Dairy Products Technology (Dairy Technology)

Practical Manual for Class XII
Dairy Products Technology for Class XII

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Preface

The attempt of CBSE to introduce Dairy Technology practical courses for Class XII is to encourage young minds to begin their career in dairying. In the present book, with a view to make the students understand the industrial scale operations in a dairy plant, things-to-observe during the visit of different sections of a dairy plant have been included. It is expected that these observations give the students first-hand information of dairy products manufacturing technology. Further, with a view to complement the theoretical aspects of dairy products technology covered in theory, the practical aspects and intricacies of dairy products manufacturing technologies have been covered. The student is expected to carefully follow the protocols given in this book to understand the role of processes involved and ingredients used in manufacturing different dairy products such as cream, butter, ghee, khoa, chhana, paneer, shrikhand, ice-cream, condensed milk, milk powder, etc.

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भारत का संविधान

उद्देशिका

हम, भारत के लोग, भारत को एक ["सम्पूर्ण प्रभुत्व-संपन समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य"] बनाने के लिए, तथा उसके समस्त नागरिकों को:

सामाजिक, आर्थिक और राजनीतिक न्याय,
विचार, अधिनियमत, विश्वास, धर्म

और उपासना की स्वतंत्रता,
प्रतिष्ठा और अवसर की समता

ग्राह कराने के लिए, तथा उन सब में, व्यक्ति की गरिमा और ' [ राष्ट्र की एकता और अखंडता ] सम्मिलित करने वाली बंधुता बढ़ाने के लिए दुरुपयोगी होकर अपनी इस संविधान सभा में आज तारीख 26 नवम्बर, 1949 ई। को एवं इसे इस संविधान को अंगीकृत, अधिनियमित और आवश्यकता करते हैं।

1. संविधान (व्यावसायिक संस्थान) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977) से “प्रभुत्व-संपन लोकतंत्रात्मक गणराज्य” के स्थान पर प्रतिष्ठापित।
2. संविधान (बायलीस्वर संस्थान) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977 से ), “राष्ट्र की एकता” के स्थान पर प्रतिष्ठापित।

भाग 4 के
मूल कर्तव्य

51 क. मूल कर्तव्य - भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह -

(क) संविधान का पालन करे और उसके आदश्त, संस्थाओं, राष्ट्रीय और राष्ट्रमण का आदर करे;

(ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रशिक्ष करने वाले उन्हें उन्हें इन्हें इन्हें में संजोए रखें और उनका पालन करें;

(ग) भारत की प्रभुता, एकता और अखंडता की रक्षा करे और उसे अखंड रखें;

(घ) देश को रक्षा करें और आह्वान किए जाने पर राष्ट्र की सेवा करें;

(ङ) भारत के सभी लोगों व समस्तता और समाज प्रभुत्व की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग या आभारित सभी भेदभाव से परे हों, ऐसी प्रथाओं का त्याग करे जो विरोध के सम्भावन के विरुद्ध हों;

(च) हमारी सामाजिक संरचना की गैरवाद्यक रूपरेखा का महत्त्व समझे और उसका परीक्षण करें;

(छ) प्राकृतिक पर्यावरण की जिसके अंतर्गत वन, झील, नदी, और बन्य जीव हैं, रखें और उसका संरक्षण करें तथा प्राणिमात्र के प्रति दयालू रखें;

(ज) वैज्ञानिक दृष्टिकोण, मानववाद और ज्ञानज्ञ तथा सुधार की भावना का विकास करें;

(झ) सामाजिक संरचना को सुरक्षित रखें और हिंसा से दूर रहें;

(ञ) व्यक्तिगत और सामाजिक गतिविधियों के सभी श्रेणियों में उत्कर्ष की ओर बढ़ते का सत्ता प्राप्त करें जिससे राष्ट्र निरंतर बढ़ते हुए यथार्थ और उपलब्धि की नई उंचाईयों को छू ले।
THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY TO OURSELVES THIS CONSTITUTION.

1. Subs, by the Constitution (Forty-Second Amendment) Act. 1976, sec. 2, for “Sovereign Democratic Republic (w.e.f. 3.1.1977)
2. Subs, by the Constitution (Forty-Second Amendment) Act. 1976, sec. 2, for “unity of the Nation (w.e.f. 3.1.1977)

THE CONSTITUTION OF INDIA

Chapter IV A

Fundamental Duties

ARTICLE 51A

Fundamental Duties - It shall be the duty of every citizen of India-

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) To promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.
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(Practical)

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Exercise-1
Visit to Dairy Plant

Section 1
Butter manufacturing unit

Objective
- To understand the working of butter production plant
- To learn procurement of raw materials, testing and storage
- To learn the marketing strategies

Introduction
Butter is a fat rich dairy product, generally made from cream by churning and working. It contains 80% fat, which is partly crystallized. Fat is separated from milk in the form of cream using cream separator. The cream can be either purchased from a fluid milk dairy or separated from whole milk by the butter manufacturer. The cream should be sweet (pH greater than 6.6), not rancid, not oxidized, and free from off flavors.

Important sections of Butter manufacturing unit
1. Raw material procurement section
2. Cream processing section
3. Cream churning plant
4. Cold storage (4°C) and Butter storage section (-18°C or below)
5. Steam generation unit/Boiler section
6. Sales and Marketing section

Observations under each section
I. Raw material procurement section
   1. Raw material used for Butter making – Sweet Cream / Ripened or sour cream
2. Quantity of raw material purchased per batch ________ Tons
3. Cost of raw material __________ Rs/Kg
4. Tests conducted to ensure chemical quality of raw material
5. Tests conducted to ensure microbial quality of raw material

II. Cream processing

1. Cream neutralization
   a. Acidity of cream used for butter production
   b. Type of neutralizer used
2. Cream standardization
   a. Fat percentage of cream
3. Cream pasteurization, cooling and aging
   a. Time temperature combination of cream pasteurization
   b. Cooling temperature
   c. Aging time and temperature

III. Cream churning

1. Type of butter churn – Batch or Continuous
2. Capacity of butter churn
3. Number of butter churn installed
4. Time taken to complete each batch of butter
5. Temperature maintained during churning

IV. Cleaning of Butter churn

1. Cleaning frequency – everyday, every shift, alternate days etc.
2. Chemical used in cleaning the lines
3. Temperature of cleaning solution and concentration

V. Butter milk utilization

1. Quantity of butter milk obtained per day
2. Ways of butter milk utilization
3. If disposing butter milk – note down the ways of disposal

VI. Cold storage for cream or butter
1. Capacity of cold store
2. Temperature maintained in the cold store
3. Cold store cleaning and maintenance

VII. Steam generation/Boiler section
1. Capacity of Boiler
2. Make of the boiler
3. Steam consumption per day
4. Type of boiler

VIII. Sales and Marketing section
1. Cost of production per kg of Butter
2. Sale price of Butter
3. Marketing strategies/techniques used to boost the sale of the product
4. Ways of marketing – own parlors / supply chain/ Bulk or retail marketing
5. Annual turn-over of the company

Review Questions
1. Draw the layout of butter manufacturing plant
2. Draw the neat diagram of butter churn
3. What is butter milk?
4. What do you mean by cream neutralization?
5. Which microbical and chemical tests are preferred for Butter?
Section 2
Ghee refinery

Objective

● To understand the working of ghee refinery
● To learn procurement of raw materials, testing and storage
● To learn the marketing strategies

Introduction

Ghee means the pure heat clarified fat derived solely from milk or curd or from desi (cooking) butter or from cream to which no coloring matter or preservative has been added. Ghee essentially consists of 99 to 99.5% milk fat. The Major raw material used in the ghee refineries are Butter or Cream.

Important sections of Ghee refinery

1. Raw material procurement section
2. Ghee processing section
3. Cold storage
4. Ambient storage
5. Steam generation unit/Boiler section
6. Sales and Marketing section

Observations under each section

I. Raw material procurement section

1. Raw material used for ghee making – Cream/Butter
2. Quantity of raw material purchased per batch ________ Tons
3. Cost of raw material _________Rs.
4. Tests conducted to ensure chemical quality of raw material
5. Tests conducted to ensure microbial quality of raw material
II. Ghee processing section

1. Processing capacity of the refinery
2. Continuous or batch type processing
3. Number of ghee boilers installed
4. Capacity of each ghee boiler
5. Heating medium used for heating the fat
6. Time taken for completion of each batch
7. Final heating temperature
8. Number of ghee settling tanks installed
9. Capacity of each ghee settling tank
10. Filtration/clarification process following
11. Temperature of ghee clarification
12. Capacity of the clarifier
13. Number of ghee settling tanks installed
14. Capacity of each ghee storage tank
15. Type of flooring to avoid slippages

III. Cleaning of ghee refinery

1. Cleaning frequency – everyday, every shift, alternate days etc.
2. Chemical used in cleaning the lines
3. Temperature of cleaning solution and concentration

IV. Ghee residue utilization

1. Quantity of ghee residue obtained per day
2. Ways of ghee residue utilization
3. If disposing ghee residue – note down the ways of disposal

V. Cold storage for cream or butter

1. Capacity of cold store
2. Temperature maintained in the cold store
3. Cold store cleaning and maintenance

**VI. Ambient store/product storage**
1. Capacity of ambient store
2. Quantity of product stored at the time of visit
3. Cleaning and maintenance of the store

**VII. Steam generation/Boiler section**
1. Capacity of Boiler
2. Make of the boiler
3. Steam consumption per day
4. Type of boiler

**VIII. Sales and Marketing section**
6. Cost of production per kg of ghee
7. Sale price of ghee
8. Marketing strategies/techniques used to boost the sale of the product
9. Ways of marketing – own parlors / supply chain/ Bulk or retail marketing
10. Annual turn-over of the company

**Review Questions**
1. Draw the layout of Ghee refinery
2. Draw the neat diagram of ghee boiler
3. What do you mean by ghee residues?
4. Give chemical composition of ghee?
5. Give storage temperature of ghee?
Section 3
Milk Condensing Plant

Objective
The students should be able to realize the production process and recognize the equipment available at the milk condensing plant/section.

Introduction
Compared to other milk products, the production of sweetened condensed milk (SCM) and evaporated milk is very less in India. However, concentration of milk is done in milk factories for its use in milk powder production. Very few dairy industries namely AMUL and Nestle are manufacturing condensed milk in India.

Observations to be made
1. Note down the quality and analytical tests performed for the raw milk intended for SCM and evaporated milk manufacture
2. Note down the fat and SNF content of milk after its standardization for use in SCM
3. Note down amount of sugar added to milk during SCM preparation and calculate the sugar ratio
4. Perform alcohol stability test for milk intended for condensed milk manufacture
5. Note down the Baume refractometer reading of condensed milk
6. Note down the amount of seeding material i.e. lactose used for proper crystallization in SCM manufacture
7. Note down the time and temperature combination applied during forewarming of milk
8. Point out the type of evaporator employed in the condensing plant
9. In case of multiple effect evaporators, note down the number of effects and the temperature and vacuum maintained in each effect
10. Note down various accessories fitted on evaporators
11. Observe which type of vacuum pump is employed for maintaining vacuum in the evaporator
Review Questions

1. What do you mean SCM?
2. List dairy industries manufacturing SCM?
3. What do you mean by evaporated milk?
4. What is the role of evaporator?
5. What are the uses of SCM and evaporated milk?
Objective
The students should be able to realize the production process and recognize the equipment available at the milk powder plant/section (spray drying)

Introduction
Drying of milk is essential to preserve milk for longer periods. Excess milk is dried and the dried milk is used in lean season to compensate the decreased milk supply. Compared to whole milk powder (WMP) the production of skimmed milk powder is more due to the lower keeping quality of the former caused by milk fat oxidation. India produces 4,00,000 tons of SMP every year. Pakistan, Bangladesh, Egypt, Afghanistan and some Southeast Asian countries are the major buyers of Indian SMP.

Observations to be made
1. Note down the quality and analytical tests performed for the raw milk intended for milk powder manufacture
2. Note down the fat and SNF content of milk after its standardization for use in WMP and SMP
3. Note down the time and temperature combination applied during forewarming of milk for use in low heat, medium heat and high heat SMP manufacture
4. Note down the percent total solids of concentrated milk before going to the spray dryer
5. Note down the inlet milk and outlet powder temperature at spray dryer
6. Note down the inlet and outlet air temperature at spray dryer
7. Point out the type of atomizer employed in the spray dryer
8. Note down how instantization is achieved during WMP/SMP production
Review Questions

1. Differentiate SMP and WMP
2. What is the purpose of instantization?
3. List dairy industries manufacturing SMP and WMP.
5. What are the possible uses of SMP?
Section 5

Milk Powder Plant (Roller Drying)

Objective

The students should be able to realize the production process and recognize the equipment available at the roller drying section.

Introduction

Roller drying of milk causes more protein denaturation and yields in a product with low solubility and objectionable cooked flavour. After the invention of spray dryers, roller drying of milk became obsolete. However, roller dried milk powder finds special application in the manufacture of khoa, gulabjamun powder, confectionary and ice cream where higher degree of protein denaturation is preferred. Generally only the skim milk is preferred for roller drying.

