LABORATORY MANUAL

FAT RICH DAIRY PRODUCTS

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Sathish Kumar M.H.
FOREWORD

Fat rich dairy products are being manufactured in India both at commercial and domestic scale. A large portion of total milk produced in India is converted to products like cream, butter, anhydrous milk fat, ghee and different varieties of fat spreads. These are prepared not only to meet the consumer demand of products but also to preserve valuable and surplus milk fat during flush season. Processing technologies of these products have been modified from time to time to enhance the efficiency and to minimize the cost of production as well.

A complete subject consisting of both theory and practical sessions on 'Fat Rich Dairy Products' have been a part of undergraduate course in Dairy Technology since its inception at NDRI, Karnal and subsequently at other State Agricultural Universities. Efforts are made to develop a practical manual on the subject with the aim to provide students a ready reference for their better understanding of the practical aspects of the subject. The authors have done a praiseworthy job to prepare the manual that would be easy to pursue by the UG students. I hope that this manual will be helpful both for students and teachers of Dairy Technology fraternity.

I pass on my good wishes to the authors for putting their sincere and concerted efforts in bringing out this publication and wish them good luck.
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EXPERIMENT - 1

WORKING PRINCIPLE OF CREAM SEPARATOR

1.1 Objective

To learn working principle of cream separator

1.2 Principle

When milk is left undisturbed in a vessel the fat globules being lighter tend to move upwards and collect at the surface in the form of a layer of cream. In case of centrifugal separators, when milk enters the rapidly revolving bowl of the cream separator it is immediately subjected to a tremendous centrifugal force. While both the fat and skim milk are subjected to centrifugal force, the difference in density affects the heavier portion more intensely and skim milk is forced to the periphery while the fat portion moves towards the centre.

The velocity or rate at which the fat globules moves under centrifugal force is given by following equation, which is known as Stoke’s law

\[ V = \frac{d^2(\rho_s - \rho_f) r \omega^2}{18 \eta} \]

Where –

- \( V \) = Velocity of movement of a single fat globule
- \( d \) = Diameter of the fat globule
- \( \rho_s \) = Density of skim milk
- \( \rho_f \) = Density of fat
- \( r \) = Distance of fat globule from the axis of rotation
- \( \omega \) = Angular velocity = \( \frac{2\pi n}{60} \) radians/seconds
- \( \eta \) = Viscosity of skim milk
1.3 Construction and working of cream separator

Cream separator is a mechanical equipment having a centrifuge bowl with baffles inserted in the form of conical discs. The discs are stacked together, forming a single unit called the disc stack. The discs are provided with radial strips to keep them apart and rest on each other forming a separation channel through which milk flows. The disc stack is equipped with vertically aligned distribution holes. The milk enters through vertically aligned distribution holes at outer edge while the discs (80-200 nos.) rotate around the axis at high speed (10000-18000 rpm). The milk thus is subjected to centrifugal force acting on all particles.

**Parts of centrifuge bowl** – This is the heart of a cream separator where the milk is subjected to centrifugal force before separating into its components viz. fat and skim milk.

1. **Bowl base** – It is made of thick circular plate with a centre pillar having slit openings for the milk to enter the bowl. The outer edge of the plate has a groove where the leak proof gasket is set-in before assembling of bowl parts.

2. **Milk distributor** – This helps the milk to be distributed evenly throughout the bowl for efficient separation. The milk distributor is placed over the centre pillar of the bowl base. The openings are aligned with the slits on the pillar.

3. **Disc stack** – This consists of number of conical disc that may range from 80-200. The discs have vertically aligned distribution holes. Each disc has a radial strips, on their outer edge, to keep them apart while stacking and forming a separation channel. The bottom disc has radial strips on both sides and is placed first over the milk distributor.

4. **Bowl cover** – This helps to keep the disc stack in position and make an housing for the cream and skim milk to travel towards their respective outlets.

5. **Tightening nut/collar** – This is used for tightening the bowl base and bowl cover to safeguard the disc from flying-off during high speed revolving and to avoid accidents during operation.

6. **Machine spindle** – This is the part, over which the complete bowl is placed after assembly. The spindle may have a horizontal pin that is fixed in the similar shape groove made on the lower side of bowl base. This helps to carry the bowl as the
spindle moves. This spindle is connected to the high speed motor through a worm gear to control the separator speed.

7. **Separator cover** – The cover is placed over the bowl and tightened with the separator body. It carries outlet ports for cream and skim milk.

8. **Cream screw** – It is a valve that is provided on the cream outlet. It is used to control the flow of cream and thereby helps to adjust the fat content of cream as per requirement.

### 1.4 Exercise

1. Draw the neat sketch of all the parts of cream separator.

2. What is the principle behind cream separation by centrifugal separation?
Parts of Cream Separator

Cream Separator
EXPERIMENT – 2

PRODUCTION OF TABLE CREAM

2.1 Objective

To learn the process of cream production

2.2 Introduction

Milk fat being most expensive component, the recovery of fat is of great importance in dairy processing because of its economic value. The separation of milk into cream and skim milk is the foremost unit operation 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.

Low fat cream has got thinner consistency due to low fat content. Hence the consistency of the cream may be improved by homogenization. A good quality table cream should have clean, pleasant nutty flavor with smooth and uniform body.

2.3 Materials/Equipments required

1) Milk 2) Thermometer 3) Heating device 4) SS vessel 5) Stirrer 6) Gerber acid 7) Amyl alcohol 8) 0.1N NaOH 9) Phenolphthalein indicator

2.4 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. Switch 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 formula.

2.5 Formulae -

1. Percent fat recovery in cream \[ \frac{\text{Kg fat in cream} \times 100}{\text{Kg fat in milk}} \]

2. \[ C = \frac{M \times (f_m - f_s)}{(f_c - f_s)} \]

Where

C = Yield of cream (kg)

M = Weight of milk (kg)

f_m = Percent fat in milk

f_c = Percent fat in cream

f_s = Percent fat in skim milk

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  CLR____ at ____ °C
Fat ___________ %  Total solids ___________ %
Solids-Not-Fat___________%

III. Processing and cream separation

Time when heating started _______
Temperature of cream separation _________ °C
Time when cream separation started _______
Time when cream separation finished _______
Total time taken for cream separation ______ minutes

V. 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____________ %

2.6 Result and inference
2.7 Exercise

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?

Calculations
EXPERIMENT – 3
ANALYSIS OF CREAM

3.1 Objective
To learn analysis of cream for fat and acidity

3.2 Estimation of fat in cream

3.2.1 Principle
When definite quantity of sulphuric acid of specific strength and amyl alcohol are added to definite volume of milk, the protein dissolve and fat globules are set free which remain in liquid state due to heat produced by the acid. Upon centrifugation, fat being lighter separates on top of the solution as liquid fat column in butyrometer stem

3.2.2 Materials/Equipments required

3.2.3 Procedure
1. Mix the given sample thoroughly, avoid undue frothing or churning.
2. If the cream is very thick warm it to 40°C.
3. Transfer 10 ml of sulphuric acid (Gerber acid) into cream butyrometer (range 10 – 70%) using automatic measure.
4. Weigh accurately 5.0 g of cream directly into the butyrometer, taking care not to wet the neck of the butyrometer.
5. Add 1.0 ml of amyl alcohol using automatic measure.
6. Adjust the volume of the milk by adding ~ 6.0 ml of hot distilled water (70°C) and set to 70% mark on the scale of butyrometer. Clean and dry the neck of butyrometer with cotton if it is wet.
7. Stopper the butyrometer with a lock stopper, using the key, and shake the contents well.
8. Keep the butyrometer in water bath at 65° C for 5 min.

