



Participant Handbook

Sector
Food Processing

Sub-Sector
Fruits and Vegetables

Occupation
Processing - Fruits and Vegetables

Reference ID: **FIC/Q0103, Version 3.0**
NSQF Level 3



**Jam, Jelly and Ketchup
Processing Technician**



Shri Narendra Modi
Prime Minister of India

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



**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: ' Jam, Jelly and Ketchup 'QP No. ' FIC/0103, NSQF Level 3
Processing Technician

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Food Industry Capacity & Skill Initiative

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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.

About this book

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

This book is designed to enable a candidate to acquire skills that are required for employment. The content of this book is completely aligned to the National Occupation Standards QP/NOS and conform to the National Skills Qualification Framework (NSQF).

The Qualification pack of Jam, Jelly and Ketchup Processing Technician, Level 3 includes the following NOS's which have all been covered across the units

1. **FIC/N0109:** Prepare and maintain work area and process machineries for jam, jelly and ketchup processing
2. **FIC/N0110:** Prepare for production of jam, jelly and ketchup
3. **FIC/N0111:** Produce jam, Jelly and ketchup
4. **FIC/N0112:** Complete documentation and record keeping related to production of jam, jelly and ketchup
5. **FIC/N9001:** Ensure Food safety, hygiene and sanitation for processing food products
6. **DGT/VSQ/N0101:** Employability Skills (30 Hours)

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

Symbols Used



Key Learning
Outcomes



Steps



Exercise



Notes




Unit
Objectives

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1. Introduction to the Training Program



Unit 1.1 - Introduction to Training Program

Unit 1.2 - Introduction to Food Processing Industry

Unit 1.3 - Introduction to Fruit and Vegetable Processing

Unit 1.4 - Introduction to Jam and Jelly Processing

Unit 1.5 - Workplace Policy



Key Learning Outcomes



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

1. Explain the objectives of the training
2. Discuss the National Vocational Standards and Qualification Pack
3. Briefly discuss the size and scope of the food processing industry.
4. State the need for fruit and vegetable processing.
5. State the common methods of processing fruits and vegetables.
6. Define jam and jelly.
7. List the differences between Jam and Jelly.
8. Tell how to work at a workplace.

Unit 1.1 - Introduction to Training Program

Unit Objectives



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

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

1.1.1 Purpose and Benefits of the Training Program

This training program is organized to provide specific skills to individuals who want to become a processed food entrepreneur. The training program is based on the National Vocational Standards for the Food Processing Sector. The following sub-sections of this chapter describe the National Occupational Standards.

The training program will enable an individual:

- To assess and develop entrepreneurial skills
- Select the product and make the business plan
- In preparing to start a food processing unit
- Starting a food processing unit
- Complete documentation and record keeping
- In ensuring food safety, hygiene and sanitation

You will be issued a certificate after successfully completing the training and passing the exam.

1.1.2 Introduction of the Training Programme

The objective of this training program is to provide basic skills and knowledge relevant to the job role required to work in the food processing industry. This program is based on an eligibility pack called Jam, Jelly and Ketchup Processing Technician. The Qualification Pack Code for Jam, Jelly and Ketchup Processing Technician is FIC/Q0103.. It is also called QP.

A QP consists of a collection of National Occupational Standards (NOS). NOS refers to the standard competence that an employee must perform while performing any job at the workplace.

Under Jam, Jelly and Ketchup Processing Technician QP, there are five NOS which detail the job duties as a Jam, Jelly and Ketchup Processing Technician.

NOS Code	NOS Name
FIC/N0109	Prepare and maintain work area and process machineries for jam, jelly and ketchup processing
FIC/N0110	Prepare for production of jam, jelly and ketchup
FIC/N0111	Produce jam, Jelly and ketchup
FIC/N0112	Complete documentation and record keeping related to production of jam, jelly and ketchup
FIC/N9001	Ensure Food safety, hygiene and sanitation for processing food products

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



www.youtube.com/watch?v=KGXgGQdaIQw
Overview of food processing industry



www.youtube.com/watch?v=0pam4wglkNU
Orientation

Unit 1.2 - Overview of the Food Processing Industry

Unit Objectives

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

1. List the various sectors of food processing industry;
2. Define food processing

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 1.1.1 Sub-sector of food process industry

The Indian food industry is a star sector in India with bright prospects for growth and development. The Indian food and grocery market is the sixth-largest in the world. The 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 trends that is seen in this sector is the online ordering of food. Even though this segment is still in its early stages of development, it is growing at an increasingly fast pace.

The 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 the work of cooking for the family or home, but in modern times women are becoming entrepreneurs in this sector, breaking this orthodox tradition. Women are also now becoming chefs and bakers, and are contributing to the progress of this sector and the country.

1.2.2 Journey of Food from Harvest to Consumer

The following chart explains the journey harvested food undertakes to reach the consumer. The chart also shows the different types of consumers in the domestic and international market.

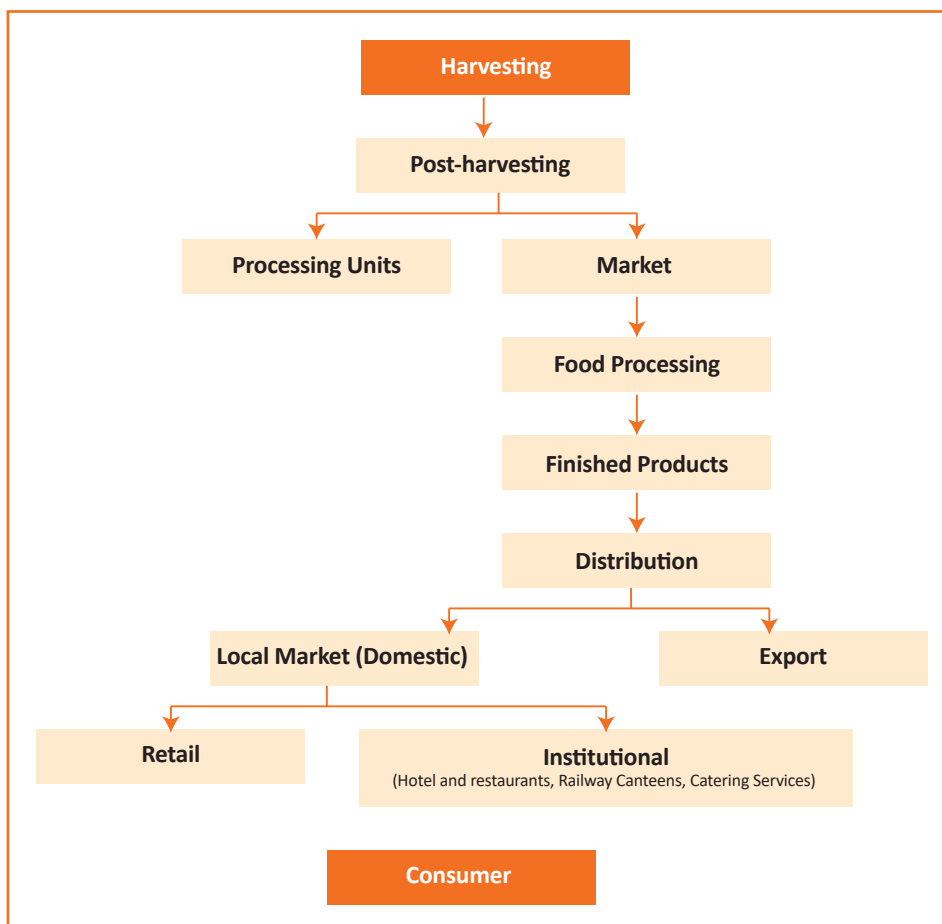


Fig. 1.2.2 Journey of Food from Harvest to Consumer

Unit 1.3 - Fruit and Vegetable Processing

Unit Objectives



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

1. State the need for fruit and vegetable processing;
2. State the common methods of fruit and vegetable processing.

1.3.1 Overview of the Fruit and Vegetable Sub-Sector

The fruit and vegetable processing sub-sector deals with processed foods, semi-processed foods, and packaged foods that are made from fruits and vegetables. This includes:

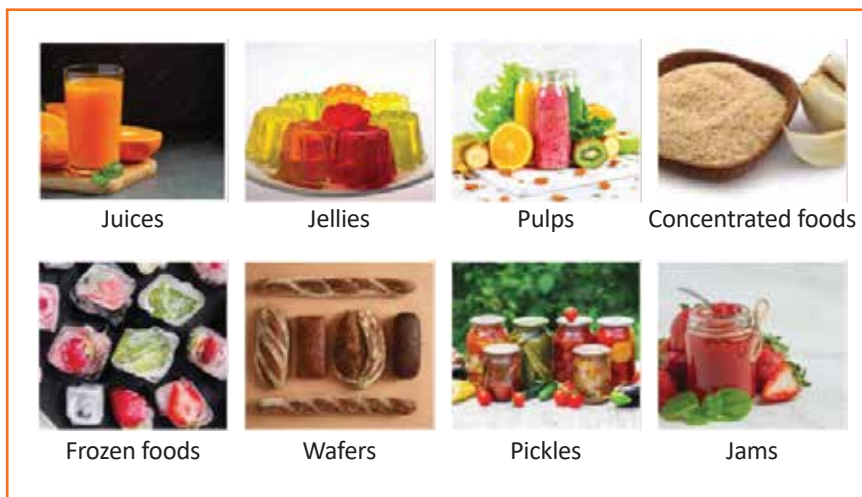


Fig. 1.3.1 Various refined and semi-refined food products

There are certain parameters that are important to consider when selecting a fruit/vegetable for processing. They are:

- Demand for processed food made from that vegetable/fruit
- High quality produce
- Continuous supply
- Huge supply in case of seasonal fruits/vegetables

These parameters are important to ensure that raw materials withstand the processing and preservation process.

1.3.2 Methods of Processing Fruits and Vegetables

Some common methods of processing fruits and vegetables are:

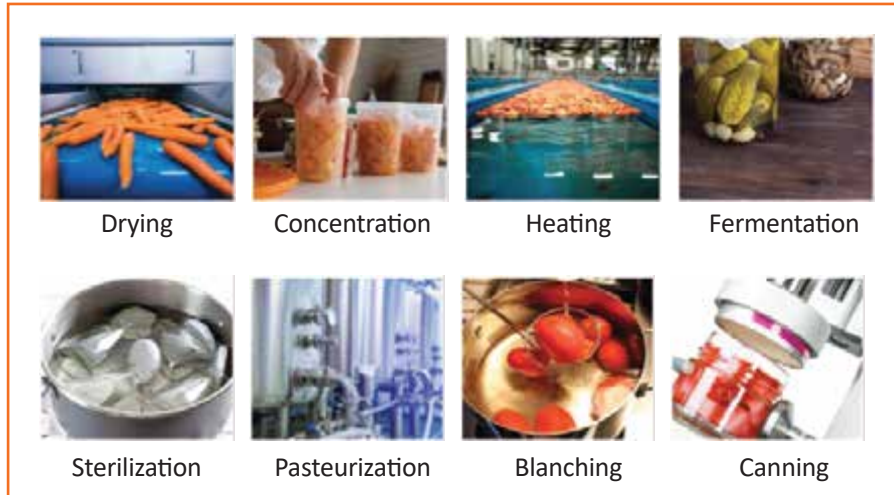


Fig. 1.3.2 Different Systems of Food Processing

Unit 1.4 - Overview of Jam, Jelly, and Ketchup

Unit Objectives



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

1. Define jam, jelly, and ketchup.
2. List the differences between jelly and jam.

1.4.1 Jam and Jelly

Jam is made from the pulp of a single fruit or a mixture of fruits. The pulp of the fruit is cooked by boiling it with an appropriate amount of sugar until it is thick enough to hold the fruit tissue in place. Fruits like apple, chikoo, papaya, plum, mango, grapes, jackfruit, pineapple, banana, guava and pear are used for making jam.



Fig. 1.4.1 Jam

Jelly is a semi-solid food product made by boiling a clear solution of fruit extract containing pectin, depulping it, and then adding sugar and acid. An ideal jelly should be transparent, well cooked but not too hard, and retain the original flavor of the fruit. It should be attractive in color and retain the shape of the mold. It should be firm enough to hold its sharp edge, but gentle enough to squeeze out of the mold. The jelly should not be sticky, syrupy or have crystallized sugar. In fact, the product should be free of dullness. It should not be hard and rubbery. As per FSSAI regulation, the total soluble solids content in case of Gem should not be less than 65 per cent. It should not be less than 60 percent by weight of jelly.



Fig. 1.4.2 Jelly

Please pay attention:

As per FSSAI, under Chapter 2.3.31 of FSSA (Food Product Standards and Food Additives) Regulations, 2011

1. Jam means a product prepared from one or two or more types of suitable fruit ingredient which
 - i. whole fruit, pieces of fruit, pulp of fruit or puree of fruit;
 - ii. with or without fruit juice or concentrated fruit juice or dehydrated fruit as an alternative
 - iii. component;
 - iv. mixed with water with or without nutritive sweetener; And
 - v. Processed to a suitable consistency.
2. Fruit jelly means fruit juice or fruit or aqueous extract of one or more fruits of sound quality by boiling with or without water, expressing and filtering the juice, adding nutritive sweeteners, and so on consistency Concentrated product. On cooling a gel is formed. The product should be clear, shiny and translucent. It may also contain any other ingredient suitable to the product, including derivatives such as fibre, extracts, spices and condiments.

1.4.2 Difference in Jam and Jelly

Most kinds of fruit and some vegetables are used to make a wide variety of jam and jelly. Jelly and jam is used as bread spread and as a filling for some cakes and cookies.

Jam is boiled fruit pulp with sugar and preservatives and is thick. Fruit jam is available in mango, apple, mixed fruit, pineapple, orange, and combination of the above mentioned flavours.

Jelly is a clear, bright mixture made from fruit juice, sugar, and sometimes pectin. It is made by boiling, but is clear, sparkling, and transparent.

Jelly and jam have differences, which are:

Jelly	Jam
<ul style="list-style-type: none"> • It is made from clear juice of fruit • It is clear, sparkling, and transparent • It is uniformly mixed product • Examples : Jamun, apple, jack fruit, strawberry 	<ul style="list-style-type: none"> • It is made with suspended fruit particles in processed pulp • It is indistinct and translucent • It is a scantily mixed product • Examples: Peach, pear, cherry, mango, plum

Ketchups are popular varieties of sauces made from tomato puree. It is also an important type of preserve that is popularly consumed as table serve.

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



<https://www.youtube.com/watch?v=g-KvHkrLcNs>

Introduction to Jam, Jelly and Ketchup

Unit 1.5 - Workplace Policy

Unit Objectives

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

1. Explain how to operate a workplace.

1.5.1 How Should You Act in a Workplace?

Workplace policy is a set of guidelines that are followed to make a workplace run smoothly and effectively. Some points to remember are as follows -

- Treat superiors, assistants and employees with respect.
- Follow the procedures laid down in the production unit.
- Always follow food safety rules.
- Do not compromise on the quality of the product at any cost.
- Do your work with full honesty.
- Perform your roles and responsibilities honestly.
- Be a team player

Workplace Hygiene and Safety Checklist:

- Put on your headgear
- Wear your shirt
- Put your coat on
- Wear your face mask
- Put on your gloves
- Wear your safety shoes
- Ready? Now you can start working.



Fig. 1.5.1 Staff taking orders

Sanitation and Sanitizing

1. **Pre-hygiene** - Clean the food items by throwing them in the dustbin to remove the remaining food items.
2. **Washing:** Use a cleaning agent to remove the frozen food items.
3. **Washing without soap:** To remove food and cleaning agents
4. **Sanitize:** To eliminate bacteria and other viruses.
5. **Air Dry:** To dry.