Observations to be made

1. Note down the quality and analytical tests performed for the raw milk intended for milk powder manufacture by roller drying.
2. Note down the quality and analytical tests performed for the raw milk used in roller drying.
3. Note down the time and temperature combination applied during forewarming of milk.
4. Note down the percent TS of concentrated milk before going to the roller dryer.
5. Note down the inlet steam temperature at roller dryer.
6. Note down the rpm of the drums (rollers).

Review Questions

1. What are the applications of roller dried milk powder?
2. Which types of drums are used in roller drier?
3. What is the purpose of forewarming of milk?
Objective

Students will learn the production process and recognize the equipments available the ice-cream section.

Introduction

Ice cream plant typically consists of ice cream mix processing equipments, ice cream freezer, hardening system, refrigeration plant and storage room for ice cream. Ice cream mix processing equipments involve:

Equipments

Mixing vat: for mixing “or” blending of all the ingredients

Homogeniser: for homogenisation of ice cream mix

Pasteurizer: for mix pasteurization. It may be batch type or continuous depending on the requirements and capacity of the plant.

Chiller: it is usually a plate heat exchanger used particularly with batch type pasteurizer as the later does not have intact chilling unit as that of continuous pasteurizer.

Ageing tank: used to keep ice cream mix under cold conditions

Ice cream mix is frozen in ice cream freezers. These may be batch type or continuous.

Ice cream freezer: these are special type of freezers used for freezing ice cream under dynamic conditions of simultaneous aeration, mixing and freezing. This results in rapid freezing and forms smaller ice crystals. Main parts of ice cream freezer are barrel, scraper and beater. Beater and scraper together form dasher.

Hardening systems: It may be of three different types: 1) hardening tunnels 2) hardening rooms and 3) hardening cabinets

Storage rooms: used to store ice cream.

Refrigeration unit: used to produce desired refrigeration in order to freeze ice cream, keeping the temperatures in hardening system and storage rooms.
Observations to be made

1. Installed capacity of the plant
2. Product line of the plant i.e. how many types of ice cream variants are being manufactured in the plant.
3. Type, make and capacity of pasteurizer
4. Type, make and capacity of homogenizer
5. Capacity of mixing and aging vats/tanks
6. Type, make and capacity of ice cream freezer
7. Provision for air incorporation: Yes/No
8. Provision for fruit and nut feeding: Yes/No
9. Refrigerant being used in the refrigeration plant
10. Capacity of the refrigeration plant
11. Type of hardening system
12. Storage capacity of storage rooms
13. Storage pattern in storage rooms i.e. first in first out (FIFO) or Last in first out (LIFO)

Activities

1. Prepare a process outline for preparing ice cream with mention of the equipments needed for each process.
2. List out five important equipments required for commercial ice cream making unit.

Review Questions

1. What is the pasteurization temperature of ice cream mix?
2. Give freezing temperature used during ice cream making?
3. Give hardening temperature of icecream.
4. List ice cream making industries.
Section 7
Cheese Plant

Objective
To lean production process and recognize various equipments used in cheese section.

Introduction
Commercial production of cheese may be fully automated and mechanized, semi-automatic or batch type. Equipments and accessories available in cheese plant depend on the type of operation i.e. automated or batch.

Equipments/materials in cheese plant

1. **Bactofuge**: Bactofuge is a machine which works on the principle of centrifugal separation and is used to remove microorganisms and spores from milk to be used for cheese making.

2. **Starter culture**: Starter culture are live microorganisms added to cheese milk to carry out desirable fermentation required essentially for cheese making.

3. **Rennet**: Rennet is an enzyme which is used for coagulating cheese milk. It may be calf rennet, microbial or plant rennet.

4. **Cheese vat**: Cheese vats are used for performing various operations of cheese making. These are jacketed vessels with input and output provisions for hot water. Cheese milk after standardization is added to vats and all operations beginning from culture addition upto cheddaring are performed in vats only.

5. **Cheese knives**: these are used for cutting curd after rennet addition and setting of curd. Two types of knives are used: horizontal and vertical.

6. **Ladle**: It is used to stir or mix the contents of vat.

7. **Milling machine**: is used to cut cheese into smaller pieces before salting.

8. **Cheese hoops**: Cheese after milling and salting is filled into cheese hoops and kept for pressing.

9. **Cheese press**: is used to press cheese hoops for removal of whey.

10. **Ripening room**: it is used to ripen cheese at specified relative humidity and temperature.
Observations to be made

1. Installed capacity of the plant

2. Product line of the plant i.e. how many types of cheese variants are being manufactured in the plant.

3. Type of operation in the plant (automated or batch)

4. Type, make and capacity of pasteurizer

5. Type, make and capacity of Bactofuge

6. Type and capacity of cheese vats

7. Type and capacity of cheese press

8. Type and capacity of milling machine

9. Conveying system for cheese curd

10. Details of ripening rooms

11. Storage capacity of storage rooms

Review Questions

1. Differentiate cheese and paneer

2. List various dairy industries manufacturing cheese

3. List down the equipments required for cheese manufacturing.
Section 8
Casein Making Unit

Objective

- To understand the working of casein making units
- To learn about the manufacturing process of different types of caseins

Introduction

Casein is a long established dairy byproduct finding its use as an ingredient in many dairy, food and non-food products. Manufacture of edible casein differs from that of non-edible casein (also called industrial casein). Edible casein is produced under sanitary conditions, with the use of food grade chemicals and sufficiently heat treated to make it safe for human consumption. Edible non-animal rennet casein is the product obtained after washing and drying the coagulum remaining after separating the whey from the skimmed milk which has been coagulated by non-animal rennet or by other coagulating enzymes. In commercial practice, pH adjustment is achieved either by direct addition of the appropriate acid to skim milk or in the case of lactic acid, by formation of lactic acid from lactose fermentation using a bacterial culture.

Important sections of casein plants

1. Raw material procurement section
2. Cream separation section or membrane filtration unit
3. Cold storage
4. Steam generation unit/Boiler section
5. Sales and Marketing section

Observations to be made

I. Raw material procurement section

1. Type of milk used for casein making __________________
2. Quantity of milk handled by the plant: ________
3. Cost of raw milk Rs.___________ / Kg
4. Tests conducted to ensure chemical quality of raw material
5. Tests conducted to ensure microbial quality of raw material

II. Cream separation section
1. Processing capacity of the cream separation section
2. Observe whether it is a continuous or semi-continuous separator and note its operational capacity ________ Kg/ hour
3. Temperature of milk used for separation _______ °C
4. Quantity of cream obtained __________ Kg
5. Quantity of skim milk obtained __________ Kg
6. Note the fat content of cream _____%
7. Note the fat content of skim milk _____%

III. Membrane filtration unit
If the industry uses ultrafiltration retentate system for casein making, then observe the following
1. Type of UF module: __________
2. Quantity of milk fed into UF system per hour (feed rate): __________ L/hr
3. Quantity of permeate: ___________ L/hr
4. Quantity of retentate: ___________ L/hr

IV. Casein making unit
1. Quantity of skim milk taken per batch for casein making __________ Kg
2. Type of casein being manufactured: ___________ (Edible or Industrial Casein)
3. Note whether non-animal rennet or acids are used for casein manufacture.
4. If rennet is used, note the type of rennet (microbial or plant) __________
5. How much water is used for dilution of rennet __________ Litres / g of rennet
6. Time taken for coagulation of milk or curd formation after rennet addition __________
7. If acid is used, note the type of acid __________
8. Quantity of acid used __________
9. Quantity of whey generated __________ Kg
10. Quantity of casein curd obtained________ Kg
11. Drying temperature used for drying casein curd ______________°C
12. Final moisture content of casein __________ %
13. Packaging size of casein __________ Kg
14. Packaging material used for packing casein __________
15. Storage temperature of casein __________ °C

IV. Steam generation/Boiler section
1. Capacity of Boiler
2. Make of the boiler
3. Steam consumption per day
4. Type of boiler

V. Sales and Marketing section
1. Cost of production per kg of casein
2. Sale price of casein

Review Questions
1. Draw the layout of casein making unit
2. What are the uses of casein?
3. List dairy industries manufacturing casein?
4. What do you mean by membran filtration of milk?
Exercise-2
Manufacture of Milk Products

Part A
Preparation of Khoa

Objective

a) To learn the method of preparation of Khoa from different varieties of milk
b) Evaluation of organoleptic qualities of Khoa

Introduction

Khoa is a partially dehydrated traditional Indian milk product obtained by thermal evaporation of buffalo, cow or mixed milk. According to Food Safety and Standards Regulation (FSSR), 2011 Khoa/ 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 there of by rapid drying. The milk fat content shall not be less than 30 per cent on dry matter basis of finished product. It may contain citric acid not more than 0.1 per cent by weight. It shall be free from added starch, added sugar and added colouring matter.

Materials

1. Steam jacketed kettle
2. Stirrer-cum-scrapper
3. Muslin cloth
4. Weighing balance
5. Thermometer
6. Parchment /butter paper
7. Milk
8. Fat and acidity testing set
9. Lactometer with jar
Procedure

1. Take a representative sample of milk & analyses it for fat, SNF & acidity also evaluate its organoleptic quality (colour, smell, taste, presence of extraneous matter, etc.)

2. Standardize the milk to desired fat & SNF ratio to meet the FSSR requirement of 30% fat on dry matter basis in final product (generally SNF: Fat ratio should be 2.25 in cow or buffalo milk to meet the FSSR standards in final product or fat should be 0.45 x SNF, but for good quality Khoa from buffalo milk SNF: Fat ratio should be 1:67 or fat should be 0.67 x SNF).

3. Filter the milk through muslin cloth into double jacketed stainless steel kettle & start heating by opening the steam valve.

4. While boiling stir the milk continuously in circular motion through sides of the kettle to remove the deposited solids.

5. When foam subsides and once the mass reaches pasty consistency reduce the steam slightly and scrape continuously to avoid formation of milk soil due to burning of the deposited solid.

6. Continue with the process of stirring and scraping continuously until final step is reached which is characterized by the mass leaving the sides of the kettle.

7. Close the steam and spread the content across sides of the kettle so that it cools down.

8. Remove the contents into aluminum or steel tray smeared with butter or covered by parchment paper after forming a pat.

9. Take the weight of Khoa and record the yield and milk equivalent.

10. Evaluate the organoleptic qualities of the product
PRODUCTION CHART OF KHOA

I. Particulars of Milk
   Type ____________________________ Quantity _________________________________ kg.
   Acidity ____________%  Lactic acid Lactometer Reading ____________ at ____ °C
   Fat __________________________ % Total Solids ____________________________ %
   Solids-Not-Fat__________________%

II. Processing
   Time when heating started ____________ AM/PM
   Boiling point of milk ____________°C
   Time taken to reach pat forming stage ________ Hours _______ Minutes
   Type of equipment used ________________________________________

III. Making Pats
   Time when pat formation started ____________ AM/PM
   Time when product preparation finished __________ AM/PM
   Total time taken for product preparation ________Hours__________ Minutes

IV. Physical Characteristics of Khoa
   Flavour __________________________________________________________
   Body and Texture________________________________________________
   Colour __________________________________________________________
   Overall sensorial quality __________________________________________

V. Chemical Composition of Khoa
   Moisture_____________________ % Fat ____________________________ %
   Total Solids _____________________ %

VI. Yield of Khoa
   Quantity _________________________ g
   Yield _____________ % Milk equivalent ____________ kg

Remarks _______________________________________________________________
Review Questions

1. Define Khoa as per FSSR (2011).
2. How much buffalo milk is required to prepare one kg of Khoa?
3. What are the characteristics of good quality Khoa?
4. Name the types of Khoa available in market.
5. Is it possible to prepare good quality Khoa from sour milk?
6. What do you mean by ‘pat’ formation in Khoa preparation?
7. What precaution and care you must take while production of Khoa?
8. Is it possible to make Khoa from concentrated milk?
9. How will you differentiate Khoa made from cow and buffalo milk by visual observation?
10. Yield of Khoa depend on which factors?
Part B
Preparation of Table Cream

Objective
To learn the production of cream

Introduction
Milk fat being most expensive component, the recovery of fat is of importance in dairy processing because of its economic value. The separation of milk into cream and skim milk is the foremost unit process to which the milk is subjected at the dairy plant. Cream is generally produced by separating milk into its components – fat and solid-not-fat. Table cream is a pasteurized sweet cream. As per FSSR 2011 Cream including sterilized cream means the product of cow or buffalo milk or a combination thereof. It shall be free from starch and other ingredients foreign to milk. It may be of following three categories, namely:

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

Since the fat of cream is low, it has thinner consistency. The consistency of the cream may be improved by homogenization. A good quality table cream should be clean, pleasant nutty flavor with smooth and uniform body.

Materials/Equipments required
1) Milk, 2) Thermometer, 3) Heating device, 4) SS vessel, 5) Stirrer, 6) Fat and acidity testing kits

Procedure
1. Clean all parts of the cream separator and assemble the bowl.
2. Place the bowl over the spindle and cover the system.
3. Put on the separator motor and allow to attain maximum speed.
4. Weigh the given milk sample and test for fat and acidity content.
5. Heat water at 70 – 80° C and take into supply tank.
6. Allow the hot water to run through the bowl to clean and pre-heat the bowl.

