FICSI
Food Industry Capacity and Skill Initiative

Participant Handbook

Customized Courses under PMKVY (210 Hrs)

Sector
Food Processing

Sub-Sector
Fruits & Vegetables

Occupation
Processing

Reference ID: **FIC/Q0204, Version-1.0**
NSQF Level: 2

Fruit and Vegetable Processing Operator

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

Email: admin@ficsi.in

Website: www.ficsi.in

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

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Prime Minister of India

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for

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **Fruit and Vegetable Processing Operator**
QP Code: 'FIC/Q0204 NSQF Level 1.0'

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Authorised Signatory
(Food Industry Capacity & Skill Initiative)

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About this Book

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

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

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

1. (FIC/N9026) : Prepare for Production (FIC/Q0204)
2. (FIC/N0135) : Carry out Production of Various Types of Pickles and Pastes (FIC/Q0204)
3. (FIC/N9901): Ensuring Food Safety and Personal Hygiene (FIC/Q0204)
4. (FIC/N0111): Prepare Jam and Jelly (FIC/Q0204)
5. DGT/VSQ/N0101 Employability Skills (FIC/Q0204)

Symbols Used


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Unit - 1.2 Roles and Responsibilities of Pickle and Paste Making Technician

FIC/N9026
(Part of - FIC/Q0204)

Key Learning Outcomes

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

1. Describe the food processing sector in brief
2. Discuss the career opportunities available within the food processing sector

Unit 1.1 Introduction to Food Processing Industry

Unit Objectives

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

1. Discuss the size and scope of the food processing industry in brief
2. Discuss the future trends and career growth opportunities available for Pickle and Paste Making Technician in the food processing industry

1.1.1 Food Processing

Agriculture is India's mainstay industry. The majority of the products from various agricultural occupations are consumed within the country and exported to different countries around the world. Agriculture produce is also used as a raw material in the food processing industry. Food processing is the process of transforming raw materials into finished goods. They could be processed foods, ready-to-eat foods, food additives, or ingredients used to make other foods. The following figure explains the different level of food processing.

Primary Food Processing

- Primary Processing relates to the conversion of raw agricultural produce, milk, meat, and fish into a commodity that is fit for human consumption
- It involves steps such as cleaning, grading, sorting, packing, etc.

Secondary Processing

- Secondary food processing is the conversion of ingredients into edible products -
- This involves combining foods in a particular way to change properties. E.g. - Preparing of orange juices from oranges

Tertiary Food Processing

- Tertiary food processing is the commercial production of what is commonly called processed food
- These are ready-to-eat (RTE) or heat-and-serve foods.

Fig 1.1 Level of Food Processing

1.1.2 Journey of food from Harvest to Consumer

The flowchart below explains the process by which food material becomes a final, consumable product for various customers.

