Vocational Higher Secondary Education (VHSE)

Second Year

DAIRY TECHNOLOGY

Reference Book

Government of Kerala
Department of Education

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List of Contributors

Zerina.P.A
Vocational Teacher in Dairy Technology,
GVHSS(Girls), B.P.Angadi, Tirur.

Beena.R.L
Assistant Professor,
Department of Dairy Technology,
College of Dairy science and Technology,
Thiruvananthapuram
Kerala Veterinary University

Deena John Kalarickal
Vocational Teacher in Dairy Technology,
GVHSS Kanakkari.

Sunil Kumar.S.N
VocationaI Instructor in Dairy Technology,
GVHSS, Ayyanthol, Thrissur.

Steny Anna Varghese
(B.Tech (Dairy Science and Technology))

Expert

Dr. P .SudheerBabu
Special Officer
(Professor &Head,
Department of Dairy Engineering)
College of Dairy science and Technology,
Thiruvananthapuram, Kerala

Academic Co-ordinator

Dr. Sahaydhas
Asst. Professor, SCERT Kerala

Foreword

Dear Learners,

This book is intended to serve as a ready reference for learners of vocational higher secondary schools. It offers suggested guidelines for the transaction of the concepts highlighted in the course content. It is expected that the learners achieve significant learning outcomes at the end of the course as envisaged in the curriculum if it is followed properly.

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 this reference book 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. P. A. Fathima
Director, SCERT, Kerala

CONTENTS

ABOUT THE COURSE

Agriculture is one of the fields which can absorb a considerable number of unemployed educated youth of the the country. In India agriculture employs about 50% of the total work force. 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.

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.

OBJECTIVES OF THE COURSE

- To train students to scientifically undertake all operations of animal husbandry ant dairy technology and to create employment potential and man power for dairy development
- To create entrepreneur in dairying and dairy associated activities.
- To develop organizational capabilities among our youth in dairy industry
- To develop skill, instill confidence by enhancing life skills
- To increase nutritional status and income of community through dairy farming.

SYLLABUS:

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 Yoghurt
  - 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
  - Methods of preparation-creamery butter method, prestratification method, Direct cream method and Desi method.
  - 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 varieties
  - Preparation of cheddar cheese
  - Preparation of cottage cheese
  - Preparation of processed cheese
  - Uses of 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 Indigeneous 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**.
- **Chakka and Srikhand**

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, IS0 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

SCHEME OF WORK: Module-3

Month	Name of Unit	Period
June	Special Milks Fermented milk products Fat Rich Dairy Products	25 30 09
July	Fat Rich Dairy Products Condensed and Dried Milk Cheese	21 20 26
August	Cheese Frozen Dairy Products Indigenous Milk Products/ Sweets	14 45 19
September	Indigenous Milk Products/ Sweets	64
October	Indigenous Milk Products/ Sweets Dairy By-products Quality Assurance	07 30 30

SCHEME OF WORK: Module-4

Month	Name of Unit	Period
November	Introduction to Dairy Extension	65
December	Dairy Co-operative Management	67
January	Dairy Co-operative Management Packaging of milk and milk products Marketing of milk and milk products	13 50 20
February	Marketing of milk and milk products Dairy Economics	50 08
March	Dairy Economics	67

Module-3
MILK PRODUCTS AND QUALITY ASSURANCE

Unit No.	Name of Unit	Period
3.1	Special Milks	25
3.2	Fermented Milks	30
3.2	Fat Rich Dairy Products	30
3.3	Condensed and Dried Milk	20
3.4	Cheese	40
3.5	Frozen Dairy Products	45
3.6	Indigenous Milk Products/ Sweets	90
3.7	Dairy By-products and waste management in dairy industry	30
3.8	Quality Assurance	30
	TOTAL PERIODS	340

30% periods for theory section and 70%periods for practical activities

Module-4
DAIRY BUSINESS MANAGEMENT

Unit No.	Name of Unit	Period
1	Introduction to Dairy Extension	65
2	Dairy Co-operative Management	80
3	Packaging of milk and milk products	50
4	Marketing of milk and milk products	70
5.	Dairy Economics	75
	TOTAL PERIODS	340

30% periods for theory section and 70%periods for practical activities

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 live stock 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 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.

Learning Outcomes

- Identify, compare and prepare sterilized milk and flavoured milk.
- Analyze and standardize different types of milks.

Sterlized 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 ^{0}C for 15 minutes or at least 130^{0}C-150^{0}C for few seconds in a continuous flow and then packed under aseptic condition in hermetically sealed containers to ensure preservation at room temperature for a long period 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 confirm 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 115-120°C for 15-20 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 diagram of manufacture.

Receiving milk
↓
Cooling for 5^0c and bulk storage
↓
Pre-heating(35-40^0c)
↓
Filtration/Clarification
↓
Cooling to 5^0c
↓
Standardizing and storage(5^0c)
↓
Pre-heating (60^0c)
↓
Homogenization (2500psi, 60^0c)
↓
Clarification (60^0c)
↓
Filling and capping (in cleaned and sanitized bottles)
↓
Sterilizing (115-120^0c/15-20 minutes)
↓
Cooling (room temperature)
↓
Storage (room temperature)

2. Ultra high temperature (UHT) processing

In these processes, the milk is heated to 135-150^0C 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 Food Safety and Standard Regulations 2011,**"Flavoured Milk"** by whatever name called may contain nuts(whole fragmented or ground) 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.

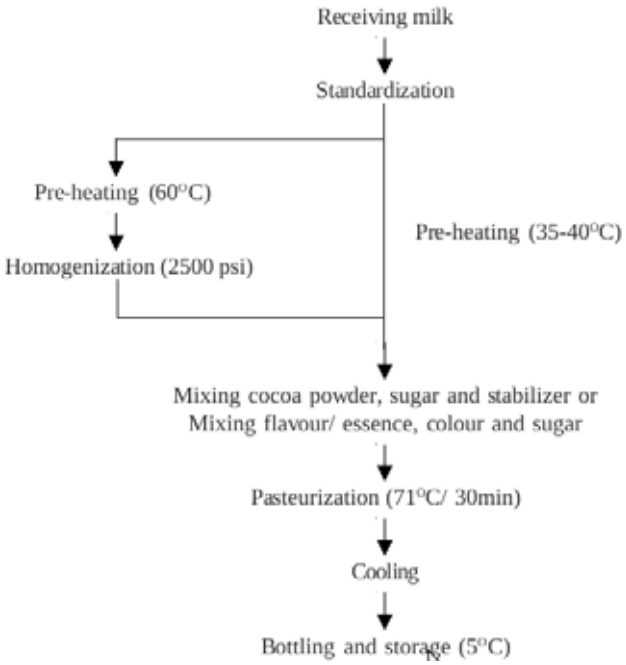


Fig 3.1.1 Preparation of chocolate milk drink

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 (35-40^0 C)
↓
Filtration/ Clarification
↓
Standardization
↓
Homogenization (2500 psi)
↓
Filling and capping
↓

Sterilization (108-111^0 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.

Flavoured Milk

TONED MILK

According to Food Safety and Standards Regulations 2011, **TONED MILK** means the product prepared by admixture of cow or buffalo milk or both with fresh skimmedmilk; 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.

DOUBLE TONED MILK

According to Food Safety and Standard Regulations 2011,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 minimum1.5% 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.

RECOMBINED MILK

According to Food Safety and Standard Regulations 2011, RECOMBINED MILK means the homogenized product prepared from milk fat, non-fat-milk solids andwater. Recombined milk shall be pasteurized 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.

STANDARDISED MILK

According to Food Safety and Standard Regulations 2011, STANDARDISED MILK means cow milk or buffalo milk or sheep milk or goat milk or a combination of anyof 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

According to Food Safety and Standard Regulations 2011, 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

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

Note : When milk is offered for sale without indication of the class, the standards prescribed for buffalo milk shall apply.

The heat treatment for the various designated milk shall be as follows:

Designation	Heat treatment
Raw	Nil.
Pasteurized	Pasteurization.
Boiled	Boiling
Flavoured	Pasteurization or Sterilization
Sterilized	Sterilization

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.