2. Organizational Standards and Norms



Unit 2.1 - Role and Responsibilities of Jam, Jelly and Ketchup Processing Technician

Unit 2.2 - Personal Hygiene



Key Learning Outcomes



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

1. Describe the role and responsibilities of the Jam, Jelly and Ketchup Processing Technician
2. Explain how to conduct yourself at work
3. Understand the importance of disciplined behavior for success in the workplace
4. How to escalate employee grievances to management
5. Explain the complaint handling process in any organization
6. Describe personal hygiene and sanitation guidelines
7. Describe the food safety hygiene standards to be followed in the work environment

Unit 2.1 - Roles and Responsibilities of Jam, Jelly, and Ketchup Processing Technician

Unit Objectives

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

1. Describe the role and responsibilities of the Jam, Jelly and Ketchup Processing Technician
2. Explain how to conduct yourself at work
3. Understand the importance of disciplined behavior for success in the workplace
4. How to escalate employee grievances to management
5. Explain the complaint handling process in any organization

2.1.1 Roles and Responsibilities

The roles and responsibilities of a jam, jelly, and ketchup processing technician are:

Roles	Responsibilities
Handle raw material from post-harvest storage to the process line	<ul style="list-style-type: none"> • Check raw material for quality • Ensure fruits and vegetables are free from dirt, debris, foreign matter, glass, and insects • Ensure minimum loss of raw material
Record-keeping and documentation	<ul style="list-style-type: none"> • Document and maintain records of raw materials • Document and maintain records of production schedule and process • Document and maintain records of finished products
Hygiene and sanitation maintenance	<ul style="list-style-type: none"> • Adopt safety- and sanitation-related measures • Follow food safety norms and practices
Inspect machines and troubleshoot issues	<ul style="list-style-type: none"> • Ensure smooth operation of machinery to complete production line • Optimize the use of machinery • Attend to minor repairs of tools and machinery when required • Ensure that safety rules and regulations are observed • Prevent accidents • Escalate issues to the supervisor when required

Roles	Responsibilities
Plan and execute pulping process	<ul style="list-style-type: none"> Examine products at different stages of fruit pulping Adhere to Good Manufacturing Practice (GMP) Ensure the products meet the quality standards set by the organization
Inspect intermediate as well as finished products	<ul style="list-style-type: none"> Check fruits' ripening quality, intermittent and finished products for quantity, quality, and salt equilibrium Ensure conformance of quality as per organizational standards
Follow storage and packaging norms	<ul style="list-style-type: none"> Ensure safe and proper storage of raw material, packing material, and finished goods

Table 2.1.1 Role and responsibilities of Jam, Jelly and Ketchup Processing Technician

2.1.2 Workplace Ethics

Workplace ethics are set of guidelines that are followed to ensure smooth and effective functioning of a workplace. Some important ones to remember are:

- Address seniors, assistants, and workers with respect
- Follow the process flow in the manufacturing unit
- Ensure proper execution of the pre-production, production and post-production plan
- Follow food safety norms at all times
- Do not compromise on the quality of the product at any given cost
- Perform your work with complete honesty
- Perform all your roles and responsibilities with integrity
- Teamwork takes you a long way



Fig. 2.1.1 Workplace Ethics

2.1.3 Grievance Management in the Workplace

A grievance is a concern, problem or complaint that an employee has about the workplace/workplace, or someone with whom he or she works, with whom he or she feels dissatisfied.

The following types of complaints in the workplace include;

- Pay and Benefits.
- Bullying/Harassment.
- Workplace hazards and safety concerns.
- Assignments.

Complaint procedure

1. The organization shall have a written grievance procedure through which the employee may escalate his/her issues
2. **Investigation Complaint:** The organization investigates.
3. **Grievance Meeting:** The organization organizes a meeting so that the employee gets an opportunity to explain the grievance.
4. Taking into account the evidence, the organization decides whether to reject the complaint or to withhold it.
5. If the employee feels unfair towards the decisions taken by the organization then he can go for appeal.

Unit 2.2 - Personal Hygiene

Unit Objectives

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

1. Identify the types of health and safety policies and procedures

2.2.1 Personal Hygiene

The expression “food hygiene” is often associated to personal hygiene. The concept of food hygiene really refers to the general cleanliness state of the food handlers’ body and clothes. Microorganisms can easily pass to food and reach the consumer if the handler comes into contact with any pathogenic microorganism by their clothes, hands, hair, nails, rings and then sets out to prepare food. As so, the personal hygiene of whoever contacts with food, as well as behaviors they assume during its processing, constitute an important preoccupation in the food business. The set of rules, conditions and practices that assure adequate personal hygiene make up the good practices for personal hygiene.

2.2.2 Importance of Personal Hygiene

It is imperative for safe food-handling outcomes for all workers to be familiar with standard sanitation and hygiene practices. Fig. 2.2.1 shows the cycles of transmission of micro-organisms. One of the basic principles is to break the cycle by avoiding cross-contamination, which can be achieved by ensuring personal hygiene practices are followed.

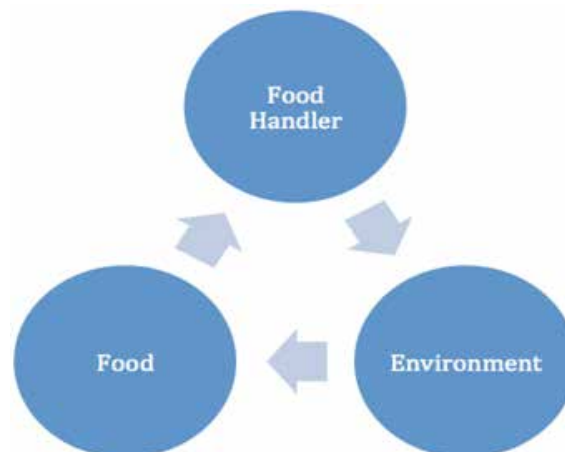


Fig. 2.2.1: Importance of Personal Hygiene

Proper personal hygiene is critical in any food service premise. Personal hygiene includes:

- Showering and bathing regularly
- Keeping hair clean hair and covered or tied back
- Keeping clean clothing and footwear that is used only at work
- Hand washing regularly



2.2.3 Hand Washing

Proper and regular hand washing is a critical part of any food safety system.

How to wash hands



Fig. 2.2.3: Methods of washing hand

How to Use Sanitizer?

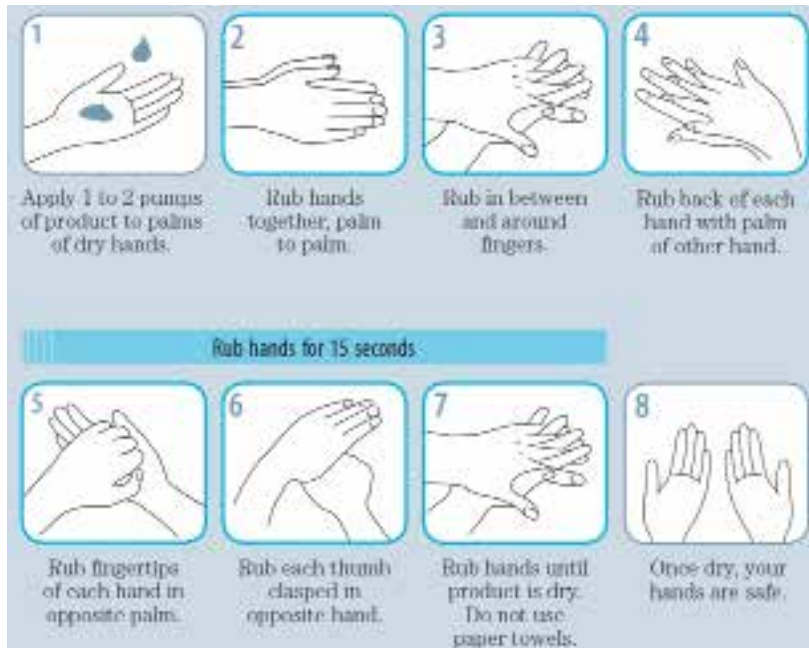


Fig. 2.2.4: Usage of Sanitizer

When to Wash and Sanitize Hand?



Fig. 2.2.5: Times to wash and sanitize hand

We need to stop the spread of COVID-19 in food industry by washing hands regularly with soap and water for 20 seconds – especially after going to the bathroom, before eating, and after coughing, sneezing, or blowing our nose.

3. Prepare Work Area and Equipment for Jam, Jelly and Ketchup Processing



Unit 3.1 - Cleaning Activities and Maintenance Check

Unit 3.2 - Post Production Cleaning of Work Area and Machinery

Unit 3.3 - Cleaning Process



Key Learning Outcomes



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

1. Describe the cleaning activities of the equipment and accessories required.
2. In the work to regularly maintain the equipment and accessories.
3. Demonstrate the process of cleaning and maintaining the work area after production.
4. Mention the type of waste generated and its disposal.
5. Describe cleaning procedures to be used to clean work areas and process machinery.

Unit 3.1 - Cleaning Activities and Maintenance Check

Unit Objectives



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

1. List the appropriate cleaning agents and sanitizers to clean the work area, machinery, tools, and equipment after jam, jelly, ketchup production and their uses
2. Discuss the standard procedure and importance of cleaning and maintenance of all machines and equipment

3.1.1 Cleaning and 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 foodstuffs 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 for jam, jelly and ketchup making, it can also introduce additional difficulty by creating a wet environment. The equipment for jam, jelly and ketchup making 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 the 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 they can't be destroyed properly. Hence, sanitizing is required for this purpose.

The primary reasons for cleaning and sanitizing the work area and machinery used for pickle and paste making are:

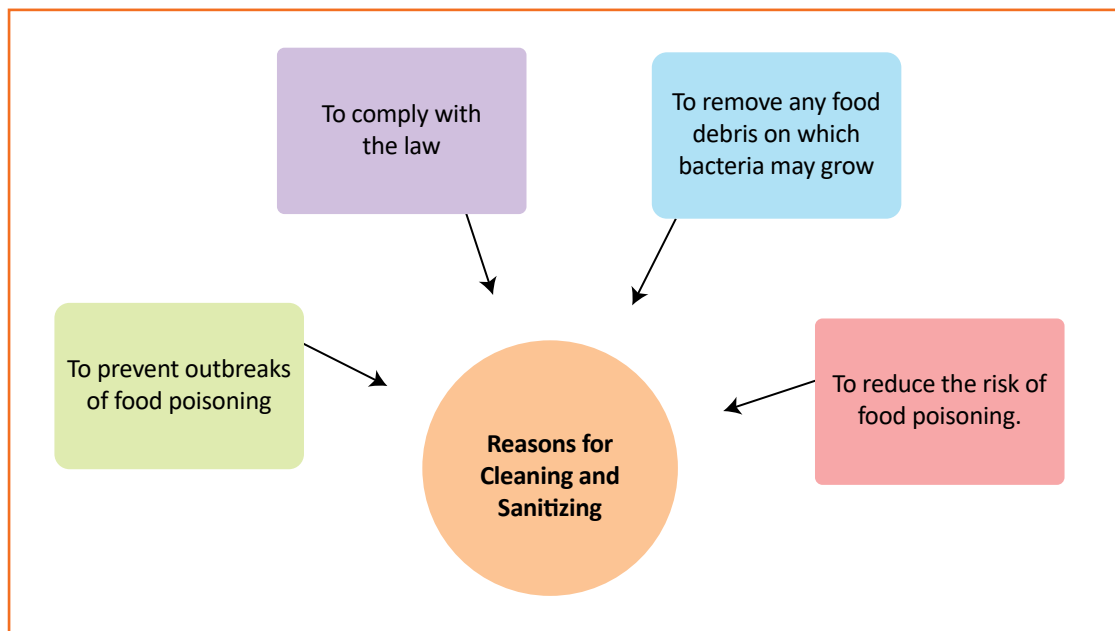


Fig. 3.1.1 Reasons for Cleaning and Sanitizing

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:

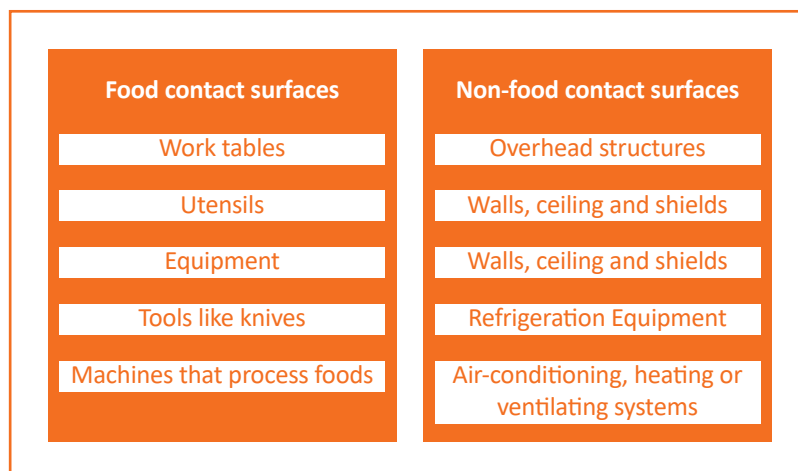


Fig. 3.1.2 Cleaning Work Area Categories

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 jam, jelly and ketchup products 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. Pickle and paste-making equipment and tools when not in usage should be stored properly to avoid any contamination risk.

3.1.2 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. Select the right kind of cleaning agent or sanitizer based on the variation of soils, water hardness, the temperature of the method, plant surfaces, machinery, equipment, and tools.

Detergent suppliers usually have a range of detergents to be employed in varying and specific circumstances. The range of products will include:

Alkalis: <ul style="list-style-type: none"> • Caustic soda • Caustic pot-ash • Coronate • Silicate, • Phosphate 	Acids: <ul style="list-style-type: none"> • Phosphoric • Nitric • Citric • Glycolic 	Chelates: <ul style="list-style-type: none"> • EDTA • NTA • Gluconate • Glucoheptonate, citrate • Polymeric 	Solvents: <ul style="list-style-type: none"> • Isopropanol • Propylene • Butyl diglycol • Ethers 	Surfactants: <ul style="list-style-type: none"> • Anionic • Cationic • Non-ionic • Amphoteric
Inhibitors: <ul style="list-style-type: none"> • Organic • Inorganic 	Enzymes: <ul style="list-style-type: none"> • Protease • Lipase • Amylase 	Enzymes: <ul style="list-style-type: none"> • Protease • Lipase • Amylase 	Stabilisers	Viscosity modifiers

Table 3.1.1 Various Ranges of Detergents

A detergent solution may contain between 2 to 15 components, which are blended carefully as per the specification. 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. However, a ‘sanitizer’ refers to a product containing both a detergent and disinfectant. 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 <ul style="list-style-type: none"> • Potassium hypochlorite, • Sodium hypochlorite, and • Calcium hypochlorite 	Cleaning stainless steel food contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained

Cleaning agents	Used for	Risk	Safety measures
Liquid chlorine	Internal cleaning of stainless steel equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained
Hydrogen peroxide	Killing bacterial spores, pathogens, spoilage organisms, and other microorganisms	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 3.1.2 Different types of cleaning agents, related risk factors, and safety measures

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

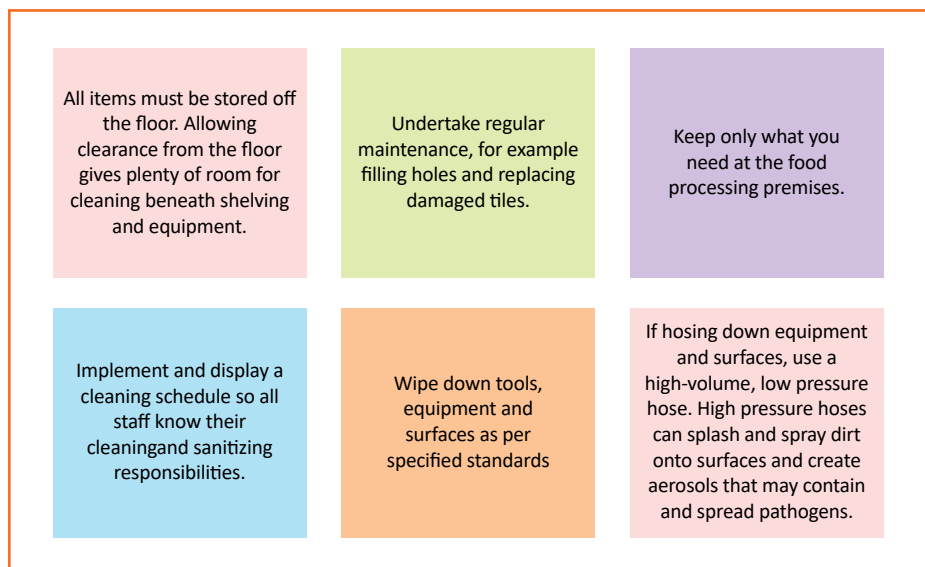


Fig. 3.1.3 Procedure for Cleaning and Sanitization

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 or 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 3.2 - Postproduction Cleaning of Work Area and Machinery

Unit Objectives



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

1. Demonstrate the process of cleaning and maintaining the work area after production
2. Mention the type of waste generated and its disposal

3.2.1 Postproduction Cleaning of Work Area and Machinery

After the production cycle is complete, cleaning the area, machines, and equipment becomes imperative before starting the following process. Otherwise, the residuals from the previous cycle may cause contamination and other related quality problems in the upcoming production cycle. There are various methods of cleaning the work area and machinery that can be applied as per the requirement.

1. Manual Cleaning:

This method of cleaning uses cloths, mops, brushes, pads, etc. It is usually used in small areas or non-waterproof equipment or machinery that requires dismantling or areas that are difficult to clean by other methods. It is a labor-intensive method and may limit the use of certain chemicals for safety reasons. The method must be clearly defined and staff trained to an appropriate level to ensure cleaning is effective.

2. Foam Cleaning:

It is the common method for cleaning most food operations. A foam blanket that is created using a wide range of available equipment is projected from a nozzle and is allowed time to act on the soil. Then, it is rinsed off with the released deposits. Foam cleaning is ideal for cleaning large areas such as floors, walls, conveyors, tables, and well-designed production equipment. Foam is a carrier for detergent. The foam is applied in an even layer. Coverage rates are quick, and chemical usage is economical. The equipment for foam cleaning may be mobile, or centralized.

3. Spray:

Spray cleaning uses a lance on a pressure washer with chemical induction by venturi. This should ideally be used where foaming properties are not essential for the cleaning action as this method can be wasteful of chemicals and can be slow to produce foam.

4. Fogging:

This method uses compressed air or other equipment to generate a fine mist of disinfectant solution, which hangs in the air long enough to disinfect airborne organisms. It also settles on

surfaces to produce a bactericidal effect. The system is available in both small portable devices and built-in automatic central systems. Fogging should never be used as a primary sanitizing method. This shall be used in conjunction with other methods. It is also vital to ensure that coverage and saturation are sufficient and the mist is acceptable to allow proper action.