9. Place the butyrometer in Gerber centrifuge, balance the machine and centrifuge the contents for 5 min. at 2000 rpm.

10. Keep the butyrometer in water bath at 65° C for 5 min.

11. Read the fat content (colorless column) directly on the butyrometer stem.

3.2.4 Procedure (Dilution Method)

1. Mix the given sample thoroughly, avoid undue frothing or churning.

2. If the cream is very thick warm it to 40°C.

3. Weigh 10.0 g of well mixed cream sample into 50.0 ml clean & dry beaker.

4. Add 10.0 ml of distilled water and mix the contents well.

5. Transfer the contents to 100 ml volumetric flask, rinse the beaker with small amounts of water and transfer each rinse until all contents are transferred.

6. Make up the volume with distilled water, stopper the flask and mix the contents well.

7. Transfer 10 ml of Gerber acid into milk butyrometer (range 0 – 10%) using automatic measure.

8. Transfer 10 ml of well mix sample of diluted cream into the butyrometer, taking care not to wet the neck of the butyrometer.

9. Add 1.0 ml of amyl alcohol using automatic measure. Clean & dry the neck of butyrometer with cotton if it is wet.

10. Stopper the butyrometer with a lock stopper, using the key, and shake the contents well.

11. Keep the butyrometer in water bath at 65°C for 5 min.

12. Place the butyrometer in Gerber centrifuge, balance the machine and centrifuge the contents for 5 min. at 1100 – 1200 rpm.

13. Keep the butyrometer in water bath at 65°C for 5 min.

14. Read the fat content (colourless column) directly on the butyrometer stem.
15. Multiply the reading with the dilution factor of 10 to get the correct fat content of cream.

3.3 Estimation of Acidity in cream

3.3.1 Principle

Normal acidity of cream is due to its serum constituents like casein, citrates, phosphates and CO₂. This acidity can be measured by titrating milk against a standard alkali solution using an indicator and is expressed in terms of lactic acid.

3.3.2 Requirements

1) Pipette 2) Porcelain dish 3) Glass stirring rod 4) Burette 5) Sodium hydroxide solution (0.1 N) 6) Phenolphthalein solution (0.5%) 7) Burette stand.

3.3.3 Procedure

1. Transfer 10 ml of cream into a white porcelain dish, with the help of pipette.
2. Add 1.0 ml of 0.5% phenolphthalein solution as indicator.
3. Titrate the contents with 0.1N NaOH solution.
4. Observe occurrence of pale pink colour as end point for the titration.
5. Note the titre value.
6. Calculate percent acidity of the sample as lactic acid.

3.3.4 Observations

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Initial reading</th>
<th>Final reading</th>
<th>Volume of alkali used</th>
<th>Acidity (% LA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Formula

\[
\text{Titratable acidity (as \% lactic acid)} = \frac{9 \times V_1 \times N}{V_2}
\]

Where,

\[V_1 = \text{Volume of N/10 NaOH used}\]
\[V_2 = \text{Volume of cream sample}\]
\[N = \text{Normality of NaOH used}\]

3.4 Result and inference

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3.5 Exercise

1. Write the principle behind estimation of acidity in cream.

2. What is the function of Gerber acid and amyl alcohol in estimation of fat in cream?

Calculations
EXPERIMENT - 4

STANDARDIZATION OF CREAM

4.1 Objective

To learn the method of standardization of cream

4.2 Introduction

Standardization refers to the adjustment of fat level in cream to desired percentage so that the final product conforms to requirements of legal standards. It is desirable and sometimes necessary to standardize cream of any richness to a definite percentage of fat. This helps to facilitate exhaustiveness of churning as well as to minimize fat loss during butter manufacturing process. Fat in cream is usually adjusted to prescribed level by addition of calculated amount of skim milk. The usual level of fat in cream is adjusted to 35 – 40% for butter making. Under Indian conditions cow milk cream may be adjusted to about 40% fat and buffalo milk cream is adjusted to about 35% fat.

4.3 Materials / Equipments required


4.4 Procedure

1. Weigh the cream precisely and record the net weight of cream.

2. Warm the cream to 45°C.

3. Mix the contents well and draw representative sample of cream and test for fat content. Also note the temperature of cream.

4. Based on the requirement or end use decide upon the fat content required in the cream.

5. Using Pearson square method, calculate the amount of skim milk required.

6. Check calculation with the help of proof sheet.

7. Weigh calculated amount of skim milk.
8. Slowly add skim milk to the cream at 40°C with constant mixing.

9. Draw another well mixed sample and test for fat content to reassure correct standardization.

10. Pasteurize the cream at 78 - 80°C for 5 - 8 minutes.

11. Cool the contents to 4 – 8°C and store for further usage.

4.4.1 Standardization process - *Pearson square method*

1. Draw a square and place in the centre the desired fat required in the mix.

2. Place the fat percent of materials to be mixed, at the left hand corners of the square.

3. Subtract the value in the centre from the larger number at the left hand corner of the square.

4. Place the remainder at the diagonally opposite right hand corner.

5. Similarly subtract the smaller number and place the remainder diagonally opposite at right hand corner.

6. The numbers on the right hand side represents parts of each of original materials to be blended to make a product of fat percent given in the centre.

7. Add the numbers at the right hand side, which represents parts of finished product.

**Example** – How many parts by weight of 40% cream and 0.10% skim milk must be mixed to make 100 kg of cream testing 35% fat?

**Solution** -

\[
\begin{array}{ccc}
40 & 34.9 \\
35.0 & \\
39.9 \\
\end{array}
\]
Hence, 34.9 parts of 40% fat cream when mixed with 5 parts of 0.10% fat skim milk will give 39.9 parts of 35% fat cream.

Or cream required will be - \[\frac{34.9}{39.9} \times 100 = 87.46 \text{ kg}\]

Skim milk required will be - \[\frac{5}{39.9} \times 100 = 12.53 \text{ kg}\]

Proof –

100 kg of 35% cream contains - \[\frac{100 \times 35}{100} = 35.0 \text{ kg fat}\]

87.46 kg of 40% cream contains - \[\frac{7.46 \times 40}{100} = 34.98 \text{ kg fat}\]

10.53 kg of 0.10% skim milk contains - \[\frac{10.53 \times 0.10}{100} = 0.0105 \text{ kg fat}\]

Total fat = 34.98 + 0.0105 = 34.99 kg (≈ 35.0)

**OBSERVATION CHART FOR STANDARDIZATION OF CREAM**

I. **Particulars of cream**

<table>
<thead>
<tr>
<th>Quantity of cream</th>
<th>Temperature of cream</th>
<th>Percent fat in cream</th>
<th>Percent fat in skim milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ kg</td>
<td>____ °C</td>
<td>____ %</td>
<td>____ %</td>
</tr>
</tbody>
</table>

II. **Standardization process**

Desired percent fat in cream ____ %

Quantity of standardized cream required ____ kg

Quantity of skim milk required ____ kg

Quantity of cream required ____ kg

Percent fat in standardized cream ____ %

III. **Processing of cream**

Time when heating started ____

Time and temperature combination used for cream pasteurization ____ °C ____ minutes

Cooling and storage temperature of cream ____ °C

4.5 **Result and inference**

---
4.6 Exercise

1. Why cream meant for butter making should be standardized?

2. List the advantages of standardization of cream.

Calculations

Teacher's signature
EXPERIMENT – 05

NEUTRALIZATION OF SOUR CREAM FOR BUTTER MAKING

5.1 Objective

To learn neutralization of sour cream to obtain optimum acidity for butter making

5.2 Introduction

Neutralization refers to partial reduction of cream acidity. It is an important part of butter making where acidity should be reduced sufficiently so that the resultant butter has satisfactory flavour and texture. The ideal churning acidity should range from 0.13% - 0.15% L.A. for medium and low acid cream and 0.17% - 0.18% L.A. for high acid cream.