Fortified milk

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 to prepare a questionnaire and conduct survey about different types of milk available in the market, their standards, pricing and packaging.
- Chart preparation- chart of flow diagram and standards of different types of milk are prepared
- Preparation of flavoured milks-students are asked to prepared different flavoured milks

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 imitation 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 prepared in a dairy plant? (4)

7. During 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

	FAT%	SNF%
Toned milk	0.5 maximum	8.7 Minimum
Double toned milk	4 .5 Minimum	8.5 Minimum
Standardized milk	1.5 Minimum	9.0 Minimum
Skim milk	3.0 Minimum	8.5 Minimum

9. 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.

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

11. 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.

12. 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.

Unit 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.

Learning Outcomes

- Identify health benefits of fermented milks .
- Classify fermented milks.
- Categorize and choose appropriate Starter culture.
- Prepare buttermilk.
- Prepare acidophilus milk.
- Prepre of Yoghurt.
- PrepareDahi.
- *Prepare Lassi.*

FERMENTED MILK

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 benefit:

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 posses 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.

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 culture is usually considered to indicate a culture containing lactic streptococci. Microorganisms commonly found in fermented milk belongs to the genus Streptococcus.They may or may not contain associative organisms of the genus Leuconostoc.Stater species most commonly used in dairy industry are *Streptococcus lactis*, *Streptococcus cremoris*, *Streptococcus diacetilactis*, *Leuconostoc citrovorum* and *Leuconostoc dextranicum*. A starter may contain a single lactic strain ora 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.

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.

BUTTERMILK

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 desibutter.It can be used as a refreshing drink.

Cultured Buttermilk

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

Preparation

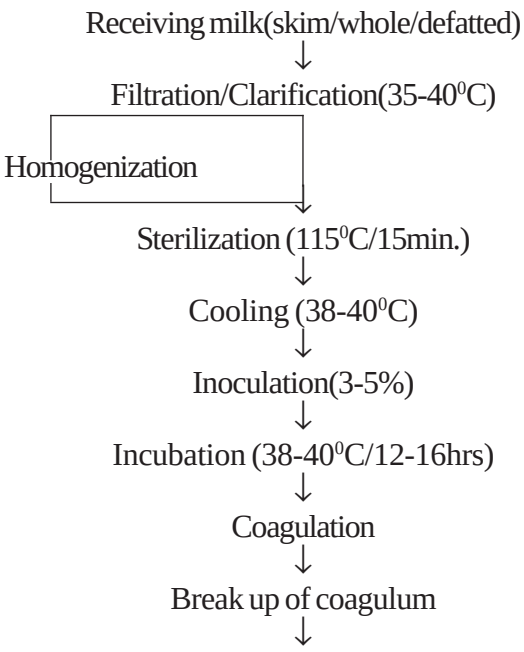
Skim milk is pasteurized, cooled and added with starter culture. After incubation, the curd is broken and cooled to 5 to 10°C.

ACIDOPHILUS MILK

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



Cooling(10^0C)

↓

Packaging and storage(5^0C)

YOGHURT

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 thermophilussu ssp. Thermophilus* It may also contain cultures of *Bifidobacterium bifidus* and *Lactobacillus acidophilus* and other cultures of suitable 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:

Parameters	Product	
	Plain Yoghurt	Fruit Yoghurt
Milk fat	Not less than 3%	Not less than 1.5%
Milk solids not fat	Not less than 8.5%	Not less than 8.5%
Milk protein	Not less than 3.2%	Not less than 2.6%
Sugar	-	Not less than 6%

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:

Receiving whole/defatted milk

↓

Addition of skim milk powder concentrate

↓

Filtration/clarification (35-40^0C)

↓

Pre-heating the mix (60^0C)
↓
Homogenization (2500 psi)
↓
Pasteurization (85^0C/30min)
↓
Cooling (43-44^0C)
↓
Inoculation (2%)
↓
Packaging
↓
Incubation (41-42^0C/3hrs) (0.75%T.A)
↓
Cooling and storage (5-7^0C)

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:

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: Preserved fruits or fresh 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.

DAHI

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:

Receiving milk
↓
Pre-heating
↓
Filtration/clarification (35-40^{0}C)
↓
Standardization
↓
Pre-heating 60^{0}C
↓
Homogenization(2500 psi)
↓
Pasteurization (80-90^{0}C/15-30min)
↓

Cooling (22-25^{0}C)
↓
Inoculation (0.5% starter culture)
↓
Packaging
↓
Incubation (22-25^{0}C /16-18hrs)
↓
Dahi
↓
Cooling and storage (5^{0}C)

Details of Manufacture:

Fresh, sweet, good quality milk is received, pre-heated to 35-40^{0}C and subjected to filtration/ clarification. It is then standardized to 2.5-3.0% fat and 10% SNF, pre-heated to 60^{0}C and homogenized single stage at a pressure of 176kg/sq.cm. The milk is pasteurized at 80-90^{0}C /15-30 minutes., cooled to 22-25^{0}C and inoculated with 1-3% of lactic starter culture. Itv is then filled in suitable containers (glass bottles/ plastic cups/ pouches) of required capacity and incubated at 22-25^{0}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^{0}C in a cold room.

LASSI

Standardized milk (4% fat) is heated to 90^{o}C for 10 min and cooled to 25^{o}C before addition of starter culture (1%). Cultured milk is incubated for 12-16 hr at 25-28^{o}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 Srikhand

Assessment Activities

- Preparation of fermented milk-prepare fermented milk

- Market Survey –Students are divided into differntgroups and each groups asked to prepare a questionnaire and conduct 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.

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
   Streptococus thermophilus
   Lactococus lactis
   Lactococus cremoris
5. A discussion is conducted in your class regarding the merits of fermented milkproduts over milk. Give a summary of the discussion. (4)
6. Complete the flow diagram for the preparation of Dahi. (3)

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.

Learning Outcomes

- Analyze and standardize different types of cream.
- Classify different types of creams.
- Identify different methods of separation.
- Analyze and standardize different types of Butter.
- Classify different types of butter.
- Identify different methods of manufacture.
- Calculate overrun.
- Analyze and standardize desi butter.
- Prepare Desi butter.
- Analyze and standardize different types of Ghee.
- Identify different methods of manufacture of ghee.
- Identify and analyze Agmark standards.
- Identify and analyse packaging and storage of ghee.
- Test the ghee and identify the adulterants.
- Analyze and standardize butter oil.

CREAM

Definition

According to Food Safety and Standards Authority of India (FSSAI) 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

Constituents	Percentage	
	I (Low fat cream)	II Medium fat cream
Water	68.2	45.45
Fat	25	50
Protein	2.54	1.69
Lactose	3.71	2.47
Ash	0.56	0.37
Total solids	31.8	54.55
Solids-not-fat	6.8	4.55

Types of cream – Table cream, light cream, coffee cream, whipping cream, heavy cream and plastic cream

Production:

Basic principle of cream separation

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 that of skim milk is 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 or rate at which the fat globules rise, is given by the following equation