5. Machine Washing:

Machine washing is an automatic or semi-automatic washing process conducted within a purpose-built machine. Many machine designs are available depending on the application, e.g., crate washing or utensil washing. They represent a significant capital investment and need to have a clear business case before purchasing. In addition, they tend to consume a large number of chemicals and water. Failure to maintain them correctly can lead to a contamination risk to the product. Chemicals used in these machines should be low foaming. An effective system for controlling the dose of chemicals should be employed, and temperature control systems should be used where critical.

When cleaning and disinfecting work areas and equipment, the following practices must be followed:

Plan the cleaning sequence to avoid re-soiling the cleaned area	All the machinery used for processing is "SWITCH OFF"	Using the right materials for cleaning while considering risk, time, efficiency and type of stains	Chemicals split are properly wiped out in the work area, with care and caution
Wear personal protective equipment required for the cleaning methods and materials being used	Residues and coarse dirt are removed	Remove any oily substances on the floor to avoid slippage	Remove any scrap lying around
Dispose any waste or chemicals used in an appropriate manner	Use a vacuum cleaner or at least a damp cloth to clean the dust from surfaces around the work area		

Table 3.2.1 Standard Practices for Cleaning the work area and equipment

3.2.2 Workflow Process for Cleaning Machinery and Equipment

Cleaning is a complex process. A defined and systematic approach should be followed to ensure it is conducted appropriately that considers several factors. This approach takes the form of a Procedure, and this is usually a legal requirement in addition to a fundamental requirement of global food standards. A collection of these cleaning procedures forms a Cleaning Plan or Program, which is plant-specific. The correct sequence of a general cleaning procedure for surfaces in a food plant is:

Cleaning Preparation	<ul style="list-style-type: none"> • A poor cleaning preparation is the single biggest reason for poor or inconsistent bacterial counts on surfaces and for high bacterial contamination in aerosols caused by rinsing. • A well designed cleaning procedure will provide for the removal of all food pieces greater than a fingernail before applying detergent. • Ideally this should be done dry by hand, scrapping or other physical method. • The collected material should be placed in waste receptacles and removed from the area. • All ingredients, food and packaging materials should also be removed from the area prior to cleaning preparation.
Pre-rinsing	<ul style="list-style-type: none"> • This step aims to remove deposits that cannot be easily removed by picking, scrapping, or other manual forms of gross cleaning. • Excess water should be removed following pre-rinsing to avoid dilution of the detergent in the following step.
Pre-rinsing	<ul style="list-style-type: none"> • The purpose of the detergent is to remove the layers of proteins, greases, and other food deposits that remain on surfaces. • Detergents are not designed to remove large pieces of food deposits or thick layers of fat. In these layers, bacteria can survive and grow and make the use of a disinfectant pointless. • The foam should be conducted carefully and methodically, and there should be a check to ensure that all surfaces have been covered. • Detergents should be made up and used according to the supplier's instructions, and appropriate time should be allowed for the detergent to work.

<p>Post-Rinsing</p>	<ul style="list-style-type: none"> • The purpose of post-rinsing is to remove the remaining food deposits. • Care should be taken to minimise the amount of splash and aerosol formed which may re-contaminate surfaces. • After post-rinsing, the surface should be free of all visible deposits, layers of soiling, and detergent residues • Any residues of detergent may neutralise the action of any subsequent disinfectant. • Any pools or accumulations of water should be removed following post-rinse.
<p>Disinfection</p>	<ul style="list-style-type: none"> • Disinfection should only be carried out on a visually clean, well-rinsed surface, with minimal water. • Direct food contact surfaces should be disinfected at least daily, with other surfaces disinfected regularly. • Disinfectants should be used safely according to the supplier's instructions.
<p>Terminal Rinsing</p>	<ul style="list-style-type: none"> • Most disinfectants are safe to leave on non-food contact surfaces without final rinsing. • However, there is a requirement to rinse food contact surfaces with water after disinfection in some sections of the food industry. • The standard of the water is important to ensure that the disinfected surface is not re-contaminated.

Table 3.2.2 Sequence for Cleaning Machinery and Equipment

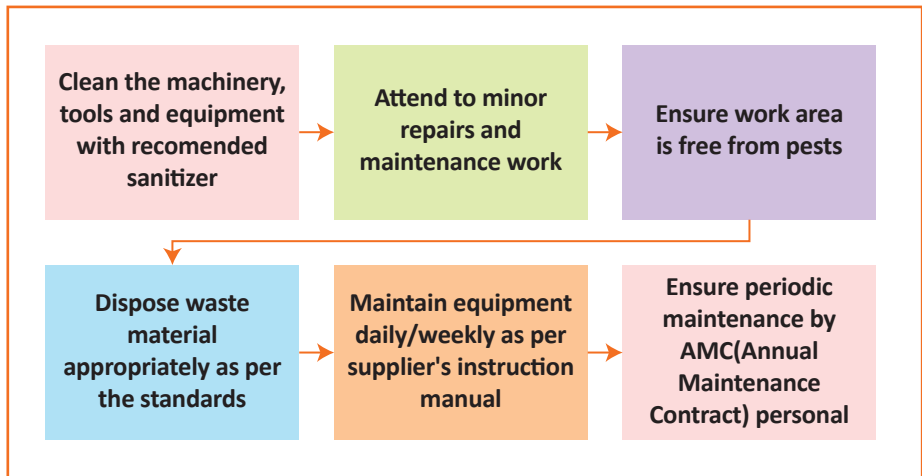


Fig. 3.2.1 Sequence for Cleaning Machinery and Equipment

Unit 3.3 - Cleaning Processes

Unit Objectives

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

1. State the cleaning processes used to clean the work area.

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 sanitizing 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 sanitizing solutions
- Ensure correct flow rate
- Ensure all connections are clean
- Monitor and verify the entire process

3.3.2 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 sanitized once more with heat treatment or sanitizing 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

3.3.3 Sterilising-In-Place (SIP)

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

SIP is a combination of three processes viz. sterilization, dis-infestation, and sanitization.

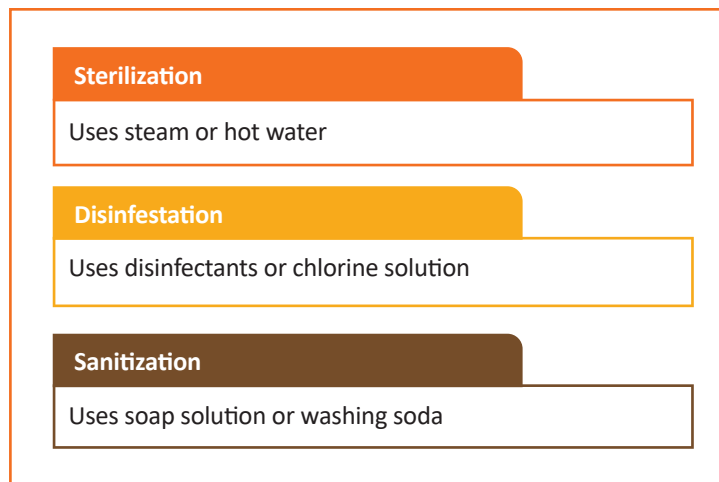


Fig. 3.3.1 Sequence for Cleaning Machinery and Equipment

3.3.4 Air-Pressure Cleaning

Baking industry follows the air-pressure cleaning method to ensure cleanliness of regularly used equipment. The following chart explains the process in detail:

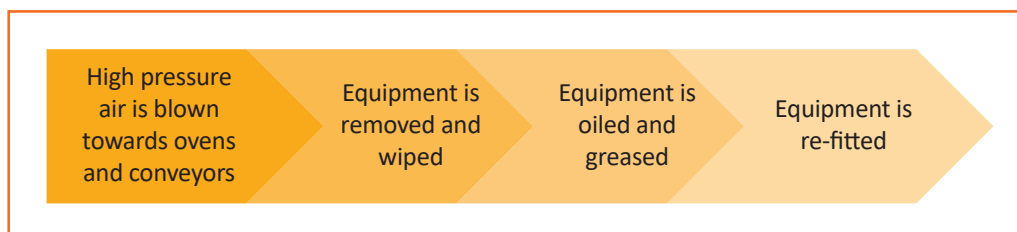


Fig. 3.3.2 Air-Pressure Cleaning

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.

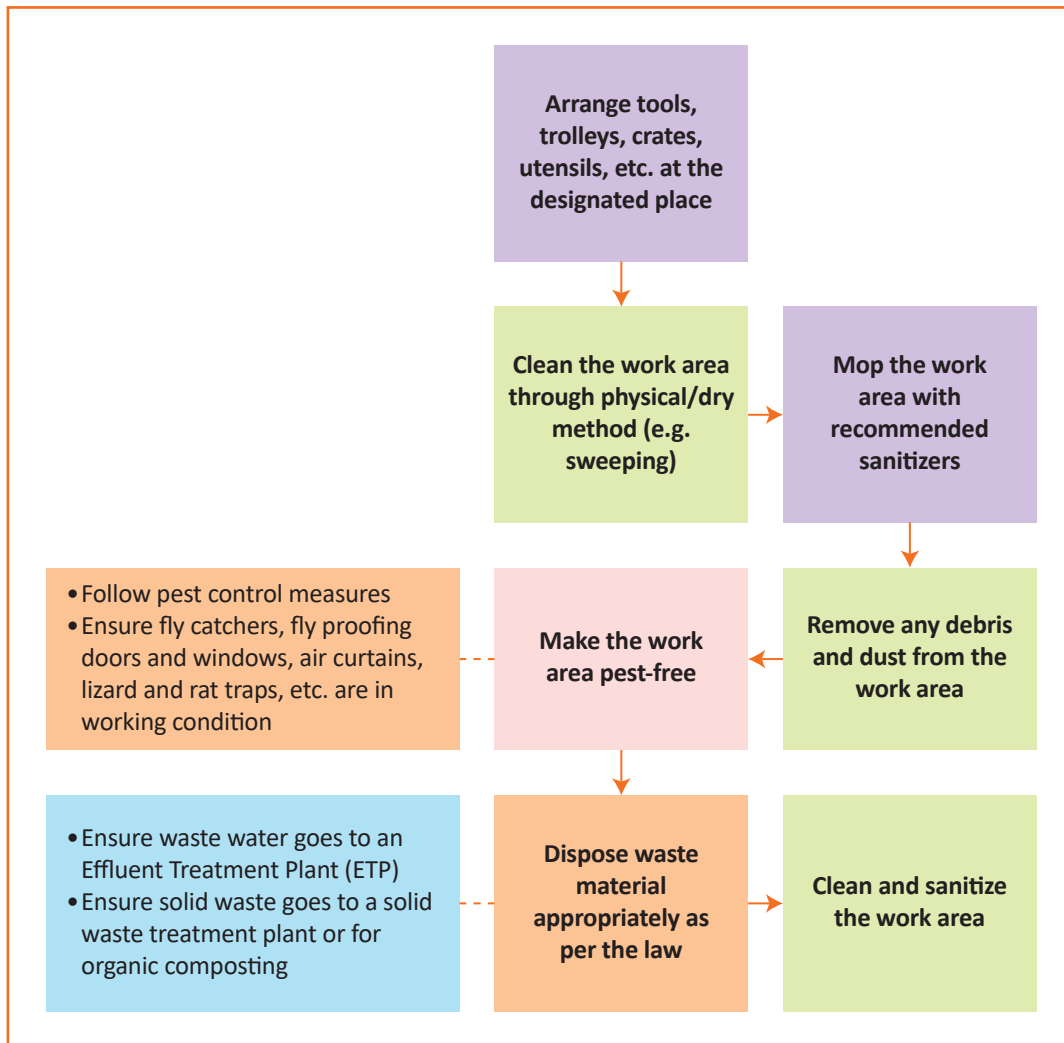


Fig. 3.3.3 Process of Cleaning the Work Area

3.3.5 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 downtime 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 breakdowns and while it is still in running condition. Generally, the strategy leads to good food hygiene and prevents foreign materials from entering food produce.

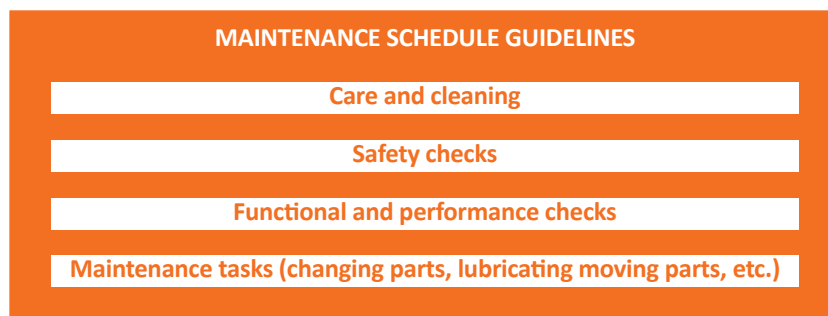


Fig. 3.3.4 Maintenance Schedule Guidelines

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. 3.3.5 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

Activity

1. List any two reasons for the cleanliness and hygiene of the work place.

2. What are standard cleaning systems?

3. Name any two cleaning and sanitizing agents for cleaning work place and equipment.

4. Describe the importance of equipment maintenance and checks.

4. Prepare for Production of Jam, Jelly and Ketchup



Unit 4.1 - Raw Material and Manpower Estimation

Unit 4.2 - Raw Material Selection and Handling

Unit 4.3 - Production Planning Process and Sequence

Unit 4.4 - Plan Production Sequence

Unit 4.5 - Raw Material Handling



Key Learning Outcomes



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

1. Use basic math for various calculations in day to day processes
2. Identify the raw materials needed for production according to the production schedule and setup
3. Organize quality raw materials according to production process and company standards
4. Mention the methods of storage of raw materials for later use.
5. Check raw material for quality and grade
6. Prepare raw material for production
7. Planning production schedules as per organizational standards and instructions
8. Organize for raw materials, packaging materials, manpower, equipment and machinery for scheduled production
9. Plan production sequence to maximize capacity utilization of resources, manpower and machinery
10. Calculate batch size based on production schedule and machine capacity
11. Give priority to urgent orders based on production schedule
12. Check quality of raw material as per company standards

Unit 4.1 - Raw Material and Manpower Estimation

Unit Objectives

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

1. Identify the raw materials required for production a.s per production schedule and formation
2. Organise quality raw material a.s per production process and company standards

4.1.1 Raw Material and Manpower Estimation

The raw material is something that is used to produce a product. The availability of raw materials affects the production process which in turn affects the revenue of an organization. Raw material's availability assists manufacturing units in conducting production processes following the requests and wishes of the consumer. Raw material inventories are fundamental in pickle and paste making processing because the uncertain demand and availability of raw materials due to seasonal reasons can cause complications over costs incurred. Moreover, raw materials is an investment that affects the financial stability and listed as a current asset on a company's balance sheet. So, it is important to apply best practices for managing raw material inventory. There are two subdivisions of raw materials:

1. Direct Materials are those resources that are part of or incorporated into the finished product. For example in jam, jeely and ketchup industry vegetables, oil, spices etc
2. Indirect Materials are those resources consumed during the manufacturing process but are not part of the finished product. For example disposable tools, protective equipment, cleaning supplies, fuel, light bulbs etc.

It is important to determine the value of opening and ending inventory for estimating raw materials for jam and jelly making as per production requirements. It is calculated as follows:

$$\text{Raw Materials Inventory} = \text{Beginning Inventory} + \text{Raw Materials Purchased} - \text{Cost Of Goods Sold}$$

1. **Beginning/opening inventory value** - The value is obtained from the previous accounting period balance sheet as the closing inventory.

$$\text{Opening Inventory} = (\text{Cost Of Goods Sold} + \text{Ending Raw Materials Inventory}) - \text{Raw Materials Purchased}$$

2. **Closing/ ending inventory value** – It is the inventory on hand at the close of an accounting period. The value is revealed on the balance sheet.

$$\text{Ending Inventory} = (\text{Raw Materials Purchased} + \text{Beginning Raw Materials Inventory}) - \text{Cost Of Goods Sold}$$

3. **Raw material Purchased** – it is calculated as

$$\text{Raw Materials Purchased} = (\text{Ending Inventory} - \text{Beginning Inventory}) + \text{Cost Of Goods Sold}$$

4. **Cost of goods sold (COGS)** – It appears as an item in the income statement during the accounting period.

$$\text{Cost of goods sold} = \text{Beginning inventory} + \text{Purchases} - \text{ending inventory}$$

Note:

- **Beginning Inventory** - The value of a company's inventory at the beginning of an accounting period.
- **Ending Inventory** - The value of goods held and available for sale by a company at the end of an accounting period.
- **Raw material** - vegetables, fruits, ingredients, spices, oil etc.
- **Sales Good** - The cumulative total of all costs used to make the product sold.

To calculate manpower requirements for Jam, Jelly and ketchup production, divide the value of goods and services produced by the total hours worked by employees over a specified period. Here are the steps to estimate manpower for production.