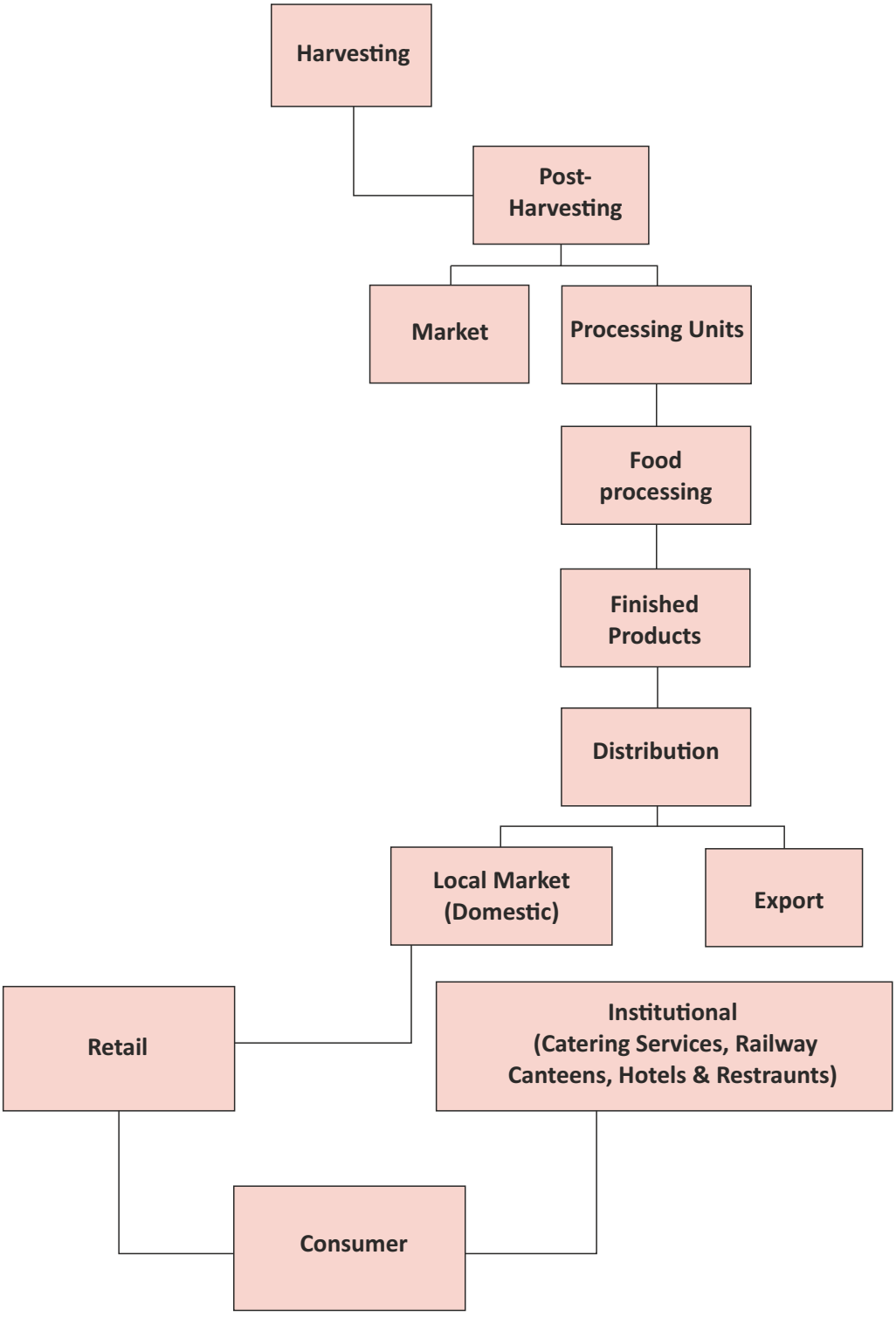

Fig.1.2 Journey of Foods from Farm to Consumer

1.1.3 India's Food Processing Industry

- The major segments in the Food Processing sector comprise of Fruits and Vegetables, Dairy, Edible Oils, Meat and Poultry, Non-alcoholic beverages, Grain-based products, Marine products, Sugar and sugar-based products, Alcoholic beverages, Pulses, Aerated beverages, Malted beverages, Spices, and Salt.
- In India, the food processing industry is divided into several sub-sectors.

Dairy	• Whole milk powder, skimmed milk powder, condensed milk, ice-cream, butter and ghee, cheese etc.
Fruit and Vegetable Processing	• Beverages, juices, concentrates, pulps, slices, frozen and dehydrated products, potato wafers, pickles and pastes etc.
Grains and Cereals	• Beverages, juices, concentrates, pulps, slices, frozen and dehydrated products, potato wafers, pickles and pastes etc.
Fisheries	• Flour, bakeries, starch glucose, cornflakes, malted foods, vermicelli, beer and malt extracts, grain-based alcohol etc.
Meat and Poultry Processing	• Fish oil, frozen and canned products
Bread and Bakery	• Biscuits, breads, buns, cakes, confectionery, pastries, cookies, etc.
Consumer Foods	• Snack foods,namkeen, biscuits, ready-to-eatfoods, alcoholic and non-alcoholic beverages

Fig.1.3 Sub-Sectors of the Food Processing Industry

Scan the QR Code to watch the related video

https://youtu.be/wMu0EpUgCd4

1.1.4 Overview of the Fruit and Vegetable 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. Theses includes:


Frozen foods


Confectionaries


Pickles


Jams


Juices


Jellies


Pulps


Concentrated foods

Fig.1.4 Various Processed and Semi-Processed Food Products

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

1. **Demand for processed food made from that vegetable/fruit**
2. **High quality produce**
3. **Continuous supply**

These parameters are critical for ensuring that raw materials can withstand the processing and preservation processes.

Scan the QR Code to watch the related video

https://youtu.be/iacTHJtrXIE


Frozen foods


Confectionaries


Pickles


Jams

Fig.1.4 Various Processed and Semi-Processed Food Products

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

1. **Demand for processed food made from that vegetable/fruit**
2. **High quality produce**
3. **Continuous supply**

These parameters are critical for ensuring that raw materials can withstand the processing and preservation processes.

1.1.5 Market trends of Pickle and Paste Processing

- Pickles are preserved relishes made from vegetables or fruits that are widely consumed and have a ready market. Pickles are also recommended by health experts for consumption, albeit in moderation, due to their high concentration of essential nutrients such as iron, vitamins, potassium, and calcium.
- As a result, growing awareness about the health benefits of these anti-oxidant-rich products, such as preventing insulin resistance, aiding weight management, improving digestion, and reducing ulcers and muscle cramps, is expected to expand the segment in the near future.
- In recent years, a surge in promotional activities by manufacturers of packed pickles across multiple platforms has piqued consumer interest.
- This is also supported by an increase in demand for multi-cultural cuisines. The rising demand for non-GMO (genetically modified organisms) and organic pickles is expected to propel the global pickles market during the forecast period.
- Furthermore, the thriving food-service sector is contributing to the increasing demand for pickles around the world, which is expected to drive market growth.
- The global packed pickles market was worth USD 7.9 billion in 2018 and is expected to grow at a CAGR of 3.5 percent between 2019 and 2025. Pickles are primarily a domestic product that is consumed on a daily basis by nearly all Indian households. This is a global trend among the Indian diaspora. The Middle East and Africa are expected to grow at a CAGR of 6.6 percent from 2019 to 2025, making them the fastest-growing regional market.
- The rising popularity of online grocery shopping apps in both developing and developed countries will be the driving force behind segment growth.
- Amazon and Walmart have made inroads into the online grocery business, gaining significant popularity among urban consumers.