Stock's Law

$$V \quad \frac{2G}{9} \quad \frac{(ds \quad df)r^2}{n}$$

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

G = acceleration due to gravity

d_s = density of skim milk

d_f = density of fat globule

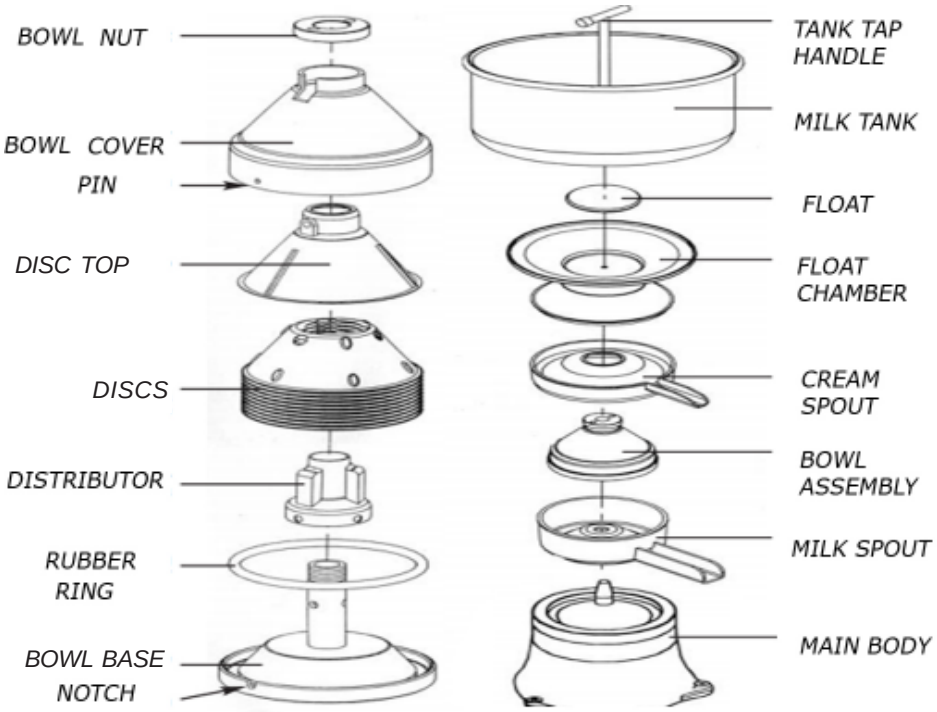
r = radius of fat globule

n = 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).Thereby the skim milk is forced to the periphery while the fat portion moves towards the centres and led through separate outlet.

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.



BUTTER

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 hout 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.

Parameters	Product	
	Table butter	Desi/Cooking butter
Moisture	Not more than 16%	-
Milk fat	Not less than 80%	Not less than 76%
Milk solids not fat	Not less than 1.5%	-
Common salt	Not more than 3%	-

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”.

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.

j) **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.)

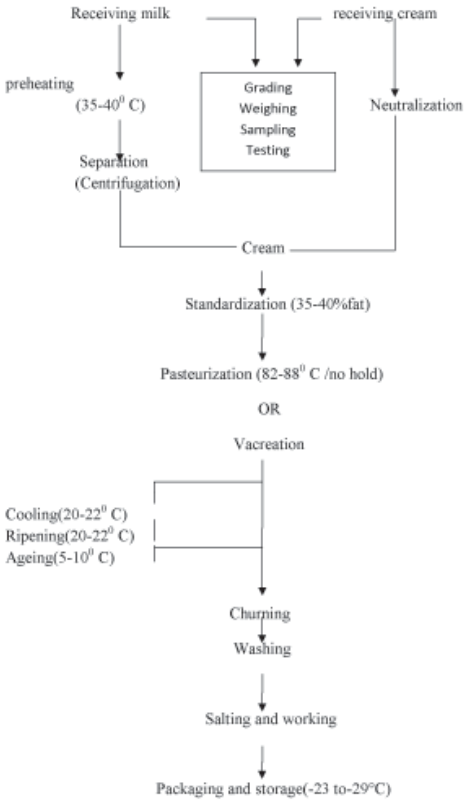
k) **Dairy butter(USA):**

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.

l) **Cremary butter:**

Made in a cremary or dairy factory.It is more uniform in quality than 'dairy butter'.

Method of manufacture



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:

Neutrlisation 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^{0}C.

Method of neutralization of cream

There are five essential steps to follow for cream neutralization. These are:

1. Adoption of definite standard of churning acidity.:

   Butter for long storge:-Cream acidity should be reduced to 0.06-0.08% before churning.

   Butter for short storge:-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 Hudroxide
- 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 71^0C 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 micr-organisms and inactivate enzymes present so as to prlong keeping quality of the cream and butter.
iii To eliminates 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 15-16seconds.
c) Vacuum pasteurization or vacreation.

Cooling and ageing

Cream is cooled by lowering its temperature and aged by holdin 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 fatt 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 is added to pasteurized and cooled(20-22^{0}c) 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^{o}C till desired an acidity is reached. Cream is subsequently cooled to 5-10^{0}C 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.(*Bixa orellana*). 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 fat

test. During the churning process there is invariably a rise in temperature from 1° to 30°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°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 over-run is given below:

Per cent Over-run (% OR) = (B - F)/F

Where,

B = Quantity of butter made (kg)

F = Fat in churn (kg)

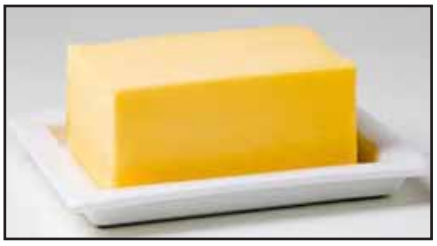
Factors Influencing Over-run:

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.



Butter

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.

GHEE

According to FSSAI, Ghee means the pure clarified fat derived solely from milk occurred or from desi (cooking) butter or from cream to which no colouring matter or preservative has been added. The standards quality of ghee produced in Kerala is specified in the Table below shall.

Parameters	Reading
Butyro Refracto meter reading at 40°C	40.0 to 43.0
Minimum Reichert Value	26.0
FFA as % oleic acid (maximum)	3.0
Moisture % (maximum)	0.5

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 smallerr 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".

AGMARK grades of ghee

Grade	Letter and Circular bordercolour
Special	Red
General	Green
Standard	Chocolate

FIG 3.3.4 Agmark label of Ghee

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, cotton-seed 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 to 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 12months at 21°C.

BUTTER OIL

Butter oil and Anhydrous Milk fat/An hydrous Butter oil means the fatty products derived exclusively from milk and/or products obtained from milk by means of process which result in almost total removal of water and milk solids not fat. It shall have pleasant taste and flavor free from off odour and rancidity. It shall be free from vegetable oil/fat, animal body fat, mineral oil, added flavor and any other substance foreign to milk.

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.

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. **Du**ring a dairy plant visit you may have noticed the working of cream separator. **C**an you explain the principle behind its working?
7. Due to high acidity you decided to neutralise cream for butter manufacture. Name the type of neutraliser, also explain the processor of addition.
8. '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.
9. .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.

10. 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.

c. 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.

d. Classify the following types cream based on their fat%

Table cream, Plastic cream, Light cream, Whipping cream, Coffee cream, Heavy cream

e. 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)

f. 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.

Unit 3.4
CONDENSED AND DRIED MILK

Milk, skim milk, whey, and other milk products can be concentrated, i.e., part of the water can be removed. Its main purpose is to diminish the volume and to enhance the shelf life quality. Water can be removed from milk by evaporation and in addition to water, volatile substances, especially dissolved gases are also removed. Evaporation is usually done under reduced pressure — hence, decreased temperature — to prevent damage caused by heating.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. Nonfat dry milk serves the same purpose for milk solids-not-fat that traditionally butter has done for milk fat. The ultimate aim of the industry is to obtain dry products which if recombined with water give little or no evidence of detrimental change compared to the original liquid product.

Learning Outcomes

- Analyze and standardize sweetened condensed milk.
- Classify different types of condensed milk.
- Prepare sweetened condensed milk.
- Identify and categorize different types of milk powders,baby foods etc.
- Identify FSSAI standards.

SWEETENED CONDENSED MILK

Sweetened Condensed Milk means 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 away as not to alter the whey protein to case in ratio of the milk being adjusted. It shall have pleasant taste and flavor free from off flavor and rancidity. It shall be free from any substance foreign to milk .It shall conform to the following requirements:

Parameters	Product	
	Sweetened condensed milk	Sweetened condensed skimmed milk
Milk fat	Not less than 9%	Not more than 1%
Milk solids	Not less than 31%	Not less than 26%
Milk protein in milk solids not fat	Not less than 34%	Not less than 34%

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)

Details of manufacture

(a) Receiving milk: when milk is received at the plant, its temperature should be at 10C or below. The milk should be clean, sweet, free from off-flavours and odours. No abnormal milk should be accepted.
The main platform and labouratory 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 suseptable 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 basic 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 35-40C to increase the efficiency of the operation.

