FICSI
Food Industry Capacity and Skill Initiative

Participant Handbook

Sector
Food Processing

Sub-Sector
Dairy Products

Occupation
Processing

Reference ID: **FIC/Q2003, Version 3.0**
NSQF level 3

Butter and Ghee Processing Operator

Published by

Food Industry Capacity & Skill Initiative (FICSI)

Shriram Bharatiya Kala Kendra, 1, Copernicus Marg, Mandi House, New Delhi-110001

Email: admin@ficsi.in

Website: www.ficsi.in

Phone: +91-97112 60230, +91-97112 60240

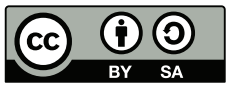
First Edition, November 2022

This book is sponsored by Food Industry Capacity & Skill Initiative (FICSI)

Printed in India by FICSI

Under Creative Commons License:

Attribution-ShareAlike: CC BY-SA



This license lets others remix, tweak, and build upon your work even for commercial purposes, as long as they credit you and license their new creations under the identical terms. This license is often compared to "copyleft" free and open-source software licenses. All new works based on yours will carry the same license, so any derivatives will also allow commercial use. This is the license used by Wikipedia and is recommended for materials that would benefit from incorporating content from Wikipedia and similarly licensed projects.

Disclaimer

The information contained herein has been obtained from various reliable sources. Food Industry Capacity & Skill Initiative (FICSI) disclaims all warranties to the accuracy, completeness or adequacy of such information. Food Industry Capacity & Skill Initiative shall have no liability for errors, omissions, or inadequacies, in the information contained herein, or for interpretations thereof. Every effort has been made to trace the owners of the copyright material included in the book. The publishers would be grateful for any omissions brought to their notice for acknowledgements in future editions of the book. No entity in Food Industry Capacity & Skill Initiative shall be responsible for any loss whatsoever, sustained by any person who relies on this material. All pictures shown are for illustration purpose only. The coded boxes in the book called Quick Response Code (QR code) will help to access the e-resources linked to the content. These QR codes are generated from links and YouTube video resources available on Internet for knowledge enhancement on the topic and are not created by FICSI. Embedding of the link or QR code in the content should not be assumed endorsement of any kind. Food Industry Capacity & Skill Initiative is not responsible for the views expressed or content or reliability of linked videos. FICSI cannot guarantee that these links/ QR codes will work all the time as we do not have control over availability of the linked pages.

> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

for

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **'Butter and Ghee Processing Operator'** QP No. **'FIC/Q2003, NSQF Level 3'**

Date of Issuance: July 29th, 2021
Valid up to: July 28th, 2024

** Valid up to the next review date of the Qualification Pack*

Authorised Signatory
(Food Industry Capacity & Skill Initiative)

Acknowledgements

The preparation of this participant Handbook would not have been possible without the support of the Food Processing Industries. The Industry feedback has been extremely encouraging from inception to conclusion & it is with their inputs that we have tried to bridge the skill gaps existing today in the Industry.

This participant handbook is dedicated to all the aspiring youth who desire to achieve special skills which would be a lifelong asset for their future endeavors and help them make a bright career in the Food Processing Sector.

FICSI is thankful to all organisations and individuals who have helped us in preparation of this participant handbook.

We also wish to extend our gratitude to all those who reviewed the content and provided valuable inputs for improving the quality, coherence, and content presentation of chapters.

About this book

This book is designed for providing skill training and/or upgrading the knowledge and basic skills to take up the job of 'Butter and Ghee Processing Operator' in 'Food Processing' sector. All the activities carried out by a specialist are covered in this course. Upon successful completion of this course, the candidate will be eligible to work as a Butter and Ghee Processing Operator.

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational Standards (NOS) is covered across Unit/s.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

- FIC/N2009: Prepare and maintain work area and process machineries for butter and ghee produc-tion
- FIC/N2010: Prepare for production of butter and ghee
- FIC/N2011: Produce butter and ghee
- FIC/N2012: Complete documentation and record keeping related to butter and ghee production
- FIC/N9001: Food safety, hygiene and sanitation for processing food products
- DGT/VSQ/N0101: Employability Skills

Symbols Used


Key Learning Outcomes


Unit Objectives


Exercise


Notes


Practical

Table of Contents

NCVET
कौशल गुणवत्ता प्रगति

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
RE IMAGINE FUTURE

FICSI
Food Industry Capacity and Skill Initiative

1. Introduction

FIC/N2009

Key Learning Outcomes

At the end of this unit, the trainee will be able to:

1. Explain the purpose of training
2. Discuss the National Occupational Standards and Qualification Pack
3. Define food processing
4. List the various sectors of the food processing industry
5. Describe the various stages of food processing for converting raw materials to food products
6. State the need for processing milk
7. List the various units within a dairy processing plant
8. State the roles and responsibilities of a butter and ghee processing operator

UNIT 1.1: Introduction to the Training Programme

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Explain the purpose of training
2. Discuss the National Occupational Standards and Qualification Pack.

1.1.1 Purpose and Benefits of the Training Programme

This training programme is developed to impart specific skills to individuals who wish to be a Butter and Ghee Processing Operator. The training programme is based upon the National Occupational Standards for the food processing sector. The National Occupational Standards have been described in the following subsection of this chapter.

The training programme will enable an individual to:

- prepare and maintain work area and process machineries for butter and ghee production;
- prepare for production of butter and ghee;
- produce butter and ghee;
- complete documentation and record keeping related to butter and ghee production;
- ensure food safety, hygiene and sanitation for processing food products.

After successful completion of training and passing the assessment, you will be issued a certificate.

Fig. 1.1.1. Skill cards

1.1.2 Introduction to QP and NOS

This training programme is intended for imparting basic skill and knowledge relevant to the job role, required to perform at a food processing industry. This programme is based on qualification pack called Butter and Ghee Processing Operator. The Qualification Pack Code for Butter and Ghee Processing Operator is FIC/Q2003. This is also called a QP.

A QP consists of a set of National Occupational Standards (NOS). NOS specify the standard competency a worker must achieve when carrying out a function at the workplace.

Under Butter and Ghee Processing Operator QP, there are five NOSs which detail the functions to be performed at work site as Butter and Ghee Processing Operator.

NOS Code	Major Function/Task
FIC/N2009	Prepare and maintain work area and process machineries for butter and ghee production
FIC/N2010	Prepare for production of butter and ghee
FIC/N2011	Produce butter and ghee
FIC/N2012	Complete documentation and record keeping related to butter and ghee production
FIC/N9001	Food safety, hygiene and sanitation for processing food products
DGT/VSQ/N0101	Employability Skills

UNIT 1.2: Introduction to the Food Processing Industry

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Define food processing
2. List the various sectors of the food processing industry
3. Describe the various stages of food processing for converting raw materials to food products.

1.2.1 Food Processing

Agriculture is the backbone of the Indian economy. The produce from various agriculture-based occupations is primarily used for consumption within the country. It is exported to different parts of the world as well. Agricultural produce is also used as raw material in the food processing industry.

Food processing is the method used to convert raw materials into food products. They could be processed foods, ready-to-eat foods, food additives or foods used to prepare other food products. Besides food processing, the food industry also relies on food preservation as an important method to store food products for longer periods of time.

The food processing industry in India is divided into several sub-sectors. They are:

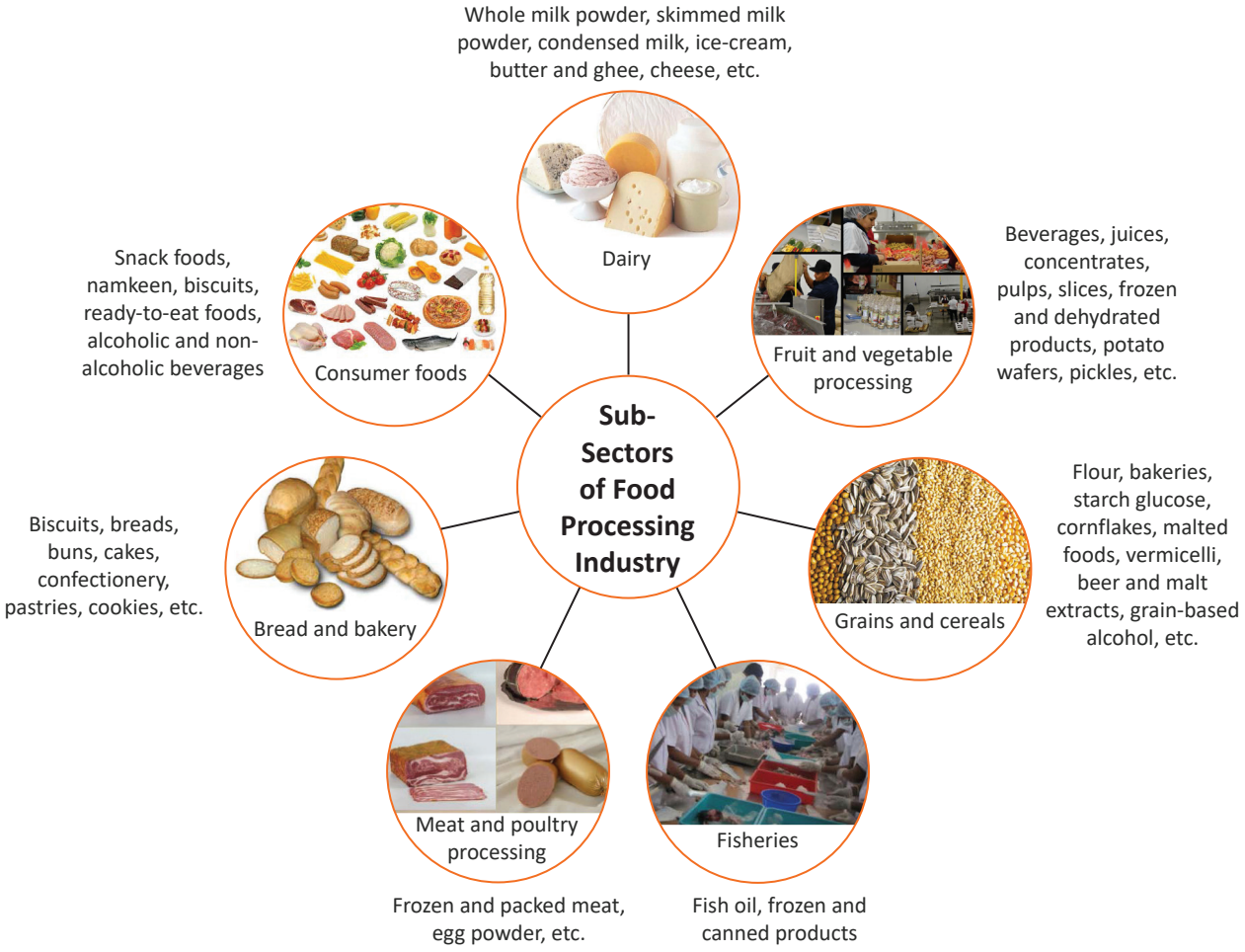


Fig. 1.2.1. Sub-sectors of food processing industry

The Indian food industry is a star sector in India with a bright prospect for growth and development. Indian food and grocery market is the sixth-largest in the world. Food industry, particularly the food processing sector in India, has shown immense potential due to its quick-paced growth. Food processing ranks fifth in the country in terms of its production, growth, export, and consumption. One of the recent trend that is seen in this sector is ordering food online. Even though this segment is still in its early stages of development, it is growing at an increasingly fast pace.

Food industry is implementing stringent food safety and quality measures in order to attract more investors and ensure the safety of its existing consumers. All these factors will have a positive impact on the way the sector functions and also on the job market in the country.

Women have always been associated with preparing food for the family or the household, but in modern times women are breaking this stereotype and turning entrepreneurs in this sector. Women are also becoming professional chefs and bakers, and contributing to the economy and towards the sector.

1.2.2 Journey of Food from Harvest to Consumer

The following chart shows the journey food material goes through to become a final, consumable product to various customers.

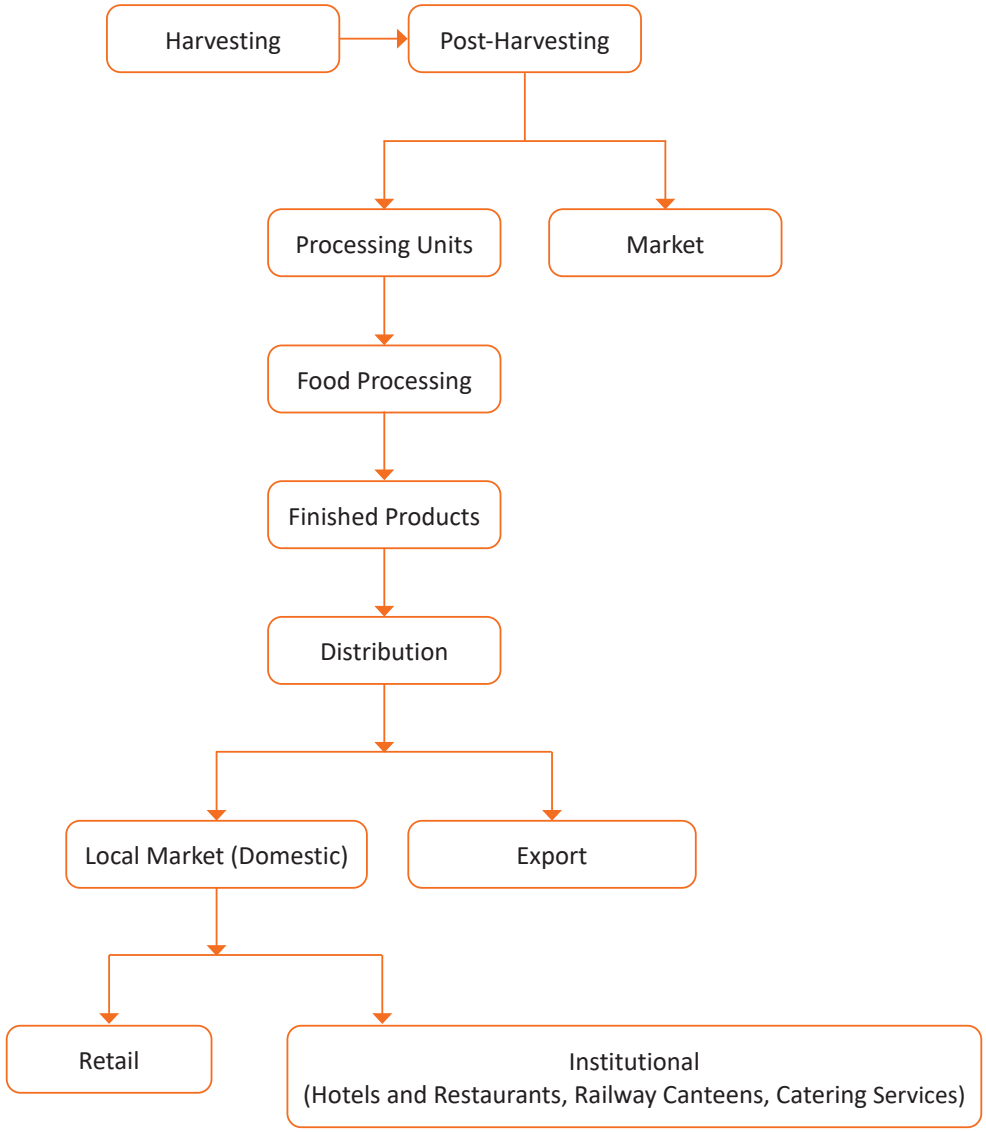


Fig. 1.2.2. Journey of harvested food

UNIT 1.3: Introduction to the Dairy Industry in India

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the need for processing milk
2. List the various units within a dairy processing plant.

1.3.1 Dairy Industry in India

Need for Processing Milk

Milk is considered wholesome food mainly because of its high nutritive value. It has to be processed because:

- It is highly perishable by nature
- It can be used for preparing other dairy products like butter, cheese, paneer, etc
- There is a huge demand for milk and milk products in the domestic as well as international market

Dairy Industry in India

Dairy farming in India is moving from traditional family-run businesses to an organised dairy industry. With technological advances in the recent years, India has seen tremendous growth in dairy farming. Modern dairy farms manage a large herd of cattle and supply milk for processing to large dairy industries.

1.3.2 Units of a Dairy Processing Plant

A dairy processing plant consists of several units as per the size and operational requirement. Some of these are:

Milk Reception Section	HACCP/ISO
Process Section	Cheese Section
Butter Oil Section	Pizza Section
Powder Section	Pouch Section
Ice Cream Section	RTF
APS Section	Frozen Foods Dispatch
Utilities	FPS - Dry Dispatch
Stores & Purchase	Pouch Dispatch
ETP Section	Administration and Accounts
Quality Assurance Section	Milk Marketing Section

Table no. 1.3.1- Different units in a dairy plant

Fig. 1.3.1. Outer view of a large-size dairy processing plant

Fig. 1.3.2. Outer view of a large-size dairy processing plant

UNIT 1.4: Attributes of a Butter and Ghee Processing Operator

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the roles and responsibilities of a butter and ghee processing operator.