- In 2019, the fruit segment dominated the packed pickles market, accounting for more than 45.0 percent of the market.
- Mangoes, pears, olives, grapes, apples, peaches, currants, plums, and tomatoes are some of the most popular pickled fruits worldwide.
- Without a smidgen of pickles, no Indian meal is complete. Pickles are eaten as both savory items and as side dishes with main courses, particularly in Indian cuisine. Aside from the domestic market, Indian pickles are in high demand abroad. Pickles are becoming increasingly popular around the world as a result of their high quality.
- On the basis of product types, the market can be segmented into fruits, vegetables, meat, seafood, relish, etc. As per taste, the market is segmented into sweet, salty, and sour pickles. On the basis of distribution channels, the market is divided into grocery retailers, hypermarkets, supermarkets, food services, online retailers, etc.
- The global pickle market has been segmented into jars, bottles, pouches, tubs, and others based on packaging type. During the assessment period, the jars segment is expected to dominate the global pickles market because jars are easy to transport and store and are cost-effective. The pouches segment is expected to grow at the fastest rate due to their ease of storage and use as refill packs. Furthermore, using Tetra Pak pouches results in longer shelf life.

1.1.6 Methods of Processing Fruits and Vegetables

The following are some common methods of processing fruits and vegetables:

Drying

Concentration

Washing

Fermentation

Sterilization

Pasteurization

Blanching

Canning

Fig.1.5 Different Food Processing Methods

Exercise

Answer the following questions:

1. Explain different levels of food processing.

_____
_____
_____

2. Write a short note on market and future trends of pickle and paste making industry.

_____
_____
_____

3. List different methods of food processing.

_____
_____
_____

4. Give any two examples of processed food products.

_____
_____
_____

Choose the correct answers:

1. _____have made inroads into the online grocery business, gaining significant popularity among urban consumers.
   a. Flipkart
   b. Amazon
   c. Pharmaeasy

2. The global pickle market has been segmented into
   a. As per population
   b. As per taste
   c. As per packaging

3. Important parameters to consider when selecting a fruit/vegetable for processing:
   a. Demand
   b. High quality produce
   c. Both a & b

4. _____processing is related to the conversion of raw agricultural produce into a commodity that is fit for human consumption.
   a. Primary
   b. Secondary
   c. Tertiary

Unit 1.2 Roles and Responsibilities of Pickle and Paste Making Technician

Unit Objectives

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

1 Summarise the key roles and responsibilities of 'Pickle and Paste Making Technician'

2 List the various terminologies used in the process of making pickle and paste

3 Discuss the various organisational procedures and processes for making pickles and pastes

4 Discuss the standards to be followed for handling hazards and ensuring a clean work area

1.2.1 Roles and Responsibilities of 'Pickle and Paste Making Technician

The following table explains the roles and responsibilities of Pickle and Paste making technician.

Roles	Responsibilities
Handle raw material from post-harvest storage to process line	• Check raw material for quality • Ensure fruits and vegetables are free from dirt, • debris, foreign matter, glass and insects • Ensure minimum loss of material
Record-keeping and documentation	• Document and maintain records of production Schedule and process • Document and maintain records of finished Products
Hygiene and sanitation maintenance	• Adopt safety- and sanitation-related measures • Follow food safety norms and practices
Inspect machines and troubleshoot issues or escalate them to the supervisor	• 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
Plan and execute pickling process, examine products at different stages of pickling	• Adhere to Good Manufacturing Practice (GMP) • Ensure the products meet the quality standards set by the organization

Inspect intermediate as well as finished products	• Check cured fruits and vegetables, fermented pickles, and finished products for quantity, quality, and salt equilibriumEnsure conformance of quality as per organizational
Follow storage and packaging norms	• Ensure safe and proper storage of raw material, packing material, and finished goods

Table 1.1 Roles and Responsibilities

Scan the QR Code to watch the related video

https://youtu.be/GlvfUzTXAdg

Notes

1.2.2 Various Terminologies used in Pickle and Paste making

The following table explains various terms used in pickle and paste making.

Terminology	Meaning
Brine	It is the salt solution used in the curing process.
Brine strength	It is the weight of salt in proportion to the weight of the solution.
Degree salinometer	It is the tool for measuring the percentage of salt in the brine.
Salt equilibrium	It is the strength of salt in the brine. For pickling process, it has to be maintained between 12 to 14% of the volume of the final produce. At this strength, the pickle can be preserved for a long time.

Table 1.2 Common Terminology in Pickle and Paste Making

1.2.3 Types of Pickles and Pastes

There are various types of pickle and paste available in the market. The following table 1.3 list the different types of pickles and the places in India where they are most popular.