(c) **Standardizatio**n: 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 93C for 5 to 15 minutes. The temperture-time for HTST is 115 to 118C 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 vaccum at a low temperature till the desired concentration is reached. The chief advantage of condensing milk in vaccum are: economy of operation, rapidity of evaporation and protection of milk against heat damege.

(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.

(h) **Cooling and crystallization**: A considerable portion of lactose content in the condensed milk held at ordinary temperature is present in crystal form. The relaitive smoothness of condensed milk is controlled by the number and size of the lactose crystals it contain. The size of lactose crystals is controled 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 24C. This should take approxiately an hour. Then the cooling is completed to 13-18C 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 10C is reccomended 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 toalter the whey protein to case in 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:—

Parameters	Product	
	Evaporated milk	Evaporated skimmed milk
Milk fat	Not less than 8%	Not more than 1%
Total milk solids	Not less than 26%	Not less than 26%
Milk protein in milk solids not fat	Not less than 34%	Not less than 34%

DRIED MILK/ MILK POWDER:

MilkPowder-means the product obtained by partial removal of water from milk of Cowand/or Buffalo. The fat and/or protein content of the milk may bead justed by

addition and or withdrawal of milk constituents in such a way as not toalter the whey protein to case in ratio of the milk being adjusted. It shall be of uniform colour and shall have pleasant taste and flavor free from off flavor and rancidity. It shall also be free from vegetable oil/fat, mineral oil, thickening agents, added flavor and sweetening agent. It shall conform to the following requirements:—

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

BABY FOOD / INFANT MILK FOOD:

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 assucrose, 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 packedin hermetically sealed, cleanand sound containers orin flexible pack madefrom film or combination or any of the sub strate made of Board paper, polyethylene, polyester metallised film or in such away to protect from deterioration. It may be packed in nitrogen or a mixture of nitrogen and carbondioxide

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

1. Moisture, percentby weight(notmorethan) 4.5
2. Totalmilkprotein, percentby weight(notlessthan) 12.0
3. Milkfat, percentby weight (notlessthan) 18.0

4.	Totalash, percentby weight(notmorethan)	8.5
5.	Ashinsolubleindilute Hydrochloricacid, percentby weight (not more than)	0.1
6.	Solubility:	
	Solubility Index maximum	2.0ml
	Solubility percentby weight (not less than)	98.5
7.	VitaminA (asretinol) ìg.per100g.(not less than)	350ì g
8.	Added VitaminD (expressedas Cholecalciferol or Ergocalciferol) ìgper100g. (not less than)	4.5ì g
9.	VitaminC,mgper100g.(not less than)	35ì g
10.	Thiamine, ìgper100g.(not less than)	185ì g
11.	Riboflavin, ìgper100g.(not less than)	275ì g
12.	Niacin, ì gper100g.(not less than)	1160ì g
13.	Pyridoxine ì gper100g.(not less than)	160ì g
14.	Folicacid, ì gper100g.(not less than)	20ì g
15.	Pantothenic acid, mgper 100g.(not less than)	1.4mg
16	Vitamin B12, ìgper100g.(not less than)	0.7ì g
17	Choline, mg per100g.(not less than)	32mg
18	Vitamin K ì gper100g.(not less than)	18ì g
19	Biotin, ì gper100g.(not less than)	7.0ì g
20	Sodiummgper100g.(not less than)	90mg
21	Potassium, mgper100g.(not less than)	370mg
22	Chloride, mgper100g.(not less than)	250mg
23	Calcium, mgper100g.(not less than)	230mg
24	Phosphorous, mgper100g. (not less than)	115mg
25	Magnesium, mgper100g.(not less than)	22mg
26	Iron, mgper100g. (not less than)	5.0mg
27	Iodine, ì gper100g. (not less than)	20ì g
28	Copper,ì gper100g. (not less than)	280ì g
29	Zinc,mgper100g.(not less than)	2.5mg
	and not more than	5.0mg
30	Manganese, ìgper100g.(not less than)	202.5mgg
31	Selenium, ì gper100g.(not less than)	14ì g
32.	Bacterial count, perg.(not more than)	10,000
33	Coliform countabsentin	0.1gram
34	Yeast and mould count absent in	0.1gram
35	Salmonella and Shigellaabsentin	25gram
36	E. coliabsentin	0.1gram
37	Staphylococcusaureasabsentin	0.1gram

MALTED MILK POWDER/ FOOD:

Milk cereal based complementary food are obtained from milk, variety of cereals, pulses, soyabean, millets, nuts and edible oil seeds after processing. It may contain edible vegetable oils, milk solid, various carbohydrates such as sucrose, dextrose, dextrins/ maltodextrin, maltose and lactose, calcium salts; phosphates and citrates and other nutritionally significant minerals and vitamins. It shall contain a minimum of 10 per cent milk protein by weight of the product. It shall also contain minimum 5 per cent milk fat by weight It shall be in the form of powder, small granules or flakes, free from lumps and shall be uniform in appearance. It shall be free from dirt and extraneous matter and free from preservatives and added colour and flavour. It shall be free from any material, which is harmful to human health.

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.

MILK POWDER

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)

	Fat%
Sweetened condensed milk	Not less than 26
Sweetened condensed skim milk	Not less than 9
Evaporated milk	Not more than 0.5
Whole milk powder	Not more than 1.5
Skim milk powder	Not less than 8

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)
↓
…….(e)…….
↓
Cooling and ……(f)……
↓
Packaging
↓
Storage (10°C)

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 one of the oldest foods of mankind. It is commonly believed that cheese evolved in the Fertile Crescent between the rivers Tigris and Euphrates in Iraq some 8000 years ago. The so-called Agricultural Revolution occurred here with the domestication of plants and animals.It seems that cheese originated accidentally as a result of the activities of nomadic tribes. Since animal skin bags were a convenient way of storing liquids for nomadic people, these were used for storing surplus milk. Fermentation of the milk sugars in the warm climate prevailing would cause the milk to curdle in the bags. The swaying animals would have broken up the acid curd during journeys to produce curds and whey. The whey provided a refreshing drink on hot journeys, while the curds, preserved by the acid of fermentation and a handful of salt, became a source of high protein food supplementing the meager meat supply.

Learning Outcomes

- Identify different cheeses.
- categorize different cheeses.
- understand Preparation of cheddar cheese, cottage cheese,processed cheese
- Identify uses of cheese.

Definition

According to Food Safety and Standard Regulations 2011, **Cheese** means the ripened or unripened soft or semihard, 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 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 and/ or products obtained from milk which give a final product with similar physical, chemical and organoleptic characteristics. The product may contain starter cultures of harmless lactic acid and / or flavour producing bacteria and cultures of other harmless microorganisms, safe and suitable enzymes and sodium chloride. It may be in the form of blocks, slices, cut, shredded or grated.

i. Ripened Cheese is cheese which is not ready for consumption shortly after manufacture but whichmust be held for some time at such temperature and under such other conditions as will result in necessarybiochemical and physical changes characterizing the cheese in question.

ii. Mould Ripened cheese is a ripened cheese in which the ripening has been accomplished primarily bythe development of characteristic mould growth through the interior and/ or on the surface of the cheese.

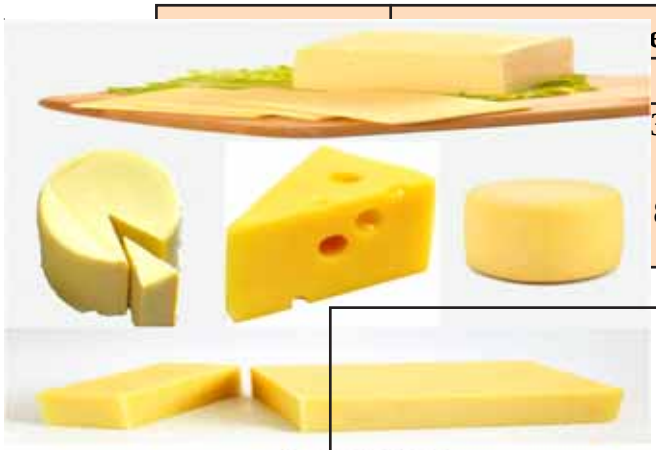
iii. Unripened cheese including fresh cheese is cheese which is ready for consumption shortly aftermanufacture.