The objectives of neutralization are –
1. To control fat loss during churning
2. To control flavour of butter
3. To control keeping quality of butter
4. To manufacture butter of uniform quality

5.3 Principle

For neutralization of sour cream, lactic acid present in cream is made to react with calculated quantity of alkali. Lactic acid to be neutralized depends on the difference between initial acidity of sour cream and the final acidity desired in cream before churning. This in turn is used to determine the quantity of alkali to be used. The following equation may be helpful in understanding the reaction of lactic acid and neutralizer (lime and soda) and also the neutralizer factor which is different for different type of neutralizer.

\[
\text{NaHCO}_3 + \text{CH}_3\text{CHOHCOOH} \rightarrow \text{CH}_3\text{CHOHCOONa} + \text{H}_2\text{O} + \text{CO}_2
\]

Sodium bicarbonate  Lactic acid  Sodium lactate  Water  Carbon dioxide
84 90

Neutralizer factor (NF) = \(\frac{90}{84} = 1.07 \approx 1.1\)
\[
Na_2CO_3 + 2CH_3CHOHCOOH \rightarrow 2CH_3CHOHCOONa + H_2O + CO_2
\]

Sodium carbonate \hspace{1cm} Lactic acid \hspace{1cm} Sodium lactate \hspace{1cm} Water \hspace{1cm} Carbon dioxide

\[
106 \hspace{1cm} 2 \times 90
\]

NF = \frac{180}{106} = 1.7

Thus, the quantitative relationship between amount of lactic acid present in solution and amount of pure neutralizer required to give exact neutralization is fixed.

Ex: 90 g of lactic acid requires 84 g NaHCO_3 (or) 53 g Na_2CO_3 (or) 40 g of NaOH for neutralization.

\[
\text{Quantity of neutralizer} = \frac{(a - b)(\text{wt. of cream})}{100 \times NF}
\]

\[
\ldots\ldots\ldots\ldots\ldots\text{Eq. (1)}
\]

Where,

\(a\) = initial acidity; \(b\) = desired acidity and \(NF\) = neutralizer factor

**Neutralizer factor (NF) of different neutralizers**

\[\text{(part of lactic acid neutralized per part of neutralizer)}\]

<table>
<thead>
<tr>
<th>Neutralizer type</th>
<th>Neutralizer factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium carbonate</td>
<td>1.70</td>
</tr>
<tr>
<td>Sodium bi-carbonate</td>
<td>1.10</td>
</tr>
<tr>
<td>Calcium hydroxide</td>
<td>2.43</td>
</tr>
<tr>
<td>Magnesium hydroxide</td>
<td>3.10</td>
</tr>
<tr>
<td>Sodium hydroxide</td>
<td>2.25</td>
</tr>
</tbody>
</table>

5.4 Materials/Equipment required

1) Sour cream 2) N/10 NaOH 3) Beakers 4) Neutralizer 5) SS container 6) Ladle 7) Burette

5.5 Procedure

1. Correctly weigh or measure the amount of cream to be neutralized.
2. Draw a representative sample of cream by thorough mixing.
3. Transfer 10 ml or 10 g of cream in 100 ml beaker.
4. Heat the sample of cream to boiling to remove $\text{CO}_2$ dissolved in cream.
5. Cool the contents and determine fat content.
6. Determine acidity of cream by titration method as described in expt no 3.
7. Decide upon the required acidity of cream.
8. Decide upon the type of neutralizer to be used – soda or lime and calculate the NF for that neutralizer.
9. Calculate the quantity of neutralizer required using equation 1.
10. Accurately weigh the calculated amount of neutralizer type and dissolve in 15-20 times its volume of warm portable water.
11. Heat the cream slowly to around $32^\circ - 36^\circ\text{C}$. Keep the cream agitated while adding the neutralizer solution uniformly and quickly. Continue agitation for next 5 - 10 minutes.
12. Check the acidity by drawing representative sample.
13. Finally pasteurize the cream at $78^\circ - 80^\circ\text{C}$ for five minutes, immediately cool to $4^\circ\text{C}$ and store overnight.

5.6 Observations

1. Weight of cream to be neutralized
2. Initial acidity of cream (a)
3. Final acidity of cream (b)
4. Neutralizer used
5. Neutralizer factor for the type of neutralizer used
6. Calculated quantity of neutralizer
7. Amount of water used for dissolving the neutralizer
8. Temperature of cream at the time of neutralization
9. Final acidity of cream after neutralization

5.7 Results and inference
5.8 Exercise

1. Why neutralization of cream is required?
2. What is neutralizer factor and how it is calculated?
3. Write the formula to calculate quantity of neutralizer for obtaining desired acidity in cream for buttermaking.
4. What is the correct method of adding neutralizer?
5. Calculate the quantity of NaOH required to reduce the acidity of 500 Kg cream from 0.45% to 0.17% LA.

Calculations
EXPERIMENT – 06

CREAM PASTEURIZATION

6.1 Objective

To pasteurize the given quantity of cream

6.2 Introduction

Thermal processing is an integral part of food and dairy industry. The main purpose of heat treatment is to render the product safe for human consumption and to enhance its shelf life. The basis behind heat treatment is the destruction of micro-organisms and enzymes that cause spoilage. Pasteurization, as applied to butter making, may be defined as a process of heating cream to a temperature sufficiently high and for a duration of time sufficiently long to ensure destruction of micro-organisms present in the cream followed by prompt and efficient cooling to 4°C or to the ripening temperature.

6.3 Batch process

a) Laboratory scale

6.3.1 Materials/Equipments required

1) Stainless steel containers 2) Measuring cylinder 3) Water bath 4) Ice-bath 5) Thermometer 6) S.S. ladle

6.3.2 Procedure

1. Measure 1.0 kg of cream in a S.S. container (small degchi).
2. Place the container in thermostatically controlled water bath at 75-80°C.
3. With the help of ladle, stir the contents slowly and continuously.
4. Keep noting temperature after every 10-15 minutes until temperature reaches to 68.0°C.
5. Maintain the temperature of 68-70°C for 30 minutes by controlling the heat of water bath.
6. Immediately remove the container and place it in cold water bath followed by ice-bath.
7. Allow the contents to cool to 6-8°C with constant stirring.
8. Alternatively, place the container in lab refrigerator until cooled.
9. Store the cream over night at low temperature until further use.

b) Commercial process

6.3.2 Materials/Equipments required

1) Double jacketed cream vat with stirrer 2) Weighing balance 3) Cans 4) Steam and chilled water supply 5) Cream 6) Thermometer (0-100°C)

6.3.3 Procedure

1. Clean and sterilize the cream vat.
2. Weigh the cream and transfer to the clean and dry vat.
3. Start the agitator motor and open the steam valve.
4. Keep noting temperature after every 10-15 minutes until temperature reaches 68-71°C.
5. Maintain the temperature for 30 minutes by controlling the steam inlet valve.
6. Drain the hot water from the jacket and fill it with chilled water to cool the contents.
7. Allow the contents to cool to 6-8°C with constant stirring.
8. Cool the cream to 22-25°C before adding starter culture, if cream is to be ripened.
9. Store the cream over night at low temperature until further use.

6.4 Continuous process – H.T.S.T. Method

6.4.1 Materials required

1) Cans 2) High temperature short time pasteurization unit

6.4.2 Procedure

1. Clean and sanitize the HTST unit.
2. Start steam for heating water in the hot well.
3. Adjust the water temperature to 90-95°C.
4. Adjust the supply of chilled water to cool the contents to desired temperature.
5. Weigh the standardized cream and transfer to supply tank and finally to balance tank.
6. Start the pump and allow the cream to pass through pasteurization unit.
7. Pasteurize cream to 80-85°C with holding time of 20-25 seconds.
8. Collect pasteurized and cooled cream in pre-sterilized cans.
9. Store the cream over night at low temperature until further use.