1.4.1 Roles and Responsibilities

The following table provides detailed information about the roles and responsibilities of a butter and ghee processing operator:

Roles	Responsibilities
Handle raw material from the time of receipt till it reaches the process line	• Check the raw material for quality • Ensure minimum loss of raw material
Record-keeping and documentation	• Document and maintain records of raw materials, production schedule, and process • Document and maintain records of finished products
Hygiene and sanitation maintenance	• Adopt safety and sanitation-related measures • Follow food safety norms and practices
Operate dairy equipment and machineries	• Optimise the use of machinery • Ensure smooth operation of machinery to complete production line
Inspect machines and troubleshoot issues	• Attend to minor repairs of tools and machinery when required • Ensure that safety rules and regulations are observed • Prevent accidents
Plan and execute the production process	• Examine products at different stages of production • Adhere to Good Manufacturing Practices (GMP) • Inspect intermediate as well as finished products • Achieve good quality products of the correct quantity • Ensure the products meet the quality standards set by the organisation
Follow storage and packaging norms	• Ensure safe and proper storage of raw material, packing material, and finished goods

Table 1.4.1 Roles and Responsibilities

Exercise

1. Fill in the blanks with the correct option

a. Food _____ is the method used to convert raw materials into food products.

i. proofing
ii. dispersing
iii. processing
iv. picking

b. Journey of food from harvest ultimately reaches the _____.

i. consumers
ii. bankers
iii. builders
iv. packers

c. Butter and ghee processing operator is responsible for handling raw material from the time of _____ to process line.

i. post production
ii. harvest
iii. receipt
iv. sorting

d. Milk is perishable in nature and therefore has to be _____.

i. consumed
ii. processed
iii. refrigerated
iv. sealed

e. _____ is the backbone of the Indian economy.

i. Agriculture
ii. Fishing
iii. Mining
iv. Meat and Poultry

f. _____ sub-sector produces juices, jellies, pulps, pickles, jams etc.

i. Dairy
ii. Grains and cereals
iii. Fisheries
iv. Fruit and Vegetable processing

g. Workplace ethics are set of _____ that are followed to ensure smooth and effective functioning of a workplace.

i. guidelines
ii. rules
iii. principles
iv. standards

h. Butter and ghee processing operator must follow _____ at all times.

i. food spoilage norms
ii. food safety norms
iii. food breakage norms
iv. food control norms

i. Milk is _____ by nature.

i. perishable
ii. edible
iii. non-perishable
iv. solid

Notes

Scan the QR codes or click on the link to watch the related videos

https://www.youtube.com/watch?v=J-2EiMVNtpM&t=14s

Overview of Food Processing Industry

https://www.youtube.com/watch?v=4XuvGYvKGnE

Overview of dairy industry

https://www.youtube.com/watch?v=t2LerU8-aXY

Introduction to Butter and Ghee

https://www.youtube.com/watch?v=GU5nObbJCxc

Orientation video

https://www.youtube.com/watch?v=zc7-SstpWjc

Roles and Responsibilities

2. Food Safety, Hygiene and Sanitation for Processing Food Products

FICSI
Food Industry Capacity and Skill Initiative

FIC/N9001

Key Learning Outcomes

At the end of this module, the trainee will be able to:

1. State the personal hygiene and sanitation guidelines to follow in a work environment
2. State the food safety and hygiene standards to follow in a work environment
3. List the different sanitisers used in the process area and equipment
4. Follow health and safety practices in the work area
5. State the importance of safety, hygiene, and sanitation in the dairy processing industry
6. Follow the industry standards to maintain a safe and hygienic workplace
7. Follow HACCP principles to eliminate food safety hazards in the process and products

UNIT 2.1: Sanitation and Hygiene

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the personal hygiene and sanitation guidelines to follow in a work environment
2. State the food safety and hygiene standards to follow in a work environment
3. List the different sanitisers used in the process area and equipment

2.1.1 Personal Sanitation

Sanitation and hygiene are the most important aspects to take care of when working in the dairy processing industry. Some important sanitation and hygiene practices that must be followed are:

Maintain a high standard of personal cleanliness viz. have a bath every day and wear clean clothes to work.

Wear Personal Protective Equipment (PPE) such as aprons, mouth mask, head cover, face mask, hand gloves, gum boots, and beard cover mask at all times during work hours.

Always keep your finger nails trimmed.

Always keep your hair trimmed and wear hair net while working.

Fig. 2.1.1. Personal sanitation

Fig. 2.1.2. Washing hands with soap and water

Wash your hands and feet at the designated area or wash stations provided.

Wash your hands with soap and water each time before you enter the production area.

Refrain from smoking, spitting, chewing paan, sneezing or coughing over any food when in the production area.

Do not handle food when suffering from a disease, illness, burns, injury or infection.

Fig. 2.1.3. Do not smoke, spit, cough

Fig. 2.1.4. Timely medical treatment

Take proper and timely medical treatment when you are ill or if you have met with an accident.

Visit a registered medical practitioner at regular intervals to keep a check on your health.

Points to be remember

- Always button up your sleeves or roll them up above the elbows. Button up your cuffs and wear a protective cap
- Gloves may not be worn all the time, but a suitable barrier cream should be used to protect the skin
- Wear cotton gloves with reinforced non-slip gripping surface when handling oil or greases covered component or material
- Use heat resistant gloves to give protection against burns
- Wear leather gloves to protect against sharp corners when handling bulky or heavy equipment
- Wear rubber gloves when using cleaning fluids to protect hands from skin damage due to air blast When cleaning component by means of compressed air
- Wear safety shoes or boots with reinforced toe caps especially at work for lifting heavy components
- Take special care of the floor at times when it is wet or there is an obstacle in your way
- Wear goggles when a chisel, a sharpening tool or a grinder is used and when cleaning with compressed air

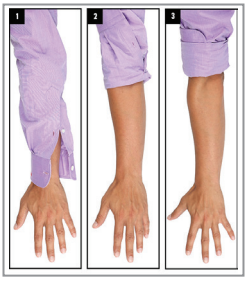


Fig. 2.1.5. Button up your sleeves

Fig. 2.1.6. Saftey shoes

Fig. 2.1.7. Goggles

Fig. 2.1.8. Gloves

UNIT 2.2: Safety Practices

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Follow health and safety practices in the work area

2.2.1 Symbols

There are some symbols that you must know and understand to ensure safety in case of an emergency or fire. They are:

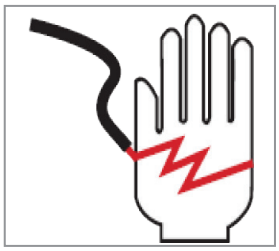
Caution

Danger Fragile Roof

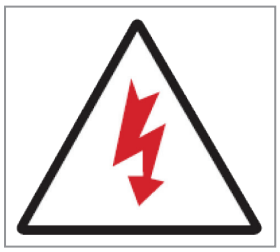
Dangerous Chemicals

Do Not Enter

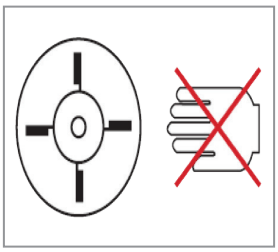
Danger Scaffolding Incomplete



Beware of Electric Shock



Electric Hazard

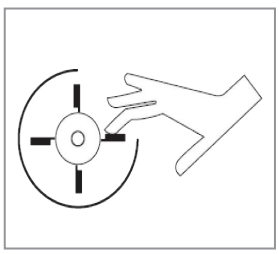


Never put your Hand Inside During the Operation

Highly Flammable

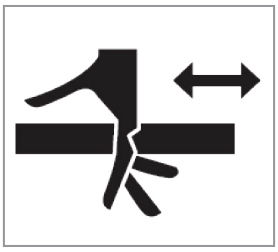
Hot Surface Do Not Touch

Mind Your Head

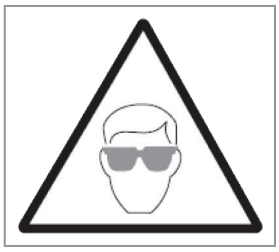


Never Open the Cover During the Operation

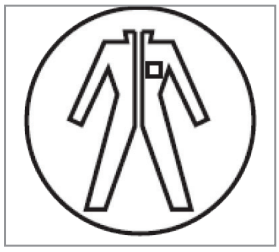
Use the Dustbin



Never Touch Moving Part



Wear Eye Protection



Wear Protective Clothing

Warning Slippery Floor

This is a Tobbacco Free Workplace

Assembly Point

Fire Exit

Fig. 2.2.1. Safety symbols

2.2.2 Emergency Measures

During an emergency, you must follow certain measures to tackle the situation in an organised manner. These measures are:

- Do not panic
- Respond to your senior immediately or inform the matter to the concerned person
- Prepare against the emergency situation by keeping a fire bucket and a water source handy
- Evacuate the work area

After the emergency, you must:

- Report the situation to a senior or the concerned authority
- Undertake recovery measures

Fire Safety Measures

Just like emergency measures, some common fire safety measures must be followed in case of a fire. They are:

- Press the closest fire alarm button (if available)
- Call the fire brigade
- Assemble at the assembly point or designated area for safety
- Evacuate the building from the closest fire exit

Types of Fire and Fire Extinguishers

Choosing the right extinguisher can prevent property damage and save lives				
Types of Fire Extinguishers → / Types of Fire ↓	Water	Foam	CO_2	Dry Chemical
A Class A: Paper, Wood, Plastic Fabric, Rubber, Trash	✓	✓	✗	✓
B Class B: Oil, Petrol, Some Paints and Solvents	✗	✓	✓	✓
C Class C: Electrical Equipment, Appliances, Computers	✗	✗	✓	✓

Fig. 2.2.2. Types of fire and fire extinguishers

How to use the Fire Extinguisher?

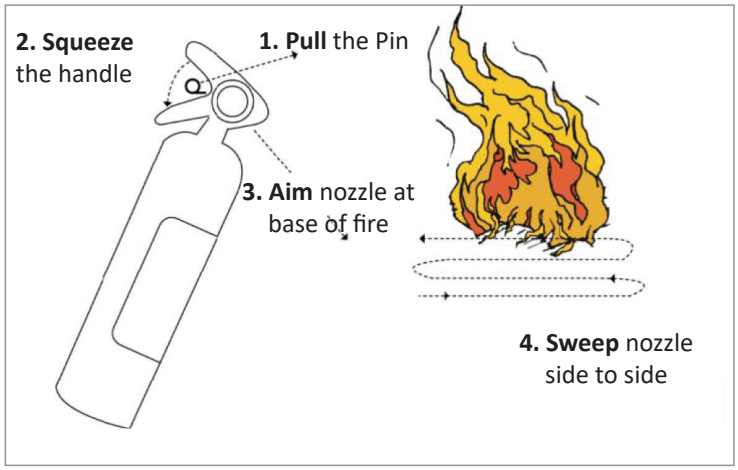


Fig. 2.2.3. Fire extinguisher

How to use the Fire Buckets?

Use the fire bucket filled with sand/water → Dump the sand/ water on the fire → Refill the fire buckets

Fig. 2.2.4. Fire bucket

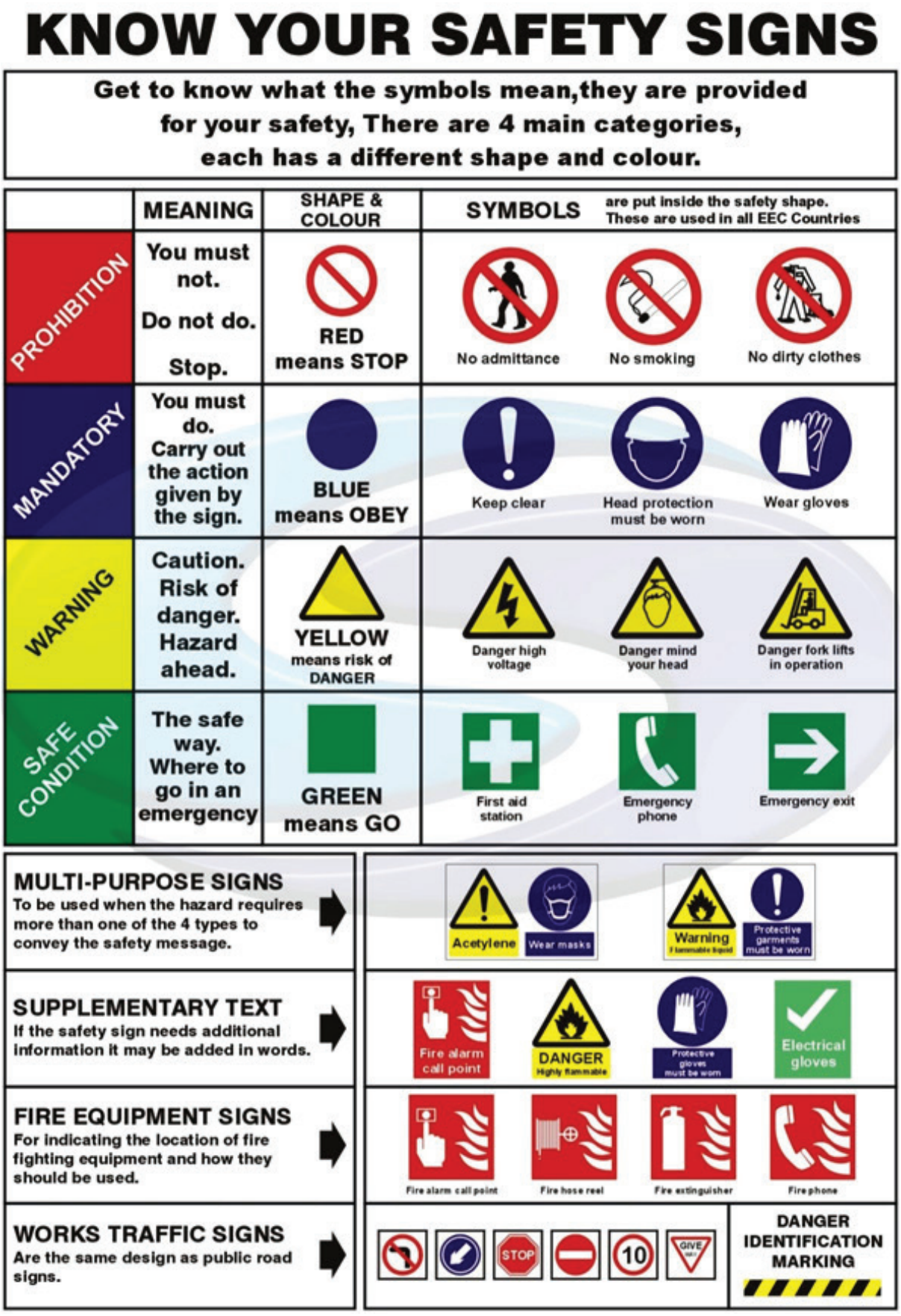


Fig. 2.2.5. Safety signs

UNIT 2.3: Good Manufacturing Practices (GMP)

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the importance of safety, hygiene, and sanitation in the dairy processing industry
2. Follow the industry standards to maintain a safe and hygiene workplace
3. State the storage and stock rotation norms

2.3.1 Good Manufacturing Practices (GMP)

GMP is a set of guidelines proposed by the Food Safety Standards Authority of India (FSSAI) to ensure the production of high quality and safe processed foods. It requires a qualitative approach towards manufacturing to reduce chances of microbial contamination, spoilage, and errors.

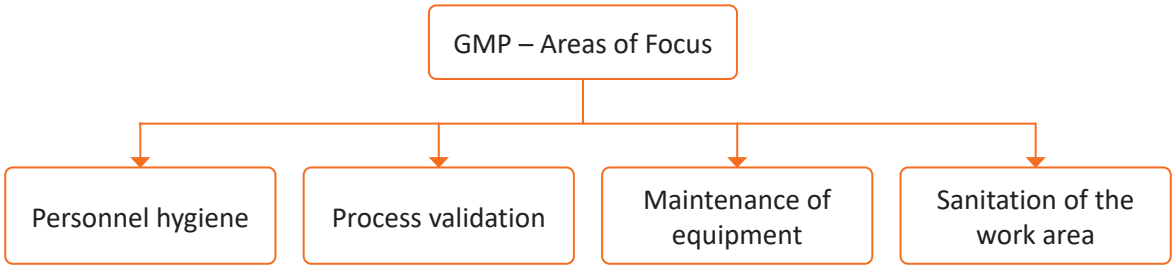
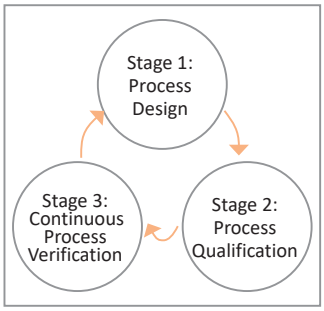


Fig. 2.3.1. Good manufacturing practices (GMP)

Area of focus	GMP
Personnel hygiene  *Fig. 2.3.2. Personnel hygiene*  *Fig. 2.3.3. Facilities for toilets*	• Your organisation follows strict hygiene and sanitation guidelines • You are provided training on Good Manufacturing Practices (GMP) • You are in a sound health condition during working hours • You follow high standards of cleanliness • Your processing unit has enough facilities for toilets and wash stations
Sanitation of the work area  *Fig. 2.3.4. Designated area for keeping utensils*  *Fig. 2.3.5. Sanitation of the work area*	• The processing unit where you work is located in a clean, pollution-free area • The entire processing unit is well ventilated and has adequate lighting • The entire work area follows high standards of cleaning and sanitisation • There is a designated area for keeping utensils and equipment. It is kept clean and pest-free at all times

Equipment maintenance  *Fig. 2.3.6. Equipment maintenance*  *Fig. 2.3.7. Monthly schedule*	• The equipment used for processing foods is protected against contamination from lubricants, metal fragments, fuel, and contaminated water • The cleaning and maintenance of tools, materials, and equipment is an easy process • The organisation follows a cleaning and sanitising drill as per daily, weekly, and monthly schedules
Process validation  *Fig. 2.3.8. Process validation*  *Fig. 2.3.9. Quality checks*	• All processes of production, like raw material procurement, execution, storage, packaging, and logistics follow strict organisational parameters • Quality checks are conducted at each step of production. This helps to ensure that food quality is maintained as per prescribed norms and standards • The stock rotation of finished product follows the FEFO and FIFO methods. This is to ensure that there is a minimum chance of food spoilage. It will also help to retain the taste of processed foods

UNIT 2.4: Hazard Analysis and Critical Control Point (HACCP)

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Follow HACCP principles to eliminate food safety hazards in the process and products

2.4.1 What is HACCP?

Hazard Analysis and Critical Control Point (HACCP) is an international food safety regulation that is followed to reduce the risk of hazards in a food processing unit. It is a system that identifies possible hazards and controls them at various points of the production process. The HACCP is based on seven principles. They are:

Conduct a hazard analysis

- Evaluate the production process and identify the points where hazards (physical, chemical, and biological) may be introduced

Identify critical control points

- Identify the critical points in the process plan where a hazard may occur
- Plan preventive measures at that critical point to control the risk

Establish critical limits

- State the boundary line between safe and unsafe processes
- State the limit until which a critical point maybe controlled

Establish a monitoring system

- State the process of monitoring critical points and critical limits

Establish corrective measures

- Specify the corrective actions that should be followed when critical limits are crossed

State verification procedures

- State the verification process to check whether HACCP principles are applied and followed
- Test the HACCP plan and ensure compliance on a regular basis
- Check whether the HACCP plan helps to prevent hazards effectively

Follow record-keeping procedures

- Keep records of all the critical points
- Maintain a log of situations when critical limits were exceeded
- State the corrective measures that were applied
- Include records of the development and maintenance of the system

Fig. 2.4.1. What is HACCP

Example of an HACCP Plan

Operational step	Hazard	Control measure	Critical limit	Monitoring method	Corrective action	Responsibility	Record
Procurement of raw material	Physical (dirt, stone particles)	Supplier guarantee specifications established by quality assurance department	As per company internal specifications	Supplier guarantee certificate is visually confirmed	Reject materials if not accompanied by supplier guarantee	Store manager	Supplier guarantee
	Chemical (toxins, pesticides from raw material)	Relative humidity of the store to be maintained					
	Microbiological (high microbiological load of raw materials, presence of pathogenic bacteria)	FIFO system should be established		Monitor temperature and humidity of storage			Store temperature logs

2.5.2 Food Safety Hazard and Risk

Hazard is a factor or agent which may lead to undesirable effects like illness or injury in the absence of its control, whereas, risk refers to the probability that the effect will occur.