Cheese or varieties of cheeses shall have pleasant taste and flavour free from off flavour and rancidity.

It may contain food additives permitted in these regulation including Appendix A. It shall conform to themicrobiological requirements prescribed in Appendix B:

Provided that cheese or varieties of cheeses coated with food grade waxes/ or polyfilm / or wrapping of clothshall bear proper label declaration as provided in regulation 2.4.5 (44) of Food Safety and Standards (Packaging and Labeling) Regulations, 2011. It shall conform to the following requirements:-

	e	Milk Fat on Dry basis
		(3)
	39.0 %	Not less than 48.0%
	80.0%	Not less than 20.0 %



CHEESE

CHEDDAR CHEESE

Definition

According to Food Safety and Standard Regulations 2011,**Cheddar Cheese** means ripened hard cheese obtained by coagulating heated/pasteurised milk of Cow and/or Buffalo or mixtures thereof with cultures of harmless lactic acid producing bacteria, non-animal rennet or othersuitable coagulating enzymes. It shall be in the form of hard pressed block with a coating of food grade waxes orwrapping of cloth or polyfilm. It shall have firm, smooth and waxy texture with a pale straw to orange colour withoutany gas holes. It may contain permitted food additives. It shall conform to the following requirements:—

(i) Moisture - Not more than 39.0 percent

(ii) Milk Fat on Dry Basis - Not less than 48.0 percent

Preparation of cheddar cheese

Flow diagram.

Receiving milk

↓

pre-heating(35-40ºC)

↓

filtration/clarification

↓

standardization

↓

pasteurization (63ºC/30 min)

↓

addition of 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
↓
milling
↓
salting
↓
hooping
↓
dressing
↓
pressing
↓
drying
↓
paraffinig
↓
curing

Details of Manufacture:

Receiving and Filtration of milk:

Good quality milk is taken and filtered(35-40ºC) 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 31ºC. 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 45º 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 37-39ºC at the rate of 1ºC 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 -16ºC 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 (104-121ºC), 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 (0-16ºC)at 75-85 % RH, during which its physical, chemical and bacteriological properties are changed, resulting in the characteristic flavor, body and texture of cheese.

COTTAGE CHEESE

Definition.

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 bacteriawith or without the addition of other suitable coagulating enzymes. Creamed Cottage Cheese is cottage cheese towhich 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. Itshall conform to the following requirements:—

(i) Moisture - Not more than 80.0 percent

(ii) Milk Fat(in Creamed Cottage Cheese) - Not less than 4.0 percent

Method of manufacture

Flow diagram of 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.

Definition

According to Food Safety and Standard Regulations 2011,**Processed Cheese** means the product obtained by grinding, mixing, melting and emulsifying one or more varieties of cheeses with the aid of heat and emulsifying agents. It may contain cream, butter, butter oil and other milk products subject to maximum 5.0 percent lactose content in the final product and edible common salt, vinegar/acetic acid, spices and other vegetable seasoning and foods other than sugars properly cooked or prepared forflavouring and characterization of the product provided these additions do not exceed one sixth of the weight of thetotal solids of the final product on dry matter basis and cultures of harmless bacteria and enzymes. It shall havepleasant taste and smell free from off flavour and rancidity. Itshall conform to the following requirements:—

(i) Moisture - Not more than 47.0 percent

(ii) Milk fat on dry basis - Not less than 40.0 percent.

Provided that processed cheese chiplets (packed sliced cheese) when sold in a package other than tin, shallnot contain more than 50.0 percent moisture.

Preparation

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

PROCESSED CHEESE SPREAD

According to Food Safety and Standard Regulations 2011, **Processed Cheese Spread** means the product obtained by grinding, mixing, melting and emulsifying oneor more varieties of cheese with emulsifying agents with the aid of heat. It may contain Cream, Butter oil and otherdairy products, subject to a maximum limit of 5.0 percent lactose in the final product, salt, vinegar, spices, condimentsand seasonings, natural carbohydrate sweetening agents namely sucrose, dextrose, corn syrup, corn syrup solids,honey, maltose, malt syrup and hydrolysed lactose and food properly cooked or otherwise prepared for flavouringand characterization of the product provided these additions do not exceed one sixth of the weight of total solids ofthe final product on dry weight basis and cultures of harmless bacteria and enzymes. It shall have pleasant taste andflavour free from off flavour and rancidity. It shall conform to thefollowing requirements:—

(i) Moisture - Not more than 60.0 percent

(ii) Milk fat on dry basis - Not less than 40.0 percent.

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

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. (2)
4. Distinguish the production of processed cheese and cottage cheese (4)
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. (2)
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. (4)
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

Unit 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.

LEARNING OUTCOMES:

- 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.
- Preparation of ice creams.

ICE CREAM

FSSAI definition and standards of ice cream:

According to Food Safety and Standard Regulations 2011, Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream(hereafter referred to as the said product) means the product obtained by freezing a pasteurized mix prepared from milk and / or other products derived from milk withor without the addition of nutritive sweetening agents, fruit and fruit products, eggs and egg products, coffee,cocoa, chocolate, condiments, spices, ginger and nuts and it may also contain bakery products such as cake orcookies as a separate layer and/or coating. The said product may be frozen hard or frozen to a soft consistency; thesaid product shall have pleasant taste and smell free from off flavour and the said product shall conform to the following requirements,namely:—

Requirement	Ice Cream	Medium Fat Ice Cream	Low Fat Ice Cream
(1)	(2)	(3)	(4)
Total Solid	Not lessthan36.0 %	Not less than 30.0 %	Not less than 26.0
Wt/Vol (gms /l)	Not lessthan 525	Not less than 475	Notlessthan 475
Milk Fat	Not lessthan 10.0 %	More than 2.5 % but less than10.0%	Not more than 2.5 %
Total Protein	Not less than 3.5%	Not less than 3.5 %	Not less than 3.0 %

Note: In case where Chocolate, Cake or similar food coating, base or layer forms a separate part of the product, only the Ice Cream portion shall conform to the requirements given above.

According to Food Safety and Standard Regulations 2011, Milk Ice or Milk Lolly (hereafter referred to as the said product) means the product obtained by freezing a pasteurized mix prepared from milk and/or other products derived from milk with or without the addition of nutritive sweetening agents, fruit and fruit products, eggs and egg products, coffee, cocoa, chocolate, condiments, spices, ginger and nuts; the said product may also contain bakery products such as cake or cookies as a separate layer and/or coating; the said product shall have pleasant taste and smell free from off flavour and rancidity. The said product shall also conform to the following requirements, namely :—

(1)	Total solids (m/m)	Not less than 20.0 percent
(2)	Milk Fat(m/m)	Not more than 2.0 percent
(3)	Milk Protein (Nx6.38)	Not less than 3.5 percent

Different varieties of ice creams:

Different varieties of ice creamsinclude 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:

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 Ice cream:

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:

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 productmade 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:

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.

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 flavourofIce 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:

This is an indigenous icecream frozen in small containers. Milk is concentrated to double fold and added with sugar, malai, crushed nuts and flavor.

Manufacture of icecream

Flowdiagram

Selection of ingredients
↓
Figuring the mix
↓
Blending the mix
↓
Pasteurization of mix
↓
Homogenizing the mix
↓
Cooling the mix
↓
Ageing of mix
↓
Freezing of mix
↓
Packaging of ice cream
↓
Hardening of ice cream
↓
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 – vegitable 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 ……. Fat equation

$X(b1) + Y(b2) + Z(b3)$ = SNF….Serum solids equation

$X + Y + Z + S + St$ = W…….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.Inorder to make a good ice cream,the ingredients are added is 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, there by 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:

Homogenizationis 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 information

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.