### 6.5 Observations

<table>
<thead>
<tr>
<th>Make, type and capacity of units used for pasteurization</th>
<th>Batch method</th>
<th>HTST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time when heating started</td>
<td>Laboratory</td>
<td>Dairy</td>
</tr>
<tr>
<td>Coming up time for heating cream at 68-71°C or 78-82°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holding time at pasteurization temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time and temperature of pasteurization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time when cooling started</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total time taken for cooling the cream to 22°C or 6-8°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total time taken for completion of process</td>
<td></td>
<td></td>
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<tr>
<td>Final temperature of cream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat and acidity of cream before and after pasteurization</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6.6 Results and inference

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________
6.7 Exercise

1. What are the methods for cream pasteurization?
2. Write time and temperature combination for different methods of cream pasteurization.
3. What are the objectives of cream pasteurization?

Calculations
EXPERIMENT – 07
CREAM RIPENING

7.1 Objective

To learn ripening and aging of cream for buttermaking

7.2 Introduction

Butter may or may not be made from cream that has been ripened. Ripening refers to the fermentation process which has been defined as the metabolic process where chemical changes occur in organic substrate like – protein, carbohydrate or fat through action of enzymes liberated by specific living organisms. Lactic acid fermentation is the most important fermentation in dairy industry. The ripening of cream requires starter culture of suitable strain (single or mixed) capable to bring about fermentation. The major objective is to produce butter with a pleasant, pronounced characteristic flavour and aroma uniformly throughout the year.

Starter - is basically a culture of one or more types or strains of lactic acid bacteria that is added to milk or cream to ferment it. It is usually a mixture of both acid producing organisms (Lactococcus lactis, L. cremoris) and flavour producing organisms (S.lactis subsp. diacetylactis, Leuconostoc citrovorum and/or Leuconostoc dextranicum). Starter culture is added at the rate of 0.5 to 2.0% of the weight of cream and incubated at about 21°C till desired acidity is reached. Usually it takes 15-16 h.

7.3 Materials/Equipment required

1) S.S. container 2) Good quality starter culture 3) Incubator (22°C) 5) Cream 6) Thermometer (0-100°C)

7.4 Procedure

1. Weigh the cream and transfer into a clean and dry vessel/vat.
2. Pasteurize the cream at 68°C for 30 minutes or at 80°C for 20 seconds.
3. Cool the contents to 22°C.
4. Break the starter curd with a sterilized stirrer and make a homogenous mixture.
5. Draw a sample and check the acidity of starter culture.
6. Start the agitator and add calculated amount of starter culture (@ 0.5 – 1.0 %).

7. Incubate the contents at 22°C for 12-14 hours or until acidity reaches to 0.65 – 0.70% lactic acid.

8. Cool the contents further to 6-8°C for aging process.


10. Store the ripened cream over night at low temperature before churning.

7.5 Observation

1. Quantity and acidity of cream .................................................................

2. Quantity and acidity of starter culture ..................................................

3. Type and name of micro-organism used as starter culture ......................

4. Temperature of ripening. .................................................................

5. Time of incubation. .................................................................

6. Time taken for cooling cream to 6-8°C ...........................................

7. Acidity and flavour of ripened cream .............................................

8. Time and temperature of aging ....................................................

7.6 Result and inference

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
7.7 Exercise

1. What is ripening of cream?
2. Why cream is ripened for butter making?
3. What types of microorganisms are required for cream ripening?
4. What is the optimum temperature and time for cream ripening?
5. What is the effect of cream ripening on shelf life of butter?

Calculations
EXPERIMENT – 08

PREPARATION OF DESI BUTTER (MAKKHAN)

8.1 Objective

To learn manufacture of desi butter (Makkhan)

8.2 Introduction

Makkhan is an indigenous (desi) butter obtained by hand churning of dahi using wooden beater (mathani). It is traditional unsalted butter characterized by its delectable and rich flavour. It is white in colour with slightly greenish tinge and has typical soft body and a smooth grainy texture with pleasant aroma. This product has been extensively used for dietary and religious practices since vedic times. Makkhan or desi butter is usually made on cottage scale and lacks organized production and marketing.

8.3 Materials/Equipment required

1) SS vessel 2) Thermometer 3) Stirrer 4) Incubator 5) Scoop 6) Balance 7) Milk 8) Starter culture

8.4 Procedure

1. Take known quantity of milk in a clean wide mouth container/ vessel.
2. Bring the temperature of milk to 22-25°C.
3. Add lactic acid culture @ 1.0% of the milk and cover the mouth.
4. Place the container in an incubator maintained at 22°C.
5. Allow the milk to incubate for 12-14 hours.
6. Add half or equal quantity of chilled water into the container.
7. Place the container on a firm surface.
8. Stir the contents using a slow speed stirrer until butter fat accumulates at the top.
9. Scum the butter fat and transfer to another pre-weighed container/ dish.
10. Continue stirring and removing butter fat until no visible fat appears.
11. Collect all the butter fat and wash it with cold water.
12. Note the weight of desi butter obtained.
13. Determine fat and moisture content of desi butter obtained.

8.5 Observations

1. Amount of milk taken ..........................................................................
2. Amount of starter culture used ............................................................
3. Temperature of addition of starter culture ..............................................
4. Total time of incubation ......................................................................
5. Amount of chilled water added ...... Temperature of the chilled water ...... °C
6. Temperature of the contents before churning .....................................
7. Time taken for butter fat separation ....................................................
8. Weight of desi butter obtained ............................................................
9. Temperature of butter ........................................................................
10. Quantity of buttermilk obtained .........................................................

8.6 Results and inference

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Teacher's signature
8.7 Exercise

1. Define desi butter and write standards for it.
2. What are the quality characteristics of desi butter?
3. How desi butter is different from table butter?

Calculations
EXPERIMENT - 09

PREPARATION OF CREAMERY AND TABLE BUTTER

9.1 Objective

To learn preparation of butter by churning cream.

9.2 Introduction

Butter is one of the leading milk products 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 of 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 is 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>

9.3 **Material/Equipment required**

9.4 Procedure –

9.4.1 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 80-82°C for 5-8 minute.

4. Cool the cream to 7-10°C and store over night at same temperature.

5. Transfer the cooled cream into the butter churn taking care to fill the churn to 1/3rd 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°C 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 buttermilk using strainer. Measure the quantity and temperature of buttermilk; also draw a representative sample for fat test.

12. Add chilled water (wash water), equal to the quantity of buttermilk 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 trolley.
17. Draw a representative sample and analyse for fat and moisture content (see experiment - 9)

18. Store the butter at - 6° to -8°C for further usage.

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

9.4.2 Preparation of table butter

1. Weigh the amount of cream received at the platform.
2. Judge the cream for its sensory properties.
3. Draw a representative sample and determine fat content.
4. Standardize the cream to 35-38% fat and pasteurize at 80-82°C for 10 minute.
5. Cool the cream to 5-7°C and store overnight at same temperature.
6. Fill the churn 1/3 rd with hot water and rotate for 4-5 minutes, leaving the vent open.
7. Drain hot water and cool the churn using pasteurized chilled water (preferably chlorinated) for 5-8 minutes and then drain out.
8. Transfer the cooled cream into the butter churn taking care to fill the churn to 1/3 rd of its capacity.
9. Measure calculated amount of butter colour and add evenly over the cream in the churn.
10. Lock the door and allow the churn to rotate at a speed of 40-50 rpm.
11. Stop the churn and press the air vent valve for few times (5 minutes intervals) during early stages of churning.
12. Allow the churn to rotate until the watch glass clears, indicating that the emulsion is broken and fat granules are separated from the serum.
13. Stop the churn and add pasteurized and chlorinated (30-40 ppm) break water (10-15% of cream) at 2°C lower than buttermilk into the churn.
14. Allow the churn to rotate for few minutes to develop the butter grains of suitable size (pea grain).
15. Stop the churn and drain the buttermilk using strainer. Measure the quantity and temperature, also draw a representative sample for fat test.
16. Add pasteurized chilled water equal to the amount of buttermilk removed at 1-2°C lower than the buttermilk temperature.
17. 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.