Hazard is that part of food which somehow entered in the food and which is non-consumable.

Types of hazards and risks at work place

There are two types of hazards: one is food safety hazard and second is health safety hazards.

Food Safety Hazard

There are four major hazards that may be introduced into the food supply any time during harvesting, processing, transporting, preparing, storing and serving food. These hazards may be microbiological, chemical, physical and allergens.

Microbiological hazards

When harmful microorganisms are found or grown on food it is called microbiological hazards. Food which contains harmful or pathogenic bacteria when eaten can make people ill.

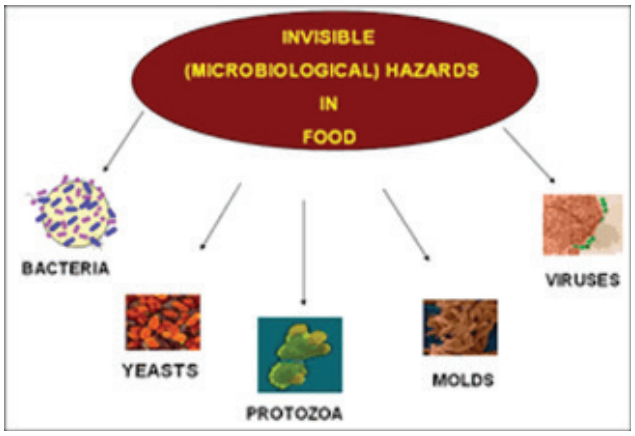


Fig. 2.5.1: Microbiological Hazards

Food spoilage and deterioration is no accident. It is a naturally occurring process. To understand how to maintain the quality of food and prevent spoilage, we need to know what can cause it.

Food spoilage: The microorganisms that can cause food-borne illness are called pathogenic microorganisms. These microorganisms grow best at room temperatures (25-30°C), but most do not grow well at refrigerator or freezer temperatures. Pathogenic microorganisms may grow in foods without any noticeable change in odor, appearance or taste. Spoilage microorganisms, including some kinds of bacteria, yeasts and molds, can grow well at temperatures as low as 4°C. When spoilage microorganisms are present, the food usually looks and/or smells awful.

Fig. 2.5.2: Food Spoilage

Physical Hazards

These include any foreign material, which you would not expect to find in your food. Hair, finger nails, pieces of wood, metal, plastic, glass and insect debris are examples of what can find their way into food as foreign matters.

Fig. 2.5.3: Physical Hazards

Chemical Hazards

Chemical hazards include, food contact materials, cleaning agents, pest control substances, contaminants (environmental, agricultural and process e.g. acrylamide), pesticides, biocides and food additives. They are naturally occurring, intentionally added or unintentionally added.

- Preservatives
- Colours and dyes
- Flavour enhancers
- Water additives
- Packaging materials
- Processing aids

Allergen

An allergen is any protein that is capable of producing an abnormal immune response in sensitive segments of the population.

A known component of food which causes physiological reactions due to an immunological response (e.g.- nuts, gluten, egg, ,milk etc, identified in legislation relevant to country of production or sale)

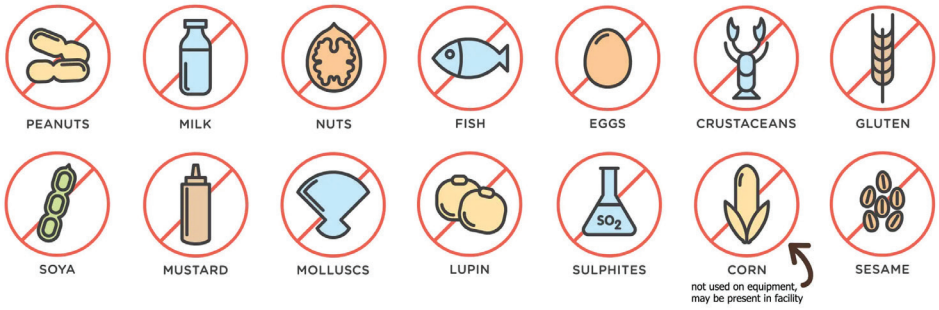


Fig. 2.5.4: Allergens

It is important to be aware of food allergens in food industry as this is the risk associated with the unintended presence of allergen due to cross contamination and should take this a matter of serious concern. Food allergies can cause serious and even deadly reactions.

What Are the Most Common Food Allergens?

There appears to be eight common allergens accounting for most food allergic reactions. They stand to be- milk, eggs, peanuts, soya, wheat, tree nuts (like walnuts and cashews), fish and shelfish (such as shrimp).

What Are the Signs & Symptoms of a Food Allergy?

The common sign and symptoms are: trouble breathing; coughing; hoarseness; throat tightness' belly pain' vomiting' diarrhe' itchy, wateru, or swollen eyes; red spots; swelling, a dropi in blood pressure and is capable of happening because a person can't digest a substance, such as lactose.

Handling of Allergenic Foods:

The common sign and symptoms are: trouble breathing; coughing; hoarseness; throat tightness' belly pain' vomiting' diarrhe' itchy, wateru, or swollen eyes; red spots; swelling, a dropi in blood pressure and is capable of happening because a person can't digest a substance, such as lactose.

Exercise

1. Identify the correct focus area of GMP from the list given below. Mark the correct option.

GMP	Area of Focus	
a. All processes of production like raw material procurement, execution, storage, packaging, and logistics follow strict organisational parameters.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
b. The equipment used for processing foods is protected against contamination from lubricants, metal fragments, fuel, and contaminated water.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
c. Your processing unit has enough facilities for toilets and wash stations.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
d. The entire work area follows high standards of cleaning and sanitisation.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
e. The entire processing unit is well ventilated and has adequate lighting.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
f. The organisation follows a cleaning and sanitising drill as per daily, weekly, and monthly schedules.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
g. You are provided training on Good Manufacturing Practices (GMP).	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐
h. You are in sound health condition during working hours.	Personnel hygiene Sanitation of the work area Equipment maintenance Process validation	☐ ☐ ☐ ☐

2. Match the column.

Hazard Analysis	HACCP Principle
a. Plan preventive measures at that critical point to control the risk	i. Follow record-keeping procedures
b. State the boundary line between safe and unsafe processes	ii. State verification procedures
c. Specify the corrective actions that should be followed when critical limits are crossed	iii. Establish critical limits
d. Test the HACCP plan and ensure compliance on a regular basis	iv. Establish a monitoring system
e. Maintain a log of situations when critical limits were exceeded	v. Conduct a hazard analysis
f. Evaluate the production process and identify the points where hazards may be introduced	vi. Identify critical control points
g. State the process of monitoring critical points and critical limits	vii. Establish corrective measures

Notes

Scan the QR codes or click on the link to watch the related videos

https://www.youtube.com/watch?v=RS4A-uczS6E&t=32s Mod. 2

GMP,GHP & FSMS

https://www.youtube.com/watch?v=iq8jOuZ5k6k

Pest Control

https://www.youtube.com/watch?v=daNjRoP_I0c&t=31s

Personnel hygiene and employee facilities

https://www.youtube.com/watch?v=gNEx8P9UqPA&t=106s

Personnel Hygiene and personal behaviour

3. Prepare and Maintain Work Area and Process Machineries for Butter and Ghee Production

FICSI
Food Industry Capacity and Skill Initiative

Unit 3.1 - Usage and Maintenance of Equipment and Machineries

Unit 3.2 - Sanitisation of Work Area

Unit 3.3 - Cleaning Processes

FIC/N2009

Key Learning Outcomes

At the end of this module, the trainee will be able to:

1. List the machineries used in a dairy processing plant
2. Explain the functions to be carried out before starting production
3. Explain the maintenance procedure to be followed for dairy processing machineries before starting production
4. Explain the lubrication system followed in the dairy industry
5. State the different types of maintenance procedures
6. State the materials and equipment used in the cleaning and maintenance of the work area
7. State the common detergents and sanitisers used in cleaning work area and machineries
8. State the properties of cleaning agents used
9. State the methods of cleaning and sanitisation
10. Describe the CIP method of cleaning
11. Describe the SIP method of cleaning
12. Explain the method of managing and disposing waste material

UNIT 3.1: Usage and Maintenance of Equipment and Machineries

Unit Objectives

At the end of this unit, the trainee will be able to:

1. List the machineries used in a dairy processing plant
2. Explain the functions to be carried out before starting production
3. Explain the maintenance procedure to be followed for dairy processing machineries before starting production
4. Explain the lubrication system followed in the dairy industry
5. State the different types of maintenance procedures

3.1.1 Equipment Used in Dairy Processing

Described below are some of the equipment used in a dairy processing unit:

1. Raw Milk Reception Dock

Milk is delivered to the dairy plant either in cans or in tankers (road/rail). The place in the dairy plant where milk first arrives and is received after grading for acceptance is known as milk reception dock or platform or Raw Milk Receiving Dock (RMRD).

Since further processing of milk mainly depends upon its quality, the decision of whether to accept or reject the milk must be done immediately after arrival and after thorough investigation.

Reception includes unloading, grading, conveying, sampling, testing, weighing or measuring, recording, dumping, and pumping.

2. Storage Tanks

Storage tanks are containers that hold hot or cold liquids used for short or long-term storage. In the dairy industry, storage tanks are classified based on structure and heat preservation capacity. Storage tanks are available in many shapes viz:

- Vertical and horizontal cylinder
- Flat bottom and cone bottom
- Open top and closed top
- Slope bottom and dish bottom

The vertical cylindrical large tanks have rounded corners to withstand the pressure of the contained liquid. These storage tanks are designed to handle varying degrees of liquid pressure during transportation.

Fig. 3.1.1. Horizontal insulated milk storage tank

Fig. 3.1.2. Vertical insulated milk storage tank

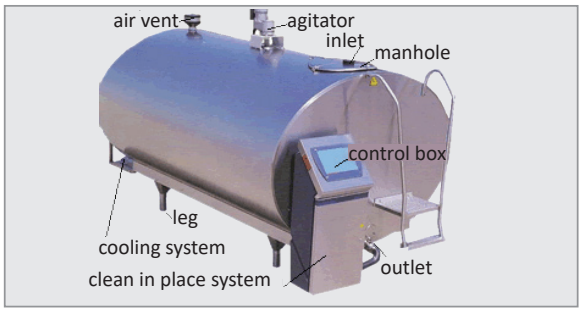


Fig. 3.1.3. Ghee boiler

Fig. 3.1.4. Bulk milk cooler

3. Milk Chiller

Chilling of milk is the rapid cooling of raw milk to sufficiently low temperature to check for the growth of microorganisms present. In the chilling process, the temperature of milk should be reduced to less than 10°C, preferably 3 - 4°C.

Fig. 3.1.5. Milk chiller

Fig. 3.1.6. Milk separator

4. Milk Separator

A separator is a device that separates milk into cream and skimmed milk.

5. Homogeniser

Homogenisation is the process used to make a uniform mixture of two mutually non-soluble liquids. This is achieved by turning one of the liquids into a state consisting of extremely small particles distributed uniformly throughout the other liquid. A typical example is the homogenisation of milk where the fat components in the milk are reduced in size and dispersed uniformly through the rest of the milk.

Fig. 3.1.7. Homogeniser

6. Pasteuriser

Pasteurisation of milk is the process of heating milk to a specific temperature for a specific period in order to kill microorganisms that could cause spoilage, disease or undesired fermentation of food.

During pasteurisation, milk is heated at 63°C for 30 minutes or 72°C for 15 seconds in an approved and full functional equipment. After pasteurisation, milk is immediately cooled to 5°C or below.

Pasteurisation is required:

- to increase milk safety for the consumer by destroying disease causing microorganisms (pathogens) that may be present in milk

- to enhance the quality of milk products by destroying microorganisms and enzymes that contribute to the reduced quality and shelf life of milk

Fig. 3.1.8. Pasteurisation unit

The following chart explains the process followed for packaging milk and milk products:

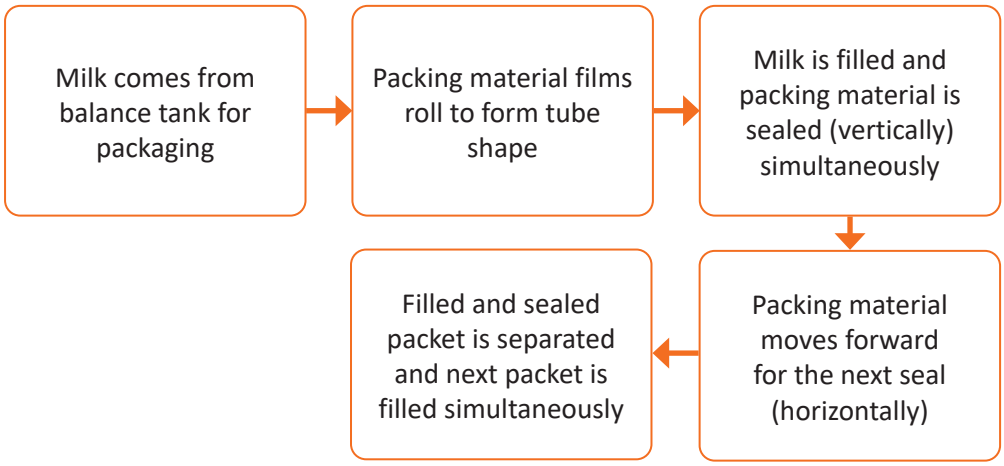


Fig. 3.1.9. Process followed for packaging milk and milk products

7. Cream Separator

A cream separator is a device used to separate cream from milk. It helps in the mechanical separation of milk into cream and skimmed milk by the use of centrifugal force. Centrifugation is a process where milk is filled in the separator and is rotated at a very high speed. Due to this, the thicker liquid separates from the thinner liquid and settles at the bottom of the equipment.

Fig. 3.1.10. Cream separator

The dairy industry uses two types of separators. They are:

- Hand-operated separators
- Power-driven separators

The following table gives details about the various types of power-driven cream separators.

Separators	Details
Open-bowl separators	• Equipped with open top milk inlet and pressure mechanism • Cream and skim milk outlets are open to atmosphere
Semi-closed separators	• Equipped with milk feed at atmospheric pressure and paring discs; located in the cream and skimmed milk outlets • Outlets discharge into closed pipes at elevated pressure • Milk inlet prevents air from getting into the milk stream • Helps to prevent foaming in cream and skimmed milk
Closed bowl or hermetic separators	• Milk inlet and cream and skim milk outlets are all connected to closed pipe lines • Milk is transferred in a closed pipeline under pressure • Milk flow is controlled at all times
Self-desludging separators	• Equipped with a self-cleaning design • Dirt is discharged periodically without interruption of the process

Table 3.1.1: Types of Cream Separators

3.1.2 Using a Cream Bowl Separator

Working of a Cream Bowl Separator

Whole milk is fed via the central pipe to the distributor at the bottom of disc stack and is subjected to rotation. The distributor serves as the base for the assembly of 110-130 discs. The coarse dirt particles settle down in the conical bottom part, which is called the sludge space. Milk flows upwards through the openings in the discs, which are inclined towards the rotational axis. Thus, in the disc assembly, milk rises in channels, which are parallel to the rotational axis. The channels are formed by the rising holes of the disks and milk is distributed in thin layers in the space between the disks (distance of 0.5-1.0 mm). It is here that separation of milk into cream, skimmed milk takes place, and at the same time, dirt is deposited as slime in the sludge space.