Types of Pickle	Example	Popular in
Chutney /Paste	Gongura, Tomato	South India
Dry	Lemon, Mango	UP. Bihar
Stuffed	Chilies	North India
Oil	Mango, mixed	Throughout India
Fermented	Cucumber, onion	Outside India
Non-Vegetarian	Chicken, mutton, pork	HP, Uttarkhand, Punjab

Table 1.3 Types of Pickle

1.2.4 Organizational Processes for Making Pickles and Pastes

Pickling is a food preservation method used to make pickles. This method extends the shelf life of a specific food. Pickling food is done by immersing it in a salt solution or vinegar. The preservative quality of salt, combined with the acidic nature of the solution, prevents spoilage. This combination also produces lactic acid. It is done in a controlled environment where the temperature, storage conditions, and humidity in the air are all monitored. The resulting product has a salty and sour flavor that people refer to as “Pickle."

Pickles are foods made from fruits or vegetables. They are spice-flavored and preserved in salt solutions or vinegar to prevent spoilage. Pickles are traditionally made in every Indian home. However, increased demand for reputable brand pickles in recent years resulted in pickle-making companies entering the market to meet domestic and international pickle demand. Pickles are produced using cutting-edge technology and higher-quality ingredients to ensure that they last longer. They are made with high-quality edible oils to increase the shelf life by more than a year.

However, there are other types of pickles made from local produce that have a shorter shelf life.

Pickles are processed in two ways: Curing and Fermentation.

Ÿ **Curing Process**

Step 1: Fruits and vegetables are washed, cleaned, and cut.

Step 2: After this, they are kept in 12% salt solution, also called as brine.

Step 3: The cured fruit or vegetable is stored in barrels.

Step 4: Later, the cured fruits and vegetables are mixed with spices and ingredients.

Step 5: Then, the mixture is covered with oil to make oil pickles.

Ÿ **Fermentation:**

Step 1: Cured fruits and vegetables are mixed with vinegar or acetic acid and are kept for fermentation.

Step 2: In this process, the fermentative bacteria produce acids necessary for the preservation process. These bacteria also generate flavor compounds. This helps to enhance the taste of fermented pickles.

The following figure gives an overview of the pickle-making process. It demonstrates how raw materials are processed to make pickles.

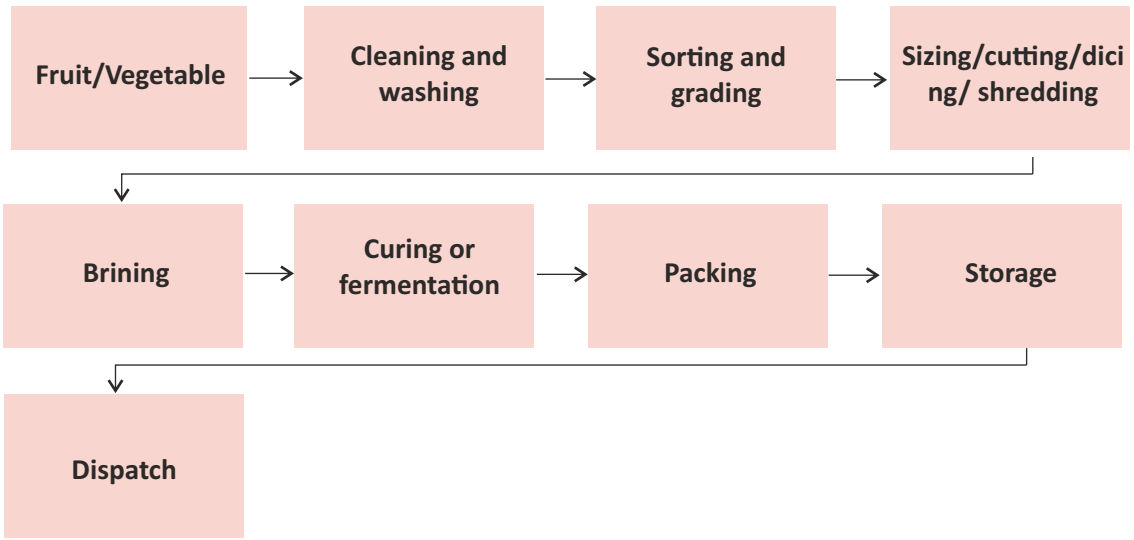

Fig.1.6 Standard Procedure for Pickle Making

1.2.5 Standard Practices for Handling Hazards and Cleaning Work Area

Every employee is concerned about their health and safety. As a result, following safety guidelines is required to avoid hazards and accidents. Similarly, sanitization and hygiene are the most important factors to consider when working in the food processing industry. The figure below depicts the standard practices for dealing with hazards, risks, and cleaning work areas:

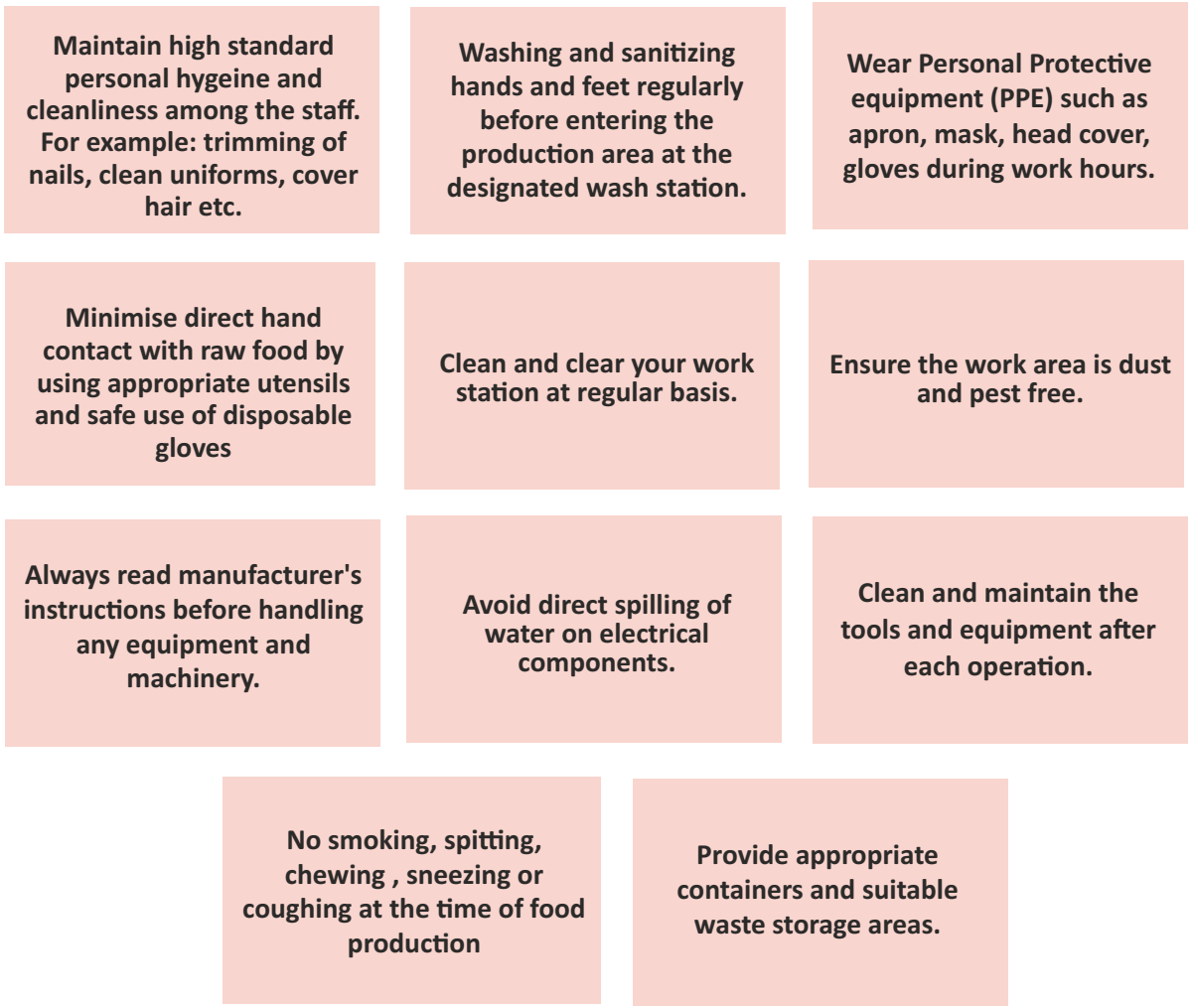

Fig.1.8 Standard Practices for Handling Hazards and Cleanliness

Scan the QR Code to watch the related video

https://youtu.be/j9HIFj-g2x4

Summary

- Food processing is the process of transforming raw materials into finished goods. They could be processed foods, ready-to-eat foods, food additives, or ingredients used to make other foods.
- There are three types of food processing – primary, secondary and tertiary processing.
- In India, the food processing industry is divided into several sub-sectors such as dairy fruit and vegetable processing, grains and cereals, fisheries, meat and poultry processing, bread and bakery and consumer foods.
- The fruit and vegetable processing sub-sector deals with processed foods, semi-processed foods, and packaged foods that are made from fruits and vegetables. For Example – juices, jellies, pulps,
- Food processing is the process of transforming raw materials into finished goods. They could be processed foods, ready-to-eat foods, food additives, or ingredients used to make other foods.
- There are three types of food processing – primary, secondary and tertiary processing.
- In India, the food processing industry is divided into several sub-sectors such as dairy fruit and vegetable processing, grains and cereals, fisheries, meat and poultry processing, bread and bakery and consumer foods.
- The fruit and vegetable processing sub-sector deals with processed foods, semi-processed foods, and packaged foods that are made from fruits and vegetables. For Example – juices, jellies, pulps, concentrated foods
- The important parameters to consider when selecting a fruit/vegetable for processing are demand for processed food made from that vegetable/fruit, high quality produce and continuous supply
- Pickles are recommended by health experts for consumption, albeit in moderation, due to their high concentration of essential nutrients such as iron, vitamins, potassium, and calcium.
- The rising demand for non-GMO (genetically modified organisms) and organic pickles is expected to propel the global pickles market during the forecast period.
- The thriving food-service sector is contributing to the increasing demand for pickles around the world, which is expected to drive market growth.
- The global packed pickles market was worth USD 7.9 billion in 2018 and is expected to grow at a CAGR of 3.5 percent between 2019 and 2025.
- Amazon and Walmart have made inroads into the online grocery business, gaining significant popularity among urban consumers.
- Mangoes, pears, olives, grapes, apples, peaches, currants, plums, and tomatoes are some of the most popular pickled fruits worldwide.
- Aside from the domestic market, Indian pickles are in high demand abroad. Pickles are becoming increasingly popular around the world as a result of their high quality.
- The pouches segment is expected to grow at the fastest rate due to their ease of storage and use as refill packs. Furthermore, using Tetra Pak pouches results in longer shelf life.
- The roles and responsibilities of Pickle and Paste making technician includes -handle raw material from post-harvest storage to process line, record-keeping and documentation, hygiene and sanitation maintenance, plan and execute pickling process to follow storage and packaging norms etc.
- Brine is the salt solution used in the curing process whereas brine strength is the weight of salt in proportion to the weight of the solution.
- Degree salinometer is the tool for measuring the percentage of salt in the brine.
- Pickling food is done by immersing it in a salt solution or vinegar.
- Pickles are processed in two ways: Curing and Fermentation.