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

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

20. 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.

21. During working process maintain temperature of contents by constant spraying of chilled water over the churn.

22. 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.

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

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

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

26. Draw a representative sample and analyse for fat, curd and moisture content. (see experiment – 10)

27. Store the butter at -18° to -20°C 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 5° 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

Particulars of cream

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Acidity</td>
<td>%LA</td>
<td></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>Cream acidity after neutralization</td>
<td>%LA</td>
<td></td>
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</table>

(b) Pasteurization

<table>
<thead>
<tr>
<th>Time pasteurization start</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>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation temperature</td>
<td>Incubation time</td>
</tr>
<tr>
<td>Acidity of ripened cream</td>
<td>%LA</td>
</tr>
</tbody>
</table>

(d) Cooling & Aging

<table>
<thead>
<tr>
<th>Cooling temperature</th>
<th>°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling period</td>
<td></td>
</tr>
</tbody>
</table>

(e) Particulars of churning

<p>| Fat in cream | % |
| Cream acidity | %LA |
| Temperature of cream | °C |
| Time when churning started |
| Time when break water added | Amount of break water |
| Temperature of break water | °C |</p>
<table>
<thead>
<tr>
<th>Particulars of cream</th>
<th>Quantity</th>
<th>Type</th>
<th>Fat %</th>
<th>Amount of fat Kg</th>
<th>Acidity %LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing of cream</td>
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<td></td>
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<tr>
<td>(a) Neutralization</td>
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<td></td>
</tr>
<tr>
<td>Type of neutralizer</td>
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<td></td>
</tr>
<tr>
<td>Amount of neutralizer g</td>
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<td></td>
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<tr>
<td>Acidity of cream after</td>
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<tr>
<td>neutralization</td>
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<td></td>
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<tr>
<td>(b) Pasteurization</td>
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<td></td>
<td></td>
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<tr>
<td>Time when pasteurization</td>
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<td></td>
<td></td>
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<tr>
<td>start</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature °C</td>
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<tr>
<td>Holding time</td>
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<tr>
<td>Cooling temperature °C</td>
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<td></td>
<td></td>
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<td>Total time taken for</td>
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</tr>
<tr>
<td>pasteurization</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Ripening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Starter quality
Incubation temperature °C
Acidity of ripened cream %LA
(d) Cooling & Aging
Cooling temperature °C
(e) Particulars of churning
Fat in cream %
Cream acidity %LA
Temperature °C
Time when churning started
Time when break water added
Temperature of break water °C
Amount of butter milk
Fat in butter milk %
Total fat lost in buttermilk %
(f) Washing of butter grains
Temperature of wash water °C
Amount of wash water ltr
(g) Salting and Working
Amount of salt added g
Time when first working started
Amount of water added g
Final moisture test %
(h) Recovery of butter
Quantity obtained Kg
Overrun %
Moisture %
9.5 Result and inference

Teacher's signature

9.6 Exercise

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.
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 = Kg fat in churn.

2. *For calculating over run*

\[ \text{Percent over run} = \frac{(\text{Wt. of butter} - \text{Wt. of fat in cream}) \times 100}{\text{Wt. of fat in cream}}. \]
Butter Churn
EXPERIMENT – 10

ANALYSIS OF BUTTER

10.1 Objective

To learn analyse butter for fat, acidity and salt

10.2 Introduction

The major constituents of butter are fat, moisture, curd and salt. These constituents need to be determined to enable the manufacturer to meet the legal standards of the final product. Fat is measured by dissolving the sample in a suitable solvent and evaporating the solvent. Moisture is directly measured by application of heat and salt is estimated by dissolving the residue, after fat extraction, in hot water and titrating the same against standard silver nitrate solution.

10.3 Sample preparation

1. Using butter trier, draw plugs of butter from various parts of butter (churn or package) to obtain a representative sample.

2. Place the plugs in a wide mouth screw cap glass bottle.

3. Place the sample bottle in water bath at 32-35°C for 10 minutes.

4. During this period constantly stir the butter, with the help of spatula, until butter soften into a uniform mass.

5. Use this sample for estimation of different constituents of butter.

10.4 Determination of moisture content

10.4.1 Materials/Equipments required

1) Aluminium butter cup 2) Tong 3) Hot plate 4) Desiccator 5) Conical flask 6) Balance 7) Burette 8) Butter

10.4.2 Procedure

1. Take weight of empty butter cup.

2. Take 10 g of well mixed sample in butter cup.
3. Heat the contents over hot plate with constant circular motion.

4. Continue heating until foaming has ceased and the curd has attained golden brown colour.

5. Allow the cup to cool in desiccator.

6. Weigh the cup.

7. Calculate moisture percentage from the differences in weights.

**10.4.3 Calculation:** \[ \text{Percent Moisture} = \frac{(B - C) \times 100}{(B - A)} \]

Where, 

- \( A \) = Weight of empty cup
- \( B \) = Weight of empty cup + sample
- \( C \) = Weight of cup after heating

**10.4.4 Observations**

<table>
<thead>
<tr>
<th></th>
<th>Sample A</th>
<th>Sample B</th>
<th>Sample C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of empty cup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight of empty cup + sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight of cup after heating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture percent</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**10.5 Determination of fat (Gerber method)**

**10.5.1 Materials/Equipments required**


**10.5.2 Procedure**

1. Weigh 5.0 g of butter directly into butter butyrometer cup.
2. Place the cup at one end of the butyrometer tightly.
3. Add 4-5 ml of warm distilled water.
4. Transfer 10 ml of sulphuric acid (Gerber acid) into butter butyrometer (range 10 – 90%) using automatic measure.
5. Add 1.0 ml of amyl alcohol using automatic measure. Clean & dry the neck of butyrometer with cotton if it is wet.
6. Stopper the butyrometer with a rubber stopper and shake the contents well.
7. Keep the butyrometer in water bath at 65°C for 5 min.
8. Place the butyrometer in Gerber centrifuge, balance the machine and centrifuge the contents for 5 min at 1100 – 1200 rpm.
9. Keep the butyrometer in water bath at 65°C for 5 min.
10. Read the fat content (colorless column) directly on the butyrometer stem.

10.6 Determination of fat (gravimetric method)

10.6.1 Materials/Equipment required


10.6.2 Procedure

1. Weigh 2-4 g of well-mixed sample in a beaker.
2. Add 3 ml of 20% HCl solution and mix well.
3. Transfer contents into Mojonnier extraction flask.
4. Add 10 ml of alcohol and mix well.
5. Add 25 ml of diethyl ether, stopper the tube with cork and shake vigorously for one minute.
6. Remove the cork and add 25 ml of petroleum ether, stopper and shake well for 30 seconds.
7. Centrifuge the Mojonnier flask for 10 minutes.
8. Decant the clear ethereal layer into a previously weighed aluminium fat dish.
9. Repeat extraction with 15 ml portions each of diethyl ether and petroleum ether, twice to completely extract fat from the sample.
10. Transfer the ethereal layers from each extraction into the fat dish.
11. Place the fat dish on a hot plate (60° - 65°C) and allow the ether layer to evaporate.