3.1.3 Preparation of Machineries

Preparation of Machineries for Production

Before beginning with the actual production process, a butter and ghee processing operator must prepare and maintain the process machineries and tools. Following is a step-by-step guide to preparing machineries for production:

1. Plan, schedule, and organise machineries
2. Ensure proper installation
3. Ensure periodic inspection
4. Ensure adequate lubrication of machineries
5. Adjust machineries and instruments, if required
6. Replace worn and damaged parts

Apart from this, a butter and ghee processing operator must also:

- Record and report observations, adjustments, repairs, and replacements
- Periodically review records on inspection, lubrication, repairs, and performance of equipment
- Keep an adequate supply of spare parts
- Determine maintenance costs
- Ensure regular cleanliness and painting of equipment
- Inspect and maintain all emergency, personnel, and plant protective equipment
- Ensure maintenance of full serviceability of all utilities
- Inspect the equipment for any physical damage and report the same, if necessary
- Follow manufacturers' instructions for maintaining, cleaning, repairing, lubricating, and servicing the equipment
- Ensure timely lubrication of gears, compressors,
- Look out for refrigerator gas leaks, air leaks, and milk leaks in equipment
- Maintain the oil, water, air, and lubrication levels at all times
- Balance the bowl in the separator and clean it thoroughly after each use
- Wash the churn and butter-making equipment immediately and thoroughly after use with hot water
- Dismantle the ventilator occasionally for complete cleaning
- Maintain the product temperature and check the flow diversion valve regularly

Spare Parts Used in the Dairy Industry

Following is a list of spare parts used in the dairy industry:

- Pipes
- Fittings
- Bolts
- Nuts
- Washers
- Bars
- Plates of different metals
- Plates of different metals
- Plates of different metals
- Rubber gaskets for milk pipes
- Plate gaskets for heat exchangers
- Graphite and rubber sealing for pumps
- Electric relays
- Special bulbs
- Selected bearings
- Springs
- Automatic switches
- Aluminium capping foils

Lubrication System

Lack of lubrication is one of the principal causes of equipment breakdown in the dairy industry. Hence, it is important to follow the following:

- A regular lubrication schedule
- A lubrication chart for each machine
- A pre-defined frequency of lubrication
- A list of places to be lubricated

Modern equipment calls for certain types of lubricants for certain types of bearings e.g. light, high speed bearing will require a light oil, whereas a heavy duty, low speed bearing will require a heavier oil.

3.1.4 Maintenance and Check

In food manufacturing, maintenance supports various key objectives, many of which are unique to food production. Maintenance plays the following roles in food manufacturing:

1. It keeps the production running smoothly.
2. It helps to prevent any contamination and ensure food safety.
3. It reduces product losses.
4. It maintains regulatory compliance.

An effective maintenance routine ensures that operations are continued, repair costs are minimized, and downtime is reduced.

Following are the types of maintenance that are carried out in a food processing unit:

1. **Reactive Maintenance** is a method where machines run until they fail. It's a hands-off approach, and the significant benefit is that it keeps routine maintenance costs low.
2. **Predictive Maintenance** uses advanced technology such as infrared and ultrasound equipment during the routine inspection of machines. This process can stop unpredicted breakdowns, and using advanced technology and the industrial unit can reduce the amount of time needed to inspect equipment piece by piece. This type of maintenance is expensive, but this method accurately stays a step-in front of faults.
3. **Proactive Maintenance** is a systemic issue-focused maintenance program. Rather than examining equipment, this approach considers how to control the problems that lead to machine wear and tear instead of the deterioration itself.
4. **Preventative Maintenance** is the checking of machines and equipment on a planned, regular basis. The purpose is to prevent costly down me and minimize the probability of faults. It requires more planning and effort than other techniques. However, it has long and short-term benefits in cost-reduction and efficiency of machine performance. Preventative checks are done before a machine breakdown and while it is still in running condition. Generally, the strategy leads to good food hygiene and prevents foreign materials from entering food produce.

It is essential to have a schedule for preventative maintenance of each piece of machinery and equipment used in the production. This consists of:

- Time schedule stating when and how frequently maintenance should be done
- Maintenance activities list for each item

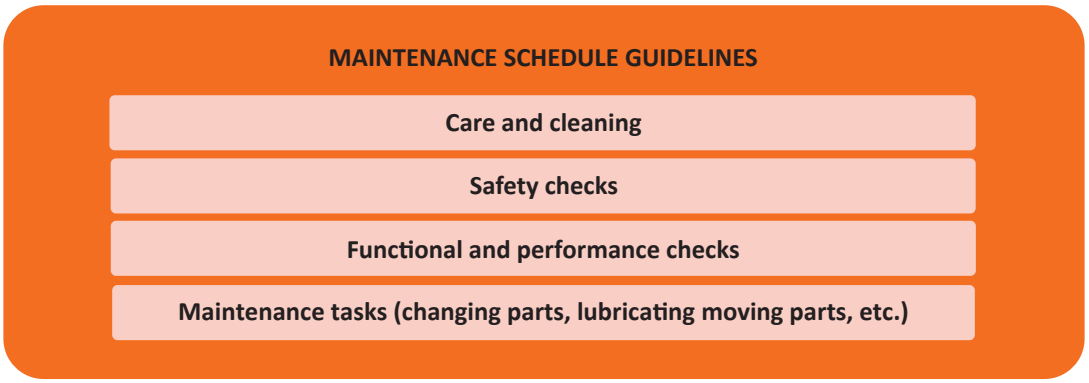


Fig. 3.1.11: Maintenance Schedule Guidelines

Checklist for Planning Maintenance

- **Identify the assets that require preventative maintenance.**
- **Distinguish what kind of safety checks the machine will need.**
- **Assess whether parts need replacing or cleaning.**
- **Decide how regularly assets need checking.**
- **Create a formal risk assessment process to help the person responsible for checks.**
- **Talk to employees who work closely with equipment to discover more about how the machines are operating at the time of the check.**
- **Find out if parts need cleaning, lubricating, or changing.**

Fig. 3.1.12: Maintenance Checklist

After completing any maintenance, the technician must keep a log for maintenance. This log entry should include a description of the work carried out, who carried it out, and the date and time it happened.

Document Maintenance Procedures. Every piece of equipment and machinery should have detailed descriptions, drawings, and photographs of how and when each machinery should be maintained or serviced. It includes:

- Maintenance procedures
- Lubrication procedures
- Tool reconciliation procedures
- Procedures for temporary repairs
- Procedures for emergency repairs
- Spare parts inventory program
- Training procedures
- Handover procedures
- Audit Procedures

Note:

An annual maintenance contract (AMC) is an agreement between an organization and a service provider that specifies the ongoing maintenance of machinery or property purchased from the provider. Therefore, ensure periodic maintenance by AMC (Annual Maintenance Contract) personal.

UNIT 3.2: Sanitisation of Work Area

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the materials and equipment used in cleaning and maintenance of the work area and machineries
2. List the various cleaning chemicals required
3. List the appropriate cleaning agents and sanitizers to clean the work area, machinery, tools, and equipment after squash production
4. State the methods of cleaning and sanitisation

3.2.1 Cleaning & Sanitizing Work Area, Machinery, Tools, and Equipment

The cleaning and sanitizing process are one of the most essential programs in the food processing industry. It has always been a critical element for ensuring food safety and quality. Food processing industries need to be kept spotlessly clean to ensure compliance with standard regulations and prevent contamination. Everything from random debris to flakes of rust and paint needs to be kept clear from foodstuff to make sure the product is entirely safe for consumption, so frequent cleaning is vital to food processing operations.

Though the entire process is quite tricky because of the complexity of the machinery and equipment used in the industry, it can also introduce additional difficulty by creating a wet environment. Equipment must be designed and built to withstand these environments, like using only food-grade stainless steel, but the complexity doesn't end there. High-pressure washers used to clean equipment can also strip the coatings on machines and cause injuries to employees, and the wet environment itself often poses a slip-and-fall hazard as well as food contamination.

Cleaning and sanitizing (disinfecting) are usually two separate processes. Effective cleaning must be carried out before sanitizing the work area and machinery, as sanitizers may not work as well if the work area or machinery has not had all visible contamination removed. Cleaning is often done using correct proportion of detergent and water. Detergents are chemicals that eliminate dirt and grease. However, it does not kill bacteria and other microorganisms. Microorganisms may be removed during the cleaning process but it can't be destroyed properly. Hence, sanitizing is required for this purpose.

The primary reasons for cleaning and sanitizing the work area and machinery are:

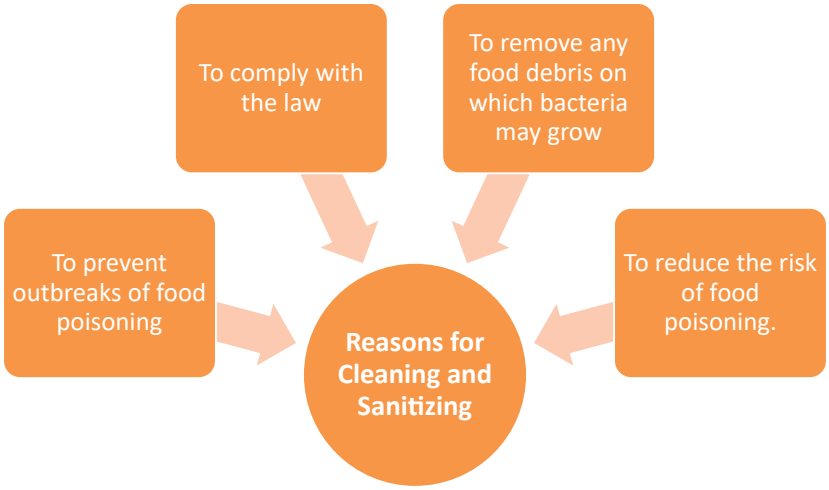


Fig. 3.2.1 Reasons for Cleaning and Sanitizing

The food processing industry follows standard procedures for cleaning the work area to ensure no bacterial growth due to the presence of leftover food particles. For cleaning purposes, the work area is divided into two categories:

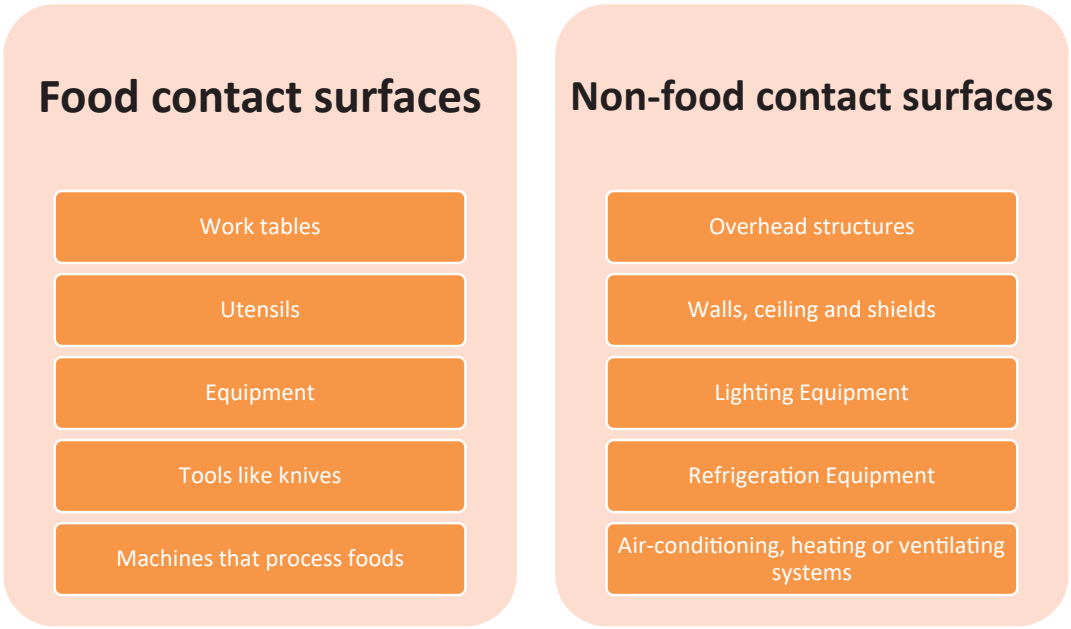


Fig. 3.2.2 Cleaning Work Area Categories

Proper and regular cleaning of the work areas protects food from any contamination. The cleanliness of the ambient air should also be controlled in the workplace, where contamination of any infectious material will be dangerous. The surfaces used for producing and storing foods with low moisture content should always be dry and hygienic during use. When wet cleaning is required, these surfaces must be sanitized and thoroughly dried to use. The entire work area in wet applications must be cleaned and sanitized absolutely before use or at the risk of contamination. Equipment and tools when not in usage should be stored properly to avoid any contamination risk.

3.2.2 Cleaning Agents and Sanitizers Used for Cleaning

There are several common cleaning and sanitizing agents that can be used to clean the food-contact and non-food contact surfaces. The nature and complexity of the detergent employed depend on the variation of soils, water hardness, and temperature of the method, plant surfaces, and safety. Detergent suppliers normally have a range of detergents to be employed in varying and specific circumstances. The range of products will include:

Fig. 3.2.3 Various Ranges of Detergents

The industry must use approved cleaning and sanitation chemical agents and the same must be prepared before use as per the instructions described on the product label. It is essential to identify the correct detergent for cleaning operation correctly. This will save money in the long term as cleaning will be more effective. The failure of a product to work is usually not due to a poor quality product but rather choosing the wrong one. Application and use are also important factors, and a good supplier will usually provide training in the correct use of the product. A 'detergent' is designed to remove soils. Another

term used is 'sanitizer' and is often used to describe similar products. A 'disinfectant' is a product that kills microbes without employing a soil removal action.

The table below lists the typical cleaning agents and their appropriate usage, risks, and safety measures that should be taken while using these agents.

Cleaning agents	Used for	Risk	Safety measures
Hypochlorite like • Potassium hypochlorite, • Sodium hypochlorite, and • Calcium hypochlorite	Cleaning stainless steel food Contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained
Liquid chlorine	Internal cleaning of stainless-steel Equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained

Cleaning agents	Used for	Risk	Safety measures
Hydrogen peroxide	Killing bacterial spores, Pathogens, spoilage Organisms, and other Microo rganisms	Has a strong odor	Use in well-ventilated and open spaces
Ozone	Cleaning food contact and on food-contact surfaces like Equipment, walls, doors, Drains, conveyors, tanks, and Other containers; Killing Microbes	No risk involved since it leaves no residue	Safe to use

Table 3.2.1 Different types of cleaning agents, related risk factors, and safety measures

Cleaning and sanitization take time and cost money. However, well-designed and organized food processing businesses can reduce the time needed for thorough cleaning with proper planning.

Fig. 3.2.4 Standard Practices for Cleaning the work area and equipment

The term sanitary refers to the state of a food contact surface or machinery where it does not contain microorganisms at a level that would permit the transmission of infectious disease or compromise food safety. Sanitizers are substances capable of destroying microorganisms, including those bacteria that cause food poisoning and other diseases. With appropriate use, they can reduce surface contamination by bacteria to a safe level. Therefore, it is essential to read and follow the directions on sanitizers carefully. Sanitizing is usually done using heat and water, or chemicals, or a combination of both methods.

Effective Practices for Sanitization

For effective and safe use of a sanitizer, follow the manufacturer's instructions provided on the label.

- Some sanitizers are toxic to people, and the residue must be rinsed off, while other sanitizers are food safe and do not require rinsing. So, the manufacturer's instructions shall always be followed for the sanitizer to ensure safe use.

- Sanitizers work best at the correct dilution. If they are too weak, they do not work effectively, and money is being wasted if they are too strong.
- Sanitizers need time to work. The contact time varies and may be seconds to minutes depending on the job.
- Check the dilution, contact time, safety precautions, shelf life, and storage of all chemicals before use.

In some cases, cleaning and disinfection may be combined into one operation using a sanitizer which has the action of both a detergent and a disinfectant. However, it is believed that the two-stage approach is more consistent and effective than the single-stage sanitizer approach. It is important that non-scented chemicals are used in food operations due to the risk of taint.

UNIT 3.3: Cleaning Processes

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the cleaning processes used to clean the work area and process machineries

3.3.1 Clean-In-Place (CIP)

CIP is a method used for internal cleaning of machineries. It is done without dismantling pipes, vessels, process equipment, filters or fittings. In this process, a sanitising agent is circulated through the entire processing unit with the help of a spray ball. The turbulence created removes soil, ensuring removal of bacteria and chemical residues.

Tips to conduct an effective CIP process:

- Use the right vessels for the right process
- Use the right cleaning and sanitising solutions
- Ensure correct flow rate
- Ensure all connections are clean
- Monitor and verify the entire process

3.3.2 Cleaning Sequence

The sequence for CIP cleaning is as follows:

1. Recover product residue from drainage
2. Remove non-retrievable residue with water or compressed air
3. Rinse for 10 minutes with warm water (50-60°C)
4. Circulate alkaline detergent (0.5-1.5 % solution) at 75°C for 30 minutes
5. Rinse with warm water (50°C) for 5-8 minutes
6. Circulate acidic detergent (0.5-1.0 % solution) at 75°C for 20 minutes
7. Rinse with warm water (50°C) for 5-8 minutes
8. Use thermal disinfection (90-95°C) and cooling for 10 minutes or chemical disinfection with a suitable sanitiser

Advantages of CIP

The major advantages of implementing CIP are:

- Guaranteed and repeatable quality assurance
- Provision of full data logging for quality assurance requirements
- Reduction in cleaning costs by recycling cleaning solutions
- Possibility to clean inaccessible areas on the equipment
- Better safety to operators because hazardous cleaning materials are not handled
- Reduction in time between two production runs
- Safety operators are not required to enter the plant to clean it
- Reduction in labour requirements
- More effective use and control of cleaning materials
- Reduction in water consumption

CIP STEPS	PASTEURIZER	SILO/TANKS	TRANSFER LINES	RECEPTION LINES	MILK TANKERS
Rinsing with Water	10min at ambient temp.	5min at Ambient temp	5min at Ambient temp	5min at ambient temp	1-3min at Ambient temp
Lye Circulation	45min at 80°C	20min at 80°C	5min at 80°C	15 min at 80°C	5min at 75°C
Fresh Water Circulation	6 min at Ambient temp	7min at Ambient temp	5min at Ambient temp	7min at Ambient temp	5min at Ambient temp
Acid Circulation	40min at 60°C	15min at 60°C	5min at 60°C	20min at 60°C	-
Fresh Water Circulation	10min at Ambient temp	7min at Ambient temp	5min at Ambient temp	10min at ambient temp.	-

Fig. 3.3.1: CIP Steps of different equipments

3.3.3 Clean-Out-Of-Place (COP)

COP is conducted at a cleaning station. This method involves dismantling of the equipment. In this process, equipment and units are scrubbed with soap in COP tanks. After this, the tanks are rinsed again to remove residual detergent or chemicals. Equipment and units are reassembled and sanitised once more with heat treatment or sanitising agent.