Additional information

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 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).

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.

$$\% \text{ Overrun} = \frac{(\text{volume of ice cream}) - (\text{volume of mix})}{\text{volume of mix}} \times 100$$

List of practical

- Preparation of different varities 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.

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 is 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 a exhibition one of the visitors asked whether it is possible to prepare ice cream without sugar and fat. How will you discus 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.
8. 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(Hint: Explain with flow diagram.)

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.

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.

LEARNING OUTCOMES

- Identify,define and classify indigenous milk products/sweets.
- Prepare khoa and khoa based sweets.
- Prepare chhana and chhana based sweets.
- Prepare and paneer based sweets.

CLASSIFICATION OF INDIGENEOUS DAIRY PRODUCTS

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.

i) Khoa and Khoa based sweets such asGulabjamun, 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) Shrikhand wadi

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

CONCEPT: Khoa and khoa based sweets – peda, Gulabjamun, kalakand, burfi-method of preparation.

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 intence 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 waterleakage.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 litres of buffalo milk or 5 litres 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 through out 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 coloured khoa that does not fetch a good price in the market as white/ cream coloredkhoa 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

KHOA BASED SWEETS :

PEDA

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

METHOD OF PREPARATION:

Break freshly made khoa (mawa) into bits. Mix sugar into it. Put into a karahi and cook over a very slow non-smoky fire, stirring all the while with a khunti. When mixture is ready pour into a greased tray and leave to cool and set. Cut into desired size and shape and serve.

Quality and quantity of peda depends on:

- Type and quality of milk
- Quality of khoa 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.

Method 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 (7% on milk basis) 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.

KALAKAND

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

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 kalakan*d* is cut into desirable shapes or alternatively served as such without any definite shape.

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

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.

Khoa Based Products

CHHANA

According to FSSAI, Chhana or paneer means the product obtained from the cow or buffalo milk or a combination thereof byprecipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70.0 per cent moisture and the milkfat content shall not be less than 50.0 per cent of the dry matter.Milk solids may also be used in preparation of this product.Provided that paneer or chhana when sold as low fat paneer or chhana, it shall conform to the following

requirements

(i) Moisture - Not more than 70.0 percent

(ii) Milk fat - Not more than 15.0 percent of dry matter:

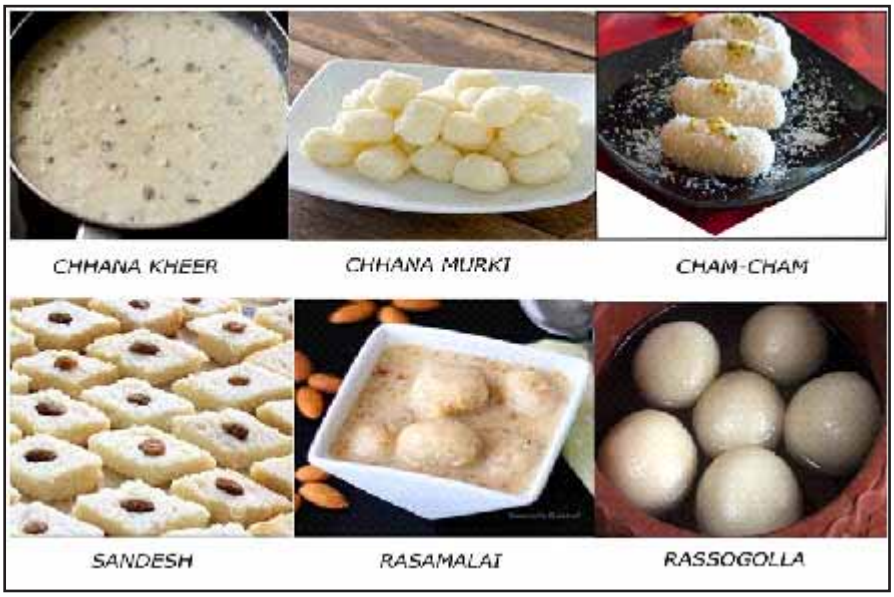
Chhana is an acid coagulated product obtained from milk. The curd mass obtained when milk is coagulated with the organic acids such as citric acid, lactic acid at higher temperature and after subsequent drainage of whey, mass of curd obtained is called chhana. It looks off-white, tastes mildly acidic, 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 chhanamaking. Chhana is used as a base for the preparation of a variety of sweets like sandesh, rasogolla, chamcham, rasomalai, pantoa, chhanamurki, etc.

Chhana Preparation

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 30min to expel free whey.

CHHANA BASED SWEETS



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. R*asogolla* 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^{O} 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^{O}C for texture and colour improvement. After 30min stabilized balls are transferred to 60^{O}Brix syrup for 1-2 hours, followed by final dipping in 50^{O}*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 ofkhoa 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 spongy 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 paneerandpaneer production is growing annually at the rate of 13%.

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.

CHAKKA AND SRIKHAND

CHAKKA

Chakka-means a white to pale yellow semi-solid product of good texture and uniform consistency obtained by draining off the whey from the Yoghurt obtained by the lactic fermentation of cow's milk, buffalo's milk, skimmed milk and recombined or standardized milk which has been subjected to minimum heat treatment equivalent to that of pasteurisation. It shall have pleasant Yoghurt / Dahi like flavour. It shall not contain any ingredient foreign to milk. It shall be free from mouldness and free from signs off at or water see page or both. It shall be smooth and it shall not appear dry. It shall not contain extraneous colour and flavours. It shall conform to the following requirements, namely:

	Requirements	Chakka
1.	Total solids, percent by weight	Min.30
2.	Milk fat (on dry basis) percent by weight	Min.33
3.	Milk protein (on dry basis) percent by weight	Min.30
4.	Titrable acidity (aslacticacid) percent by Weight	Max.2.5
5.	Total Ash (on dry basis) percent by weight	Max.3.5

Chakka when sold without any indication shall conform to the standards of Chakka.

SHRIKHAND

Shrikhand-means the product obtained from chakka or Skimmed Milk Chakka to which milk fat is added. It may contain fruits, nuts, sugar, cardamom, saffron and other spices. It shall not contain any added colouring and artificial flavouring substances. It shall conform to the following specifications, namely:—

	Requirements	**Shrikhand**
1.	Total solids, percent by weight	Not less than…58
2.	Milk fat (on dry basis) percent by weight	Not less than…8.5
3.	Milk protein (on dry basis) percent by weight	Not less than…9
4.	Titrable acidity (aslactic acid) percent by weight	Not more than….1.4
5.	Sugar (sucrose) (on dry basis) percent by weight	Not more than…72.5
6.	Total Ash (on dry basis) percent by weight	Not more than….0.9

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 chhanakheer.
- Preparation of chhanamurki.
- Preparation of rasmalai
- paration of pantooa.

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.

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

7. 1. Observe the flow diagram and answer the following questions

Milk
↓
Boil
↓
Cooled to 90^0C
↓
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.

9. 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.

10. While purchasing in a nearby bakery you saw brown coloured balls preserved in sugar syrup.
    a. Name the milk product.
    b. Explain the preparation.
11. 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.
12. 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.
13 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.

14. Name any two product that can be prepared from:
    Chhana
    Paneer
    Khoa
    Curd

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

A dairy by-product may be defined as a product of commercial value produced during the manufacture of a main product. Skim milk, buttermilk, ghee residue and whey are the main dairy by-products. Utilization of dairy by-products improves plant economy, makes valuable nutrients available for humans and reduces environmental pollution originating from dairy waste. Conversion of edible substances into non-food items is not ordinarily justifiable, especially in countries, where there is an overall shortage of milk supplies. It has always been realized that economic disposal of by-products is an essential prerequisite to profitable dairying. Each and every component of milk must be judiciously processed into edible form for the obvious reason of its unique nutritional value. These by-products are, therefore, receiving increasing attention for their proper utilisation by the research workers all over the world. However, it should be recognized that just because it is technically feasible for any dairy by-product to be processed into interesting by-products, it does not mean that we can utilize it. Processing of by-products needs to be economically feasible, if one is to invest capital and resources into a programme to utilize them.