7. Heat the milk to 45 – 50° C and transfer to the supply tank.

8. Open the valve and allow the hot milk to enter the bowl.

9. Take pre-weighed containers to receive cream and skim milk separately.

10. At the end of operation allow hot water to run through the bowl.

11. Take weight of cream and skim milk and test them for fat content.

12. Dismantle the bowl and clean all parts with detergent solution, rinse with hot water and allow to air dry.

13. Calculate the percent recovery of fat.

14. Calculate percent fat loss during operation using the following formula –

---

**PRODUCTION CHART FOR TABLE CREAM**

I. **Particulars of cream separator**
   
   Name of manufacturer ____________________________ Model ________________
   
   Hand / Power operated __________________________ Capacity ________________

II. **Particulars of milk**
   
   Type ______________________________ Quantity ____________________________ kg.
   
   Acidity _______________% Lactic acid Lactometer Reading _______ at ____°C
   
   Fat _______________% Total Solids ____________________________ %
   
   Solids-Not-Fat _______________%

III. **Processing and cream separation**
   
   Time when heating started_________AM/PM
   
   Temperature of cream separation ___________°C
   
   Time when cream separation started ______ AM/PM
   
   Time when cream separation finished______ AM/PM
   
   Total time taken for cream separation _______Minutes

IV. **Separation efficiency**
Fat in cream _____ % Total fat in cream_______g
Fat in skim milk_____ % Total fat in skim milk_______ g
Total fat recovered in cream_______ % Yield of cream ______kg
Total fat lost in skim milk _________%  
Total fat lost during operation_______ %

VI. Chemical composition of cream

Fat ____________________ % Acidity________________% LA  
Total Solids ____________ % Moisture________________ %

Formuals -

1. \( \text{\% fat recovery in cream} = \frac{Kg \text{ fat in cream} \times 100}{Kg \text{ fat in milk}} \)

2. \( \text{Yield of cream} = \frac{M \times (fm - fs)}{(fc - fs)} \)

Where
C = Weight of cream (kg)
M = Weight of milk (kg)
fm = % fat in milk
fc = % fat in cream
fs = % fat in skim milk
Result & Inference

Signature of the Teacher

Review Questions

1. Write the FSSR, 2011 standards for different varieties of cream
2. What is the pasteurization temperature for cream?
3. Why milk should be heated to 45°C before it is subjected to cream separation?
Part C
Preparation of Chhana

Objective
1. To make Chhana from cow and buffalo milk
2. To compare the yield and quality of Chhana from cow and buffalo milk

Introduction
Chhana is a traditional Indian milk product obtained by heat and acid coagulation of milk followed by partial removal of whey. Chhana is used as a variety of a sweet like SandeshRasogolla, Rasomalai, chamcham, pantooa etc. According to the Food Safety and Standard Regulation (FSSR, 2011), Chhana means the product obtained from cow or buffalo milk or a combination thereof by precipitation 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. Low fat Chhana 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:

Materials

Procedure
Chhana from cow milk
1. Take the representative sample of milk and determine its fat, SNF and acidity content as well as organoleptic quality.
2. Transfer the milk into a clean and dry SS kettle/karahi through a muslin cloth.
3. Start heating milk with continuous stirring and scraping with the help of a stainless steel ladle to prevent burning of milk solids.
4. Heat the milk up to 90°C without any holding.

5. Cool milk up to the temperature at which coagulation is to be achieved. Optimum temperature of coagulation is 80°C for cow milk.

6. Simultaneously heat the coagulant solution (1% citric acid) to a temperature of 80°C (or any other temperature at which milk is to be coagulated).

7. Add calculated quantity of the coagulant slowly throughout the container while stirring milk gently but continuously.

8. Stop adding coagulant as soon as coagulation of milk is completed as observed by separation of clean greenish whey. Normally 45-60 second is required to achieve complete coagulation.

9. Record the pH at this stage which should be preferably between 5.4 - 5.5

10. Transfer the curd and all the solids that are sticking to the kettle, immediately over a piece of clean and wet muslin cloth. Collect the whey in another container.

11. Tie the four ends of the cloth containing the coagulum with a knot and hang it onto a hook/stand. Collect the whey that drops off from the mass in a container.

12. Let the product drain for 30 min or until most of the free whey is drained out.

13. Remove the product from muslin cloth and keep in a clean container preferably previously sterilized.

14. Record the weight of Chhana and whey and take their representative sample for chemical analysis.

15. Evaluate the organoleptic qualities of the product

**Chhana from buffalo milk**

1. Take the representative sample of milk and determine its fat, SNF and acidity content as well as organoleptic quality. If the fat content is more than 5%, standardize the milk to 5% fat.

2. Transfer the milk into a clean and dry SS kettle/karahi through a muslin cloth.

3. Start heating milk with continuous stirring and scraping with the help of a stainless steel ladle to prevent burning of milk solids.

4. Add potable water @ 30% of the initial quantity of the milk.

5. Heat the milk just up to 90°C without any holding.
6. Cool milk up to the temperature at which coagulation is to be achieved i.e. to 65°C.

7. Simultaneously heat the coagulant solution (1% citric acid) to 65°C.

8. Add calculated quantity of the coagulant slowly throughout the container while stirring milk gently but continuously.

9. Stop adding coagulant as soon as coagulation of milk is completed as observed by separation of clean greenish whey. Normally 45-60 second is required to achieve complete coagulation.

10. Record the pH at this stage which should preferably be between 5.6 - 5.7

11. Keep the curd in whey for about 15 min (called delayed straining) and then transfer over a piece of clean and wet muslin cloth.

12. Transfer the curd and all the solids that are sticking to the kettle, immediately over a piece of clean and wet muslin cloth. Collect the whey in another container.

13. Tie the four ends of the muslin cloth containing Chhana with a knot and hang it onto a hook/stand. Collect the whey that drops off from the mass in a container.

14. Let the product drain for 30 min or until most of the free whey is drained out.

15. Remove the product from muslin cloth and keep in a clean container preferably previously sterilized.

16. Record the weight of Chhana and whey and take and their representative sample for chemical analysis.

17. Evaluate the organoleptic qualities of the product.
**PRODUCTION CHART OF CHHANA**

**I. Particulars of Milk**

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>kg.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Acidity % lactic acid</th>
<th>Lactometer Reading.</th>
<th>at °C</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Fat %</th>
<th>Total Solids %</th>
<th>Solids-Not-Fat %</th>
</tr>
</thead>
</table>

**II. Coagulation**

<table>
<thead>
<tr>
<th>Name of Coagulant used</th>
<th>Strength of the coagulant added</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Amount of coagulant</th>
<th>pH after coagulation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Temperature of coagulation</th>
<th>Citric acid used per kg of milk</th>
</tr>
</thead>
</table>

**III. Straining**

<table>
<thead>
<tr>
<th>Type of strainer used</th>
<th>Time taken for straining</th>
<th>min</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Temperature when straining started</th>
<th>Time taken to prepare Chhana</th>
<th>min</th>
</tr>
</thead>
</table>

**IV. Physical Quality of Chhana/Paneer**

<table>
<thead>
<tr>
<th>Colour</th>
<th>Flavour</th>
<th>Body and Texture</th>
<th>Overall sensorial attributes</th>
</tr>
</thead>
</table>

**V. Chemical Composition of Chhana**

<table>
<thead>
<tr>
<th>Moisture %</th>
<th>Fat %</th>
<th>Total Solids %</th>
</tr>
</thead>
</table>

**VI. Yield of Chhana**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Yield</th>
<th>Milk equivalent</th>
<th>kg</th>
</tr>
</thead>
</table>

**VII. Whey**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Acidity % lactic acid</th>
<th>Fat %</th>
<th>Fat loss in whey</th>
<th>g</th>
</tr>
</thead>
</table>

**Remarks:** ________________________________________________________________
**Review Questions**

1. What should be the desired fat: SNF ratio for making Chhana from cow milk?

2. What is the yield of Chhana made from cow milk?

3. Why cow milk Chhana has different texture than buffalo milk Chhana?

4. How do we judge the end point at the time of coagulation in Chhana making?

5. What is the optimum temperature and pH of coagulation of cow milk for Chhana making?
Part D

Preparation of Paneer

Objective

a) To learn the preparation of paneer from cow and buffalo milk
b) To evaluate the organoleptic properties of paneer prepared from cow and buffalo milk

Introduction

Paneer is an indigenous milk product obtained by heat and acid coagulation of milk followed by pressing. According to the Food Safety and Standards Regulations (2011), paneer shall contain not more than 70.0 per cent moisture and the milk fat content shall not be less than 50.0 per cent of the dry matter. Paneer prepared from skim milk shall contain not more than 70.0 % moisture and milk fat content shall not be more than 15 % on dry matter basis. Paneer is used in a variety of culinary dishes usually prepared from buffalo milk.

Materials

1) Double jacketed SS vat/ SS kettle or karahi, 2) SS ladle, 3) Weighing balance, 4) Muslin cloth, 5) Lactometer with jar, 6) Fat testing kit for milk, 7) Thermometer, 8) Coagulant solution (citric acid), 9) Paneer pressing moulds, 10) Milk, 11) pH meter

Procedure

1. Collect representative sample of milk and analyze it for fat, SNF, acidity and organoleptic quality.
2. Standardize milk to 4.5% fat and 8.5% SNF
3. Filter the standardized milk into a clean SS kettle through a muslin cloth.
4. Heat the milk up to 90°C without holding while stirring it continuously with the help of a stirrer or ladle.
5. Simultaneously heat the coagulant (1% citric acid) to a temperature at which coagulation of milk is to be achieved.
6. Coagulate buffalo milk at 70°C and cow milk at 80°C by slowly adding hot coagulant solution throughout the whole container while gently stirring the milk.

7. As soon as the coagulation of milk is completed (evidenced by the separation of clear greenish-yellow whey) stop adding the coagulation. The pH of milk at this stage should be about 5.3.

8. Leave the curd undisturbed for 5 minutes to settle down and then drain out the whey through a muslin cloth.

9. The temperature of curd should not be allowed to drop below 63°C during and at the end of draining.

10. Fill the curd into hoops lined with clean and wet muslin cloth. These hoops are generally rectangular/circular frames open both at bottom and top. Wooden/SS planks are used to cover these ends.

11. After proper filling of hoop, cover the curd with cloth, put a wooden plank on the top and apply pressure by placing adequate weights on top of the hoop (the weight depends upon the size of the paneer block). The pressure required is nearly 2-3 kg/cm² for 15 – 20 minutes.

12. Place the paneer cube in chilled water for about one hour to cool and making it firm.

13. After cooling drain the water and pack it in a suitable packaging material and store under refrigerated cooperators

14. Evaluate the organoleptic qualities of the product
### PRODUCTION CHART OF PANEER

#### I. Particulars of Milk

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Acidity</th>
<th>Lactometer reading</th>
<th>Fat</th>
<th>Solids-Not-Fat</th>
<th>Total Solids</th>
</tr>
</thead>
</table>

#### II. Coagulation

<table>
<thead>
<tr>
<th>Coagulant Used</th>
<th>Strength of Coagulant</th>
<th>Amount of Coagulant Used</th>
<th>pH after Coagulation</th>
<th>Temperature of Coagulation</th>
<th>Quantity of Coagulant used per kg of Milk</th>
</tr>
</thead>
</table>

#### III. Straining

<table>
<thead>
<tr>
<th>Type of Strainer</th>
<th>Time Taken for Straining</th>
<th>Temperature when Straining Started</th>
<th>Time Taken to Prepare the Product</th>
</tr>
</thead>
</table>

#### IV. Physical Quality of Paneer

<table>
<thead>
<tr>
<th>Colour</th>
<th>Body and Texture</th>
<th>Flavour</th>
<th></th>
</tr>
</thead>
</table>

#### V. Chemical Composition of Paneer

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Fat</th>
<th>Total Solids</th>
</tr>
</thead>
</table>

#### VI. Yield of Paneer

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Yield</th>
<th>Milk Equivalent of Paneer</th>
</tr>
</thead>
</table>

#### VII. Whey

<table>
<thead>
<tr>
<th>Amount</th>
<th>Acidity</th>
<th>Fat</th>
<th>Fat Loss in Whey</th>
</tr>
</thead>
</table>

**Remarks:** ______________________________________________________
Review Questions

1. What should be the desired Fat: SNF ratio for making paneer from buffalo milk?
2. What is the normal yield of paneer from buffalo milk?
3. Why do we keep the paneer in chilled water after pressing?
4. What is the optimum coagulation temperature of Buffalo milk for paneer production?
5. What should be optimum pH of coagulation to obtain good quality paneer?
6. How paneer differs from Chhana?
Objective

a) To learn the method of preparation of ghee using butter

b) Organoleptic evaluation of ghee

Introduction

Ghee means the pure heat clarified fat derived solely from milk or curd or from desi (cooking) butter or from cream to which no colouring matter or preservative has been added. Ghee is a very popular product since from ancient time and have greater demand during festival and other ceremonial functions where use of ghee in food has been considered to delicacy due to its pleasing flavour and aroma. The principle involved in ghee preparation includes concentration of milk fat in the form of cream or butter, followed by heat clarification of fat rich milk portion and thus reducing the amount of water to less than 0.5%. The curd content is then removed as ghee residue from clarified fat.