12. Place the fat dish in an oven for 1 hour and then allow the fat dish to cool by placing in a desiccators.

13. Weigh the fat dish and note the weight.

14. Repeat heating, cooling and weighing until successive weighing do not differ by more than 1 mg.

15. Calculate amount of fat by difference of weight in fat dish before and after extraction (reading A).

16. Divide reading A by the weight of sample and multiply by 100 to get percent fat in sample.

\[
\text{Percent fat} = \frac{\text{wt. of residue (A)}}{\text{wt. of sample}} \times 100
\]

10.6. 3 Observations

<table>
<thead>
<tr>
<th></th>
<th>Sample A</th>
<th>Sample B</th>
<th>Sample C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight of empty Aluminium dish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight of dish with residual fat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat percent</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.7 Determination of salt content

10.7.1 Materials/Equipment required

1) Conical flask 2) Burette 3) Beaker 4) Water bath 5) Potassium chromate indicator 6) 0.1N silver nitrate 7) Calcium carbonate.

10.7.2 Procedure

1. Weigh 5 g of well mixed sample, from above cup, into 250 ml conical flask.
2. Add 100 ml of boiling distilled water, swirl the contents and allow to stand for 10 minutes.

3. Add 2 ml of potassium chromate indicator and 0.25 g calcium carbonate.

4. Mix the contents and titrate against 0.1N silver nitrate solution until brick red colour persist for half minutes.

5. Carry out blank without sample.

10.7.3 Calculation

\[
\text{Percent salt} = \frac{5.85 \times N \times (V_1 - V_2)}{W}
\]

Where, 
- \( N \) = Normality of silver nitrate solution.
- \( V_1 \) = Volume of silver nitrate used for sample titration
- \( V_2 \) = Volume of silver nitrate used for blank titration
- \( W \) = Weight of sample

10.7.4 Observations

<table>
<thead>
<tr>
<th></th>
<th>Sample A</th>
<th>Sample B</th>
<th>Sample C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume of silver nitrate (with sample)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume of silver nitrate (Blank)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent salt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent curd</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.8 Results and inference

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

10.8 Results and inference

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________
10.9 Exercise

1. Enlist methods to determine fat content of butter.
2. Write the reaction involved in salt determination of butter.
3. Which of the method is more accurate for fat determination and why?

Calculations
EXPERIMENT – 11

PREPARATION OF GHEE FROM CREAM

11.1 Objective

To learn preparation process of ghee from cream

11.2 Introduction

Ghee is the pure clarified butter fat prepared chiefly from cream and / or desi butter (Makkhan) to which no colouring matter is added. Ghee manufacture has great significance and relevance to Indian masses and the dairy industry. Ghee is a very popular product since ancient time and has 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. Ghee is characterized by its pleasant, cooked and rich flavour. The preferred texture is of larger uniform size grains having non-greasy consistency.

Definition: 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.

Gross composition of ghee

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Type of ghee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cow</td>
</tr>
<tr>
<td>Milk fat</td>
<td>99 to 99.5 %</td>
</tr>
<tr>
<td>Moisture</td>
<td>Less than 0.5%</td>
</tr>
<tr>
<td>Vitamin A (IU)</td>
<td>19-34</td>
</tr>
<tr>
<td>Tocopherol (mg/g)</td>
<td>26-48</td>
</tr>
<tr>
<td>Charred casein</td>
<td>Traces</td>
</tr>
<tr>
<td>Free fatty acid (% oleic acid)</td>
<td>2.8</td>
</tr>
</tbody>
</table>
11.3 Materials/Equipment required

1) SS vessels 2) Balance 3) Double jacketed steam kettle 4) Stirrer 5) Muslin cloth or cotton filter, 6) Thermometer 7) Cream.

11.4 Procedure

1. Ensure the double jacketed steam kettle is clean and dry.
2. Take weighed amount of cream into double jacketed steam kettle.
3. Open the steam inlet valve and allow the condensed water to drain from steam trap valve and note down the time.
4. Stir the contents while heating process using a stirrer (*khunti*).
5. Allow the contents to boil and avoid over flowing by controlling the steam inlet valve.
6. Note down the temperature and time of first foaming and second foaming.
7. Notice the crackling sound. As soon as it subsides reduce the steam inflow.
8. Continue heating the contents until second foam subsides and residual content start browning.
9. Control the temperature in the range of 114°C ± 2°C.
10. Allow the contents to cool to 75-80°C.
11. Decant the clarified fat into a clean and dry pre-weighed container.
12. Filter the contents through dry filter cloth.
13. Hang the cloth over the container to collect remaining ghee from ghee residue.
14. After some time, squeeze the cloth to recover entrapped ghee.
15. Weigh the ghee and ghee residue obtained from given amount of cream.
16. Analyse the sensory attributes of ghee as per the score card given in annexure 02.

**PRODUCTION CHART FOR GHEE PREPARATION FROM CREAM**

a) Particulars of Cream

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity _____ Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>Amount of fat _____ Kg</td>
</tr>
</tbody>
</table>

49
Acidity _____ %LA

b) Processing of cream

Type of kettle

Temperature & Time (first foaming observed) _____ °C

Temperature & Time (second foaming observed) _____ °C

Temperature & Time (crackling sound observed) _____ °C

Time when heating started

Temperature & Time (first foaming subsided) _____ °C

Temperature & Time (second foaming subsided) _____ °C

Final heating temperature _____ °C

Time heating stopped

Colour of ghee residue

Holding time if any

Cooling temperature

c) Filtration

Temperature of ghee _____ °C

Type of strainer used

Quantity of ghee residue _____ Kg

Fat in residue _____ %

d) Particulars of ghee

Quantity _____ Kg

Colour

Fat _____ %

Moisture _____ %

FFA value _____ % OA

Total fat recovery _____ %

11.5 Results and inference
11.6 Exercise

1. What is the cause for crackling sound during the ghee preparation?

2. What are the components responsible for ghee flavor?

3. How do you minimize the fat loss during ghee production from cream?

Calculations
EXPERIMENT – 12

PREPARATION OF GHEE FROM CREAMERY BUTTER

12.1 Objective
To learn preparation process of ghee from creamery butter

12.2 Introduction
Butter is water in oil emulsion and has around 16% moisture. Therefore there is need to remove this moisture by heat treatment to prepare ghee. The SNF content of butter is less than the cream; therefore, the fat absorption by SNF is less thus minimal loss of fat occurs in ghee residue.

12.3 Materials/Equipment required
1) SS vessels 2) Balance 3) Double jacketed steam kettle 4) Stirrer 5) Muslin cloth or cotton filter 6) Thermometer and 7) Butter.

12.4 Procedure
1. Ensure the double jacketed steam kettle is clean and dry.
2. Take weighed amount of butter into double jacketed steam kettle.
3. Open the steam inlet valve and allow the condensed water to drain from steam trap valve and note down the time.
4. Stir the contents while heating process using a stirrer (khunti).
5. Allow the contents to boil and avoid over flowing by controlling the steam inlet valve.
6. Note down the temperature and time of first foaming and second foaming.
7. Notice the crackling sound. As soon as it subsides reduce the steam inflow.
8. Continue heating the contents until second foam subsides and residual content start browning.
9. Control the temperature in the range of 114°C ± 2°C.
10. Allow the contents to cool to 75-80°C.
11. Decant the clarified fat into a clean and dry pre-weighed container.