LEARNING OUTCOMES:

- Define and classify Dairy by-products.
- Identify the method of preparation.
- Prepare whey products.
- Identify and aware of the waste management systems in dairy industry.

DAIRY BY-PRODUCTS

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

Main product	By-product
Cream	Skim milk
Butter	Buttermilk
Ghee	LassiGhee residue
Chhana/Paneer Cheese Casein	Whey

RENNET

ACID RENNET

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: 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.

WHEY BEVERAGES

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.

EFFLUENT TREATMENT PLANT

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:

PARAMETER	READING
P^H	6-9
BOD	50Mg/L
COD	250Mg/L
Total suspended solids	50Mg/L
Oil and grease	10Mg/L
Total nitrogen	10Mg/L
Total phosphorus	2Mg/L

PRE-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.

List of Practicals

Preparation ofwhey sip-up, whey drink

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.

TE Questions

1. 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.

2. Distinguish acid casein and rennet casein

3. 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)

4. Whey is used for the production of fermented beverages. List out four commercially available whey beverages. (2)

5. Match the following (2)

Main product	By-product
Cream	Buttermilk
Butter	Ghee residue
Ghee	Whey
Chhana/PaneerCheeseCasein	Skim milk

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.

LEARNING OUTCOMES:

- Identify and aware of quality and safety of dairy food.
- Identify and analyse different standards.
- Identify and classify milk born milk borne diseases.
- Recommend remedial measures.
- Aware of action plan to avoid hazards.
- Apply of hygienic precautions.
- Aware about the importance of Cold chain in milk preservation.
- Aware about automation.

IMPORTANCE OF QUALITY ASSURANCE

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

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

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 19 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

A) Precautions to be taken to avoid contamination by handling personnel

The food handling personnel should:

- Bath daily
- Use no perfume, aftershave, fragrant creams
- Use no jewellery
- Use no false nails or nail polish
- Trim short fingernails
- Use metal detectable bandages covered with gloves
- Not eat/ drink/use chewing gum while on duty
- Wash their hands thoroughly when they enter food handling areasbefore starting work and after handling contaminated materials and after breaks and after using toilet facilities

B) Precautions to be taken to avoid contamination from ingredients

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

C) Precautions to be taken to avoid contamination from premises/ environment

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

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.

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 andto 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, Panchayatsetc 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.

MILK-BORNE HAZARDS AND APPLY HYGIENIC PRECAUTIONS

Hygienic precautions should be taken right from the milking of cattle (farm to consumer)

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

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:

Organoleptic tests:

The organoleptic 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 organoleptically 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- 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

QUALITY CONTROL OF PASTEURISED MILK:

When milk is pasteurised at 63ºC for 30 min in batch pasteuriser or 72ºC for 15 seconds in heat exchanger, continuous flow pasteurisers, ALL PATHOGENIC BACTERIA ARE DESTROYED, there by 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 pasteursation. 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.

COLD CHAIN IN MILK PRESERVATION

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 retails outlets, supermarkets, and to retails 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.

AUTOMATION IN DAIRY PLANTS-QUALITY CONTROL LAB, BULK VENDING MACHINES

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.
- Eonomial production.
- Improved working conditions.

Automation for dairy lab:

Alarge dairy laboratory can process thousands of milk samples per day. Accomplishing the chemical analysis in a correct and efficientmanner can makethetest

results more reliable and the lab moreprofitable. 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 p^Hmeter, 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 pre-requisites 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 steelmobile milk vending machines are mounted on vehicles. The tanks are filled with milk at the dairyand 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

LISTS OF PRACTICALS

- 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 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.

TE QUESTIONS:

1. Expand the following

   HACCP,GMP,TQM,ISO
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.
6. Write an article about FSSAI and its relevance in Dairy Industry, to publish in Your school Magazine.
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 market.

LIST OF PRACTICAL WORKS

- 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 ,kulfi
- 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 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

MODULE 4
DAIRY BUSINESS MANAGEMENT

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 : 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.

LEARNING OUTCOMES

- Interact with farmers.
- Apply the dairy extension education concepts.
- Choose and apply various visual aids to impart the extension education concepts.
- Choose and apply various audio aids to impart the extension education concepts
- Prepare charts, posters and bulletins
- Operate a camera, OHP projector, TV and multimedia

objectives of extension:

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.

Basics of dairy extension:

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.

Extension teaching methods – introduction to audio visual aids

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

AUDIO-VISUAL-AIDS

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 be ing 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 farmequipments, 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.

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 for extension of dairy activities .Comment on the statement .(hint:-functions and limitations)
2. Dairy extension education helps to educate dairy stake holders how 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.

LEARNING OUTCOMES:

- Compare and evaluate various development programmes and five year plans.
- Analyze the achievements of white revolution
- Analyze and compare various phases of operation flood
- Evaluate and recommend the requirements of a dairy co-operative society
- Evaluate the working of a dairy co-operative society and union
- Evaluate and draw the sketches of various registers maintained in a society
- Analyse and study the accounts maintained in a society
- Analyse and study the functions of Federation in a 3 tier system
- Analyse the various schemes by the department
- Evaluate and understand the implementation procedure.

Various development programmes and five year plans

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 12^{th} five-year plan.

FIVE YEAR PLANS AND DAIRY DEVELOPMENT

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 growthinlivestockproduction,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 planprovidedeffective health coverage and reduced economic loses due to diseases. The plan also helped to enlarge export of livestockproducts.

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 wereachieved

Important Developments in Different Five Year Plans

Five year plan	Key developments
First Five Year Plan (1951– 56)	· Establishment of Key Village Schemes (1952) · 146 key village blocks with AI centres · Establishment of 650 veterinary hospitals
Second Five Year Plan (1956 – 61)	· Establishment of 196 key village blocks with 670 AI centres · Establishment of 1900 veterinary hospitals
Third Five Year Plan (1961 – 66)	· 143 government milk supply schemes in big towns · Establishment of NDDB · Establishment of a separate department for dairy development in each State
Fourth Five Year Plan (1969 – 74)	· Launch of Operation Flood, phase I · Establishment of progeny testing scheme –All India Co-ordinated Project on Buffaloes · Shift of breeding policy from indigenous to crossbreeding · Formation of Indian Dairy Corporation
Fifth Five Year Plan (1974 – 79)	· Implementation of Operation Flood, phase II
Sixth Five Year Plan (1980 –85)	· Establishment of frozen semen stations in different States
Seventh Five Year Plan (1985 – 90)	· Implementation of Operation Flood, phase III
Eight Five Year plan (1992-97	· Frozen semen technology based upon progeny bulls
Ninth Five Year plan (1997-02)	· Effective health coverage to reduce economic losses due to diseases
Tenth Five Year Plan (2002 – 07	· Conservation of threatened indigenous breeds
Eleventh Five Year Plan (2007 – 12)	· National Agricultural Development Programme (NADP) · National Project for Cattle and Buffalo Breeding(NPCBB)

Indian Council of Agricultural Research

The current Five Year Plan is 12th Plan.

Ongoing Dairy Development Schemes.

Government of India is making efforts for strengthening the dairy sector through various Central sector schemes like "National Programme for Bovine Breeding and Dairy Development", National Dairy Plan (Phase-I) and "Dairy Entrepreneurship

Development Scheme".The restructured Scheme National Programme for Bovine Breeding and Dairy Development (NPBBDD) was launched by merging four existing schemes i.e. Intensive Dairy Development Programme (IDDP), Strengthening Infrastructure for Quality & Clean Milk Production(SIQ&CMP), In order to meet the growing demand for milk with a focus to improve milch animal productivity and increase milk production, the Government has approved National Dairy Plan Phase-I (NDP-I) in February, 2012. NDP-I will help to meet the projected national demand of 150 million tonnes of milk by 2016-17 from domestic production through productivity enhancement, strengthening and expanding village level infrastructure for milk procurement and provide producers with greater access to markets. The strategy involves improving genetic potential of bovines, producing required number of quality bulls, and superior quality frozen semen and adopting adequate bio-security measures etc. The scheme is implemented by NDDB through end implementing agencies like **state Dairy Cooperative Federations/Unions/Milk Producers Companies.** NDP-I would focus on 15 major milk producing States - Uttar Pradesh, Punjab, Haryana, Gujarat, Rajasthan, Madhya Pradesh, Bihar, West Bengal, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Orissa and **Kerala** which account for over 90% of the country's milk production. Now the area of Operation of NDP-I has been extended to three more states i.e.Uttarakhand, Chhattisgarh and Jharkhand.Coverage of NDP- I will however be across the country in terms of benefits accruing from the scheme.