There are five methods of ghee making:

i. Desi or Indigenous Method

ii. Direct Cream Method

iii. Creamery Butter Method

iv. Pre-stratification Method

v. Continuous Method

Materials

1) Milk, 2) Lactometer with cylinder, 3) Fat testing kit for milk, 4) Lactic culture, 5) SS vessel and ladle, 6) Muslin cloth, 7) Thermometer, 8) Weighing balance, 9) pH meter/strips, 10) Heating medium, 11) Incubator
Procedure

1. Collect the representative sample of milk and analyse it for fat, SNF, acidity and organoleptic quality.

2. Standardize milk to 5.0% fat and 8.5 % SNF (based on the type of dahi) by adding calculated amount of cream.

3. Filter the milk into a clean SS kettle through a muslin cloth.

4. Heat the milk to 90°C for 15 minutes and cool it to 32°C.

5. Add the lactic culture to milk @ 1.5% and mix well and incubate at the temperature of 32°C for 6-8 hrs

6. Cool the curd to 10°C and churn to obtain Makkan (Butter)

7. Take the Makkan in stainless steel vessel

8. Heat over the direct fire with continuous stirring and scraping till the temperature reaches 110-115°C

9. When the whole mass turns to golden yellow color and ghee residues turns brown color stop heating and allow it to cool to 70°C

10. Filter the whole mass through double layered muslin cloth to remove ghee residues

11. The product thus obtained is bottled, labeled and stored at room temperature (30°C)
PRODUCTION CHART OF GHEE

I. Particulars of Milk

Type _______________________________ Quantity ________________________________ Kg.

Acidity ____________________ % lactic acid Lactometer reading.________ at____°C

Fat _______________________________ % Total Solids _______________________________ %

Solids-Not-Fat ____________________%

II. Processing and filling

Quantity of cream required for standardization ________________g

Time temperature combination of milk processing ________ °C _________ Minutes,

Rate of culture addition________________ Quantity of culture added __________ g

Temperature of the milk during culture inoculation ________________ °C

Temperature of incubation ______°C, Time when incubation started ______AM/PM

Time when incubation stopped _____AM/PM

Duration of incubation ____Hour____ Minutes

III. Production of Makkhan

Quantity of dahi taken for makkhan preparation ______ kg

Temperature of churning_______°C, Time when churning started _____ AM/PM

Time when churning finished___ AM/PM, Time taken for churning__Hour__ Minutes

Quantity of Makkhan obtained_______Kg Milk equivalent of Lassi__________ kg
IV. Production of Ghee

Quantity of *Makkhan* taken for Ghee preparation _______ kg

Time when ghee preparation started ____ AM/PM,

Temperature when the onset of first effervescence ____ °C,

Final clarification temperature ____ °C,

Quantity of ghee obtained ____ kg,

Quantity of ghee residue obtained ____ kg,

IV. Organoleptic Quality

Flavour __________________ Colour ____________________________

Body texture ____________________________

Overall sensorial attribute of Ghee ________________

Remarks:_________________________________________________________________
Calculation & Inference:  


Signature of the Teacher

**Review Questions**

1. Define Ghee
2. List different methods of ghee making?
3. What do you mean by creamary butter method?
Objective
To learn preparation of butter by churning cream

Introduction
Butter is one of the leading milk product in developed countries of the world. It serves as a balance wheel of dairy industry. Surplus milk is generally converted into butter to be used during the times of scarcity. It is an article of commerce and a sign if wealth. Butter is a fat concentrate, which is obtained by churning cream, gathering the fat into a compact mass and then working it for proper distribution of moisture and salt. The water content was dispersed in fine droplets through consistent working, so that the butter attains smooth consistency for easy spreadability and mouthfeel. With introduction of artificial refrigeration systems and pasteurization process, the industrial production of butter developed rapidly and large scale butter making in factories became possible during the later part of the 19th century.

Definition
(i) General – Butter may be defined as a fat concentrate which is obtained by churning cream, gathering the fat into compact mass and then working it.
(ii) FSSR 2011 - Butter means the fatty product derived exclusively from milk of cow and/ or buffalo or its products principally in the form of an emulsion of the type water-in-oil. The product may be with or without added common salt and starter cultures of harmless lactic acid and / or flavour producing bacteria. Table butter shall be obtained from pasteurised milk and/ or other milk products which have undergone adequate heat treatment to ensure microbial safety. It shall be free from animal body fat, vegetable oil and fat, mineral oil and added flavour. It shall have pleasant taste and flavour free from off flavour and rancidity. It may contain food additives permitted in these regulations. It shall conform to the microbiological requirements prescribed in the regulation. It shall conform to the following requirements: Moisture 16.0 percent m/m, milk fat- Table butter (80.0 percent m/m), desi/cooking butter (not less than 76.0 percent m/m)milk solids not fat (not more than 1.5 %), common salt (not more than 3.0 percent).
BIS (Bureau of Indian standards) has specified two types of butter namely-

A) **Table butter** – Means product made from pasteurized cream obtained from pasteurized cow / buffalo milk / combination with or without ripening with standard lactic culture, addition of common salt, annatto or carotene as colouring matter and diacetyl as flavouring agent.

B) **White butter** – Means the product made from pasteurized cream obtained from pasteurized cow / buffalo milk / combination without ripening and addition of any preservative, colouring matter and added flavouring agent.

**BIS – Standards (IS 13690:1992)**

<table>
<thead>
<tr>
<th>Constituents</th>
<th>White butter</th>
<th>Table butter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat (%)</td>
<td>82.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Moisture (%) max.</td>
<td>16.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Curd (%) max.</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Salt (%) max.</td>
<td>Nil</td>
<td>2.5</td>
</tr>
<tr>
<td>Acidity (% L.A.) max.</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Coliform count (NMT)</td>
<td>5/ml</td>
<td>5/ml</td>
</tr>
<tr>
<td>Yeast &amp; mold count (NMT)</td>
<td>20/ml</td>
<td>20/ml</td>
</tr>
<tr>
<td>Diacetyl content (max.)</td>
<td>Nil</td>
<td>4 ppm</td>
</tr>
</tbody>
</table>

**Material/Equipment required**


**Procedure**

**Preparation of white butter (Cooking butter / unsalted butter)**

1. Weigh the amount of cream received at the platform.
2. Draw a representative sample and determine fat content.
3. Standardize the cream to 35-38% fat and pasteurize at 80-82º C for 5-8 minute.
4. Cool the cream to 7-10º C and store over night at same temperature.
5. Transfer the cooled cream into the butter churn taking care to fill the churn to 1/3 rd of its capacity.

6. Lock the door and allow the churn to rotate at a speed of 40-50 rpm.

7. Stop the churn and press the air vent valve for few times (5 minutes intervals) during early stages of churning.

8. Allow the churn to rotate until the watch glass appears clear. This indicates that the emulsion is broken and fat granules are separated from the serum.

9. Stop the churn and add break water (10-15%) of cream at 2 ºC lower than butter milk, into the churn.

10. Allow the churn to rotate for few minutes to develop the butter grains to suitable size.

11. Stop the churn and drain the butter milk using strainer. Measure the quantity and temperature of butter milk, also draw a representative sample for fat test.

12. Add chilled water (wash water), equal to the quantity of butter milk removed, into the churn.

13. Allow the churn to rotate at slower speed (15 rpm) for five minutes, to wash the butter grains of excess butter milk.

14. Stop the churn and allow the wash water to drain.

15. Allow the churn to rotate at the speed of 6-8 rpm for working of butter (gathering of butter grains into bigger lump and even distribution of moisture) for about 20-30 minutes.

16. Stop the churn, open the door and collect butter in plastic tubs or butter trolly.

17. Store the butter at - 6º to -8ºC for further usage.

Note: Cooking butter is generally used as an intermediate product for manufacture of ghee.

Preparation of table butter

1. Weigh the amount of cream received at the platform.

2. Judge the cream for its sensory properties and taste.

3. Draw a representative sample and determine fat content.

4. Standardize the cream to 35-38% fat and pasteurize at 80-82º C for 10 minute.

1. Cool the cream to 5-7º C and store overnight at same temperature.
2. Fill the churn 1/3 rd with hot water and rotate for 4-5 minutes, leaving the vent open.

3. Drain hot water and cool the churn using pasteurized chilled water (preferably chlorinated) for 5-8 minutes and then drain out.

4. Transfer the cooled cream into the butter churn taking care to fill the churn to 1/3 rd of its capacity.

5. Measure calculated amount of butter colour and add evenly over the cream in the churn.

6. Lock the door and allow the churn to rotate at a speed of 40-50 rpm.

7. Stop the churn and press the air vent valve for few times (5 minutes intervals) during early stages of churning.

8. Allow the churn to rotate until the watch glass clears, indicating that the emulsion is broken and fat granules are separated from the serum.

9. Stop the churn and add pasteurized and chlorinated (30-40 ppm) break water (10-15% of cream) at 2ºC lower than buttermilk into the churn.

10. Allow the churn to rotate for few minutes to develop the butter grains of suitable size (pea grain).

11. Stop the churn and drain the buttermilk using strainer. Measure the quantity and temperature, also draw a representative sample for fat test.

12. Add pasteurized chilled water equal to the amount of buttermilk removed at 1-2ºC lower than the buttermilk temperature.

13. Allow the churn to rotate at slower speed (15 rpm) for five minutes, to wash the butter grains of excess buttermilk. If need be second washing may be done with half the quantity of wash water in similar manner.

14. Stop the churn and allow the wash water to drain.

15. Weigh calculated amount of salt (@ 1.5-2.0%) and sprinkle evenly on to the butter grains.

16. Allow the churn to rotate at the speed of 6-8 rpm for proper working of butter (gathering of butter grains into bigger lump and even distribution of salt & moisture throughout the body of butter) for about 20-30 minutes.

17. During working process maintain temperature of contents by constant spraying of chilled water over the churn.
18. Stop the churn, open the door and draw a sample for moisture test to ascertain required moisture content in resultant butter using the formula -

\[
\text{Kg of water to be added} = \frac{(A + 1.5 \times B)}{100}
\]

Where, \(A\) = percent moisture to be raised and \(B\) = Kg fat in churn.

19. If need be, add calculated amount of pasteurized chilled water to the churn for adjusting final moisture content of butter.

20. Unload the churn by collecting butter in pre-sterilized linedplastic tubs or butter trolley.

21. Clean the churn using hot detergent solution followed by hot and then cold rinsing.

22. Store the butter at -18º to -20ºC for packaging at later stage.

**Precautions**

1. Wash and sanitize the churn before use with chlorinated water (40-50 ppm).
2. Ensure that the churn is cooled below 5º C before transferring cream.
3. Use only pasteurized and chilled water having low iron and copper content (max.5 ppm) as break and wash water.
4. Perform fat, salt and moisture test accurately and keep safety margin to meet legal standards.
5. Store door gasket of churn in cold store to avoid cracking.
# PRODUCTION CHART – CREAMERY BUTTER

<table>
<thead>
<tr>
<th>Particulars of Cream</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Quantity Kg</td>
</tr>
<tr>
<td>Fat</td>
<td>% Amount of fat Kg</td>
</tr>
<tr>
<td>Acidity</td>
<td>%LA</td>
</tr>
</tbody>
</table>

### Processing of cream

<table>
<thead>
<tr>
<th>(a) Neutralization</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of neutralizer</td>
<td>Amount of neutralizer g</td>
</tr>
<tr>
<td>Cream acidity after neutralization</td>
<td>%LA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(b) Pasteurization</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time pasteurization start</td>
<td>Temperature °C</td>
</tr>
<tr>
<td>Holding time</td>
<td>Cooling temperature °C</td>
</tr>
<tr>
<td>Total time taken for pasteurization</td>
<td>Cream acidity %LA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(c) Ripening</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter quality</td>
<td>Amount of starter added</td>
</tr>
<tr>
<td>Incubation temperature</td>
<td>°C Incubation time</td>
</tr>
<tr>
<td>Acidity of ripened cream</td>
<td>%LA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(d) Cooling &amp; Aging</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling temperature</td>
<td>°C Cooling period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(e) Particulars of churning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat in cream</td>
<td>% Rate of colour addition</td>
</tr>
<tr>
<td>Cream acidity</td>
<td>%LA Amount of colour added ml</td>
</tr>
<tr>
<td>Temperature of cream</td>
<td>°C</td>
</tr>
<tr>
<td>Time when churning started</td>
<td>Time when churning completed</td>
</tr>
<tr>
<td>Particulars of Cream</td>
<td>Quantity</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Type</td>
<td>Kg</td>
</tr>
<tr>
<td>Fat</td>
<td>%</td>
</tr>
<tr>
<td>Acidity</td>
<td>% LA</td>
</tr>
</tbody>
</table>