12. Filter the contents through dry filter cloth.

13. Hang the cloth over the container to collect remaining ghee from ghee residue.

14. After some time, squeeze the cloth to recover entrapped ghee.

15. Weigh the ghee and ghee residue obtained from given amount of cream.

16. Do the sensory evaluation of ghee as per the score card given in annexure 02.

PRODUCTION CHART FOR GHEE PREPARATION FROM BUTTER

a) Particulars of butter

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kg</td>
<td>°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fat</th>
<th>Amount of fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>Kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acidity</th>
<th>%LA</th>
</tr>
</thead>
</table>

b) Processing of butter

| Type of kettle | Time when heating started |

<table>
<thead>
<tr>
<th>Temperature and Time</th>
<th>Temperature and Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>°C</td>
</tr>
</tbody>
</table>

(first foaming observed)

<table>
<thead>
<tr>
<th>Temperature and Time</th>
<th>Temperature and Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>°C</td>
</tr>
</tbody>
</table>

(second foaming observed)

<table>
<thead>
<tr>
<th>Temperature and Time</th>
<th>Final heating temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>°C</td>
</tr>
</tbody>
</table>

(crackling sound observed)

| Time heating stopped |

| Colour of ghee residue |

<table>
<thead>
<tr>
<th>Cooling temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
</tr>
</tbody>
</table>
c) Filtration

Temperature of ghee ___ °C
Type of strainer used

Quantity of ghee residue ___ Kg
Fat in residue ___ %

d) Particulars of ghee

Quantity ___ Kg
Colour

Fat ___ %
Moisture ___ %

FFA Value ___ %
oleic acid
Total fat recovery ___ %

12.5 Results and inference

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
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__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Teacher's signature

12.6 Exercise

1. What are the sensorial differences between the ghee prepared from cream and butter?

2. Write the difference in phospholipids content of ghee prepared from cream and butter and what is the reason for this difference?

3. How do you minimize the fat loss during ghee production from butter?
PREPARATION OF GHEE BY PRE-STRATIFICATION METHOD

13.1 Objective

To learn the process of ghee preparation by pre-stratification method

13.2 Principle

In this method ghee is produced using specially designed equipment wherein butter being heated and held undisturbed at 85°C for 30 minutes. It separates into three layers, top layer consists of denatured protein particles (curd particles) and impurities that float on surface, middle layer consists of clear fat and bottom layer consists of buttermilk serum. The buttermilk serum is drawn from the bottom and the rest is boiled to free it completely from moisture and to precipitate the curd. This method is economical from the point of fuel consumption to the extent of 35 to 50 percent. It saves time and consequently labour cost.

13.3 Materials / Equipment required

1) Pre-stratification vat 2) SS vessels 3) Balance 4) Double jacketed steam kettle 5) Stirrer 6) Muslin cloth or cotton filter 7) Thermometer 8) Butter melter 9) Unsalted butter.

13.4 Procedure

1. Take weighed amount of cooking butter into butter melter.

2. Turn on steam valve of butter melter, start agitator motor and allow the butter melt completely.

3. As soon as molten butter reaches 80°C, then pump the molten butter into pre-stratification tank.

4. Open the steam valve to heat the contents slowly and maintain at 85°C for 30 minutes without stirring.

5. Open the faucet and drain /collect bottom layer of buttermilk.

6. Close the faucet when butter fat start coming out.
7. Transfer the remaining contents to ghee boiler.
8. Allow the contents to boil. Control the steam inlet to avoid over flowing.
9. Continue heating the contents until second foam subsides and residual content start browning.
10. Control the temperature in the range of 114°C± 2°C.
11. Notice the crackling sound. As soon as it subsides close the steam inlet valve.
12. Allow the contents to cool to 75-80°C.
13. Decant the clarified fat into a clean and dry pre-weighed container.
14. Filter the contents through dry filter cloth.
15. Hang the cloth over the container to collect remaining ghee from ghee residue.
16. Weigh the ghee and ghee residue obtained from given amount of cream.
17. Do the sensory evaluation of ghee as per the score card given in annexure 02.

**PRODUCTION CHART FOR GHEE PREPARATION BY PRE-STRATIFICATION METHOD**

**Particulars of butter**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____Kg</td>
<td>_____°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fat</th>
<th>Amount of fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____%</td>
<td>_____Kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acidity</th>
<th>%LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____</td>
<td>%LA</td>
</tr>
</tbody>
</table>

**Processing of butter**

<table>
<thead>
<tr>
<th>Time when heating started</th>
<th>Time when temperature reaches 85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature and Time</th>
<th>Temperature and Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____°C</td>
<td>_____°C</td>
</tr>
<tr>
<td>(first foaming observed)</td>
<td>(first foaming subsided)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature and Time</th>
<th>Temperature and Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____°C</td>
<td>_____°C</td>
</tr>
</tbody>
</table>
(second foaming observed)  (second foaming subsided)

<table>
<thead>
<tr>
<th>Temperature &amp; Time</th>
<th>Final heating</th>
<th>Crackling sound observed</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ °C</td>
<td>____ °C</td>
<td>(crackling sound observed)</td>
<td>temperature</td>
</tr>
</tbody>
</table>

Time heating stopped
Holding time if any

Colour of ghee residue
Cooling temperature

Filtration

<table>
<thead>
<tr>
<th>Temperature of ghee</th>
<th>Type of strainer used</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ °C</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity of ghee residue</th>
<th>Fat in residue</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ Kg</td>
<td>____ %</td>
</tr>
</tbody>
</table>

Fat in residue ____ %

Particulars of ghee

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ Kg</td>
<td></td>
</tr>
</tbody>
</table>

Colour

<table>
<thead>
<tr>
<th>Fat</th>
<th>Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ %</td>
<td>____ %</td>
</tr>
</tbody>
</table>

FFA Value ____ % OA

Total fat recovery ____ %

13.5 Results and inference

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Teacher's signature
13.6 Exercise

1. Write sensorial characteristics of ghee prepared by pre-stratification process.

2. Compare the fat recovery of creamery butter method and pre-stratification method.

3. Draw the neat labeled diagram of pre-stratification tank.

Calculations
EXPERIMENT – 14
CHEMICAL ANALYSIS OF GHEE

14.1 Objective

a. To learn the method of determining moisture content of ghee
b. To determine butyro-refractometer (BR) number of ghee
c. To learn the method of determining free fatty acid (FFA) and acid value of ghee

14.2 Principle

Milk fat has unique physico-chemical properties which differentiate it from other vegetable fats and oils. These properties may be used to check the purity of ghee and to avoid adulteration of ghee with cheaper fats and oils. Also, ghee is examined for routine physico-chemical analysis to maintain consistency in quality throughout the year. The common tests include moisture, butyro-refractometer (BR) number, free fatty acid value and acid number.

Moisture content of ghee can be determined by hot air oven method, by heating the ghee sample at 103°C for 3 h. BR number is defined as ratio of velocity of light in vacuum to the velocity of light in the oil or fat medium. More precisely it is the ratio between the sine of angle of incidence to the sine of angle of refraction when a ray of light of known wavelength passes from air into oil. It varies with the temperature and wavelength therefore these two parameters to be kept constant. Measures of fat acidity normally reflect the amount of fatty acids hydrolyzed from triacylglycerols. FFA is the percentage by weight of a specified fatty acid (e.g., percent oleic acid). Acid value is defined as the mg of KOH required to neutralize the free acids present in 1 g of fat or oil. In addition to FFAs, acid phosphates and amino acids also can contribute to acidity.

14.3 Materials/Equipments required

14.4 Procedure

A. Determination of moisture content in ghee
1. Take a clean dry aluminum dish and weigh the same along with top lid.
2. Transfer slowly 3-4 g of ghee and record the weight.
3. Keep the dish in an oven at 103°C for 3h.
4. Remove the dish and close the lid and cool it in a desiccator.
5. Weigh the dish and record its weight.
6. Heat in the oven for another 1 h and check the difference in weight. Repeat the heating and cooling process till the difference in weight does not exceed 1 mg.
7. Calculate the moisture using the below mentioned formula.

\[
Moisture\% = \left(\frac{W_2 - W_1}{W}\right) \times 100
\]

Where, \(W\) = Weight of the ghee sample taken
\(W_2\) = Weight of the sample along with aluminum dish
\(W_1\) = Weight of the sample along with aluminum dish after drying

B. Determination of butyro-refractometer value of ghee
1. Turn on the water bath and set the temperature to 40°C (thermostat should have the accuracy of ±0.1°C).
2. Turn ON the agitator, and open the control knob to circulate water through prism.
3. Ensure that samples are visually clear and free of sediment.
4. After temperature of water bath reaches the set temperature, place one or two drops of sample on the lower prism. Close prisms and adjust mirror until you see the sharp line.
5. Record the value.

