development. Ample labour and a small land base encourage farmers to practice dairying as an occupation subsidiary agriculture. India is the highest milk producer in the entire globe. India is well known as the ‘Oyster’ of the global dairy industry, with opportunities galore for the entrepreneurs globally. The main Objective of Indian Dairy Industry is to manage the national resources in a manner to enhance milk production and upgrade milk processing using innovative technologies. The Indian Dairy Industry which is in the developing stage provides gainful employment to a vast majority of rural households. It employs about 8.47 million people on yearly basis out which 71% are women. Jobs in Indian Dairy Industry are mainly in the fields of production and processing of dairy products.
LEARNING OUTCOME OF THE COURSE

1. To train students to scientifically undertake all operations of animal husbandry and dairy technology and to create employment potential and man power for dairy development
2. To create entrepreneur in dairying and dairy associated activities.
3. To develop organizational capabilities among our youth in dairy industry
4. To develop skill, instill confidence by enhancing life skills
5. To increase nutritional status and income of community through dairy farming.
COURSE STRUCTURE OF DAIRY TECHNOLOGY (DT)

This course will consists of four modules:

<table>
<thead>
<tr>
<th>MODULE NO</th>
<th>MODULE NAME</th>
<th>NUMBER OF PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dairy farm management</td>
<td>340</td>
</tr>
<tr>
<td>2</td>
<td>Milk production, processing and quality control</td>
<td>340</td>
</tr>
<tr>
<td>3</td>
<td>Milk products and quality assurance</td>
<td>340</td>
</tr>
<tr>
<td>4</td>
<td>Dairy business management</td>
<td>340</td>
</tr>
</tbody>
</table>

This will be taught as per the designated time schedule. Practical assessment will be conducted at the end of each module.
SYLLABUS AND LIST OF PRACTICALS:

MODULE 3 MILK PRODUCTS AND QUALITY ASSURANCE

Unit 3.1 Special Milks (25 hours)

• Sterilized milk and Flavoured milks:
  ➢ Definition
  ➢ Types
  ➢ Details of manufacture with flow diagram
  ➢ Sterilized flavoured milks-details of manufacture.

• Definition and FSSAI standards of:
  ➢ Toned milk
  ➢ Double toned milk
  ➢ Recombined milk
  ➢ Reconstituted milk
  ➢ Standardized milk
  ➢ Soft curd milk
  ➢ Vitaminized/ irradiated milk
  ➢ Frozen Concentrated milk
  ➢ Humanized milk
  ➢ Filled milk
  ➢ Imitation milk
  ➢ Vegetable toned milk

Unit 3.2 Fermented Milks (30 hours)

• Fermented milks:
  ➢ Definition
  ➢ health benefits

• Starter culture:
  ➢ classification
  ➢ Starter culture-Definition and propagation.

• Preparation of fermented milks:
  ➢ Preparation of buttermilk
  ➢ Preparation of Acidophilus milk
  ➢ Preparation of Yogurt
  ➢ Preparation of Dahi
  ➢ Preparation of Lassi

Unit 3.3 Fat Rich Dairy Products (30 hours)
• Cream:
  ➢ Definition
  ➢ Composition
  ➢ FSSAI standards
  ➢ Types of cream
  ➢ Methods of separation- Gravitational and centrifugal

• Butter:
  ➢ Definition
  ➢ Composition
  ➢ FSSAI standards
  ➢ Classification of butter
  ➢ Method of manufacture
  ➢ Overrun in butter-measuring and its causes
  ➢ Desi butter-FSSAI definition, Standards and preparation

• Ghee
  ➢ Definition
  ➢ Composition
  ➢ FSSAI standards
  ➢ Agmark grading of ghee and Agmark standards
  ➢ Packaging and storage of ghee
  ➢ Adulterants in Ghee
  ➢ Butter oil -definition and composition

Unit 3.4 Condensed and Dried Milks (20 hours)

• Condensed milk:
  ➢ FSSAI definition and standards of sweetened condensed milk
  ➢ sweetened condensed skim milk, Evaporated milk, Evaporated skim milk
  ➢ preparation of sweetened condensed milk.

• Dried Milks:
  ➢ Milk powder(whole milk powder and skim milk powder), Baby food, malted milk.
  ➢ FSSAI definition and standards.

3.5 CHEESE (40 hours)

• cheese
  ➢ FSSAI Definition with standards
  ➢ Popular verities
  ➢ Preparation of cheddar cheese
  ➢ Preparation of cottage cheese
  ➢ Preparation of processed cheese
3.6 Frozen Dairy Products (45 hours)

- ICE CREAM
  - FSSAI definition and standards, ISI recommendations
  - Different varieties of ice cream – Plain, Chocolate, fruit, nut, milk ices, ices, sherbets, fancy, moulded, novelties, softy.
  - Methods of manufacture with flow diagram -
    - selection of ingredients,
    - figuring the mix ,
    - making the mix ,
    - pasteurizing the mix,
    - homogenizing the mix ,
    - cooling and ageing the mix ,
    - freezing the mix , packaging ,
    - hardening and storage
    - Role of constituents in ice cream
    - Overrun in ice cream

3.7 Indigenous Milk Products/ Sweets (90 hours)

- Indigenous Milk Products/ Sweets:
  - Definition
  - Classification
- Khoa and khoa based sweets – Peda, Gulabjamun, Kalakand, Burfi- method of preparation
- Chhana and chhana based sweets - Sandesh, Rasagolla, Rasamalai, Chhana-kheer, Chhana-murki, pantooa - method of preparation
- Paneer and paneer based products.

3.8 Dairy By-products and waste management in dairy industry (30 hours)

- Dairy By-products:
  - Definition and classification
- Casein – rennet casein, acid casein, edible casein – definition and method of preparation
- Whey – whey beverage, whevit, whey sip-up, whey drink - method of preparation
- ETP (Effluent Treatment Plant)

3.9 Quality Assurance (30 hours)

- Current awareness on quality and safety of dairy foods
• HACCP, GMP, ISO standards, FSSAI, AGMARK, MMPO, PFA
• Milk borne diseases (pathogens) - public health significance
• Action plan to avoid hazards – briefing of importance of hygienic precautions to be taken right from the milking of cattle (farm to plant)
• Cold chain in milk preservation
• Automation in dairy plants-quality control lab, bulk vending machines.

MODULE 4 DAIRY BUSINESS MANAGEMENT AND ENTREPRENEURSHIP

Unit 4.1 : Introduction to Dairy Extension (65 hours)

Basics of dairy extension:
  ➢ Objectives
  ➢ Relevance in dairy industry

Extension teaching methods – introduction to audio visual aids
  ➢ Use of audio aids in dairy extension activities
  ➢ Use of visual aids in dairy extension activities
  ➢ Charts
  ➢ Posters
  ➢ Bulletins

Handling of audio-visual aids
  ➢ Basic idea about operating a camera, OHP projector, TV and multimedia

Unit 4.2 Dairy co-operative Management (80 hours)

Live stock development programmes and Five year plans:
  ➢ History
  ➢ Basic concepts

Operation flood programme:
  ➢ Aim of white revolution and its achievements
  ➢ Achievements of operation flood

Formation of dairy co-operatives:
  ➢ Basic requirements of a dairy co-operative society
  ➢ Registration of a dairy co-operative society

Working of dairy co-operatives and unions:
  ➢ Basic working principles of dairy co-operatives and union

Registers and records maintained in the society:
  ➢ Basic idea about the common registers maintained in a society

Maintenance of accounts of dairy co-operative societies:
  ➢ Basic idea about the account maintenance in a primary society

Functions of milk federation:
  ➢ Basic idea about the structure of APCOS
  ➢ Functions of Federation

Function of dairy development department:
  ➢ Various schemes by the department
Implementation procedure

Unit 4.3 : Packaging of milk and milk products (50 hours)

- Definition – Purpose of packaging
- Common packaging materials
- Packaging of milk and milk products
- Design of packaging materials

Unit 4.4 : Marketing of milk and milk products (70 hours)

- Marketing:
  - Definition and basic concepts of marketing.
- Marketing plans:
  - Transportation of milk and milk products
- Analysis of consumer demand and acceptance:
  - Market Survey
- Role of salesman and marketing personalities in marketing of milk and milk products:
  - Basic idea

Unit 4.5 : Dairy Economics (75 hours)

- Cost analysis of milk and milk products:
  - Basic concepts
  - Method
- Economic institutions supporting Dairy Development programmes:
  - Functioning of Dairy Development Programmes
- Project report for starting a small scale dairy farm:
  - A project of 20 cow farm
- Project report for starting a small scale dairy processing unit:
  - A project of a small scale production unit

List of practical works – Module 3

- Preparation of flavoured milks-chocolate flavoured milk and fruit flavoured milk.
- Preparation of buttermilk.
- Preparation of Yoghurt.
- Preparation of Dahi.
- Preparation of Lassi and Srikhand.
- Methods of separation of cream-Gravitational and centrifugal.
- Preparation of butter
- Preparation of ghee
- Preparation of cheddar cheese.
• Preparation of cottage cheese.
• Preparation of processed cheese.
• Preparation of ice cream
• Preparation of khoa.
• Preparation of peda.
• Preparation of burfi.
• Preparation of kalakand.
• Preparation of gulab jamun.
• Preparation of paneer.
• Preparation of chhana.
• Preparation of sandesh.
• Preparation of rasagolla.
• Preparation of chhanakheer.
• Preparation of chhanamurki.
• Preparation of pantooa.
• Preparation of whey sip-up, whey drink.
• Market survey and documentation of standards of different brands of various dairy products
• Visit to a dairy plant

**List of practical works – Module 4**

• Farm visit
• Surveys
• Demonstration
• Interaction with farmers
• Instructional videos
• Exhibition
• Farm visit/individual farmer visit/survey to know about the advantages and disadvantages of dairy farming.
• Study of a live animal to identify the body parts.
• Organizing a farm visit for judging cattles, identifying different breeds and studying their characters.
• Showing models of different systems of housing.
• Visit to a farm for measuring space requirements and sketch lay out of different cattle sheds
• Instructional videos and demonstration of restraining equipments
• Visit to farm to study the calf management practices and other management practices-weaning, deworming, dehorning, identification etc. and practice measurement of pulse, respiration and temperature.
• Visit to dairy farms or veterinary hospitals to observe AI.
• Visit to fodder cultivating units either dairy farmers or fodder producers to identify different varieties of grasses and their cultivation, fodder preservation (Hay, silage etc)
• Visit to a cattle feed manufacturing unit to aware of different types of feeds
• Instructional videos to observe different types of milking methods
• Farm visit to practice hand milking
• Sample analysis of milk for adulteration and preservatives in milk
• Sample estimation of Fat, specific gravity, acidity etc of milk
• Plat form tests to be demonstrated in lab
• Plant visit to observe milk processing
• Farm visit/farmer visit/sample collection and survey to observe and study clean milk production practices.
LEARNING OUTCOMES OF THE UNITS

On completion of the course the learners are competent to;

3.1.1. Identify, compare and prepare sterilized milk and flavoured milk.
3.1.2. Analyze and standardize different types of milks.
3.2.1. Identify health benefits of fermented milks.
3.2.2. Classify fermented milks.
3.2.3. Categorize and choose appropriate Starter culture.
3.2.4. Prepare buttermilk.
3.2.5. Prepare acidophilus milk.
3.2.6. Prepare of Yogurt.
3.2.7. Prepare Dahi.
3.2.8. Prepare Lassi.
3.3.1. Analyze and standardize different types of cream.
3.3.2. Classify different types of creams.
3.3.3. Identify different methods of separation.
3.3.4. Analyze and standardize different types of Butter.
3.3.5. Classify different types of butter.
3.3.6. Identify different methods of manufacture.
3.3.7. Calculate overrun.
3.3.8. Analyze and standardize desi butter.
3.3.9. Prepare Desi butter.
3.3.10. Analyze and standardize different types of Ghee.
3.3.11. Identify different methods of manufacture of ghee.
3.3.12. Identify and analyze Agmark standards.
3.3.13. Identify and analyse packaging and storage of ghee.
3.3.14. Test the ghee and identify the adulterants.
3.3.15. Analyze and standardize butter oil.
3.4.1. Analyze and standardize sweetened condensed milk.
3.4.2. Classify different types of condensed milk.
3.4.3. Prepare sweetened condensed milk.
3.4.4. Identify and categorize different types of milk powders, baby foods etc.
3.4.5. Identify FSSAI standards.
3.5.1. Identify different cheeses.
3.5.2. Categorize different cheeses.
3.5.3. Understand Preparation of cheddar cheese, cottage cheese, processed cheese
3.5.4. Identify uses of cheese.
3.6.1. Identify different standards of ice cream.
3.6.2. Understand ISI recommendations.
3.6.3. Identify and categorize different varieties of ice creams.
3.6.4. Identify methods of manufacture and constituents.
3.6.5. Measure overrun in ice creams.
3.6.6. Preparation of ice creams.
3.7.1. Identify, define and classify indigenous milk products/sweets.
3.7.2. Prepare khoa and khoa based sweets.
3.7.3 Prepare chhana and chhana based sweets.
3.7.4. Prepare and paneer based sweets.
3.8.2. Identify the method of preparation.
3.8.3. Prepare whey products.
3.8.4. Identify and aware of the waste management systems in dairy industry.
3.9.1. Identify and aware of quality and safety of dairy food.
3.9.2. Identify and analyse different standards.
3.9.3. Identify and classify milk borne diseases.
3.9.4. Recommend remedial measures.
3.9.5. Aware of action plan to avoid hazards.
3.9.6. Apply of hygienic precautions.
3.9.7. Aware about the importance of Cold chain in milk preservation.
3.9.8. Aware about automation.

Module 4

*The learner will be able to:*

4.1.1. Interact with farmers.
4.1.2. Apply the dairy extension education concepts.
4.1.3. Choose and apply various visual aids to impart the extension education concepts.
4.1.4. Choose and apply various audio aids to impart the extension education concepts
4.1.5. Prepare charts, posters and bulletins
4.1.6. Operate a camera, OHP projector, TV and multimedia
4.2.1. Compare and evaluate various development programmes and five year plans.
4.2.2. Analyze the achievements of white revolution
4.2.3. Analyze and compare various phases of operation flood
4.2.4. Evaluate and recommend the requirements of a dairy co-operative society
4.2.5. Evaluate the working of a dairy co-operative society and union
4.2.6. Evaluate and draw the sketches of various registers maintained in a society
4.2.7. Analyse and study the accounts maintained in a society
4.2.8. Analyse and study the functions of Federation in a 3 tier system
4.2.9. Analyse the various schemes by the department
4.2.10. Evaluate and understand the implementation procedure.
4.3.1. Choose and apply right packaging material.
4.4.1. Choose the marketing technique.
4.4.2. Choose the proper transportation method.
4.4.3. Select the target group.
4.4.2. Describe importance of marketing personnel.
4.5.1. Price milk and milk product.
4.5.2. Aware of dairy development programmes.
4.5.3. Prepare project for starting a small scale dairy farm unit.
4.5.4. Prepare project for starting small scale dairy processing unit.
### Scheme of work: module-3

<table>
<thead>
<tr>
<th>MONTH</th>
<th>NAME OF UNIT</th>
<th>PERIOD</th>
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</thead>
<tbody>
<tr>
<td>June</td>
<td>Special Milks</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Fermented milk products</td>
<td>30</td>
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<tr>
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<td>Fat Rich Dairy Products</td>
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<tr>
<td>July</td>
<td>Fat Rich Dairy Products</td>
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<td>Condensed and Dried Milk</td>
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<td>Cheese</td>
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<td>August</td>
<td>Cheese</td>
<td>14</td>
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<td>Frozen Dairy Products</td>
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<td>Indigenous Milk Products/ Sweets</td>
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<td>September</td>
<td>Indigenous Milk Products/ Sweets</td>
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<td>October</td>
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<tr>
<td></td>
<td>Dairy By-products</td>
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<td></td>
<td>Quality Assurance</td>
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### Scheme of work: module-4

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<tbody>
<tr>
<td>November</td>
<td>Introduction to Dairy Extension</td>
<td>65</td>
</tr>
<tr>
<td>December</td>
<td>Dairy Co-operative Management</td>
<td>67</td>
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<td>January</td>
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<td></td>
<td>Packaging of milk and milk products</td>
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<td>Marketing of milk and milk products</td>
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<td>Dairy Economics</td>
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<tr>
<td>March</td>
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## STRUCTURE OF MODULE 3
### MILK PRODUCTS AND QUALITY ASSURANCE

<table>
<thead>
<tr>
<th>UNIT NO.</th>
<th>NAME OF UNITS</th>
<th>PERIODS</th>
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<tbody>
<tr>
<td>3.1</td>
<td>Special Milks</td>
<td>25</td>
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<td>3.2</td>
<td>Fermented Milks</td>
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<td>3.2</td>
<td>Fat Rich Dairy Products</td>
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<td>3.3</td>
<td>Condensed and Dried Milk</td>
<td>20</td>
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<td>3.4</td>
<td>Cheese</td>
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<td>3.5</td>
<td>Frozen Dairy Products</td>
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<td>3.6</td>
<td>Indigenous Milk Products/ Sweets</td>
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<tr>
<td>3.7</td>
<td>Dairy By-products and waste management in dairy industry</td>
<td>30</td>
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<tr>
<td>3.8</td>
<td>Quality Assurance</td>
<td>30</td>
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**TOTAL PERIODS** 340

30% periods for theory section and 70% periods for practical activities
STRUCTURE OF MODULE 4

DAIRY BUSINESS MANAGEMENT

<table>
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<th>NAME OF UNITS</th>
<th>PERIODS</th>
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<td>1</td>
<td>Introduction to Dairy Extension</td>
<td>65</td>
</tr>
<tr>
<td>2</td>
<td>Dairy Co-operative Management</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>Packaging of milk and milk products</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>Marketing of milk and milk products</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>Dairy Economics</td>
<td>75</td>
</tr>
</tbody>
</table>

TOTAL PERIODS 340

30% periods for theory section and 70% periods for practical activities
CLASS ROOM ACTIVITIES

- Instructional video presentation.
- Group Discussion
- Charts
- Pictures and Diagrams.
- Power point presentation.
- CD’S
- Seminar
- Demonstration
- Models
GENERAL PRACTICAL ACTIVITIES

- Preparation of various dairy products
- Conduct of market survey
- Dairy Farm visit
- Dairy plant visit
- Visit to dairy co-operative societies
- Conduction of Expo and marketing of prepared products
MODULE 3: MILK PRODUCTS AND QUALITY ASSURANCE

OVERVIEW

The largest producer and consumer of cattle and buffalo milk in the world is India, with an estimate of about 132.4 million tons during the year 2012-2013. Being an agrarian country most of the milk is produced in the villages by farmers with small land holdings and also by landless agricultural labourers. Milk is mostly produced in small quantities of 2-4 litres, by small and marginal farmers, whose principal occupation is agriculture. It can be seen that the bulk of the animals are held by small and marginal farmers and surprisingly not by large farmers.

Numerous persons and agencies are involved in the collection, transport and distribution of milk; village producers either directly supply to village co-operatives, milk collectors who collect milk from producers and supply to the collection centers of organized dairies or to urban areas or halwaais, milk vendors, dairies who process market milk and milk products, wholesalers and retailers.

According to FAO report of 2012 worldwide, dairy farms produced about 730 million tones of milk in 2011. Throughout the world, there are more than 6 billion consumers of milk and milk products. Over 750 million people live within dairy farming households. Milk is a key contributor to improving nutrition and food security, particularly in developing countries. Improvements in livestock and dairy technology offer significant promise in reducing poverty and mal-nutrition in the world. In 2010, the largest producer of milk and milk products was India followed by the United States, China, Germany, Brazil and Russia. (FAOSTAT-2012).

Milk products are edible or value-added products prepared from liquid or powdered milk either by adding nuts, cereals etc or prepared by changing the form of the milk itself without any addition before consumption. They are highly nutritious and supplement all the essential nutrients to the consumer. Indigenous dairy products are those originated / developed within the country. There are different classifications of indigenous dairy products mainly;

- Heat desiccated products
- Heat-acid coagulated products
- Fermented products
- Fat rich products
- Frozen products
- Cereal based products
Milk sanitation is the protection of milk from dirt and contamination and is essential to prevent milk infection. Clean milk is a necessity and is possible by using good milking hygiene. Quality, as defined by Kramar 1951, “is the sum of the characteristics of the given food item which influences the acceptability or preference for that by the consumer”. It is an essential component for any milk processing industry whether small, medium or large scale. Milk being made up of 87% water, is prone to adulteration by unscrupulous middlemen and unfaithful farm workers. Moreover, its high nutritive value makes it an ideal medium for the rapid multiplication of bacteria, particularly under un-hygienic production and storage at ambient temperatures. Such unhygienic practices allow certain pathogen to grow, multiply and produce certain toxins and cause diseases, on consuming such contaminated milk and milk products. Any disease caused by consuming such contaminated milk and milk products is called milk borne disease. Hence Quality Assurance has public health significance.

UNIT-WISE DETAILING

Unit 3.1: Special Milks

There are many different varieties of milk available for consumption. The different milks tend to vary according to the way they are produced, and their fat content. Such milks are broadly classified as special milks. Special milk may be flavoured milk, sterilized milk, vitaminized milk, frozen concentrated milk, standardized milk, homogenized milk, recombined milk, toned milk, double toned milk, humanized milk, filled milk, imitation milk and vegetable milk.

The flavoured milk market is one of the fastest growing dairy sectors. Most flavoured milk products are produced using low fat milk. The most popular flavours are chocolate, strawberry, mango and banana. Heat treated milk are manufactured to improve the shelf life of milk by killing the harmful bacteria. Sterilized milk is heat treated milk is available in whole, semi skimmed and skimmed varieties. It goes through a more severe form of heat treatment, which destroys nearly all the bacteria in it. Special milk improves the palatability and enhances the shelf life of milk.

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
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</thead>
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<tr>
<td>Sterilized milk and flavoured milk:</td>
<td>* The learner will be able to:</td>
<td>* Discussion</td>
<td>Participation in group Discussion</td>
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<tr>
<td>* Definition</td>
<td>* Identify, compare and prepare sterilized milk and flavoured milk</td>
<td>* Demonstration</td>
<td>* Survey report</td>
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<tr>
<td>* Types</td>
<td></td>
<td>* Market survey</td>
<td></td>
</tr>
<tr>
<td>* details of manufacture with flow diagram</td>
<td></td>
<td></td>
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</tbody>
</table>
### UNIT IN DETAIL

#### LEARNING OUTCOME

3.1.1 Identify, compare and prepare sterilized milk and flavoured milk.

#### CONCEPT
Definition of sterilized and flavoured milk, Types and details of manufacture of sterilized milk and flavoured milk with flow diagram

Sterilized milk.

According to FSSAI Sterilized milk may be defined as milk which has been heated in sealed container continuously to a temperature of either 115°C for 15 minutes or at least 130°C for a period of one second or more in a continuous flow and then packed under aseptic condition in hermatically sealed containers to ensure preservation at room temperature for a period not less than 15 days from the date of manufacture.

1. In – bottle sterilization.
2. UHT sterilization.

Details of manufacture:

1. In-bottle sterilization
The raw milk, on receipt, should be cooled to 5°C for bulk storage in order to check any bacterial growth. Next, it should be pre heated to 35-40°C for efficient filtration/clarification, so as to remove visible dirt, etc. The milk should again be cooled to 5°C so as to preserve its quality. It should then be standardized to the prescribed percentage of fat and solids-not-fat content in order to conform to legal standards. The milk should be pre heated to 60°C for efficient homogenization to prevent any subsequent formation of a cream layer; usually single-stage homogenization is carried out at 2500 psi pressure. The hot milk from the homogenizer should be filled into the cleaned and sanitized bottle coming from the bottle washing machine and then sealed with special caps. The filled and capped bottles should then be placed in metal crates for sterilization by the batch process, or fed into conveyors for the continuous process. Usually the milk is sterilized at 108-111°C for 25-35 minutes. The sterilized milk bottles should be gradually cooled to room temperature. Any sudden cooling may led to bottle breakage. Finally the milk-in-bottles should be stored in a cool place.
Flow diagramme of manufacture.

Receiving milk

\[ \text{Cooling for } 5^0\text{c and bulk storage} \]
\[ \text{Pre-heating}(35-40^0\text{c}) \]
\[ \text{Filtration/Clarification} \]
\[ \text{Cooling to } 5^0\text{c} \]
\[ \text{Standardizing and storage}(5^0\text{c}) \]
2. **Ultra high temperature (UHT) processing.**

In these processes, the milk is heated to 135-150°C for a few seconds, generally in a plate or tubular heat-exchanger. The milk, which is then almost sterile, has to be filled into containers for distributions; the filling has to be done aseptically. Ideally, heating and cooling should be as quick as possible.

This applies only as long as the product remains under aseptic conditions, so it is necessary to prevent re-infection by packaging the product in previously sterilized packaging materials under aseptic conditions after heat treatment. Any intermediate storage between treatment and packaging must take place under aseptic conditions. This is why UHT processing is also called *aseptic processing.*

**Flavoured Milk:**

Flavoured milk is milk to which some flavour has been added. When the ‘milk’ is used, the product should contain a milk fat percentage at least equal to the minimum legal requirement for market milk. But when the fat level is lower (1-2 per cent), the term ‘drink’ is used.

**Types:**

The main types of flavoured milk are as follows:

1. chocolate milk/drink
2. fruit flavoured milk/drink
3. sterilized flavoured milk/drink

According to FSSAI “**Flavoured Milk**” by whatever name called may contain nuts(whole fragmented orground) chocolate, coffee or any other edible flavor, edible food colours and cane sugar. Flavoured milk shall be pasteurized, sterilized or boiled. The type of milk shall be mentioned on the label.

**Details of manufacture:**

i. Preparation of Chocolate Milk Drink
The milk on receipt is standardized to 2% fat level for preparation of drink. Standardized milk is then pre-heated to 35-40°C and filtered; alternatively, after standardization it is pre-heated to 60°C, homogenized at 2500 psi and then clarified. To the warm milk, cocoa powder (1 to 1.5%), sugar (5 to 7%) and stabilizer (sodium alginate – 0.2%) are slowly added and stirred to dissolve them properly. The mixture is then pasteurized at 71°C/30 min., cooled rapidly to 5°C, bottled and kept under refrigeration (5°C) until used. The detailed flow diagram for the manufacture of chocolate milk/drink is given below.

Flow diagram of manufacture of chocolate/fruit flavoured milks/drinks

ii. Preparation of Fruit Flavoured Milk
The method of preparation of fruit flavoured milk is similar to that used for chocolate milk/drink. Instead of cocoa powder, permitted fruit flavours/essence, together with permitted (matching) colours and sugar are used. The common flavours used are strawberry, orange, lemon, pineapple, banana, vanilla, etc.

iii. Preparation of Sterilized Flavoured Milk
These combine the advantages of both sterilized and flavoured milk/drinks. The method of preparation is given below:

- Receiving milk
  - Pre-heating (35-40°C)
  - Filtration/Clarification
  - Standardization
  - Homogenization (2500 psi)
  - Filling and capping
  - Sterilization (108-111°C/25-30 min)
  - Cooling to room temperature
  - Storage (room temperature)

The incoming milk should be pre-heated to 35-40°C for filtration, so as to remove visible dirt, etc. Flavour/essence, permitted (matching) colour and sugar (syrup) are added to clarified milk and mixed well. The fruit flavoured milk is now filled in cleaned and sterilized bottles and then capped properly. The filled bottles are then sterilized at 108-111°C for 25-30 minutes. Sterilized milk bottles should be gradually cooled to room temperature. Finally, the sterilized milk is stored in a cool place.
3.1.2 Analyze and standardize different types of milks

CONCEPT


As per FSSAI, TONED MILK means the product prepared by admixture of cow or buffalo milk or both with fresh skimmed milk; or by admixture of cow or buffalo milk or both that has been standardized to fat minimum 3% and solids-not-fat minimum 8.5% by adjustment of milk solids. It shall be pasteurized and shall show a negative Phosphatase Test. When fat or dry non-fat milk solids are used, it shall be ensured that the product remains homogeneous and no deposition of solids takes place on standing.

As per FSSAI, DOUBLE TONED MILK means the product prepared by admixture of cow or buffalo milk or both with fresh skimmed milk; or by admixture of cow or buffalo milk or both that has been standardized to fat minimum 1.5% and solids-not-fat minimum 9% by adjustment of milk solids. It shall be pasteurized and shall show a negative Phosphatase Test. When fat or dry non-fat milk solids are used, it shall be ensured that the product remains homogeneous and no deposition of solids takes place on standing.

As per FSSAI, RECOMBINED MILK means the homogenised product prepared from milk fat, non-fat milk solids and water. Recombined milk shall be pasteurised and shall show a
negative Phosphatase test. As per FSSAI recombined milk should contain a minimum of 3.0 per cent fat and 8.5 per cent solids-not-fat throughout the country.

As per FSSAI, STANDARDISED MILK means cow milk or buffalo milk or sheep milk or goat milk or a combination of any of these milk that has been standardized to fat minimum 4.5% and solids-not-fat minimum 8.5% by the adjustment of milk solids. Standardized milk shall be pasteurized and shall show a negative Phosphatase Test. The standardization can be done either by partially skimming the fat in the milk with a cream separator, or by admixture with fresh or reconstituted skim milk in proper proportions.

SKIMMED MILK means the product prepared from milk from which almost all the milk fat has been removed mechanically.

**FSSAI standards for different classes and designations of milk**

<table>
<thead>
<tr>
<th>Class of milk</th>
<th>Locality</th>
<th>Designation</th>
<th>Minimum % milk fat</th>
<th>Minimum % milk solids not fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo milk</td>
<td>Kerala</td>
<td>Raw, pasteurized, boiled, flavored,</td>
<td>5.0</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sterilized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow milk</td>
<td>Kerala</td>
<td>Do</td>
<td>3.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Goat or sheep milk</td>
<td>Kerala</td>
<td>Do</td>
<td>3.0-3.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Mixed milk</td>
<td>All India</td>
<td>Do</td>
<td>4.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Standardized milk</td>
<td>All India</td>
<td>Pasteurized, flavored and sterilized</td>
<td>4.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Recombined milk</td>
<td>All India</td>
<td>Do</td>
<td>3.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Toned milk</td>
<td>All India</td>
<td>Do</td>
<td>3.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Double toned milk</td>
<td>All India</td>
<td>Do</td>
<td>1.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Skim Milk</td>
<td>All India</td>
<td>Do</td>
<td>0.5 Max</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Reconstituted Milk: Reconstituted milk refers to milk prepared by dispersing whole milk powder in water (approximately in the proportion of 1 part powder to 7-8 parts water). During the lean season, reconstituted milk is the main source of milk supply in cities.

Soft-curd milk: Soft-curd milk is milk that forms a soft curd when coagulated with rennet or pepsin under standardized procedure. Soft-curd milk has a curd tension of less than 25g. Characteristics

1. Low casein content
2. Low calcium content
**Vitaminized/ irradiated milk:** Vitaminized milk is milk to which one or more vitamins are added. Irradiated milk is milk in which the vitamin D content has been increased by exposure to ultra-violet rays.

Addition of vitamins (and minerals) to milk is called fortification, and such milk is called fortified milk.

**Frozen concentrated milk:** This refers to milk which has been partially concentrated and then solidified by freezing.

**Humanized milk:** When whole cow or buffalo milk is so modified in its chemical composition that it resembles human milk, it is called humanized Milk.

**Filled milk:** This refers to the product obtained when vegetable fat, skim milk powder and water are combined in the correct proportion to yield fluid milk.

**Imitation milk:** A product resembling milk but of non-dairy origin.

**Vegetable toned milk:** The milk protein of skim milk powder is substituted by vegetable protein isolated from groundnut.

**List of Practical**
- Preparation of flavoured milks—chocolate flavoured milk and fruit flavoured milk.

**Assessment Activities.**
- Market Survey – Students are divided into groups of 6 and asked prepare a questionnaire and conduct survey about different types of milk available in the market, their standards, price, and packaging.
- Chart preparation—chart of flow diagram and standards different types of milk are prepared
- Preparation of flavoured milks—students are asked to prepare flavoured milks

**List of items in portfolio.**
- Survey report
- Charts
- Practical record

**TE Questions**
1. Process of adding vitamins to milk is known as ………………. (flavouring, fortification, fermentation) (1)
2. Distinguish between sterilized milk and flavoured milk (2)
3. Distinguish between recombined milk and reconstituted milk (2)
4. Distinguish between Immitation milk and filled milk (2)
5. Arrange the following steps to give the flow diagram for the preparation of chocolate milk. Also specify the temperature where ever necessary.
   (Filtration/clarification, pasteurization, bottling and storage, cooling, mixing cocoa powder, sugar and stabilizer, receiving milk, pre-heating) (4)

6. How is sterilized flavoured milk is prepared in a dairy plant (4)

7. During the dairy plant visit you may have seen the production of UHT sterilized milk. Explain the production details that you have observed. (4)

8. Match the following

<table>
<thead>
<tr>
<th></th>
<th>FAT%</th>
<th>SNF %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toned milk</td>
<td>0.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Double toned milk</td>
<td>4</td>
<td>8.8</td>
</tr>
<tr>
<td>Standardized milk</td>
<td>1.5</td>
<td>9</td>
</tr>
<tr>
<td>Skim milk</td>
<td>3</td>
<td>8.5</td>
</tr>
<tr>
<td>Human milk</td>
<td>4.5</td>
<td>8.5</td>
</tr>
</tbody>
</table>
3.2: Fermented Milks

Fermented milks are dairy foods that have been fermented with lactic acid bacteria such as Lactobacillus, Lactococcus, and Leuconostoc. The fermentation process increases the shelf-life of the product, while enhancing the taste and improving the digestibility and palatability of milk.

Initially the souring of milk was done by natural fermentation. With the advent of science of bacteriology and nutrition, fermentation process emerged as a well-developed controlled sequence of changes in milk with the use of selective microorganisms. Selective organism produces lactic acid and may impart other beneficial effect to the product. The use of different microorganisms led the development of a wide range of milk products viz. dahi, yoghurt, shrikhand, lassi, kefir, koumiss, yakult, laben, etc. In India, dahi is being produced with varieties of taste varying with region-to-region and individual food habits. The consumption statistics shows that about 6.9 per cent of total milk produced in India is utilized for making dahi intended for direct composition. In this unit various types of fermented milk products and their methods of manufacture will be discussed.