**PRODUCTION CHART FOR TABLE BUTTER**

<table>
<thead>
<tr>
<th>Particulars of Cream</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Kg</td>
</tr>
<tr>
<td>Fat</td>
<td>%</td>
</tr>
<tr>
<td>Acidity</td>
<td>% LA</td>
</tr>
</tbody>
</table>
### Processing of Cream

#### (a) Neutralization

<table>
<thead>
<tr>
<th>Type of neutralizer</th>
<th>Amount of neutralizer</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity of cream after neutralization</td>
<td>%LA</td>
<td></td>
</tr>
</tbody>
</table>

#### (b) Pasteurization

<table>
<thead>
<tr>
<th>Time when pasteurization started</th>
<th>Temperature</th>
<th>°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding time</td>
<td>Cooling temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Total time taken for pasteurization</td>
<td>Cream acidity</td>
<td>%LA</td>
</tr>
</tbody>
</table>

#### (c) Ripening

<table>
<thead>
<tr>
<th>Starter quality</th>
<th>Amount of starter added</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation temperature</td>
<td>°C</td>
<td>Incubation time</td>
</tr>
<tr>
<td>Acidity of ripened cream</td>
<td>%LA</td>
<td></td>
</tr>
</tbody>
</table>

#### (d) Cooling & Aging

<table>
<thead>
<tr>
<th>Cooling temperature</th>
<th>°C</th>
<th>Cooling period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulars of churning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat in cream</td>
<td>%</td>
<td>Rate of colour addition</td>
</tr>
<tr>
<td>Cream acidity</td>
<td>%LA</td>
<td>Amount of colour added</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Time when churning started</td>
<td>Time when churning completed</td>
<td></td>
</tr>
<tr>
<td>Time when break water added</td>
<td>Amount of break water</td>
<td></td>
</tr>
<tr>
<td>Temperature of break water</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Amount of butter milk</td>
<td>Temperature of buttermilk</td>
<td>°C</td>
</tr>
<tr>
<td>Fat in butter milk</td>
<td>%</td>
<td>Amount of fat lost in buttermilk</td>
</tr>
<tr>
<td>-------------------</td>
<td>---</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Total fat lost in buttermilk</td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>

**Washing of butter grains**

<table>
<thead>
<tr>
<th>Temperature of wash water</th>
<th>ºC</th>
<th>Amount of wash water</th>
<th>ltr</th>
</tr>
</thead>
</table>

**Salting and Working**

<table>
<thead>
<tr>
<th>Amount of salt added</th>
<th>g</th>
<th>Quality of salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time when first working started</td>
<td></td>
<td>First moisture test</td>
</tr>
<tr>
<td>Amount of water added</td>
<td>g</td>
<td>Time when second working started</td>
</tr>
<tr>
<td>Final moisture test</td>
<td>%</td>
<td>Total time for working</td>
</tr>
</tbody>
</table>

**Recovery of Butter**

<table>
<thead>
<tr>
<th>Quantity obtained</th>
<th>Kg</th>
<th>Salt</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overrun</td>
<td>%</td>
<td>Total fat recovery</td>
<td>%</td>
</tr>
<tr>
<td>Moisture</td>
<td>%</td>
<td>Total time for butter making</td>
<td></td>
</tr>
</tbody>
</table>

**Calculations**

1. **For Moisture adjustment** –

   \[ \text{Kg of water to be added} = \frac{(A \times 1.5 \times B)}{100} \]

   Where, \( A = \% \) moisture to be raised and \( B = \text{Kg fat in churn} \).

2. **For calculating Over run**

   \[ \text{Percent over run} = \frac{(Wt. \text{ of butter} - Wt. \text{ of fat in cream}) \times 100}{(Wt. \text{ of fat in cream})} \]
Result and inference

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Teacher’s signature

Review Questions

1. What is the difference between table butter and creamery butter?
2. Write the method to calculate the quantity of salt.
3. How moisture is adjusted in buttermaking?
4. What should be the optimum load of churn?
5. Write optimum acidity, fat and temperature of churning.
Part G
Preparation of Dahi/Yoghurt

Objective

a) To learn the method of preparation of dahi & yoghurt using different types of milk

b) Organoleptic evaluation of dahi

Introduction

Dahi is a fermented dairy product, produced by fermentation process by deliberately adding live, harmless, lactic acid producing bacteria in the form of bacterial culture to milk. Lactic acid bacteria added in the form of starter culture multiply and grow, produces lactic acid, acetic acid and carbon dioxide by utilizing lactose present in the milk. Some bacteria use the citric acid of milk to produce certain volatile organic compounds mainly diacetyl, which is responsible for flavor of dahi. Judicious combination of acid producing and flavour producing microorganisms in the starter helps in the production of Dahi with a firm body and good flavour. Fermentation leads to partial breakdown of milk constituents particularly lactose and proteins and increases the digestibility of cultured milk products. As per Food safety and standards regulation (FSSR, 2011), Dahi shall have the same minimum percentage of milk fat and milk solids-not-fat as the milk from which it is prepared and it may contain added cane sugar.

Materials

1) Milk, 2) Lactometer with cylinder, 3) Fat testing kit for milk, 4) Lactic culture, 5) SS vessel and ladle, 6) Muslin cloth, 7) Thermometer, 8) Weighing balance, 9) pH meter/strips, 10) Heating medium, 11) Incubator, 12) Dahi culture or yoghurt culture (Streptococcus thermophilus + Lb. delbreuckii Subsp. bulgaricus)

Procedure

1. Collect the representative sample of milk and analyse it for fat, SNF, acidity and organoleptic quality.

2. Standardize milk to 0 - 5.0% fat and 11 - 13% SNF (based on the type of dahi) by adding cream and calculated amount of skimmed milk powder.

3. Filter the milk into a clean SS kettle through a muslin cloth.

4. Homogenize at 175Kg/cm² and Heat the milk to 90°C for 15 minutes and cool it to 32°C.
5. Add the lactic culture to milk @ 1.5% and mix well (for Yoghurt:ST:LB)

6. Fill the product into dahi cups and incubate at temperature of 32°C for 6-8 hrs/for yoghurt incubate at 42°C/5 hrs.

7. At the end of the incubation, make sure that the product has reached the pH of 4.6

8. Store at refrigerated temperature (<5°C)

**PRODUCTION CHART OF DAHI/YOGHURT**

I. **Particulars of Milk**
   - Type ____________________________ Quantity ________________________________ Kg.
   - Acidity __________ % lactic acid Lactometer reading._______ at______ °C
   - Fat ______________ % Total Solids ____________________________ %
   - Solids-Not-Fat _____________ %

II. **Milk Standardization**
   - Quantity of cream required __________g Quantity of SMP required ___________ g
   - Time when mixing was started ______Hour______Minutes

III. **Processing and filling**
   - Time temperature combination of mix processing _______ °C ________ Minutes,
   - Rate of culture addition___________ Quantity of culture added _________ g
   - Temperature of the mix during culture inoculation ______________ °C
   - Temperature of incubation _______°C, Time when incubation started _____AM/PM
   - Time when incubation stopped _____AM/PM
   - Duration of incubation _____Hour_____ Minutes
   - Amount of Dahi obtained _______ kg

IV. **Organoleptic Quality**
   - Acidity of the product at the end of incubation_______% LA
   - Flavour __________________ Colour ____________________________
   - Body texture ____________________________
   - Overall sensorial attribute of Dahi ____________

**Remarks:**_________________________________________________________________
Review Questions

1. Define Dahi as per FSSR 2011
2. Explain the importance of pasteurization and homogenization with respect to quality of dahi
3. Name the flavoring compound which is mainly responsible for flavor of dahi
Part H
Preparation of Chakka and Shrikhand

Objective

a) To learn the method of preparation of Chakka and Shrikhand using different types of milk

b) Organoleptic evaluation of Chakka and Shrikhand

Introduction

Chakka is a fermented, intermediate dairy product obtained during the production of Shrikhand. Scientifically chakka can be described as strained dahi, in other words it is the curd mass obtained after removing whey from dahi, either by muslin cloth or basket centrifuge. Chakka is the base material for the production of shrikhand and shrikhandwadi. Shrikhand is a popular fermented, sweetened, indigenous dairy product having semi solid consistency with typical sweetish-sour taste. It is very popular in the state of Gujarat, Maharashtra and part of Karnataka. It is prepared by mixing chakka (Strained dahi), with sugar, color, flavor, spices and other ingredients like fruit pulp, nuts etc. to form soft homogenous mass.

Materials

1) Milk, 2) Lactometer with cylinder, 3) Fat testing kit for milk, 4) Lactic culture, 5) SS vessel and ladle, 6) Muslin cloth, 7) Thermometer, 8) Weighing balance, 9) pH meter/strips, 10) Heating medium, 11) Incubator.

Procedure

1. Collect the representative sample of milk and analyse it for fat, SNF, acidity and organoleptic quality.

2. Standardize milk to 0 - 5.0% fat and 9% SNF by adding cream and calculated amount of skimmed milk powder.

3. Filter the milk into a clean SS kettle through a muslin cloth.

4. Homogenize at 175 Kg/cm² and Heat the milk to 85°C for 30 minutes and cool it to 30°C.
5. Add the lactic culture to milk @ 1.5% and mix well.

6. Incubate the milk added with culture at temperature of 30°C for 8-10 hrs

7. At the end of the incubation, make sure that the product has reached the pH of 4.6

8. Break the curd and collect it in a muslin cloth and hang it for complete removal of whey or take the curd mass in basket centrifuge and process it for 30min at 900rpm

9. The product thus obtained is called chakka

10. Take the chakka in a stainless steel vessel or in a planetary mixer, weigh sugar @ 80% w/w of chakka and mix it well to get a homogenous mass.

11. To this mass add cardamom (1g/kg) may be added as optional ingredient to give pleasant flavor.

12. Mix the curd mass thoroughly; the product thus obtained is called as Shrikhand.
## PRODUCTION CHART OF CHAKKA AND SHRIKHAND

### I. Particulars of Milk

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Kg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity _______________ % lactic acid</td>
<td>Lactometer reading._______ at______ °C</td>
<td></td>
</tr>
<tr>
<td>Fat _______________ % Total Solids _______________ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solids-Not-Fat _______________ %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### II. Milk Standardization

- Quantity of cream required ____________ g
- Quantity of SMP required ____________ g
- Time when mixing was started _______Hour______Minutes

### III. Processing and filling

- Time temperature combination of mix processing _______ °C _______ Minutes,
- Rate of culture addition__________ Quantity of culture added _______ g
- Temperature of the mix during culture inoculation ___________ °C
- Temperature of incubation _______°C, Time when incubation started ______AM/PM
- Time when incubation stopped _____AM/PM;
- Duration of incubation _____Hour_____ Minutes
- Amount of Dahi obtained ____ Kg; Duration of hanging______ Hour ____ Minutes;
- Quantity of Chakka Obtained _____ Kg; Quantity of Sugar added _____ Kg
- Quantity of Cardamom added _____ g; Quantity of Shrikhand obtained ______ Kg

### IV. Organoleptic Quality

- Acidity of the product at the end of incubation_______% LA
- Flavour __________________ Colour _________________________
- Body texture __________________________
- Overall sensorial attribute of Lassi _____________

### Remarks:

_________________________________________________________________
Review Questions

1. Define Chakka and Shrikhand as per FSSR 2011
2. Write the flow diagram for the production of Shirkhand
Part I

Preparation of
Sweetened Condensed Milk (SCM)

Objective
The students should be able to comprehend the production process of sweetened condensed milk.

Introduction
Sweetened condensed milk (SCM) is made from standardized whole milk with sugar acting as a preservative. Evaporation is done under vacuum. It is thick and highly viscous in consistency with clean appearance. The product can be readily reconstituted by the addition of water. One kg of SCM gives 2.5 kg of sweetened reconstituted milk. The milk received at the plant is subjected to platform tests. Clarification, Standardization, stabilization by adding salts, forewarming and concentration under vacuum. Sugar in the form of syrup is added and a final concentration of 74-75 per cent TS is reached. The product is cooled crystallized and canned under aseptic conditions in automatic filling and sealing machines.

Materials Required
a) Milk condensing unit (batch or, continuous)
b) Sediment, fat, SNF, Acidity, MBR and alcohol test set
c) Sample bottles and sampling device
d) Refractometer
e) Thermometer
f) Sugar
g) Seed lactose

Procedure
1) Test the quality of the incoming milk by standard platform tests. The milk should be free from an objectionable odour have not more than 0.18 per cent lactic acid and be negative to the alcohol test.
2) Cool the clarified milk to 5°C.

3) Take a representative sample of the raw milk and determine its fat and SNF per cent.

4) Determine the fat and SNF per cent of the cream and skim milk available for standardisation.

5) Standardize the milk to the desired SNF: fat ratio (2.44), using cream/ skim milk.

6) Note the mode of heating employed for forewarming. Observe the time taken to reach the prefixed temperature and also the time of holding in the forewarmer.