Exercise

Answer the following questions:

Ÿ List the roles and responsibilities of pickle and paste making technician.

_____

_____

2. Name any two types of pickle.

_____

_____

3. What is brine strength.

_____

_____

4. Write a short note on standard procedure for pickle making.

_____

_____

Fill in the Blanks:

Ÿ _____and _____ are the most important factors to consider when working in the food processing industry.

Ÿ _____is done by immersing it in a salt solution or vinegar.

Ÿ _____is the tool for measuring the percentage of salt in the brine.

Ÿ _____attend to minor repairs of tools and machinery as per requirement.

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2. Prepare for Production

Unit 2.1 - Plan for Production

Unit 2.2 - Cleaning and Maintenance

FIC/N9026
(Part of - FIC/Q0204)

Key Learning Outcomes

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

1 Discuss the standard practices to be followed for production

2 Demonstrate the tasks to be performed at the workplace for planning the production

Unit 2.1 Plan for Production

Unit Objectives

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

1 Discuss the significance of supervisors' work instructions with regards to the production requirements

2 Describe the relevance of planning and prioritizing the production work

3 State the importance of planning and arranging the estimated resource requirement

4 Explain the various factors to be considered while allocating responsibilities to the team

5 Estimate the resource requirement as per the production requirement

6 Discuss the capacity utilization of machinery with respect to the processing time, production order, and batch size for each product

2.1.1 Significance of Supervisors' Work Instructions

Supervision is an amalgamation of the word super means 'from the above' and vision means 'to see'. In general, supervision means managing the activities of others. The Production supervisors are mainly concerned with overseeing and managing the performance of employees under their control. They play a significant role in the pickle and paste manufacturing process, where the overall aim is to maintain and improve the production processes of an organization through managing teams and other resources. To accomplish this goal, they must analyze production requirements and suggest constructive improvements to enhance production output. Also, they must ensure all production goes effortlessly and efficiently by thoroughly monitoring workers and their workflows. The Production Supervisors fulfill the following responsibilities:

- **Set daily objectives and communicate them to employees**
- **Organize workflow by assigning responsibilities**
- **Preparing production schedules**
- **Ensure the safe use of equipment and schedule regular maintenance**
- **Check production output according to specifications**
- **Submit reports on performance and progress**
- **Identify issues in efficiency and suggest improvements**
- **Provide training to the employees on regular basis**
- **Enforce strict safety guidelines and company standards**
- **Assist in the recruitment and onboarding of new hires**

Ensure optimum efficiency

Ensuring the flow of raw materials and other resources

Fig.2.1 Responsibilities of Supervisor in Production

Supervisors' work instructions are vital for pickle and paste making production or manufacturing process. It provides instruction and guidance for work tasks in day-to-day operations, non-standard tasks, and emergencies. When the production team is supported with good work instructions, the company saves tons of money and time and delivers high-quality products.