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
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<td><strong>Fermented milks</strong></td>
<td><em>The learner will be able to:</em></td>
<td><em>Dairy plant visit</em></td>
<td><em>Visit report</em></td>
</tr>
<tr>
<td>Definition</td>
<td>Identify health benefits of fermented milks</td>
<td><em>Market survey.</em></td>
<td><em>Survey report</em></td>
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<tr>
<td>health benefits</td>
<td>classify fermented milks.</td>
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<td></td>
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<tr>
<td>classification</td>
<td></td>
<td></td>
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</tbody>
</table>

**SKILLS:**
- Data collection skill
- Observation skill
- Analyzing skill
- Understanding skill

<table>
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<tr>
<th><strong>Starter culture:</strong></th>
<th><em>Categorize and choose appropriate Starter culture.</em></th>
<th><em>Interactive lectures</em></th>
<th><em>Test/quiz</em></th>
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<tr>
<td>Definition</td>
<td></td>
<td><em>Instructional videos.</em></td>
<td><em>Seminar report</em></td>
</tr>
<tr>
<td>propagation</td>
<td></td>
<td><em>Seminar</em></td>
<td><em>chart</em></td>
</tr>
</tbody>
</table>

**SKILLS:**
- Data collection skill
| **Observation skill** | **Analyzing skill** | **Buttermilk.**  
| preparation | |  
| Prepare buttermilk. | Visit a dairy plant  
| Instructional lectures  
| Videos  
| Referencing from secondary sources. | Situational analysis  
| chart  
| Test/ quiz. | **Acidophilus milk.**  
| Preparation  
| Culture |  
| Prepare acidophilus milk | Visit to a dairy plant  
| Videos  
| Referencing from secondary sources. | Chart  
| Record  
| Tests/quiz | **Yogurt:**  
| Yogurt culture  
| Preparation  
| Flavoured Yogurt-methods of preparation |  
| Prepre of Yogurt | Visit to a dairy plant  
| Videos  
| Referencing from secondary sources. | Chart  
| Record  
| Tests/quiz  
| Flow diagram. | **SKILLS:**  
| Data collection skill  
| Observation skill  
| preparation skill |  
| Data collection skill  
| Observation skill  
| preparation skill |  
| Data collection skill  
| Observation skill  
| preparation skill |  
| Yogurt culture  
| Preparation  
| Flavoured Yogurt-methods of preparation | **SKILLS:** |
UNIT IN DETAIL

LEARNING OUTCOME

3.2.1 Identify health benefits of fermented milks and classify fermented milks.

CONCEPT

Definition, health benefits and classification of fermented milks

Fermented milk refers to those milks which have been made by employing selected micro-organisms to develop the characteristic flavour and/or body and texture.

Health benefits:

i. Much more palatable than milk
ii. Nutritive value usually increased
iii. More easily assimilated by the human system than milk
iv. May contain beneficial antibiotics
v. May possess therapeutic properties

Classification:
The compositional and organoleptic qualities of fermented milks depend on initial quality of milk, manufacturing conditions, types and levels of starter cultures and age of the products.

Natural Butter Milk, Cultured Butter Milk, Acidophilus Milk, Bulgarian Butter Milk, Kumiss, Kefir, Yoghurt and Dahi.

LEARNING OUTCOME

3.2.2 Categorize and choose appropriate Starter culture

CONCEPT

Definition and propagation of starter culture

**Definition:**
Starter cultures are carefully selected organisms which are intentionally added to initiate the fermentation process. Lactic starter is a culture usually considered to indicate a culture containing lactic streptococci. Microorganisms commonly found in fermented milk belong to the genus Streptococcus. They may or may not contain associative organisms of the genus Leuconostoc. Starter species most commonly used in dairy industry are *Lactococcus lactis*, *Lactococcus cremoris*, *Lactococcus diacetylactis*, *Leuconostoc citrovorum* and *Leuconostoc dextranicum*. A starter may contain a single lactic strain or a mixture of lactic streptococci with or without Leuconostoc species.

**Propagation/maintenance of starter culture:**

**Mother Starter Culture**
It refers to the stock lactic cultures prepared routinely in the laboratory or dairy plant from day to day for bulk propagation.

Propagation/maintenance of starter culture:

i. **Preparation of Mother Culture:** The milk is pasteurized in cleaned and sterilized bottles at 72-73°C for 45 minutes and the bottles then submerged in the cooling water, and thereafter, these milk bottles are stored in a refrigerator for future use. The milk containing bottle is inoculated by injecting few drops of the desired culture. Thereafter, the content is incubated at desired temperature.
The preparation of mother culture is a very important step in the production of bulk starters for manufacture of fermented milk products at large scale. The mother cultures are generally maintained in narrow neck polyethylene bottles, which are thoroughly cleaned and sterilized using steam jets. Sometimes these bottles are sanitized with 0.1 per cent hypochlorite solution.

**ii. Preparation of Bulk Starters**

It is made in large amounts to be actually added to the milk, whenever required for the manufacture of fermented milks or milk products. The vessels of different sizes are used for preparation of bulk starters. These vessels are closed completely air tight after the initial stage of filling with milk. These cans are filled with milk and heat treated by steam at 72-73°C for 45 min and cooled to incubation temperatures. The bulk culture is inoculated and incubated in the same manner as the mother cultures.
Additional knowledge:

iii. Continuous Starter Production

Recently, this culturing technique has stimulated a lot of interest and dairy industry is striving for the introduction of this technique in the cheese plants with the advent of this technology, the manipulation and transfer of large bulk of starters are now avoided.

Many cheese plants today may use a very huge amount of bulk starters every day. This has been possible only through continuous cultivation of the starters. The handling of large size cans for bulk starters is extensively cumbersome and inconvenient. Inspite of convenience and ease, the continuous starter production suffers from a serious problem. During the operation of starters, if the starter gets contaminated (attacked by a phage), the whole bulk and all the equipment get contaminated. Hence, the control of purity and activity is even more important in continuous starter production than in a batch method of production.

iv. Preparation of Master Culture

In case of preparation of master culture, the method of inoculation is the same as for mother culture. For this, litmus milk may be used in the polyethylene tubes. Specific care must be taken to sterilize the chalk before adding to the milk as spores in chalk may be extremely resistant to heat. Litmus milk previously sterilized in glass bottles is filled into the tubes using a hypodermic needle. These are now ready for inoculation with the starter cultures. Such cultures may be maintained indefinitely with careful checking and testing after three months interval. Polyethylene containers are preferred over glass tubes and bottles as these are unbreakable, very light easily portable.
LEARNING OUTCOME
3.2.3 Prepare buttermilk.

CONCEPT
Buttermilk preparation

Buttermilk is a by-product obtained during the churning of cream for butter making. In Indigenous method country butter milk is obtained as a by-product of churning whole milk curd for production of desi butter. It can be used as a refreshing drink.

Cultured Butter milk
This is obtained by inoculation and incubation of pasteurized skim milk with lactic starter.

Preparation:

Skim milk is pasteurized, cooled and added with starter culture. After incubation, the curd is broken and cooled to 5 to 10°C.

LEARNING OUTCOME
3.2.4 Prepare Acidophilus milk

CONCEPT
Preparation

Acidophilus milk is produced by adding culture named Lactobacillus acidophilus. It has therapeutic and health promoting properties.

Flow diagram of manufacture of acidophilus milk:

- Receiving milk (skim/whole/defatted)
- Filtration/Clarification (35-40°C)
- Homogenization
- Sterilization (115°C/15min.)
- Cooling (38-40°C)
- Inoculation (3-5%)
- Incubation (38-40°C/12-16hrs)
- Coagulation
- Break up of coagulum
- Cooling (10°C)
Packaging and storage($^{0}$C)

**LEARNING OUTCOME**

3.2.5 Prepare Yogurt.

**CONCEPT**
Convey knowledge about the product and its preparation

According to FSSAI, Yoghurt means a coagulated product obtained from pasteurized or boiled milk or concentrated milk, pasteurized skimmed milk and/or pasteurized cream or a mixture of two or more of the seproducts by lactic acid fermentation through the action of Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus ssp. Thermophilus It may also contain cultures of Bifidobacterium bifidus and Lactobacillus acidophilus and other cultures ofsuitable lactic acid producing harmless bacteria and if added declaration to this effect shall be made on the label. The microorganisms in the final product must be viable and abundant. It may contain milk powder, skimmed milk powder, unfermented buttermilk, concentrated whey, whey powder, whey protein, whey protein concentrate, water soluble milk proteins, edible casein, and caseinates manufactured from pasteurized products. It may also contain sugar, corn syrup or glucose syrup in sweetened, flavoured and fruit yoghurt or fruits in fruits yoghurt. It shall have smooth surface and thick consistency without separation of whey. It shall be free from vegetable oil/fat, animal body fat, mineral oil and any other substance foreign to milk. It shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Plain Yoghurt</th>
<th>Fruit Yoghurt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat</td>
<td>Not less than 3%</td>
<td>Not less than 1.5%</td>
</tr>
<tr>
<td>Milk solids not fat</td>
<td>Not less than 8.5%</td>
<td>Not less than 8.5%</td>
</tr>
<tr>
<td>Milk protein</td>
<td>Not less than 3.2%</td>
<td>Not less than 2.6%</td>
</tr>
<tr>
<td>Sugar</td>
<td>-</td>
<td>Not less than 6%</td>
</tr>
</tbody>
</table>

The product is incubated at 40-45°C/5 hours. Yoghurt is characterized by a pungent, fruity small and acid taste. It has a firm body like dahi. Commercial yoghurts are divided into three main categories, i.e., plain/natural, fruit and flavoured.

*Flow diagram of manufacture of Yoghurt:*

1. Receiving whole/defatted milk
2. Addition of skim milk powder concentrate
3. Filtration/clarification (35-40°C)
4. Pre-heating the mix (60°C)
5. Homogenization (2500 psi)
6. Pasteurization (85°C/30min)
Cooling (43-44°C) ↓
Inoculation (2%) ↓
Packaging ↓
Incubation (41-42°C/3hrs) (0.75%T.A) ↓
Cooling and storage (5-7°C)

**Details of manufacture:**
Skim milk powder is added to whole/ defatted milk, pre-heated and homogenized. Stabilizers may or may not be added. The mix is heated in a vat to 85°C/ 30 minutes and then cooled to 43-44°C. It is then added with 2% starter culture *Lactobacillus delbrueckii subsp. bulgaricus* and *Streptococcus thermophilus ssp. thermophiles* (1:1) and stirred briefly to ensure proper mixing. The mix is then packaged and stored at 41-42°C / 3-4 hours till a titratable acidity of 0.75% is reached. The finished product is then stored at 5-7°C.

**Flavoured yoghurt:**
Flavoured yoghurt is a product obtained by adding different flavours to yoghurt. Flavours are of three types, viz., synthetic or artificial, natural with synthetics added and natural fruits. These flavours are added to yoghurt in one of the following ways:

1. **By mix blending:** The flavouring material, sugar and colour are added to the mix prior to fermentation.
2. **Fruit on bottom:** Preserve or fruits are added to the package prior to filling or setting.
3. **Bulk mixing:** Yoghurt is prepared, bulk chilled and mixed with a fruit dressing and packaged. Fresh fruit, preserves, flavours, sugar and colour are blended in after fermentation.

**LEARNING OUTCOME**

3.2.6 Prepare dahi

**CONCEPT**

Dahi preparation

According to Food Safety and Standard Regulations 2011, “Dahi or curd” means the product obtained from pasteurized or boiled milk by souring, natural or otherwise, by a harmless lactic acid.
culture or other harmless bacterial culture may also be used in conjunction with lactic acid bacteria cultures for sourcing. Dahi may contain added cane sugar. Dahi shall have the same minimum percentage of milk fat and milk solids not fat as the milk from which it is prepared. In household, the milk is boiled, cooled to room temperature, inoculated with 0.5 to 1.0 percent starter (previous day’s dahi or butter milk) and then incubated undisturbed for setting for about overnight. In cold weather, the dahi setting vessel is usually wrapped up with woolen cloth to maintain appropriate temperature. In the confectionary shops, the method employed for preparation of dahi is more or less same except that the milk is concentrated in an open pan before inoculation and usually dahi is set in an earthenware. In a dairy plant, it is prepared as follows:

**Flow diagram of manufacture of Dahi:**

1. **Receiving milk**
2. Pre-heating
3. Filtration/clarification (35-40°C)
4. Standardization
5. Pre-heating 60°C
6. Homogenization (2500 psi)
7. Pasteurization (80-90°C/15-30min)
8. Cooling (22-25°C)
9. Inoculation (0.5% starter culture)
10. Packaging
11. Incubation (22-25°C /16-18hrs)
12. Dahi
13. Cooling and storage (5°C)

**Details of Manufacture:**

Fresh, sweet, good quality milk is received, pre-heated to 35-40°C and subjected to filtration/clarification. It is then standardized to 2.5-3.0% fat and 10% SNF, pre-heated to 60°C and homogenized single stage at a pressure of 176kg/sq.cm. The milk is pasteurized at 80-90°C /15-30 minutes., cooled to 22-25°C and inoculated with 1-3% of lactic starter culture. It is then filled in suitable containers (glass bottles/ plastic cups/ pouches) of required capacity and incubated at 22-25°C / 16-18 hours, during which period the acidity reaches 0.6-0.7% lactic acid and a firm curd is formed. The set curd is stored at about 5°C in a cold room.
LEARNING OUTCOME

3.2.7 Prepare lassi

CONCEPT

Lassi preparation

Method:

Standardized milk (4% fat) is heated to 90°C for 10 min and cooled to 25°C before addition of starter culture (1%). Cultured milk is incubated for 12-16 hr at 25-28°C, the set curd is broken by stirring and sugar syrup is mixed. The mixture is homogenized and packaged after the addition of flavour. On an average the product contains 3 per cent fat, 6-7 per cent SNF and 10-11 per cent sugar. The acidity ranges from 0.6 to 0.7% LA.

List of practicals

- Preparation of buttermilk.
- Preparation of Yoghurt.
- Preparation of Dahi.
- Preparation of Lassi and Shrikhand

Assessment Activities.

- Preparation of fermented milk-prepare fermented milk
- Market Survey –Students are divided into different groups and each group is asked to prepare a questionnaire and conduct a survey about a specific fermented milk, which brands are available in the local market, their price, consumer preference.
- Chart preparation- prepare chart of flow diagram of preparation and culture used in different types of fermented milks.

List of items in portfolio.

- Survey report
- Charts
- Practical record

TE Questions

1. The two strains added for the preparation of yoghurt are ..................... And ....................... (2)
2. Though yoghurt is said to have high therapeutic value. Most of the people are unaware of its preparation. How can you help them? (6)
3. Acidophilus milk is prepared by adding ...................... culture to milk (1)
4. You are given the following starter cultures. Which all products can you prepare from it

- *Lactobacillus acidophilus*
- *Lactobacillus bulgaricus*
- *Streptococcus thermophilus*
- *Lactococcus lactis*
- *Lactococcus cremoris*

5. A discussion is conducted in your class regarding the merits of fermented milk products over milk. Give a summary of the discussion.

6. Complete the flow diagram for the preparation of Dahi.

   Receiving milk
   ↓
   ................(a)............
   ↓
   Filtration/ clarification
   ↓
   Standardization
   ↓
   .....................(b)...........
   ↓
   Homogenization (176 kg/sq cm)
   ↓
   Pasteurization(......(c).........°C/......(d)...... min)
   ↓
   Cooling (22 – 25°C)
   ↓
   Addition of starter culture (.........(e)......%)
   ↓
   Packaging
   ↓
   Incubation (.........(f).........°C/16-18 hrs)
   ↓
   Dahi
   ↓
   Cooling and storage(4-5°C)

7. You planned to prepare acidophilus milk and curd for your practical. Name the cultures that you will purchase to prepare the above product.

8. You read an article in a leading magazine ‘therapeutic value of fermented milk products’. Highlight the importance of fermented milk products and list their advantages.
UNIT 3.3: Fat Rich Dairy Products

Being largest entity in milk, fat globules can relatively be easily separated from the rest of the milk, thereby yielding products of varying fat concentrations. Also processes leading to change in status of fat globules with respect to type of emulsion can result in different products. Thus, milk fraction concentrated in fat gives cream, which in turn can be converted in products such as butter, ghee, butteroil etc.

UNIT GRID

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<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
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<td><strong>Cream:</strong></td>
<td><em>The learner will be able to:</em></td>
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</tr>
<tr>
<td>• Definition</td>
<td>• Analyze and standardize different types of cream.</td>
<td>• Demonstration</td>
<td>• Survey report</td>
</tr>
<tr>
<td>• Composition</td>
<td>• Classify different types of creams</td>
<td>• Interactive lectures</td>
<td>• Participation in group discussion</td>
</tr>
<tr>
<td>• FSSAI standards</td>
<td>• Identify different methods of separation</td>
<td>• Instructional videos, charts</td>
<td>• record presentation</td>
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<tr>
<td>• Types of cream</td>
<td></td>
<td>• Dairy plant visit.</td>
<td>• Plant visit report</td>
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<tr>
<td>• Methods of separation: Gravitational and centrifugal</td>
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<tr>
<td><strong>SKILLS:</strong></td>
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</tr>
<tr>
<td>• Data collection skill</td>
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<tr>
<td>• Observation skill</td>
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<td>• Analyzing skill</td>
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<tr>
<td>• Activity skill</td>
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<tr>
<td><strong>Butter:</strong></td>
<td>• Analyze and standardize different types of Butter</td>
<td>• Dairy plant visit</td>
<td>• Flow diagrams</td>
</tr>
<tr>
<td>• Definition</td>
<td>• Classify different types of butter</td>
<td>• Demonstration</td>
<td>• Visit report</td>
</tr>
<tr>
<td>• Composition</td>
<td>• Identify different methods of manufacture</td>
<td>• Interactive lectures</td>
<td></td>
</tr>
<tr>
<td>• FSSAI standards</td>
<td>• Calculate overrun</td>
<td>• Instructional videos</td>
<td></td>
</tr>
<tr>
<td>• Classification of butter</td>
<td>• Analyze and standardize desi</td>
<td>• charts.</td>
<td></td>
</tr>
<tr>
<td>• Method of manufacture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Overrun in butter- measuring and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>its causes</td>
<td>butter.</td>
<td>SKILLS:</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>• Desi butter-FSSAI definition, Standards, preparation</td>
<td>• Prepare Desi butter.</td>
<td>• Data collection skill</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Observation skill</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Analyzing skill</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Implementation/Activity skill</td>
<td></td>
</tr>
<tr>
<td><strong>Ghee:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Definition</td>
<td>• Analyze and standardize different types of Ghee.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Composition</td>
<td>• Identify different methods of manufacture.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• FSSAI standards</td>
<td>• Identify and analyze Agmark standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Methods of preparation-creamery butter method, prestratification method,</td>
<td>• Identify and analyse packaging and storage of ghee.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct cream method and Desi method.</td>
<td>• Test the ghee and identify the adulterants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Agmark grading of ghee and Agmark standards</td>
<td>• Analyze and standardize butter oil.</td>
<td>• Seminar presentation</td>
<td></td>
</tr>
<tr>
<td>• Packaging and storage of ghee</td>
<td></td>
<td>• Instructional lectures</td>
<td></td>
</tr>
<tr>
<td>• Adulterants in Ghee</td>
<td></td>
<td>• visual media</td>
<td></td>
</tr>
<tr>
<td>• Butter oil - definition and composition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| • Market survey                                                            | • Survey report                                                        | • Tests/quiz                                                          |
| • Instructional lectures                                                   |                                                                        |                                                                        |
| • visual media                                                             |                                                                        |                                                                        |
| • Seminar presentation                                                    |• Participation in group discussion                                    |                                                                        |
|                                                                             |• Survey report                                                         |                                                                        |
|                                                                             |• Tests/quiz                                                            |                                                                        |
SKILLS:
- Data collection skill
- Observation skill
- Analyzing skill
- Learning skill
- Understanding skill

UNIT IN DETAIL

LEARNING OUTCOME

3.3.1 Analyze and standardize different types of cream, Classify different types of creams and Identify different methods of separation

CONCEPT
- Definition of cream
- Composition of cream
- FSSAI standards
- Types of cream
- Methods of separation with principle - Gravitational and centrifugal

Definition: Cream is a fat rich product containing minimum 25% milk fat.

FSSAI standards: According to Food Safety and Standards Regulations (FSSR) 2011, Cream including sterilized cream means the product of cow or buffalo milk or a combination thereof. It shall be free from starch and other ingredients foreign to milk. It may be of following three categories, namely:

1. Low fat cream: containing milk fat not less than 25.0 percent by weight.
2. Medium fat cream: containing milk fat not less than 40.0 percent by weight.
3. High fat cream: containing milk fat not less than 60.0 percent by weight.

Note:- Cream sold without any indication about milk fat content shall be treated as high fat cream

Chemical composition of cream

<table>
<thead>
<tr>
<th>Constituents</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I (Low fat cream)</td>
</tr>
<tr>
<td>Water</td>
<td>68.2</td>
</tr>
<tr>
<td>Fat</td>
<td>25</td>
</tr>
<tr>
<td>Protein</td>
<td>2.54</td>
</tr>
<tr>
<td>Lactose</td>
<td>3.71</td>
</tr>
<tr>
<td>Ash</td>
<td>0.56</td>
</tr>
<tr>
<td>Total solids</td>
<td>31.8</td>
</tr>
</tbody>
</table>
Types of cream – Table cream, light cream, coffee cream, whipping cream, heavy cream and plastic cream

Production:

Principle: The basic principle of cream separation, whether by gravity or centrifugal methods, is based on the fact that milk fat is lighter than the skim milk portion. At 16°C the density of milk fat is 0.93 and skim milk 1.036. Hence when milk is subjected to gravity or centrifugal force, the two components, viz. cream and skim milk, by virtue of their differing densities, stratify or separate from one another.

Methods of separation –

Gravitational: When milk is kept undisturbed for some time, a creamy layer appears on the top.

The velocity at which the fat globules rise, is given by the following equation

Stock’s Law:

\[ V = \frac{2G(ds - df) r^2}{9n} \]

\( V \) = velocity or rate at which a single fat globule rises

\( G \) = acceleration due to gravity

\( ds \) = density of skim milk

\( df \) = density of fat globule
\( r = \text{radius of fat globule} \)

\( n = \text{viscosity of skim milk} \)

**Centrifugal method:**

When milk enters the rapidly revolving bowl of the cream separator, it is immediately subjected to centrifugal force, which is 3000 to 6000 times greater than gravitational force. While both the fat and skim milk are subjected to the centrifugal force, the difference in density affects the heavier portion (skim milk) more intensely than the lighter portion (cream). Therefore, the skim milk is forced to the periphery while the fat portion moves towards the centre.

The important parts of the centrifugal cream separator are as follows: Supply can, Faucet, Float, Cream screw, skim milk screw, Bowl shell, Milk distributor, Cream spout, skim milk spout, Top disc, Disc, Bowl nut, rubber ring, spindle etc.
LEARNING OUTCOME

3.3.2 Analyze and standardize different types of Butter, Classify different types of butter, Identify different methods of manufacture, Calculate overrun, Analyze and standardize desi butter and Prepare Desi butter.

CONCEPT

- Definition of butter
- Composition
- FSSAI standards
- Classification of butter
- Method of manufacture
- Overrun in butter-measuring and its causes
- Desi butter- FSSAI definition, Standards, preparation

Definition:

Butter means the fatty product derived exclusively from milk of Cow and/or Buffalo or its products principally in the form of an emulsion of the type water-in-oil. The product may be with or without added common salt and starter cultures of harmless lactic acid and/or flavour producing bacteria. Table butter shall be obtained from pasteurised milk and/or other milk products which have undergone adequate heat treatment to ensure microbial safety. It shall be free from animal, body fat, vegetable oil and fat, mineral oil and added flavour. It shall have pleasant taste and flavour free from off flavour and rancidity. Provided that where butter is sold or offered for sale without any indication as to whether it is table or desi butter, the standards of table butter shall apply. It shall confirm to the following requirements.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Table butter</td>
</tr>
<tr>
<td>Moisture</td>
<td>Not more than 16%</td>
</tr>
<tr>
<td>Milk fat</td>
<td>Not less than 80%</td>
</tr>
<tr>
<td>Milk solids not fat</td>
<td>Not less than 1.5%</td>
</tr>
<tr>
<td>Common salt</td>
<td>Not more than 3%</td>
</tr>
</tbody>
</table>

Classification of Butter:

Butter may be classified based on treatment given to cream, salt content, method of manufacturing and end use.

a) **Pasteurized cream butter:**
   Made usually from pasteurized sweet cream. Such butter usually has a milder flavour than that made from similar cream not pasteurized.

b) **Ripened cream butter:**
   Made from cream in which a pleasant delicate aroma has been developed before churning by ripening (i.e. inoculating the cream with a butter culture and holding it at a desired temperature)-properly made. Ripened cream butter has a delicate flavour which is sometimes referred to as “real butter flavour”.

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c) **Unripened cream butter:**
   Made from unripened cream. The flavours of such butter is usually mild.

d) **Salted butter:**
Butter to which salt has been added.
e) **Unsalted Butter:**
Contains no added salt.
f) **Sweet cream butter:**
In this case, the acidity of the churned cream does not exceed 0.20%.
g) **Sour cream butter:**
Made from cream which has more than 0.20% acidity.
h) **Fresh butter:**
Such butter has not undergone cold storage.(usually, fresh butter is not kept for more than 3 weeks.
i) **Cold storage butter:**
   Here, it has been stored at a temperature of about-18 degree Celsius for some time. (Generally cold storage butter is from 1 to 6 months old when offered for retail trade.)
j) **Dairy butter(USA):**
Made on a farm. It is usually made from un pasteurized sour cream which has not been standardized for acidity. This butter generally has a sour flavour due to the high acid content of the cream.
k) **Cremary butter:**
   Made in a cremary or dairy factory. It is more uniform in quality than ‘dairy butter’.

Method of manufacture:

```
Receiving milk -> preheating (35-40°C) -> Separation (Centrifugation) -> Cream
                    |                      |                      |
                    |                      |                      |
                    |                      |                      |
                    |                      | Grade -> Weighing -> Sampling -> Testing
                    |                      | Neutralization       
                    |                      |                      |
                    |                      |                      |
                    |                      | Standardization (35-40% fat) -> 50
```
Pasteurization (82-88° C / no hold)

OR

Vacreation

Cooling (20-22° C)

Cooling (10-15° C)

Ripening (20-22° C)

Ageing (5-10° C)

Churning

Washing

Salting and working

Packaging and storage (-23 to -29°C)

**Details of manufacture**

**Receiving milk/cream:** This consists of unloading, grading, sampling, weighing and testing.

**Pre-heating of milk:** To increase efficiency of cream separation

**Separation of milk:** By centrifugal methods.

**Neutralization of cream:**

Neutralization of sour cream for butter making refers to partial reduction in its acidity.

**Objectives**

1. To avoid excess loss of fat which result from the churning highly acid
pasteurized cream sour. (In pasteurization of sour cream, the casein curdles, by entrapping fat globules, as the bulk of curd goes in butter milk, causing high fat loss.)

2. To guard against undesirable off-flavours in cream. (which may result when high acid cream is pasteurized).

3. To improve the keeping quality of butter from high acid cream. Salted-acid butter develops a fish flavor during commercial storage at -23 to -29°C.

**Method of neutralization of cream**

There are five essential steps to follow for cream neutralization.

1. Adoption of definite standard of churning acidity:
   - Butter for long storage: Cream acidity should be reduced to 0.06-0.08% before churning.
   - Butter for short storage: Cream acidity should be reduced to 0.25-0.30% before churning.
2. Correct estimation of acidity.
3. Calculating the amount of neutralizer to be added.
4. Adding neutralizer in the correct manner.
5. Checking results by re-testing acidity.

**Type of Neutralizers**

The neutralizers used for reducing acidity in cream belong to either one or the other of two groups namely:

- **Lime Neutralizers**: Calcium Hydroxide and Magnesium Hydroxide
- **Soda Neutralizers**: Caustic Soda, sodium carbonate, sodium bicarbonate

**Standardization of cream**

It refers to adjustment of fat to desired percentage, confirming to standard requirements.

It is done by adding calculated quantity of skim milk. Desired level of fat in cream for butter making is 33 to 40 per cent. Standardization to both higher and lower level leads to higher fat loss in butter milk.

**Pasteurization of cream**

It refers to adjustment every particle of cream to a temperature not less that 71°C and holding it at that temperature for at least 20 min or any suitable temperature-time combination using properly operated equipments.

The main objectives of pasteurization are:

i. To destroy pathogenic microorganisms in cream so as to make it, and the resultant butter, safe for human consumption.
ii. To destroy undesirable micro-organisms and inactivate enzymes present so as to prolong keeping quality of the cream and butter.
iii. To eliminate some of the gaseous and tainting substances.
iv. To complete the neutralization process
v. To remove some of volatile off-flavours during vacreation (eg.: feed, weed)

Methods:

a) Holder pasteurization: $71^0C$ for 20 minutes, and then promptly cooled.

b) HTST: $95-100^0C$ for 15-16 seconds.

c) Vacuum pasteurization or vacreation.

**Cooling and ageing**

Cream is cooled by lowering its temperature and aged by holding it at this (low) temperature for few hours. After pasteurization cream as to be cooled and then aged to make churning possible. When cream leaves the pasteurizer, the fat in the globule is in liquid form. When cream is cooled, fat crystallization starts, cream will not churn unless the butter fat is at least partially crystallized. If solidification of fat is not sufficient, the fat losses in buttermilk will be high, and butter obtained will have an unsatisfactory, week body. High cooling and ageing temperature of cream, shorten the churning period, yield large fat losses in butter milk and produce butter which has a relatively soft body. Low cooling and ageing temperature prolong the churning period, decrease fat losses and produce a firm body. The optimum temperature for cooling and ageing is $5-10^0C$

**Ripening of cream**

Ripening refers to the process of fermentation of cream with the help of suitable starter culture. This step can be eliminated if sweet-cream butter is desired.

**Objectives:**

1. To produce butter with a pleasing, pronounced characteristic flavor and aroma (higher diacetyl content.)

2. To obtain exhaustive churning, i.e. low fat loss in butter milk. Starter culture consisting of a mixture of both acid producing (*Streptococcus lactis*, *S. cremories*) and flavour producing (*S. diacetylactis*, *Leuconostoc citrovorum* and/or *Leuc. dextranicum*) organisms is added to pasteurized and cooled ($20-22^0C$) cream. Amount of starter added depends on several factors and usually ranges between 0.5-2.0 percent of the weight of the cream. After being thoroughly mixed, the cream is incubated at about $21^0C$ till desired an acidity is reached. Cream is subsequently cooled to $5-10^0C$ to arrest further acid development.

**Churning of cream**

**Definition:** Churning of cream consists of agitation at suitable temperature until the fat globules adhere forming larger and larger masses, and until a relatively complex separation of fat and serum occurs.

**Churning operation**

Filling cream into the churn. The cream should be strained so as to remove lumps and chance objects. The amount then filled should preferably below rated capacity.

**Addition of butter colour**
The amount of color varies from 0-250 ml per 100Kg of butter fat. The butter colour preferably added to the cream in the churn.

**Colour permitted in butter:**

Annato or Carotene. Annatto is obtained from the seeds of the Annatto plant.\(^{Bixaorellana}\). Carotene is extracted from carrots and other carotene-rich vegetable matter. This colour is slightly on the greenish side.

**Operating the churn**

After initially rotating the churn for 5 to 10 minutes, the liberated gas is removed once or twice by opening the churn vent. Then the cream sample is drawn for the fattest. During the churning process there is invariably a rise in temperature from 1\(^{o}\)C to 30\(^{o}\)C Churning is accompanied by foaming. Then comes the ‘breaking’ stage cream breaks away from the spy glass which becomes clear. At this stage the fat in the skim-milk emulsion breaks and very small butter granules of the size of pinheads make their appearance. It is sometimes necessary, especially in the tropics, to add ‘break water’ at this stage, to reduce the temperature of the churn contents, and thereby control the body of the butter (addition of break water can be avoided by providing an air-conditioned butter-making room and/or chill-water spray over the butter churn). The amount and temperature of break-water depends on the temperature reduction required. After the breaking stage, the churning is continued until the butter grains are of the desired size (viz., ‘pea-size’ in large churns).

**Draining the buttermilk and washing**

When the cream has been churned, the churn is stopped in the proper position, and butter milk is drained. After draining, chilled water is added to the butter in the churn. The temperature of the water is usually 1-2\(^{o}\)C lower than the churning temperature of cream, and an amount equal to the quantity of buttermilk removed. After a few revolutions, the wash water is drained out. Normally one wash is enough.

**Salting of butter**

In conventional process, butter may be salted by adding salt to butter churn after initial working of butter. Salt to be added must be high quality. It should be 99.5 to 99.8% sodium chloride and microbial count should be less than 10/g. Salt sets up osmotic gradient which draws water from the butter grains. This can lead butter to be leaky. Salted butter should therefore, must be thoroughly worked. Salt may be added either in dry form or as saturated brine solution.

**Final working of butter**

The objective of working butter is to incorporate moisture and uniformly distribute added moisture and salt in butter. During this process remaining fat globules also break up and form a continuous phase, and moisture is finally distributed to retard bacterial growth in butter. It is safer to slightly over-work butter.
than to under-work. Under-worked butter may be leaky in body with large visible water droplets and may develop mottles on standing. Moisture droplet size normally ranges from 1 to 15 micron and there are approximately 10 billion droplets per gram of butter. Working affects the colour of butter (making is slightly light). Working also increase air content (this favors growth of microorganisms, oxidative effects and therefore poor keeping quality). Vacuum working of butter may be carried out with advantage to reduce the air content of butter. Vacuum range from 15-40 cm of Hg may be used. Air content of conventional butter range from 3-7% by volume with an average of 4 ml/100 while that of vacuum worked butter it is about 1 ml/100g.

**Storage of butter**

The commercial storage of butter is at -23 to -29°C.

**Overrun in butter**

It may be defined as the increase in the amount of butter made from a given amount of fat. It is usually expressed as percentage overrun. The presence of moisture, curd, salt, air, etc., in butter increases the amount of butter. The formula used for the calculation of Theoretical overrun is given below: 

\[
\text{Per cent Over-run (\% OR)} = \frac{B - F}{F}
\]

Where,

- \(B\) = Quantity of butter made (kg)
- \(F\) = Fat in churn (kg)

**Factors Influencing Over-run:**

1. Inaccuracy in weighing of milk, cream or butter
2. Inaccuracy in fat testing of the samples of milk, cream or butter
3. Fat losses in skim milk and butter milk
4. Fluctuation in fat content of butter
5. Weight allowance in butter packages
6. Handling losses

**Desi butter**

**Definition**

The butter obtained by traditional process of churning dahi or malai as practiced at domestic levels.

**Preparation:**
Milk will be cultured and kept for overnight for fermentation. Resultant curd was churned using hand driven wooden beaters to separate the milk fat in the form of desi butter.

Some follow slightly different method wherein milk is heated continuously to about 80°C, the malai (creamy layer) that forms over the surface was collected manually. This malai is then churned to get the desi butter.

**Additional knowledge:**

Permitted food additives in butter as per FSSR

<table>
<thead>
<tr>
<th>Additive</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colors (natural: singly or in combination)</td>
<td></td>
</tr>
<tr>
<td>Curcumin</td>
<td>100 ppm max.</td>
</tr>
<tr>
<td>Beta carotene</td>
<td>100 ppm max.</td>
</tr>
<tr>
<td>Carotene (Natural extract)</td>
<td>100 ppm max.</td>
</tr>
<tr>
<td>Annatto extract on Bixin/ Nor bixin basis</td>
<td>20 ppm max.</td>
</tr>
<tr>
<td>Beta apo-8 carotenal</td>
<td>35 ppm max.</td>
</tr>
<tr>
<td>Methyl ester of Beta apo-8 Carotenoic acid</td>
<td>35 ppm max.</td>
</tr>
<tr>
<td>Acidity regulators</td>
<td></td>
</tr>
<tr>
<td>Sodium and Calcium hydroxide</td>
<td>2000 ppm max.</td>
</tr>
</tbody>
</table>

**Overrun in butter-measuring and its causes:**

It may be defined as the increase in the amount of butter made from a given amount of fat. It is usually expressed as percentage overrun. The presence of moisture, curd, salt, air, etc., in butter increases the amount of butter.