Tips to conduct an effective COP process:

- Follow the order of tasks
- Use cleaning tanks as much as possible
- Ensure tools used in COP do not lead to contamination

Food processing equipment and units that undergo the COP process are:

- Fittings
- Gaskets
- Valves
- Tank vents
- Grinders
- Pumps
- Knives
- Nozzles

3.3.4 Sterilising-In-Place (SIP)

SIP is the process by which food processing equipment is sanitised after the CIP process. It helps to eliminate any residual microbiological contamination.

SIP is a combination of three processes viz. sterilisation, disinfestation, and sanitisation.

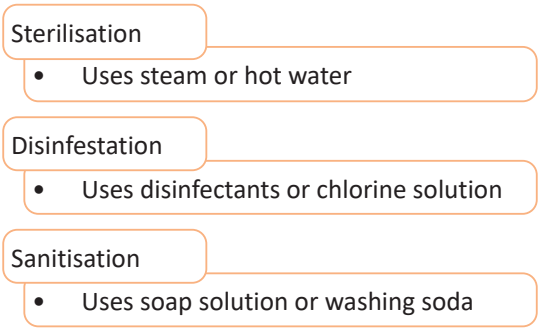


Fig. 3.3.2. Sterilising-In-Place (SIP)

3.3.5 Process of Cleaning the Work Area

The following chart explains the process of cleaning the work area before production. The dotted boxes explain pest-control measures and methods used for waste material disposal in detail.

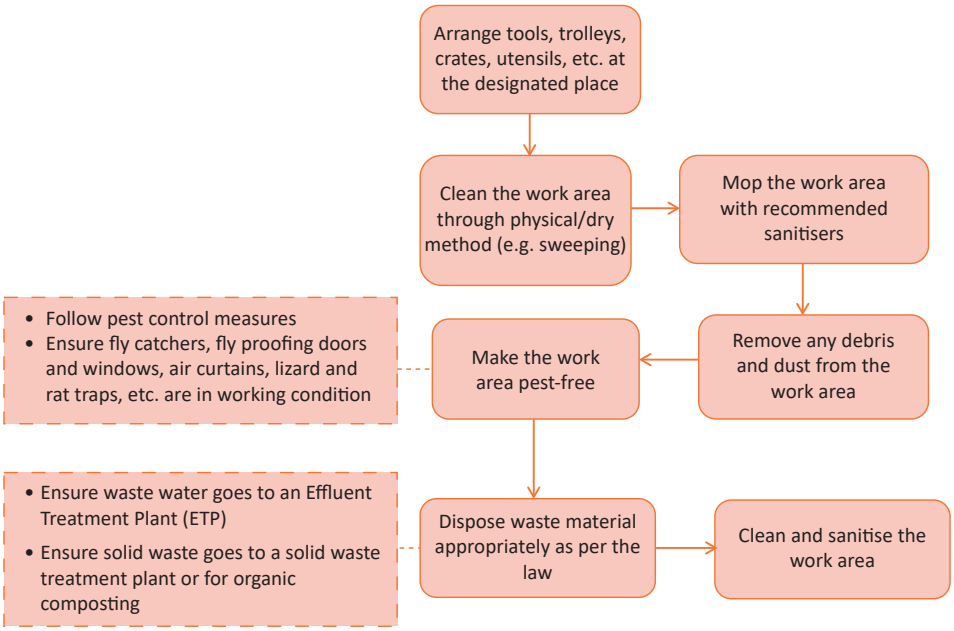


Fig. 3.3.3. Process of cleaning the work area

3.3.6 Process of Cleaning Machineries, Tools and Equipment

The chart explains cleaning of machineries, tools, and equipment used in the fod processing industry. The dotted chart states the techniques used for mechanical cleaning of equipment.

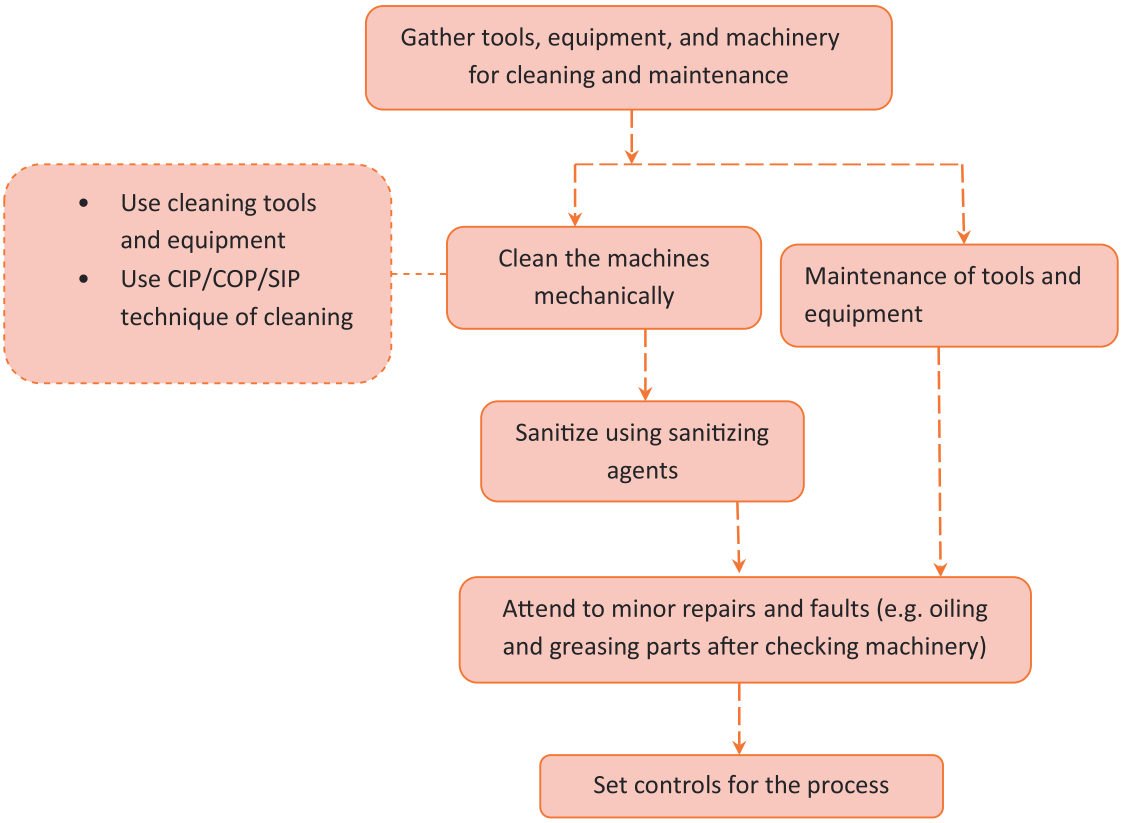


Fig. 3.3.4. Process of cleaning machineries, tools and equipment

3.3.7 Waste Management in Dairy Industry

All dairy processing plants have a waste management plan in place. This is because food products processed in dairy units contain a large amount of carbohydrates, proteins, fats, and mineral salts. During flushing of waste material and while cleaning the process equipment, these nutrients enter the drainage and favour the growth of anaerobic and aerobic bacteria . As a result, flushed water emits obnoxious odour and can pose a problem during disposal. Increased waste causes additional load to the Effluent Treatment Plant (ETP), which leads to compromising the quality of treated waste. Violating the norms will cause severe repercussions as per the law. So while disposing any waste, it is important for a dairy products processor to consult the supervisor and/or follow the norms. .

Exercise

1. Match the columns.

Equipment in Dairy Processing Plant	Usage
a. Raw Milk Reception Dock	i. Rapid cooling of milk
b. Milk Chiller	ii. Uniform mixture of two mutually non-soluble liquids
c. Milk Separator	iii. Short or long term storage
d. Homogeniser	iv. Process of heating milk to a specific temperature
e. Storage Tanks	v. Arrival and receiving milk after grading for acceptance
f. Pasteuriser	vi. Separates milk into cream and skimmed milk
g. Milk Packaging Machine	vii. Separate milk from cream
h. Cream Separator	viii. Ideal for packaging free-flowing type or granular food products

2. Fill in the blanks with the correct option.

a. The production area of the dairy processing plant use _____ and _____ sanitisers.

i. thermal, biological
ii. biological, chemical
iii. thermal, chemical
iv. biological, microbial

b. Sanitisation implies to _____ of all pathogenic and almost all non-pathogenic organisms.

i. addition
ii. destruction
iii. deposition
iv. concentration

c. RMRD is short form of _____.

i. Random Milk Reception Dock
ii. Regular Milk Reception Dock
iii. Raw Milk Reception Dock
iv. Ripened Milk Reception Dock

d. Process which is helpful in eliminating any microbiological contamination is _____.

i. SIP
ii. COP
iii. CIP
iv. SAP

e. The full form of SIP is _____.

i. Sanitisation-in-place
ii. Sanitisation-inward-place
iii. Sanitisation-in-pipes
iv. Side-in-place

f. Waste _____ is the collection, transportation, processing, recycling or disposal, and monitoring of waste materials.

i. management
ii. termination
iii. destruction
iv. separation

g. Cleaning and sanitisation are _____ processes employed in the dairy industry to ensure hygiene and product safety.

i. supplementary
ii. complementary
iii. independent
iv. different

h. _____ sanitisers are used to eliminate microorganisms.

i. Chemical
ii. Thermal
iii. Low temperature
iv. Chlorine based

i. Detergents used for cleaning the work area in a dairy processing unit should be _____.

i. toxic
ii. dangerous
iii. non-toxic
iv. destructive

j. Process which is helpful in eliminating any microbiological contamination is _____.

i. SIP
ii. COP
iii. CIP
iv. SAP

Notes

Scan the QR codes or click on the link to watch the related videos

https://www.youtube.com/watch?v=1y_bN5Kt40o	https://www.youtube.com/watch?v=QWpU7DAfNcs&t=38s	https://www.youtube.com/watch?v=tRAnusofqJ8&t=52s
Equipment's used in Butter and Ghee	Cleaning and Sanitation	Maintenance

NCVET
कौशल गुणवत्ता प्रगति

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
RE IMAGINE FUTURE

FICSI
Food Industry Capacity and Skill Initiative

4. Prepare for Production of Butter and Ghee

Unit 4.1 - Basic Calculations

Unit 4.2 - Factors Affecting Efficiency During Production

Unit 4.3 - Plan Production Sequence

FIC/N2010

Key Learning Outcomes

At the end of this module, the trainee will be able to:

1. Explain the various calculations required for standardisation of cream
2. State the factors affecting operation efficiency during production
3. Describe the process of planning production sequence to maximise capacity utilisation of resources
4. Demonstrate the process of production planning

UNIT 4.1: Basic Calculations

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Explain the various calculations required for standardisation of cream

4.1.1 Basic Mathematics

Calculating Fat Content

A butter and ghee processing operator must calculate the fat content of cream received and the fat content of cream used for churning. For this purpose, two methods can be used:

- Arithmetical calculations
- Pearson's Square Method

Arithmetic

Example:

Let's say, cream of 42.30% fat content is available in a quantity of 5,300 litres. Skimmed milk with 0% fat content has to be added to it. The desired fat content in the cream is 40%. How much skimmed milk should be added to the cream in order to standardise it?

Calculation:

Quantity of fat in cream = 5300 x 0.423 x p kg = 2241.9 p kg (where p is the density of the cream).

The total amount of cream that would have this quantity of fat as 40 per cent of its content would be 2241.9p x 10040 = 5605p kg = 5605pp' where p' is the new density of the cream.

305 (= 5605-5300) litres of skimmed milk shall be added to 5300 litres of cream to obtain 5605 litres of standardised cream.

Alternatively, the Pearson's Square Method can be used with more convenience as shown below (to be calculated)

Example 2

If in the above example whole milk with 4·2 per cent fat content were to be used as a diluent, the calculations will be as shown below:

The essentials of the method are shown in Fig.1. The fat content of the cream used is set in the top left-hand corner of a square (42.3 per cent) with the fat content of the diluent at the bottom left-hand corner (4.2 per cent). The required fat content is then placed at the intersection of the square's diagonals (40 per cent) and the proportions of the cream and the whole milk are simply obtained by subtraction along the diagonals.

Cream required = 40 - 4.2 = 35·8 parts

Whole milk required = 42.3-40 = 2·3 parts

Thus, the amount of whole milk added to 5300 litres of cream should be 5300 × 2.335.81 = 3411

i.e. the cream should be made up to 56411 with whole milk.

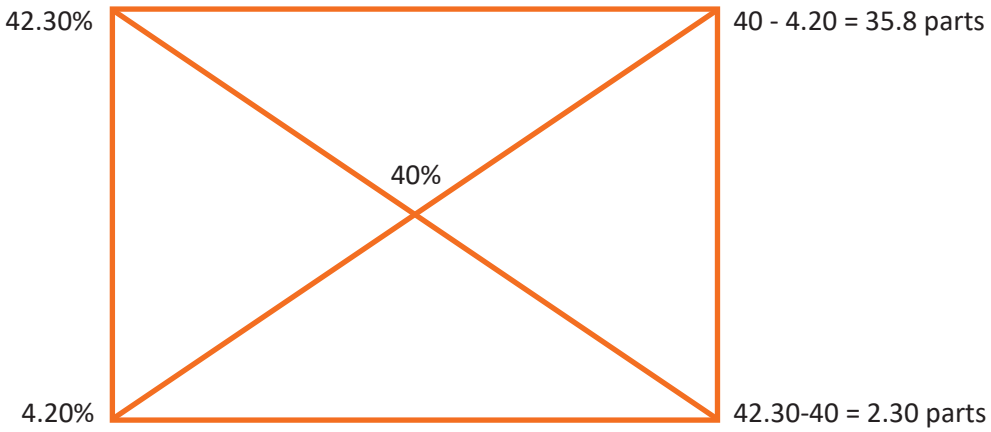


Fig.4.1.1. Pearson's square as a means of calculating proportions of components for standardising

UNIT 4.2: Factors Affecting Efficiency During Production

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the factors affecting operation efficiency during production

4.2.1 Factors Affecting Efficiency

Effective operation of a dairy plant is possible only when all factors involved work in sync. This can be achieved only by optimising the use of available resources and facilities. Some of the factors that affect the plant operation efficiency are:

Factors	Corrective measure
Services and utilities	Uninterrupted supply of services and utilities
Supply of raw material	Adequate supply of raw material and its scheduled arrival
Quality of raw material	Quality checks for milk used for production
Work schedule	No wastage of working hours
Efficient labour	Employ skilled labour
Proper processing units	Using the floor space efficiently
Utilities	Easy availability of water, electricity, refrigeration, and steam
Stock supplies and spare parts	Adequate supply of stocks and spare parts

Table 4.2.1-Factors affecting the plant operation efficiency

UNIT 4.3: Plan Production Sequence

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Describe the process of planning production sequence to maximise capacity utilisation of resources
2. Demonstrate the process of production planning

4.3.1 Production Sequence

Every organisation in the food processing industry follows the method of preparing a production sequence before beginning production. This helps to ensure the following:

- Optimum utilisation of resources
- Optimum utilisation of manpower
- Optimum utilisation of machineries
- Better control over inventory
- Better quality control

The following chart provides an overview of the production planning process:

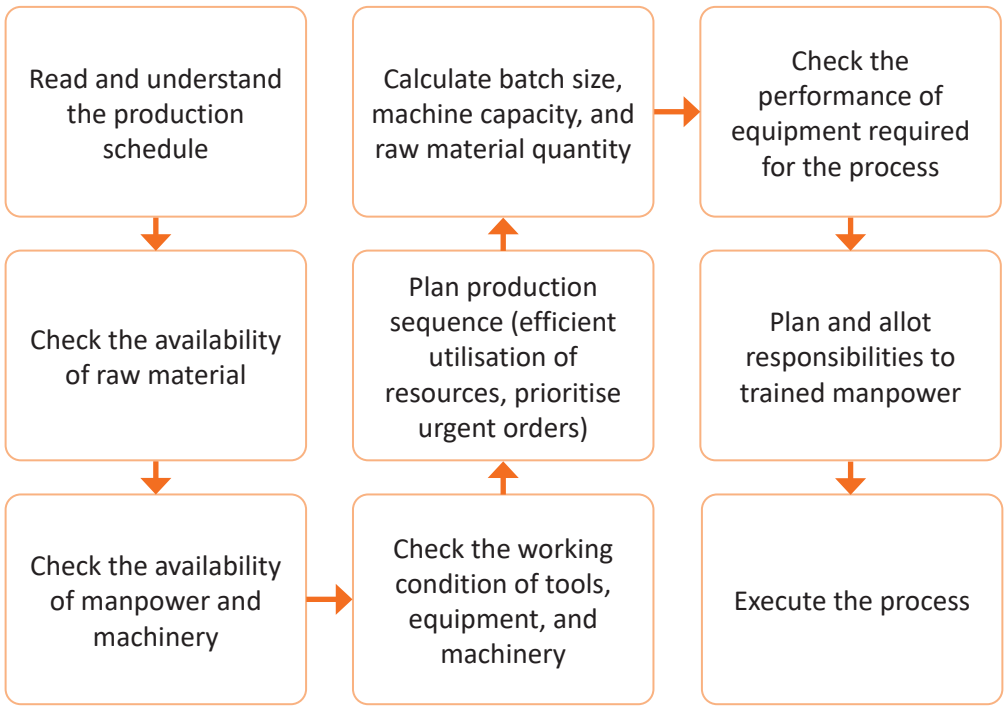


Fig.4.3.1. Production sequence

4.3.2 Process Loss

While drafting the production schedule, one must have an estimate of the process losses. Process loss is the loss that occurs while converting raw material into finished product. Such loss may occur due to:

a. The nature of raw material

In the dairy industry such a loss is frequent due to the perishable nature of milk. As a result, there may be a huge difference between the quantity of raw material processed and the quantity of finished product received. Such a loss is considered normal loss.

b. Mishandling of raw material/machinery

Such a loss occurs when the raw material is mishandled due to lack of knowledge. It may also happen if the machine has an abrupt breakdown or an accident takes place. Such a loss is considered abnormal loss.