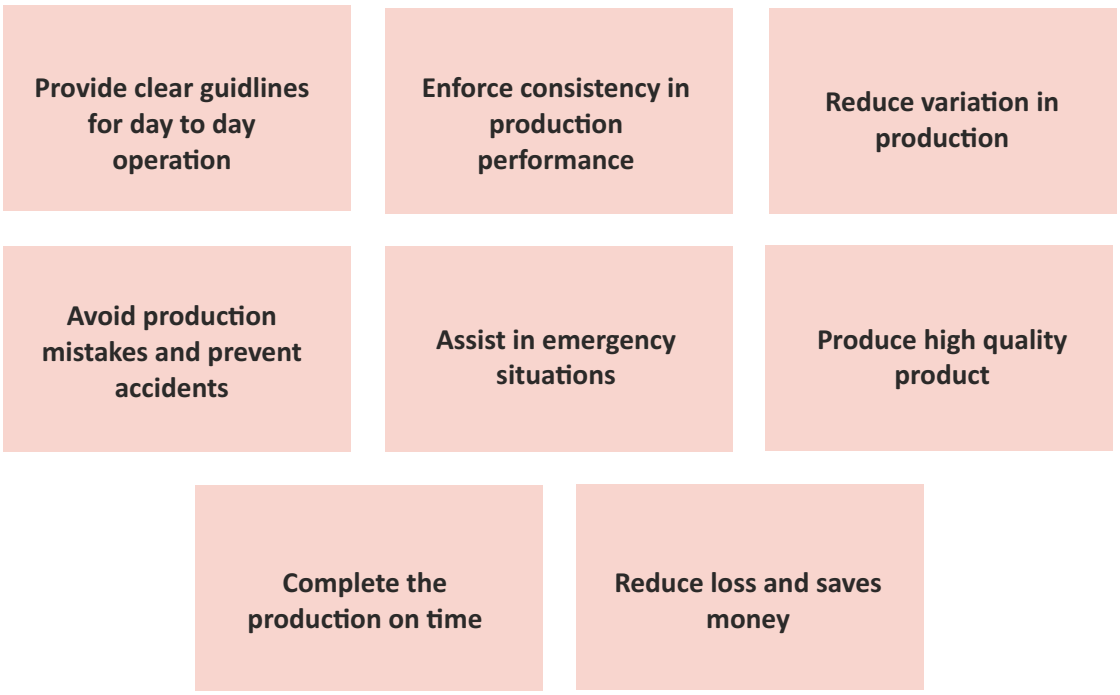

Fig.2.2 Significance of Supervisors' Work Instructions

2.1.2 Planning and Prioritizing Production work

Production refers to the transformation of inputs into finished goods/ or the creation of services to satisfy the customer needs. Production involves applying processes by which the inputs can be transformed into the desired product (output) of potential utility while improving properties and adding economic value through the best method without compromising on quality. So it is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to

add value, following the policies communicated by management. A simplified production system is shown below:

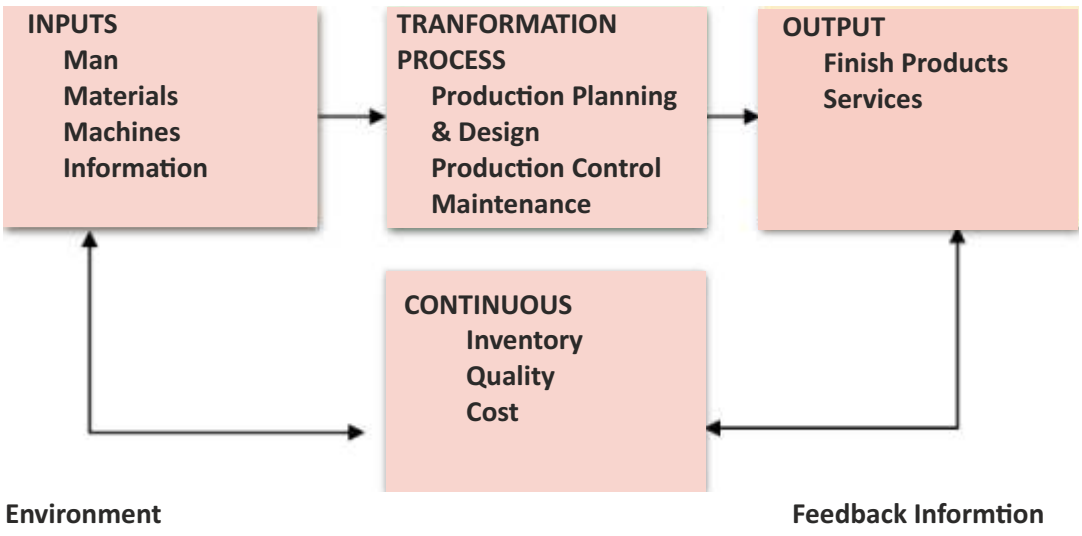

Fig.2.3 Schematic Production System

2.1.2.1 Production Planning

Production planning is a process that is necessarily required to ensure efficient and economical production. Therefore, planned production is an essential feature of the food processing industry. It is an instrument to coordinate and integrate the entire manufacturing activities in a production system. It develops the requirements for storage and production capacity needs based on food processing. The production planning for pickle and paste making consists of various plans related to routing, selection of vendors, selection of desired vegetables and fruits for pickle and paste preparation,availability of other raw materials that are required in producing pickle and paste like desired oil, spices filling the inventory with desired packaging material, inspection of production line for any maintenance etc.

The production process planning is rarely linear. Often new ideas and unforeseen possibilities surface. This creative problem-solving process may lead to considering a previously deemed unacceptable option, or it may reveal a solution that was not thought about in any previous plans. These back and forth developments ultimately lead to the best solution for expanding, refurbishing or constructing a new food plant.