The formula used for the calculation of Theoretical over-run is given below:

\[
\text{Per cent Over-run (\% OR)} = \frac{(B - F)}{F} \times 100
\]

Where,

- \( B \) = Quantity of butter made (kg)
- \( F \) = Fat in churn (kg)

Factors Influencing Over-run:
1. Inaccuracy in weighing of milk, cream or butter
2. Inaccuracy in fat testing of the samples of milk, cream or butter
3. Fat losses in skim milk and butter milk
4. Fluctuation in fat content of butter
5. Weight allowance in butter packages
6. Handling losses

Additional information:

The weight of butter obtained from a given lot of cream is always more than the amount of fat present in cream. The amount of butter, which exceeds the amount of fat present in cream is called overrun. It is a source of profit to the manufacturer and also helps to check the efficiency of the working of the plant. There are several types of overrun which include: i) Theoretical: Theoretically, maximum obtainable overrun in butter is 25% because 80 kg fat yields 100 kg of butter as per PFA standard. ii) Compositional: It is based on the composition of butter and varies according to the fat content in butter. iii) Factory: It is calculated on the basis of total packed butter and total fat received in the factory for butter-making. iv) Churn: This is calculated for a particular type of churn

Desi butter- FSSAI definition, Standards, preparation:
Definition: The butter obtained by traditional process of churning dahi or malai as practiced at domestic levels.

Preparation:
- Milk will be cultured and kept for overnight for fermentation. Resultant curd was churned using hand driven wooden beaters to separate the milk fat in the form of desi butter.
- Some follow slightly different method wherein milk is heated continuously to about 80°C, the malai (creamy layer) that forms over the surface was collected manually. This malai is then churned to get the desi butter.

LEARNING OUTCOME

3.3.3 Analyze and standardize different types of Ghee, Identify different methods of manufacture, Identify and analyze Agmark standards, Identify and analyze packaging and storage of ghee, Test the ghee and identify the adulterants and Analyze and standardize butter oil.

CONCEPT
- Definition of ghee
- Composition
- FSSAI standards
- Agmark grading of ghee and Agmark standards
- Packaging and storage of ghee
- Adulterants in Ghee
- Butter oil -definition and composition
As per FSSAI, Ghee means the pure clarified fat derived solely from milk or curd or from desi (cooking) butter or from cream to which no colouring matter or preservative has been added.

**Composition:**

milk fat: 99 to 99.5%, moisture: not more than 0.5%

**Additional knowledge:**

Ghee is a complex lipid of glycerides, free fatty acids, phospholipids, sterols, sterol esters, fat soluble vitamins, carbonyls, hydrocarbons, carotenoids.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Cow milk ghee</th>
<th>Buffalo milk ghee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (%)</td>
<td>99 – 99.5</td>
<td>99 – 99.5</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Carotene (mg/g)</td>
<td>3.2-7.4</td>
<td>-</td>
</tr>
<tr>
<td>Vitamin A (IU/g)</td>
<td>19-34</td>
<td>17-38</td>
</tr>
<tr>
<td>Cholesterol (mg/100g)</td>
<td>302 – 362</td>
<td>209 – 312</td>
</tr>
<tr>
<td>Tocopherol (mg/g)</td>
<td>26 – 48</td>
<td>18 – 31</td>
</tr>
<tr>
<td>Free fatty acid (%)</td>
<td>2.8</td>
<td>2.8</td>
</tr>
</tbody>
</table>

**Methods of Preparation:**

The principle involved in ghee preparation include;

1. Concentration of milk fat in the form of cream or butter.
2. Heat clarification of fat rich milk portion and thus reducing the amount of water to less than 0.5%.
3. Removal of the curd content in the form of ghee residue.

There are five methods of ghee making:

i. Desi or Indigenous Method
ii. Direct Cream Method
iii. Creamery Butter Method
iv. Prestratification Method
v. Continuous Method

1. **Desi Method**

This was the practice from age-old days in rural areas where excessive milk will be cultured and kept for overnight for fermentation. Resultant curd was churned using hand driven wooden beaters to separate the milk fat in the form of desi butter. Some follow slightly
different method wherein milk is heated continuously to about 80°C, the malai (creamy layer) that forms over the surface was collected manually. This malai is then churned to get the desi butter. After collection of desi butter over a period of time, this butter is melted in a metal pan or earthenware vessel on an open fire. Extent of frothing is an index to judge when to terminate heating. Heating should be stop when sudden foaming appears and leave the contents undisturbed after heating. Curd particles starts settling down over a period of time and decant the clear fat carefully. In this method it is possible to achieve only 75 – 85% fat recovery.

2. Direct Cream Method

This method involves separation of cream of 60 to 70% fat from milk by centrifugation process, fresh cream or cultured cream is heated to 114±2°C in a stainless steel, jacketed ghee kettle. This kettle is fitted with an agitator, steam control valve, pressure and temperature gauges. A movable hollow stainless tube centrally bored for emptying out the contents or alternatively provision can be made for tilting device on the ghee kettle to decant the product. Heating is discontinued as soon as the colour of the ghee residue turns to golden yellow or light brown. Usually, first plenty of effervescence accompanied by a crackling sound in the preliminary stages of boiling but both gradually subsides when the moisture content decreases. When almost all the moisture is evaporated, the temperature of the liquid medium suddenly shoots up and care has to be exercised at this stage to control the heating. The end point is indicated by the appearance of second effervescence, which is smaller than the first one accompanied by the browning of curd particles. At this stage the typical ghee flavour emanates and this indicates that the final stage in the preparation of ghee.

3. Creamery Butter Method

This is the standard method adopted in most of the organized dairies. Unsalted or white butter is used as raw material. Butter mass or butter blocks are melted at 60°C to 80°C in butter melter. Molten butter is pumped into the ghee boiler where final heating will be done using steam as heating medium. Increase the steam pressure to raise the temperature. Scum which is forming on the top of the surface of the product is removed from time to time with the help of perforated ladle. Moment of disappearance of effervescence, appearance of finer air bubbles on the surface of the fat and browning of the curd particles indicates to stop heating. At this stage typical ghee aroma is produced. Final heating temperature is adjusted to about 114±2°C. To get the cooked flavour, heating beyond this temperature is also being in practice. Ghee is filtered via oil filter into the settling tank.

4. Pre-Stratification Method

Butter is produced from aged cream of 38 to 40% fat using continuous butter making machine or batch churn. Butter is then transferred to butter melter, and melt at 80°C. This molten butter is kept undisturbed in a ghee kettle or boiler at a temperature of 80-85°C for 30 min. Here, in ghee kettle, stratification of mass takes place, product stratifies into 3 distinct layers. Denatured protein particles (curd particles) and impurities are collected on top layer and floats on surface. Middle layer consists of clear fat and bottom layer consists of
buttermilk serum carrying 80% of moisture and 70% of solods-not-fat contained in butter.

The bottom layer is then carefully removed without disturbing the both top and middle layers. Middle layer, largely consists of fat is heated to 114±2°C along with top layer of floating curd particles and denatured protein. This step is necessary to develop characteristic ghee aroma. Milder flavour ghee can be produced, since most of the curd content is removed before final clarification temperature of ghee.

**Grading of Ghee:**

The quality of ghee can be judged by physical and chemical analysis. Customer can only perceive appearance, taste and aroma of ghee. Therefore grading i.e. classification according to its quality and purity is necessary to assure the customer. The Agricultural Produce (Grading & Marking) Act, 1936 empowers the Central Government to fix quality standards, known as ‘AGMARK’ standards and to prescribe terms and conditions for using the seal of ‘AGMARK’. The word 'AGMARK’ is a derivative of "Agricultural Marketing".

<table>
<thead>
<tr>
<th>Grade</th>
<th>Letter and Circular bordercolour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special</td>
<td>Red</td>
</tr>
<tr>
<td>General</td>
<td>Green</td>
</tr>
<tr>
<td>Standard</td>
<td>Chocolate</td>
</tr>
</tbody>
</table>

**Additional knowledge:**

- The labels shall be printed on the watermark paper of the Government of India and shall have a micro tint back ground bearing the words ‘Government of India’ in olive green color
- Each label shall have printed thereon a serial number along with a letter or letters denoting the series, e.g. A054987.
- Each label shall have printed thereon the approximate weight content of the package on which it is affixed.
Adulterants in Ghee:

Adulteration of ghee in India is more prevalent especially in unorganized sector. Being the most expensive fat people started to adulterate the product to make profits. Major adulterants of ghee are as follows:

i). Vanaspati (Hydrogenated vegetable oil). Because of close resemblance in its texture most commonly used this as adultrant to ghee.

ii). Refined (de-odourized) vegetable oil- E.g. Ground nut, coconut, cottonseed oils, etc

iii). Animal body fat.

Government has made it compulsory that all Vanaspati must contain a maximum of 5% of Sesame oil which can be identified in ghee by a simple colour test (known as Baudouin test). By means of this Adultration of ghee with Vanaspatiti an extent of 3% can be detected.

Packaging and storage of ghee:

Ghee should be filled upto the brim in a rust free tin cans/container for bulk packing. Regular pack sizes available in the market are 15 lit, 5 lit, 1 lit and 500 ml. Self standing laminates are used for 14 lit and 500 ml packs which have barrier to moisture, air and light. Exposure of ghee to sunlight for a long time also causes oxidation and produce off flavors in the ghee.

Ghee has a long keeping quality; it can be stored for 6 to 12 months under ambient temperature provided proper packaging and filling. At higher temperature of storage,
development of oxidized flavor especially with ghee which has appreciable initial acidity is more pronounced. At Lower (refrigerated) temperature storage, although it delays acid development there by prolongs shelf life but it imparts greasy and pasty texture to ghee. So, storage temperature of 21°C is recommended. Ghee can be stored up to 12 months at 21°C.

**Butter oil** - definition and composition

Butter oil/ anhydrous milk fat/ dry butter fat/ dehydrated butter fat/milk fat refers to the fat-concentrate obtained mainly from butter or cream by the removal of practically all the water and solids-not-fat content.

**Composition:**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Butter fat</strong></td>
<td>99.5 to 99.8</td>
</tr>
<tr>
<td><strong>Moisture</strong></td>
<td>0.1 to 0.3</td>
</tr>
<tr>
<td><strong>Acidity</strong></td>
<td>0.2 to 0.5</td>
</tr>
<tr>
<td><strong>Peroxide value</strong></td>
<td>0.0 to 0.1</td>
</tr>
</tbody>
</table>

**List of Practicals**

- Methods of separation of cream-Gravitational and centrifugal.
- Preparation of butter
- Preparation of ghee

**ASSESSMENT ACTIVITIES**

- Assessment of participation in market survey on fat rich dairy products and evaluation of survey report.
- Seminar presentation
- Participation in preparation of fat rich dairy products.
- Participation in group discussion.

**LIST OF ITEMS IN PORTFOLIO**

- Survey report.
- Photography of preparation of products.
- Seminar report.

**TE Questions**

1. The plastic cream contain approximately ..............% of milk fat (25%, 50%, 65%) (1)
2. According to FSSAI rule butter should contain a minimum of …………..% of milk fat (50%, 80%, 99%)  (1)

3. Distinguish : (3)

   (a) Ripened butter and unripened butter  
   (b) Frozen cream and sterilized cream  
   (c) Red label ghee and green label ghee  

4. One of the dairy magazine invited articles on the production of various milk products. You decided to send an article on the three methods of the preparation of ghee – Creamery butter method, prestratification method and direct cream method. Prepare an article.  (4)

5. During the dairy plant visit you may have seen cream separator. List out the main parts of cream separator with their diagrams.

   6. During dairy plant visit you may have noticed the working of cream separator. Can you explain the principle behind its working?

Unit 3.4: Condensed and Dried Milks

The commercially successful manufacture of condensed milk was initiated by the American, Gail Borden, who is known as ‘the father of the process of milk condensing’. Sweetened condensed milk is milk that is concentrated by evaporation, to which sucrose is added to form an almost saturated sugar solution, after which it is packed. The high sugar concentration is primarily responsible for the keeping quality of the product and for its fairly long shelf life.

Dry milk production has become an increasingly important segment of the dairy industry which is expected to grow further because of its features such as better keeping quality, less storage space, and lower transportation costs which result in attractive economics. Various names have been applied to the same dry milk product. For example, nonfat dry milk also has been called skim milk powder, dried skim milk, nonfat dry milk solids, and dehydrated skim milk. Dry whole milk, dry cream, dry buttermilk, and others frequently are called dried or powdered whole milk, etc., according to their identities.

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/CONCEPT/ SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
</table>
| Condensed milk       | The learner will be able to: | • Dairy plant visit  
|                      |                    | • Analyze and standardize sweetened condensed  
|                      |                    | • Interactive lectures  
|                      |                    | • Instructiona  | • Tests/quiz  
|                      |                    |                      | • Records  
|                      |                    |                      | • Survey report  |
### UNIT IN DETAIL

#### LEARNING OUTCOME

3.4.1 Analyze and standardize sweetened condensed milk, Classify different types of condensed milk and Prepare sweetened condensed milk

#### CONCEPT

- FSSAI definition and standards of sweetened condensed milk
- sweetened condensed skim milk, Evaporated milk, Evaporated skim milk
- preparation of sweetened condensed milk

#### Dried Milks:

- Milk powder (whole milk powder and skim milk powder)
- Baby food
- Malted milk
- FSSAI definition and standards

#### SKILLS:

- Data collection skill
- Observation skill
- Analyzing skill

#### Dried Milks:

- Identify and categorize different types of milk powders, baby foods etc.
- Identify FSSAI standards.

#### SKILLS:

- Data collection skill
- Observation skill
- Analyzing skill

<table>
<thead>
<tr>
<th>sweetened condensed skim milk, Evaporated milk, Evaporated skim milk</th>
<th>Preparation of sweetened condensed milk</th>
<th>SKILLS:</th>
<th>Dried Milks:</th>
<th>SKILLS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>milk.</td>
<td>Classify different types of condensed milk.</td>
<td>Data collection skill</td>
<td>Milk powder (whole milk powder and skim milk powder)</td>
<td>Identify and categorize different types of milk powders, baby foods etc.</td>
</tr>
<tr>
<td></td>
<td>Prepare sweetened condensed milk.</td>
<td>Observation skill</td>
<td>Baby food</td>
<td>Identify FSSAI standards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analyzing skill</td>
<td>Malted milk</td>
<td>Pictures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FSSAI definition and standards</td>
<td>market survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dairy plant visit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Videos</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tests/quiz</td>
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<tr>
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<td></td>
<td></td>
<td>Records</td>
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<td></td>
<td></td>
<td>album</td>
</tr>
</tbody>
</table>

- Visit report.
Definition of sweetened condensed milk:
As per FSSAI it is the product obtained by partial removal of water from milk of Cow and/or Buffalo with the addition of sugar or a combination of sucrose with other sugars or by any other process which leads to a product of the same composition and characteristics. The fat and/ or protein content of the milk may be adjusted by addition and / or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall have pleasant taste and flavour free from off flavour and rancidity. It shall be free from any substance foreign to milk. It may contain added refined lactose, calcium chloride, citric acid and sodium citrate, sodium salts of ortho-phosphoric acid and poly-phosphoric acid not exceeding 0.3% by weight of the finished product. It should contain not less than 9% milk fat, not less than 31% total milk solids and not less than 40% cane sugar.

Definition of sweetened skim milk:
As per FSSAI it is the product obtained by partial removal of water from skim milk with the addition of sugar or a combination of sucrose with other sugars or by any other process which leads to a product of the same composition and characteristics. The fat and/ or protein content of the milk may be adjusted by addition and / or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall have pleasant taste and flavour free from off flavour and rancidity. It shall be free from any substance foreign to milk. It may contain added refined lactose, calcium chloride, citric acid and sodium citrate, sodium salts of ortho-phosphoric acid and poly-phosphoric acid not exceeding 0.3% by weight of the finished product. It should contain not less than 26% total milk solids and not less than 40% cane sugar. The fat content should not exceed 0.5% by weight.

Definition of evaporated milk:
As per FSSAI it is the product obtained by partial removal of water from milk of cow and/ or buffalo by heat or any other process which leads to a product of the same composition and characteristics. The fat and protein content of the milk may be adjusted by addition and/ or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall have pleasant taste and flavor, free from off flavour and rancidity. It shall be free from any substance foreign to milk. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of ortho-phosphoric acid and poly-phosphoric acid not exceeding 0.3% by weight of the finished product. It should contain not less than 8% milk fat and not less than 26% total milk solids.

Definition of evaporated skim milk:
As per FSSAI it is the product obtained by partial removal of water from skim milk by heat or any other process which leads to a product of the same composition and characteristics. The fat and protein content of the milk may be adjusted by addition and/ or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall have pleasant taste and flavor, free from off flavour and rancidity. It shall be free from any substance foreign to milk. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of ortho-phosphoric acid and poly-phosphoric acid not exceeding 0.3% by weight of the finished product. It
should contain not less than 20% total milk solids. The fat content should not exceed 0.5% by weight.

**Preparation of sweetened condensed milk:**

The basic principle in the production of condensed and evaporated milk is that high quality milk is filtered, standardized, fore warmed and condensed/evaporated to the desired level. The concentrated product is preserved by the addition of sugar for condensed milk and by heat sterilization for evaporated milk.

**Flow Diagram**

```
Receiving milk
Filtration/clarification (38-40°C)
Standardization
Fore warming/pre-heating (115-118°C/no hold)
Addition of sugar
Condensing (2.5:1)
Homogenization
Cooling and crystallization
Packaging
Storage (10°C)
```

**Sweetened condensed milk**

**Details of manufacture**

Basic principle: The basic principle in the production of condensed/ evaporated milk is that high quality milk is filtered/ clarified, standardized, forewarmed and condensed/ evaporated
to the desired level. The condensed product is preserved by the addition of sugar for condensed milk and by heat-sterilization for evaporated milk.

(a) **Receiving milk:** when milk is received at the plant, its temperature should be at 10°C or below. The milk should be clean, sweet, free from off-flavours and odours. No abnormal milk should be accepted.

The main platform and laboratory tests are clot-on-boiling and Alcohol tests to determine its acceptance for condensing.

- **Alcohol test:** 5ml of milk is placed in a test tube and an equal amount of solution with 68% alcohol is added. The mixture is shaken and any formation of clot/ flakes denotes a positive test, i.e. the milk is susceptible for heat coagulation. This test detects: abnormal milk which is high in mineral salts, developed acidity in milk, mastitis milk likely to sweet curdling etc.
- **Clot-On-Boiling test:** 5ml of milk is placed in a test tube and kept in a boiling water bath for 5 minutes. If curd is observed, the milk is said to fail the COB test and should be rejected.

After the milk has been accepted on the basis of Alcohol and COB tests, it is weighed, sampled and tested for fat, SNF etc.

(b) **Filtration/ clarification:** This is done in order to remove visible foreign matter. The milk is generally pre-heated to 35-40°C to increase the efficiency of the operation.

(c) **Standardization:** This is done so as to conform to legal standards in the finished product.

(d) **Forewarming/ preheating:** This refers to heating of milk before it is condensed. The temperature-time of forewarming/ pre-heating extends over a wide range, such as 82 to 93°C for 5 to 15 minutes. The temperature-time for HTST is 115 to 118°C for No-Hold/ Flash.

(e) **Addition of sugar:** sugar is added for the purpose of preserving the condensed milk without resorting to sterilization by heat. The amount of sugar in the finished product ranges from 40 to 45%. Sugar is added at the end of the condensing process.

(f) **Condensing:** The basic principle consists in the removal of water from the standardized milk by boiling it under partial vacuum at a low temperature till the desired concentration is reached. The chief advantage of condensing milk in vacuum are: economy of operation, rapidity of evaporation and protection of milk against heat damage.

(g) **Homogenization:** The object is to obtain a uniform fat emulsion and reduce fat separation to a minimum during storage. A special type of homogenizer suitable for handling a highly viscous product is used at a total pressure is used at a total pressure of 2500 psi.

**Cooling and crystallization:** A considerable portion of lactose content in the condensed milk held at ordinary temperature is present in crystal form. The relative smoothness of condensed milk is controlled by the number and size of the lactose crystals it contain. The size of lactose
crystals is controlled by the procedure used for cooling the condensed milk. Rapid crystallization leads to the formation of a large number of small crystals, giving a smooth texture to the condensed milk; on the other hand, slow crystallization creates a small number of crystals which produce a sandy or gritty texture. Cooling of the product may be continued slowly to 24°C. This should take approximately an hour. Then the cooling is completed to 13-18°C with continued agitation. The rate of crystal formation is controlled by the amount of agitation, number of nuclei, total solids in the product, temperature and viscosity.

(i) Packaging and storage:
Bulk packaging may be done in barrels of various sizes, drums with polythene liners or tin containers. For the retail market, fillers are used to package milk in cans. After filling, the cans are sealed, labelled and packed in cases for storage and distribution. During storage, a wide temperature variation may increase the tendency to sandiness. Cool storage is important to prevent changes in viscosity. Temperature of 10°C is recommended for the storage of sweetened condensed milk.

**Evaporated milk**

Evaporated Milk means the product obtained by partial removal of water from milk of cow and/or buffalo by heat or any other process which leads to a product of the same composition and characteristics. The fat and protein content of the milk may be adjusted by addition and/or withdrawal of milk constituents in such away as not to alter the whey protein to casein ratio of the milk being adjusted. It shall have pleasant taste and flavor free from of flavour and rancidity. It shall be free from any substance foreign to milk. It shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Evaporated milk</th>
<th>Evaporated skimmed milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat</td>
<td>Not less than 8%</td>
<td>Not more than 1%</td>
</tr>
<tr>
<td>Total milk solids</td>
<td>Not less than 26%</td>
<td>Not less than 26%</td>
</tr>
<tr>
<td>Milk protein in milk solids not fat</td>
<td>Not less than 34%</td>
<td>Not less than 34%</td>
</tr>
</tbody>
</table>

**LEARNING OUTCOME**

3.4.2 Identify and categorize different types of milk powders, baby foods etc and Identify FSSAI standards.

**CONCEPT**

FSSAI definition and standards of:
- Milk powder (whole milk powder and skim milk powder)
- Baby food
- malted milk

**Definition of whole milk powder:**

As per FSSAI it is the product obtained by partial removal of water from milk of Cow and/or Buffalo. The fat and/or protein content of the milk may be adjusted by addition and/or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall be of uniform colour and shall have pleasant taste and flavour free from off flavour and rancidity. It shall also be free from vegetable oil/fat, mineral oil, thickening agents, added flavour and sweetening agent. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of ortho-phosphoric acid and poly-phosphoric acid not exceeding 0.3% by weight of the finished product. The milk powder should contain not more than 5% moisture and not less than 26% milk fat.

**Definition of skim milk powder:**

As per FSSAI it is the product obtained by partial removal of water from skim milk. The fat and/or protein content of the milk may be adjusted by addition and/or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall be of uniform colour and shall have pleasant taste and flavour free from off flavour and rancidity. It shall also be free from vegetable oil/fat, mineral oil, thickening agents, added flavour and sweetening agent. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of ortho-phosphoric acid and poly-phosphoric acid not exceeding 0.3% by weight of the finished product. The skim milk powder may not contain more than 1.5% milk fat and moisture may not exceed 5%.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Whole milk powder</th>
<th>Skimmed milk powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>Not more than 4%</td>
<td>Not more than 5%</td>
</tr>
<tr>
<td>Milk fat</td>
<td>Not less than 26%</td>
<td>Not more than 1.5%</td>
</tr>
<tr>
<td>Milk protein in milk solids not Fat</td>
<td>Not less than 34%</td>
<td>Not less than 34%</td>
</tr>
<tr>
<td>Titratable acidity (ml D.N NaOH/10gm solids not fat)</td>
<td>Not more than 18.0</td>
<td>Not more than 18.0</td>
</tr>
<tr>
<td>Insolubility Index</td>
<td>Not more than 2ml</td>
<td>Not more than 2ml</td>
</tr>
<tr>
<td>Total ash on dry weight basis</td>
<td>Not more than 7.3%</td>
<td>Not more than 8.2%</td>
</tr>
</tbody>
</table>

Infant Milk Food means the product prepared by spray drying of the milk of cow or buffalo or amixture there of. The milk may be modified by the partial removal/substitution of different milk solids; carbohydrates, such as sucrose, dextrose and dextrins/maltodextrin, maltose and lactose; salts like phosphates and citrates; vitamins A, D, E, B Group, Vitamin C and other vitamins; and minerals like iron, copper, zinc and iodine. The product shall be free of lumps and shall be uniform in appearance. It shall be free from starch and added antioxidants. It shall also be free from dirt, extraneous matter, preservatives and added colour and flavor and from any material which is
harmful to human health. It shall not have rancid taste or must yodour. It shall not contain food additives. It shall be packed in hermetically sealed, clean and sound containers or in flexible packs made from film or combination or any of the substrates made of Board paper, polyethylene, polyester metallised film or in such a way to protect from deterioration. It may be packed in nitrogen or a mixture of nitrogen and carbon dioxide.

As per FSSAI, it shall conform to the following requirements, namely:

1. Moisture, percent by weight (not more than) 4.5
2. Total milk protein, percent by weight (not less than) 12.0
3. Milk fat, percent by weight (not less than) 18.0
4. Total ash, percent by weight (not more than) 8.5
5. Ash insoluble in dilute Hydrochloric acid, percent by weight (not more than) 0.1
6. Solubility:
   Solubility Index maximum 2.0 ml
   Solubility percent by weight (not less than) 98.5
7. Vitamin A (as retinol) ìg per 100 g (not less than) 350 ìg
8. Added Vitamin D (expressed as Cholecalciferol or Ergocalciferol) ìg per 100 g (not less than) 4.5 ìg
9. Vitamin C, mg per 100 g (not less than) 35 ìg
10. Thiamine, ìg per 100 g (not less than) 185 ìg
11. Riboflavin, ìg per 100 g (not less than) 275 ìg
12. Niacin, ìg per 100 g (not less than) 1160 ìg
13. Pyridoxine, ìg per 100 g (not less than) 160 ìg
14. Folic acid, ìg per 100 g (not less than) 20 ìg
15. Pantothenic acid, mg per 100 g (not less than) 1.4 mg
16. Vitamin B12, ìg per 100 g (not less than) 0.7 ìg
17. Choline, mg per 100 g (not less than) 32 mg
18. Vitamin K, ìg per 100 g (not less than) 18 ìg
19. Biotin, ìg per 100 g (not less than) 7.0 ìg
20. Sodium, mg per 100 g (not less than) 90 mg
21. Potassium, mg per 100 g (not less than) 370 mg
22. Chloride, mg per 100 g (not less than) 250 mg
23. Calcium, mg per 100 g (not less than) 230 mg
24. Phosphorous, mg per 100 g (not less than) 115 mg
25. Magnesium, mg per 100 g (not less than) 22 mg
26. Iron, mg per 100 g (not less than) 5.0 mg
27. Iodine, ìg per 100 g (not less than) 20 ìg
28. Copper, ìg per 100 g (not less than) 280 ìg
29. Zinc, mg per 100 g (not less than) 2.5 mg
   and not more than 5.0 mg
30. Manganese, ìg per 100 g (not less than) 202.5 mg
31. Selenium, ìg per 100 g (not less than) 14 ìg
32. Bacterial count, per gram (not more than) 10,000
33. Coliform count, absent in 0.1 gram
Yeast and mould count absent in 0.1 gram
Salmonella and Shigella absent in 25 gram
E. coli absent in 0.1 gram
Staphylococcus aureas absent in 0.1 gram

Definition of malted milk powder:

As per FSSAI it is the product obtained by mixing whole milk, partly skimmed milk or milk powder with the wort separately from a mash of ground barley malt, any other malted cereal grain and wheat flour or any other cereal flour or malt extract with or without addition of flavouring agents and spices, emulsifying agents, eggs, protein isolates, edible common salt, sodium or potassium bicarbonate, minerals and vitamins and without added sugar in such a manner as to secure complete hydrolysis of starchy material and prepared in a powder or granule or flake form by roller drying, spray drying, vacuum drying or by any other process. It may contain cocoa powder. It shall be free from dirt and other extraneous matter. It shall not contain any added starch (except starch natural to cocoa powder) and added non-milk fat. It shall not contain any preservative or added colour. Malted milk food containing cocoa powder may contain added sugar.

Composition of malted milk powder

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>3.29 %</td>
</tr>
<tr>
<td>Fat</td>
<td>7.55 %</td>
</tr>
<tr>
<td>Protein</td>
<td>13.19 %</td>
</tr>
<tr>
<td>Lactose</td>
<td>72.4 %</td>
</tr>
<tr>
<td>Ash</td>
<td>3.66 %</td>
</tr>
</tbody>
</table>

ASSESSMENT ACTIVITIES

- Dairy plant visit to study the large scale preparation of different products and assessment of participation in activities and evaluation visit report.
- Assessment of participation in market survey and evaluation of survey report.
- Participation in preparation of fat rich dairy products.
- Participation in group discussion.
- Practical examination.
LIST OF ITEMS IN PORTFOLIO

- Dairy plant visit report
- Practical evaluation records.
- Photography of preparation of different products.
- Practical records
- survey report

TE Questions

1. Distinguish sweetened skim milk and evaporated skim milk
   (2)
2. Distinguish infant food and malted milk powder
   (2)
3. Following are hints regarding the preparation of sweetened condensed milk
   (4)
   - Condensing milk
   - Cooling and crystallization
   - Addition of sugar

   Based on the hints, design a flow diagram for the production of sweetened condensed milk. Remember to put necessary specifications where ever necessary.

4. Match the following
   (5)

<table>
<thead>
<tr>
<th></th>
<th>Fat%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweetened condensed milk</td>
<td>Not less than 26</td>
</tr>
<tr>
<td>Sweetened condensed skim milk</td>
<td>Not less than 9</td>
</tr>
<tr>
<td>Evaporated milk</td>
<td>Not more than 0.5</td>
</tr>
<tr>
<td>Whole milk powder</td>
<td>Not more than 1.5</td>
</tr>
<tr>
<td>Skim milk powder</td>
<td>Not less than 8</td>
</tr>
</tbody>
</table>

5. Complete the flow diagram for the preparation of sweetened condensed milk (4)

   Receiving milk
   ↓
   ....................(a)....................
   ↓
   Standardization
   ↓
   Fore warming/pre-heating (.........(b).......°C/no hold)
   ↓
   ....................(c)....................
   ↓
   Condensing (......(d)......:1)
6. You are asked to draw the flow diagram for preparation of condensed milk on the wall of product room of a dairy plant. Demonstrate how you will do it.

UNIT 3.5: CHEESE

Cheese is produced in wide-ranging flavors, textures, and forms. Cheese consists of proteins and fat from milk, usually the milk of cows, buffalo, goats, or sheep. It is produced by coagulation of the milk protein casein. Typically, the milk is acidified and addition of the enzyme rennet causes coagulation. Additional ingredients may be added to some cheeses, such as black peppers, garlic, chives or cranberries.

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheese:</td>
<td>The learner will be able to:</td>
<td>Instructional lectures, visual media, visit to a dairy plant, picture/diagram</td>
<td>Seminar, group discussion, chart preparation</td>
</tr>
<tr>
<td>• FSSAI Definition with standards</td>
<td>• Identify different cheeses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Popular varieties</td>
<td>• Categorize different cheeses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preparation of cheddar cheese</td>
<td>• Understand Preparation of cheddar cheese, cottage cheese, processed cheese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preparation of cottage cheese</td>
<td>• Identify uses of cheese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preparation of processed cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Uses of cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKILLS:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Observation skill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Understanding skill</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LEARNING OUTCOME

3.5.1 The learner will be able to, Identify different cheeses, categorize different cheeses, understand Preparation of cheddar cheese, cottage cheese, processed cheese, Identify uses of cheese

CONCEPT

- FSSAI Definition of cheese with standards
- Popular varieties
- Preparation of cheddar cheese
- Preparation of cottage cheese
- Preparation of processed cheese
- Uses of cheese

FSSAI Definition of cheese with standards

"Cheese" means the ripened or unripened soft or semi-hard, hard and extra hard product, which may be coated with food grade waxes or poly film and in which the whey protein/casein ratio does not exceed that of milk. Cheese is obtained by coagulating wholly or a partly milk and/or products obtained from milk through the action of non-animal rennet or other suitable coagulating agents and by partially draining the whey resulting from such coagulation and or processing techniques involving coagulation of milk or products obtained from milk which gave a final product with similar physical, chemical and organoleptic characteristics.

Popular varieties:

1. Soft cheese, eg:- cream cheese,
2. Semi hard cheese, eg:- limberger cheese, brick cheese
3. Hard cheese, eg:- cheddar, romano, parmesan, edam, gouda, swiss, emmental
4. External mould cheese, eg:- camembert
5. Internal mould cheese, eg:- stiltol, Roquefort
Preparation of cheddar cheese

Receiving milk
   ↓
pre-heating(35-40ºC)
   ↓
filtration/clarification
   ↓
standardization
   ↓
pasteurization(63ºC/30 min)
   ↓
adding starter/ripening(31ºC @ 0.5-1%)
   ↓
Addition of colour(30-200 ml/1000 Kg milk)
   ↓
Renneting(31ºC 15-25 ml/100 L milk)
   ↓
coagulation/setting
   ↓
cutting
   ↓
cooking(37-39ºC)
   ↓
drainage of whey
   ↓
cheddaring
Details of Manufacture:

**Receiving and Filtration of milk:**
Good quality milk is taken and filtered (35-40°C) to remove dirt and other suspended particles.

**Standardization:**
Standardization refers to adjustment of the casein/fat ratio in cheese milk to 0.68-0.70. The objective is to regulate the fat in the finished product and to produce maximum amount of cheese per Kg of fat in cheese milk.

**Pasteurization:**
LTLT/HTST pasteurization of cheese milk can be done. The objectives are

1. To destroy all the pathogens.
2. To destroy all spoilage causing microorganisms.

**Addition of starter culture:**
The starter culture is the “heart” of cheese. Good quality lactic starter culture is added @0.5-1.0% at 31°C. After addition of starter, it is mixed well and kept at the same temperature till the pH is reduced to therenneting pH.

**Addition of colour:**
When colour is used, it should be added just before renneting. The usual amount is 30 to 200 ml for 1000 Kg of milk. The colour is diluted with approximately 20 times its volume of potable water.

**Renneting:**
Adding rennet enzyme to cheese is called Renneting.

**Rennet:**
Rennet is a crude preparation containing two enzymes- rennin and pepsin. It is obtained from the fourth or true stomach (abomasum) of the young calf known as “vell”. The new name of Rennet is “Chymosin”. Rennin is a powerful clotting enzyme, which causes rapid clotting. Rennet is available in powder/ liquid form. 15-25 ml is added to about 100 L milk. Rennet is diluted with 20-40 times its volume of potable water before addition and mixed thoroughly for uniform distribution. There are also other rennet preparations, other than calf rennet like plant rennet, bacterial rennet etc.

**Coagulation:**

After thorough addition of rennet, the cheese milk is kept undisturbed for clot formation. When a sanitized glass rod is inserted at a 45° angle, and lifted straight up, there should be a clean break in the curd. It is the right time for cutting the curd.