4.2.3 Capacity Utilization

Capacity utilization is a relationship between the actual and potential production output, using its capacity of machinery and available resources. The capacity utilization percentage provides an insight into a food processing industry's operational efficiency and can vary based on consumer and market demand.

1. Following are the steps to calculate the capacity utilization of production:

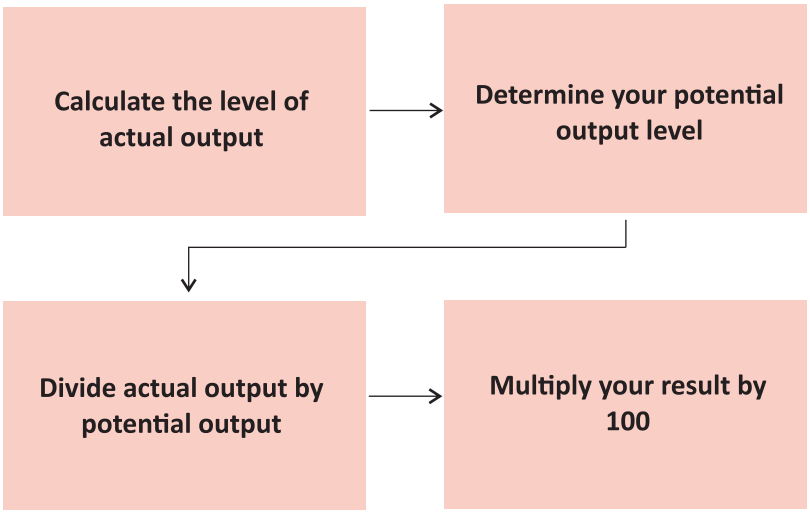


Fig.2.10 Steps to calculate Capacity utilization

The capacity utilization formula gives you the capacity utilization rate:

Capacity utilization = (actual output level / potential output) x 100

In the above formula, the actual output level represents the number of units a manufacturing unit produces within a specific period. The potential output means the maximum capacity that companies and economies can operate at when they use all resources without incurring additional operational expenses.

2. Each machine in the production line operates at a particular cycle time. Therefore, the efficiencies of a production operation in a manufacturing system can be measured based on the utilization of production resources such as machines in a particular cycle.

   Machine capacity = operating hours x operating rate x the number of machines

3. We can calculate the capacity of a process with respect to the batch size, using the following formula:

   Capacity = (batch size) / (set-up time + batch size * time per unit)

Exercise

1. Arrange the production sequence in the right order.

Procedure/Steps	Order the steps (as 1, 2, 3, 4, 5, 6, 7, 8 and 9)
a. Execute the process of making dairy products	
b. Check the availability of raw material	
c. Plan and allot responsibilities to trained manpower	
d. Plan production sequence (efficient utilisation of resources, prioritise urgent orders)	
e. Calculate batch size, machine capacity, and raw material quantity	
f. Check the working condition of tools, equipment, and machinery	
g. Check the performance of equipment required for the process	
h. Check the availability of machinery	
i. Read and understand the production schedule	

2. Match the columns.

Factors affecting efficiency	Measures
a. Utilities	i. Enhance efficiency and save time and labour
b. Efficient labour	ii. Proper scheduling of raw material
c. Work schedule	iii. Quality checks must be performed
d. Quality of raw material	iv. No working hour is wasted
e. Processing units	v. Water,electricity,refrigeration etc. should be easily available in the processing plant
f. Supply of raw material	vi. Speed and efficiency in production

Notes

5. Produce Butter and Ghee

FIC/N2011

Key Learning Outcomes

At the end of this module, the trainee will be able to:

1. Describe milk
2. State the composition of milk
3. List the different types of milk products
4. State the composition and nutritive value of milk products
5. List the various fat-rich products produced in the dairy industry
6. Explain the standard operating procedures followed in the dairy industry
7. Define butter
8. State the composition of butter
9. State the method of preparing cream for butter manufacturing
10. State the need for neutralisation of cream
11. State the importance of standardisation of cream
12. Explain the method of pasteurising cream
13. State the different types of pasteurisation methods
14. State the method of ripening cream
15. Describe the method of cooling and ageing cream
16. Explain the method of churning cream
17. Explain the method of adding colour to butter
18. State the method of adding salt to butter
19. Describe the quantity and quality of salt to be added
20. Explain the method of adding salt
21. Explain the method of adjusting moisture content in butter
22. State the method of producing butter by continuous method
23. Explain the different processes followed to produce butter by the continuous method
24. Explain the need for packaging butter
25. List the packaging materials used for packing butter
26. Explain the method of packaging and storing butter
27. Define ghee
28. State the various methods of preparing ghee
29. Explain the method of granulating and cooling ghee
30. Explain the method of packaging and storing ghee
31. Arrange for proper cleaning of production area, equipment, and tools used
32. Organise periodic maintenance of all production machineries

UNIT 5.1: Introduction to Milk

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Describe milk
2. State the composition of milk
3. List the different types of milk products
4. State the composition and nutritive value of milk products

5.1.1 Milk

As per FSSAI, "Milk is a whole, fresh, clean lacteal secretion obtained by complete milking of one or more healthy milch animals excluding that obtained within 15 days before calving or 5 days after calving. It should have the prescribed percentage of milk fat and SNF (Solid Not Fat)."

Milk of different classes and of different designations must conform to the standards laid down by FSSAI. Mixed milk means a combination of the milk from cow, buffalo, sheep, goat or any other milch animal. The combination also should conform to the standards laid by the FSSAI. The following table explains the composition of milk:

Nutritional Factor	Description	Energy Value
Protein	Milk contains protein casein, which is high quality protein. Milk contains all essential amino acids in an appropriate proportion.	4.1 KC/g
Minerals	Milk contains calcium and phosphorus.	
Vitamins	Milk is a good source of vitamins A, D, thiamine, and riboflavin.	
Fat	Milk fat plays a very important role in the flavour and physical properties of milk and its products. The fat content in milk is generally from 3.5 to 4.5%.	9.3 KC/g
Lactose	Lactose is the sugar component of milk. The principal function of lactose is to supply energy.	4.1 KC/g

Table 5.1.1 Composition of Milk

Testing Milk for Quality

Milk testing and quality control are crucial for production of milk and milk products. Milk is tested for quality at the reception dock either by organoleptic test or by Clot-On-Boiling (COB) test.

UNIT 5.2: Introduction to Fat Rich Dairy Products

Unit Objectives

At the end of this unit, the trainee will be able to:

1. List the various fat-rich products produced in the dairy industry

5.2.1 Fat-Rich Dairy Products

Fat-Rich Dairy Products

While processing milk, fat globules are separated from the rest of the milk. The fat content is then used to produce the following fat-rich products:

<table>
<tr><th>Products</th><th>Description</th></tr>
<tr><td>Cream</td><td>

Yellow component of milk, which is highly rich in fat component
Naturally rises to the surface when milk is allowed to stand
May contain permitted food additives
Further classified as:

<table>
<tr><th>Low fat cream</th><th>Medium fat cream</th><th>High fat cream</th></tr>
<tr><td>Contains milk fat, not less than 25.0 % by weight</td><td>Contains milk fat, not less than 40.0 % by weight</td><td>Contains milk fat, not less than 60.0 % by weight</td></tr>
</table>
</td></tr>
<tr><td>Butter</td><td>

Defined as fat concentrate
Obtained by churning cream
Consists of 80 %-90 % fat
Contains 16 % water and other dairy ingredients
Contains permitted additives like water, salt, and colour
Fat-free dry matter should not exceed 2 %

</td></tr>
<tr><td>Fat spreads</td><td>

Solid foods that are emulsive in nature
Contains water base as well as fats and oils
Fats could be from a vegetable, animal, marine animal or milk

</td></tr>
<tr><td>Cream powder</td><td>

Product obtained by partial removal of water from cream
Fat and/or protein content of the cream may be adjusted by addition and/or withdrawal of milk constituents
Done without altering the whey protein to casein ratio of milk
Has uniform colour and a pleasant taste and flavour, free from unusual and strange flavour and rancidity
Is free from vegetable oil fat, mineral oil, added flavour, and any substance foreign to milk

</td></tr>
<tr><td>Ghee</td><td>

Product obtained by clarifying fat derived from milk/curd/cooking butter/cream
Contains no colouring matter or added preservative

</td></tr>
</table>

Butter oil	• Product obtained by total removal of water and milk solids, not fat • Has a pleasant taste and flavour, free from unusual and strange odour and rancidity • Is free from vegetable oil fat, mineral oil, added flavour, and any substance foreign to milk • May contain permitted food additives

Table no.5.2.1. List of fat rich dairy products

Fig. 5.2.1. Fat-Rich Dairy Products

UNIT 5.3: Standard Operating Procedures

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Explain the standard operating procedures followed in the dairy industry

5.3.1 Standard Operating Procedures (SOPs)

A butter and ghee processing operator is required to follow the Standard Operating Procedures (SOP) set by the dairy processing plant. SOPs must be followed in order to ensure quality and safety of the products. Listed here is an example to explain SOPs for a process:

- SOP for churning butter:
- Before starting the machine, check the oil in the gearbox
- Clean the churn before filling it with cream
- Do not run the churn when manhole is open
- Do not put cream that is above 15°C in temperature in the churn
- Close the water and steam valve after completion of work

The correct process of opening and closing valves is crucial for a butter and ghee processing operator to understand. It is also important for the operator to understand the precaution set by the dairy industry while operating the steam and chilled water line. Before starting production, both the lines must be checked properly in co-ordination with boiler and refrigeration section. The production process must be in harmony with the operation of these sections because if there is any change in the supply of steam or chilled water, milk quality will suffer.

UNIT 5.4: Production of Butter

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Define butter
2. State the composition of butter
3. State the method of preparing cream for butter manufacturing
4. State the need for neutralisation of cream
5. State the importance of standardisation of cream
6. Explain the method of pasteurising cream
7. State the different types of pasteurisation methods
8. State the method of ripening cream
9. Describe the method of cooling and ageing cream
10. Explain the method of churning cream
11. Explain the method of adding colour to butter
12. State the method of adding salt to butter
13. Describe the quantity and quality of salt to be added
14. Explain the method of adding salt
15. Explain the method of adjusting moisture content in butter
16. State the method of producing butter by continuous method
17. Explain the different processes followed to produce butter by the continuous method

5.4.1 Introduction to Butter

Butter

Butter is a dairy product made by churning fresh or fermented cream. As per FSSAI (2011), butter is described as:

- Fatty product derived exclusively from milk of cow and/or buffalo or its products
- Principally in the form of water-in-oil type of an emulsion
- May or may not contain common salt
- May or may not contain starter cultures of harmless lactic acid and/or flavour producing bacteria
- Free from animal body fat, vegetable oil and fat, mineral oil, and added flavour
- Have pleasant taste and flavour, free from strange and unusual odour and rancidity
- May contain food additives if permitted in the regulation
- Shall conform to the microbiological requirements of the regulation

The following table explains the FSSAI standards for composition of butter:

Product	Moisture	Milk fat	Milk SNF	Common salt
Table butter	16.0 % (w/w, max.)	80.0 % (w/w, min.)	1.5 % (w/w, max)	3.0 % (w/w, max.)
Cooking butter	N/A	76.0 % (w/w, min.)	N/A	N/A

Table 5.4.1. FSSAI Standards for Butter composition

The following table explains the regulation for adding permitted colours and flavours:

Additive	Quantity
Colours (natural: individual or in combination)	
Curcumin	100 ppm max.
Beta carotene	100 ppm max.
Carotene (natural extract)	100 ppm max.
Annatto extract on Bixin/Nor bixin basis (50:50 ratio)	20 ppm max.
Beta apo-8 carotenal	35 ppm max.
Methyl ester of Beta apo-8 Carotenoic acid	35 ppm max.
Acidity Regulators	
Sodium and calcium hydroxide	2000 ppm max.

Table 5.4.2. Regulations for adding permitted colours and flavours

5.4.2 Preparation of Cream

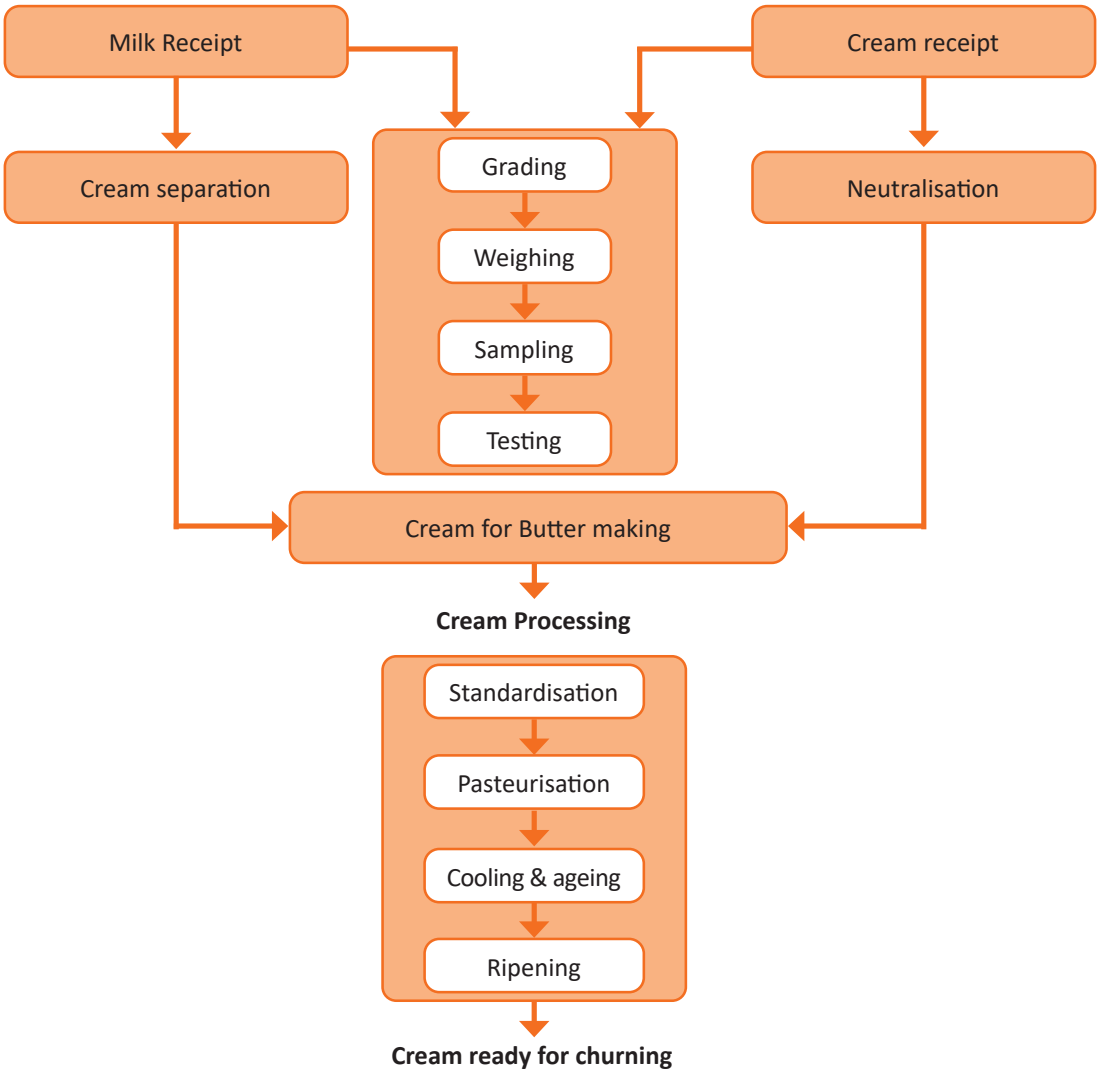


Fig. 5.4.1. Preparation of cream

5.4.3 Neutralisation of Cream

Neutralisation of Cream

Neutralisation is the process of reducing the acidity of cream.

Objectives of neutralisation:

- It helps to enhance the keeping quality of butter.
- It helps to prevent high fat loss that may occur while churning cream.
- It reduces the acidity in cream to a point (0.14 %-0.16 %), which permits pasteurisation without the risk of curdling.
- It helps to produce butter that can be stored in cold storage.
- It guards against undesirable flavours, which may result when a cream of high acid is subjected to pasteurisation at higher temperatures.
- It helps to avoid the fish-like flavour that salted-acid-butter may develop in commercial cold storage conditions (-23°C to -29°C).

5.4.4 Pasteurisation of Cream

Pasteurisation refers to the process of heating every particle of cream to not less than 70°C for 20 minutes or 80°C for 25 seconds.

Objectives of Pasteurisation

- It helps to destroy organisms that may be pathogenic or cause spoilage.
- It helps to inactivate enzymes.
- It helps to complete the neutralisation process in the production of butter.
- It helps to eliminate some of the gaseous, tainting substances.
- It helps in the removal of some volatile off colours.