C. Determination of free fatty acids (FFA) and acid value of ghee
1. Weigh 2 - 3 g of completely molten ghee in a conical flask.
2. Add 50 ml of freshly neutralized alcohol (95%).
3. Add 2 – 3 drops of phenolphthalein indicator.
4. Titrate against 0.1N NaOH till the appearance pink colour and colour should persist for 30 seconds.
5. Note down the volume of alkali consumed and calculate the free fatty acid and acid value as per the formula given below.

\[
Free\ Fatty\ Acid\ (\%\ Oleic\ acid) = \frac{28.2 \times V \times N}{W}
\]

Where, \(V\) = Volume of alkali consumed
\(N\) = Normality of alkali used
\(W\) = Weight of the sample taken

\[
Acid\ value = Percent\ FFA \times 1.99
\]

14.5 Results and inference

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Teacher’s signature
14.6 Exercise

1. What are the technical consequences if the moisture content of ghee is more than the 0.5%?

2. Provide the details of components which contribute to acid value of ghee.

3. Write the FSSR-2011 standards and AGMARK standards for BR number and FFA value of ghee.

Calculations
EXPERIMENT 15

PREPARATION OF TABLE SPREAD

15.1 Objective
To learn the process of table spread manufacturing process

15.2 Introduction

It is a water-in-oil type emulsion, normally having lower level of fat. These soft spreadable products rich in poly-unsaturated fatty acids (PUFA) are perceived to have better nutritional profile. Evolution of fat spreads has continued along the lines of achieving lower and lower fat levels without losing the sensory appeal of the high-fat products viz., conventional table butter, margarine, etc.

Definition: According to FSSR-2011, Fat spread is a product in the form of water in oil emulsion. It may contain, not more than 80% fat and not less than 40% fat by weight, moisture should not be more than 56% and not less than 16% by weight. It may contain edible salt not exceeding 2% by weight in aqueous phase, annatto and/or carotene as colouring agents, starch not less than 100 ppm and not more than 150 ppm, diacetyl may be used as flavouring agent not exceeding 4.0 ppm, permitted class II preservatives namely sorbic acid, and its sodium, potassium and calcium salts (calculated as sorbic acid), benzoic acid and its sodium and potassium salts (calculated as benzoic acid) singly or in combination not exceeding 1000 ppm by weight. It may contain sequestering agent, permitted emulsifier and stabilizer, permitted antioxidants (BHA or TBHQ) not exceeding 200 ppm of the fat content of the spread. It shall be free from animal body fat, mineral oil and wax. Vegetable fat spread shall contain raw or refined Sesame oil (Til oil) in sufficient quantity, (so that when separated fat is mixed with refined groundnut oil in the proportion of 20:80 the red colour produced by Baudouin test shall not be lighter than 2.5 red units in 1 cm cell on a Lovibond scale). The vegetable fat spread shall contain not less than 25 IU synthetic vitamin A per gram at the time of packing. Acid value of extracted fat should not be more than 0.5.

Fat Spreads are classified as ‘Dairy Spreads’ wherein only milk fat is used as a source of fat and ‘Non-Dairy Spreads’ wherein vegetable fat with or without milk fat is used as a source of fat.
15.3 Materials/Equipment required

1) Steam kettle with agitator 2) Homogenizer 3) Stirrer 4) Cream 5) Stabilizer (CMC) 6) Whey protein concentrate (WPC) 7) Skim milk powder (SMP) 8) Emulsifier (GMS) 9) Salt 10) BHA 11) Annatto colour 12) Flavour

15.4 Procedure

1. Prepare aqueous and fat phase separately.

2. Standardize the composition to 45-48% fat and 14-16% SNF.

3. Ingredients like SMP, WPC, stabilizer (0.3 – 0.5%), preservative, salt (1%) and emulsifier (0.3 – 0.5%) can be added to water phase at 40 - 45°C with continuous stirring.

4. Fat soluble vitamins and colour can be added to fat phase at 45°C and stir continuously.

5. Mix both the phases and homogenize the mixture at 200 bar and 50 bar pressure in first and second stage respectively at 65°C.

6. Pasteurize the mix at 80°C/20 minutes allow to cool to 50°C.

7. Hot fill the resultant spread in pre-sterilized polystyrene tubs.

8. Place the tubs at 8-10°C for 10-12 hours for setting.

9. Store product at 5°C until use.

PRODUCTION CHART FOR PREPARATION OF SPREAD

<table>
<thead>
<tr>
<th>Particulars of Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredient name</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### Processing of spread

<table>
<thead>
<tr>
<th>Temperature (Homogenization)</th>
<th>__°C</th>
<th>Homogenization Pressure</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (Pasteurization)</td>
<td>__°C</td>
<td>Holding time</td>
<td></td>
</tr>
<tr>
<td>Quantity of spread</td>
<td>____Kg</td>
<td>Filling temperature</td>
<td>____°C</td>
</tr>
<tr>
<td>Setting temperature</td>
<td>__°C</td>
<td>Setting time</td>
<td></td>
</tr>
</tbody>
</table>

15.5 Result and inference

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14.6 Exercise

1. What are the various classification of spreads according to FSSAI?

2. What is function of votators in spread preparation?

3. Write physico-chemical changes of fat during setting.

4. Write about polymorphism of milk fat during storage of milk fat.

5. What saturated fat index (SFI) of fat? What are ideal values of SFI for milk fat?

6. Define viscosity? How do you measure the viscosity of table spread?
### Score card for Butter

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Maximum score</th>
<th>Sample score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour and appearance</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Flavour</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Body and texture</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td>05</td>
<td></td>
</tr>
</tbody>
</table>

Indicate the degree of defects. Encircle the one applicable and deduct score correspondingly from the appropriate attribute.

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>DEFECT</th>
<th>DEGREE OF DEFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Suspicion</td>
</tr>
<tr>
<td>Colour and appearance</td>
<td>Mottled and wavy</td>
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<tr>
<td></td>
<td>Mouldy</td>
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<td>Dull</td>
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<tr>
<td></td>
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<tr>
<td>Flavour</td>
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<tr>
<td></td>
<td>Tallowy</td>
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<tr>
<td></td>
<td>Neutralizer</td>
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<tr>
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<td>Others</td>
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<tr>
<td>Body and texture</td>
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<tr>
<td></td>
<td>Greasy</td>
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<td>Oily</td>
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</tr>
<tr>
<td></td>
<td>Crumbly</td>
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</tbody>
</table>
Score card and sensory evaluation procedure of ghee

1. Temper the ghee sample at 25 – 30°C.
2. Open the container lid and take a whiff of air and assess the odour.
3. Transfer the sample into glass container, check the colour and look for any suspended particles.
4. Take a small sample and rub it at the back of your hand for few seconds, sniff.
5. Take a sip (10-15 ml) of sample in the mouth and ascertain the flavour.
6. Spit the sample in the spittoon and note the persistence of any after taste.
7. Detect marks for any defect using the score guide and enter your scores in the given scorecard.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Maximum score</th>
<th>Sample score</th>
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<tbody>
<tr>
<td>Colour and appearance</td>
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<tr>
<td>Flavour</td>
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<tr>
<td>Texture</td>
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<tr>
<td>Freedom from suspension</td>
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</table>

Indicate the degree of defects. Encircle the one applicable and deduct score correspondingly from the appropriate attribute.

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>DEFECT</th>
<th>DEGREE OF DEFECTS</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Suspicion</td>
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<tr>
<td>Texture (30)</td>
<td>Hard</td>
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<tr>
<td>Suspended impurities (10)</td>
<td>Ghee residue</td>
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