**Cutting the curd:**

Horizontal and vertical knives are used for cutting the cheese curd. They are metal wires/ plates arranged horizontally or vertically at equal distance apart on a rectangular frame. They cut the coagulum into uniform cubes. The curd is usually first cut with the horizontal knife lengthwise and then with the vertical knife lengthwise and widthwise.

**Cooking and drainage of whey:**

The cheese curd is slowly cooked to 37-39°C at the rate of 1°C every 4 minutes. Cooking is done for expulsion of further whey from within the curd cubes. After cooking, the whey is drained out.

**Cheddaring**

It is a step which involves a series of operations consisting of packing, turning, piling and re-piling the slabs of matted curd. This process of piling and re-piling is repeated every 15 min. This process squashes the individual curd particles as well as releases more whey. In this process, the curd granules fuse under gravity into solid blocks. Rapid matting of the curd particles occurs under the combined effect of heat and acid. The original rubber-like texture gradually changes into a close-knit texture (‘chicken breast’ structure, typical of Cheddar cheese) with the matted curd particles becoming fibrous. When the acidity of whey reaches 0.45-0.50% lactic acid, cheddaring is complete.

**Milling:**

The cheddar cheese curd is cut into small pieces with the help of cheese mill. This is to facilitate uniform distribution of salt in the next step.

**Salting:**

Common salt is added to give good flavor, body and texture and to
improve the keeping quality of the finished product. Salt is added @ 1-2% of the curd in the cheese vat.

**Hooping:**

The curd is placed in hoops/moulds in which the cheese curd is pressed into final shape.

**Dressing:**

This refers to the arrangement of the cheese cloth before and after pressing, removing all wrinkles and giving final perfect shape.

**Pressing:**

The cheese curd is pressed in a cheese press. The average pressure is around 70psi for round and 25 psi for square hoops for 30-60 minutes. The whey is further expelled and whey pockets are filled with curd.

**Drying:**

The cheese blocks are dried at 12-16°C at 50% Relative Humidity. This is for the rind formation in cheese.

**Paraffining:**

This involves dipping the cheese for a few seconds in a bath of melted paraffin (104-121°C), whereby a thin coating of paraffin is applied to the surface of the cheese. Paraffining is done to protect cheese from insects, to prevent mould growth and to reduce loss of moisture during curing/ripening.

**Ripening/ Curing / Maturing:**

This refers to storage of cheese for at least 2 to 3 months at a low temperature (0-16°C) at 75-85 % RH, during which its physical, chemical and bacteriological properties are changed, resulting in the characteristic flavor, body and texture of cheese.

**Preparation of cottage cheese**

According to Food Safety and Standard Regulations 2011, *Cottage Cheese* means soft unripened cheese obtained by coagulation of pasteurised skimmed milk of Cow and/or Buffalo or mixtures thereof with cultures of harmless lactic acid bacteria with or without the addition of other suitable coagulating enzymes. Creamed Cottage Cheese is cottage cheese to which a pasteurised creaming mixture of cream, skimmed milk, condensed milk, non-fat dry milk, dry milk protein, Sodium/ Potassium/ Calcium/ Ammonium caseinate is added. It shall have a soft texture with a natural white colour. It may contain spices, condiments, seasonings and fruits pulp. It shall conform to the following requirements:—
Flow diagram for manufacture of cottage cheese

Receiving pasteurized skim milk
↓
Adding calcium chloride
↓
Adding starter
↓
Adding rennet
↓
Setting
↓
Cutting
↓
Cooking
↓
Draining of whey
↓
Washing and draining the curd
↓
Salting
↓
Creaming
↓
Packaging and storage.

Preparation of processed cheese

Processed cheese refers to a product obtained by heating cheese with permitted emulsifiers and/or stabilizers, viz. citric acid, sodium citrate, sodium salts of orthophosphoric and polyphosphoric acid, with or without added condiments and acidifying agents, viz. lactic acid, vinegar, phosphoric acid and citric acid.

Flow diagram for manufacture of processed cheese

Receiving raw cheese
↓
Analyzing
↓
Selecting for blending
Tempering and cleaning  
↓  
Quartering and grinding  
↓  
Processing  
↓  
Packaging  
↓  
Cooling and storage  

**Uses of cheese**

i. Direct consumption as such or in sandwiches  
ii. In the preparation of special dishes like pizza  
iii. In the preparation of sauce  

**List of practicals**

- Preparation of cheddar cheese.  
- Preparation of cottage cheese.  
- Preparation of processed cheese.  

**ASSESSMENT ACTIVITIES**

- Seminar presentation on FSSAI standards different verities of cheese and its preparation  
- Group discussion  
- Chart preparation on the method of preparation of cheese  

**LIST OF ITEMS IN PORTFOLIO**

- Seminar report  
- Charts prepared by students.  

**TE Questions**

1. A market survey is conducted to analyze the popular varieties of cheese. Give three varieties of cheese with an example. (3)  
2. You are invited as a Interviewer to conduct an Interview for the post of Technical Superintendent in the processed cheese unit. In the context prepare 6 questions to check the candidates knowledge about the production techniques of processed cheese.  
3. Skim milk, starter culture, CaCl2, Rennet  
   Suggest a product that can be prepared from the above row materials in a cheese manufacturing industry. Explain the process of
manufacturing the product width the help of a flow diagram.

4. Distinguish the production of processed cheese and cottage cheese

5. Cottage cheese is a soft unripened variety of cheese made from ............... to which some cream and salt are added.(1)

6. While visiting a Cheese plant, you have observed that a waxy coating has been applied on the surface of the cheese. Discus the significance of such coating.

7. During field visit to a cheese manufacturing plant you happen to hear the conversation between two workers Reghu and Reji:

   Reghu: I have finished turning
   Reji: OK I will do both piling and repiling

   • Identify the cheese variety
     (1)
   • Identify and explain the process
     (5)

8. During your visit to Ooty Dairy Plant you have the opportunity to watch the preparation of cheese. Your friend seeing the terms like parafinning and ripening in the study tour notes, he got confused. Help him in clarifying the doubts.

9. Differentiate between green cheese and cured/matured cheese.

10. Your teacher demonstrated the manufacture of cheese by blending cheese of different ages

   • Name this type of cheese
   • Explain its preparation

3.6: FROZEN DAIRY PRODUCTS

The production and consumption of frozen dairy products has increasing day by day. Frozen dairy products include ice cream, kulfi, sipup, ices, milk shake etc. Among these ice cream is the most popular frozen dairy product which can be mass produced and thus is widely available in developed parts of the world.

Ice cream is a sweet frozen dessert, made from milk fat and solids, sugar, flavoring, a stabilizer (usually gelatin), and sometimes eggs, fruits, or nuts. Its coldness makes it especially desirable during hot weather. Digestibility is generally high. The main function of sweeteners is to increase the acceptance of the product by making it sweet and by enhancing the pleasing creamy flavor. Because of these reasons the production and consumption of ice cream
has increasing day by day. Plain, Chocolate, fruit, nut, milk ices, ices, sherbets, fancy, moulded, novelties, softy etc are the different varieties of ice cream.

**VARIETIES OF ICE-CREAM**

**UNIT GRID**

<table>
<thead>
<tr>
<th>IDEAS/ CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE CREAM</td>
<td><em>The learner will be able to:</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• FSSAI definition and standards</td>
<td>• Diagram</td>
<td>• Records</td>
</tr>
<tr>
<td></td>
<td>• ISI recommendations</td>
<td>• Chart</td>
<td>• Tests</td>
</tr>
<tr>
<td></td>
<td>• Different varieties of ice creams – Plain, Chocolate, fruit, nut, milk ices, ices, sherbets, fancy, moulded, novelties, softy etc</td>
<td>• interactive lectures</td>
<td>• Chart</td>
</tr>
<tr>
<td></td>
<td>• Methods of manufacture with flow diagram</td>
<td>• dairy plant visit</td>
<td>• Flow diagram</td>
</tr>
<tr>
<td></td>
<td>• Role of constituents in ice cream</td>
<td>• market survey</td>
<td>• Survey report</td>
</tr>
<tr>
<td></td>
<td>• Overrun in ice cream</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**UNIT IN DETAIL**

**LEARNING OUTCOME**

3.6.1 The learner will be able to identify different standards of ice cream, Understand ISI recommendations, Identify and categorize different varieties of ice creams, Identify methods of manufacture and constituents, Measure overrun in ice creams and Preparation of ice creams.

**CONCEPT**

- FSSAI definition and standards of ice cream
- ISI recommendations
- Different varieties of ice creams – Plain, Chocolate, fruit, nut, milk ices, sherbets, fancy, moulded, novelties, softy etc
- Methods of manufacture with flow diagram
- Role of constituents in ice cream
- Overrun in ice cream

FSSAI definition and standards of ice cream:

According to the FSSAI rules, *ice cream* may be defined as a frozen product obtained from the cow or buffalo milk or a combination thereof or from cream and/or other milk products, with or without the addition of cane sugar, eggs,
fruits, fruit juices, preserved fruits, nuts, chocolate, edible flavours and permitted food colours. It may contain permitted stabilizers and emulsifiers not exceeding 0.5 per cent by weight. The mixture must be suitably heated before freezing. The ice cream should contain not less than 10% milk fat, 3.5% protein, and 36% total solids. If the ice cream contains fruits or nuts the content of milk fat may be proportionately reduced but may not be less than 8% by weight. Starch may be added to a maximum extent of 5% , with a declaration on the label.

ISI recommendations

Different varieties of ice creams – Plain, Chocolate, fruit, nut, milk ices, ices, sherbets, fancy, moulded, novelties, softy etc

Plain ice cream: An ice cream in which the total amount of the colour and flavouring ingredients is less than 5% of the volume of the unfrozen ice cream. Examples are vanilla, coffee, maple and caramel ice cream.

Chocolate: Ice cream flavoured with cocoa or chocolate. It usually contains higher sugar content viz., 16 to 17%, about 2.5 to 3.5% of cocoa and stabilizer and emulsifier. Other variants of chocolate frozen product includes chocobar (where chocolate acts as a couverture), chocolate frosties (chocolate layer containing crispies), chocochips

Fruit: Fruit Ice cream is made by adding various fruits at the time of freezing with or without additional fruit flavouring or colour. The fruits may be fresh, frozen, canned or preserved.

Nut: Ice cream containing nut meats, such as almonds, pistachio or walnut, with or without additional flavouring or colour.

Ice Milk / Milk Ice: A product similar to ice cream containing 2 -7% fat and 12-15% MSNF, sweetened, flavoured and frozen like ice cream.

Ices: Made of fruit juices, sugar and stabilizer with or without additional fruits, color, flavouring or water and frozen to the consistency of ice cream. Usually contains 28 – 30% sugar, 15-20% overrun, and no dairy products.

Sherbets: Sherbet is a product made of fruit juices, sugar, stabilizer, and milk products. It is similar to anice, except milk, either whole, skim, condensed, or powdered, or ice cream mix is used in place of all or part of the water used in ices, sherbet contains 1-2% milk fat.

Novelties: An ice cream novelty is defined as a unique single-serve portion – controlled product. Novelties include special combinations of ice cream with flavour and confections, cup items, and fancy molded items. They are usually produced by either extrusion or molding, and examples include coated ice cream bars (e.g. Mars), Coated ice cream bars on a stick (e.g. Magnum), ice cream cake, and ice cream logs (e.g. Vienetta), ice cream sandwiches, popsicles and fudgesicles.
Puddings: Ice cream containing a generous amount of mixed fruits, nut meats, and raisins, with or without liquor, spices or eggs.

Fancy moulded ice cream: It is moulded in fancy shapes and composed either of one colour and flavour of ice cream or a combination of colours and flavours or especially decorated.

Soft serve ice cream: Soft serve ice cream is a type of frozen dessert that is similar to, but softer than the ice cream. These products are sold as drawn from the freezer without hardening. It is generally lower in milk fat (3.6%) than ice cream (10-18%) and produced at a temperature of about -4°C compared to ice cream, which is stored at -15°C. A warmer temperature of soft serve ice cream allows the taste buds to detect more flavour. The air introduced into soft serve ice cream may vary from 0-60% of the volume of the finished product. The ideal acceptable air content is between 33 and 45% of volume.

![Kulfi](image)

**KULFI**

Methods of manufacture with flow diagram:

1. Selection of ingredients
2. Figuring the mix
3. Blending the mix
Pasteurization of mix (68°C/30 min)
↓
Homogenizing the mix (1st stage 2500psi, 2nd stage 500psi)
↓
Cooling of mix (0-4 °C)
↓
Ageing of mix
↓
Freezing of mix (-4 to -5 °C)
↓
Packaging of ice cream
↓
Hardening of ice cream (-23 to -29 °C)
↓
Storage of ice cream

**Selection of ingredients:**

Ice ingredients may be grouped into dairy and non dairy products. Dairy products supplies source of fat and milk solids-not-fat. Non dairy products include sweetening agents, stabilizer, emulsifier, flavour, colour, fruits, nuts etc.

1. **Dairy products**
   - Source of fat: Sweet cream, frozen cream, unsalted butter and butteroil
   - Source of milk-solids-not-fat: skim milk, skim milk powder, condensed skim milk and sweet cream butter milk
   - Source of both fat and milk-solids-not-fat: whole milk, whole milk powder, condensed whole milk and evaporated milk

2. **Non-Dairy products**
   - Sweetening agents: (i) Cane sugar (sucrose) (ii)corn sugar (iii)corn syrup solids (iv)corn syrup (v) invert sugar (vi)saccharin
   - Sugar depress the freezing point of the mix, produce a thinner mix with a slower wipping rate and an ice cream with a smoother body and texture with faster melting qualities.
   - Stabilizers: (i) Gelatin – animal source (ii)sodium alginate – vegetable origin (iii) guar gum – Indian origin
   - These may be defined as substances which help to preserve emulsion. Stabilizers are added in the ice cream to produce smoothness in body and texture, retard or reduce ice crystal growth during storage and provide uniformity in the product and resistance to melting. Stabilizers function through their ability to form gel structures in water.
   - Stabilizers which are permitted and used in ice cream making are: Gelatin, sodium alginate, carageenan, agar agar, carboxy methyl cellulose,
pectin, guar gum and other gums.

Emulsifiers: (i) Mono- or di-glycerides of fat forming fatty acids.

These may be defined as substances which help to form emulsions, it improves the wipping quality of the mix, provide a drier ice cream with a smoother body and texture.

Flavours: (i) Vanilla – most popular flavour all over the world (ii) Chocolate (iii) Strawberry (iv) Pineapple (v) Banana (vi) Mango etc.

Colours: (i) Yellow (ii) Green (iii) Pink etc.

Egg solids: Yolk solids – improve wipping ability

Fruits and nuts: (i) Apple (ii) Banana (iii) Mango (iv) Pineapple (v) Grape (vi) Almond (vii) Pistachio (viii) Cashewnut (ix) Groundnut

**Figuring of ice cream mix:**

Knowledge of calculation of ice cream mix is helpful in properly balancing a mix, in establishing and maintaining uniform quality and in producing ice cream that confirms to legal standards.

**Procedure**

The weight of the ingredients needed to make 100kg of the desired mix is found out by algebraic methods. Symbols such as X, Y, Z are used to represent the weights of dairy ingredients required for a 100kg batch of mix. These symbols are then used in writing the three equations that express the weight of fat, snf and total weights of dairy ingredients needed for 100kg of mix. The weights so determined are obtained by means of spring balance, and the components are mixed to form an ice cream mix with desired body and a delicately blended flavour.

**Calculation**

If an ice cream mix contains F %fat, SNF% serum solids, S% sugar and St% stabilizer is to be prepared, and we given whole milk testing a1% fat, b1% SNF, cream testing a2% fat, b2% SNF and skim milk testing a3% fat, b3% SNF, then by forming 3 simultaneous equations of fat, serum solids and weight, we get.

\[
X(a1) + Y(a2) + Z(a3) = F \quad \text{Fat equation}
\]
\[
X(b1) + Y(b2) + Z(b3) = \text{SNF} \quad \text{Serum solids equation}
\]
\[
X + Y + Z + S + St = W \quad \text{Weight equation}
\]

Here X= whole milk, Y= cream, Z= skim milk and W= total weight of ice cream mix. Now the simultaneous equations are solved to get the relative measure of components.

**Blending the mix:**

First the ingredients are selected based on the desired formulation, then the ingredients are weighed and blended together to produce ice cream mix.
Blending requires rapid agitation to incorporate powders, and often high speed blenders are used. In order to make a good ice cream, the ingredients are added as follows:

All the liquid ingredients are mixed together and placed in the steam jacketed vat. The dry ingredients, including skim milk powder, sugar and stabilizer are mixed together and are added while the liquid material is agitated and before the temperature reaches 49°C.

**Pasteurization of the mix:**

Proper pasteurization of the all ice cream mixes should be compulsory because this process destroys all pathogenic or disease producing bacteria, thereby safeguarding the health of the consumer.

The advantages of pasteurization are (1) it renders the mix completely free of pathogenic bacteria. (2) It dissolves and helps to blend the ingredients of the mix. (3) It improves flavor. (4) It improves keeping quality and (5) it produces more uniform product. Pasteurization of ice cream mix consist of heating the mix to 68.5°C /30 minutes or 80°C /25 seconds and then rapidly cooling to below 5°C.

**Homogenization of ice cream mix:**

Homogenization is essential because it prevents fat separation during ageing, produces more uniform ice cream with a smooth texture, improves whipping ability, shortens ageing period, decreases the risk of churning occurring in freezer and leads to the use of slightly less stabilizer. The ice cream mix is usually homogenized at temperatures from 63 to 77°C. A pressure of 2500 to 3000 psi with one valve or 2500 to 3000 psi at the first stage and 500 psi at the second will usually give good results for an average mix with 3 to 12 % fat.

**Cooling of mix:**

After homogenization the mix is immediately cooled to 0-5°C and after it should be held for ageing.

**Ageing of mix:**

Ageing refers to holding the mix at low temperature for a definite period of time before freezing. The ageing temperature should not exceed 5°C. The ageing time may be 3 to 4 hours. Ageing helps to improves the body & texture of ice cream, improves whipping capacity of the mix, increases maximum overrun and increases the melting resistance.

**Freezing of mix:**

Freezing is the most important operation in the making of ice cream. The ice cream mix with proper amount of colour and flavouring materials added to the freezer is quickly frozen while being agitated to incorporate air in such a way as to produce
and control the formation of small ice crystals- so necessary to give smoothness in body & texture, palatability and satisfactory overrun in the finished ice cream.

**Packaging of ice cream:**

When ice cream is drawn from the freezer, it is usually collected in containers which give it the desired shape or size for convenient handling during the hardening and marketing process. The chief requirements for packages of ice cream are protection against contamination, an attractive appearance, ease of opening and reclosure and ease of disposal.

**Hardening and storage:**

When ice cream is drawn from the freezer and put into the container to be placed in the hardening room, it has a semi-fluid consistency. So the freezing process should be continued without agitation during the hardening until the temperature of ice cream reaches -18°C or below. Mostly the hardening time is about 12 hours. After the ice cream is hardened, it may be immediately marketed or it may be stored for a week or two at the most. The temperature inside the storage room should be maintained uniformly at a point between -23 to -18°C and the packages should be piled very close, to delay changes in ice cream temperature.

**Role of constituents in ice cream:**

**Role of Stabilizers in Ice Cream**

- To increase the viscosity of the mix.
- To stabilize the mix i.e. to prevent wheying off
- To help in suspension of flavouring particles.
- To produce a stable foam with desired stiffness at the time of packaging
- To reduce or slow down the growth of lactose crystals during storage mainly during temperature fluctuations

**Additional knowledge:**

Procedure

The weight of the ingredients needed to make 100kg of the desired mix is found out by algebraic methods. Symbols such as X, Y, Z are used to represent the weights of dairy ingredients required for a 100kg batch of mix.

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\[ X(b1) + Y(b2) + Z(b3) = SNF \] ….. Serum solids equation
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Additional knowledge:

Ice cream packages are of two types

1) Multi service:
   This type of container is seldom used in modern operations. They are cleaned, sterilized and used repeatedly.

2) Single service:
   This type of containers is widely used for bulk and retail sale. Ice cream is packed in fibreboard cartons coated with wax. The wax coating helps in protection against moisture and oxygen. The most recent trend for such
factory filled carry home packages is the all plastic cylinder container with reclosable lid. Retail ice cream may be packed in cups, sticks or bars.

Hardening and storage: When ice cream is drawn from the freezer and put into the container to be placed in the hardening room, it has a semi-fluid consistency. So the freezing process should be continued without agitation during the hardening until the temperature of ice cream reaches -18°C or below. Mostly the hardening time is about 12 hours. After the ice cream is hardened, it may be immediately marketed or it may be stored for a week or two at the most. The temperature inside the storage room should be maintained uniformly at a point between -23 to -18°C and the packages should be piled very close, to delay changes in ice cream temperature.

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- To help in suspension of flavouring particles.
- To produce a stable foam with desired stiffness at the time of packaging
- To reduce or slow down the growth of lactose crystals during storage mainly during temperature fluctuations.

Additional knowledge:
Stabilizers are also used:
- To reduce moisture migration from the product to the package or the air.
- To help prevent shrinkage of the product volume during storage.
- To provide uniformity to the product and resistance to melting.
- To produce smoothness in texture during consumption.
- Mask the detection of ice crystals in the mouth during eating.

Role of emulsifiers in ice cream
- Promote nucleation of fat during aging thus reducing aging time
- Improve the whipping ability of the mix.
- Produce a dry and stiff ice cream
- Increase resistance to shrinkage
- Increase resistance to the development of coarse/icy texture
- Provide smooth texture in the finished product

Role of milk fat in ice cream
Imparts characteristics richness and mellows the flavour of ice cream. It tends to retard the rate of whipping. Lecithin contained in milk fat has important contribution to the flavour and tactual qualities of ice cream. It contributes to smoothness of texture and contributes to body and melting resistance of the product. It does not lower the Freezing point (FP) of mix.
Role of milk SNF in ice cream
MSNF increases viscosity and resistance to melting, but also lowers the F.P. Lactose adds slightly to the sweet taste and minerals tend to have a slightly salty taste. Proteins help to make ice cream more compact and smooth cream. As a thumb rule, the MSNF should not be more than 15.6-18.5% of the TS in the mix; based on the turnover (slow or rapid).

Additional knowledge:
The amount of MSNF generally varies inversely with the fat content of the mix and ranges from 7.5-8.0% in an 18% fat ice cream to 14.0% in a 4% fat ice milk mix. Indian PFA regulation does not permit less than 10.7% SNF by specifying a minimum of 3.5% protein content. The limiting factor for MSNF is occurrence of ‘sandiness’ defect in ice.

Role of sweeteners in Ice cream
- To increase the acceptance of the product, not only by making it sweeter but also by enhancing the pleasing creamy flavour and the delicate fruit flavour.
- It increases the viscosity and TS content of mix; this improves the body and texture.
- It depresses the Freezing point of mix, resulting in slower freezing and thus requiring a lower temperature for proper hardening.
- It is usually the cheapest source of TS in the mix.

Overrun in ice cream:
Overrun is usually defined as the volume of ice cream obtained in excess of the volume of the mix. It is usually expressed as percentage. This increased volume is composed mainly of the air incorporated during the freezing process.

\[
\% \text{ Overrun} = \left( \frac{\text{volume of ice cream}}{\text{volume of mix}} - 1 \right) \times 100
\]

List of practical
- Preparation of different varieties of ice-cream
- Preparation of milk sip-up/milk ices
- Preparation of kulfi

ASSESSMENT ACTIVITIES
- Dairy plant visit to study the large scale preparation of different frozen dairy products and assessment of participation in activities and evaluation visit report.
• Assessment of participation in market survey and evaluation of survey report.
• Participation in preparation of fat rich dairy products.
• Participation in group discussion.
• Practical examination.

LIST OF ITEMS IN PORTFOLIO
• Dairy plant visit report
• Practical evaluation records.
• Photography of preparation of different products.
• Practical records
• survey report

TE Questions

1. Your friend plans to start an ice cream manufacturing factory in your town. The managing committee of the plant is confused with the type of ice cream to be produced in the factory. They request you to give an idea of the different varieties of ice creams that can be manufactured to suit the market in Kerala. Prepare a note.
(4)

2. The ice cream should contain not less than ..........% milk fat, 3.5% protein, and ..........% total solids  (2)

3. Before freezing ice cream mix is held for some time at a specific temperature. Is this step necessary for the production of a good quality ice cream? Justify your answer

4. An ice cream plant is much profitable due to its overrun. Define overrun in ice cream.  
(2)

5. While conducting an exhibition one of the visitors asked whether it is possible to prepare ice cream without sugar and fat. How will you discuss the role of each constituent in the ice cream.
(4)

6. A discussion is conducted in your class on the role of ingredients of ice cream. The students are divided into different groups. Your group is entitled to present the role of milk fat and stabilizers in ice cream. Prepare a note.  
(4)

7. A training has been given to you in an ice cream plant. You decided to prepare an ice cream in your house. What ingredients you will need for preparation?
(5)

• The prepared ice cream is found to be sandy in texture. Explain the reason for this.

• For a family function you decided to prepare ice cream at home. Describe the method of preparation of ice cream on industrial scale and compare the method with manufacture of homemade ice cream.
Unit 3.7: Indigenous Milk Products/ Sweets

Milk plays a significant role as a source of animal protein in the average Indian diet which is predominantly vegetarian. Because of higher ambient temperatures prevailing in Indian sub-continent, ancient Indians developed more stable products from milk for conservation of its nutritional goodness. So the ethnic dairy foods, commonly termed as traditional or Indian indigenous milk products, were developed over ages utilizing locally available equipment, utensils and manufacturing procedures.

The term Indian dairy products refers to those milk products which originated in undivided India. The importance of milk and milk products in this country has been recognized since Vedic times. The credit for first publication on the subject goes to Dr.W.LDavies the first Director of Dairy Research, Indian Dairy Research Institute (now NDRI), Bangalore.

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- Peda
- Gulabjamun
- Kalakand
- Burfi

**SKILLS:**
- Data collection skill.
- Observation skill.
- Analyzing skill.
- Differentiating skill.
- Responding skill.

### Channa and channa based sweets:

*Method of preparation of:*

- Channa
- Sandesh
- Rasagolla
- Rasamalai
- Channakheer
- Channamurki
- pantooa

Prepare channa and channa based sweets.

**SKILLS:**
- Data collection skill
- Observation skill
- Analyzing skill
- Recording skill
- Responding skill

### Paneer and paneer based products:

*Method of preparation of:*

Prepare and paneer based

**SKILLS:**
- Data collection skill
- Observation skill
- Analyzing skill
- Recording skill
- Responding skill

- Demonstration
- Chart preparation
- Instructional lectures
- Instructional videos
- Flow diagrams
- Spot tests
- Demonstration
- Practical exam
- Records

- Flow diagrams
- Spot tests
### UNIT IN DETAIL

**CONCEPT:** Definition and Classification of Indigenous milk products/sweets.

**Indigenous Milk Products/ Sweets**

Traditional Indian dairy products or Indian Indigenous milk products can be defined as all milk products which are native of India and which were evolved over ages utilizing locally available fuels and cooking ware.

The term Indian dairy products refers to those milk products which originated in undivided India.

**Classification**

Indian indigenous milk products have different nomenclature in various regions because of the variation in the ingredients added and method of manufacture involved. For better understanding of the nature of the products, indigenous milk products can be conveniently classified into nine major categories.

1. **Concentrated / partially desiccated products:**

   In this class of products, milk is concentrated using heat energy. Moisture percent in milk gets reduced due to evaporation of vapours of the product. Based on extent of heat treatment product characteristics such as smell, colour, aroma and texture imparted to the products.

### SKILLS:

- Data collection skill
- Observation skill
- Analyzing skill
- Responding skill
- Equipment handling skill
- Process skill

### Preparation

- Instructional lectures
- Instructional videos

### Demonstration

- Practical exam
- Records
i) Khoa and Khoa based sweets such as Gulabjamun, Burfi, Kalakand, Milk cake etc.

ii) Rabri
iii) Basundi

2. Heat and acid coagulated products:

These are the coagulated products obtained upon addition of acidulant(s) to heated milk. Extent of removal of moisture controls the texture.

i) Chhana and Chhana based sweets such as Rasagolla, Rasamalai, Sandesh etc.

ii) Paneer.

3. Fermented products:

Lactic cultures are used to ferment the milk at specific temperature and for specific duration. Dahi is the well known product since from ancient time and mistidahi is popular in eastern region.

i) Dahi
ii) Mistidahi
iii) Chakka
iv) Shrikhand
v) Shrikhandwadi

4. Fat rich products:

i) Ghee
ii) Makkhan (desi butter)
iii) Malai

5. Frozen products:

i) Kulfi
ii) Malai – ka – baraf
iii) Milk – ice

6. Cereal based puddings:

i) Kheer
ii) Payasam

7. Chhana and khoa based sweets

i) Kala-Jamun
ii) Pantooa
Status, Scope & Challenges of Traditional Milk Products

Traditional Indian Dairy products are those products which are known in this country for ages. Milk and milk products formed the main food of Vedic Indians. Khoa sweets have been the item of choice for centuries in India. In early Buddhist and Jain eras, there is a mention that sweets were prepared from thickened milk named as Sihakesara and Morandeku. The rich people used to enjoy such sweets at the end of their meals. Buddha allowed his followers to carry some sweets during journeys, where it was difficult to get food stuff. In the Maurya period, the sweets were prepared from concentrated milk with the addition of honey, jaggery or sugar. In the post-Maurya period (AD 750 to 1200), milk was used in various forms. The milk was drunk when half of the quantity was evaporated. The milk was very much relished when the quantity of milk was reduced to one third of the original quantity. When milk was reduced to one-sixth of the original quantity, it was used for preparing sweets and when it was reduced to one-eighth, it was called Sarkara (Powder). The ancient medical literature states that the physical and mental happiness of individuals depend on the food they take.

India has become the largest producer of milk in the world. It produces more than 118 million tons of milk annually, as in the year 2011. Milk production in India is highly seasonal. The availability of milk is abundant after monsoons and all through the winter which is flush season, the quantity of milk in the summer declines which is lean season. It is happening over the centuries in our country. When we have too much production of any commodities without a matching demand, price come down and that is where the indigenous dairy products play their balancing role. Surplus milk in the evening is boiled and converted into dahi, then to makkhan and finally to ghee which has a shelf life of about one year.

In India only 5-6% of total milk is converted into western type of products in the organized sector. Nearly half of the milk produced in India (50-55%) is utilized for the manufacture of traditional milk products and approximately 45.7% is used as fluid milk. Only about 20% of the total milk produced is processed by the organized dairy sector. Collection of the entire surplus milk from about 5.8 lakh villages and its processing requires huge capital investment on equipments, buildings and other infrastructure. The milk that is supplied in the cities and towns is very expensive as a result of high costs of procurement, processing and packaging and due to losses because of souring of milk. Conversion of surplus milk into indigenous milk products in and around production areas is least expensive and more profitable. A large proportion of the milk is converted into indigenous dairy products such as khoa, chhana, paneer and khoa and chhana based sweets.

KHOA

Khoa is the product obtained by drying of cow or buffalo or goat or sheep milk or milk solids or a combination thereof. The milk fat content should not be less than 20% of the finished product.

Khoa is a semi solid mass having more intense shade colour with a tinge brown colour. It is obtained by continuous heating in a karahi over a direct fire kettle or in a steam. Depending on the method of preparation, three varieties of khoa are available - Pindi, dhap and danedar. These varieties differ in composition and texture and are made use of preparing different sweets.

Khoa is a concentrated whole milk product obtained by open pan condensing of milk under atmospheric pressure.

According to Food Safety and Standard Regulations 2011, Khoya, by whatever variety of names it is sold such as Pindi, Danedar, Dhap, Mawa or Kava, means the product obtained from cow or buffalo or goat or sheep milk or milk solids or a combination thereof by rapid drying. The milk fat content shall not be less than 30 percent on dry weight basis of finished product. It may contain citric acid not more than 0.1 percent by weight. It shall be free from added starch, added sugar and added colouring matter.

Good quality khoa should be a compact mass of very small uniformly-sized granules, which shows no signs of fat and/or water leakage. Even if kept for over 24 hours, it should not taste gritty.

METHOD OF PREPARATION:

Traditional method:

Generally buffalo milk is preferred for manufacture of khoa as it results in higher yield, smooth texture and soft body with sweet taste. Where buffalo milk is not available, cow milk is used for khoa making but it results in pasty body and slightly saltish taste due to higher chlorides in the product.

4 liters of buffalo milk or 5 liters of cow milk which approximately yields 1 kg khoa is used per batch. Filtered milk is taken in a heavy bottomed wide mouth iron pan (karahi) and boiled on a brisk non-smoky fire. An iron scraper (khunti) is used for stirring the milk during boiling and also to scrap the milk film forming on the surface during boiling. A rapid stirring and scrapping is carried out throughout boiling to facilitate quick and rapid evaporation of water from milk and also to prevent scorching of milk film on surface. Due to continuous evaporation of water, the milk progressively thickens. The researchers have observed that at 2.8 fold concentration of cow milk and 2.5 fold concentration of buffalo milk, heat denaturation of milk proteins takes place and the proteins will not go into solution again. The
heating is continued till the milk thickens considerably and at this stage heating is reduced and speed of stirring and scraping is increased to obtain good quality product. If the milk is subjected to high heat treatment with less stirring and scraping at this stage it results in dark colored khoa that does not fetch a good price in the market as white/cream colored khoa is preferred for sweets making.

As the concentration is progressing, the product slowly tends to leave the sides of the pan and starts’ accumulating at the bottom and at this stage; the pan has to be removed from the fire. The contents are worked up and the residual heat of the vessel helps in further evaporation of moisture. The contents are transferred to the non corrosive metal moulds and allowed to cool.

**Flow chart**

```
MILK
↓
PASTUERISATION
↓
BOILING IN STAINLESS STEEL VAT WITH CONTINUOUS STIRRING
↓
SEMI SOLID CONSISTENCY
↓
COOLING
↓
MOULDED TO DESIRED SHAPE
↓
PACKING AND STORAGE
```

**Additional information:**

**BIS standards of khoa**

BIS specifications are not mandatory, but suggestive of acceptance levels.

**Varieties of khoa**

There are three distinct varieties of khoa. They differ in their
composition, body and textural characteristics and end use.

Pindi

This variety is identified as a circular ball of hemispherical pat with compact mass, homogenous and smooth texture. It shall not show any sign of fat leakage or presence of free water. It possesses pleasant cooked flavour and devoid of objectionable tastes like burnt, acidic, etc. This variety of khoa is used in the manufacture of burfi, peda and other varieties of sweets.

Dhap

It is a raw (katcha) khoa characterized by loose but smooth texture and soft grains and sticky body. Dhap variety carries highest percentage of moisture over other varieties of khoa. This high moisture is necessary to provide adequate free water for soaking of maida (refined wheat flour) and semolina (suji) and for homogenous distribution of other ingredients in the preparation of smooth gulabjamun balls. This variety of khoa is used in the manufacture of gulabjamun, kalajamun, pantooa, carrot halwa, etc.

Danedar

This is characterized by the granular texture with hard grains of different sizes and shapes embedded in viscous serum. Slightly sour milk is preferred in the manufacture of this variety as it yields granular texture. This variety of khoa is used in the manufacture of kalakand, milk cake, etc.