Methods of Pasteurisation

Pasteurisation is done by either batch method or the High Temperature Short Time (HTST) method. Pasteurization is done either by Low temperature for long (LTLT) :

LTLT (Batch pasteurisation)	HTST pasteurisation
• Cream is heated to 70°C for 20 minutes or to 80°C for 25 seconds and then promptly cooled	• Cream is heated to 95°C to 100°C for 15 seconds and then promptly cooled
• Ideal for small-scale operations	• Ideal for large-scale operations
• Done with the help of jacketed vats	• Done with the help of plate heat exchangers

Table 5.4.3. Methods of Pasteurization

Fig.5.4.2. HTST pasteuriser

Cooling of Pasteurised Cream

After pasteurisation process, cream is cooled to minimise the growth of microorganisms. This also helps to achieve the desired fat crystallisation required for producing butter.

5.4.5 Ripening, Cooling, and Ageing Cream

Ripening of Cream

Ripening refers to the process of fermenting cream with the help of suitable starter culture. It is ripening which gives the final product its buttery flavour. It also enhances the keeping quality of butter.

The amount of starter to be added depends on several factors. In most cases, starters could range between 0.5%-2.0% of the weight of cream. After thoroughly mixing starters with the cream, it is incubated at about 21°C till the desired level of acidity is reached. The cream is then cooled at a temperature between 5°C-10°C so that acidity does not rise any further.

Cooling and Ageing Cream

Cooling and ageing are processes that prepare the cream for subsequent operation of churning. When cream leaves the pasteuriser, the fat in the globule is in liquid form. When the cream is cooled, fat crystallization starts. This helps to get the right consistency for the resultant butter. The rate of cooling also has an important influence on the body and texture of butter. The temperature to which cream is cooled is chosen in such a way that butter produced is of optimum consistency and cream churns to butter in the required time.

5.4.6 Churning Cream

Churning Cream

Churning is the process in which cream is converted into butter. The following chart explains the process in detail:

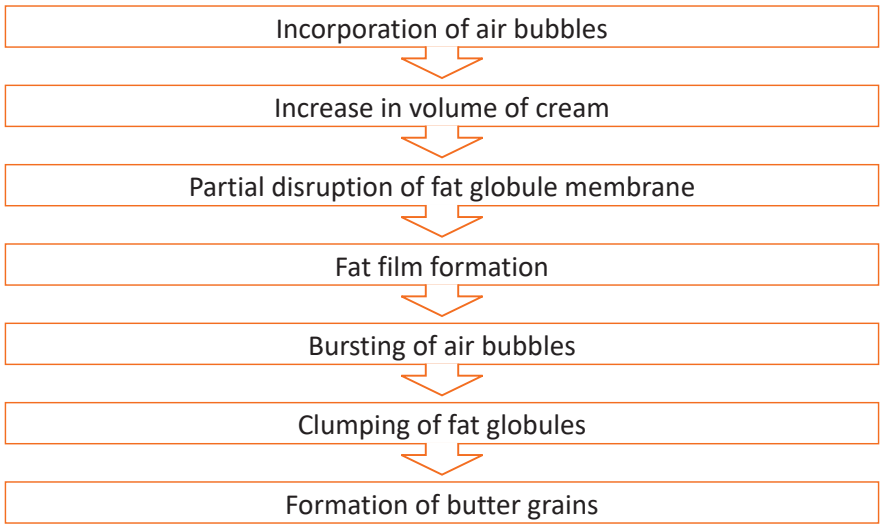


Fig.5.4.3. Churning cream

5.4.7 Addition of Colour and Salt

Addition of Colour

The natural components responsible for giving butter its colour (like carotene) vary as per season, breed, stage of lactation, feed, etc. Hence, artificial colours are added to butter so as to produce a uniform product throughout the year.

The amount of colour may vary. In some cases, 250 grams of colour is added to every 100 kilograms of butter. Colour has to be added to cream while loading the churner. Otherwise, it may be added to and mixed with salt before the final processing of butter.

Addition of Salt

Salt is added to butter for the following reasons:

- It enhances the flavour and marketability of butter.
- It improves the keeping quality of butter.
- It prevents the growth of bacteria, yeast, and moulds.
- It increases the overrun in butter. (Overrun is the difference between the weight of butter and that of the fat used to manufacture content.)

As per FSSR, 2011, the maximum permissible limit of salt in butter should not exceed 3.0 %. Salt should be white, free from foreign insoluble matter, and must be chemically pure.

Methods of Adding Salt

The following table explains the different methods of adding salt:

Adding dry salt	Adding wet salt	Adding brine
Dry salt is sprinkled evenly over butter granules before processing butter.	Dry salt is sprinkled over butter granules. This is followed by pouring enough water over salt before processing butter.	Salt is added in the form of saturated solution of brine.

Adding dry salt	Adding wet salt	Adding brine
Dry salt crystals do not get sufficient moisture and make the butter 'gritty'.	Helps in rapid dissolving of salt. It helps to avoid presence of any undissolved crystals.	Requires additional equipment and maintenance. Hence, it is not preferred in commercial butter manufacturing.

Table 5.4.4. Different methods of adding salt

Addition of Moisture

After the addition of salt, the moisture content in butter is adjusted by adding calculated amount of additional water. The maximum limit for moisture content is considered to be 16 %.

5.4.8 Continuous Method of Preparing Butter

Continuous Method of Preparing Butter

Most large-scale dairy processing units use the continuous method of preparing butter. This method has the following advantages over the batch method of processing:

- Highly economical: It requires less labour and power.
- More hygienic: It requires no manual handling of machinery. There is no scope for air-borne contamination.
- Saves time: It helps to produce butter within a span of few minutes.
- Ease of production: It helps to produce large volume of butter.
- Ease of packaging: It helps to connect produced butter directly to packaging lines.

Processes Followed to Produce Butter

The following table explains the processes followed to produce butter by the continuous method:

Churning or frothing	Concentration and phase reversal	Emulsification
Butter grain is formed by aggregation of fat globules under the action of air present in the cream	Concentrated cream will be subjected to combined effects of cooling and working and bring about a direct conversion of cream to butter	Liquid butter fat and serum are emulsified and emulsion is cooled and worked to form butter

Table 5.4.5. Procedure of continuous method to produce Butter.

UNIT 5.5: Packaging and Storage of Butter

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Explain the need for packaging butter
2. List the packaging materials used for packing butter
3. Explain the method of packaging and storing butter

5.5.1 Packaging and Storage of Butter

Need for Packaging Butter

Butter has to be packaged appropriately in order to:

- Protect butter from contamination
- Prevent loss of weight (due to evaporation) during storage
- Prevent degradation of butter (resulting in the development of flavour)
- Enhance marketability

Packaging Materials

The following table explains the different materials used to pack butter depending upon their use:

Consumer packs	Bulk packaging
Parchment paper/butter paper	Cardboard boxes
Wax-coated paper	Teak wood drums
Cellophane	Lacquered tin cans
Aluminium foil laminates	

Table no. 5.5.1. Different materials used to pack butter on the basis of their uses

Method of Packaging

The dairy industry follows three methods of packaging butter. They are:

- Manual moulding and wrapping
- Mechanical moulding and hand wrapping
- Fully automatic units that mechanically moulds, packs, and wraps butter

Fig. 5.5.1: Butter packaging

Storage of Butter

Butter should be placed in cold storage immediately after wrapping. It should be chilled at 4^0C for 24 to 48 hours. Low storage temperature improves its keeping quality and reduces the risk of the package being deformed.

UNIT 5.6: Production of Ghee

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Define ghee
2. State the various methods of preparing ghee
3. Explain the method of granulating and cooling ghee

5.6.1 Introduction to Ghee

Ghee

According to FSSR (2011), ghee means the pure, heat clarified fat derived solely from milk, curd, desi (cooking) butter or from cream to which no colouring matter or preservative has been added.

Methods of Preparing Ghee

Ghee is prepared with the help of the following five methods:

1. **Indigenous method:**

   In this method, excessive milk is cultured and kept overnight for fermentation. The resultant curd is churned using hand-driven wooden beaters to separate the milk fat in the form of butter. The butter is then boiled. This is followed by the clarification and decantation process, which results in the production of ghee.

2. **Direct cream method:**

   This method involves separation of cream of 60 % to 70 % fat from milk by centrifugation process. Alternatively, fresh cream or cultured cream is heated to 112-116°C in a stainless steel, jacketed ghee kettle to produce ghee.

3. **Creamery buttery method:**

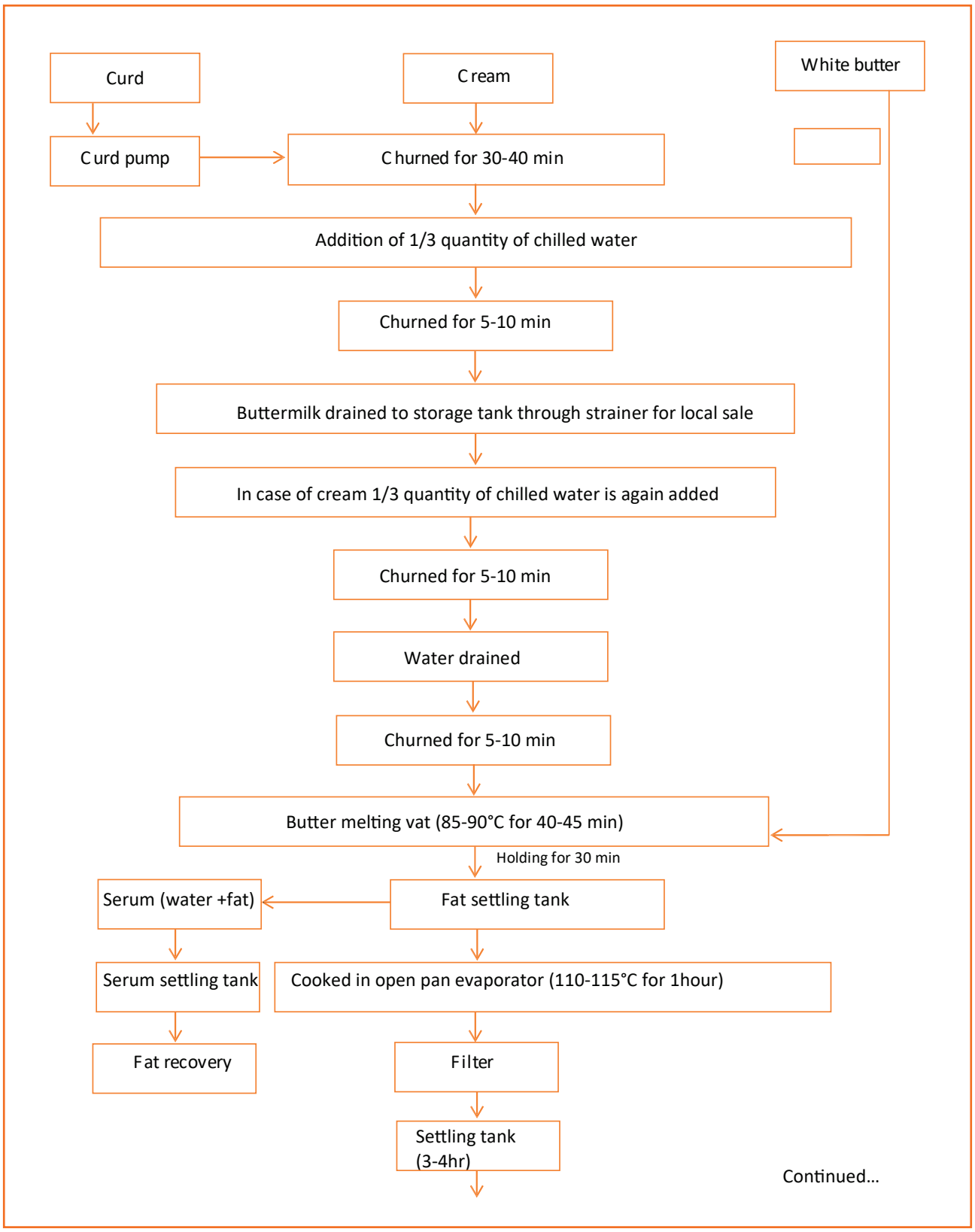
   In this method, unsalted or white butter is used as raw material. Butter mass or butter blocks are melted at 60°C to 80°C in butter melter. Molten butter is pumped into the ghee boiler where final heating will be done using steam as heating medium.

4. **Pre-stratification method:**

   In this method, butter is heated to 80°C for about 30 minutes. After this, buttermilk is drawn-off and the fat is heated to 120°C at which it is fully clarified and sent for packaging.

5. **Continuous method:**

   This method is commonly used in large industrial units. Butter is heated in a butter melter to molten state and then transferred to the balance tank. It is further pumped to Scraped Surface Heat Exchanger (SSHE), followed by flashing in vapour separator. Heating in SSHE and flashing are repeated in next two stages to reduce the moisture level. Ghee is then passed through centrifugal clarifier where residue is removed. Clarified ghee is stored for filling and packing.


Curd
Cream
White butter
Curd pump
Churned for 30-40 min
Addition of 1/3 quantity of chilled water
Churned for 5-10 min
Buttermilk drained to storage tank through strainer for local sale
In case of cream 1/3 quantity of chilled water is again added
Churned for 5-10 min
Water drained
Churned for 5-10 min
Butter melting vat (85-90°C for 40-45 min)
Holding for 30 min
Serum (water +fat)
Fat settling tank
Serum settling tank
Cooked in open pan evaporator (110-115°C for 1hour)
Fat recovery
Filter
Settling tank (3-4hr)
Continued...

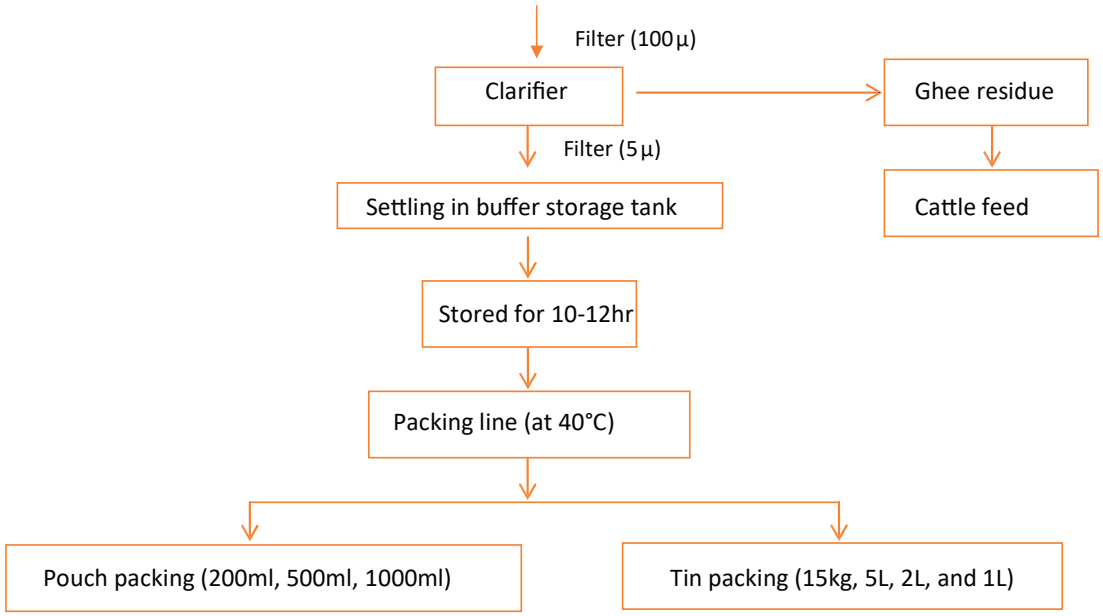


Fig. 5.6.1: Flow chart for ghee preparation

5.6.2 Granulation and Cooling of Ghee

Granulation and Cooling of Ghee

Granulation is an important criterion for determining the quality of ghee. A higher temperature of clarification gives better grain size to the produced ghee. For better granulation, ghee should be slowly cooled to 28°C for 2-3 hours.

UNIT 5.7: Packaging and Storage of Ghee

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Explain the method of packaging and storing ghee

5.7.1 Packaging and Storage of Ghee

Packaging Ghee

Ghee can be stored for 6-12 months if it is filled and packed properly. Hence, the packaging material should be such that would:

- Not react with ghee
- Be easily available and be cost-effective
- Be non-toxic
- Not allow printing ink to penetrate into the product
- Protect against tempering
- Have barrier properties against spoilage causing agents
- Withstand wear and tear during transportation

The following packaging materials are used for packaging ghee:

- Tin cans
- Glass bottles
- Semi-rigid containers
- Flexible film pouches
- Storage of Ghee

Ghee can be stored upto 12 months at 21^0C. Storing at a higher temperature may increase the acidity of ghee. Although lower temperature increases the shelf life, it may also result in a greasy texture of ghee.

Fig. 5.7.1: Ghee packaging

5.7.2 Tests Done for Butter

- Butter is filled in a petriplate and kept in foodscan to test various parameters like fat, SNF, TS, salt, curd and moisture.
- The colour of butter is test using a photometer. The colour range is 38-42.

5.7.3 Tests Done for Ghee

Sl. No.	Tests	Procedure	Observation & Interpretation
1	Free fatty acid	9.4ml of sample is taken in a conical flask and 50ml neutralized spirit is added. It is placed on the hot plate till boiling. Cooled at room temperature and titrated with 0.1 N NaOH solution using phenolphthalein as an indicator. Light pink colour appears.	Free Fatty acid%= Titrate value * 0.3
2	Moisture	A clean flat bottomed dish is weighed and to it 10ml sample is transferred and weight is noted. Ghee is heated in a hot plate until appearance of dark brown colour. It is cooled and weighed.	Moisture%= (wt of moisture / wt of ghee) ×100 Moisture content in ghee should be 0.3%

Table 5.7.1: Tests Done for Ghee

UNIT 5.8: Post Production Cleaning and Maintenance

Unit Objectives

At the end of this unit, the trainee will be able to:

1. Arrange for proper cleaning of production area, equipment, and tools used
2. Organise periodic maintenance of all production machineries

5.8.1 Post Production Cleaning Method

This explains the method of cleaning the work area after production.