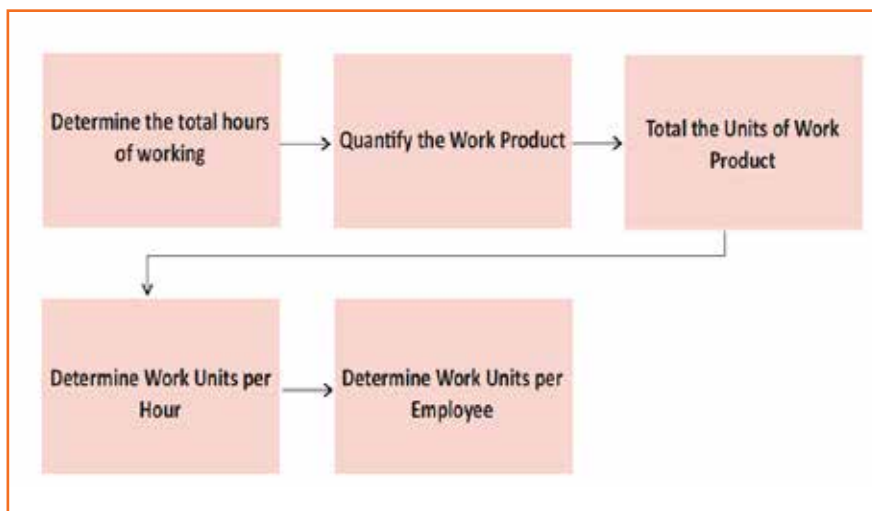


Fig. 4.1.1 Steps to Calculate Manpower Estimation for Production

Unit 4.2 - Raw Material: Selection and Handling

Unit Objectives



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

1. Identify the raw materials required for production as per production schedule and formation
2. Organise quality raw material as per production process and company standards
3. State the methods for storing raw material for later use
4. Check the raw material for quality and grade
5. Prepare the raw material for production

4.2.1 Selection of Raw Material

Raw Material Procurement and Storage

It is important to choose only those fruits/vegetables that are in the best condition during procurement. The fruit processing industry for pulp manufacturing in India uses a wide range of fruits/vegetables. Some of the commonly used are mango (totapari, alphonso), guava, papaya, banana, etc. Vegetables used for commercial pulp manufacturing are tomato, carrot, etc.

Fruit selection depends on following factors:

- Tree or crop type
- Region where the crop has grown as per weather
- Growing practices
- Location of the crop
- Degrees of maturity and ripeness
- Method of pulping/harvesting

The procured fruits are carried to the manufacturing areas in plastic cases, which take approximately 20kg of products. These cases not only protect the product from physical damage, but also protect the fruit quality by maintaining a high level of air circulation. The fruit reaches the manufacturing unit in about 2 to 10 hours. Ripened fruits have to be processed quickly. Hence, the manufacturing unit and the processing area are located close.

Unit 4.3: Production Planning Process and Sequence

Unit Objectives

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

1. Plan the production schedule as per organisational standards and instructions
2. Organise for raw material, packaging materials, manpower, equipment, and machineries for the scheduled production
3. Plan the production sequence to maximise capacity utilisation of resources, manpower, and machineries
4. Calculate the batch size based on the production schedule and machine capacity
5. Prioritise urgent orders based on the production schedule
6. Check the conformance of raw material quality to company standards

4.3.1 Production Plan

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

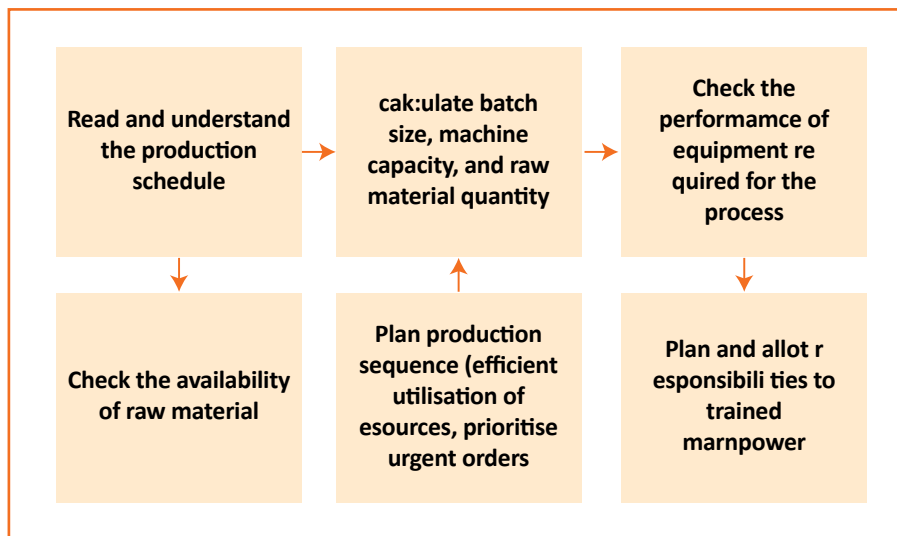


Fig. 4.3.1 Production plan

Unit 4.4: Plan Production Sequence

Unit Objectives



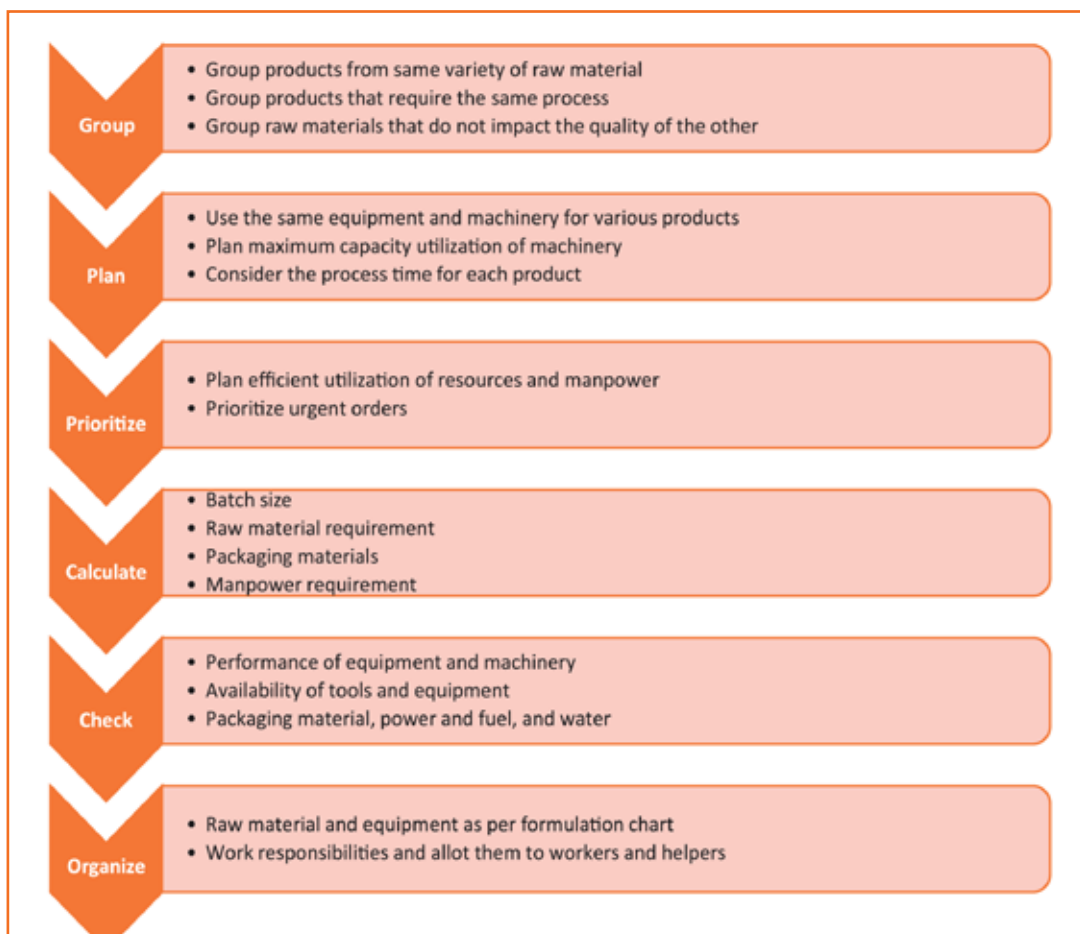
At the end of this unit, participants will be able to:

1. Plan the production to maximize capacity of resources, manpower and machinery
2. Calculate the batch size and prioritize urgent orders based on the production schedule and machine capacity
3. Check the conformation of raw material quality to company standards

4.4.1 Planning the Production Sequence

The main ingredients used in pickle making are fruits and vegetables. Different type of pickle are made based on the maturity of fruits and vegetables

Ingredients used in pickle making are divided into groups based on their roles. The following table explain this classification.



Unit 4.5: Raw Material handling

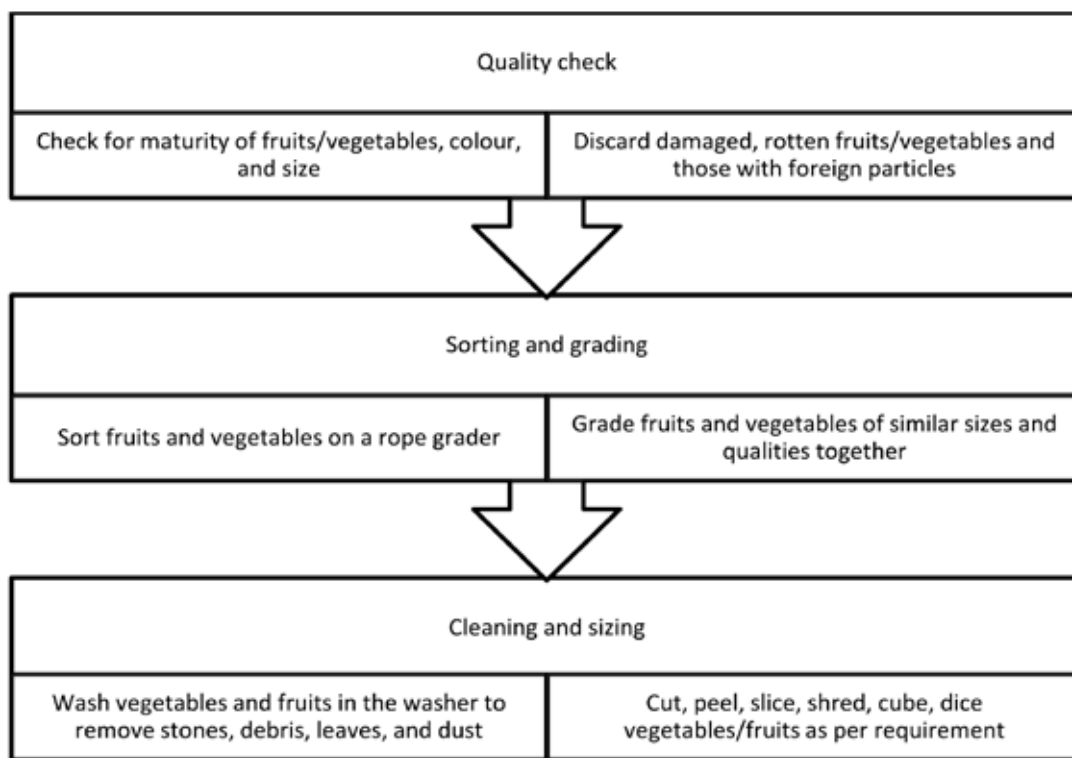
Unit Objectives

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

1. Check raw material for quality and grade
2. Prepare raw material for production

4.5.1 How to Manage Raw Material

Before starting the actual process of making jams and jellies, it is important to understand how to handle the raw materials purchased from the farmer/supplier. Given below is a simple chart that shows the process of raw material prior to the process of making jams and jellies:



5. Carry out Production of Jam, Jelly and Ketchup as per Production Needs



Unit 5.1 - Production process of preparing Jam and Jelly

Unit 5.2 - Process of Preparing Ketchup

Unit 5.3 - Operation packaging machine

Unit 5.4 - Labelling and Coding



Key Learning Outcomes



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

1. Prepare jams and jellies
2. Discuss the process of making jam and jelly
3. Prepare ketchup
4. Describe the process of making ketchup
5. Filling, packing and storing of jam, jelly and ketchup
6. Describe the reporting process for any non-conformity in the packaging of jam, jelly and ketchup.

Unit 5.1 - Production Process of Jam and Jelly

Unit Objectives



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

1. Elaborate on the operating procedure of cooking kettle or tank
2. State the significance of stirring the pulp continuously during the heating process
3. State the importance of achieving specified pressure and temperature while cooking the fruit pulp or fruit juice
4. Discuss the procedure and significance to check the quality of cooked product through physical parameters such as colour, appearance, texture, taste, etc. and to send the sample finished product for quality lab analysis
5. Explain the procedure to transfer the finished product to the filling tank

5.1.1 Preparation of Jam and Jelly

Jam is made using pulp from a single fruit or a mixture of fruits. It gets produced by boiling the fruit pulp with an appropriate amount of sugar until it's a thick adequate consistency to hold the fruit tissues in position. Fruits like Apple, sapota, papaya, plums, mango, grapes, jack fruit, pineapple, banana, guava, and pears are used to prepare jam.



Fig 5.1.1: Jam

Jelly is a semi-solid food product made by boiling a clear, strained solution of pectin-containing fruit extract, free from pulp, subsequently adding sugar and acid. A perfect jelly should be translucent, well set but not too stiff, and retain the fruit's original flavour. It should be of attractive color and preserve the shape of the mold. It should be firm enough to keep a sharp edge but adequately tender when squeezed from the mold. The jelly should not be gummy, sticky, syrupy, or have crystallized sugar. In fact, the product should be free from dullness with little (or) no syneresis (weeping) and neither tough nor rubbery. As per FSSAI regulation, the total soluble solids content, in the case of jams shall be not less than 65 per cent. by weight and not less than 60 per cent. by weight in case of jellies.



Fig 5.1.2: Jelly

Please Note:

As per FSSAI, under chapter 2.3.31 of FSSA (FOOD PRODUCTS STANDARDS AND FOOD ADDITIVES) REGULATIONS, 2011

1. Jam means the product prepared from a suitable fruit ingredient of one or two or more types which shall be-
 - i. Whole fruit, pieces of fruit, fruit pulp or fruit puree;
 - ii. With or without fruit juice or concentrated fruit juice or dehydrated fruit as an optional
 - iii. Ingredient;
 - iv. Mixed with a nutritive sweetener, with or without water; and
 - v. Processed to a suitable consistency.

2. Fruit jelly means product prepared by boiling fruit juice or fruit(s) or aqueous extracts of one or more fruits of sound quality, with or without water, expressing and straining the juice, adding nutritive sweeteners, and concentrating to such a consistency that gel formation takes place on cooling. The product shall be clear, sparkling and translucent. It may also contain any other ingredient suitable to the products including derivatives like fibre, extracts, spices and condiments.

5.1.2 Material Specification for the Preparation of Jam and Jelly

The list of raw materials required for making jam is as below:

Fruit provides a specific colour and flavour to the jams and jellies. It also provides some of the pectin and acid required for a gel. Therefore, the fruit should be just at the ripe stage to retain the best natural colour and flavour. Fruit-pulp technicians can use irregular sizes and shapes of fruits for jam and jelly production as long as they are of good quality since they will be cut, mashed, or made into juice. The fruit can be used in the form of whole fruit, pieces of fruit, fruit pulp or fruit puree. With or without fruit juice or concentrated fruit juice or dehydrated fruit as an optional ingredient.

1. Pectin the ingredient that causes the fruit to gel. Some types of fruits have sufficient natural pectin to make high-quality products. Others require added pectin, specifically when used for making jellies, which should be firm enough to hold their shape. The highest quality pectin is available in just-ripe fruit as pectin from under-ripe or over-ripe fruit will not form a gel.
2. Acid is required both for gel formation and flavour. The acid concentration varies with fruits and is higher in under-ripe fruits. Usually, when fruits are low in acid, lemon juice or citric acid can be added for jam and jelly production.
3. Sugar is an essential ingredient in a jam. It should be present in the right proportion with pectin and acid to make a good gel. Sugar acts as a preservative for the product that prevents the growth of micro-organisms. It also adds to the taste of the product.