KHOA BASED SWEETS:

**PEDA**

Peda is popular khoa sweet which contains mainly khoa, sugar, dry fruits, and cardamom.

**METHOD OF PREPARATION:**

*Traditional method:*

Peda or doodhpeda is prepared using khoa as base material. Khoa is mixed with sugar in the ratio of 3:1 and then heated in a karahi on a gentle fire till the mixture turns relatively firm. After heating removing the karahi from fire, desired flavourings and nuts are added to the peda mass. The heat process removes some of the moisture of khoa. Sugar provides sweetness and exerts a preservative effect. The content is mixed into balls of 15-20g size. The balls are flattened to give them disc shape or use peda shaping machine.

**Flow chart**

Khoa(72%TS)is heated to 60 in steam jacketed pan
And transferred to planetary mixer
Khoa + sugar + flavour + other ingredients
   Thoroughly mixed in planetary mixer
   ↓
Peda mass is transferred to cold room
   ↓
Peda mass temperature is brought down to 5°C
   ↓
Peda mass is fed to Rheon or peda shaping machine
   ↓
Packaging
   ↓
Preferably stored in refrigerated conditions
   ↓

Peda

**Additional information:**

**Quality of Peda**
Chemical quality of peda depends on:

- Type and quality of milk,
- Quality of khoa if used,
- Amount of sugar added,
- Method of production
- Optional ingredients and flavors added

**BURFI**

Burfi is a unique adaptability of khoa in terms of its flavour, body and texture to blend with a wide range of food adjuncts has permitted development of an impressive array of burfi varieties.
Burfi is one of the most popular khoa based indigenous sweets. It is white to light cream in colour with firm body and smooth texture with very fine grains. Sugar is added in different proportions and other ingredients incorporated according to the demand of consumers.

Methods of Production

Buffalo milk is preferred for making burfi. Milk used for burfi should not have objectionable flavours and titratable acidity should not be more than 0.16 percent. Milk is filtered before use to remove visible objectionable foreign matter. Standardized buffalo milk with 6% fat and 9% SNF in quantities of 4-5 lit per batch is taken in a double jacketed stainless steel kettle and heated. Milk is boiled continuously with constant stirring and scraping so as to avoid burning of solids on the surface of the kettle. When a semisolid consistency is attained, heating is discontinued. Powdered sugar @ 30% on the basis of khoa is added and blended thoroughly into khoa with the help of a flattened wooden ladle. When a homogeneous mass with desirable flow characteristics is achieved, the blend is transferred to greased trays. The product is allowed to set for minimum of 4 hours. Then burfiis cut into desirable shapes and sizes with a knife and packed burfi is stored at room temperature.

Preparation of burfi from pre-made khoa

Burfi can also be prepared from pre made khoa obtained from market. Hot sugar syrup is prepared from 300 gm sugar by adding minimum quantity of water. Hot sugar syrup is added to 1 kg khoa and heated to 80°C. The mixture is kneaded properly and when desirable flow characteristics are attained, it is poured in trays and allowed to set at room temperature.

Flowchart:
Khoa+additives

↓

Blender (planetary mixer)

↓
Kalakand is a milk sweet basically prepared from Danedar variety of khoa. Kalakand is characterized by large sized hard grains with less cohesive body. The chemical composition of Kalakand is more or less similar to burfi, but there are large differences in the sensory and rheological properties of the two sweets. Contrary to burfi, kalakand has more distinct cooked flavour and brown colour. The body of kalakand is greasier with grainy texture. The grains are hard and of large size. Good quality kalakand is normally prepared in one step from buffalo milk. However, it can also be prepared from khoa. The firmly set product is cut to required shape and size. When making kalakand from khoa, danedar variety is used.

**Preparation of kalakand from milk**

Buffalo milk is preferred for kalakand manufacture. Slightly sour milk (upto 0.18% lactic acid) can be used for its preparation. Buffalo milk standardized to 6% fat and 9% SNF is taken in a pan and boiled. At the appearance of first boiling, 0.05% citric acid (on weight of milk) dissolved in small quantity of water is added to milk. There is no need to add citric acid in case of slightly acidic milk. The milk is boiled with continuous stirring and scraping. At pat formation stage, sugar @ 30% on expected yield of khoa or alternatively 7.5% on the basis of milk is added and stirring is continued. When desirable textural and body characteristics are achieved, mixture is removed from fire and poured in a tray, smeared with a thin layer of ghee for setting. The kalakand/ is cut into desirable shapes or alternatively served as such without any definite shape.

Buffalo milk

↓

Standardized to fat :SNF=6:9-9.5

↓
Boiled in karahi(10-15 minutes)
↓
Citric acid added(0.02)
↓
Sugar + flavourings added
↓
Heating(5 minutes)
↓
Transferred to tray and cooled
↓
Cut into shapes

**Preparation of kalakand from khoa**

Danedarkhoa is taken in a pan and heated. To this sugar @ 30% is added and heating is continued with stirring. When desirable flow characteristics are observed, kalakand is poured into a tray and set for minimum 4 hr.

**GULABJAMUN**

Gulabjamun is a khoa based sweet popular all over India. Dhap variety of khoa having 40-45% moisture is preferred for Gulabjamun preparation.

There are large variations in the sensory quality of Gulabjamun. The most liked product should have brown colour, smooth and spherical shape, soft and slightly spongy body, free from both lumps and hard central core, uniform granular texture, with cooked flavour and free from doughy feel and the sweet should be fully succulent with sugar syrup with optimum sweetness

**BIS Specifications of Gulabjamun**

Gulabjamun shall be prepared from khoa, skim milk powder, milk powder, ghee, cream, butter or other milk solids. It may contain maida (wheat flour), citric acid and baking powder. It shall be free from dirt and other foreign matter as well as insects and mould growth. It should be, as far as possible, manufactured and packed under hygienic conditions. The proportion of free syrup in a gulabjamun pack shall not exceed 60% of the declared net mass.
Requirements for sugar syrup

The sugar syrup shall be clear and light to golden yellow in colour, and shall conform to the requirements given in the table as follows. The proportion of free syrup in a gulabjamun pack shall not exceed 60% of the declared net mass. There should not be excessive free fat floating in the syrup or adhering to gulabjamun pieces. The package should not also contain broken pieces of gulabjamuns in the syrup.

Method of Preparation

Dhap variety of khoa, maida and baking powder (750 g khoa, 250 g maida and 5 g baking powder) are blended to form homogenous and smooth dough. Small amount of water can be added in case of hard dough and if it does not roll into smooth balls. The mix should be prepared fresh every time. The balls are then deep fat fried at 140° C to golden brown colour and transferred into 60% sugar syrup maintained at 60 °C. It takes about 2 hours for the balls to completely absorb sugar syrup.

Flowchart: (Industrial method)

Khoa (TS 60-70%) + refined flour(19-22%)

+ other ingredients are thoroughly mixed in

Planetary mixer and made into dough

Dough is fed to portioning machine

Each portion weighing 8g, is transferred by belt conveyer from portioning machine

To ball forming machine

Balls are transferred by conveyer to ball frying machine(oil temp of 140°C)for 12-13 minutes.
Fried balls are transferred to soaking tank (Sugar syrup (62.5% soln) prepared in a kettle and strained and pumped to sugar syrup soaking tank. Balls Soaked for 2-3 hours till it weighs 16 g)

↓

Gulabjamun taken out manually and filled in cups. Fresh sugar syrup is also added

↓

Filled cups stored under refrigerated conditions

**CHHANA**

Chhana is an acid coagulated product obtained from milk. The curd mass obtained when milk is coagulated with the organic acids such as citric acid, lactic acid at higher temperature and after subsequent drainage of whey, mass of curd obtained is called chhana. It looks off-white, tastes mildly acidic, and has characteristic spongy texture.

Chhana is mainly prepared from cow milk and used for preparation of varieties of Bengali sweets. About 4 to 4.5% of the total milk produced in India is used for chhana making. Chhana is used as a base for the preparation of a variety of sweets like sandesh, rasogolla, chamcham, rasomalai, pantoa, chhanamurki, etc. Following table (Table: 15.1) depicts the chemical composition of chhana. Table 15.2 reveals the partitioning of milk solids in chhana and its whey.
Table 15.1 Typical composition of cow and buffalo milk *chhana*

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cow milk <em>chhana</em></th>
<th>Buffalo milk <em>chhana</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture %</td>
<td>53.4</td>
<td>51.7</td>
</tr>
<tr>
<td>Fat %</td>
<td>24.8</td>
<td>29.7</td>
</tr>
<tr>
<td>Lactose %</td>
<td>2.2</td>
<td>2.3</td>
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<tr>
<td>Protein %</td>
<td>17.4</td>
<td>14.4</td>
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<tr>
<td>Ash %</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>pH</td>
<td>5.7</td>
<td>5.4</td>
</tr>
</tbody>
</table>

**Methods of Manufacturing:**

*Traditional method of manufacture:*

Chhana has been prepared by boiling about 15-40 lit of cow milk in a steel pan. Acidic whey (previous day whey) added to boiling hot milk serve as coagulant with continuous stirring till the completion of coagulation. Contents
poured over a muslin cloth held over another vessel. Whey is collected in a vessel. Muslin cloth containing curd mass washed with potable water by immersion process and allowed to drain for 30 min to expel free whey.

**Flowchart:**

```
Buffalowmilk(whole or 5-6% fat)
↓
Standardization(5% fat)
↓
Addition of citrate 0.05% of milk
↓
Pre-heating(60± or 2°)
↓
Homogenization(176 kg/cm square)
↓
Heating (98°C)
↓
Cooling(70°C or 82-83°C)
↓
Coagulation(0.5-2% lactic acid; pH 5.4-5.7 or 1% citric acid pH 5.1-5.7)
↓
Holding coagulated mass
In whey for 30 min
↓
```

111
Straining whey

Cooling the mass in tap water
For 15-20 min

Dripping whey

Chhana

**CHHANA BASED SWEETS**

*CHHANA KHEER*  
*CHHANA MURKI*  
*CHAM-CHAM*  

*SANDESH*  
*RASAMALAI*  
*RASSOGOLLA*

**CHHANA BASED PRODUCTS**

**RASOGOLLA**

Rasogolla popularly known as king of Bengal sweets. Product was developed by Nobin Chandra Das in 1868. Production is largely confined to cottage and small scale industry. K. C. Das used to be a brand name for rasogolla in past.
Rasogolla resembles ping-pong ball in shape, snow-white in colour and possesses a spongy, slightly chewy body and juicy and smooth texture. Rasogolla balls are stored and served in sugar syrup. The product is flavoured with kewara, pista and rose and sometimes centered with cardamom or pista.

**Preparation Rasogolla:**

Rasogolla is prepared from soft, fresh cow milk chhana. Kneading of chhana to smooth paste by manually or using planetary mixer is first step in Rasogolla making. The smooth paste is portioned and rolled between palms to form balls of about 15mm diameter each weighing about 8 - 10g in weight. Each ball should have smooth surface without visible cracks on surface. On an average, one kg chhana yields 90 -100 rasogolla balls. These rasogolla balls are cooked in sugar syrup of approximately 50 Brix. Heating is regulated to maintain stability of the balls. Balls are cooked for 14- 15 min. During cooking small amount of water is continuously added to maintain syrup concentration. This makes up for the loss of water due to evaporation. About 10% of sugar syrup should be replaced with fresh one each time to cook another batch. After cooking rasogolla balls are transferred to dilute sugar syrup at 60\(^\circ\)C for texture and colour improvement. After 30min stabilized balls are transferred to 60\(^\circ\) Brix syrup for 1-2 hours, followed by final dipping in 50\(^\circ\)brix syrup.

**Preparation of cooking medium**

Sugar syrup preparation includes dissolution of sugar in water and boiling till it is concentrated to desired brix level. While boiling, scum appearing on top of the surface is scooped off before cooking the rasogolla balls. Pinch of milk can be added during boiling to remove the scum.

**RASOMALAI**

Rasomalai is chhana based product, prepared in a similar way as rasogollaupto ball formation stage, followed by flattening the balls and cooking. These flattened balls are soaked in thick concentrated sweetened milk or rabri. Rasomalaiis marketed as flattened chhana patties floating in thickened sweet milk. It is very delicate, chewy and spongy sweet. It tastes better when served chilled.

**Method of preparation**

Chhana is kneaded into smooth dough along with 1 to 4 % wheat flour. Dough is portioned and rolled into balls having a smooth texture
without cracks. These balls are flattened to differentiate from rasogolla balls. Flattened balls are processed like rasogolla and subsequently stored in sweetened (5-6% sugar) milk thickened to one third of its volume. Rabri without the creamy layer can also be used instead of thickened milk to soak the cooked flattened balls. Rasmalai has limited shelf life of 3-5 days at refrigerated temperature.

**Chhana - Murki**

Chhana-murki is a sugar-coated sweet in the shape of small cubes. Chhana is kneaded and formed into 10mm thick flat slab. Same slab can also be prepared from paneer as well. It is then cut into small cubes of about 10mm cubes. Cubes are cooked in boiling sugar syrup in karahi for five min with gentle stirring. Slightly higher concentration sugar syrup is used to promote coating over the surface. Then karahi is removed from the fire and stirring is continued till the sugar is crystallized and coated uniformly over the cubes. Cubes are then cooled and sprinkled with flavour and colour and decorated with dry nuts flakes.

**Pantooa**

This is a chhana and khoa based product similar to gulabjamun. Equal quantity of khoa and chhana are broken into small bits. Maida and baking powder are also used in this product for obtaining smooth texture and soft body. After mixing maida and baking powder, broken bits of chhana and khoa are added into it. Small quantity of water is added to knead the above mixture and to form dough. From here onwards proceed similar to gulabjamun processing, i.e making balls and frying them in ghee or in oil, followed by dipping in sugar syrup. It has shelf life of 7 days at room temperature and 14 days at refrigerated temperature where as canned product can keep upto 6 months.
**PANEER**

Paneer is a heat-acid coagulated milk product obtained by coagulating standardized milk with the permitted acids at specified temperature. The resultant coagulum is filtered and pressed to get the sliceable curd mass. Paneer has a firm, close, cohesive and sponginess body and smooth texture. It is mainly prepared from buffalo milk and used for large number of culinary dishes. Though originally it was localized in Northern part of India but now it is preferred almost all parts of the country. Paneer is generally sold as blocks or slices, it is also referred as Indian fresh cheese. It is reported that about 5% of the milk produced in India is converted into paneer and paneer production is growing annually at the rate of 13%.
Method of Manufacture

*Traditional method of manufacture:*

Buffalo milk is boiled in a bigger iron vessel and a small portion of this is transferred to a smaller vessel. The coagulant (usually sour whey) is added to hot milk and stirred with a ladle till coagulation is completed. The contents of the vessel are emptied over a piece of coarse cloth to drain off whey. The whole process is repeated till all the milk is coagulated. The curd is collected after draining the whey and pressed to remove more whey. Finally, product is then dipped in chilled water.

*Additional information:*

**Chemistry of Milk Coagulation During Paneer Production**

The phenomenon of coagulation involves formation of large structural aggregates and network of protein in which milk fat globules gets embedded. Acid and heat treatment causes the physical and chemical changes in casein. Heating causes interaction of β-lactoglobulin with κ-casein and the complex formed between β-lactoglobulin and α-lactalbumin. Acidification initiates the progressive removal of tri-calcium phosphate from the surface of the casein and it gets converted into mono-calcium phosphate. Further calcium is progressively removed from calcium hydrogen caseinate to form soluble calcium salt and casein. Colloidal dispersion of discrete casein micelles changes into large structural aggregates of casein. Under such a circumstance dispersion is no longer stable, casein gets precipitated...
and forms coagulum. Fat is embedded in the casein network.

**Practical works:**
- Preparation of khoa.
- Preparation of peda.
- Preparation of burfi.
- Preparation of kalakand.
- Preparation of gulabjamun.
- Preparation of paneer.
- Preparation of chhana.
- Preparation of sandesh.
- Preparation of rasagolla.
- Preparation of chhanamurki.
- Preparation of rasmalai.
- Preparation of whey sip-up and whey drink
- Market survey and documentation of standards of different brands of various dairy products
- Visit to a dairy plant

**ASSESSMENT ACTIVITIES**
- Dairy plant visit to study the large scale preparation of different products and assessment of participation in activities and evaluation visit report.
- Prepare flow diagrams of preparation of different Indian milk products.
- Preparation of different Indian milk products.
- Demonstration of preparation.
- Practical examination.

**LIST OF ITEMS IN PORTFOLIO**
- Dairy plant visit report
- Practical evaluation records.
- Photography of preparation of different products.
- Practical records
TE Questions

1. ................. is an example for khoa based product.
   (1)

2. ................. is an example for chhana based product.
   (1)

3. Khoa can be easily prepared in small scale. Describe the method of preparation of khoa with the help of a flow diagram. (4)

4. Indigenous dairy products are classified into different groups. List out the classification with examples. (4)

5. Name a product that can be prepared using both khoa and channa. Explain its preparation.

6. During your practical exam you are asked to
   • Prepare a chhana based sweet. How will you proceed?

7.

Fill up the blanks (Hint: process → product)

1) 3 litre of raw milk is given to you, from this prepare two other types of milks by adding flavour, colour, fruits, etc. So that it will attract more customers.

2) Observe the flow diagram and answer the following questions

Indian dairy products

1) 3 litre of raw milk is given to you, from this prepare two other types of milks by adding flavour, colour, fruits, etc. So that it will attract more customers.

2) Observe the flow diagram and answer the following questions

Milk
   ↓
Boil
   ↓
Cooled to 90°C

Addition of 1%......................

Coagulation

Straining

Chhana

a. Identify the process done using the flow diagram.
b. Fill in the blanks.
c. Give any one use of the by-products obtained.

3) For school youth festival P.T.A. decided to give whey drink as welcome drink to the judges.
   a. Explain how you will help them in preparing the product.
   b. Also name any two other products from whey.

4) You planned to purchase condensed milk for preparing payasam.
   Name the one that you prefer. Mention the reason.
   a. Sweetened condensed milk  c. Unsweetened condensed milk
   b. Sweetened condensed skim milk  d. Unsweetened condensed skim milk

5) While purchasing in a nearby bakery you saw brown coloured balls preserved in sugar syrup.
   a. Name the milk product.
   b. Explain the preparation.

6) You are planning to sell flavoured milk in the stall setup in school during vocational expo. Explain the preparation.

7) In the product section of a dairy plant a chart was displayed showing the flow diagram of peda manufacture. Draw the chart. Explain the process.

8) For vocational expo you prepared different types of milk products and displayed with their names labelled. A visitor asked about the products kheer, sandesh, burfi and peda. Explain how you will answer him.

9) Match the following:

   (A)                        (B)
   a. Cream                 -- (1) Addition of flavour, sugar, and stabilizer.
   b. Butter                -- (2) Inoculation.
   c. Flavoured milk        -- (3) Gravity separation.
   d. Fermented milk        -- (4) Churning
   e. Whole milk powder     -- (5) Freezing
   f. Ice cream             -- (6) Drum drying.
10) Name any two products that can be prepared from:
   a. Chhana
   b. Paneer
   c. Khoa
   d. Curd

   QUESTIONS:

1. Due to high acidity you decided to neutralise cream for butter manufacture. Name the type of neutraliser, also explain the processor of addition.

2. You planned to prepare acidophiles milk and curd for your practical. Name the cultures that you will purchase to prepare the above product.

3. You are working as lab assistant in a dairy plant and were instructed by the manager to purchase rennet.
   a. Give the use of rennet.
   b. Also explain the different sources of industrial rennet.

4. ‘Over run is very important for deciding profit of a product’. Explain what you understand by over run to two products ice cream and butter.

5. You are given a mixed culture of *Streptococcus thermophiles* and *Lactobacillus bulgaricus*.
   a. Name the product that you can prepare with these cultures.
   b. Explain the method of manufacture in detail with the help of flow diagram.

6. In a primary co-operative society samples are tested for both fat and SNF.
   a. Name the pricing system followed here.
   b. Give the advantages and disadvantages of this pricing system.

7. In Kerala’s dairy sector, as a dairy development programme the contribution of KCMMF is enormous. Comment this statement.

8. You read in a dairy magazine an article on a process that is done in milk to avoid cream separation.
   a. Identify the process.
   b. Explain the process with advantages and disadvantages.

9. You never see gravity separation of cream in any dairy plant in our state. Instead centrifugal separation is used for separating cream.
   a. Explain the reason.
   b. Also compare the advantages and disadvantages of both methods.

10. You read an article about key village scheme in a dairy magazine.
    Explain that to your friend.

11. To give your neighbour’s daughter of one year you want to purchase special milk. Which one will you choose from among the following.
    Toned milk, Double toned milk, Humanized milk, Homogenized milk.
12. You kept milk undisturbed for two days in refrigerator and even after that there was no visible cream separation. Mention the possible reason and write one sentence about it.

13. You are asked to draw the flow diagram for preparation of condensed milk on the wall of product room of a dairy plant. Demonstrate how you will do it.

14. Identify the most common packaging materials used in the market. Explain its advantages.

15. You read an article in a leading magazine ‘therapeutic value of fermented milk products’. Highlight the importance of fermented milk products, list their advantages.

16. Classify the following types cream based on their fat% Table cream, Plastic cream, Light cream, Whipping cream, Coffee cream, Heavy cream.

17. You are appointed as product supervisor in a newly opened ice cream plant. Explain in detail how you will prepare the ice cream mix for preparation of ice cream (Hind: Explain with flow diagram.)

18. While purchasing a bottle of ghee you noted that it is written ‘red label’ on bottle. Explain that you understand by red label. (Give relevant standards)

19. You are working as lab. Assistant in a Q.C. lab. After manufacturing a batch of butter you are asked to check whether it confirms to legal standards. Mention the parameters that you check. Give the expected values.

20. Name the pricing policy adopted by KCMMF. Explain its advantages and disadvantages.

3.8: Dairy By-products and waste management in dairy industry

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
</table>
| Dairy By-products   | The learner will be able to: Define and classify Dairy by-products | • Instructional video  
• Flow diagram  
• dairy plant visit  
• market survey | • Record  
• Visit report  
• Quiz,  
• Spot questions. |
| SKILLS:             |                 |            |            |
| Casein  
**Definition and method of preparation of**  
- acid casein  
- rennet casein  
- edible casein.  

<table>
<thead>
<tr>
<th>Identify the method of preparation</th>
</tr>
</thead>
</table>
| • Pictures  
• market survey  
• Dairy plant visit  
• videos |
| Survey report  
Visit report |

| Whey  
**Definition and method of preparation of**  
- whey beverage  
- whevit  
- whey sip-up  
- whey drink  

<table>
<thead>
<tr>
<th>Prepare whey products</th>
</tr>
</thead>
</table>
| • Instructional video  
• Flow diagram  
• dairy plant visit  
• market survey |
| Record  
Visit report  
Quiz  
Spot questions. |
### Waste Management in Dairy Industry

- Introduction and importance
- ETP (Effluent Treatment Plants)

Identify and aware of the waste management systems in dairy industry

<table>
<thead>
<tr>
<th>Instructional video</th>
<th>Flow diagram</th>
<th>dairy plant visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record</td>
<td>Visit report</td>
<td>Quiz</td>
</tr>
<tr>
<td>Spot question</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### UNIT IN DETAIL

### LEARNING OUTCOME

3.8.1 The learner will be able to define and classify Dairy by-products

### CONCEPT

- Definition of dairy by-products
- Classification

**Definition**

A dairy by-product may be defined as a product of commercial value produced during the manufacture of a main product.

**Classification**

The by-product of Indian Dairy Industry

<table>
<thead>
<tr>
<th>Main product</th>
<th>By-product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cream</td>
<td>Skim milk</td>
</tr>
<tr>
<td>Butter</td>
<td>Buttermilk</td>
</tr>
<tr>
<td>Ghee</td>
<td>Lassi</td>
</tr>
<tr>
<td>Ghee residue</td>
<td></td>
</tr>
<tr>
<td>Chhana/Paneer</td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
</tr>
<tr>
<td>Casein</td>
<td>Whey</td>
</tr>
</tbody>
</table>
LEARNING OUTCOME

3.8.2 The learner will be able to Identify the method of preparation of Rennet casein, Acid casein and Edible casein

CONCEPT

Definition and method of preparation of
- Acid casein
- Rennet casein
- Edible casein

Acid casein: Acid casein, free casein or simply casein is industrial casein which has been precipitated by various acids from skim milk. Acid casein is used for the production of plastics. This is normally yellowish white in colour for cow and chalky white for buffalo milk, a slightly acid taste, a total acidity equivalent to not more than 10.5ml and N/10 alkali per g., not more than 10% moisture and not more than 4% ash.

Method of preparation

Flow Diagram

- Receiving skim milk
- Precipitating using acid
  (Casein begins to precipitate at pH 5.3)
  And maximum at pH 4.7)
- Draining and washing
- Pressing
- Milling and pressing
- Drying (moisture reduced to less than 8%, Inlet temperature- 71-77°C)
- Grinding
- Packaging
- Storage
Rennet Casein: Rennet casein is industrial casein which has been precipitated by rennet from skim milk. Rennet casein is used for the production of adhesives, paper coating, paint, fibre etc. This is normally light-yellowish in colour for cow and whitish for buffalo milk, is tasteless, has a pH of about 7.0, not more than 10% moisture and approximately 7.5% ash.

Method of preparation
High quality fresh skim milk is heated to 36-38°C. Sufficient rennet and calcium chloride are added to it to give a setting time of 20-30 minutes. The coagulum is agitated for 2-5 minutes after coagulation begins but before the coagulum reaches a solid clot, so as to produce curd particles of an optimum size for further processing. Then the temperature of curd rises to 54-66°C and the curd is cooked at this temperature for about 30 minutes. After cooking, this is processed in the same manner as acid caseins.

Additional knowledge:
The rennet should previously have been diluted with about 15-20 times its weight in water; calcium chloride is also use @ 1% solution.

Edible casein: According to Food Safety and Standards Authority of India (FSSAI - 2011) Standards, edible casein products mean the products obtained by separating, washing and drying the coagulum of skimmed milk. Edible casein is used in various food products such as ice cream, coffee whiteners, imitation milk etc.

Method of preparation
This includes:
1. Precipitation of curd at pH 4.1-4.3
2. At least 3 separate washings of the curd in waters of proper pH and with a contact time of 15-20 minutes each.
3. Last but one washing with hot water at 71-77°C, which effects pasteurization of curd for reducing bacterial count.
4. Last washing with neutral water at 41°C.

LEARNING OUTCOME
3.8.3 The learner will be able to prepare whey products

CONCEPT
Definition and method of preparation of whey beverages

- whevit
- whey sip-up
- whey drink

Whey beverage: Whey is obtained as a by-product of chhana/ paneer/ cheese industries. Whey is used for the production of fermented beverages, both alcoholic and non-alcoholic (acid). Whevit, Yeast-whey, Plain condensed
whey, sweetened condensed whey, whey sip-up, whey drink are some of the commercially available whey beverages.

Whevit:

Whevit is a nourishing soft drink. National Dairy Research Institute, Karnal, have developed a soft drink out of whey known as “Whevit”. The manufacturing process of whevit is fresh whey obtained from chhana (or paneer) making is passed through a cream separator, and the separated whey is steamed for 30 min in a double jacketed vat. It is cooled to room temperature and kept overnight to allow the precipitated proteins to settle down, and then filtered through a muslin cloth. Now 50% sugar syrup @ 22-23% of whey, 10% citric acid @ 2-2.1% of whey and sugar mixture, selected colour and flavours in requisite amounts are added. This mixture is inoculated with a culture of *Saccharomyces cerevisiae* @ 1% of yeast whey broth (whey broth is prepared by adding 1% sugar in filtered whey and sterilizing it at 15 lb pressure for 15 min; the inoculums is prepared by inoculating it with the yeast culture and incubating it for 48 h at 25°C). After mixing the inoculums in the whey, it is incubated at 22°C for 14-16 h. The product is then filled in bottles leaving about 5% air space. The bottles are then crown corked to retain CO2 and pasteurized at 75°C for 30 min in hot water, cooled and stored at low temperature (5-10°C). In the above process of manufacture, the carbonation is achieved by the fermentation of sugar by the yeast culture. With a view to meet situation where cultivation of the yeast and fermentation of whey is not practicable, the process has been modified to incorporate CO2 through a carbonated plant.

Whey sip-up: Whey can be used for the preparation of sip-up by the addition of sugar, stabilizers, flavour and colour.

Whey drink: Whey can be used as a refreshing drink by adding different flavours, colour and sugar. The different flavours available in the market include pineapple, mango, chocolate, strawberry, vanilla etc.

List of Practicals

- Preparation of whey sip-up, whey drink.

**LEARNING OUTCOME**

3.8.4 Identify and aware of the Waste Management concept in Dairy Industry

**CONCEPT**

*Introduction and importance*

- ETP (Effluent Treatment Plant)

**Introduction:**
Each product in dairy industry produces waste of different quality and quantity. The microorganism present, utilize them and cause pollution. As per the Environmental Protection Act-1986, it is compulsory to pre-treat the effluents before discharge in inland water or rivers. Dairy effluents contain dissolved sugars and proteins, fats etc.

Additional Knowledge:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6-9</td>
</tr>
<tr>
<td>BOD</td>
<td>50Mg/L</td>
</tr>
<tr>
<td>COD</td>
<td>250Mg/L</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>50Mg/L</td>
</tr>
<tr>
<td>Oil and grease</td>
<td>10Mg/L</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>10Mg/L</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>2Mg/L</td>
</tr>
</tbody>
</table>

TREATMENTS OF EFFLUENT

Pretreatment of effluents comprises of screening, flow equalisation, neutralisation and air flotation, followed by biological treatment. If space is available, land treatment or pond systems are potential treatment methods. Pretreated dairy effluents can be discharged to a municipal sewage system.

Additional Knowledge:

Other possible biological treatment systems include trickling filters, rotating biological contactors and activated sludge treatment.

ASSESSMENT ACTIVITIES

- Assessment of participation in market survey and evaluation of survey report.
- Seminar presentation
- Participation in preparation of dairy by-products.
- Participation in group discussion.

LIST OF ITEMS IN PORTFOLIO

- Survey report.
- Photography of preparation of products.
- Seminar report.
TE Questions

1. Distinguish acid casein and rennet casein  
   (4)
2. Disposal of whey is a major problem faced by the cheese manufacturing plant, many plant owners are ignorant of the ways in which whey can be utilized. As a student of dairy suggest a suitable method, you think the best, to utilize the whey.  
   (4)
3. Whey is used for the production of fermented beverages. List out four commercially available whey beverages.  
   (2)
4. Match the following  
   (2)

<table>
<thead>
<tr>
<th>Main product</th>
<th>By-product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cream</td>
<td>Buttermilk</td>
</tr>
<tr>
<td>Butter</td>
<td>Ghee residue</td>
</tr>
<tr>
<td>Ghee</td>
<td>Whey</td>
</tr>
<tr>
<td>Chhana/Paneer</td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
</tr>
<tr>
<td>Casein</td>
<td>Skim milk</td>
</tr>
</tbody>
</table>
Unit 3.9: Quality Assurance

**Quality assurance (QA)** is a way of preventing mistakes or defects in manufactured products and avoiding problems when delivering solutions or services to customers; which ISO 9000 defines as "part of quality management focused on providing confidence that quality requirements will be fulfilled".

Quality assurance comprises administrative and procedural activities implemented in a quality system so that requirements and goals for a product, service or activity will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. This can be contrasted with quality control, which is focused on process output.

**UNIT GRID**

<table>
<thead>
<tr>
<th>IDEAS/ CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current awareness on quality and safety of dairy foods</td>
<td>The learner will be able to: Identify and aware of quality and safety of dairy food</td>
<td>• Instructio nal video • Market survey</td>
<td>• Spot question • Record • Problem solving</td>
</tr>
<tr>
<td><strong>SKILLS:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Data collection skill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Observation skill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Analyzing skill</td>
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<td></td>
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<tr>
<td>• Recording skill</td>
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<td></td>
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</tr>
<tr>
<td>• Responding skill</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>IDEAS/ CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HACCP, GMP, IS0 standards, FSSAI, AGMARK, MMPO, PFA:</td>
<td>Identify and analyse different standards.</td>
<td>• Instructio nal video • Market survey • Chart preparatio n • Instructio nal lectures</td>
<td>• Survey report • Spot question</td>
</tr>
<tr>
<td><strong>SKILLS:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Data collection skill</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| SKILLS: | Actionplan to avoid hazards:  
Briefing of importance of hygienic precautions to be taken right from the milking of cattle (farm to consumer)  
|----------|-----------------------------------------------------------------|
| • Observation skill  
• Analyzing skill  
• Recording skill  
• Responding skill  
| • Aware of action plan to avoid hazards  
• Apply of hygienic precaution s  
| • Videos  
• Charts  
• Pictures  
• Field visit  
| • Spot questions  
• Record  
• Visit report  

| SKILLS: | Milk borne diseases (pathogens) - public health significance  
|----------|-----------------------------------------------------------------|
| • Observation skill  
• Analyzing skill  
• Recording skill  
• Responding skill  
| • Identify and classify milk born milk borne diseases  
• Recomme nd remedial measures  
| • Videos  
• Charts  
• Pictures  
• Field visit  
| • Chart  
• Visit report  

- Milk borne diseases (pathogens) - public health significance
- SKILLS:  
  - Data collection skill.  
  - Observation skill.  
  - Analyzing skill.  
  - Differentiating skill.
- Actionplan to avoid hazards:  
  - Briefing of importance of hygienic precautions to be taken right from the milking of cattle (farm to consumer)  
  - SKILLS:  
    - Observation skill  
    - Analyzing skill  
    - Recording skill  
    - Responding skill  
  - Aware of action plan to avoid hazards  
  - Apply of hygienic precautions  
  - Videos  
  - Charts  
  - Pictures  
  - Field visit  
  - Spot questions  
  - Record  
  - Visit report
### Cold chain in milk preservation

**SKILLS:**
- Data collection skill
- Observation skill
- Analyzing skill
- Recording skill
- Responding skill

- Aware about the importance of Cold chain in milk preservation

- Instructio nal video
- Instructional lectures
- Dairy plant visit

- Visit report
- Spot questions

### Automation in dairy plants-quality control lab, bulk vending machines

**SKILLS:**
- Data collection skill
- Observation skill
- Recording skill
- Responding skill

- Aware about automation

- Instructio nal video
- Instructional lectures
- Dairy plant visit

- Spot questions
- Record
- Visit report

---

#### UNIT IN DETAIL

#### LEARNING OUTCOME

**3.9.1** Identify and aware of quality and safety of dairy food

#### CONCEPT

Current awareness on quality and safety of dairy foods

Objectives and importance of quality assurance:

Quality Assurance is important,

— To maintain legal standards and legal requirements.
— To fulfil customer’s requirement in terms of various attributes like
• Physical (body, texture, colour, etc).
• Chemical composition.
• Microbiological standards.
• Safety.
• Consumers should get what they pay for.
• This leads to increased consumer satisfaction and less complaints.
  — To check adulteration in incoming material in order to prevent substandard product, hazards or problems in the process.
  — To check efficiency of processes like heating, cooling, removing hardness from water, effluent treatment etc.
  — To safeguard nutritive value of milk and milk products.
  — To check wastage of material.
  — To help in research and developments.
  — To ensure general cleanliness and sanitation in factory premises.