7) Dissolve the sugar (88°C) in a separate vat and keep it ready to be drawn in the condensing unit at the end of the condensing process. Note down the proper concentration of sugar (65 per cent) by using a refractometer.

8) Rinse all parts of the pan with hot water and steam to a temperature of about 85°C or higher.

9) Open the water to the condenser and start the vacuum pump.

10) Obtain the required vacuum in the pan (25" vacuum).

11) Draw the standardized milk through the forewarmer into the vacuum pan.

12) After the bottom coil is submerged in the milk, let the steam enter the bottom coil. Similarly, the steam is allowed in other coils, one by one, after they are covered with the milk.

13) Maintain the level of the milk in the pan to be just above the topmost coil and regulate the flow of the milk to the pan accordingly.

14) Note down the steam pressure in the coils, the level of the vacuum and the temperature of the milk in the pan at regular intervals. Also check the uniformity of the flow of water to the condenser. The sugar syrup is taken into the vacuum pan when the total solids are about 30 per cent.

15) Draw the sample at regular intervals and check the total solids concentration by using a refractometer.

16) Record the rate of evaporation.

17) Determine correctly the stage of striking by visual examination as confirmed by the refractometer reading of the sample.

18) For drawing out the condensed milk into the cooling tank, shut off the water to the condenser, stop the vacuum pump, open the vacuum release valve and open the
milk discharge valve, the steps being followed in succession.

19) Cool the condensed milk to 29 -30°C with continuous agitation.

20) Prepare seed material by mixing seed lactose with enough of condensed milk (2-3 kgs) and add 200-300 grams of ground lactose for each 1000 kg of the product.

21) Add the seed material to the pre-cooled milk in the cooling tank in the course of five to ten minutes ensuring satisfactory agitation and mixing of all the additives.

22) Rapidly cool the milk in the tank to 21°C and keep the agitator working until filling.

23) Store the sweetened condensed milk at the temperature of 15°C and below till filling.

24) See that the filling room, the filler and the pipes conveying the condensed milk have been properly sanitized and the temperature of the filling room is around 16-20°C.

25) Immerse the cans in a detergent solution and later scold the water before passing it through the sterilizers. Allow the dry hot cans to be carried to the filler.

26) Draw the condensed milk from the cooling storage tanks to the filler ensuring that the rate of pumping synchronizes with the rate of filling.

27) Check the operation of the seaming rolls prior to filling by working with a few empty cans and lids.

28) Fill the cans to the brim and see that the lids are tightly sealed.

29) Test the cans for leakage.

Precautions

● Make sure of the time-temperature combination of forewarming before commencing the process.

● Ensure free flow of the water through the condenser.

● Make sure that the steam supply to the steam coils is started after the coil gets submerged in the milk and the steam supply is closed immediately after the level of the condensed milk falls below the coil.

● Ensure continuous agitation during cooling.

● The seed lactose should be sterilized and it should be of uniform size, preferably 200 mesh or smaller.

● Maintain freedom from contamination during filling.
Review Questions

- Give a flow diagram of the preparation of sweetened condensed milk.
- How is seed material prepared and added and for what purpose?
- What do you understand by the term ‘striking the pan’?
Part J
Preparation of roller dried milk powder

Objective

The students should be able, to identify and explain the steps involved in the production of roller dried milk powder.

Introduction

Dried milk products play a significant role in conserving the milk solids since their biological value can be retained for a long period of time under relatively simple storage conditions. The roller dried powder finds special application in the manufacture of confectionery, infant foods, ice-cream, milk sweets, etc. Milk is pre-condensed to about 20 -25 per cent total solids (TS) in a vacuum pan/evaporator and fed to the rotating drum driers which are internally heated with steam. The film of the dried product is continuously scraped off by a stationary knife located opposite the point of application of milk. The dried milk film so obtained is ground to obtain powder which is then sifted, packed and stored.

Materials Required

Raw materials: Condensed skim milk having 20-25 per cent total solids for skim milk powder (SMP) or Condensed standardized milk having 20-25 per cent total solids with a fat: SNF ratio of 1: 2.5 for whole milk powder (WMP)

Equipment: (i) Roller drier with powder grinding and sieving unit; (ii) Milk condensing unit

Procedure

1) Separate the milk (for SMP) or clarify and standardize it (for WMP).

2) Forewarm (95°C) and re-condense to 20 percent total solids. Homogenize the condensed milk in case of WMP manufacture.

3) Prepare the rollers: (a) Make sure that the knives are not touching the rollers; (b) Start revolving the rollers; (c) Clean the rollers by pouring water and detergent solution in the trough and rotate for 10-20 minutes; (d) Stop the rollers allow the detergent solution to drain flush with plenty of warm water and rotate the rollers; (e) Open the main steam valve and make sure that the condensate valve is open; (f) Maintain a
steady pressure of steam (55-65 psi); (g) Start the powder conveyors and the vapour exhaust fan.

4) Drying on the rollers: (a) Start taking the condensed milk in the feed line on to the feed trough and immediately adjust the knives. Ensure that the rate of milk flow to the trough is proper and that the dried milk is being scraped uniformly; (b) Half dried or charred powder obtained during initial setting may be collected separately and discarded. Cover the conveyors and adjust their running to remove the powder.

5) Start the grinding motor and conveyor, sieve the powder into the filling hopper.

6) Stopping the rollers: (a) When the milk is over, stop the conveyors and run some hot water over the rollers; (b) Take off the knives and stop the steam; (c) Stop the rollers only when there is no steam pressure inside and the rollers are sufficiently cool; (d) Stop the vapour exhaust fan.

**Precautions**

- Do not start the main drive motor if the knives are touching the rollers.
- In case of power breakdown immediately close the feed valve and let out the steam from the rollers.
- Ensure that the knives are properly ground.
- Ensure that the vapours do not fall back on to the dried milk.

**Review Questions**

- What should be the optimum TS in milk when taking it for roller drying?
- What pressure of steam should be maintained in the rollers?
- What should be done in case of a power breakdown during the roller drying operation?
Objective
The students should be able to comprehend the operation process of manufacture of spray dried milk powder.

Introduction
Dried milk products are capable of being stored at room temperature. Spray drying is the most important method of drying milk and milk products. By spraying into a stream of hot air the droplets formed present an extremely large amount of surface area and get dried immediately due to rapid evaporation of the moisture. Milk is pre-heated and concentrated to 40-45 percent TS. Hot air is filtered and directed into the drying chamber. The concentrate is atomized to obtain small particles ranging from 50-150 μm in diameter. The air leaving the drying chamber enters a cyclone separator where the fines are collected. The dried product is cooled sifted and packed in suitable packaging material.

Materials required

Raw materials: (i) Condensed skim milk having 40-45 per cent total solids for skim milk powder (SMP) or Condensed standardised milk having 40-45 per cent total solids with a fat: SNF ratio of 1: 2.5 for whole milk powder (WMP).

Equipment required: (1) Spray drier; (ii) Milk condensing unit

Procedure
1) Separate the milk (for SMP) or clarify and standardize it (for WMP).
2) Forewarm (95°C) and re-condense to 40 per cent total solids. Homogenize the condensed milk in case of WMP manufacture.
3) Operating the spray drier: (a) Clean the spray drier and connect the pipe lines, valves and cyclone separator; (b) Open the steam valve in the air heating coils; (c) Start the exhaust fan, keeping the main door partially open; (d) Start the blower and close the main door; (e) Adjust the temperature of hot air to 180°C and maintain this temperature for ten minutes to ensure sterility of the unit; (f) Start the atomizer and allow it to attain speed; (g) Run it With nearly 20 litres of water through the
feed pump; (h) When the outlet air temperature reaches 100°C, change the feed to concentrate. The temperature inside the drying chamber should be nearly 90°C; (i) Collect the powder in the powder silo.

4) Stopping the spray drier: (a) When the milk is over flush the balance tank with about 20 litres of hot water (90°C) and immediately reduce the flow of milk to the drier; (b) Stop the atomizer and the feed pump when the tank is empty; (c) Stop the steam in the air heating coils; (d) Stop exhaust fan and the air blower.

Precautions

● The atomizer is a very delicate and the most important part of the spray drying plant and must be handled carefully.

● Never run the atomizer with cold milk or highly concentrated milk as the nozzles may get clogged.

● Maintain steady temperature of hot air in the drying chamber.

● In case of power breakdown, immediately close the milk valve to the drying chamber.

Review Questions

● What should be the optimum TS in milk when taking it for spray drying?

● What should be the inlet and outlet air temperature during spray drying?

● What sequence of operation will you follow when stopping the spray drying plant?
Part L
Preparation of Acid Casein

Objective
The student should be able to prepare good quality acid casein.

Introduction
Casein exists in milk as a calcium caseinate calcium phosphate complex which is held in colloidal solution. When pH of milk is lower by addition of acid, the complex is dissociated. The acid forms a soluble compound with calcium caseinate by displacing calcium with hydrogen ion (H⁺) and sets free calcium phosphate in the soluble form releasing the casein free which is practically insoluble at pH 5.3. Casein begins to precipitate out from the solution and at isoelectric point (4.6) casein losses its hydrophilic property and maximum precipitate occurs. Casein is the major protein of milk contributing about 80 percent of total proteins and finds specific uses in edible foods, animal feeds and various industrial applications. The various acids used for precipitation are hydro chloric acid, lactic acid, sulphuric acid and the casein manufactured by using such acids is named accordingly for example lactic acid casein.

Materials required
i. Vat
ii. Strainer
iii. Thermometer
iv. Stirrer
v. pH meter
vi. Cheese or Curd milling machine
vii. Skim milk with not more than 0.1 percent milk fat
viii. Acids: hydro chloric acid (10 percent solution), lactic acid (10 percent solution), sulphuric acid (5 percent solution).

Procedure
i. Take good quality skim milk in a vat and raise its temperature to 35 to 38°C. Add diluted acid slowly with constant stirring till clean greenish yellow whey is obtained.
ii. Stop adding acid and stir for a minute.

iii. Push the curd towards the back of the vat and drain the whey through strainer.

iv. Wash the curd with water three times. The pH of the wash water for first two washing should be 4.6 and third washing with neutral water. Amount of wash water should be equal to whey removed. Before draining the wash water curd should be well stirred but care should be taken not to break the curd into fine particles.

v. Drain the wash water. Collect the curd in muslin cloth and place it under pressure for 3-4 hours until the maximum moisture is drained out.

vi. Pass the pressed curd through milling machine.

vii. Then dry the curd in a drier at a temperature of 52-57°C until moisture content reduces to 8-10 percent.

viii. Cool the dried casein and pulverize in a grinding mill to a desire particle size that is 30, 40, 60 or 90 mesh size.

**Observations**

i. Type of milk taken: __________________

ii. Quantity of milk taken: _____________

iii. Heating temperature of skim milk: ______________

iv. Type of acid used: _________________

v. Amount of acid used: _______________

vi. Amount of whey obtained: ___________

vii. Amount of curd obtained: ___________

viii. Amount of casein obtained: __________

**Calculations**

i. Calculate the yield of acid casein obtained using the following formula.

**Results**

Record the result in terms of quantity of casein obtained and yield.

**Review Questions**

1. What do you mean by acid casein?
2. Give uses of acid casein.
Part M
Preparation of Rennet Casein

Objective
The student should be able to prepare good quality rennet casein.

Introduction
The enzyme rennin and / or pepsin displace glycomacropeptide from kappa casein fraction of the casein. In the presence of calcium (Ca\(^{2+}\)), the casein precipitates.

Materials required
i. Horizontal Vat
ii. Strainer
iii. Rennet / Rennin enzyme
iv. Thermometer
v. Stirrer
vi. pH meter
vii. Titratable acidity testing set (0.1 N sodium hydroxide, phenolphthalein indicator, burette and pipette)
viii. Cheese or Curd milling machine
ix. Cabinet / Tunnel / Tray drier
x. Skim milk with not more than 0.1 percent milk fat

Procedure
i. Take good quality skim milk in a vat and filter it to remove extraneous matter.
ii. Raise its temperature of skim milk to 29 to 31°C in the vat.
iii. Add calcium chloride at the rate of 0.02 percent of the skim milk.
iv. Add 70-100 mL of rennet extract diluted with twenty times its volume of water or 2-3 g of rennet powder diluted in water to every 500 Kg of skim milk.
v. Allow the milk to set without disturbing it. This would take about 25-40 minutes. Maintain the temperature of the milk in the vat during the setting period.
vi. When the curd is set firmly enough to handle cut the curd into pieces.

vii. Stir the curd slowly and at the same time start heating the curd-whey mixture until the temperature reaches to 46-48 °C.

viii. Allow the curd to settle and drain the whey.

ix. Wash the curd twice with water equal to the amount of whey drained.

x. Drain wash water and press the curd for 1 hour.

xi. Shred the curd and dry in thin layer in the cabinet / tunnel / tray drier.

xii. Ground and pulverize the dried casein.

xiii. Pack in bags and store.