Fruits that have sufficient acid and pectin	Fruits that do not have enough acid or pectin	Fruits that do not have enough acid and pectin
Unripe fruits: especially apple, quince, lemon, grapefruit, passion fruit, guava	Ripe fruits: especially apples, orange, mango	Ripe fruits: especially melon, banana, strawberry, pineapple
<i>Sugar: fruit juice ratio = 1:1</i>	<i>Sugar: fruit juice ratio = 0.6 to 0.75:1</i>	<i>Sugar: fruit juice ratio = 0.5:1</i>

Table 5.1.1 Pectin and acid contents of fruits

5.1.3 Equipment Used in Making Jam and Jellies

Basic equipment/ accessories

1. Cutting Knife (SS), coring knife, pitting knife, peeling knife
2. Cutting and Chopping equipment
3. Cooking Vessels/VAT
4. Refractometer, pH meter
5. Heat production system
6. Other various machines

Types of Equipment And Tools	Description
<p>Cooking Kettle</p> 	<p>A cooking kettle is an all-purpose machine for making high-quality products such as jam, marmalade, and jellies. With a cooking kettle, various stirring- and mixing processes can be carried out.</p> <p>Operation of Cooking Kettle</p> <p>“The kettle is equipped with Jacketed system which contains hot water, so as to ensure the proper cooking of the jam solution in the cooking vessel/ VAT”. The electric heater or kettle provided with the steam connections, heats the water bath to the desired temperature and keeps it constant. The product is evenly heated and blended because of the integrated mixer. After the cooking procedure, drain the kettle simply with the help of a disc valve on the bottom. Cooking kettles mainly consists of:</p> <ul style="list-style-type: none"> • A spherical tank • vapour-liquid separator • Condenser • Agitator • Receiving tank, etc. <p>Cooking kettles have the advantages of a large heating area, high thermal efficiency, quick heating of materials, uniform heating, and easy control of heating temperature. Unlike conventional stockpot cooking, a steam kettle provides efficient heat transfer, uniform heating, and superior product handling, resulting in faster food service operations in your kitchen. These are just a few of the advantages of incorporating a steam kettle further into the jam jelly production process.</p>
<p>Peeler</p> 	<p>Peeler is used for peeling various kinds of ball-shaped fruits and vegetables, equipped with rotating soft and hard brushes which thoroughly clean and peel the vegetables.</p>

Types of Equipment And Tools	Description
<p>Pulper machine</p> 	<p>Pulper is used for extracting pulp of most fruits & vegetables like mango, apple, tamarind, custard apple, plum, apricot, peach, kiwi, tomato, etc. The fruits and vegetables are fed into the pulping chamber, wherewith the help of blades and brushes gets pressed against the sieve. The extracted pulp goes through the perforations in the sieve and discharges the stone and skin by pushing forward from the other end.</p>
<p>Filter/Sieve</p>  <p><i>(Source: https://rdpf.co.in/ss-in-line-filter-supplier-in-mumbai-india/)</i></p>	<p>A sieve is equipment used to separate the passage of granular materials according to particle size.</p>
<p>Plate Heat Exchanger/ Pasteurizer</p> 	<p>A pasteurization machine is used to sterilize the jam/jelly/fruit pulp to destroy pathogenic microorganisms by heating the product to a moderately high temperature for a brief period. In commercial processing, the same is achieved through heat exchangers. In case of small production, the temp of pasteurization is normally achieved in the cooking vessel only.</p>
<p>Refractometer</p> 	<p>Refractometer measures total soluble solids (TSS) as °Brix, which corresponds to % sugar.</p>
<p>Weighing balance</p> 	<p>Weighing balance is used to weigh small amounts of ingredients or laboratory chemicals, ingredients and products, and fruit and vegetables, respectively.</p>


Types of Equipment And Tools		Description
Crown machine 	corking/capping	The crown corking/capping machine is used for sealing the caps/corks of the jars/bottles.

Table 5.1.2 Equipment used in Jams and Jellies

5.1.4 Processing of Jam

To achieve the desired quality of jam, the required and accurate amount of ingredients must be added. The following steps explain the preparation of jam in the food processing industry.

1. **Quality inspection of fruits:** The best quality fruits selected for jam making are loaded into the funnel-shaped hopper. The fruits are transported through this hopper for cleaning and crushing.
2. **Cleaning, crushing, and chopping:** The surface dirt from the fruits are removed using the gentle water spray. Some fruits like citrus and apples are subjected to manual peeling, slicing, and dicing.
3. **Pulping:** Fruits are pulped using a Pulper.
4. **Cooking:** The required pre-measured amount of fruits, sugar, and pectin are mixed in the cooking kettles. The mixture is slowly cooked with occasional stirring. The fruit pulp is crushed with a ladle during cooking. The cooking is continued till the temperature of the mass reaches 105.5°C. This mixture is then subjected to cooking and cooling three times. Cooking of the jam is stopped precisely at the setting time. The jam is not adequately set if this point is not reached. If the cooking process is carried out beyond this set point, the jam will undergo crystallization and darkening. Please Note: -
 - To ensure that everything is dissolved, give it a good stir. Once the jam is boiling, do not stir it; instead, use a wooden spoon to check that it is not sticking to the bottom of the pan. Stirring the fruit pulp continuously lowers the temperature and delays the setting point. It is wasteful to remove scum regularly.
 - If the sugar is still dry, keep stirring until the juices run and the sugar melts. Once all of the sugar has been melted, stir rarely or not at all. The less you stir, the faster everything heats up and evaporates the moisture.
 - To avoid scorching, stir your mixture frequently and constantly for 15 to 40 minutes, depending on the cooking time of the fruit. Scorching can ruin an otherwise delicious jam or preserve. Dip a cold metal spoon into the boiling mixture to see if it's ready.
 - It is important to maintain the specified pressure and temperature while cooking the fruit

pulp or juice to avoid scorched flavour and undesirable colour in the jam-making process. Temperature helps to determine the sugar-to-water ratio in a jam at this stage. Hence, monitor the pressure and temperature gauges and adjust the controls of the cooking kettle to achieve the specified temperature to cook the mixture for jam-making process.

5. **Sheet/Flake Test:** During the boiling process, a small portion of jam is taken out with a spoon or wooden ladle and let to cool slightly. After that, it's allowed to drop. If the product falls off in the form of a sheet/flakes rather than flowing in a continuous stream/syrup, the endpoint has reached, and the product is ready. Otherwise, boiling is required to continue till the sheet test is positive.



Fig 5.1.3: Inspection Table for Jam/Jelly Test

6. **Refractometer method Test:** Before placing a drop on the Refractometer glass, cool the jam immediately as the reading is calibrated at 20°C.
7. **Weighing method:** The weight of the jam made from pectin-rich fruits is one and half times the sugar. The disadvantage of jam making is that frequent weighing at the end of boiling is required, resulting in wastage of heat energy and practically time-consuming.
8. **Transporting the final product for filling:** The transportation of the finished product should be carried out under such conditions that will preclude the contamination with or development of pathogenic or toxigenic micro-organisms or infestation and protect the product against deterioration. The tabletop shall be of waterproof material, and other portions of the tables shall be free from corners, cracks, and cervices. There should be proper ventilation to prevent condensation and drippage.
9. **Filling:** Pasteurized jars are used to fill up the required amount of jam. The top of the jars is vacuum-sealed using metal caps. The process of filling and vacuum packaging of the jars removes all air, resulting in maintaining the product's sterility.
10. **Labelling and packaging:** The sealed jam jars are conveyed through the labelling machine. These labels must contain specific information about the ingredients used in the preparation of jam. The jars are later packed into cartons for shipment and further distribution.

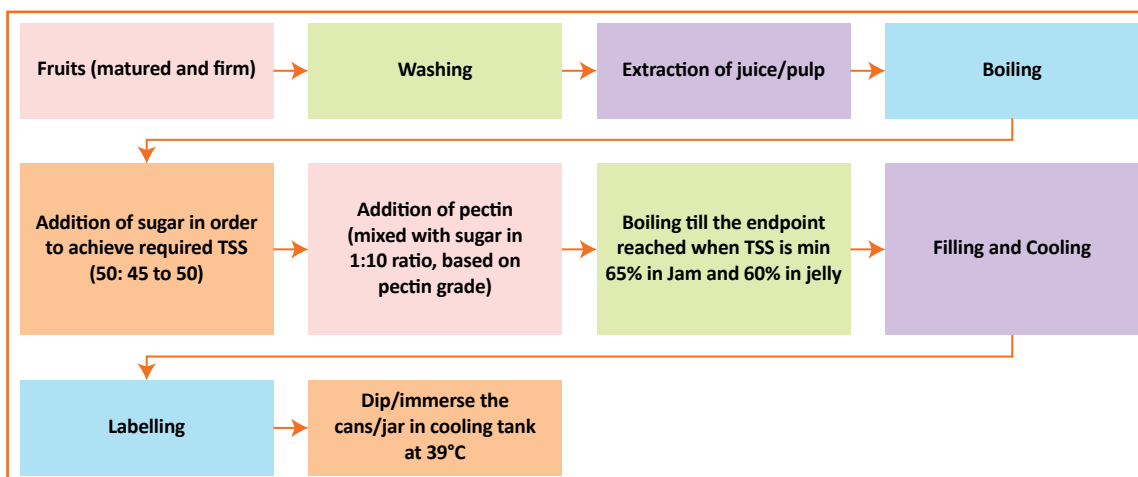


Fig. 5.1.4 Process flowchart for preparation of jam

Problems in the jam production

1. **Crystallization:** In the jam invert sugar must be present in the concentration of 30 –50%. If this concentration decreases below 30%, cane sugar may undergo crystallization upon storage. If the concentration of inverted sugar increases above 50%, the jam will form into a honey-like mass due to the formation of tiny glucose crystals. This crystallization can be prevented by adding corn syrup or glucose along with cane sugar in the jam preparation.
2. **Sticky or gummy jam:** High percentage of total soluble solids makes the jam sticky and gummy. This can be prevented by adding a sufficient amount of citric acid, pectin, or both.
3. **Premature setting:** This problem arises because of low total soluble solids and high pectin content. The addition of more amount of sugar is the best solution for it.
4. **Surface graining and shrinkage:** Jam must be stored in a cool place to prevent moisture loss due to evaporation. This moisture loss results in shrinkage and surface graining which affect the appearance of the product.
5. **Microbial spoilage:** During the storage, there may be mold growth in the jam, which can be prevented by storing jam in 80% humidity.
6. **Fermentation:** The occurrence is due to improper sealing of the jars. This problem can be solved by using the boiling water bath process.

5.1.5 Processing of Jelly

Jelly is prepared by boiling the fruit with or without water, straining, mixing the strained and clear juice extract with sugar, and boiling the mixture until it forms a clear gel. Guava, apple, plum are the fruits generally used for the preparation of jelly. Jelly shall have minimum TSS of 60% by weight. The permitted additives as defined in relevant Indian Food Standardization Code (IFC) shall only be added. Please refer to the IFC 4.1.2.5 of the FSSAI, 2011 regulation.

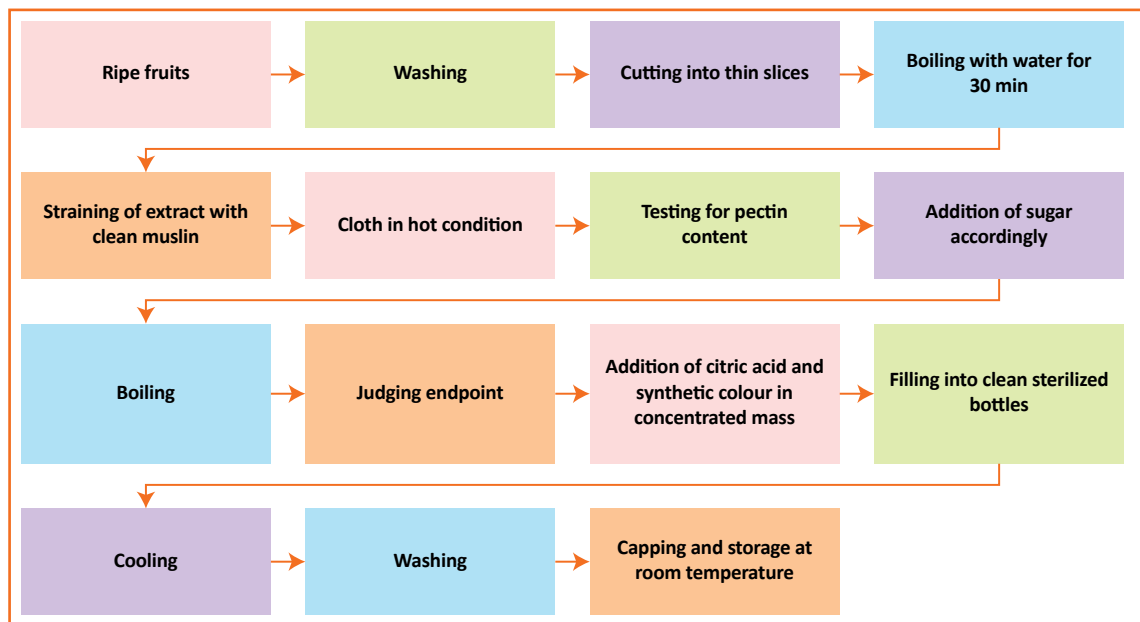


Fig. 5.1.5 Process flowchart of preparing jelly

Testing of pectin quality

Two different methods usually determine the pectin quality in strained fruit juice or pulp:

1. **Alcohol test:** One part of extracted fruit juice or filtered pulp is mixed with three parts of 95% alcohol and is allowed to stand for few minutes. A single translucent lump or clot will be formed in the case of an extract rich in pectin. In that case, an equal amount of sugar is to be added. The presence of a moderate amount of pectin suggests the formation of a less firm and fragmented clot. Therefore, three-fourths of the amount of sugar is to be added. The formation of numerous small granular clots, on the other hand, indicates the poor content of pectin in the extract in which half the quantity of sugar is ought to be added.
2. **Jelmeter test:** The jelmeter is held in the left hand using thumb and forefinger. The little finger is applied to close the bottom of the jelmeter tube. The strained extract is poured into the jelmeter using a spoon and held in the right hand until it gets filled to the brim. The little finger from the bottom is withdrawn, where the extract is allowed to drip for one minute, replacing the finger at the end. The jelmeter's reading of the extract level in the jelmeter gets recorded to indicate how many parts of sugar need to add to one portion of juice.
3. **Jelly test:**
 - ❑ **Temperature test:** The temperature of the jelly with a candy or jelly thermometer is taken. It should be 220°F.
 - ❑ **Spoon or sheet test:** A cool metal spoon is dipped into the boiling jelly mixture and lifted out. When the mixture starts to boil, the drops will be light, and syrupy begins to boil. The drops will become heavier as the syrup continues to boil. Once two drops form together and sheet off the spoon it indicates that the jelling point is reached.
 - ❑ **Refractometer test:** The endpoint is determined with the refractometer to 68 Brix.

Problems in jelly making:

1. **Failure of jelly to set:** It is due to an improper balance between various constituents of jelly e.g. lack of acid or pectin, too much addition of sugar, inaccuracy of measurement, inadequate cooking, overcooking, and slow cooking preventing the pectin from building a proper network of gel.
2. **Cloudy jelly:** Unclarified juice or pectin extract, under-ripe fruit, non-removal of scum, premature gelation, over-cooking, or pouring so slowly into containers can result in a cloudy jelly.
3. **Colour changes:** Darkening at the top of the jars can be caused by storing them in warm a place or an imperfect jar seal.
4. **Colour fading:** Fading can occur with red fruits if stored in too warm and too bright areas or stored too long as the natural colorants are highly susceptible to high temperature and light. Another possible cause of colour fading could be the insufficient processing to destroy the enzymes affecting colour on the elevated processing temperature might cause destruction. The chemical changes caused by oxidation can also be aided by trapped air bubbles.
5. **Crystal formation:** Excess sugar can “Seed” the jelly when high methoxyl pectin is used. Excess sugar is caused by overcooking, a lack of acid, or under cooking. Tartarate crystals can be formed in grape jelly if the juice is left to stand in the cold for several hours before being used.
6. **Gummy and Excess softness jelly:** Gummy jelly is caused by prolonged or overcooking in which more than the desired inversion of sugar occurs. Excess softness can be caused by an imbalance of the proportions of sugar, juice or fruit, acid, and pectin used. It can be solved by selecting fully ripened fruits.
7. **Weeping jelly:** Synergetic refers to the spontaneous exudation of fluid from a gel, also known as weeping jelly. It can be due to over-cooking, the accumulation of too low sugar or premature gelation, insufficient pectin, and storing in a warm place. “Weeping” arises during quick-setting and is due to disproportion of acid and pectin in the fruit mixture or the pectin quality of the fruit.
8. **Presence of mold and bubbles:** The appearance of mold can result from imperfectly sealed jars and air-borne contamination if insufficient sugar is used. Water availability makes a favourable environment for contamination from the jars if they are not adequately sterilized or left under processed. Mold is noticeable before the taste is affected. Bubbles are usually caused when the jelly is not brought to the correct temperature before it is filled in the jar. This can be rectified by filling them in a boiling water canner.
9. **Stiff and Tough jelly:** Overcooking or using too much pectin makes too tough jelly which fails to spread when applied on bread. Toughness happens because of the excess natural pectin content of the fruit. It can be solved by choosing fully ripened fruit rather than unripened ones.

5.1.6 Lab Analysis for Quality Check

It is an optimum standard maintained continuously as per the company standard norms to produce a quality product and specific guidelines as specific requirements stated in FSSAI Regulations, 2011 under chapter 2.3.31. Every step involved in the process requires monitoring, inclusive of food safety and personal hygiene. For example, in jam and jelly, a quality check is done based on technical specification and organoleptic, which differ from fruit to fruit. Following are the parameters for quality check:

1. **pH** - a numeric scale to check acid levels in fruits. Each fruit has its own acidity level. The processing company maintains it as per their requirement.