Benefits of following quality assurance:

• Reduction in unit cost of production
• Reduction in wastage and scrape
• Less complaints from customer
• Avoids repeated inspection
• Increases production since rejection reduces
• Efficiency of unit goes up
• Management gets proud place in society
• Boost employee’s morale
• Reduction in production bottlenecks

Additional Knowledge:

<table>
<thead>
<tr>
<th>Basic principles of TQM (Total Quality Management)</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Be customer focused – place the customer at the centre of everything you do</td>
</tr>
<tr>
<td>— Do it right first time and every time- quality first and always</td>
</tr>
<tr>
<td>— Communicate and educate the people and retain them</td>
</tr>
</tbody>
</table>

LEARNING OUTCOME

3.9.2 Identify and analyse different standards.

CONCEPT

HACCP, GMP, IS0 standards, FSSAI, AGMARK, MMPO, PFA:

Introduction:

HACCP, GMP, IS0 standards, and FSSAI are QA systems that focus on processes; i.e. process organisation, process control and process
improvement. Quality systems are of two types - obligatory and voluntary. HACCP is obligatory in developed countries for food sectors to ensure safe products to consumers. Other quality management systems, such as ISO, can be used in enterprises on a voluntary basis. However, many food processing and packaging companies are trying to move towards world class quality by building a solid structure using a number of systems together, such as GMP, HACCP, and the ISO family, on a voluntary basis.

HACCP:

HACCP (Hazard Analysis of Critical Control Point) is a food safety program that was developed nearly 30 years ago for NASA, based on regulations of the United Nations Codex Alimentarius Commission (CAC) to ensure the safety of food products that were to be used by the astronauts in the space program. It is a systematic approach to the identification, evaluation, and control of steps in food manufacturing, which are critical to product safety. It identifies risks in the production processes that can lead to unsafe products, and designs measurements to reduce these risks to an acceptable level. The HACCP system establishes process control through identifying points in the production process that are most critical to monitor and control. The system can be applied to control any stage in the food system, and is designed to provide enough feedback to direct corrective activities. HACCP is guided by seven principles.

Seven principles of HACCP:

1. Identify the potential hazard(s) associated with food production at all stages, from growth, processing, manufacture and distribution, until the point of consumption. Assess the likelihood of occurrence of the hazard(s) and identify the preventive measures for their control
2. Determine the points/procedures/operational steps that can be controlled to eliminate the hazard(s) or minimize its likelihood of occurrence – (Critical control point (CCP)). A step means any stage in food production or manufacture including agricultural practice, raw material receipt, formulation, processing, storage, transport, retail and consumer handling.
3. Establish targets and tolerances which much be met to ensure that each CCP is under control
4. Establish a monitoring system to ensure control of CCP by scheduled testing or observations
5. Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control
6. Establish procedures for verification which include supplementary tests and procedures to confirm that the HACCP system is working effectively
7. Establish documentation concerning all procedures and records appropriate to these principles and their application

Monitoring of CCPs is done best by using indicators that can be measured easily.
GMP:

Good Manufacturing Practice (GMP) contains ten principles that introduce employees to critical behaviours to maintain good manufacturing practices in plants. GMP denotes all the actions that must be undertaken and conditions to be fulfilled in order to ensure that production of food, wrapping materials and other materials expected to be in contact with food, is executed in a proper way to guarantee safe end products and safe food for human consumption.

GMP deal with contamination

- by people
- by food materials
- by packaging materials
- by hazardous materials
- by miscellaneous materials

Hygiene

All employees working direct contact with food, food contact surfaces and food packaging must conform to hygienic practices. This protects against food contamination by microorganisms or unwanted material. Any behaviour that could result in food contamination such as eating, use of tobacco, chewing gum or other unhygienic practices, is not allowed in food handling areas.

GMP practices for Production employees:

- Bath daily
- No perfume, aftershave, fragrant creams
- No jewellery
- No false nails or nail polish
- Fingernails should be trimmed short
- Use metal detectable bandages covered with gloves
- No eating, drinking or chewing gum

All employees must wash their hands thoroughly:

- when they enter food handling areas
- before starting work
- after handling contaminated materials
- after breaks
- after using toilet facilities

Food Handling Practices:

Personnel
- Do not leave gloves, masks, etc. lying around while on break or at shift end.
- Crates, boxes, containers or buckets must not be placed directly on the floor.
- Store brooms and dust pans at stations provided.

**Product**

- Keep hand contact with ingredients to a minimum.
- Check ingredients for expiration dates to ensure that fresh ingredients are used.
- Cooling product should always be kept covered.

**Premises**

- Keep unscreened doors and windows closed.
- Report any pests or evidence of pests such as flies, insects, mice droppings.

**Personnel Practices**

- Do not lean, sit or step on product surfaces.
- Do not handle ingredients or products with either cut or infected hands.
- Do not engage in horseplay.
- Keep hand contact with ingredients and product to a minimum.

**Sanitation**

- Keep contact surfaces clean and free of contamination from tools, cords, cleaning utensils, machine parts, lubricants and paper.
- Clean all spills promptly.
- Keep everything off the floor and the area clean and floors swept.
- Work areas should be cleaned regularly throughout the shift.
- Keep your immediate working area swept or dust mopped. Wipe or mop up spilled liquids promptly.
- Scrape the floor around the work area after completing a job.
- Leave your work area clean at the end of your shift.

**Retail store**

- Monitor and maintain proper temperatures
- Rotate ingredients using *FIFO (First In First Out)* and check for expired items.
- Check best before dates and the quality of the food before using.
- Refrigerate cold foods immediately upon receipt.
- Sanitize equipment, cutting boards, work surfaces and utensils.
- Always wash hands after handling money.
ISO:

ISO (International Organization for Standardization) is the world’s largest developer of voluntary International Standards providing benefits for business, government and society. ISO standards ensure the safety and quality of products to protect consumers worldwide. They address issues of concern to consumers such as nutritional value, labelling and declaration, taste, hygiene, genetically modified organisms, limits on additives, pesticides, contaminants, and so on. They facilitate trade, spread knowledge, and share technological advances and good management practices. ISO standards make industry more competitive and promote global trade. They disseminate best practice and innovations so that industry does not need to reinvent the wheel, while at the same time facilitating market access to the latest technologies.

Additional Knowledge:

ISO 9000 certification process
1. Decision making and commitment of top management
2. Allocation of the available resources
3. Initial assessment of the organisation’s structure
4. Identification and analysis of the organisation’s processes
5. Documentation of the system
6. Training personnel
7. Trial of the system for a short period
8. Internal audit
9. Certification audit

FSSAI:

FSSAI (Food Safety and Standards Authority of India) has been established under Food Safety and Standards Act, 2006, which consolidates various acts & orders that have hitherto handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption. Today FSSAI has replaced PFA and is made compulsory.

Functions performed by FSSAI:

- Framing of Regulations to lay down the Standards and guidelines in relation to articles of food and specifying appropriate system of enforcing various standards.
- Laying down mechanisms and guidelines for accreditation of certification bodies engaged in certification of food safety management system for food businesses.
- Laying down procedure and guidelines for accreditation of laboratories and notification of the accredited laboratories.
- To provide scientific advice and technical support to Central Government and State Governments in the matters of framing the
policy and rules in areas which have a direct or indirect bearing of food safety and nutrition.

- Collect and collate data regarding food consumption, incidence and prevalence of biological risk, contaminants in food, residues of various, contaminants in foods products, identification of emerging risks and introduction of rapid alert system.
- Creating an information network across the country so that the public, consumers, Panchayatetc receive rapid, reliable and objective information about food safety and issues of concern.
- Provide training programmes for persons who are involved or intend to get involved in food businesses.
- Promote general awareness about food safety and food standards

**AGMARK:**

The Directorate of Marketing and Inspection enforces the Agricultural Produce (Grading and Marketing) Act, 1937. Under this Act Grade standards are prescribed for agricultural and allied products example ghee. Quality standards for agricultural commodities are framed based on their intrinsic quality. Food safety factors are being incorporated in the standards to complete in World Trade.

**AGMARK is a,**

- Quality Certification Mark.
- It ensures quality and purity of a product
- It acts as a Third Party Guarantee to Quality Certified.

**Milk and Milk Product order (MMPO):**

The objective of the order is to maintain and increase the supply of liquid milk of desired quality in the interest of the general public and also for regulating the production, processing and distribution of milk and milk products. As per the provisions of this order, any person/dairy plant handling more than 10,000 liters per day of milk or 500 MT of milk solids per annum needs to be registered with the Registering Authority appointed by the Central Government.

**Prevention of Food Adulteration Act, 1954:**

- The Act was promulgated by Parliament in 1954 to make provision for the prevention of adulteration of food. Broadly, the PFA Act covers food standards, general procedures for sampling, analysis of food, powers of authorized officers, nature of penalties and other parameters related to food.
- It deals with parameters relating to food additives, preservative, coloring matters, packing & labeling of foods, prohibition & regulations of sales etc. The provisions of PFA Act and Rules are implemented by State Government and local bodies as provided in the rules.
LEARNING OUTCOME

3.9.3 Aware of action plan to avoid milk-borne hazards and apply hygienic precautions

CONCEPT

Briefing of importance of hygienic precautions to be taken right from the milking of cattle (farm to consumer)

Concept about Clean Milk Production in farms – dealt in module 1

Safety Precautions (Quality Control) to be followed at milk processing centres.

Milk sampling:

Accurate sampling is the first pre-requisite for fair and just quality control system. Liquid milk in cans and bulk tanks should be thoroughly mixed to disperse the milk fat before a milk sample is taken for any chemical control tests. Representative samples of packed products must be taken for any investigation on quality. Plungers and dippers me used in sampling milk from milk cans.

Additional Knowledge:

<table>
<thead>
<tr>
<th>Sampling milk for bacteriological testing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling milk for bacteriological tests require a lot of care. Dippers used must have been sterilised in an autoclave or pressure cooker for at least 15 minutes at 120°C beforehand in order not to contaminate the sample. On the spot sterilisation may be employed using 70% Alcohol swab and flaming or scaling in hot steam or boiling water for 1 minute.</td>
</tr>
</tbody>
</table>

Fig: Equipments used for taking milk samples

Preservation of sample:

Milk samples for chemical tests:
Milk samples for fat testing may be preserved with chemicals like Potassium dichromate (1 Tablet or ½ ml 14% solution in a ¼ litre sample bottle is adequate.) Milk samples that have been kept cooling a refrigerator or ice-box must first be warmed in water bath at 40ºC, cooled to 20ºC, mixed and a sample then taken for butterfat determination.

Additional Knowledge:

| Other preservative chemicals include Sodium azid at the rate of 0.08% and Bronopol (2-bromo-2-nitro-1,3-propanediol) used at the rate of 0.02%. |

If the laboratory cannot start work on a sample immediately after sampling, the sample must be cooled to near freezing point quickly and be kept cool till the work can start. If samples are to be taken in the field e.g. at a milk cooling centre, ice boxes with ice packs are useful.

Labelling and records keeping:

Samples must be clearly labelled with name of farmer or code number and records of dates, and places included in standard data sheets. Good records must be kept neat and in a dry place. It is desirable that milk producers should see their milk being tested, and the records should be made available to them if they so require.

Common testing of milk:

Organooleptic tests:

The organooleptic test permits rapid segregation of poor quality milk at the milk receiving platform. No equipment is required, but the milk grader must have good sense of sight, smell and taste. The result of the test is obtained instantly, and the cost of the test is low. Milk which cannot be adequately judged organooleptically must be subjected to other more sensitive and objective tests.

Procedure:

- Open a can of milk.
- Immediately smell the milk.
- Observe the appearance of the milk.
- If still unable to make a clear judgement, taste the milk, but do not swallow it. Spit the milk sample into a bucket provided for that purpose or into a drain basin, flush with water.
- Look at the can lid and the milk can to check cleanliness.

Judgement:

Abnormal smell and taste may be caused by:

- Atmospheric taint (e.g. barny/cowy odour).
- Physiological taints (hormonal imbalance, cows in late lactation-s spontaneous rancidity).
- Bacterial taints.
- Chemical taints or discolouring.
- Advanced acidification (pH < 6.4).

Other platform tests include, (most of them covered in module 2)

- Clot on Boiling (C.O.B) Test
- Alcohol Test
- Alcohol-Alizarin test
- Acidity test
- Resazurin test
- Lactometer test
- Freezing Point Determination

The freezing point of milk is regarded to be the most constant of all measurable properties of milk. A small adulteration of milk with water will cause a detectable elevation of the freezing point of milk from its normal values of -0.54°C. Since the test is accurate and sensitive to added water in milk, it is used to detect whether milk is of normal composition and adulterated.

![Cryoscope](image)

**Fig. A** Cryoscope is used for determination of freezing point of milk.

**QUALITY CONTROL OF PASTEURISED MILK:**

When milk is pasteurised at 63°C for 30 min in batch pasteuriser or 72°C for 15 seconds in heat exchanger, continuous flow pasteurisers, ALL PATHOGENIC BACTERIA ARE DESTROYED, thereby rendering milk safe for human consumption. Simultaneously various enzymes present in milk, and which might affect its flavour, are destroyed.

In order to determine whether or not milk has been adequately pasteurised, **Alkaline Phosphatase test** is done. One of the enzymes normally present in milk phosphatase, is measured. A negative phosphatase result indicates that the enzyme and any pathogenic bacteria have been destroyed during pasteurisation. If it is positive, it means the pasteurisation process was
inadequate and the milk may not be safe for human consumption and will have a short shelf life.

Apparatus required for Alkaline Phosphatase test:

- Test tubes
- 5 mls pipettes
- 1 ml pipettes
- 100 ml volumetric flask
- 500 ml volumetric flask
- water bath at 37°C

Note: All glassware must be rinsed, cleaned, rinsed in chromic acid solution and boiled in water for 30 min.

Additional Knowledge:

<table>
<thead>
<tr>
<th>Reagents used in Alkaline Phosphatase test:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Buffer solution:</strong></td>
</tr>
<tr>
<td>0.75g anhydrous sodium carbonate and 1.75g Sodium bicarbonate in 500 ml distilled water are mixed together.</td>
</tr>
<tr>
<td><strong>Buffer-substrate solution:</strong></td>
</tr>
<tr>
<td>Place 0.15g of di-sodium paranitrophenylphosphate(the substrate) into a clean 100ml measuring cylinder.</td>
</tr>
<tr>
<td>Add the buffer solution to make to 100 ml mark.</td>
</tr>
<tr>
<td>Store this buffer-substrate solution in a refrigerator and protected against light. It should not be used after one week. Prepare a fresh stock.</td>
</tr>
</tbody>
</table>

Procedure:

Pipette 5ml buffer-substrate solution into a test tube, stopper and warm the solution in the water bath at 37°C. Add to the test tube 1ml of the milk to be tested, stopper and mix well and place in water bath at 37°C. Prepare a blank sample from boiled milk of the same type as that undergoing the test. Incubate both the test samples and the blank sample at 37°C for 2hrs. After incubation, remove the tubes and mix them thoroughly.

Place one sample against the blank in a Lovibond comparator and rotate the disc until the colour of the test sample is matched and read the disc number.

Interpretation:

<table>
<thead>
<tr>
<th>Disc Reading after 2 hours incubation at</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>37°C</td>
<td>Properly pasteurised</td>
</tr>
<tr>
<td>0-10</td>
<td>Slightly under pasteurised</td>
</tr>
<tr>
<td>10-18</td>
<td>UNDER PASTEURISED</td>
</tr>
<tr>
<td>&gt; 42</td>
<td>NOT PASTEURISED</td>
</tr>
</tbody>
</table>

LEARNING OUTCOME

3.9.4    Aware about the importance of Cold chain in milk preservation

CONCEPT

Cold chain logistics must be carefully monitored and managed in order to maintain high quality milk and dairy products. Any breach of the cold chain can have a severe impact on product quality, causing problems such as sourness, unpleasant taste and odour, texture and appearance problems, aggregation, colour changes, pH reduction, and health risks associated with bacterial growth.

The recommended temperature for preserving optimal freshness and taste in milk and dairy products is 0-4°C (32-36°F). Maintaining this narrow temperature range is critical during every stage of transport from the dairy farms to the supermarket shelves. Studies have shown, for example, that every 2°C (35°F) increase in the storage temperature of milk reduces its shelf life by 50%. Statistically, breaks in the milk and dairy cold chain occur most often during truck loading/unloading and supermarket stocking.

India's poor road network and lack of investment in cold chain infrastructure have long challenged the country’s dairy industry, highlighting the value for companies of undertaking the tough task of establish their own milk collection.

Lack of cold chain infrastructure leads to lots of inefficiencies like:

- About 20 per cent of all foods produced in India are wasted
- The producer’s share in the domestic consumer’s retail price is only 25% where as it is 50% in developed countries.

A good cold chain management should result in the consumer receiving fresh and high quality products, leading to greater customer satisfaction and increased demand. The export of fresh produce often involves long journey times and frequent handling. This makes effective cold chain management more difficult since the breakdown in temperature control at any stage will affect the final quality of the product.
Cold Chain network:

i) At the farm

Quality control and assurance must begin at the farm. This is achieved through farmers using approved practices of milk production and handling; and observation of laid down regulations regarding, use of veterinary drugs on lactating animals, regulations against adulterations of milk etc.

ii) At Milk collection Centres

All milk from different farmers or bulked milk from various collecting centres must be checked for wholesomeness, bacteriological, and chemical quality.

iii) At the Dairy Factories

Milk from individual farmers or bulked milk from various collecting centres should be checked for good quality.

iv) Within the Dairy Factory

Once the dairy processing unit has accepted the farmer milk, it has the responsibility of ensuring that the milk is handled hygienically during processing. It must carry out quality assurance test to ensure that the products produced conform to specified standards as to the adequacy of effect of processes applied and the keeping quality of manufactured products. A good example is the phosphatase test used on pasteurised milk and the acidity development test done on U.H.T milk.

v) During marketing of processed products

Public Health authorities are employed by law to check the quality of food stuffs sold for public consumption and may impound substandard or contaminated foodstuffs including possible prosecution of culprits. This is done in order to protect the interest of the milk consuming public.

Supply chain in Indian Dairy Industry:

Steps are:

1. Supply of inputs for dairying in form of fodder, animal feed plant, veterinary aids for the animal (cattle and buffaloes).

2. Milk is taken out from the milching animal on the daily basis by the dairy farmers (large, medium and small scale farmers).

3. Collection of milk by collection centres (various milk co-operatives societies).
4. Milk collected by the cooperative societies are sent to the dairy plants where chilling of milk, processing and packaging of milk and milk product, transportation of milk and milk product is carried out.

5. The transportation of chilled milk and milk products from one place to another is done through the means of refrigerated vans, or insulated milk tankers vans of private, government and cooperatives societies.

6. Final processed milk and milk products are transported to various retail outlets, supermarkets, and to retail markets from where the processed milk and milk products finally reaches to their end customers.

Issues and challenges in the supply chain of dairy industry:

Issues and Challenges at the Procurement stage:

1. Meeting seasonal spikes in demand and ability to measure the quality of procured milk at the source.

2. Complex logic of payments to producers based on fat, solid non-fat (SNF) and quality of milk received.

3. Keeping track of truck and tanker routes, as well as capabilities for viewing, monitoring and payment based on route or distance.

4. Visibility into the shelf life and stock-outs of raw material.

LEARNING OUTCOME

3.9.5 Aware about automation in dairy plants.

CONCEPT
Automation in dairy plants-quality control lab, bulk vending machines

Introduction:

Automation is a system of operation of instruments by the control unit and sensing device. The application of automation to plant operations is done by computer and its related components. The use of instruments reduces dependence on human effort and is more dependable. Till the 1970s, milk preservation and processing facilities in villages were either absent or limited by capacity constraints, and considerable amount of milk was wasted. This in turn resulted in possible loss of income for milk farmers. Then came the white revolution brought on by Operation Flood, often regarded as one of the world’s largest rural development programs and credited with making India one of the world’s largest producers of milk. Bringing the farmers under the organized sector of the milk cooperatives has helped standardize milk production in the country and greatly improved the quality of milk that reach
our homes. Access to bulk milk coolers and milk processing technologies that convert milk into other dairy products with a longer shelf life have not only reduced losses due to the perishability of milk but also opened up new markets for surplus milk production. The development of **intelligent automation solutions** for dairy industry companies demands more than just system know-how.

Types of automation in a dairy plant:

- Decentralised (semi-automatic)
- Centralised (fully automatic)

In decentralised automation system, individual sections of the plant is operated on separate automatic controls. In centralised system, all controls are located at a central point.

Advantages of automation:

- Uniform high product quality
- Better process control.
- Economical production.
- Improved working conditions.

**Automation for dairy lab:**

Automation is a system of operation of instruments by the control unit and sensing device. The application of automation to plant operations is done by computer and its related components. The use of instruments reduces dependence on human effort and is more dependable. Till the 1970s, milk preservation and processing facilities in villages were either absent or limited by capacity constraints, and considerable amount of milk was wasted. This in turn resulted in possible loss of income for milk farmers. Then came the white revolution brought on by Operation Flood, often regarded as one of the world’s largest rural development programs and credited with making India one of the world’s largest producers of milk. Bringing the farmers under the organized sector of the milk cooperatives has helped standardize milk production in the country and greatly improved the quality of milk that reach our homes. Access to bulk milk coolers and milk processing technologies that convert milk into other dairy products with a longer shelf life have not only reduced losses due to the perishability of milk but also opened up new markets for surplus milk production. The development of **intelligent automation solutions** for dairy industry companies demands more than just system know-how.

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- Better process control.
- Economical production.
- Improved working conditions.

**Automation for dairy lab:**
A large dairy laboratory can process thousands of milk samples per day. Accomplishing the chemical analysis in a correct and efficient manner can make the test results more reliable and the lab more profitable. Towards this end, Advanced Instruments has been developed, to produce a milk analysis system coupled with automated sample handling robotics. Some automated instruments are humidity chambers, analysis kits, digital pH meter, digital colorimeter, laminar flow benches, microplate reader etc.

**Milk vending machine:**
Milk vending stations have been available since the 1980s. With the rise of environmental concerns, consumers wished to reduce packaging waste by buying bulk products, where appropriate. Customers bring their own containers and refill them. Bulk milk can be less expensive than packaged milk. Some farms and dairies also provide dispensers for specialties like milk with a natural fat content. Initially coin-operated only, modern machines incorporate up-to-date cash systems such as credit or debit card readers. They transmit data to the operator by a mobile phone link and alert the service staff when the product runs low or technical problems occur. Stainless steel milk tankers on the road have made people associate dairy operations with stainless steel for decades. No wonder milk vending stations involve stainless steel in both the milk-contact surfaces and the body. The machines are suitable for indoor and weather-protected outdoor locations. Milk is one of the most sensitive foodstuffs of all. Perfect hygiene and rigorous temperature control are prerequisites of a safe supply chain. Proper logistics of bulk milk can be a challenge in rural areas. For the flexible delivery of fresh milk in India, a farming company developed a novel system. Thermally insulated stainless steel mobile milk vending machines are mounted on vehicles. The tanks are filled with milk at the dairy and sealed with password protected digital locks to prevent tampering. The milk is dispensed at the customer’s doorsteps through an automatic vending machine attached to the mobile tank.
ASSESSMENT ACTIVITIES

- Dairy plant visit to study the cold chain in milk storage and automation in dairy plants and assessment of participation in activities and evaluation visit report.
- Assessment of participation in market survey and evaluation of survey report.
- Participation in group discussion.

LIST OF ITEMS IN PORTFOLIO

- Dairy plant visit report
- Market survey report

TE QUESTIONS:

1. Expand the following
   HACCP,GMP,TQM,I
   SO

2. Suppose you are working in the production section of a dairy plant, what are the GMP practices to be followed by the employee (you) ?

3. HACCP is based on …………..principles.

4. Enlist seven principles of HACCP.

5. Suppose You are starting a dairy plant with 15000 litres. Whether MMPO registration is required ?. Explain with reason.


7. Name a milk product with Agmark standards?.

EXTENDED ACTIVITIES:

- Dairy plant visit to visualize and practice the commercial preparation of dairy products.
- Conduction of Expo and marketing of prepared products
- Market survey on different brands of dairy products available in the mar-ket.
OVERVIEW

India ranks first among the world’s milk producing Nations since 1998 and has the largest bovine population in the World. Milk production in India during the period 1950-51 to 2014-15, has increased from 17 million tonnes to 146.3 million tonnes as compared to 137.7 million tonnes during 2013-14 recording a growth of 6.26 % FAO reported 3.1% increase in world milk Production from 765 million tonnes in 2013 to 789 million tonnes in 2014. The per capita availability of milk in the country which was 130 gram per day during 1950-51 has increased to 322 gram per day in 2014-15 as against the world average of 293.7 grams per day during 2013. This represents sustained growth in the availability of milk and milk products for our growing population. Dairying has become an important secondary source of income for millions of rural families and has assumed the most important role in providing employment and income generating opportunities particularly for marginal and women farmers. Most of the milk is produced by animals reared by small, marginal farmers and landless labourers. The milk produced in the area was being purchased by middlemen, contractors or private agencies at low cost and the same was being sold to the consumers or Government organizations with high margin of profit. The profit from milk sale so gained was being distributed only among few persons, who never bothered to invest these profits for the producers’ benefit or dairy development activities. Additionally during flush season because of ample supply of milk the middlemen used to offer still lower prices for milk to the producers forcing either to convert milk into uneconomical products or alternately heeding to the middlemen’s demand resulting in very low return for milk, which was always below the cost of production. The surplus milk converted into products and no market value for the by-products obtained was leading to unnecessary wastage. This was the system which was replaced by the ‘Anand Pattern’.
UNIT-WISE DETAILING

UNIT : 4.1 INTRODUCTION TO DAIRY EXTENSION

Introduction

Dairy extension is an educational process for bringing desirable changes among the dairy stakeholders, which involves both learning, & teaching and needs some tools or methods commonly known as extension-teaching methods. It is, therefore, necessary here to understand what is meant by learning, teaching & extension methods. Fundamental objective of extension education is the overall development of the rural people. The ultimate objective of dairy extension education is development of dairy stakeholders by improving their living standards.

The following are the general objectives of extension:

1. To assist people to discover and analyze their problems and identify their needs.
2. To develop leadership among people and help them in organizing groups to solve their problems.
3. To disseminate research information of economic and practical importance in a way people would be able to understand and use.
4. To assist people in mobilizing and utilizing the resources which they have or need from outside.
5. To collect and transmit feedback information for solving management problems.

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/ CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
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<td>Basics of dairy extension:</td>
<td>The learner will be able to;</td>
<td>• Group discussion</td>
<td>• Seminar</td>
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<td>➢ Objectives</td>
<td></td>
<td>• Market survey</td>
<td>• Group discussion</td>
</tr>
<tr>
<td>➢ Relevance in dairy industry</td>
<td></td>
<td>• Instructional lectures, chart.</td>
<td>• Test, chart/graph preparati on, record</td>
</tr>
<tr>
<td>SKILLS:</td>
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<tr>
<td>• Data collection skill</td>
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<td>• Observation skill</td>
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<td>• Analyzing skill</td>
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<td></td>
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<tr>
<td>• Listening skill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension teaching methods – introduction to audio visual aids</td>
<td>• Interact with farmers • Choose and apply various visual aids to</td>
<td>• Survey reports via census journals/ internet / Instructional audio/video, market survey, instructional lectures.</td>
<td>• Seminar</td>
</tr>
<tr>
<td>➢ Use of audio aids in dairy extension</td>
<td></td>
<td></td>
<td>• Group discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Test, chart/graph preparati on, record</td>
</tr>
</tbody>
</table>
activities
- Use of visual aids in dairy extension activities
- Charts
- Posters
- Bulletins

SKILLS:
- Data collection skill
- Observation skill
- Analyzing skill
- Comparison skill
- Listening skill
- Writing skill
- Oral presentation skill
- Decision skill

impart the extension education concepts
- Choose and apply various audio aids to impart the extension education concepts
- Prepare charts, posters and bulletins

- Group discussion
- Preparation charts, posters and bulletins

record, presentation.
- Equipment handling

Handling of audio-visual aids
- Basic idea about operating a camera, OHP projector, TV and multimedia

SKILLS:
- Observation skill
- Analyzing skill
- Comparison skill
- Listening skill
- Writing skill
- Oral presentation skill

- Operate a camera, OHP projector, TV and multimedia

- Group discussion
- Market survey
- Instructional lectures, chart.
- Demonstration and practice

- Seminar
- Group discussion
- Tests, record, presentation
- Methodology demonstration
- Equipment handling

UNIT IN DETAIL

LEARNING OUTCOME

4.1.1 Interact with farmers and apply the dairy extension education concepts

CONCEPT

Basics of dairy extension:

- Objectives
- Relevance in dairy industry
Dairy Extension Education is the process of educating dairy stakeholders how to live better by learning ways to improve their farm, home and community institutions.

Dairy Extension Education is helping people to help themselves in changing their behaviour (knowledge, attitude and skill), in a desirable direction, in order to bring overall development in an individual, his family, his community and thereby for the nation.

But the task developing an individual is not so easy. For this, an Extension Educator is to be a teacher, guide, friend and philosopher to the villagers/dairy stakeholders. Thus, if one aspires to be an Extension Educator, he must be processing an attitude and aptitude essentially demanded by the profession (i.e. interest and ability to work for the villagers) in addition to having a sound knowledge and understanding of the subject. Thus, it can be a challenging profession with a satisfaction for the work done.

The Dairy Extension Education focuses on the applied dimension of education by extending and applying knowledge and problem-solving to address individual and community issues in the field of dairying. The foundation of Dairy Extension Education is responding to priority needs by involving the dairy stakeholders.

LEARNING OUTCOME

4.1.2 Interact with farmers, choose and apply various visual aids to impart the extension education concepts

CONCEPT

Extension teaching methods – introduction to audio visual aids

- Use of audio aids in dairy extension activities
- Use of visual aids in dairy extension activities
- Charts
- Posters
- Bulletins

AUDIO-VISUAL-AIDS

Introduction

There are a number of audio-visual aids that could be used in our day-to-day life. This unit will focus on selected audio-visual aids that are normally available and accessible to the users. The term audio-visual aid refers to anything that an extension professional uses to help to convey the message when communicating with his clientele. The spoken words are the main
communication tools. However, when the extension professional is speaking to a large village meeting or discussing a problem in a field with a group of farmers, its impact and effectiveness can be greatly enhanced by the use of suitable audio-visual aids. Audio-visual aids are instructional devices through which the messages can be heard and seen, simultaneously.

**Audio-Visual Aids:**

An audio aid is an instructional device in which the message can be heard but not seen.

A visual aid is an instructional or communicating device in which the message can be seen but not heard.

An audio-visual aid is an instructional device in which message can be heard as well as seen.

**Functions of Audio-Visual Aids**

- Convey meaning clearly
- Capture attention, arouse and sustain interest
- Enhance the correctness, clarity and effectiveness of the idea and skills being transferred
- Help in learning more, faster, and with thoroughness
- Help in remembering for a longer period
- Reach more people, irrespective of their level of literacy or language
- Save the instructor’s time
- Reduce the possibility of misinterpreting concepts
- Clarify the relationship between material objects and concepts
- Supplement the spoken word - the combination of audio and visual stimuli is particularly effective since the two most important senses are involved
- Highlight the main points of the message clearly.

**Limitations of Audio-Visual Aids**

Learners may sometimes form distorted impressions, unless audio-visual aids are supplemented with required explanations.

They may tempt the instructor to narrow down his teaching to only a few big ideas, not giving the complete picture of a subject.

Some instructors acquire the mistaken notion that they have little to do when audio-visual aids are used.

**Important Audio-Visual Aids:**

Audio-Visual aids are supporting materials & they alone cannot generate learning. They should be considered only a tool that helps to do a job in a better way. Visual aids are of different types. The following are the more commonly used ones in India:

1 **Posters**
A good poster creates awareness & interest among the people. It inspires & takes people towards action. It consists of 3 main parts. The first usually announces the purpose or the approach, the second sets out conditions, & the third recommends action. A poster should be bold enough to attract attention of the people, & should communicate only one idea at a time. It should have simple letters which are clear & forceful. The size of a poster should not be less than 50 X 75 cm.

2 Flannel graphs

Flannel graphs serve as a good teaching aid when a piece of sandpaper is fixed to the back of a picture, a photograph, a letter, etc. They can be made to adhere easily to a piece of thick flannel cloth, fixed on a board. They are used as an aid for group methods like informal talks or lectures.

3 Flash cards

Flash cards are a set of small compact cards approximately 30 to 45 cm. in size, and are used to bring home an idea, such as the benefits of a smokeless chulha, the rearing of cross breed cows, compost-making and other practices. Pictures on the theme are drawn on these cards in a logical sequence, which are then flashed before the audience. Upon seeing them, the villagers are able to follow a story more easily.

4 Puppets

Puppets are very popular and especially suitable for village situations. Puppet shows can be effectively organised to gather the rural people. For a puppet show, a short story, brief scenes and quick dialogues are necessary. Such shows can teach a lesson about any specific topic like animal health, literacy, or home-making.

5 Models

Models create a sense of realisation in a person. Models of new farm equipments, compost pits, sanitation devices and animals are mostly prepared for those people who are not in a position to see them in the actual form. They are used to create interest, promote understanding and influence the people to adopt a certain practice.

6 Bulletin-boards

A bulletin-board can serve the purpose of making announcements, displaying events of short duration & photographs of local activities. The information should be written in simple language.

7 Photographs

They are a very simple visual aid. Good photographs show some action & catch the feelings & emotions of the people. They are so arranged that they tell a story. They are displayed on a bulletin-board at a common meeting-
place where a large number of people can see them. They should be clear & bold in composition with proper captions. One good picture is perceived as equivalent to 1000 words.

8 Cultural programmes
Local cultural programmes, such as folk-songs & dramas, are used as an effective medium of communicating the message of development programmes. Dramatization of a theme or story creates a lively interest among the audience. Folk-songs & dances related to the subjects of local interest & importance, when acted on the stage, bring them home more forcefully.

LEARNING OUTCOME
4.1.3 Operate a camera, OHP projector, TV and multimedia

CONCEPT
Handling of audio-visual aids -Basic idea about operating a camera, OHP projector, TV and multimedia

- Basic knowledge about operating a camera
- Basic knowledge about operating an Over Head Projector (OHP)
- Basic knowledge about operating a TV
- Basic knowledge about multimedia

LISTS OF PRACTICALS
Handling of Audio-visual aids- Camera, 0HP, T.V, slide projector and multi-media. Preparation 0f charts, posters and bulletins

ASSESSMENT ACTIVITIES:
Seminar on different audio visual aids
Students are divided into one group asked to prepare a chart of functions of extension and other group limitations of extension education.
Class tests, record, presentation
Methodology demonstration – a topic of dairy extension is given and asked to take a demonstration class to farmers.
Equipment handling-like camera, multimedia projector, OHP projector

TE QUESTIONS
1. Audiovisual aids are the most powerful aid
activities. Comment on the statement. (hint: functions and limitations)

2. Dairy extension education helps to educate to live better by learning ways to improve their farm, home and community institutions explain your opinion.