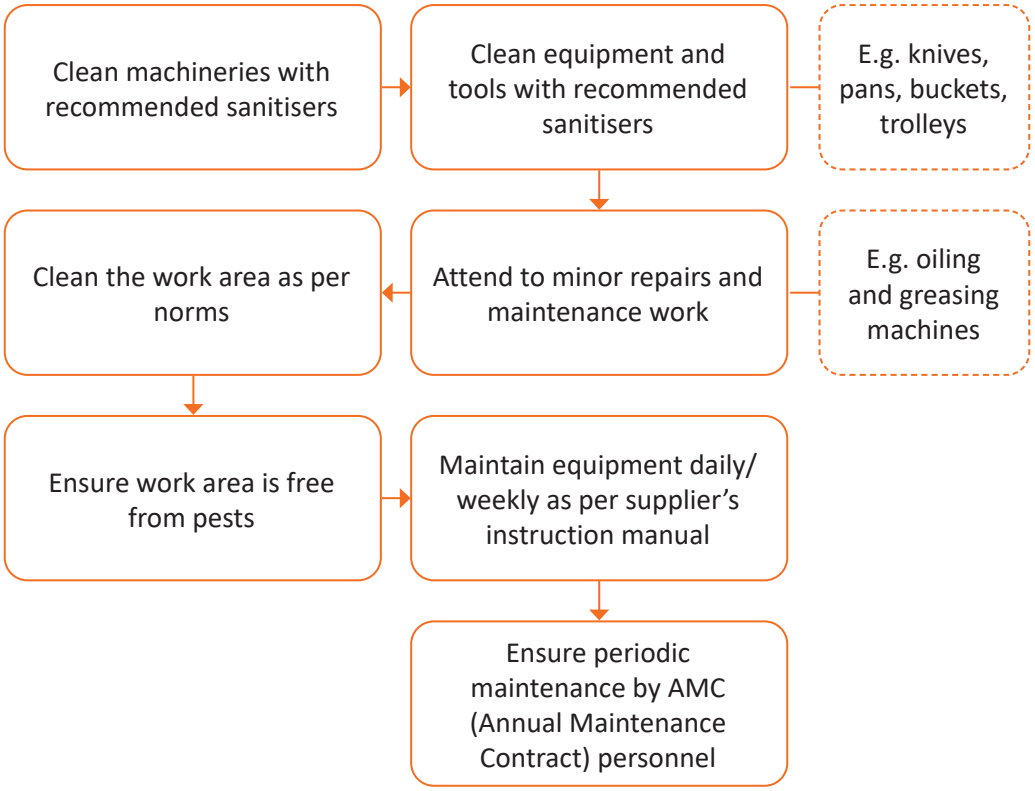


Fig.5.8.1. Post production cleaning and maintenance process

Exercise

1. Fill in the blanks with the correct option.

a. Milk can be used after _____ days of calving.

i. 6
ii. 10
iii. 5
iv. 7

b. Lactose is the _____ component of milk.

i. protein
ii. sugar
iii. liquid
iv. vitamins

c. Milk contains a high quality protein called _____.

i. amino acid
ii. casein
iii. proteinase
iv. lactase

d. _____ is the process in which cream is converted into butter.

i. Concentration
ii. Preservation
iii. Emulsification
iv. Churning

e. As per FSSR, 2011, the maximum permissible limit of salt in butter should not exceed _____.

i. 2%
ii. 3%
iii. 1%
iv. 10%

f. Two methods used to calculate fat content of cream are _____ and _____.

i. Pearson's square method, Correlation
ii. Arithmetical calculations, Pearson's square method
iii. Arithmetical calculations, Correlation
iv. Correlation, Summation

g. Butter should be chilled at 4°C for _____ hours.

i. 10-15
ii. 24-48
iii. 15-20
iv. 5-10

h. A higher temperature used during _____ gives better grain size to the produced ghee.

i. concentration
ii. preservation
iii. clarification
iv. churning

i. Storing ghee at a higher temperature increases the _____ of ghee.

i. purity
ii. rancidity
iii. acidity
iv. clarity

j. Ghee can be stored for _____ months if it is filled and packed properly.

i. 6-12 ii. 4-10

iii. 1-6 iv. 1-4

2. Match the columns.

Name of the method	Method
a. Indigenous method	i. Cream and fat separation
b. Direct cream method	ii. Butter blocks are melted at 60°C to 80°C in butter-melter
c. Creamery buttery method	iii. Culturing and fermentation, followed by boiling
d. Pre-stratification method	iv. Heating butter
e. Continuous method	v. Heated to molten state

3. Arrange the post production cleaning process in the right order.

Procedure/Steps	Order the steps (as 1, 2, 3, 4, 5 and 6)
a. Ensure periodic maintenance by AMC (Annual Maintenance Contract)personnel	
b. Clean machineries with recommended sanitisers	
c. Attend to minor repairs and maintenance work	
d. Clean equipment and tools with recommended sanitisers	
e. Clean the work area as per norms	
f. Ensure work area is free from pests	

Practical

Objective

1. Execute the process of producing butter from butter cream

Materials Required (symbol)

- Cream
- Storage Tanks
- Pasteurizer
- PPE
- Standard Operating System (SOP)
- Safety Manual

Method:

2. Pasteurize the cream at the temperature of 95◦C or more to destroy enzymes and microorganism.
3. Start ripening of the cream
4. Add starter culture at 0.5% - 2.0% of the weight of the cream
5. Mix the starter with the cream and incubate it to 21◦C till the desired level of acidity is reached.
6. Let the cream cool at a temperature between 5◦C-10◦C so that acidity does not rise any further.
7. Hold the cream at cooling temperature to crystallize the butter fat globules to ensure proper churning and get the texture of the butter.
8. Keep the cool crystallised cream in the aging tank for 12-15 hours
9. Pump the cream from the aging tank to churn using continuous butter maker
10. Check the butter granules are formed and grow larger and coalesce
11. Add salt to improve the flavour and the shelf life, as it acts as a preservative
12. Pat the butter to shape and wrap in waxed paper-manually/mechanically or using fully automatic moulding-packing and wrapping butter
13. Keep the packed butter chilled at 4◦C for 24 to 48 hours before cold storage and dispatch

Precautions:

1. Maintain proper temperature during churning to obtain proper grain size.
2. Over ripening of cream should be avoided
3. End to end butter churn should be used for better results
4. Butter should be prepared by adopting hygienic conditions
5. Ensure that the final product is as per FSSAI standards

Observation:

Sr. No.	Name of Process	Time Taken to finish each process
1		
2		
3		
4		
5		

Conclusion:

Sr. No.	Conclusion			
1				
2				
3				
4				
5				

Practical

Objective

1. Execute the process of producing ghee from butter/cream

Materials Required (symbol)

- Ripened cream/Cream/Butter
- PPE
- Standard Operating System (SOP)
- Safety Manual

Method:

2. 1.Warm the milk at 40◦C-50◦C.
3. Separation of Cream
4. 38-40% cream acquired
5. Pasteurize at 80◦C per 15 seconds
6. Cool it for 7◦C-8◦C
7. Churning of Butter
8. Boiling of Ghee for fat clarification
9. Filtration of the ghee residues
10. Packaging of the obtained ghee

Precautions:

1. Wear PPE while operating machines
2. Safely handle all electrical systems
3. Ensure that machines are turned off after the operation
4. Cool the ghee slowly to get large sized grains as sudden cooling will lead to small sized grains

Observation:

Sr. No.	Ingredients	Quantity of Ghee Produced	Size of ghee granules
1			
2			
3			
4			
5			

Conclusion:

Sr. No.	Conclusion			
1				
2				
3				
4				
5				

Notes

Scan the QR codes or click on the link to watch the related videos

https://www.youtube.com/watch?v=1aGi2zZDMpU

Butter Manufacturing

https://www.youtube.com/watch?v=Kz6Rkoogb7A

Packaging and Storage of Butter and Ghee

https://www.youtube.com/watch?v=5o6xyViYzKU

Ghee processing

https://www.youtube.com/watch?v=xtZxtUHw2WE

Testing Ghee Adulteration with Starch

https://www.youtube.com/watch?v=SNbE7bTpbQU

Testing Butter Adulteration with Starch

https://www.youtube.com/watch?v=PEhHesYE3_4

Testing Butter and Ghee Adulteration with coal tar

NCVET
कौशल गुणवत्ता प्रगति

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
RE IMAGINE FUTURE

6. Complete Documentation and Record Keeping Related to Butter and Ghee Production

FICSI
Food Industry Capacity and Skill Initiative

Unit 6.1 - Documentation and Record Keeping

FIC/N2012

Key Learning Outcomes

At the end of this module, the trainee will be able to:

1. State the need for documenting and maintaining records of raw materials, process, and finished products
2. State the method of documenting and recording the details of raw material to final finished product
3. Observe the various facilities, machineries in the food processing industry

UNIT 6.1: Documentation and Record Keeping

Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the need for documenting and maintaining records of raw materials, process, and finished products
2. State the method of documenting and recording the details of raw material to final finished product

6.1.1 Need for Documentation

Every organisation has to maintain records of raw material procurement, production processes, and sales. This is to ensure that the business runs effectively and is profitable. Listed below are some reasons why there is a need for documentation:

- It gives detailed knowledge about running of the business
- It helps to control product quality
- It helps to keep track of the money invested in the business
- It helps to identify the separate costs of raw material or product ingredients
- It helps to identify the production cost of a particular process
- It helps to ensure that quality assurance procedures are followed
- It helps to ensure that the production unit is running smoothly/effectively
- It works as an evidence for legal procedures
- It helps to set an appropriate product price
- It helps to take corrective measures at the right time

6.1.2 How to Keep Records?

Every food processing organisation follows a more or less similar way of keeping records. Production records keep a log of:

- The quantity and type of raw materials
- The quantity and type of ingredients used
- The processing conditions in which production took place (e.g. the temperature set or the air pressure applied)
- The product quality

Product quality can be maintained only when:

- The same quantity and quality of ingredients and raw materials are mixed in every batch
- A standard formulation is used for every batch
- Standard process parameters are applied for every batch

Every batch of food is given a batch number. This number is recorded in:

- Stock control books (where raw material procurement is noted)
- Processing log books (where production process is noted)
- Product sales records (where sales and distribution is noted)

The batch number must correlate with the product code number, which is printed on labels. This helps to trace any fault found in a batch back to the raw material used or the production process.

Example of a stock control book:

• Product Name			• Batch Number	
• Raw material*	• Supplier	• Results of inspection for:		
		A	B	C

Exercise

1. Tick the correct options.

a. What is the need for documentation?

i. It gives detailed knowledge about the running of a business. ☐

ii. It helps to control product quality. ☐

iii. It helps to keep track of the money invested in the business. ☐

iv. It helps to identify the separate costs of raw material or product ingredients. ☐

v. It helps to identify the production cost of a particular process. ☐

vi. It helps in raw material storage. ☐

vii. It helps to ensure that quality assurance procedures are followed. ☐

viii. It helps to ensure that the production unit is running smoothly/effectively. ☐

ix. It works as an evidence for legal procedures. ☐

x. It helps to clean the food handling equipment and machineries. ☐

xi. It helps in sending the produce to the market. ☐

xii. It helps to set an appropriate product price. ☐

xiii. It helps to take corrective measures at the right time. ☐

b. Production records keep a log of _____ .

i. The quantity and type of raw materials. ☐

ii. The amount of finished products stored. ☐

iii. The quantity and type of ingredients used. ☐

iv. The processing conditions in which production took place (e.g. the temperature set or the air pressure applied). ☐

v. The product quality. ☐

2. Match the columns.

Column A	Column B
a. Every production process completed is given a number	i. Stock control books
b. The details of raw material procurement is noted	ii. Batch number
c. The details of production process is noted	iii. Quality procedures are followed
d. The details of product sales is recorded	iv. Legal evidence
e. Records serve as	v. Processing log books
f. Properly maintained records help to identify whether	vi. Sales and distribution log

Notes

Scan the QR codes or click on the link to watch the related videos

https://www.youtube.com/watch?v=kcpGlHBpphA&t=71s

Audit, Documentation and Record keeping

NCVET
कौशल गुणवत्ता प्रगति

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
RE IMAGINE FUTURE

FICSI
Food Industry Capacity and Skill Initiative

7. Employability Skills

DGT/VSQ/N0101

Scan the QR codes or click on the link to watch the related videos

https://www.skillindiadigital.gov.in/content/list

Employability Skills

NCVET
कौशल गुणवत्ता प्रगति

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
RE IMAGINE FUTURE

FICSI
Food Industry Capacity and Skill Initiative

8. Annexure

Module No.	Unit No.	Topic Name	Page No	Link for QR Code (s)	QR code (s)
1. Introduction	UNIT 1.2: Introduction to the Food Processing Industry	1.2.1 Food Processing	11	https://www.youtube.com/watch?v=J-2EiMVNtpM&t=14s	Overview of Food Processing Industry
	UNIT 1.3: Introduction to the Dairy Industry in India	1.3.1 Dairy Industry in India	11	https://www.youtube.com/watch?v=4XuvGYvKGnE	Overview of dairy industry
		1.3.2 Units of a Dairy Processing Plant	11	https://www.youtube.com/watch?v=t2LerU8-aXY	Introduction to Butter and Ghee
	UNIT 1.4: Attributes of a Butter and Ghee Processing Operator	1.4.1 Roles and Responsibilities	11	https://www.youtube.com/watch?v=GU5nObbJCxc	Orientation video
		1.4.1 Roles and Responsibilities	11	https://www.youtube.com/watch?v=zc7-SstpWjc	Roles and Responsibilities
2. Food Safety, Hygiene and Sanitation for Processing Food Products	UNIT 2.3: Good Manufacturing Practices (GMP)	2.3.1 Good Manufacturing Practices (GMP)	29	https://www.youtube.com/watch?v=RS4A-uczS6E&t=32s Mod. 2	GMP,GHP & FSMS

Module No.	Unit No.	Topic Name	Page No	Link for QR Code (s)	QR code (s)
	UNIT 2.1: Sanitation and Hy-giene	2.1.1 Person-al Sanitation	29	https://www.youtube.com/watch?v=iq8jOuZ5k6k	Pest Control
		2.1.1 Person-al Sanitation	29	https://www.youtube.com/watch?v=daNjRoP_I0c&t=31s	Personnel hygiene and employee facilities
	UNIT 2.3: Good Man-ufacturing Practices (GMP)	2.3.1 Good Manufac-tur-ing Practic-es (GMP)	29	https://www.youtube.com/watch?v=gNEx-8P9UqPA&t=106s	Personnel Hygiene and per-sonal behaviour
		2.1.1 Person-al Sanitation	51	https://www.youtube.com/watch?v=1y_bN5Kt40o	Equipment's used in Butter and Ghee
3. Prepare and Main-tain Work Area and Process Machin-er-ies for Butter and Ghee Pro-duc-tion	UNIT 3.1: Usage and Mainte-nance of Equipment and Ma-chin-eries	3.1.1 Equip-ment Used in Dairy Pro-cess-ing	51	https://www.youtube.com/watch?v=QWpU7DAf-Ncs&t=38s	Cleaning and Sanitation

Module No.	Unit No.	Topic Name	Page No	Link for QR Code (s)	QR code (s)
	UNIT 3.3: Cleaning Processes	3.3.5 Process of Cleaning the Work Ar-ea	51	https://www.youtube.com/watch?v=tRAnusofqJ8&t=52s	Maintenance
5. Pro-duce But-ter and Ghee	UNIT 5.2: Introduction to Fat Rich Dairy Prod-ucts	5.2.1 Fat-Rich Dairy Prod-ucts	88	https://www.youtube.com/watch?v=1aGi2zZDMpU	Butter Manufacturing
	UNIT 5.5: Packaging and Storage of Butter	5.5.1 Pack-ag-ing and Stor-age of Butter	88	https://www.youtube.com/watch?v=Kz6Rkoogb7A	Packaging and Storage of Butter and Ghee
	UNIT 5.6: Production of Ghee	5.6.1 In-tro-duction to Ghee	88	https://www.youtube.com/watch?v=5o6xyViYzKU	Ghee processing
	UNIT 5.7: Packaging and Storage of Ghee	5.7.3 Tests Done for Ghee	88	https://www.youtube.com/watch?v=xtZxtUHw2WE	Testing Ghee Adulteration with Starch
		5.7.3 Tests Done for Ghee	88	https://www.youtube.com/watch?v=SNbE7bTpbQU	Testing Butter Adulteration with Starch

Module No.	Unit No.	Topic Name	Page No	Link for QR Code (s)	QR code (s)
		5.7.3 Tests Done for Ghee	88	https://www.youtube.com/watch?v=PEhHesYE3_4	Testing Butter and Ghee Adulteration with coal tar
6. Complete Documen-tation and Record Keeping Related to Butter and Ghee Pro-duc-tion	UNIT 6.1: Documen-ta-tion and Record Keeping	6.1.1 Need for Documen-ta-tion	94	https://www.youtube.com/watch?v=kcpGlHBpphA&t=71s	Audit, Documentation and Record keeping
Employability Skills (30 Hrs)				https://www.skillindiadigital.gov.in/content/list	

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

NCVET
कौशल गुणवत्ता प्रगति

N·S·D·C
RE IMAGINE FUTURE

FICSI
Food Industry Capacity and Skill Initiative

Address: **Food Industry Capacity and Skill Initiative**
Shriram Bharatiya Kala Kendra, 3rd floor, 1
Copernicus Marg, Mandi House, New Delhi-110001
Email: admin@ficsi.in
Web: www.ficsi.in
Phone: +91-9711260230, +91-9711260240

Price: ₹