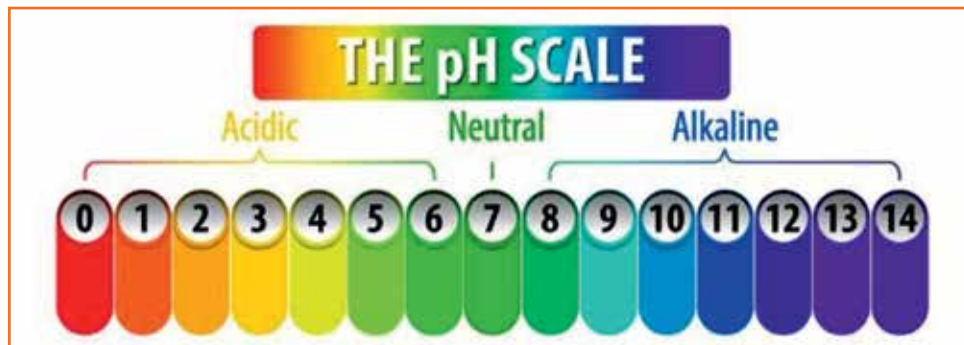


Fig. 5.1.6 pH Scale

2. **Viscosity** - Viscosity is a measure of a fluid's resistance to flow. It is measured by viscometer as per the need.
3. **Taste/flavour, colour, and texture** - it is checked by tasting the product.
4. **Determination of pectin** - It is determined by placing 1 ml of boiled fruit extract in a test tube with the addition of 3 ml alcohol (90%) and leaving for a few minutes until clotting occurs.
5. **Titrateable Acidity** - It measures the total acid concentration in fruit and is determined by exhaustive titration of intrinsic acids with a standard base. Titrateable fruit acidity is expressed as g/100 mL of the predominant acid.



Fig. 5.1.7 Pectin in Fruit

6. **Determination of total soluble solids** - It is the extracted mass of fruit, which contains fibers and fruit sugar. Each fruit or vegetable has its own Brix ratio. It is maintained as per company's requirement.

Exercise

I. Answer the following questions:

1. Explain the operation of the cooking kettle.

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2. List the ingredients of jam and jelly.

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3. What is pectin?

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4. List any three problems in making jelly.

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5. Explain the procedure to check the quality of the jam.

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6. What are the problems that occur in the procedure of jelly making?

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Equipment used in jam, jelly and ketchup processing



www.youtube.com/watch?v=a_SmTLGXeO8&t=48s

How to start Jam, Jelly business



www.youtube.com/watch?v=_jIC02psi0g&t=79s

Apple jam processing



www.youtube.com/watch?v=dgpqWOAoBB0

Orange jelly processing

Unit 5.2 - Process of Preparing Ketchup

Unit Objectives



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

1. List the ingredients used in preparing ketchup such as sugar, salt, spice powder, vinegar, etc.
2. Elaborate the procedure to prepare ketchup from the fruit pulp
3. Explain the method to test the viscosity of the ketchup using viscometer

5.2.1 Preparation of Ketchup

Ketchup is made from strained tomato juice or pulp with the addition of spices, salt, sugar, and vinegar (onion and garlic are added optionally). As per FSSAI, chapter 2.3.27, it states the requirement of TSS of tomato which shall not be less than 25% (m/m). Ketchup is made from more or less the same ingredients and methods as chutney, with the exception that the fruit pulp or juice is sieved after cooking to remove the skin, seeds, and stalks of fruits/vegetables and spices added to give a smooth consistency to the finished product. However, cooking takes longer because fine pulp/ juice is used. High-quality ketchup is prepared by maceration of spices, herbs, fruits, and vegetables in cold vinegar or by boiling them in vinegar. Thickening agents are also added to the sauce to prevent the sedimentation of solid particles. Ketchup should be cooked to such a consistency that it can be freely poured without the fruit tissues separating out in the bottle. The colour of the ketchup should be bright. Ketchup usually thickens slightly on cooling. The container shall be well filled with the product and shall occupy not less than 90% of the water capacity of the container, when packed in the rigid containers. The water capacity of the container is the volume of distilled water at 20°C which the sealed container is capable of holding when completely filled.



Fig 5.2.1 Ketchup

5.2.2 List of Ingredients Used in Preparing Ketchup

Spices: The spices should be of excellent quality and added in the correct proportions to give the product a pleasing taste and flavour. The natural tomato flavour is not dominated by any particular spice. The spices preferred in ketchup manufacture include red chili, black pepper, nutmeg, clove, cinnamon, cardamom, mace, and cumin. Besides these spices, seasonings like onion, ginger, and garlic may also be used in ketchup recipes. Certain specific measures are recommended for adding spice to make excellent quality ketchup or sauce.

- Red chili powder, spices, onion, and ginger should be tied loosely in the bag for better diffusion of flavoring principles in ketchup.
- The head portion of the clove should always be removed before it is grinded as it may lead to a black neck defect in ketchup.
- Usually, garlic is not the preferred seasoning in ketchup or sauce manufacture as its flavour may predominate over other spices.

The essence of clove, cinnamon, and cardamom is preferred in place of using coarsely ground powder because of the convenience of use and better flavour note in the finished product.

Methods of using ingredients for the production of Ketchup	
Bag method	The coarsely ground spices are tied loosely in a muslin cloth bag, and the bag is placed in the tomato juice during boiling. The bag is pressed intermittently to release the flavouring component during processing. The proportion of these spices should be standardized so that they should not affect the color of the resultant product and do not impart bitterness. This bag can be used for the second batch also.
Use of oleoresins	Oleoresins are pure and natural extracts of spices obtained by solvent extraction. These concentrated extracts contain all the flavour components, be it volatile oils or non-volatile resinous fractions. These are the resins of active flavouring components in some solvents. The active flavouring molecule is extracted with a suitable solvent, and it can provide the complete flavour profile of the raw spice with the quick release of the flavour. Oleoresins are added few minutes before the final boiling during the manufacture of ketchup.
Use of extracts	Spice extract is prepared on a large scale by steeping or boiling spices in vinegar. The aroma component of the spices gets extracted in vinegar, and vinegary extract may be used in place of whole spice. It assists in maintaining the same taste and aroma and standardizes the proportion of spices in the recipe.

Methods of using ingredients for the production of Ketchup	
Sugar	Sugar is mainly used to adjust the sugar-to-acid ratio of the ketchup or sauce. Sugar may be added in the form of granular sugar, corn syrup, and other sweetening syrups. However, granular sugar is the most preferred one. About 1/3rd of sugar is added in the initial stage of boiling. This helps in preserving the natural colour of the product. The rest of the sugar is added a minute before the final concentration is reached. Initial addition of sugar will adversely affect the colour of the product as cooking of the product with higher amount of sugar under acidic conditions flavour brown coloured, Furfural, commercial level, sugar level varies between 10-26%. A higher amount of sugar may impart higher sweetness which is not liked by consumers.
Common salt	Salt bleaches the colour of the tomato and also dissolves to some extent, copper from the processing equipment. It is, therefore, desirable to add towards the endpoint of the process. The range of common salt varies between 1.5 to 3.5%, and salt is added to enhance the flavour of the product and exert preservative action to a lesser extent. Salt of very high purity is preferred for ketchup manufacture. Salt also counteracts the highly acidic flavour of tomato pulp.
Vinegar	Vinegar is always added towards the end of the process in ketchup or sauce manufacture. Since it is a volatile product, most of the acid will lose during cooking. Tomato Ketchup" shall comply to the requirement of Acidity as acetic acid which shall not be less than 0.2%. In addition, vinegar contributes to the flavour as well as microbial stability of the ketchup.
Thickening agent	Pectin may also be added @ 0.1-0.2 percent by weight of finished product in clear juice or pulp to check the problem of serum separation and to also increase viscosity.

Table 5.2.1 List of ingredients used in the following way during the production of ketchup

5.2.3 Procedure to Prepare Ketchup

The steps of processing ketchup are given below in the table:

<p>Cooking & Concentration</p>	<p>The tomatoes juice, and other ingredients are cooked and concentrated to get the desired flavour, uniform taste, and fine thickness or body. The cooking continues till the concentration reached 25 percent TSS. However, a concentration of 28-30 percent total solid is ideal as further increase may adversely affect the flavour of the product. However, to improve ketchup’s stability, a slightly higher amount of sugar, salt and vinegar are added.</p>
<p>Bottling & Packaging</p>	<p>After attaining the desired total solid level and consistency, the ketchup is finally passed through a finisher to remove any tomato fiber, seeds, and any other suspended solids. After cooking, the Ketchup or sauce should be bottled hot at 85 880C to prevent browning and loss of vitamins during subsequent storage and distribution. Hot filling of the bottle also assists in the creation of a vacuum in the headspace during the cooling of ketchup. The crown cork used for the ketchup bottle should be lined with polyvinyl chloride (PVC) to prevent the contact of ketchup with the metallic portion to avoid black neck formation. However, nowadays, sauce and ketchup are also packed in laminated flexible packaging materials consisted of polyethylene (PE), polyester (PET), and aluminum. Moreover, certain squeezable bottles are also used for the packaging of these products. Bottled and packaged products are stored under ambient temperature (30-350C) under dry places.</p>
<p>Pasteurization</p>	<p>The hot-filled bottles are pasteurized in hot water (85-88^o) for 30-35 minutes. Care must be taken to cool the bottle immediately after pasteurization to avoid the degradation of nutrients and over-processing. Shelf-life is also enhanced by using preservatives.</p>

Table 5.2.2 Processing of ketchup

The following flow-chart shows the process of making tomato ketchup in brief:

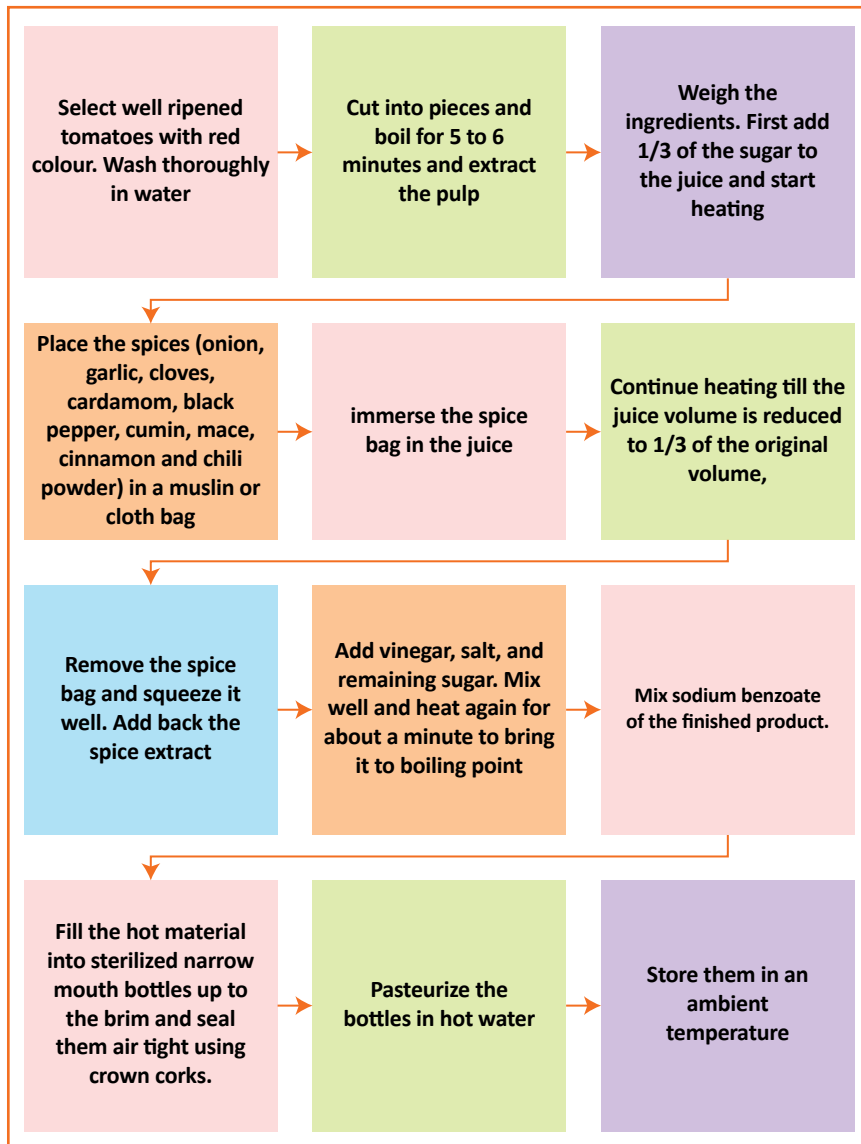


Fig. 5.2.2 Processing of ketchup



Fig 5.2.3 Storage Tank for Ketchup Making

Problem during the preparation of Ketchup

- **Black neck:** It is a formation of the black ring in the neck of the bottles. It is caused by the iron which gets into the product from equipment metal or cap/crown cork. This iron when comes in contact with tannins in spice forms ferrous tannate, which on oxidation changes to black colour.

Prevention of black neck

- Fill hot sauce at a temperature not less than 85°C.
- Leave less headspace in bottles (more air in bottles will result in more blackening).
- Reduce the chances of iron contamination.
- Partial replacement of sugar by corn syrup or glucose may prevent blackening.
- Store bottles in a horizontal or inverted position to diffuse the entrapped air/oxygen.

5.2.4 Method to Test the Viscosity of Ketchup Using Viscometer

Viscosity is the measure of a substance's resistance to flow (under certain conditions). A viscometer is a measuring instrument used to determine a fluid's internal flow resistance or viscosity. The Pascal-second (Pa s) is the SI physical unit of dynamic viscosity (η), which is equivalent to $1 \text{ kg m}^{-1} \text{ s}^{-1}$. Fluids that have a constant viscosity autonomous from stress are called Newtonian. For example, water is a Newtonian fluid. Irrespective of whether you shake the cup of water, the viscosity/thickness or rate of flow doesn't change. In ketchup, viscosity corresponds to thickness. Ketchup is a non-Newtonian fluid because, unlike water, its viscosity is dependent on the shear rate. Therefore, it requires measuring its resistance to gradual deformation by stress (either shear stress or tensile stress).

- Various instruments are available to measure viscosity for quality control to the food processing industry and thus ensure that products made are of consistent quality. A common instrument that is used in the food industry is the Bostwick consistometer, which determines the consistency of food by measuring the distance it flows under its own weight. Typical food products measured include tomato ketchup, tomato puree, jams, etc., to name a few. The low maintenance and ease of Bostwick consistometer make them very popular.



Fig 5.2.4 Bostwick Consistometer

- Other common methods to test the viscosity of ketchup are listed below -

Methods to test the Viscosity Of Ketchup	
Capillary Viscometer	One of the oldest methods of measuring viscosity, the capillary viscometer, measures the time between the volume of sample to pass through the length of the capillary tubes.
Rotational Viscometer	Measures the torque required to revolve an object within the volume of liquid
Viscosity Cup Method	Measures by observing the time it take the volume of liquid to empty the cup through a small hole in the bottom of a container/cup.
Vibrational Viscometer	By measuring the vibrational waves using a vibrating rod submerged in fluid, viscosity is calculated by analyzing the dampening of the vibration.
Falling ball viscometers	A falling ball viscometer measures the viscosity of fluids, and some units can also measure the viscosity of gases.

Table 5.2.3 Methods to test the Viscosity of Ketchup

Exercise

Answer the following questions:

1. How does sugar play an important role in the process of making ketchup?

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2. Explain the bag method way of spices used during the manufacturing of ketchup.

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3. What is a black neck?

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4. What is a viscometer?

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5. Explain the process flow of ketchup making.

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Jam, Jelly and Ketchup Processing



www.youtube.com/watch?v=kkvF6yNPFxc&t=219s
Tomato Ketchup Processing

Unit 5.3 - Operating Packaging Machine

Unit Objectives



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

1. Discuss the procedure to load and operate the packaging machine
2. State the importance of setting packaging machine for filling volume, speed, size, etc.
3. Elaborate the standard procedure to wash bottle/plastic containers to fill measured quantity of finished products
4. State the significance of spraying water on containers to cool and set product (setting in case of jam and jelly) or arrange filled jam/jelly containers in the rack for a specified time as per the standards

5.3.1 Introduction

Food packaging is the most reliable process of food containment. This is the best way to safely control and protect the food against physical, chemical, biological, and environmental factors.

- Packaging performs varied tasks such as protecting the contents in its containment from spoilage and leakage, easier transportation and storage, and better communications between the manufacturer and consumer.
- The most important four functions of packaging include:

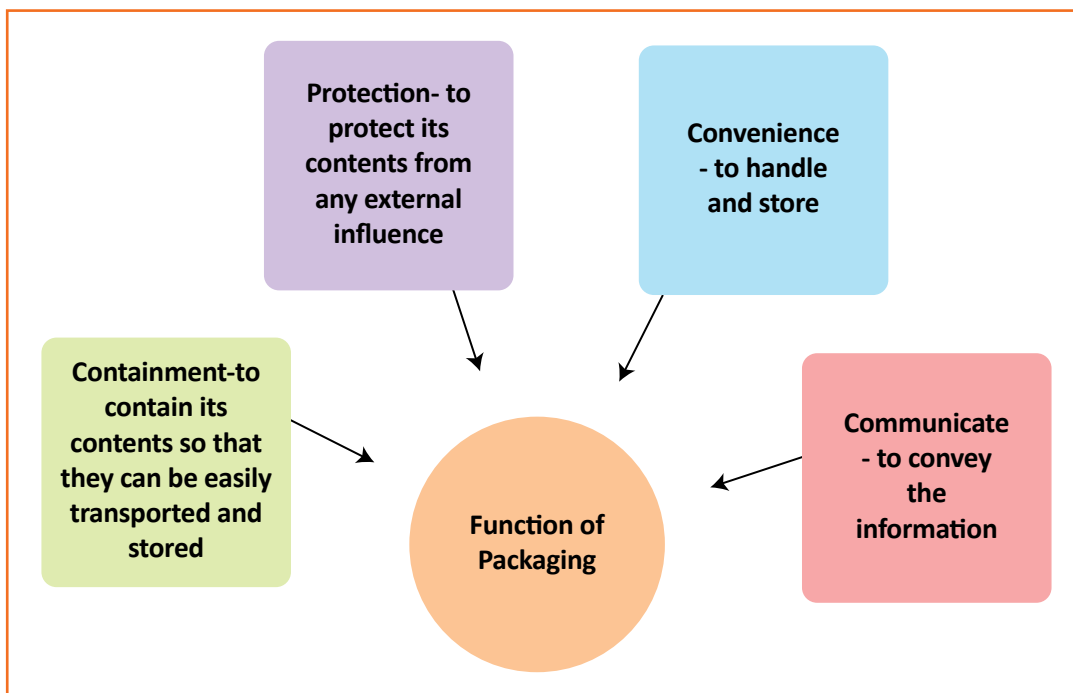


Fig. 5.3.1 Functions of packaging

The principal factors which affect the efficiency and utilization of a packaging line are as follows:

1. The suitability of the machine for the purpose
2. The output speed required
3. The likelihood and frequency of stoppages and the time is taken to clear them

Purpose of Packaging –

Shelf life	To maintain the organoleptic properties over a long period
Preservation	Prevent temperature fluctuations, bacterial ingress, dust, etc.
Barrier Protection	Prevent migration of oxygen, water vapor, UV light, etc.
Physical Protection	Protection from shock, vibration, compression, etc.
Security	Prevent pilferage and/or tampering. Also, assures authenticity
Portion control	A single serving pack has a precise amount of contents to control usage.