UNIT: 4.2 DAIRY CO-OPERATIVE MANAGEMENT

The milk produced in the area was being purchased by middlemen, contractors or private agencies at low cost and the same was being sold to the consumers or Government organizations with high margin of profit. The profit from milk sale so gained was being distributed only among few persons, who never bothered to invest these profits for the producers' benefit or dairy development activities. Additionally during flush season because of ample supply of milk the middlemen used to offer still lower prices for milk to the producers forcing either to convert milk into uneconomical products or alternately heeding to the middlemen's demand resulting in very low return for milk, which was always below the cost of production. The surplus milk converted into products and no market value for the by-products obtained was leading to unnecessary wastage. This was the system which was replaced by the 'Anand Pattern'. This chapter deals with the evolution of Anand pattern and various other schemes developed for the well-being of dairy farmers.

UNIT GRID

<table>
<thead>
<tr>
<th>IDEAS/CONCEPT/SKILLS</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
</tr>
</thead>
</table>
| Livestock development programmes - five year plans | • Compare and evaluate various development programmes and five year plans | • Visit to livestock farms and observe the implementation of various programmes | • Visit report  
• Seminar  
• Record |
| SKILLS:  
• Data collection skill  
• Observational skill  
• Analyzing skill  
• Listening skill | | | |
<p>| Operation flood programme | • Analyze the achievements of white | • Interactive lectures, Instructional | • Situational analysis, Record, |</p>
<table>
<thead>
<tr>
<th>SKILLS:</th>
<th>revolution and its achievements</th>
<th>videos</th>
<th>• Test/quiz,</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data collection skill</td>
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<tr>
<td>• Analyzing skill</td>
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<tr>
<td>• Understanding skill</td>
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<tr>
<td>• Evaluate and recommend the requirements of a dairy cooperative society</td>
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<tr>
<td>• Visit a successful dairy cooperative society and study the operations, Instructional lecture, Diagrams, sketches</td>
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<tr>
<td>• Situational analysis</td>
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<tr>
<td>• Evaluation of plan and design of dairy cooperative society,</td>
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<td>• record /chart</td>
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<tr>
<td>• Test/ quiz</td>
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<thead>
<tr>
<th>Formation of dairy co-operatives</th>
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<tbody>
<tr>
<td>Basic requirements of a dairy cooperative society</td>
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<tr>
<td>Registration of a dairy cooperative society</td>
</tr>
<tr>
<td>SKILLS:</td>
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<tr>
<td>• Data collection skill</td>
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<tr>
<td>• Observation skill</td>
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<tr>
<td>• Decision skill</td>
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<td>• Implementing skill</td>
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<td><strong>tation/Activity skill</strong></td>
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<table>
<thead>
<tr>
<th><strong>Registers and records maintained in the society</strong></th>
<th><strong>Maintenance of accounts of dairy co-operative societies</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Evaluate and draw the sketches of various registers maintained in a society</td>
<td>• Analyse and study the accounts maintained in a society</td>
</tr>
<tr>
<td>• Visit a successful dairy co-operative society note the various registers maintained</td>
<td>• Visit a successful dairy co-operative society note the accounting system</td>
</tr>
<tr>
<td>• Visit report • Seminar • Record</td>
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UNIT IN DETAIL

LEARNING OUTCOME

LEARNING OUTCOME

4.2.1 Compare and evaluate various development programmes and five year plans

CONCEPT

Livestock development programmes- five year plans

Introduction: The five-year plan in India is framed, executed and monitored by the Planning Commission of India, which is headed by the Prime Minister. Currently, India is in its 11th five-year plan. A glimpse of the five-year plans of our country, along with the respective objectives in each plan, is as under:

Five-Year Plans:

First five year plan

In the First five year plan (1951-56) the dairy development programme started in a small way. The main activities of the dairy development programme were to supply the good quality milk under hygienic conditions to big cities. This was supported by the scheme of procurement of milk from rural areas. In this plan period dairy development activities were started in Andhra Pradesh, Bihar, Madhya Pradesh Orissa, Tamil Nadu and Uttar Pradesh. 146 key village blocks having the facility of artificial insemination was established. 650 veterinary hospitals and 25 gosadans were also established. The milk supply scheme was started in two metro cities i.e.
Bombay and Calcutta. In this plan period, total production of milk in the country was 18 million tonnes. During this plan period, in 1955, the Indian Dairy Research Institute was transformed into the National Dairy Research Institute (NDRI). Its headquarter was shifted to Karnal from Bangalore.

**Second five year plan**

In the second five year plan (1956-61) certain specific objectives relating to production, marketing and consumption was laid down. In this plan period major thrust was given on quality control and paying remunerative price to both milk producer as well as consumer. It favored the establishment of milk producer co-operative societies at village level to ensure supply of milk to city dairies, creameries and milk drying plants. In this plan period, it was envisaged to establish dairy factory at Anand, the Delhi milk supply scheme, 36 milk plants, expansion of existing 114 key village blocks and 670 Artificial Insemination center, 34 new gosadans, 248 goshalas, 1900 veterinary hospitals. The plan promoted the three private entrepreneurs: Glaxo, Levers and Nestle to establish milk product plants. In the first five year plan NDRI, Southern region station at Bangalore was established. In this plan expansion of the same was carried out. During the second plan period, seven liquid milk plants were completed and eight pilot schemes, three milk creameries and two milk product factories were taken up. In addition, civil works on 31 milk supply schemes were on the verge of completion.

**Third year plan**

The major objective of third five year plan (1961-66) was to develop dairy projects emphasizing milk production in rural areas linked with plants for marketing surplus milk to urban centers. This plan emphasized the need to collect milk by a network of village milk producer’s co-operative societies and to organize manufacture and marketing of milk and milk products on co-operative lines. The efforts and money invested on dairying in earlier two plan periods have yielded appropriate results but still the major problem confronting the dairy industry was the absence of public participation.

Hence, the plan felt the need of cooperatives and the establishment of separate dairy development departments in each state. One of the most important highlight of this plan period was the establishment of National Dairy Development Board, at Anand in 1965.

**Fourth five year plan**

In the Fourth Five Year Plan (1969-74) target was kept to set up 49 milk supply schemes, 11 milk product factories and 43 rural dairy centers. Of these 6 milk supply schemes, 2 milk product factories and 32 rural dairy centers were commissioned. The cross breeding in cattle with exotic dairy breeds was taken up on a large scale during the plan by establishing frozen semen stations. The project operation flood was conceived and formulated by National Dairy Development Board in this plan Period.
**Fifth five year plan**

By 1974, 100 Dairy Plants and 62 pilot dairy schemes were set up. Of these 100 dairy plants, 94 were managed by government either through state dairy development corporations or by government department. By 1975, expansion work to increase the capacities of dairy plants in the four metros was completed and two large new plants were commissioned in Bombay and Delhi. A new large plant for Madras was also established and construction of a similar plant for Calcutta was in progress. Apart from these, establishment of 13 new plants and expansion of the capacity of 7 existing rural dairy plants acting as feeder balancing units was also planned. Probably for the first time more and appropriate attention was paid to the function of research and development in the field of dairying during fifth five year plan (1974-79). During this plan period for the benefit of farmers particularly of weaker sections of Gujarat, Maharashtra, Uttar Pradesh and Orissa, a Project on Cattle breeding, farm forestry and food for work programme was taken up.

**Sixth five year plan**

Sixth Five year Plan (1980-85) laid special emphasis on projects for increasing the productivity of various indigenous species of livestock through genetic improvement and better healthcare. In this plan period necessary steps were taken to make available reliable and timely statistics of livestock. During this plan, a new development project was started in Sikkim, 3 integrated cattle - cum - dairy development projects were started in Rajasthan, Madhya Pradesh and Karnataka.

**Seventh five year plan (1992-97)**

Seventh five year plan provided necessary infrastructure to achieve the accelerated growth in livestock production, providing employment and helped to strengthen animal health facilities by providing good quality fodder.

**Eighth five year plan (1992-97)**

The emphasis was laid on enhancement of the productivity of milch cattle through upgradation by cross breeding. Frozen semen technology based upon progeny bulls is a major part of the programme.

**Ninth five year plan (1997-98 to 2001-02)**

Ninth five year plan provided effective health coverage and reduced economic loses due to diseases. The plan also helped to enlarge export of livestock products.

**Tenth five year plan (2002-2007)**

The overall focus was on four broad pillars viz. (i) removing policy distortions that is hindering the natural growth of livestock production; (ii) building participatory institutions of collective action for small-scale farmers that allow them to get vertically
integrated with livestock processors and input suppliers; (iii) creating an environment in which farmers will increase investment in ways that will improve productivity in the livestock sector; and (iv) promoting effective regulatory institutions to deal with the threat of environmental and health crises stemming from livestock.

**Eleventh plan (2007-2012)**

One of the goals for the eleventh five year plan for the livestock sector was to achieve an overall growth between 6% to 7% per annum for the sector as a whole with milk group achieving a growth of 5.0% per annum. The Department of Animal Husbandry and Dairying managed large infrastructure of livestock farms and fodder production stations. Many of the infrastructures were out dated and an exercise on restructuring the existing infrastructure was taken up on priority basis. Under Dairy Development, milk producers cooperatives continued to play major role despite liberalization of the sector. However, the dairy cooperatives had to reform themselves and become competitive. NDDB set up a consortorium with NABARD and NCDC to fund the dairy cooperatives. Primary attention was given on creating infrastructure for production of clean milk and to improve the processing, marketing and transport facility. The processing capacity was expanded both in the cooperative and private sector. R & D efforts in developing process and packing technology for Indian milk products were achieved.

**POINTS TO BE DISCUSSSED**

- Brief about the various Five Year Plans

**ASSESSMENT:**

- Visit report
- Seminar
- Record

**LEARNING OUTCOME**

4.2.2 Operation flood programme

**CONCEPT**

- Aim of white revolution and its achievements
- Achievements of operation flood

**Introduction:**

Operation flood is the program related to the white revolution. Operation Flood had created a national milk grid linking milk producers throughout India with consumers in over 700 towns and cities, reducing seasonal and regional price variations while ensuring that the producer gets a major share of the price consumers pay, by cutting out middlemen. By reducing malpractices, it had helped dairy farmers direct their own development, placing control of the
resources they create in their own hands. The bedrock of Operation Flood has been village milk producers’ co-operatives, which procure milk and provide inputs and services, making modern management and technology available to members. Operation Flood’s objectives included:

- Increase milk production (‘a flood of milk’)
- Increase rural incomes
- Fair prices for consumers

**BIRTH OF AMUL**

In 1945, the farmers of Kaira district, in Gujarat went on strike, protesting against economic exploitation at the hands of contractors, who were collecting milk on behalf of the British Government. The British Government of the then Bombay province had granted monopoly over milk collection in Kaira District to a private firm called Polson Dairy, which in turn had hired contractors to do the job. The contractors paid the lowest possible price to the farmers, exploiting the minthe process. Led by Shri. Tribhuvandas Patel, the farmers sought inspiration and advice from eminent national leaders such as Sardar Vallabhbhai Patel and Morarji Desai. It was Sardar Patel who advised the farmers to form their own co-operative and was of the opinion that the farmers should control not only milk production, but also ‘procurement’, ‘processing’ and ‘marketing’. The strike succeeded in the objectives as monopolistic restrictions on procurement were removed. The colonial Government agreed to let the farmers form their co-operative, confident that the poor illiterate farmers would not be able to run their co-operative beyond two days. However, the humble organization that started with two small village level societies collecting only 247 litres of milk per day, went on to become a ‘billionlitre idea’. This is the genesis of Kaira District co-operative Milk Producer’s Union, better known to the world as ‘Amul’. Amul formed the basis for the Anand model of dairying. The basic unit in this model is the milk producer’s co-operative society at the village level. Membership is open to all who need the co-operative’s services and who are willing to accept the responsibilities of being a member. Each co-operative is expected to carry out the continuing education of its members, elected leaders and employees. All the milk co-operatives in a district form a union that, ideally, has its own processing facilities.

**REPLICATION OF ANAND PATTERN THROUGHOUT INDIA**

Dr V Kurien, was born in 1921 in Kozhikode, Kerala. After completing his education in USA, he came for Government work in India. He was deputed by the Government to the Creamery in Anand in 1949. He worked along with Shri Tribhuvandas Patel for the development of AMUL. In 1965, the then Prime Minister of India, Sri Lal Bahadur Sastri visited Anand to inaugurate a cattle feed plant. Seeing the development of AMUL and improved living status of the dairy farmers, he entrusted Dr V Kurien to replicate Anand Pattern throughout the country.
Program implementation

Operation Flood was implemented in three phases.

**Phase I**

Phase I (1970–1980) was financed by the sale of skimmed milk powder and butter oil donated by the European Union (then the European Economic Community) through the World Food Program. During its first phase, Operation Flood linked 18 of India’s premier milksheds with consumers in India’s major metropolitan cities: Delhi, Mumbai, Kolkata and Chennai. Thus establishing mother dairies in four metros.

**Phase II**

Operation Flood Phase II (1981–1985) increased the milk-sheds from 18 to 136; 290 urban markets expanded the outlets for milk. By the end of 1985, a self-sustaining system of 43,000 village cooperatives with 4,250,000 milk producers were covered. Domestic milk powder production increased from 22,000 tons in the pre-project year to 140,000 tons by 1989, all of the increase coming from dairies set up under Operation Flood. In this way EEC gifts and World Bank loan helped promote self-reliance. Direct marketing of milk by producers’ cooperatives increased by several million liters a day.

**Phase III**

Phase III (1985–1996) enabled dairy cooperatives to expand and strengthen the infrastructure required to procure and market increasing volumes of milk. Veterinary first-aid health care services, feed and artificial insemination services for cooperative members were extended, along with intensified member education. Operation Flood’s Phase III consolidated India’s dairy cooperative movement, adding 30,000 new dairy cooperatives to the 43,000 existing societies organized during Phase II. Phase III gave increased emphasis to research and development in animal health and animal nutrition.

**DAIRY DEVELOPMENT IN KERALA**

As part of the national programme, 'Operation Flood', project was started in the state in 1980. Kerala Co-operative Milk Marketing Federation (KCMMF) was formed on 25th January 1980. The federation took part in implementing OFII and OFIII in Kerala. The objectives of federation were

1. To carry out activities of production, procurement, processing and marketing of milk and milk products.
2. To manufacture balanced cattle feed and supply it to the milk producers through co-operative societies. To provide veterinary and health service to the milk producers.
3. To advise, guide, assist and control the primary milk co-operative societies in all aspects of management of the society.
(5) To impart technical knowledge and training and
(6) To provide technical, administrative, financial and other assistance to the member unions and village societies.

The project area covered the southern revenue districts of Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam and Thrissur. The programme was implemented by the Federation in collaboration with the National Dairy Development Board. With the implementation of North Kerala Dairy Projects supported by the Swiss Development Agency, the Malabar region was also covered and thus the entire state came under the network of the Anand Pattern Dairy co-operatives (APCOS).

KCMMF has three tier structure with APCOS at the base level, three Regional Milk Unions -
- Thiruvananthapuram Regional Co-operative Milk Producers Union (TRCMPU)
- Ernakulam Regional Co-operative Milk Producers Union (ERCMPU)
- Malabar Regional Co-operative Milk Producers Union (MRCMPU)

And KCMMF at the apex level. KCMMF market milk and milk products under the brand name MILMA. The management of KCMMF is vested in the Board of Directors. The members of the Board of Directors are elected by the primary societies.

**LEARNING OUTCOME**

4.2.3 Formation of dairy co-operatives

**CONCEPT**

Organisation of a Primary Dairy Cooperative

- Basic requirements of a dairy co-operative society
- Registration of a dairy co-operative society

To assess whether any project or industry would be viable in a certain area, a survey of available resources in that particular area is carried out. While conducting a survey of the villages concerning milk procurement, the following aspects are studied in detail.

- The existing cattle and buffalo population
- The production and utilization / disposal pattern of milk and milk products
- Marketing channels for surplus milk
- Returns from the sale of milk realized by the farmers
- Agricultural facilities and production patterns
- Basic amenities such as communication links, educational facilities, etc.
- Other sources of income
- Performance of other institutions including multipurpose cooperatives, etc.
- Different communities living in a village and their inter-relationship
- Other relevant information if any

Survey forms the basis for establishing any milk cooperative society. The Union’s field staff conducts the survey. The study is carried out in the village itself.

After conducting the survey, the field staff should be in a position to judge whether the people are interested in forming a cooperative society for milk or not. He should record his opinion on the format accordingly. He also decides whether the village can be considered for setting up a cooperative in the very first stage, or it should qualify for the same at a later date. This information is then submitted to the milk procurement section of the Union for review. The union analyses this information carefully. And on the basis of marks allotted to each section of information, the merit of a village is finally assessed. Depending on the merit, further action for organizing cooperative society is decided.

**Organisation and Registration of society:**

After the Survey, villages are categorised on the basis of milk potential and other related factor such as approachability and location in the proposed milk route. The milk union’s personnel initiate work pertaining to the organisation of a dairy cooperative society once the categorisations of villages are complete and proposed area for the route is decided. The State Cooperative Societies Act and Rules form the basis for organisation and registration of a society.

Normally following steps are taken to form a society:

**Organising Gram Sabha**

This involves the following activities to be undertaken:

- One person from the milk union’s procurement wing visits the selected villages and arranges meeting of villagers. This meeting is called as gram-sabha and the interested villagers participate in the same.
- A well accepted elderly person from the village is requested to preside.
- The officer / staff of the milk union explains the purpose and advantages of organising the dairy cooperative society in the village.
The principles and concept of cooperation and the activities and functioning of the society are explained.

- Once the milk producers have decided to form a milk producers’ cooperative society, an organiser is selected from amongst them.
- The organiser is authorised to collect the share subscription (as per the State Cooperative Societies Act, Rules, model by-laws of the society etc.) and entrance fee from all those milk producers who are interested in becoming members (promoters) of the society. The share collection takes a few days and normally the concerned supervisor keeps a close watch on the developments.
- After a sufficient number of milk producers become members (depending on the expected quantity of milk procurement, number of milk producers in the village etc.), the amount of share money and entrance fee is deposited to a local bank in the name of the proposed society.

**Society Organisation Meeting**

A general meeting of all the milk producers who have subscribed to the share deposit of the proposed society is convened. At this meeting, one of the members is elected as Chairman to preside over the meeting. The following issues are discussed and resolved. These resolutions are then minutes in the Proceeding Book.

- To form a milk producers’ cooperative society on the lines of bye-laws as suggested by the milk union, named ----Milk Producers’ Cooperative Society and to apply for registration in due course under the State Cooperative Societies Act. Till the registration certificate is obtained, this will be called Proposed Society.
- To decide the area of operation of the society (Revenue village, part of village, Khatian/Daag No, Tola, Hamlets etc.).
- To constitute an ad-hoc managing committee comprising members as per rule to look after the society’s affairs till the registration.
- To elect the Chairman (Chief Promoter) of the proposed society as per rule.
- To authorise the managing committee to appoint society staff for day-to-day work (normally on honorary basis for initial period). Generally at the beginning only a Secretary is appointed and then as the procurement goes up, other supporting staff are appointed. The staff should be the resident of the same village.
- To authorise the Chairman and Secretary to open a bank account in the name of the Proposed Society at the nearest branch. The Chairman and Secretary will operate this account jointly.
- To obtain tangible security from the Secretary to become eligible for operating bank account and handling of cash.
- To regularise the collection of share money and entrance fees from milk producers towards membership.
- To make the dairy cooperative society duty bound to follow all directions and suggestions given by the Milk Union to which the society desires to be affiliated.
- To collect milk from all the members and supply the same to the milk union as suggested/directed by the milk union.
- To supply the inputs on cost to the members as provided by the milk union.
- To select the milk collection centre/location/premise for the society in the village which desirably a centrally located position and accessible by most of the members.
- To procure the Milk Cans, Milk Collection and Testing equipment, Stationary, Chemicals for testing etc. before the date of commencement of milk procurement by the society.
- To decide the modalities of milk transportation (Head Load) if the society is not on the main road/lifting point of the milk truck.
- To raise fund /deposit from individual or to request milk union for an advance to facilitate quick payment in the beginning.
- It may please be noted that constitution of ad-hoc managing committee / Chief promoter, collection of the share money, application for registration etc. are governed and decided by the State Cooperative Societies Act, Rules and the Milk Union’s policy of organisation and registration of society.

**Registration of Society**

In normal circumstances a proposed society (which has been organised as per bye-laws) is allowed to function as such for a period up to which the milk union assess its attainment of sustainability. A performance review of the functioning of the society is done and if satisfied with its growth and sustainability, the milk union proposes for its registration. The proposal is recommended by the milk union and forwarded to the concerned office of the Registrar, Cooperative Societies of the State. The general procedure for preparing the proposal for registration is indicated below:

- The application form for registration is collected.
- All members including those on the ad-hoc managing committee sign the application as Promoters.
- The application is submitted to the appropriate authority for consideration along with the following documents. The requirement may vary from state to state.

**First General Body Meeting of the Registered Society:**

Once the society is registered, a general body meeting of all the members is convened by the Secretary of the proposed society with the permission /consultation of the Chairman. The following suggestive /
indicative agenda items are considered in the meeting (depending upon the state act, rules etc.).

- Selection of a person to chair this meeting.
- Thanks to the registering authority and accepting the registered bye-laws.
- Election to the regular Managing Committee and Chairman of the Society as per bye-laws.
- Regularising / terminating the existing staff / appointing new staff, if required.
- Accepting the statements of accounts for the period it functioned as a proposed society.
- Informing the bank about the registration of the society and request them to make the account of the proposed society in the name of the registered society.
- Regularisation of membership according to the bye-laws. Enrollment of new members.
- Affiliation of the society with the Cooperative Milk Union and other related organisations.
- Appointment of local auditor.

**LEARNING OUTCOME**

4.2.4 Evaluate the working of a dairy co-operative society, union and federation

**CONCEPT**

Function of a Dairy Cooperative Society (DCS)
The functions of a dairy cooperative society can be listed as follows:
1) Collection of milk twice a day from farmers.
2) Make regular payment to suppliers.
3) Dispatch the milk collected to Milk union.
4) Provide to members:
   - Balanced cattle feed.
   - Fodder seeds of improved variety.
   - Services for animal health care.
   - Services for breeding of milch animals.
   - Patronage based portion of the surplus.
   - Contribute to village development.

The producers in this system are not only assured of regular and remunerative payment for their milk but also benefit from the milk production enhancement inputs. The micro-level inputs such as veterinary first-aid and artificial insemination are organised by village societies with the support of the milk union. One staff member of the society is trained for carrying out these functions. In addition, the supply of balanced cattle feed and the sale of fodder seeds are also channelized through the societies. Society also organises other services such as cattle insurance, health insurance and promotional activities for the members and the village.
Functions of a Milk Producers’ Cooperative Union:

The major functions of Milk Union are:

1. Procure, process and market milk and milk products.
2. Arrange/Provide macro level inputs like cattle-feed, animal health and breeding care, etc.
3. Arrange for training and education of managing committee members, staff, and members of dairy cooperative society and also for the Board members, managers and staff of the milk union.

In general, the Union carries out five important functions: procurement, processing and marketing of milk and milk products, providing technical inputs, institutional strengthening of milk cooperatives, enhancing women involvement in dairy cooperatives, organisation of extension activities and rural development services. The union owns and operates dairy plant; cattle feed plant, fodder and bull mother farms, semen collection station etc. for animal husbandry activities.

In addition to the above, the milk union carries out research development and other promotional activities for the overall benefit of milk producers. The milk union organizes the macro-level inputs such as compounded cattle feed, fodder seeds, and various veterinary services for treatment of sick animals, all of which are made available to the milk producers through the dairy cooperative societies. Thus, it is at the Union level that professional skills are hired for specialized purposes, which individual producers cannot afford to do.

The union pays to the societies dividends on their shares and bonus in relation to the quantity of milk supplied by them during the year. The milk products processed by the union are also marketed through the State Milk Federation. A special feature of the Anand Pattern is that the unions are under continuous and concurrent audit to maintain financial propriety.

Functions of a Milk Federation:

The important functions of the state milk marketing federation are:

- Marketing of milk and milk products.
- Manage production planning and State Milk Grid (movement of milk within the state).
- Coordinate with state government, central government, NDDB and other agencies.

The Milk Unions become members of a Cooperative Milk Marketing Federation by subscribing share capital to it as per provision of the bye-laws of the Federation. The Federation is responsible for evolving and implementation of policies on cooperative marketing of all member unions’ liquid milk and milk products, deciding the product-price mix, cooperative provision of joint services (artificial insemination, breeding, cattle feed etc.).
cooperative marketing of technical inputs to members and strengthening the institutional structure of the dairy cooperatives.

**LEARNING OUTCOME**

4.2.5 Evaluate and draw the sketches of various registers maintained in a society

**CONCEPT**

Registers and records maintained in the society - Basic idea about the common registers maintained in a society

Some of the common registers maintained in a dairy co-operative society include

1) Milk purchase register / Milk Record register
   The fat, SNF and quantity of milk purchased is entered in this register against the corresponding farmer.

2) Truck sheet
   After determining the overall fat percentage of the entire milk pooled in the society, the details are entered in a “Truck sheet” and given to the dairy vehicle. It will contain details like “name of the society”, number of cans, approximate quantity, general fat and SNF percentage, time of arrival and departure of vehicle etc. It will be written by the Secretary of the society.

3) General Ledger
4) Cash book
5) Payment Register
   Society will be paying to the farmers once in seven days and the dairy pays to the society once in ten days. The union will be supplying balanced cattle feed and its value will be deducted from the milk value. All the members will be given “pass book” in which all such details will be entered.

**LEARNING OUTCOME**

4.2.6 Analyse and study the accounts maintained in a society

**CONCEPT**

Maintenance of accounts of dairy co-operative societies - Basic idea about the account maintenance in a primary society

*Accounting:*

There is a set of a standard registers, most of which are to be completed daily. The others are completed as and when any transaction takes place. It is the responsibility of the concerned staff of the society to complete the records on time and regular basis. All the records are to be countersigned by the Secretary/Chairman as per the decisions of the society and as required under the provisions of bye-laws. The registers and formats are designed in such a
way that they reflect the volume of business and financial standing of the society at any given time.
A society appoints a local person as an internal auditor who audits the transactions made by the society on regular basis. The society prepares its monthly accounts statement for the managing committee meeting and also other accounts statements on quarterly basis. The annual accounts are prepared for statutory audit.

**LEARNING OUTCOME**

4.2.7 Analyse and study the functions of Federation in a 3 tier system

**CONCEPT**

Functions of milk federation - Basic idea about the structure of APCOS and Functions of Federation

The Federation’s Board consists of the elected chairmen of all the members unions and the Federation’s Managing Director. There are also other members in the board as ex-officio and also as technical experts. The Board of the Federation evolves the Federation’s policies on all its functions. Equitable distribution of profit is done on the basis of business transacted by the milk unions with the Federation and as per the provisions of the bye-laws. The Federation’s Board is advised by its Programming Committee, which is composed of each member union’s chief executive, the Federation’s chief Quality Control Officer and one or more non-voting co-opted technical experts. The Committee meets on a regular basis and is also responsible for day-to-day implementation of the Board’s policies and plans.

The important functions of the state milk marketing federation are:

- Marketing of milk and milk products.
- Manage production planning and State Milk Grid (movement of milk within the state).
- Coordinate with state government, central government, NDDB and other agencies.

The Milk Unions become members of a Cooperative Milk Marketing Federation by subscribing share capital to it as per provision of the bye-laws of the Federation. The Federation is responsible for evolving and implementation of policies on cooperative marketing of all member unions’ liquid milk and milk products, deciding the product-price mix, cooperative provision of joint services (artificial insemination, breeding, cattle feed etc.), cooperative marketing of technical inputs to members and strengthening the institutional structure of the dairy cooperatives.

The Federation’s Board consists of the elected chairmen of all the members unions and the Federation’s Managing Director. There are also other members in the board as ex-officio and also as technical experts. The Board of the
Federation evolves the Federation’s policies on all its functions. Equitable distribution of profit is done on the basis of business transacted by the milk unions with the Federation and as per the provisions of the bye-laws.

The Federation’s Board is advised by its Programming Committee, which is composed of each member union’s chief executive, the Federation’s chief Quality Control Officer and one or more non-voting co-opted technical experts. The Committee meets on a regular basis and is also responsible for day-to-day implementation of the Board’s policies and plans.

LEARNING OUTCOME

4.2.8 Analyse and understand the various schemes by the department.

CONCEPT

Function of dairy development department (DDD) - Various schemes by the department and Implementation procedure

INTRODUCTION

The Dairy Development Department (DDD) of Kerala was started in June 1962. The Department has statutory functions under the Kerala Co-operative Societies Act 1969, besides extension and developmental programmes. There are 3648 Primary Dairy Co-operatives, three Regional Milk Unions and one apex Federation (commonly known as ‘Milma’) under the administrative supervision of this department. The agency is the nodal agency for fodder development and rural dairy extension service in the state. Dairy farmers and entrepreneurs are given training in different aspects of the field at the Five Dairy Training Centres of the department. The Kerala Dairy Farmers Welfare Fund is the first of the pension schemes started by a state government in India.

The main activities of DDD is to educate the farmers providing inputs and technical advice for producing good quality milk and cultivate scientific management practices to reduce the cost of production and increase the profit, organisation and registration of dairy co-operative societies, supervision, inspection, election, arbitration etc related to dairy co-operative societies, implementing plan schemes related to dairy sector, ensuring the quality of milk and milk products, enhancing production and consumption of milk products and overall development of agriculture sector.

Various schemes by DDD

- Milk shed development
- Fodder development
- Extension and Advisory Services
• Modernization of Dairy Co-operatives
• Strengthening of quality Control Labs
• Cattle Feed Subsidy

Loan from Nationalized Bank:

All categories of individuals can obtain loan from nationalized banks with no upper limit. The interest rate is about 14% p.a. for amount up to Rs 2 lakhs and about 18% for higher loans. Interest rates fluctuate marginally from time to time. Banks extend funds up to 75% of the project capita. Remaining 25% is margin money to be arranged by the entrepreneur. Individuals should possess land with clear title as no loan is granted for purchase of land for the unit.

The period of loan refund is decided based on the life of assets created from the loan. Banks may charge 2% extra interest if timely payment is not made. If bank observes better ability of individual in generating profits, it may relax certain rules. Banks conduct periodical inspections of the project before and after starting the project at the cost of the entrepreneur.

Project Formulation:

The project should be based on sound technical information. Availability of cattle feed and fodder, nearness to market for sale of milk, approach road, availability of water, electricity, cost of raw material, cows, construction material for shed, equipment’s etc. should be found out. Considering the market situation in urban area a model project for 5 crossbred cows to be located within 5 km from urban area is presented here. For larger projects, the plan in multiples of 5 cows ‘can be derived from the estimates.

LISTS OF PRACTICALS:

• Visit to milk co-operative societies -documentation of functioning
• Record keeping in dairy co-operatives

ASSESSMENT ACTIVITIES:

• Participation in the field visit and assessment of report.
• Seminar
• Record
TE QUESTIONS

1. What are the different procedures for registering a society? (6 marks)
2. Take a class to the farmers about role of KCMMF in the dairy sector of Kerala? (5 marks)
3. Prepare a report about Operation Flood and its significance to publish in a newspaper on National Milk Day? (5 marks)
4. Explain about five year plans? (6 marks)
5. You read an article about key village scheme in a dairy magazine. Explain that to your friend.
UNIT: 4.3 PACKAGING OF MILK AND MILK PRODUCTS

The appropriate packaging of milk is of utmost importance not only to preserve its nutritive value and saving of wastage, but also to improve the marketability to achieve better returns. The challenge to the packaging industry is to deliver the nutritious milk to the consumer in most economical, hygienic, safe and environmentally friendly package.

There are two main types of packaging systems for fluid milk one is traditional bottling system in which container is to be returned and other is one way delivery in which container is disposable and does not travel back to the dairy. In the non-returnable distribution system there are several alternative systems where different packaging materials, shapes, sizes, forms and machines are employed for packs.

For selection of a suitable package material, the knowledge of important characteristics of milk/milk products is essential

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<td>• Demonstration of different packaging materials,</td>
<td>• Participation in the Selection of apt packaging material,</td>
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<td>• Interactive lectures,</td>
<td>• Charts prepared</td>
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<td>Analyzing skill</td>
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<td>➢ Properties</td>
<td></td>
<td>• Instructional videos, pictures, charts, visit to packaging</td>
<td>• Charts prepared, visit report</td>
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<td>Data collection skill</td>
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UNIT IN DETAIL

LEARNING OUTCOME
4.3.1 The learner will be able to identify the importance of packaging and choose and apply right packaging material

CONCEPT

Definition:
Packaging means placing a commodity into a protective wrapper or container for transport or storage.

Purpose:
1. To contain and protect the product during handling and storage thereby increasing shelf life
2. To inform consumers about product quality and facilitate transportation
3. To attract the attention of consumers and increase sale
4. To prevent scope of adulteration (tamper proof system)

Additional knowledge:
The name, trade name, description of food contained in the package, the name and business address of the manufacturer etc. are printed on the package. A statement about the addition of preservative and its class, permitted colouring agent/antioxidant/vitamins, anticaking agent/stabilizing agent/emulsifying agent/minerals, chemical composition of product and the amount of energy supplied by the product, the net weight or number or volume of contents, batch number or code number are also mentioned on the package.

LEARNING OUTCOME
4.3.2 The learner will be able to choose and apply right packaging materials for milk and milk products and identify the properties of packaging materials used in the dairy industry.

CONCEPT

Packaging of milk and milk products
- Common packaging materials

| n skill | of packaging materials used in the dairy industry | materials manufacturing units. |
Properties

Common packaging materials for market milk industry are:
Bulk distribution: Tankers, Milk cans
Retail distribution: Returnable containers (Cans), Single serve containers
(Polythene sachets, prefabricated containers etc.)

Milk Cans

Packaging Material for Pasteurized Milk
1. Glass
2. Plastics: (1) LDPE is widely used (2) LLDPE: 25% thinner film used and LDPE and LLDPE in 5:1 to 4:1 ratio.
3. Others: Coated paper board, wax coated paper board ESL (Extended Shelf life Pouch)

Additional knowledge:
The necessary characteristics of packages for pasteurized milk are:
1. It should be free from off-flavours.
2. It should act as barrier to bacterial contamination
3. It should be resistant to UV light
4. It should possess good mechanical properties (sealing, tensile, structural strength etc).
5. It should be tamper proof
6. It should possess good oxygen barrier properties.
7. It should be economical. It should fit in to processing- in-Line.

Packaging Material for UHT sterilized milk
Aseptic packaging system:
Types of aseptic pack
Carton Boxes, Bags and Pouches, Bottles and Jars, Metal Cans, Plastic Cans and Composite Cans
Aseptic packaging is a packaging concept where product is packed under aseptic conditions.

**Additional knowledge:**
Aseptic or long-life milk was originally introduced in Sweden in the early 1960’s originally called the “Tetra-pack” system. It utilizes a laminate pre sterilizer and a filling environment heater. Aluminium foil is an integral part of the flexible laminate in order to provide a barrier against light and gas. In UHT processing, Milk is preheated to 73–850°C then rapidly raised to 135°C for fraction of second and then suddenly cooled by flashing into a vacuum chamber. It must be packed under completely sterile conditions. No refrigeration is necessary for at least 3-6 months. If kept under refrigeration a shelf life of up to 1 year is possible.