Observations

i. Type of milk taken: __________________

ii. Quantity of milk taken: _____________

iii. Heating temperature of skim milk: ______________

iv. Type of rennet used: _______________

v. Amount of rennet used: ______________

vi. Quantity of water used for dilution of rennet: ______________

vii. Amount of whey obtained: ______________

viii. Amount of rennet curd obtained: ______________

ix. Amount of casein obtained: ______________

Calculations

i. Calculate the yield of rennet casein obtained using the following formula.

\[
Yield \ of \ casein \ (\%) = \frac{\text{Amount of acid casein obtained} \ (g)}{\text{Amount of milk taken} \ (g)} \times 100
\]

Results

Record the result in terms of quantity of rennet casein obtained and yield.

Review Questions

1. What do you mean by rennet casein?

2. Give uses of rennet casein.
Objective

In this chapter student will learn various sensory attributes that decides acceptability or rejectability of milk and milk products.

Sensory evaluation procedure of milk and milk products

For every milk and milk product there is a specific score card and scientific technique for sensory evaluation. However the sequence of observation is mostly same for almost all the products. First, for a packaged product the quality of the package in which the product is marketed is evaluated. This is followed by observing the appearance characteristics of the product. In the next step flavour of the product is judged and finally the body and texture is evaluated. In the following sections the detailed procedure for sensory evaluation of milk and milk products are described.
Part A
Sensory Evaluation of Milk

Desirable Sensorial Attributes of Milk

Flavour: Excellent quality milk should seem pleasantly sweet with no foretaste, leave only a clean, pleasing sensation after the sample has been expectorated or swallowed, with no aftertaste. The flavor of milk is imparted by the natural components such as proteins, fat, salts, milk sugar (lactose), and possibly small amounts of other milk components. The natural richness of milk is due to presence of milk fat and sweetness is due to milk sugar. Pasteurized milk commonly possesses some degree of heated flavour especially immediately after processing, but the intensity diminishes during storage.

Colour: Colour of cow milk is yellowish creamy white and buffalo milk is creamy white. The scattering (refraction) of light by the insoluble colloidal minerals, protein, and fat particles are mainly responsible for the opaqueness and white colour of milk. Cow milk contains more beta-carotene which scatters yellowish light lending to creamy-yellow hue to cow milk.

Evaluation technique

1. Examine the container for the extent of fullness, cleanliness and freedom from cracks or chips.
2. The container should have attractive appearance, clear and contain the full volume of milk.
3. Should reflect cleanliness, recently filling and should posses dry, firm and milk solid free surface free from cuts/nicks/pinholes.
4. Warm the sample to 40°C.
5. Fifty ml of sample should be served in clean, odourless glass or plastic bottles.
6. Observe the kind, amount and size of the sediment particles that may have settled at the bottom.
7. Immediately after opening the lid smell the milk and closely inspect the underside of the closure for presence of cream or foam and examine the top of the milk
sample for its colour, presence of cream plug or partially churned fat globules.

8. Gently swirling the container contents in a circular pattern to mix the sample properly and take a generous sip (not less than 10 ml) roll it in the mouth and note the flavour and tactual sensation, then expectorate.

9. Aftertaste may be enhanced by drawing a breath of fresh air very slowly through the nose.

10. By placing the nose directly over the container immediately after the milk has been swirled in the container and taking a full ‘whiff’ of air, any off-odor that may be present can be more readily noted.

11. Agitation (or swirling) of the milk leaves a thin film of milk on the inner surface of the container, which tends to evaporate, thus readily optimizing the opportunity to detect any odor(s) that may be present.

12. Indicate the scores on different attributes in the Evaluation Card (Table 1).

---

### Sensory Score Card for Milk

**Name:** __________________________  **Date:** ______________

**A. Assign scores for each sample for different characteristics**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Maximum score</th>
<th>Sample Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sample No. 1</td>
</tr>
<tr>
<td>Flavour</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Consistency</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Odour</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Colour &amp; Appearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

Comments, if any:

Signature of the Judge
B. Indicate the degree of defects (if any) such as the following. Encircle the one applicable and deduct from the attributes.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Defect</th>
<th>Degree of Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Suspicion</td>
</tr>
<tr>
<td>Flavour</td>
<td>Cooked, oxidized, rancid, metallic, neutralizer, feed, barny, cowy, flavor defects due to adulterants and other additives</td>
<td>5</td>
</tr>
<tr>
<td>Consistency</td>
<td>Watery, ropy, curdy</td>
<td>5</td>
</tr>
<tr>
<td>Odour</td>
<td>Stale, acidic abnormal</td>
<td>5</td>
</tr>
<tr>
<td>Colour and appearance</td>
<td>Suspended particles, filth, foreign matter, bloody</td>
<td>2</td>
</tr>
</tbody>
</table>

After averaging of data (recorded in the score card by the panelists) the following grades should be awarded to each sample. Any attribute showing pronounced defect should be graded poor and rejected.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>90 and above</td>
<td>A</td>
</tr>
<tr>
<td>Good</td>
<td>80 to 89</td>
<td>B</td>
</tr>
<tr>
<td>Fair</td>
<td>60 to 79</td>
<td>C</td>
</tr>
<tr>
<td>Poor</td>
<td>59 and below</td>
<td>D</td>
</tr>
</tbody>
</table>
Part B

Sensory Evaluation of Butter

Desirable Attributes of Butter

The desirable sensory attributes of good quality butter should be:

Package: Package for butter should be attractive, neat, clean and tidy in appearance and should have good “finish” (smooth and attractive surface). All packages should be fastened firmly and neatly.

Flavour: Good quality butter should have a mild, sweet, clean and pleasant flavour and delicate aroma. A characteristic feature of high-quality butter is that instigate appetite to ‘crave more of the product’.

Body and Texture: The body of good quality butter should be firm and exhibit a distinct waxy, close-knit texture. When broken, the appearance of broken surface of good quality butter should be somewhat jagged, irregular, wrought-iron like. It should have smooth “spreadability”.

Salt: It must be uniformly distributed and properly dissolved. If undissolved salt is present, gritty defect is usually noticed at once.

Colour and Appearance: Good quality butter should have a uniform light, pale yellow colour.

Scoring Technique of Butter

1. The judging room of butter should be clean, well ventilated and well lit. The temperature of the judging room should be 18-21°C. There should be no strong, offensive or irritating odour present in the room or adjacent areas.

2. Temper butter to 10°C. Delicate aroma of butter is more readily detected, body and characteristics is more easily and precisely determined when butter is at 10°C.

3. Take a representative sample of the product. For large blocks trier (two-edged, curved bladed tool) should be used for sampling of butter. The trier used should not be washed in warm water but should be wiped with-single service towel or absorbent paper. Washing the trier in warm water may result in a molten, greasy surface on the first plug of butter taken. This obscures the true condition of the body and makes observation of the colour more difficult.
4. Stand squarely in front of the sample and observe relative cleanliness and neatness of the package. Remove the cover or package and observe for evenness and neatness of the wrapping material. Observe the surface for possible discrepancies or yeast and mould growth. Hold the trier firmly in one hand, insert it straight down near the centre of the butter and turn it 180° and withdraw the plug. In case of retail pack (500g or less) a spatula or spoon may be used in place of trier.

5. Immediately after withdrawing the plug or drawing the sample using a spatula or spoon pass the butter slowly under the nose, inhale through the nose very slowly and notice the aroma present. Make a mental record of this aroma.

6. Examine the colour for its intensity and uniformity.

7. Examine the body and texture by pressing the ball of thumb against the sides of the plug until it shows a break. Notice the presence or absence of free moisture or beads of water and their clearness and also the nature of break, whether it is smooth or jagged/irregular.

8. Take 4-5 g of the sample and put it into the mouth. Chew until it melts. Roll the melted butter in the mouth until it comes to body temperature.

9. Feel the presence of “grit” (un-dissolved salt between the teeth).

10. Critically feel the manner in which the butter melts. Notice the various sensations of taste and smell.

11. Just before expectorating, roll it to the back of the mouth to detect the palate flavours.

12. Expectorate the sample, observe the aftertaste and notice whether or not the flavour persists.

13. Indicate the scores on different attributes in the Evaluation Card as shown in the following page. The hints given in Butter Scoring Guide will aid the judge to score the product properly.
**Butter Score Card**

Place score opposite the rating for perfect score. Check criticism in space opposite to the defect noted and in proper sample column. Write any other criticisms if necessary. DO NOT write anything in space indicating grade.

<table>
<thead>
<tr>
<th>Perfect Score</th>
<th>Criticisms</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour 12</td>
<td>Sample scores</td>
<td></td>
</tr>
<tr>
<td>Normal range 7.5 to 12</td>
<td><strong>Criticism</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bitter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cheesy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cooked</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cowy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Metallic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Musty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neutralizer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oily</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Old Cream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cream or Garlic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rancid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scorched</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tallowy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unclean</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weedy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whey</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yeasty</td>
<td></td>
</tr>
<tr>
<td>Body and Texture 6</td>
<td>Sample scores</td>
<td></td>
</tr>
<tr>
<td>Normal range 3 to 6</td>
<td>Criticism</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crumbly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greasy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gummy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leaky</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mealy/Grainy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ragged boring</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pasty/Sticky</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weak/Soft</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Colour 3</th>
<th>Sample scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal range 2 to 4</td>
<td>Criticism</td>
</tr>
<tr>
<td></td>
<td>Mottles, uneven, wavy specks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Salt 2</th>
<th>Sample scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal range 2 to 3</td>
<td>Criticism</td>
</tr>
<tr>
<td></td>
<td>Gritty</td>
</tr>
<tr>
<td></td>
<td>Sharp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package 2</th>
<th>Sample scores</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total 25</th>
<th>Total score of each sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total grade per sample</td>
</tr>
</tbody>
</table>

**Butter Scoring Guide**

The scores suggested here are to be used as a guide only and are not to be used as specific scores with no range. For example, a slight acid flavour defect may be scored 10.5 or 9.5 as well as the score of 10 suggested. The numerical score is to be used as an indication of the intensity of the defect.

<table>
<thead>
<tr>
<th>Flavour</th>
<th>Slight</th>
<th>Definite</th>
<th>Pronounced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Bitter</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Cheesy</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Coarse</td>
<td>10</td>
<td>9.5</td>
<td>9</td>
</tr>
<tr>
<td>Cooked</td>
<td>10</td>
<td>9.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Cowy</td>
<td>9.5</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Feed</td>
<td>10</td>
<td>9.5</td>
<td>9</td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>Fishy</td>
<td>9</td>
<td>8.5</td>
<td>8</td>
</tr>
<tr>
<td>Flat</td>
<td>10</td>
<td>9.5</td>
<td>9</td>
</tr>
<tr>
<td>Malty</td>
<td>9.5</td>
<td>8</td>
<td>8.5</td>
</tr>
<tr>
<td>Metallic</td>
<td>9.5</td>
<td>8</td>
<td>8.5</td>
</tr>
<tr>
<td>Musty</td>
<td>9.5</td>
<td>9</td>
<td>8.5</td>
</tr>
<tr>
<td>Neutralizer</td>
<td>9.5</td>
<td>9</td>
<td>8.5</td>
</tr>
<tr>
<td>Oily</td>
<td>9</td>
<td>8.5</td>
<td>8</td>
</tr>
<tr>
<td>Old Cream</td>
<td>9.5</td>
<td>9</td>
<td>8.5</td>
</tr>
<tr>
<td>Onion or Garlic</td>
<td>8.5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Rancid</td>
<td>8</td>
<td>8.5</td>
<td>8</td>
</tr>
<tr>
<td>Scorched</td>
<td>10</td>
<td>9.5</td>
<td>9</td>
</tr>
<tr>
<td>Tallowy</td>
<td>9</td>
<td>8.5</td>
<td>8</td>
</tr>
<tr>
<td>Unclean</td>
<td>9.5</td>
<td>9</td>
<td>8.5</td>
</tr>
<tr>
<td>Weedy</td>
<td>9</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Whey</td>
<td>10</td>
<td>9.5</td>
<td>9</td>
</tr>
<tr>
<td>Yeasty</td>
<td>9</td>
<td>8.5</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body and Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crumbly</td>
</tr>
<tr>
<td>Greasy</td>
</tr>
<tr>
<td>Gummy</td>
</tr>
<tr>
<td>Leaky</td>
</tr>
<tr>
<td>Mealy/Grainy</td>
</tr>
<tr>
<td>Ragged boring</td>
</tr>
<tr>
<td>Short</td>
</tr>
<tr>
<td>Pasty/Sticky</td>
</tr>
<tr>
<td>Weak/Soft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour specks</td>
</tr>
<tr>
<td>Un-natural colour</td>
</tr>
<tr>
<td>Mottled</td>
</tr>
<tr>
<td>Wavy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gritty</td>
</tr>
<tr>
<td>Sharp</td>
</tr>
</tbody>
</table>
Part C

Sensory Evaluation of Ghee

Desirable Sensory Attributes of Ghee

Flavour: Perfect ghee flavour can be described as multitude of sensory perceptions which are pleasant, enjoyable and lingers in mouth. The village produced ghee (purely desi ghee) is characterized by a curdy flavour that lingers in the mouth. The highly prized characteristic flavour of ghee is due to a complex mixture of compounds produced during the various stages of processing. Carbonyls, dicarbonyls, lactones, free fatty acids, esters, alcohols, diols and hydrocarbons are the major compounds associated with the flavour of ghee.