Table 5.3.1 Purpose of packaging

Some of the packaging machinery used in food processing industries are:

1. Filling machines are most often but not exclusively used in the food packaging industry. Filling machines are used to fill liquids, grains, and other products into a container. The accuracy of the filling machine helps to maintain a consistent product for consumers efficiently.
2. Form Fill Seal or FFS is a kind of packaging machine, where the laminates are fitted inside the equipment and thus, the machine itself first forms a package by sealing the lower half of the pack, and then fills the product as FFS contains a filling hopper and once the product is filled, the top is sealed and cut into proper packets. Form Fill Seal is used in multiple forms of flexible packaging applications. Many products within industrial, retail, pharmaceutical, and food packaging are sealed using a heat sealer. Sealers come in multiple sizes and specifications.
3. Cartoning systems are used in most packaging applications utilizing corrugated boxes. Tape guns are used in smaller operations, but higher volumes require case sealers for efficient packaging. Manual and automatic case sealers are used in retail, food, industrial, and pharmaceutical bulk packaging.
4. A bottling system is a collection of automatic machines connected by a conveyor belt or a group of highly specialized, fully automatic units that are completely integrated by a synchronized drive arrangement.
5. Coding machines apply a code (including bar codes), dates, and other variable or unique information to a package or transit container. These machines are usually attached to a larger packaging machine such as a cartoner, filler, or wrapper.
6. Labelling Machines apply labels and decoration onto all types of packaging containers, display, point-of-sale, and transit packs. Labels are used on every kind of product to brand, decorate or provide information for the consumer.

7. Conveyors are machines and equipment which carry ingredients, products, containers, packs, or packaging components from one place to another.

5.3.2 Workflow Process of Jam and Jelly Packaging Machine

1. Packaging machines for jams, jellies, and ketchup consists of an Unscrambler that orientates the bottles towards - the Airjet Cleaner where the bottles get cleansed with the filtered air purging & direct the bottles toward the filling station where the bottles get filled with jams, jellies, and sauce, then goes towards the Capping Station - where the filled bottles get capped at required torque & the caps are supplied with an elevator mechanism to get the capping done to the bottle.

The packaging line consists of:

- i. Cleaning Machine - for empty containers with water and steam treatment



Fig. 5.3.2 Cleaning and Sterilizing Machine

- ii. Bottle Unscrambler - for Container/bottle feeding

- iii. Linear piston filler - for filling dense and semi-dense products
- iv. Filling Area – where jars/bottles are placed



Fig. 5.3.3 Filling Machine

- v. Cooling Conveyer - to cool the containers before moving to the capping machine



Fig. 5.3.4 Cooling Machine(left) & Capping Machine(Right)

- vi. Automatic linear capping/corking machine with cap/cork feeder- for capping the containers
- vii. Drying unit with air knives – to seal the caps of the container
- viii. Electronic Vacuum detector with the rejecting system – to reject the uncapped or cross capped containers

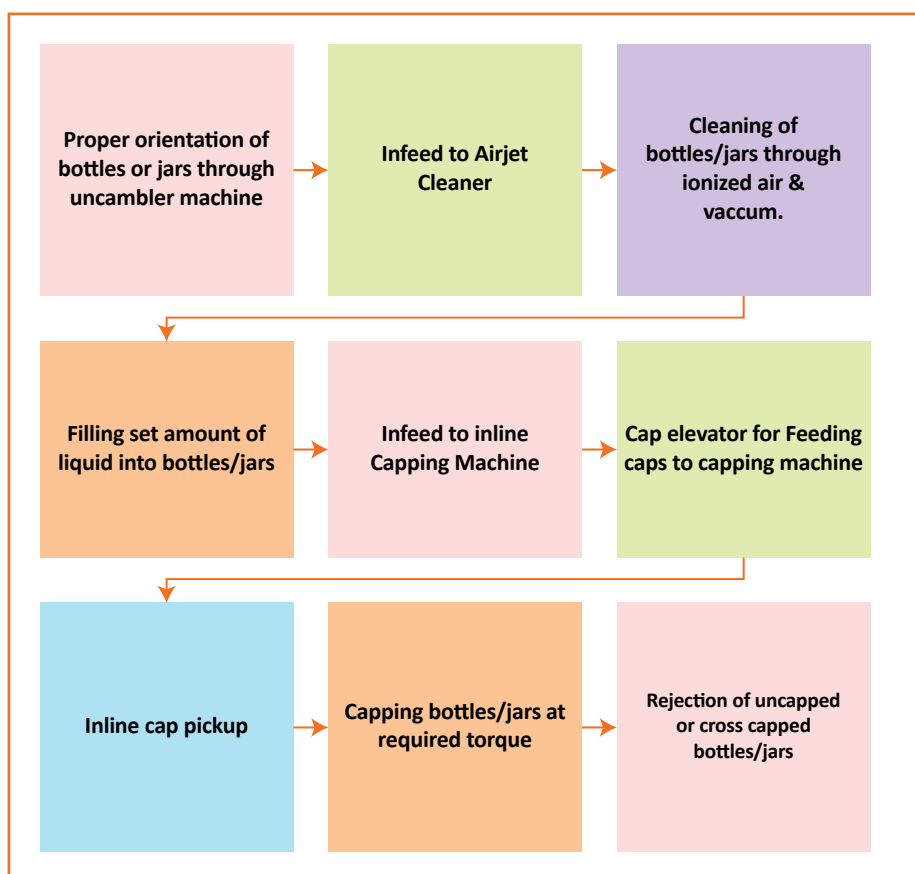


Fig. 5.3.5 Workflow process of Jam, Jelly and Ketchup packaging line

2. Packaging criteria

- Rinsing machines for jars or other containers should be used to remove dust and debris from the containers before filling, removing the possibility of producing contaminated products or reducing the shelf life of a batch.
- Jam, jelly, or ketchup should be filled hot at 85-80 degrees C to prevent browning and loss of vitamins during subsequent storage and distribution.
- The liquid must be kept at a constant temperature throughout the process to ensure the product flow evenly and the fill can be consistently and reliably repeated.
- Packaging material should be heat-resistant i.e., should have resistance towards high filling temperature.
- It should be sturdy to prevent handling and storage hazards.
- The package should not react with and change the product's properties over a given period of storage and preservation.
- Containers should be cooled before applying the label to avoid wrinkles or peeling off of the label. It will also help the jam/jelly/ketchup to set in the container.
- Packaged products should be stored under ambient temperature in a dry place.

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



<https://www.youtube.com/watch?v=EGkvS6gCtGY&t=30s>

Packaging and storage

Unit 5.4 - Labelling and Coding

Unit Objectives



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

1. Elaborate the standard procedure to load labels in the labelling machine
2. Discuss the procedure to set date coding machine for a batch number, date of manufacture, date of expiry, etc.

5.4.1 Standard Procedure to Load Labels in Labelling Machine

The following chart explains the standard procedure to load labels in a labelling machine.

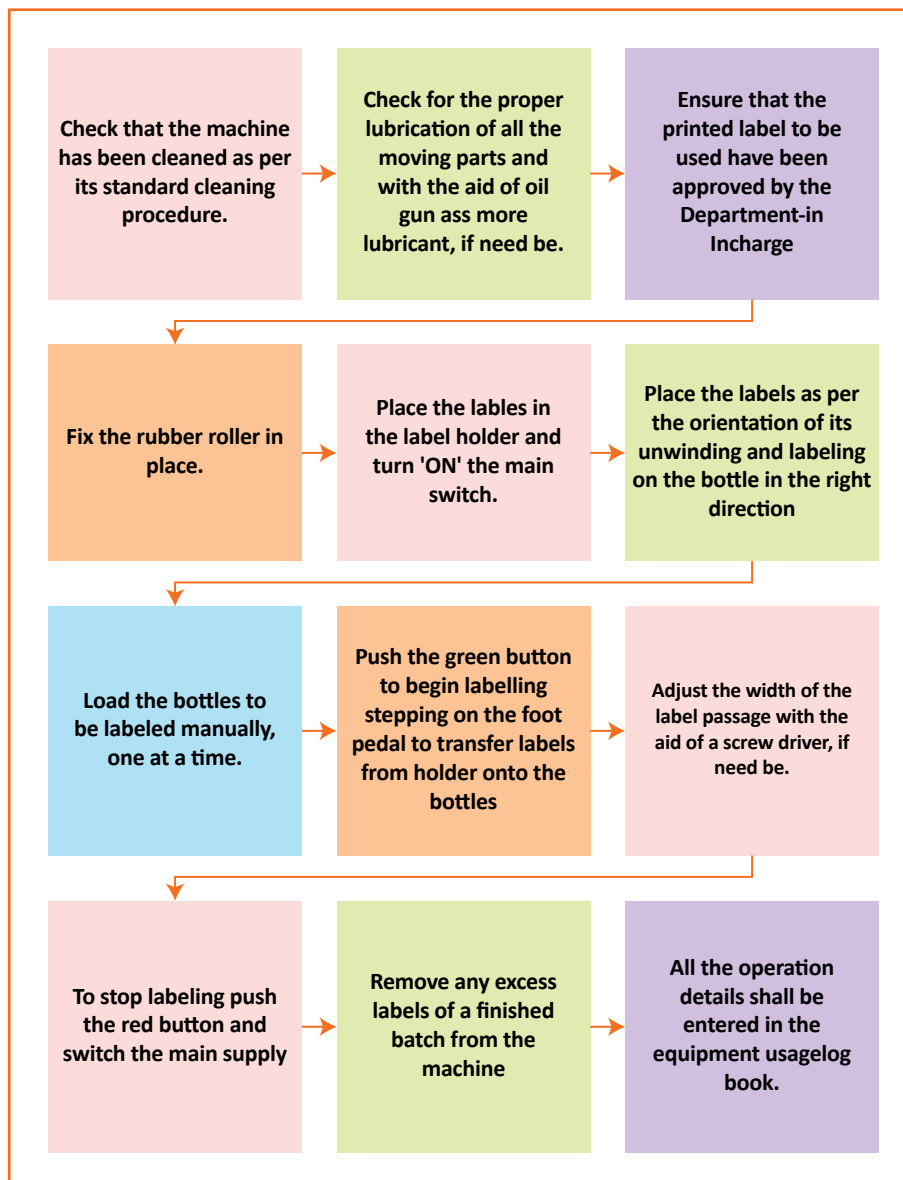


Fig. 5.4.1 Standard Procedure to load labels in labelling machine

Standard procedure to proceed to set date coding machine



Fig. 5.4.2 Labelling Machine

Following are the procedure to set date coding machine -

Pre-start-up

- Check the status of the machine for its operation.
- Visually check the machine and surrounding area for cleanliness.
- Take the line clearance from the in-process quality assurance officer before starting the coding operation and enter the line in Batch Production Record.
- Write the Batch No., Product Name, Date, and Signature on the machine status tag.
- Get the coding details such as Batch No., Mfg. Date, Exp. Date & MRP of the bottle from the production officer.
- Take the packaging material already issued from the production officer as per the secondary packing material requisition from the store.

Startup:

Note: Batch coding should be done in a separate room with restricted admission to only a coding operator and production employee.

- Ensure that one coding operation of the product is carried out at one time. Switch "ON" the machine from the main panel.
- Switch on the machine and adjust the coding materials for alignment of impression.
- Set the rubber stereotypes on coding muster.
- Put ink on ink roller and run machine till ink spreads uniformly.
- Get the first coded material and specimen sample attached in batch production record, approved by the in-process quality assurance officer.
- Start coding operation only after getting approval from the in-process quality assurance officer.
- Store the coded material in plastic crates, put a status tag, store the crates under lock and key in storage rack after completion of day's work.

- Collect and count the rejected coded materials in poly bags and do the entries in Batch Production Record.
- Get the last coded material approved by the In-process quality assurance officer and attached in batch production record.
- Record the operation time in the equipment logbook as per SOP
- After completing the batch, rubber stereotypes are to be destroyed as per SOP and Enter in Batch Production Record.
- After completion of the operation switch off the coding machine.
- Remove the coded /encoded packaging units from the machine and store them under lock and key.
- Collect and count the rejected packaging unit from the machine, keep it in polybags, and enter the quantity in BPR.
- Destroy and dispose of the collected packaging units.
- Switch off the main electric supply. Record the operation, cleaning & Maintenance details in the equipment logbook as per SOP and get it checked by the production officer.



Fig. 5.4.3 Coding Machine

Exercise

Answer the following questions:

1. What is the function of a labelling machine?

.....
.....
.....

2. List any two functions of the jam, jelly, and ketchup packaging machine.

.....
.....
.....

3. Explain the standard procedure to set dates in a coding machine.

.....
.....
.....

4. List any two examples of the packaging machine.

.....
.....
.....

6. Complete Documentation and Record keeping Related to Production of Jam, Jelly and Ketchup



Unit 6.1 – Documentation and Record Keeping



Key Learning Outcomes



At the end of this module, participants 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

Unit 6.1: Documentation and Record Keeping

Unit Objectives

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

1. State the factors for making the design for food processing unit
2. State the design and construction requirements for food processing unit

6.1.1 Need for Documentation

Every organisation has to maintain records of raw material procurement, production processes, and sales. The purpose is to assist in determining whether anything has happened to the food or been done to the food that would render it unsafe (i.e., adulterated). Accordingly, firms must maintain records and government authorities may access the records.

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 organization follows a more or less similar way of keeping records. Production records keep a log of:

- Quantity and type of raw materials
- Quantity and type of ingredients used
- Processing conditions in which production took place (e.g. the temperature set or the air pressure applied)
- Product quality

Exercise

Select the correct options

1. What is the need for documentation?
 - a) It gives detailed information on how to run a business.
 - b) It helps in controlling the quality of the product.
 - c) It helps in keeping track of the money invested in the business.
 - d) It helps in identifying the individual costs of raw materials or product materials.
2. It helps in identifying the production cost of a particular process.
 - a) It helps in storage of raw materials.
 - b) Helps to ensure that quality assurance procedures are followed.
 - c) It helps in ensuring that the production unit is running smoothly/effectively.
 - d) It serves as an evidence for legal procedures.
3. It helps to clean food handling equipment and machinery.
 - a) It helps in sending the produce to the market.
 - b) It helps in determining fair product price.
 - c) It helps in taking corrective measures at the right time.
 - d) Maintain a log of production records.
4. Quantity and type of raw materials.
 - a) Quantity of finished products stored
 - b) Quantity and type of material used
 - c) Processing conditions in which the production took place (eg temperature set or applied air pressure)
 - d) Product quality

Match the columns

Column A	Column B
Each production process completed is assigned a number	Stock control books
Details of purchase of raw material are noted	Batch number
The details of the production process are noted	Quality procedures are followed
Product sales details entered	Legal evidence
Serve as a record	Log book processing
Properly maintained records help identify whether	Sales and Delivery Log

7. Food Safety, Hygiene and Sanitation for the Processing of Food Products



Unit 7.1 – Sanitation and Hygiene

Unit 7.2 – Safety Practices

Unit 7.3 – Good Manufacturing Practices (GMP)

Unit 7.4 – Hazard Analysis and Critical Control Point (HACCP)

Unit 7.5 – Introduction to Food Microbiology



Key Learning Outcomes



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

1. State the personal hygiene and sanitation guidelines;
2. State the food safety hygiene standards to follow in a work environment;
3. Follow the fire safety practices in the work area.
4. State the importance of safety, hygiene, and sanitation in the food processing industry;
5. Follow the industry standards to maintain a safe and hygienic workplace;
6. State the storage requirements for raw materials and finished products;
7. Determine the quality of food and intake measures to prevent spoilage;
8. Follow stock rotation based on FIFO/FEFO;
9. Follow HACCP principles to eliminate food safety hazards in the process and products;
10. State the types of food microbes;
11. State the causes for food spoilage;
12. State the process for food spoilage;
13. State the criteria to check food spoilage;
14. State the need for food preservation;
15. State the different types of food preservation processes.