**Composition of tetrapak cartons**

**Packaging materials used for flavoured milk**
- a. Glass bottles
- b. Metal cans
- c. PET coated bottles
- d. Polyethylene sachets

**Packaging of sterilized milk**
- 1. Metal tins
- 2. Glass bottles
Common packaging materials for Dairy products:
Packaging materials used for Fat rich dairy products
Cream:
1. linear polyethylene, polystyrene or polypropylene
2. Tin plate, aerosol cans and polyethylene tubes.
3. Wax coated paper board cartons.
4. PE extruded or wax coated paperboard tubs.

Butter:
1. Al-foil/parchment or glassine paper
2. PVC or cardboard with a parchment
3. Tinplate containers
4. vegetable parchment paper or grease proof paper, aluminium foil, and paper board cartons

Ghee:
1. Lacquered tinplate containers
2. Polyethylene film, multi – layer co-extruded films of LDPE/HDPE
3. Aluminium foil laminate standy pouches
4. Stainless steel containers
5. Tetrapaksor tinplate

Additional knowledge:
Cream:
1. linear polyethylene, polystyrene or polypropylene and closed with a peelable lid or snap-on cover.
2. Tin plate containers have also been used for larger sizes.
3. Whipped cream and synthetic formulations are sold in aerosol cans and polyethylene tubes.
4. Imitation cream made from soybeans and vegetable oils is often marketed in wax coated paper board cartons.
5. Ultra pasteurization has been applied to heavy and light creams. The product then goes for packing. A strong seal is necessary for product protection. PE extruded or wax coated paperboard tubs are used to pack single portion cream.
6. Sterilized/ UHT cream is packed in similar lines to that of UHT milk.

Butter:

1. Al-foil, surface treated with lacquer for protecting against corrosion
2. Al-foil/parchment or glassine paper
3. PVC or cardboard with a parchment insert can be used.
4. Tinplate containers are the best for product protection
5. Flexible packaging materials like vegetable parchment paper or grease proof paper, aluminium foil, and paper board cartons which together give similar protection to the product are more commonly used.
6. Paperboard can be extrusion coated with PP, Injection-moulded pots and tubs of PP can also be used for packaging of the butter.

Ghee:

1. Lacquered tinplate containers of capacities ranging from 250 litres to 15 litres / kilograms.
2. For shorter shelf-life polyethylene film, multi – layer co-extruded films of LDPE/HDPE
3. Aluminium foil laminate standy pouches are also commonly used for packaging ghee.
4. For long – term storage, stainless steel containers. tetrapaks or tinplate cans are desirable.
5. Recently it is packed in certain laminates and Bag - in - Box containers

Packaging materials used for Heat-acid coagulated and Fermented Dairy products:
The packaging materials used are glass, polyethylene, LD / LLDP, HDPE cups, polystyrene- EVOH (polyvinyl alcohol), Polystyrene –PETG (polyethylene glycol terephthalate), tetrapack

Packaging of Ice cream:
The chief requirements of packages for ice cream are protection against contamination, attractiveness, ease of opening and ease of disposal, protection against moisture loss and temperature fluctuations is desirable.

Package forms
1. Aluminium foil cartons
2. Paper cups - Cylindrical containers
3. Plastic containers

Packaging of Dried Milks:
Requirements of Package for Dried Milks

- The material should be resistant to damage by exposure to high / low temperature and humid atmosphere.
- Convenient closure: Sealing is of supreme importance. Simple, effective re-closure is also desirable.
- Very low Water vapour and gas permeability.
- Impermeability to light

<table>
<thead>
<tr>
<th>Additional knowledge:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low Water vapour and gas permeability: Dried milk absorbs moisture very easily. Powder with &gt; 5% moisture gets deteriorated during storage. The stale and gluey flavours result from Maillard reaction. It results in losses of solubility, colour change; lumping and free flowing properties are affected. For long storage, vacuum and N2 flushing is essential especially in hot climate. An impervious container is needed which should also be odour-proof.</td>
</tr>
<tr>
<td>Impermeability to light: To avoid surface bleaching and fat oxidation.</td>
</tr>
</tbody>
</table>

Packaging materials available

1. Glass: Bottles, barrels, jars, etc.
2. Metal: Cans, barrels, drums, bins, etc.
3. Wood: Drums, bins, cask, barrels, etc.
4. Paper and paper derivatives
5. Metal foils
6. Thermoplastics and their derivatives
7. Composite films
   - Co-polymer film, Coated film, Co-extruded plastic film, Laminates

Packaging of condensed milk and evaporated milk

- Aluminium cans
- lacquered hermetically sealed tin cans (For retail marketing)
- Bulk packed in barrels made of gumwood (early days).
- Later white oak, paraffin lined barrels were used (50 to 300 kg).
- For industrial purposes steel drum containers with removable lids are used which are suited for re-use.

Evaporated milk is packed in cans before sterilization.

Plastic packaging materials include:

polyolefins, LDPE (Low density polyethylene), LLDPE (Linear low density polyethylene), HDPE (High density polyethylene), HMHD (High molecular high density) polyethylene, BOPP (Biaxially oriented polypropylene) films, PET (Polyethylene Terephthalate) films, MPET (Metallized Polyester) films, MPP (Metallized Polypropylene) films etc.

Properties:
• These are flexible in nature and are mostly used as wrapper or sachets, bags or pouches.
• Plastics have good barrier properties against moisture and gases.
• Plastics are non-corrosive.
• Heat-sealable
• Suitable for high-speed filling.
• Good wet and dry strength.
• Suitable for printing and even sandwiched printing layer can be provided.
• Plastics can be recycled.

Characteristics of Paper and paper board
• Paper and board are very popular packaging materials. Paper is thin material mainly used for writing upon, printing upon or for packaging. Paper is a versatile material with many uses.

Characteristics of Glass Containers
1. They are impervious to moisture, gases, odors, and microorganisms
2. They are inert and do not react with food products
3. They are suitable for heat processing when hermetically sealed
4. They are transparent to microwaves
5. They are reusable and recyclable
6. They are re-sealable
7. They are transparent and display the contents.

Characteristics of metal cans
1. They can be heat processed.
2. They have excellent barrier and protective properties.
3. They are tamperproof.
4. They can be made in a wide range of shapes and sizes.
5. Ease of fabrication

Properties of aluminum
1. It is lightest of the commonly used metals.
2. High electrical and thermal conductivity.

Properties of Aluminum foil

Aluminum foil is impermeable to light, gas, moisture, odors, solvents and has the stiffness. However, Aluminum foil is subject to abrasion, scratching and rupture.

PET Bottles
It can be recycle and reuse
LISTS OF PRACTICALS:

- Collection of packaging materials of various market samples
- Design of packaging materials

ASSESSMENT ACTIVITIES

Design of suitable packaging for different milk and milk products.

List of Items In The Portfolio

- Participation in the Selection of apt packaging material for milk and milk products
- Participation in test/identification
- Charts prepared
- Visit report

TE Questions

1. Identify the most common packaging materials used in the market. Explain its advantages.

Additional Information:

Recent Innovations in Milk Packaging:

1. Green Bottle - cardboard pulp with a plastic inner bag.
2. Ecolean - Design modification incorporating an air filled handle and a pouring spout
3. Jugit: Dairy Crest Three-layer PE one-litre capacity bag that is effectively a cartridge that fits into a rigid plastic jug with a lid.
4. HDPE Self Stacking Bottles:
   • Avoiding crates for distribution
   • Accommodates 9% more milk during distribution
   • Reduces Contamination
   • Ease of stacking
5. Repol Polypropylene Random Copolymer
   • Numerous advantages like clarity, rigidity, process-ability, low density and cost competitiveness.
   • Mainly for packaging of flavoured milk
   • Bottles can be retorted
   • Weight of the bottle is one tenth that of Glass bottles
Modified Atmosphere packaging

Modified Atmosphere packaging (MAP) is a technique that is being used to extend the shelf life of fresh foods such as meat, fish and cut fruit, as well as of various bakery products, snack foods and other dried foods. In this method of packaging air in a package is replaced with a gas composition that will retard microbial growth and slow down chemical deterioration of the food.

Modified atmosphere packaging (MAP) is defined as ‘the packaging of a perishable product in an atmosphere which has been modified so that its composition is other than that of air.

MAP is the alteration of the gaseous environment produced as a result of respiration (passive MAP) or by the addition and removal of gases from food packages (active MAP) to manipulate the levels of O2 and CO2.

Gaseous atmosphere is modified by
1. Direct injection of gases (often CO2 or nitrogen) into a package,
2. Evacuating air from the package and filling with required gas.

Vacuum Packaging

An alternative to controlling or modifying the atmosphere is vacuum packaging, where all of the gas in the package is removed. This can be a very effective way of retarding chemical changes such as development of oxidative rancidity, but care needs to be taken to prevent the growth of the pathogen, C. botulinum, which grows under anaerobic conditions.

Active packaging

Active packaging refers to the incorporation of certain additives into packaging film or within packaging containers with the aim of maintaining and extending product shelf life

Active packaging includes additives or freshness enhancers that are capable of scavenging oxygen; adsorbing carbon dioxide, moisture, ethylene and/or flavour/odour taints; releasing ethanol, sorbates, antioxidants and/or other preservatives; and/or maintaining temperature control

“Active packaging technologies involve interactions between the food, the packaging materials and the internal gaseous atmosphere and its main objectives are: Shelf life extension, Easier handling and Preserve quality of the product
UNIT: 4.4 MARKETING OF MILK AND MILK PRODUCTS
Marketing of milk/milk products is the last or final stage of market milk/milk products industry. A successful marketing programme requires a product of high quality, an attractive package, the physical equipment and personnel required for transporting the product from the milk/milk products storage rooms to the consumers/retailers, sales promotion personnel and effective advertising.

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<th>ACTIVITIES</th>
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<td>• Visit a milk and milk products marketing unit&lt;br&gt;• Records/Pictures&lt;br&gt;• Videos</td>
<td>• Tests/quiz&lt;br&gt;• Records&lt;br&gt;• Pictures</td>
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<tr>
<td>SKILLS:</td>
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<tr>
<td>• Basic concepts</td>
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<td>• Data collection skill</td>
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<td>• Observation skill</td>
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<td>• Analyzing skill</td>
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<tr>
<td>Marketing plans</td>
<td>• Choose the proper transportation method.</td>
<td>• Visit a milk and milk products marketing unit&lt;br&gt;• Records/Pictures&lt;br&gt;• Videos</td>
<td>• Tests/quiz&lt;br&gt;• Records&lt;br&gt;• Pictures</td>
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<tr>
<td>SKILLS:</td>
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<tr>
<td>• Transportation of milk and milk products</td>
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<tr>
<td>Analysis of consumer demand and acceptance</td>
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<td>• Market survey&lt;br&gt;• videos&lt;br&gt;• lectures</td>
<td>• Survey report&lt;br&gt;• Seminar&lt;br&gt;• Record</td>
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<tr>
<td>Role of salesmen and marketing personalities in marketing of milk and milk products</td>
<td>• Describe importance of marketing personnel</td>
<td>• Market survey&lt;br&gt;• videos&lt;br&gt;• lectures</td>
<td>• Survey report&lt;br&gt;• Seminar&lt;br&gt;• Record</td>
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<td>• Basic idea</td>
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<td>• Data collection</td>
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UNIT IN DETAIL

LEARNING OUTCOME

4.4.1 Choose the marketing technique

CONCEPT

Definition of marketing
  • Basic concepts

The production concept
According to this concept, consumers will choose those products which are relatively cheap and available at almost all places. The business organizations adopting this concept produces product on a mass scale and aim to produce products at low cost with higher production efficiency so as to keep the selling price low. This concept is adopted by firms for their expansion.

The product concept
This concept is based upon the assumption that consumers’ purchase is strongly affected by quality, performance and features. The business organization adopting this concept produces high quality, superior products and continuously upgrades them.

The selling concept
This concept is based upon the assumption that consumers (individual as well as business) will not purchase products in sufficient quantity if left alone. This concept is favourable for unsought goods as well as for overcapacity plants.

The marketing concept
This concept gives priority to consumers’ needs. Instead of producing the product and then trying to sell it, this concept relies on producing the product what is required by consumers.

LEARNING OUTCOME

4.4.2 Choose the proper transportation method
CONCEPT

Marketing plans

- Transportation of milk and milk products

**Collection and transport of milk and milk products:**

In developing countries, most milk is produced by small-scale producers who are widely dispersed in rural areas, while the majority of markets are in urban areas. The logistical challenge of linking producers to markets is compounded by the highly perishable nature of milk, which calls for streamlined collection and transport. Milk being perishable commodity, it becomes necessary to transport the fresh raw milk to the consumer or the chilling/processing plant within 4 hours of its production. Thus, transportation becomes an integral part of milk collection system. An efficient and suitable facility is selected on the basis of the raw milk collection as well as regional requirements.

**Factors determining selection of mode of transport**

The following factors may be considered in selection of a suitable, efficient and economic transportation system and transport:

**Local conditions:**

- **Geographical location:** In hilly areas where roads are not developed, small quantity of milk can be carried out on head for short distance and on shoulder sling for comparatively longer distance and larger quantity. In places where river is to be crossed, a boat and road in combination may be used.

- **Condition of road:** Condition of road such as dusty, narrow, broken, having sharp turnings, congestion, business, obstacles like railway crossing, etc. are also taken into account in selecting a suitable vehicle for milk transportation.

**Volume of milk/Carrying load:**

For small quantity and short distance head load, shoulder sling, cycle, etc.; for moderate quantities and longer distance motor cycle, cart, tri-wheeler, etc. by road can be transported. If quantity of milk is large, milk in cans on truck & lorries or in road/rail tankers for long distances can be carried.

**Distance of transport:**

Depending upon the distance of transport and quantity of milk, a most economic type of transport system is selected.

**Variable resources:** If the organization is having road/rail tankers and facilities exist for bulking, chilling, loading and unloading, road/rail tankers may be used. In absence of such facilities, only milk in cans or tanks on truck or lorries is transported.
On the other hand, hired transportation facilities are available, which can also be used very effectively.

Modes of transport

These depend upon the carrying load, the distance of collection and local conditions.

Modes of milk transportation in India

<table>
<thead>
<tr>
<th>Mode</th>
<th>Optimum load (kg)</th>
<th>Optimum distance (km)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-load</td>
<td>15-25</td>
<td>3 – 8</td>
<td>Generally employed for small loads and distances. Important in hilly areas.</td>
</tr>
<tr>
<td>Shoulder-sling</td>
<td>Up to 40</td>
<td>3 – 6</td>
<td>Meant for heavier loads but for shorter distances than head-load.</td>
</tr>
<tr>
<td>Pack-animal</td>
<td>Up to 80</td>
<td>6 - 10</td>
<td>Ponies, horses and donkeys usually employed.</td>
</tr>
<tr>
<td>Bullock-cart</td>
<td>300-400</td>
<td>10 –12</td>
<td>Rather slow.</td>
</tr>
<tr>
<td>Tonga</td>
<td>250-300</td>
<td>12 or more</td>
<td>Larger quantities transported; faster than head-load, shoulder-sling and pack animal.</td>
</tr>
<tr>
<td>Bicycle</td>
<td>40 or more</td>
<td>15 or more</td>
<td>Quick and handy; easily accessible to milk producer’s home.</td>
</tr>
<tr>
<td>Cycle-rickshaw</td>
<td>150-200</td>
<td>10 or more</td>
<td>More carrying capacity than bicycle.</td>
</tr>
<tr>
<td>Boat</td>
<td>40-200</td>
<td>2 – 8</td>
<td>Only means of transport when rivers, etc., have to be crossed.</td>
</tr>
<tr>
<td>Auto-rickshaw</td>
<td>250-500</td>
<td>15 or more</td>
<td>Greater carrying capacity and faster than cycle-rickshaw.</td>
</tr>
<tr>
<td>Motor truck</td>
<td>½ to 3 tonnes</td>
<td>15 or more</td>
<td>With the improvement in road facilities and construction of all season roads, motor trucks have been found most effective means of transportation.</td>
</tr>
<tr>
<td>Railway wagon</td>
<td>11 tonnes or more</td>
<td>80 or more</td>
<td>Railway wagons are most dependable and economical for long distance but less popular means of milk transportation.</td>
</tr>
<tr>
<td>Tankers</td>
<td>5 tonnes or more</td>
<td>80 or more</td>
<td>Road tanker: Insulated stainless steel tanks are mounted on road truck chasis for bulk handling (3000 – 12000 l) and for long distance (100 to 1000 Km.) transportation. The tanker may be divided into 2 to 3 equal capacity compartments with separate outlets.</td>
</tr>
<tr>
<td>(road or rail)</td>
<td></td>
<td></td>
<td>Rail tanker: Insulated and/or refrigeratored stainless steel tanks are mounted on rail truck/chasis of the capacity in the range of 10,000 to 50,000 l to transport milk for a long distance.</td>
</tr>
</tbody>
</table>
Cost of transportation:

Cost of transportation should be kept at minimum level by selecting a suitable transport of optimum size and capacity taking into consideration the quantity of milk to be transported, type of vehicles available, road condition and time involved.

In India, raw milk collected at various collection centers in the rural areas is dispatched to the dairy plant in two ways:

1. Transporting milk through cans: Suitable when milk volume handled is low (capacity of a can is 40-50 litres).
2. Transporting milk through tankers (2000 to 10,000 liters of chilled milk): This method is useful especially for transporting chilled milk from bulk milk coolers or chilling centers. Refrigerated/insulated tanker is important for transporting market milk and other perishable dairy products.

The tankers or wagons should be suitably insulated so as to permit not more than 1-1.5°C rise in temperature up to 12 h of journey.

The good quality milk is received in the dairy plant for further processing and is safely packed in a suitable container. The packed milk is then placed in crates and is taken by the salesmen or marketing personals in insulated vehicles. Delivery of milk and milk products at right time in right place is essential to meet the demand of consumers and to increase the supply of products thereby increasing the profitability of the firm.

Advantages of Tanker Over Cans

- quick mode of transportation
- low transport cost per liter
- better temperature control
less risk of contamination

time and labors savings

Lower investment in Cans.

Savings in detergent.
A comparative advantage road Vs Rail Transport

<table>
<thead>
<tr>
<th>Type of transport</th>
<th>Advantages</th>
</tr>
</thead>
</table>
| Roadways          | i) Most economic to transport milk in containers by using bicycle, tricycle, motor cycle, carts, trucks, lorries and tankers.  
ii) Loading and unloading possible directly at godowns of seller and buyer.  
iii) Cheaper than rail over short distances.  
v) Most convenient and less time consuming. |
| Railways          | i) Cheaper than roadways over long distances  
ii) Larger quantity of milk can be handled at a time. |

Fig 4.4.2 Advantages of Road Vs Rail Milk Transportation

Do You Know? Transport pipes: Subterranean pipelines made of stainless steel in developed countries for transporting milk between the dairy and collecting point. Milk is pushed or flowing by gravity at suitable location.

LEARNING OUTCOME

4.4.3 Select the target group

CONCEPT

Analysis of consumer demand and acceptance
Market Survey

Demand forecasting and sales forecasting are important for any marketing planning and control as it serves the basis for comparison over a period of time. Forecasting helps in identifying and solving marketing and sales problems. Demand forecasting is one of the most important aspects of managing a business. Finding the right balance of supply and demand allows an organization to produce enough to meet the demand of its customers. If the organization overestimates demand, it runs the risk of producing too much, leaving it with unsold merchandise. If the organization produces too little, it runs the risk of not meeting demand and losing sales.

Market demand

It is the total quantity of products or services that is bought by a specified customer group in a specific geographical area in a specified time period in a specified marketing environment under a specified marketing programme.

LEARNING OUTCOME

4.4.4 Describe importance of marketing personnel

CONCEPT

Role of salesmen and marketing personalities in marketing of milk and milk products

- Basic idea

Important Channel Participants:

- Manufacturers, wholesalers are acting as important channel participant.

Manufacturers

Those who produce the product are referred to as manufacturers.

Wholesalers

They sell to retailers, other merchants, industrial users, commercial users, institutional users.

They do not sell in large quantities to final consumers.

Additional knowledge:
Wholesalers can be classified into merchant wholesalers, agents and manufacturer’s sales and branch office. Merchant Wholesalers take ownership and associated risk. Based upon number of functions carried out by the merchant wholesaler, they are categorized as full function (jobber) or limited function merchant wholesaler. Full function wholesaler carry out almost all or most of the marketing functions. Limited function Wholesalers carry out only some of the functions. Agent Wholesalers do not
take ownership and rarely take possession of the products. Agents are further classified as manufacturer’s agents, brokers, commission merchants, selling agents and auction companies. Manufacture agents are independent firm which are mostly used in place of manufacturer’s own sales force.

Role of salesmen and marketing personalities:
1. Collect information regarding to current or potential consumers, competitors and others important variables of marketing environment.
2. Create and transmit persuasive communications to increase sale.
3. Put purchase orders to suppliers/producers.
4. Bear risk of distribution work.
5. Arrange for storage and transport of physical goods (milk and milk products).
6. Arrange for payment to parties.
7. Undertake presale, sale and after sale service.
8. Helps in sales promotion (advertising).
10. Provide feedback, market intelligence and credit to channel member.

LIST OF PRACTICALS
Market survey for consumer demand and satisfaction
Cost analysis of milk and milk products

ASSESSMENT ACTIVITIES
1. Case study – Suppose you have to transport huge quantities of milk from one place to another. Select suitable method of transportation.
2. Prepare chart showing advantages of road transport and rail transport.

TE QUESTIONS
1. 2000 litres of milk has to be transported from society to the dairy plant. How you will transport? Substantiate.. (hint: Can or Tanker).
2. Enlist roles of Sales man.
3. 10,000 litres of milk has to transported from Karnataka to Khozhikode Dairy. Which mode of transportation will you select?. Substantiate your answer.
4. Write an article about different concepts of marketing.
UNITGRID : 4.5 DAIRY ECONOMICS

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<tr>
<th>IDEAS/ CONCEPT/SKILL</th>
<th>LEARNING OUTCOME</th>
<th>ACTIVITIES</th>
<th>ASSESSMENT</th>
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</table>
| Cost analysis of milk and milk products  
  - Basic concepts  
  - Method | The learner will be able to;  
  - Price milk and milk product | Visit a milk and milk products production/marketing unit  
Records/ Pictures Videos | Tests/quiz  
Records/ Pictures |
| SKILLS:  
  - Data collection skill  
  - Observation skill  
  - Analyzing skill  
  - Implementation/Activity skill | Economic institutions supporting Dairy Development programmes  
  - Functioning of Dairy Development Programmes | Visit a milk and milk products production/marketing unit  
Records/ Pictures Videos | • Situational analysis  
• Evaluation of plan and design of dairy co-operative society,  
• record /chart  
• Test/ quiz |
| Project report for starting a small scale dairy farm  
  - A project of 20 cow farm | • Prepare project for starting a small scale dairy farm unit | Visit to dairy farm  
Records/ Pictures Videos | • Situational analysis  
• Evaluation of plan and design of dairy farm,  
• record /chart  
• Test/ quiz |
| Project report for starting a small scale dairy processing unit  
  - A project of a small scale production unit | • Prepare project for starting a small scale dairy processing unit | Visit to dairy processing unit  
Records/ Pictures Videos | • Situational analysis  
• Evaluation of plan and design of dairy farm,  
• record /chart  
• Test/ quiz |

UNIT IN DETAIL:

LEARNING OUTCOME

4.5.1 Price milk and milk product

CONCEPT:
Cost analysis of milk and milk products
In dairy industry price determination and price policy decision are to be performed for milk producers as well as for consumers. In dairy industry, milk collection takes place either through organized set up consisting of cooperative and other private well established dairy plants. The unorganized set up consists of private personnel / middle men.

In simple terms, price is the exchange value of a product. For an organization, it is the quantum of money (in modern exchange economy or goods and services in barter trade) obtained by it by selling its goods/services. For a consumer, it is money given to the seller. Price as understood in terms of goods/services to satisfy need and wants of human beings and is called utility. Value represents the worth attached by consumers to goods/services.

**Objectives of Pricing**

Although most of the organization aim at profit maximization but in general the various objectives the organizations try to achieve are as follows: Short term profit maximization, long term profit optimization, minimum return on investment, minimum return on sales turnover, target sales volume, target market share, more penetration in the market, selling in new markets, combined target profit on entire product line whatever may be the profit in individual products, eliminating competition or keeping similarity with competitors, fast turn around and early cash recovery, stabilizing prices in the market, supplying goods at affordable prices for economically weaker sections of society, setting prices of goods to stimulate economic development.

**Factors Influencing Pricing:**

External and internal factors as listed below are impacting the pricing decision.

**External factors:**

Market conditions, consumers behavior for the concerned product, bargaining power of major consumers and suppliers, pricing policy of competitors, government laws specifically for pricing of products, legal rules, society's view point.

**Internal factors**

Marketing objectives of the organization, The nature of product, Price elasticity of demand of the product, Product's stage in product life cycle, Pattern of use and turn around rate of the product, cost of production, marketing costs, Extent of product differentiation,
interaction and influence of marketing mix elements on price, Organization's product width and line length.

**Pricing methods of Milk**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Method</th>
<th>Characteristics</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Based on volume or weight</td>
<td>By using the weighing machine or spring balance.</td>
<td>Simple to calculate milk price&lt;br&gt;No expensive testing equipment is required</td>
<td>No incentive to improve quality of milk</td>
</tr>
<tr>
<td>2</td>
<td>Based on fat amount</td>
<td>By finding out the fat percentage of milk by conducting test. Using directly fat percentage or kg fat</td>
<td>Fairly simple to calculate milk price&lt;br&gt;No benefit to milk producers adding water to milk</td>
<td>Necessary to purchase fat testing machines.</td>
</tr>
<tr>
<td>3</td>
<td>Based on fat as well as solids-not-fat content</td>
<td>By using the formula*</td>
<td>Provides an incentive to increase fat and SNF</td>
<td>Necessary to purchase fat testing machine and density meter.</td>
</tr>
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</table>

**Pricing Strategy for Milk Products:**

Milk is a complete food. It is an essential food item for all the households. Apart from liquid milk, large numbers of traditional and western dairy products are sold in the market. There are no specified rules for setting the price for consumers just like two axis pricing method for milk producers. The price of milk and milk products is generally determined based upon market conditions (type of competition). In India, 'Amul' is the market leader in dairy industry. It is a cooperative organization. Generally, it is seen that Amul decides the price for a milk product, particularly liquid milk, and others immediately follow. For setting the liquid milk price the usual factors considered are.

i. Price to be paid to milk producers.

ii. Other expenses viz. processing, transportation, storage etc.

For other milk products forces of demand and supply as well as organizations strategy is important. For example, when Amul introduced their ice cream in the market, they sold it at
fairly low price so as to penetrate the market.

Economic institutions supporting dairy development programmes

For setting up of any enterprise whether dairy farming unit for milk production or dairy processing units/plants for manufacturing milk and milk products, finance is a prerequisite and of paramount importance.

LEARNING OUTCOME

4.5.2 Aware of Dairy Development Programmes

CONCEPT

Financial Assistance Available from Banks/NABARD for Dairy Farming

Loan from banks with refinance facility from NABARD is available for starting dairy farming. For obtaining bank loan, the farmers should apply to the nearest branch of a commercial bank, regional rural bank or co-operative bank in their area in the prescribed application form which is available in the branches of financing banks. For dairy schemes with very large outlays, detailed project reports will have to be prepared. The items of finance would include capital asset items such as purchase of milch animals, construction of sheds, purchase of equipments etc. The feeding cost during the initial period of one/two months is capitalized and given as term loan. Cost towards land development, fencing, digging of well, commissioning of diesel engine/pumpset, electricity connections, essential servants’ quarters, godown, transport vehicle, milk processing facilities etc. can be considered for loan. Cost of land is not considered for loan.

Ministry of Food Processing Industries, Government of India

The Ministry of Food Processing Industries is concerned with formulation and implementation of the policies & plans for the food processing industries. In the era of economic liberalization, all segments including; private, public and co-operative sectors have defined roles to play and the Ministry promotes their active participation.

LISTS OF PRACTICALS:

Cost analysis of milk and milk products

Preparation of project reports for starting a 2, 10 and 50 animal farm/ 5000 litre milk processing unit
LIST OF PRACTICAL WORKS IN MODULE 4

- Handling of Audio-visual aids- Camera, 0HP, T.V ,slide projector and multi-media.
- Preparation of charts, posters and bulletins
- Visit to milk co-operative societies -documentation of functioning
- Record keeping in dairy co-operatives
- Collection of packaging materials of various market samples
- Design of packaging materials
- Market survey for consumer demand and satisfaction
- Cost analysis of milk and milk products
- Preparation of project reports for starting a 2, 10 and 50 animal farm/ a 5000 litre milk processing unit

POINTS TO BE DISCUSSED

ASSESSMENT:

LEARNING OUTCOME

4.5.3 Prepare project for starting a small scale dairy farm unit

CONCEPT

Internal sources of financing

Entrepreneur can raise finance from the following internal sources:

- Owner’s own investment such as saving and equity.
- Deposits and loans given by the owner.
- Drawing personal loan from provident fund, life Insurance policy etc.
- In case of running enterprise, funds can be raised through retention of prof-its.
- Using back the profits earned by one’s own enterprise.

External sources of financing

- Entrepreneurs can raise funds externally from the following sources:
- Borrowings from non institutional sources like relatives and friends but this amount may not be large enough to set up a unit.
- Borrowings from the commercial banks for working capital.
- Term loans from development financing institutions like, ICICI (Industrial Credit
and Investment Corporation of India) Bank Ltd, Industrial Devel-opment Bank of India (IDBI) Bank Ltd, Small Industry Development Bank of India (SIDBI), Infrastructural Finance Corporation of India (IFCI ven-ture funds limited) etc.

- Hire-purchase or leasing facilities from national small industries corpora-tions, state small industries development corporations, etc.
- Credit facilities provided by different financial institutions as well as com-mercial banks.

The following project can be considered as an example for capital expenses of a dairy unit of three cows:
ITEMS OF COST

(A) Livestock

3 Crossbred cows @ ₹ 60,000 each with 2 small calves. 

(B) Building

Cattle Shed and Calf pen 

Hutment 

(C) Equipment

Chaff Cutter, handpump milking pails etc. 

Total 

Value (₹)

180,000

40,000

30,000

30,000

2,80,000

INCOME AND EXPENDITURE STATEMENT

1. Depreciation (10%)

On animals, buildings and equipments

28,000

2. Interests on fixed capital (10%)

28,000

3. Land rent (5%)

14,000

Fixed Cost

70,000

4. Cash Expenses

(a) Concentrates

(b) Seeds, fertilizers and tractor charges

(c) Fodder purchased

(d) Water and Electricity

(e) Miscellaneous

40,000

25,000

15,000

5,000

10,000

95,000

Total (1 + 2 + 3 + 4) Items

1,65,000

(Cash + Fixed cost)

5. Gross Income

Sales of 7,200 milk @ ₹ 30 per litre

Sale of surplus fodder

Appreciation on young stock

2,16,000

4,000

5,000

2,25,000

Profit

₹ 2,25,000 - 1,65,000 = 60,000

Net profit (Approx.) ₹ 60,000 from three crossbred cows is highly impressive; however, it may be noted that dairying at this level is profitable only when high yielding cows are maintained under proven conditions of Agro-husbandry management.

The details of farm steed, land space needed for various buildings and for growing fodder are dealt in Chapter 40 and 44.
POINTS TO BE DISCUSSED

ASSESSMENT:

LEARNING OUTCOME

4.5.4 Prepare project for starting a small scale dairy processing unit

CONCEPT

The types of milk processing projects that are normally considered for financial assistance are:

i) Bulk Milk Cooler (BMC) / Milk Chilling plants This involves collection of milk from villages, chilling the milk to 3-4 degree Celsius and transporting to the main dairy for further processing and manufacture of products. In majority of cases these are part of the milk processing facility

ii). Market Milk Plants / Milk Processing Plants It involves procurement of milk from the villages, chilling, standardization, homogenization, pasteurization, packing of market milks of various kinds (whole, standardised, toned and double toned milk) as well as manufacture of milk products.

ASSESSMENT ACTIVITIES:

- Cost analysis of milk and milk products
- Preparation of project reports for starting a 2, 10 and 50 animal farms
- Preparation of project reports for starting a 5000 litres milk processing units
- Seminars and records

TE QUESTIONS:

1. In a primary co-operative society samples are tested for both fat and SNF.
   a. Name the pricing system followed here.
   b. Give the advantages and disadvantages of this pricing system.

2. Pricing of milk in APCOS is based on ............ and ............... Of the milk ( 1 mark )

3. Explain different pricing policies of milk ?( 6 marks )

4. Name the pricing policy adopted by KCMMF. Explain its advantages and dis-advantages.
EXTENDED ACTIVITIES:

1. Conduct a market survey for different milk products highlighting on their prices and brands
2. On-Job Training
3. Co-operative society visit
4. Expo and sale of prepared products
ON THE JOB TRAINING

- On the Job training occurs whenever more experienced employee or supervisor teaches less experienced person on how to do one or more tasks of a job. It is a form of training taking place in a normal working situation. The training utilizes actual equipments and materials.

- OJT of the course will be 30 days duration. OJT consist of Farm training and dairy plant training and training in Dairy Department. 10 days OJT has to be conducted at the end of first module, which can be further divided as 7 days training at Dairy farm management and 3 days training in feeds and Foders.

- 20 days OJT has to be conducted at the end of second module which should include milk products training in Dairy development department training centers and inplant training in dairy plants (processing, quality control and marketing).

Vocational higher secondary schools are at liberty to conduct the entire on the job training according to their local feasibility of institutions and industries. Flexibility in the duration can also provided accordingly, but the vocational teacher as to ensure student gets OJT in all important skills like farm management, fodder cultivation, feed computation, Processing and quality assurance of milk and milk products, dairy business management (marketing and co-operative management).
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<th>S.No.</th>
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<td>1</td>
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<td>A H Varnam and J P Sutherland</td>
<td>Milk and Milk Products Technology Chemistry and Microbiology</td>
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<td>4</td>
<td>Gerrit Smit</td>
<td>Dairy Processing- Improving quality</td>
</tr>
<tr>
<td>5</td>
<td>Webb, Byron H Johnson, Arnold H Eds</td>
<td>Fundamentals of Dairy Chemistry</td>
</tr>
<tr>
<td>6</td>
<td>Walstra, Pieter And Jenness, Robert</td>
<td>Dairy Chemistry and Physics</td>
</tr>
<tr>
<td>7</td>
<td>R.K.Robinson</td>
<td>Modern Dairy Technology – Advances in Milk Processing Ed.2 Vol 2</td>
</tr>
<tr>
<td>8</td>
<td>Ralph Early</td>
<td>The Technology of Dairy Products</td>
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<td>9</td>
<td>Edgar Spreer</td>
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<td>Food Safety and Standards Authority</td>
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<td>of India,2011, Ministry of Health</td>
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<td>and Family Welfare.</td>
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<td>11</td>
<td>Website of Indian Council of</td>
<td>Agricultural Research (<a href="http://ecoursesonline.iasri.res.in/">http://ecoursesonline.iasri.res.in/</a>)</td>
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<td>12</td>
<td>National Dairy Development Board</td>
<td>(<a href="http://www.NABARD.org">http://www.NABARD.org</a>)</td>
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