Texture: Granulation of ghee is an important criterion for its selection. Good grainy texture is much appreciated by consumers. Milk fat has a unique property of forming grains. Texture of ghee depends on a number of factors such as source of fat, method of preparation, amount of free fatty acids, rate of seeding, storage conditions among others. Buffalo ghee is around 74% solid if stored undisturbed at 28°C for 20-24 h. Similarly, Cow ghee and goat ghee are 70% and 30% solids respectively under identical conditions of storage. Consumers do not like hard, greasy or waxy texture in ghee.

Colour: Cow ghee has distinct golden yellow colour due to its high carotenoids content (about 72µg/100g), while buffalo ghee has white colour with greenish tinge due to the presence of biliverdin and bilirubin. Colour of ghee also depends on its method of manufacture such as ghee made by direct cream method is darker in colour. Brown discolouration is a serious defect in ghee.

Technique for Sensory Evaluation of Ghee

1. Representative sample should be drawn from the bulk lot in a clean and dry glass bottle. The bottle should be capped.

2. Samples should be presented at room temperature. Odour, taste and residue are better detected at 40°C while texture is analyzed after solidification. Crystallization temperature for cow ghee is 25-30°C and for buffalo ghee is 30-35°C.

3. Start with the visual observation of the sample. Judge the colour first, and then look for suspended impurities (residue).
4. Remove the lid and perceive the odour immediately by inhaling the smell.

5. Take a spoonful of ghee in mouth for taste and aroma. After each sample, mouth should be rinsed with 1% lukewarm (40°C) saline water.

6. Body and texture is evaluated with the help of a spatula or glass rod.

**Sensory Evaluation Card for Ghee**

Name: ____________________________ Date: ____________________________

A. Assign score for each sample for different characteristics. First go through section B.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Defect</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sample 1</td>
</tr>
<tr>
<td>Flavour 12</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat/Lacking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Curdy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burnt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rancid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rancid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oxidized</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smoky</td>
<td></td>
</tr>
<tr>
<td>Texture 8</td>
<td>Greasy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hard</td>
<td></td>
</tr>
<tr>
<td>Colour 3</td>
<td>Brown/burnt</td>
<td></td>
</tr>
<tr>
<td>Freedom from suspended impurities 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Score 25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B. Indicate, if any, the degree of defects such as following. Encircle the one applicable and deduct from the attribute:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Defect</th>
<th>Degree of defect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Suspicious</td>
</tr>
<tr>
<td>Flavour</td>
<td>Flat/Lacking</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Curdy</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Burnt</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rancid</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Oxidized</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Smoky</td>
<td>0.5</td>
</tr>
<tr>
<td>Texture</td>
<td>Greasy</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Hard</td>
<td>1</td>
</tr>
<tr>
<td>Colour</td>
<td>Brown burnt</td>
<td>0</td>
</tr>
<tr>
<td>Freedom from suspended impurities</td>
<td>Ghee residue</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Grading:** After computation of recorded scores in the above Table by the panelists, the following gradation should be specified:

<table>
<thead>
<tr>
<th>Quality</th>
<th>Score</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>22.5 or more</td>
<td>A</td>
</tr>
<tr>
<td>Good</td>
<td>20-22</td>
<td>B</td>
</tr>
<tr>
<td>Fair</td>
<td>18-19</td>
<td>C</td>
</tr>
<tr>
<td>Poor</td>
<td>17 and below</td>
<td>D</td>
</tr>
</tbody>
</table>
Part D
Sensory Evaluation of Dahi

Name: __________________________        Date: ______________

Desirable Sensorial Characteristics of Dahi

**Flavour:** Good quality dahi should have pleasant, sweetish aroma and a mild clean acid taste. A good diacetyl flavour is always desired in dahi. It should be free from any off flavour. Any sign of bitterness, rawness, yeasty, sharp and unclean off flavour should not be present in dahi.

**Body and Texture:** Good dahi should be a weak gel like junket when made from whole milk. The body should be firm, homogenous and free from gas holes and air bubbles. On cutting, the edges should appear clean and sharp. The surface should be smooth, preferably with a creamy layer. Defects like graininess or lumpiness, ropiness, shrunken, thin and wheying off should be absent in dahi.

**Acidity:** Generally acidity in the range of 0.75-0.85% lactic acid is appropriated for good quality dahi. Excessive acidity imparts too much sourness and sharp astringent taste to the product, whereas low acidity is considered as raw or bland.

**Colour and Appearance:** It should be creamy yellow if made from cow milk and creamy white if made from buffalo milk. It should be attractive, pleasing and uniform without showing any sign of browning and visible foreign matter. Dahi should have smooth and glossy surface without traces of any free whey on sides or top. Consumers often judge the wholesomeness and purity of dahi on the basis of presence of a creamy layer on the top, hence it is usually desirable.

**Sensory evaluation technique of dahi**

1. First look outside of the container. Look for any smudges on the package, and whether the manufacturing date is easy to read and in the proper place.

2. Open the container without disturbing the product and immediately assess the product for its odour. View the top of the product, particularly notice for any whey separation, yeast or mould growth, discolouration or watery liquid exudates.

3. Look around the sides of the cup for possible indications that the product may have shrunk.
4. Trip the cup upside down on a plate and puncture the bottom. Then lift the cup to get a dahi ‘mound’ left on a plate. With the help of a spatula or a knife scrape out dahi remaining in the cup bottom. Notice for any unusual aromas.

5. Observe how it appears on the plate. The dahi should resemble a thick mass with little or no running.

6. Next, notice for the presence for any unusual colour. If the dahi colour does not resemble the type of milk from which it is prepared then the product is characterized to possess ‘atypical colour’.

7. Place a spoonful of dahi in the mouth and notice how dahi clings or sticks to the tongue and sides of the mouth.

8. Move dahi in mouth using tongue and notice how fast the dahi dissipates off the tongue as it is being moved around. If dahi is low in total solids, it will dissipate fast, thus it's body perceived to be weak.

9. After noticing the texture and mouthfeel, perceive the first flavour sensations and notice where in the mouth they are being observed. One of the first sensations is acidity of dahi. The sensation is on the sides of tongue. After the acid sensation, the next flavours that are noticed are cooked, too high or low flavouring.

10. Then, notice for the presence of any strong off-flavours like oxidized, atypical (foreign), old ingredient, unclean, and yeasty.

11. Expectorate (spit it out) the dahi from mouth so that the flavour will not stay in the mouth for long time afterwards.

12. After expectorating, some flavours that are not associated with being the most pleasant are noticed. These include rancid, bitter, old ingredient, lacks freshness and unnatural flavours.

13. Indicate the scores for different attributes in the Evaluation Card. The hints given in Section B will aid the judge to score the product properly.

14. Defects arising from pronounced manufacturing, handling and storage errors, such as rancid, old ingredient, foreign, oxidized or spoilage issues, such as unclean or yeasty require greater penalties than less serious defects, such as low acid, high acetaldehyde, etc. The origin and remedies of some common defects of dahi are presented below.
**Sensory Evaluation Card for Dahi**

Name: ___________________________  Date: __________

A. Assign score for each sample for different characteristics. **First go through section B.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Maximum score</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Body &amp; Texture</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Acidity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Colour and appearance</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Container &amp; Closure</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td></td>
</tr>
</tbody>
</table>

B. Indicate, if any, the degree of defects as given below by writing **S for Slight, D for Definite & P for Pronounced** in the respective box and assign score for the corresponding attribute:

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Slight</th>
<th>Definite</th>
<th>Pronounced</th>
<th>Sample No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flavour</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High acetaldehyde</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Lacks fine flavor</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Cooked</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Flat (Low diacetyl)</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Foreign</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Old ingredient/ Stale</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Oxidized</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yeasty</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Unclean</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bitter</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Rancid</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Body &amp; Texture</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheying off</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Thick</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Thin</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Gel like</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Ropy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acidity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High acid</td>
<td>3</td>
<td>2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Low acid</td>
<td>2.5</td>
<td>2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td><strong>Colour &amp; Appearance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atypical colour</td>
<td>2.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Presence of suspended particles/foreign matter</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Excessive dark colour</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Whey separation</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Layered appearance</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td><strong>Container &amp; Closure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smudged/ Blurred print</td>
<td>1.5</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Difficulty of opening</td>
<td>1.5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Deformed container</td>
<td>1.5</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Remarks, if any:

Signature
Part E
Sensory Evaluation of Paneer

Name: __________________________				Date: ______________

Sensorial characteristics of good quality paneer

**Colour and Appearance:** Excellent quality paneer should have uniform marble white colour with greenish tinge if made from buffalo milk and slightly yellowish white colour if prepared from cow milk.

**Body and Texture:** The body of paneer should neither be too firm nor too soft. The texture of good quality paneer should be compact, smooth, slightly spongy and velvety. While masticating, it should impart a feeling of fibrous texture with modest degree of chewiness. Paneer should retain its shape while frying.

**Flavour:** Paneer must have a characteristics blend of the flavours of heated milk, coagulated curd and acid. It is pleasant, mildly acidic, slyght sweet and nutty.

**Technique for Sensory Evaluation of Paneer**

1. **Tempering:** The optimum temperature of sensory evaluation of paneer is 15°C. It is highly essential that the temperature of all the samples should be same for uniformity in evaluation of body and texture.

2. **Start with the visual observation of the package for neatness and cleanliness, proper protection and absence of soiling material, moisture/whey droplets etc. on the surface.** Collection of whey inside the package is highly undesirable.

3. **Remove the sample from the package and immediately inhale the smell and observe the surface.** The spoilage of paneer during storage starts from surface due to formation of bacterial slime (greenish/yellowish coloration) and production of putrid smell. Also, note the colour of the product, presence of burnt particles in the paneer samples.

4. **Collect a slice/plug from the larger block with the help of a knife.**

5. **While cutting, note the resistance offered and whether the plug is intact or broken into pieces.**

6. **Apply some pressure on the paneer block with thumb and note whether the compressed area is returned back to its original form after removing the pressure.**
7. Take a piece of paneer in the mouth and start masticating, while masticating note the ease of biting by teeth and the taste quality and overall flavour.

8. Expectorate the sample, observe the after taste and notice whether or not any off-flavour is present (this could be better observed by inhaling a whiff of fresh air and then slowly exhaling it, while noting for the presence of any off-flavour in the background).

**Paneer Score Card**

**Section A:** Evaluate the given sample of paneer for its sensory attributes and place appropriate scores against each sample in the following table. Use the scoring guide given in Section B.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Maximum Score</th>
<th>Sample Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Body and texture</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Colour and appearance</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Remarks: 

Signature

**SECTION B**

**Paneer Scoring Guide**

The scores suggested here are to be used as a guide only and are not to be used as specific scores with no range. For example, a slight acid flavour defect may be scored 10.5 or 9.5 as well as the score of 10 as suggested. The numerical score is to be used as an indication of the intensity of the defect.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Defect</th>
<th>Slight</th>
<th>Definite</th>
<th>Pronounced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour (12)</td>
<td>Bitter</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Feed/weed</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Flat</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Musty</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Putrid/cherry</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Rancid</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Attribute</td>
<td>Defect</td>
<td>Slight</td>
<td>Definite</td>
<td>Pronounced</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------</td>
<td>--------</td>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>Smoky/Burnt</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Sour/acid</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Stale</td>
<td>11</td>
<td>9</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Unclean</td>
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<td>7</td>
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<tr>
<td>Yeasty</td>
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<td>Body &amp; texture (10)</td>
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<tr>
<td>Crumbly</td>
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<td>7</td>
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<tr>
<td>Hard</td>
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<tr>
<td>Mealy/coarse</td>
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<td>6</td>
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<td>8.5</td>
<td>7</td>
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<tr>
<td>Pasty</td>
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<tr>
<td>Rubberly/chewy</td>
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<td>7</td>
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</tr>
<tr>
<td>weak</td>
<td>9</td>
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<td>7</td>
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<td>Colour and Appearance (3)</td>
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<td>1.5</td>
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<tr>
<td>Dry/skin</td>
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<td>Mouldy</td>
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<td>Surface time</td>
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<tr>
<td>Visible dirt/foreign matter</td>
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<td>Package (2)</td>
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<tr>
<td>Soiled/greasy</td>
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Grade the sample as under:

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<th>Total score</th>
<th>Grade</th>
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<td>23 or more</td>
<td>Excellent (A)</td>
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<tr>
<td>21-22</td>
<td>Good (B)</td>
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<tr>
<td>15-20</td>
<td>Fair (C)</td>
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<tr>
<td>19 or less</td>
<td>Poor (D)</td>
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Review Questions

1. What are the precautions that need to be taken during sensory evaluation of milk?
2. What are the desirable flavour attributes of milk?
3. What is the score card prescribed for sensory evaluation of milk?
4. What are the possible defects in butter?
5. Why is cow ghee golden yellow in colour?
6. What is the procedure for carrying out sensory evaluation of ghee?
7. What are the desirable body and texture attributes of dahi?
8. What is the technique for Sensory evaluation of paneer?