UNIT 7.1: Sanitation and Hygiene

Unit Objectives

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

1. State the personal hygiene and sanitation guidelines;
2. State the food safety hygiene standards to follow in a work environment.

7.1.1 Personal Sanitation

Sanitation and hygiene are the most important aspects to take care of when working in a food processing area. 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 a hair net while working.



Personal sanitation

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.



Washing hands with soap and water

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.



Do not smoke, spit, cough

UNIT 7.2: Safety Practices

Unit Objectives

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

1. Follow the fire safety practices in the work area.

7.2.1 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. 7.2.1. Safety symbols

7.2.2 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 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 →		Water	Foam	CO ₂	Dry Chemical
Types of Fire ↓					
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. 7.2.2. Types of fire and fire extinguishers

How to use the Fire Extinguisher?

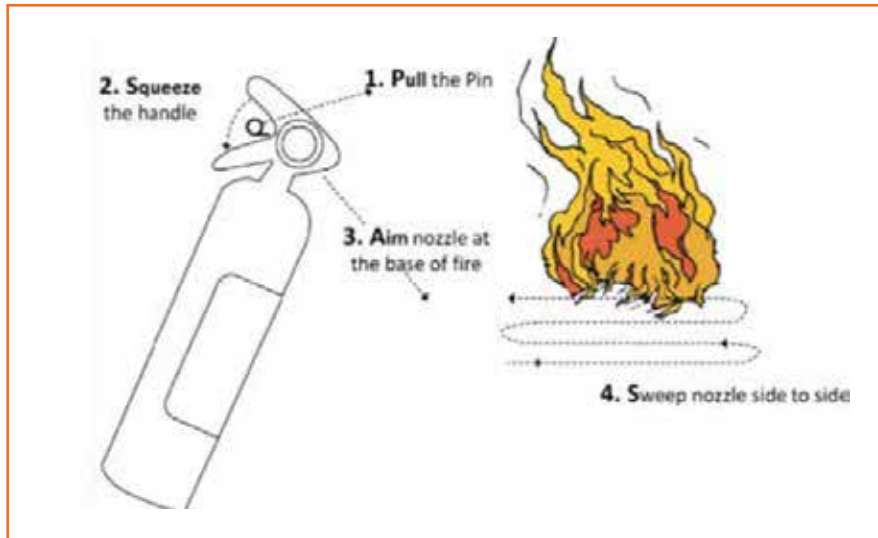


Fig. 7.2.3. Fire extinguisher

How to use the Fire Buckets?

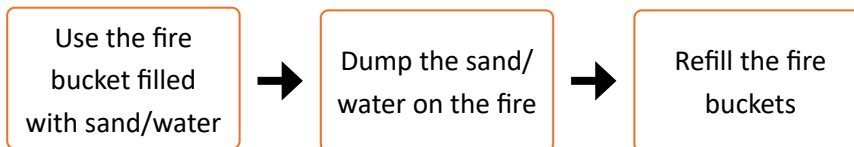


Fig. 7.2.4. Fire bucket

UNIT 7.3: Good Manufacturing Practices (GMP)

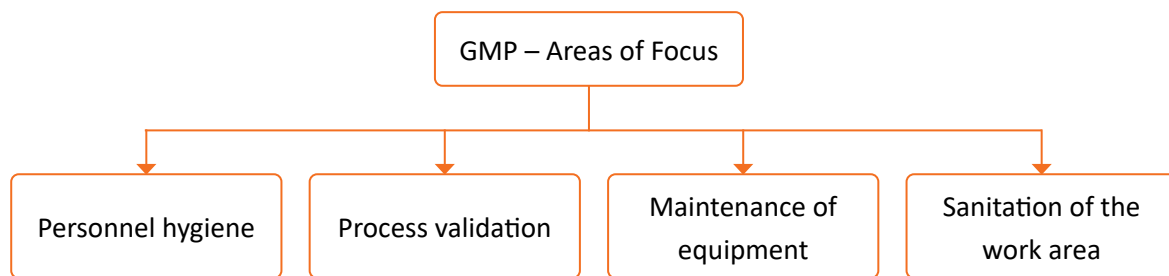
Unit Objectives



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

1. State the importance of safety, hygiene, and sanitation in the food processing industry;
2. Follow the industry standards to maintain a safe and hygienic workplace.

7.3.1 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.



Area of focus		GMP
Personnel hygiene		<ul style="list-style-type: none"> • 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
		
Personnel hygiene	Facilities for toilets	





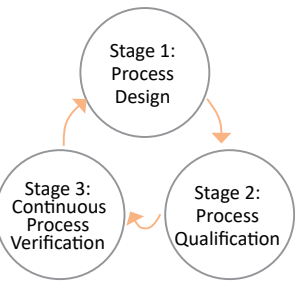
Area of focus		GMP
Sanitation of the work area		<ul style="list-style-type: none"> The processing unit where you work is located in a clean, pollution-free area The entire processing unit is well ventilated and has adequate lighting The entire work area follows high standards of cleaning and sanitisation There is a designated area for keeping utensils and equipment. It is kept clean and pest-free at all times
		
Designated area for keeping utensils	Sanitation of the work area	
Equipment maintenance		<ul style="list-style-type: none"> 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
		
Equipment maintenance	Monthly schedule	
Process validation		<ul style="list-style-type: none"> 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
		
Process validation	Quality checks	

Table 7.3.1

7.3.2 Food Storage

Store food in such a way that:

- It is safe from the possibility of contamination and
- The environmental conditions in which it is stored have an impact on the safety and suitability of the food.
- Will not have an adverse effect.

When storing potentially hazardous food:

- Keep it under temperature control and
- If it is food that is intended to be stored frozen, ensure that during storage
- Food stays frozen.

7.3.3 Stock Rotation System

FIFO (First-In-First-Out) is a stock rotation system that dispatches processed food depending on the order in which it is produced.



Fig. 7.3.1. FIFO stock rotation

FEFO (First-Expired-First-Out) is a stock rotation system wherein products that need to be consumed earlier are shipped first.



Fig. 7.3.2. FEFO stock rotation

JIT (Just-In-Time): A system where finished product is dispatched to the distributor, retail industry or institution as soon as the product is ready. A carton of processed food can be stored for a maximum of 2 days in the storehouse.

UNIT 7.4 - Hazard Analysis and Critical Control Point (HACCP)

Unit Objectives

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

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

7.4.1 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	<ul style="list-style-type: none"> • Evaluate the production process and identify the points where hazards (physical, chemical, and biological) may be introduced
Identify critical control points	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • State the boundary line between safe and unsafe processes • State the limit until which a critical point maybe controlled
Establish a monitoring system	<ul style="list-style-type: none"> • State the process of monitoring critical points and critical limits
Establish corrective measures	<ul style="list-style-type: none"> • Specify the corrective actions that should be followed when critical limits are crossed
State verification procedures	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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

Table 7.4.1 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					
	Micro-biological (high micro-biological load of raw materials, presence of pathogenic bacteria)	FIFO system should be established		Monitor temperature and humidity of storage			Store temperature logs

UNIT 7.5 - Introduction to Food Microbiology, Food Spoilage and Food Preservation

Unit Objectives

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

1. State the types of food microbes;
2. State the causes for food spoilage;
3. State the process for food spoilage;
4. State the criteria to check food spoilage;
5. State the need for food preservation;
6. State the different types of food preservation processes.

7.5.1 What is Food Microbiology?

Food microbiology is the study of microorganisms found in food products. Microorganisms are classified as:

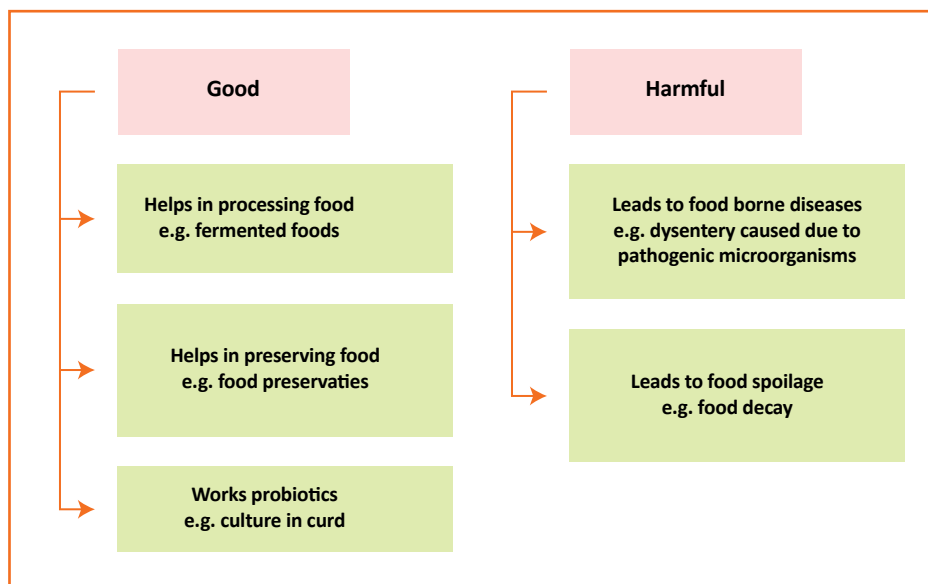










Fig. 7.5.1 Food microbiology

7.5.2 Types of Food Contaminants

Food spoilage is the process by which the original nutritional value, texture, flavours, and the form of food is damaged. The food then becomes harmful and unsuitable for human consumption.

Some types of contaminants in foods are:

Types of contaminants	Examples
Microbial	Bacteria, moulds, yeasts, viruses, etc.   <i>Fig. 7.5.1. Microbial Contaminants</i> <i>Fig. 7.5.2. Microbial Contaminants</i>
Biological	Hair, excreta, bone splinters, etc.   <i>Fig. 7.5.3. Biological Contaminants</i> <i>Fig. 7.5.4. Biological Contaminants</i>
Chemical	Pesticide residues, detergents, etc.   <i>Fig. 7.5.5. Chemical Contaminants</i> <i>Fig. 7.5.6. Chemical Contaminants</i>
Physical	Bolts from machinery, stones, glass, etc.   <i>Fig. 7.5.7. Physical Contaminants</i> <i>Fig. 7.5.8. Physical Contaminants</i>

Process of Food Spoilage

The following process chart shows how food spoilage takes place:

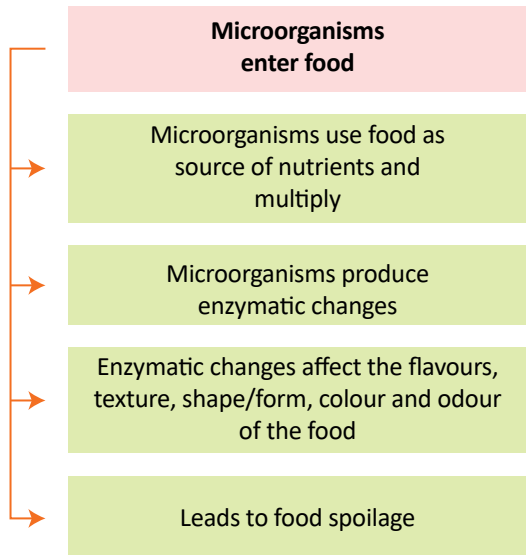


Fig. 7.5.9. Microbial spoilage of food



Fig. 7.5.10. Moulds on fruits

Classification of Food Based on Spoilage

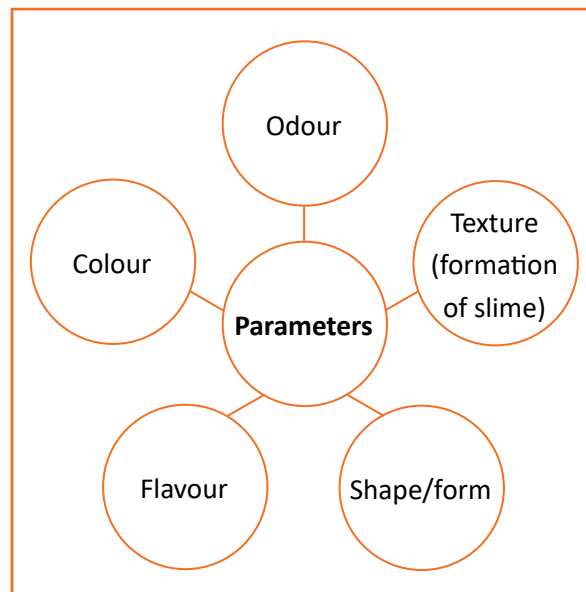
The following table shows how food is classified based on spoilage:

Non-perishable foods	Semi-perishable foods	Perishable foods
Does not spoil unless handled carelessly E.g.: Sugar	Spoils only if handled carelessly or stored improperly E.g.: Potatoes	Spoils readily and needs to be stored with special preservatives/processes E.g.: Milk

Table 6.6.1 Classification of Food based on Spoilage

Parameters to Check Food Spoilage

Following parameters will help you to check food spoilage:



7.5.3 What is Food Preservation?

Food preservation is the process by which processed and unprocessed food is protected against microbes, spoiling agents, and contaminants. The objective of preserving processed food is to:

- Retain the original nutritive value
- Retain the original colour
- Retain the original flavour
- Retain the original texture of the food
- Extend the shelf life of the food
- Ensure year-round availability
- Prevent or delay spoilage

Common Methods of Food Preservation

The most commonly followed methods of food preservation are:

- Fresh storage
- Cold storage
- Freezing
- Drying/ dehydration
- Concentration
- Chemical preservation
- Preservation with sugar
- Pasteurisation
- Sterilisation
- Filtration
- Irradiation
- Curing
- Fermentation
- Salting

Exercise

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

GMP	Area of Focus	
i. All processes of production like raw material procurement, execution, storage, packaging, and logistics follow strict organisational parameters.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>
ii. The equipment used for processing foods is protected against contamination from lubricants, metal fragments, fuel, and contaminated water.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>
iii. Your processing unit has enough facilities for toilets and wash stations.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>
iv. The entire work area follows high standards of cleaning and sanitisation.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>
v. The entire processing unit is well ventilated and has adequate lighting.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>
vi. The organisation follows a cleaning and sanitising drill as per daily, weekly, and monthly schedules.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>

GMP	Area of Focus	
vii. You are provided training on Good Manufacturing Practices (GMP).	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>
viii. You are in sound health condition during working hours.	Personnel hygiene	<input type="checkbox"/>
	Sanitation of the work area	<input type="checkbox"/>
	Equipment maintenance	<input type="checkbox"/>
	Process validation	<input type="checkbox"/>

2. Match the columns

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

3. Arrange the right sequence of food spoilage

Procedure/ Steps	Order the steps (as 1, 2, 3, 4 and 5)
i. Leads to food spoilage	
ii. Microorganisms produce enzymatic changes	
iii. Microorganisms enter food	
iv. Enzymatic changes affect the flavour, texture, shape/form, colour, and odour of the food	
v. Microorganisms use food as a source of nutrients and multiply	



8. Employability Skills



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Employability Skills








9. Annexure

Lists of QR Codes used in the PH



ANNEXURE - Lists of QR Codes used in the PH

S.No.	Chapter No.	Unit No.	Topic Name	Page No.	QR code(s)	URL
1	Chapter 1: Introduction to the Training Program	Unit 1.1 - Introduction to the training program	Overview of the Food Processing Industry	4		https://www.youtube.com/watch?v=KGXgGQdalQw
2		Unit 1.1 - Introduction to the training program	Orientation	4		https://www.youtube.com/watch?v=0pam4wglkNU
3		Unit 1.4 – In- troduction to Jam and Jelly Processing	Role and re- sponsibilities of a Pro- cessed Food Entrepreneur	11		https://www.youtube.com/watch?v=g-KvHkrLcNs
4	Chapter 5: Carry out Production of Jam, Jelly and Ketchup as per Production Needs	Unit 5.1 - Production Process of Preparing Jam and Jelly	Equipment used in jam, jelly and ketchup pro- cessing	61		https://www.youtube.com/watch?v=BHdXld5Wi4A
5		Unit 5.1 - Production Process of Preparing Jam and Jelly	How to start Jam, Jelly business	61		https://www.youtube.com/watch?v=a_SmTLGxeO8&t=48s
6		Unit 5.1 - Production Process of Preparing Jam and Jelly	Apple jam processing	61		https://www.youtube.com/watch?v=_jIC02psi0g&t=79s

S.No.	Chapter No.	Unit No.	Topic Name	Page No.	QR code(s)	URL
7	Chapter 5: Carry out Production of Jam, Jelly and Ketchup as per Production Needs	Unit 5.1 - Production Process of Preparing Jam and Jelly	Orange jelly processing	61		https://www.youtube.com/watch?v=dg-pqWOAoBB0
8		Unit 5.2 - Process of Preparing Ketchup	Jam, Jelly and Ketchup Processing	69		https://www.youtube.com/watch?v=-_dkq0ifCq4
9		Unit 5.2 - Process of Preparing Ketchup	Tomato Ketchup Processing	69		https://www.youtube.com/watch?v=kkvF6yN-PFXc&t=219s
10		Unit 5.3 - Operation packaging machine	Packaging and storage	75		https://www.youtube.com/watch?v=EG-kvS6gCtGY&t=30s
11		Employabil- ity skills (30 hours)	Employabil- ity skills (30 hours)	Employabil- ity skills (30 hours)		





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