OPERATION FLOOD

Operarion 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

In1945,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 aprivate firm called Polson Dairy, which in turn had hired contractors to do the job. The secontractors 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 Vallabhabhai 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 procurementwereremoved. 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 ‘billionlitreidea’. This is the genesis of Kaira Districtco-operative Milk Producer’s Union, better kn own 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. Eachco-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.TribhuvandasPatel 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.

(3) To provide veterinary and health service to the milk producers.

(4) 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, Alapuzha, 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.

ORGANISATION OF A PRIMARY DAIRY COOPERATIVE

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. Heshould 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, 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 than 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.

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:
   - o Balanced cattle feed.
   - o Fodder seeds of improved variety.
   - o Services for animal health care.
   - o Services for breeding of milch animals.
   - o Patronage based portion of the surplus.
   - o 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.

Registers and records maintained in the 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 societiy", 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.

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.

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.

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- Manage production planning and State Milk Grid (movement of milk within the state).
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Function of dairy development department (DDD)

Various schemes by the department and Implementation procedure

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 C0-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 news paper 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.

LEARNING OUTCOMES:

- Choose and apply right packaging material.

Packaging Material:

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 information:

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.

COMMON PACKAGING MATERIALS:

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.)

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)

Packaging Material for UHT sterilized milk

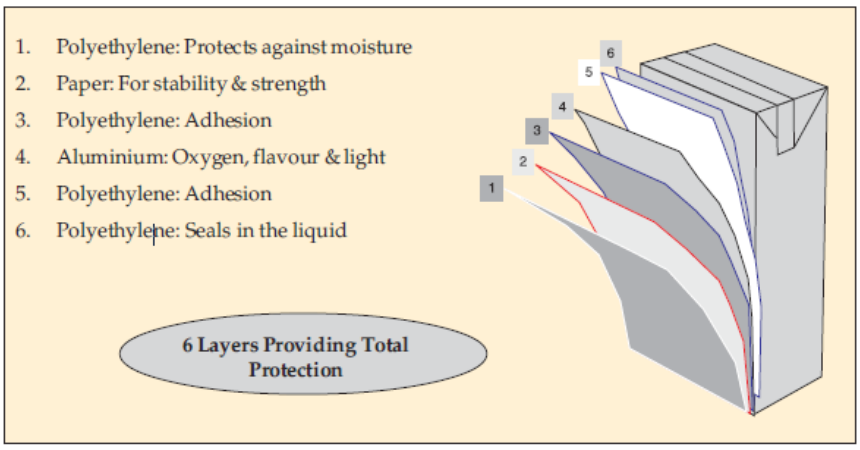
Aseptic packaging system:

Aseptic packaging is a packaging concept in which sterile product is packed in pre-sterilized containers under asepticconditions.No refrigeration is necessary for at least 3-6 months. If kept under refrigeration the shelf life is enhanced up to 1 year.

Types of aseptic pack

Carton Boxes, Bags and Pouches, Bottles and Jars, Metal Cans, Plastic Cans and Composite Cans

Different layers of tetrapak carton:



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. Tetra paks or tinplate

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

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 hermitically 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

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
4. They are suitable for heat processing when hermetically sealed
5. They are transparent to microwaves

6. They are reusable and recyclable
7. They are re sealable
8. 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.
3. Soft, ductile and low tensile strength.

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 recycled and reused

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.

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

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.

LEARNING OUTCOMES:

- Choose the marketing technique.
- Choose the proper transportation method.
- Select the target group.
- Describe importance of marketing personnel.

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.

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 transportationsystem and transport:

- **Local conditions:**

  Geographical locatio**n:** 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 becrossed, 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 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

Mode	Optimum load (kg)	Optimum distance (km)	Remarks
Head-load	15-25	3 – 8	Generally employed for small loads and distances. Important in hilly areas.
Shoulder-sling	Up to 40	3 – 6	Meant for heavier loads but for shorter distances than head-load.
Pack-animal	Up to 80	6 - 10	Ponies, horses and donkeys usually employed.
Bullock-cart	300-400	10 –12	Rather slow.
Tonga	250-300	12 or more	Larger quantities transported; faster than head-load, shoulder-sling and pack animal.
Bicycle	40 or more	15 or more	Quick and handy; easily accessible to milk producer's home.
Cycle-rickshaw	150-200	10 or more	More carrying capacity than bicycle.
Boat	40-200	2 – 8	Only means of transport when rivers, etc., have to be crossed.
Auto-rickshaw	250-500	15 or more	Greater carrying capacity and faster than cycle-rickshaw.
Motor truck	½ to 3 tonnes	15 or more	With the improvement in road facilities and construction of all season roads, motor trucks have been found most effective means of transportation.
Railway wagon	11 tonnes or more	80 or more	Railway wagons are most dependable and economical for long distance but less popular means of milk transportation.
Tankers (road or rail)	5 tonnes or more	80 or more	. **Road tanker:** Insulated stainless steel tanks are mounted on road truck chesis 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. **Rail tanker:** Insulated and/or refrigerated stainless steel tanks are mounted on rail truck/chesis of the capacity in the range of 10,000 to 50,000 l to transport milk for a long distance

Cost of transportation:

Truck carrying milk cans

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 tothedairyplantintwo ways:

- Transporting milk through cans: Suitable when milk volume handled is low(capacity of a can is 40-50 litres.
- 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 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 profitabilityof 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 investment in Cans.
- Savings in detergent.

A comparative advantage road Vs Rail Transport

Type of transport	Advantages
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. iv) 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

Rail Milk Tanker

Road Milk Tanker

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.

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.

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).
9. Keep necessary records / documents.
10. Provide feedback, market intelligence and credit to channel member.
11. Facilities introduction of new product in market.

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.

UNIT :4.5
DAIRY ECONOMICS

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.

LEARNING OUTCOMES:

- Price milk and milk product.
- Aware of dairy development programmes.
- Prepare project for starting a small scale dairy farm unit/a small scale dairy processing unit

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

Sr. No.	Method	Characteristics	Advantages	Disadvantages
1	Based on volume or weight	By using the weighing machine or spring balance.	Simple to calculate milk price No expensive testing equipment is required	No incentive to improve quality of milk
2	Based on fat amount	By finding out the fat percentage of milk by conducting test. Using directly fat percentage or kg fat	Fairly simple to calculate milk price No benefit to milk producers adding water to milk	Necessary to purchase fat testing machines.
3	Based on fat as well as solids-not-fat content	By using the formula*	Provides an incentive to increase fat and SNF	Necessary to purchase fat testing machine and density meter.

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.

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 profits.
- 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 Development Bank of India (IDBI) Bank Ltd, Small Industry Development Bank of India (SIDBI), Infrastructural Finance Corporation of India (IFCI venture funds limited) etc.
- Hire-purchase or leasing facilities from national small industries corporations, state small industries development corporations, etc.
- Credit facilities provided by different financial institutions as well as commercial banks.

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.

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

ASSESSMENT ACTIVITIES:

- Project for starting a small scale dairy farm/ processing unit and evaluating its viability.
- Seminars/ 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 disadvantages.

EXTENDED ACTIVITIES:

1. Conduct a market survey for different milk products highlighting on their prices and brands

LIST OF PRACTICAL WORKS IN MODULE 4

- Handling of Audio-visual aids- Camera, 0HP, T.V ,slide projector and multimedia.
- Preparation 0f 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

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