The Production Plan for pickle and paste making begins with collecting data on any current or proposed food processing and storage operation. It consists of various charts, manuals, production budgets, etc., based on information received from management. These production plans and charts provide practical form by carrying different features under production control. Production planning is based on the following crucial elements:

Raw Material Procurement of raw material, component and spare parts of machines or equipment in the right quantities and specifications at the right time from the right source at the right place.	**Method of Processing** It includes determining the best sequence of operations (process plan) and planning for tooling, jigs and fixtures etc.	**Machine & Equipment** It involves facilities planning, capacity planning, allocations, and utilization of plant and equipment, machines etc
Manpower Planning for manpower (labour and managerial levels) having appropriate skills and expertise.	**Routing** It determining the flow of work material handling in the plant, and sequence of operations or processing steps.	**Estimation** It involves deciding the quantity of the product which needs to be produced and cost involved in it on the basis of sale forecast.
Utilization It is the process assigning specific jobs to machines, men, or work centers based on relative priorities and capacity utilization.	**Scheduling** It provides a timetable for production activities.	**Dispatching** It is a release of orders and instructions for starting of production in accordance with routing sheet and scheduling charts.
Inspection It is related to maintenance of quality in production and of evaluating the efficiency of the processes, methods and labours to achieve the quality standard	**Evaluation** It is to improve performance. Performance of machines, processes and labour is evaluated to improve the same.	**Cost control** It is controlled by wastage reduction, value analysis, inventory control and efficient utilization of all resources.

Fig.2.4 Elements of Production Planning

2.1.2.2 Prioritizing Workload

Prioritizing the production workload assist in taking control of time and ensures to meet important deadlines. Knowing daily priorities reduces stress, helps employees to focus, and improves their productivity. It also allows the employees to set better boundaries, eliminate distractions, and improve their work-life balance.

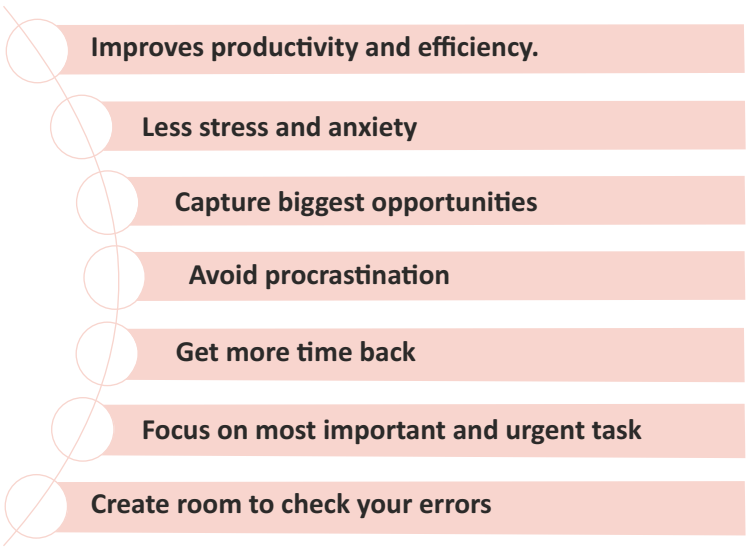

Fig.2.5 Significance of Prioritizing Production Workload

2.1.2.3 Allocation of Work or Responsibility to the Team

Work allocation needs to be done fairly to operate the team based on equality. The primary responsibility of a supervisor is to allocate tasks to each person in the team. This requires making decisions about who is capable of performing specific tasks for successful production. Following are the factors to keep in mind when distributing work:

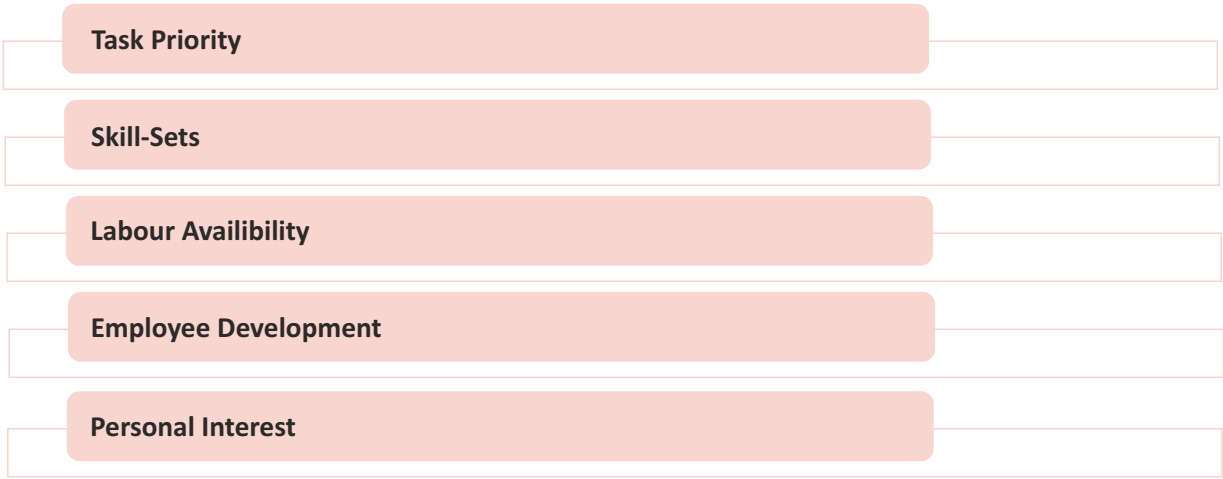

Fig.2.6 Criteria for the Work Allocation

The following chart explains the planning and allocation of work:

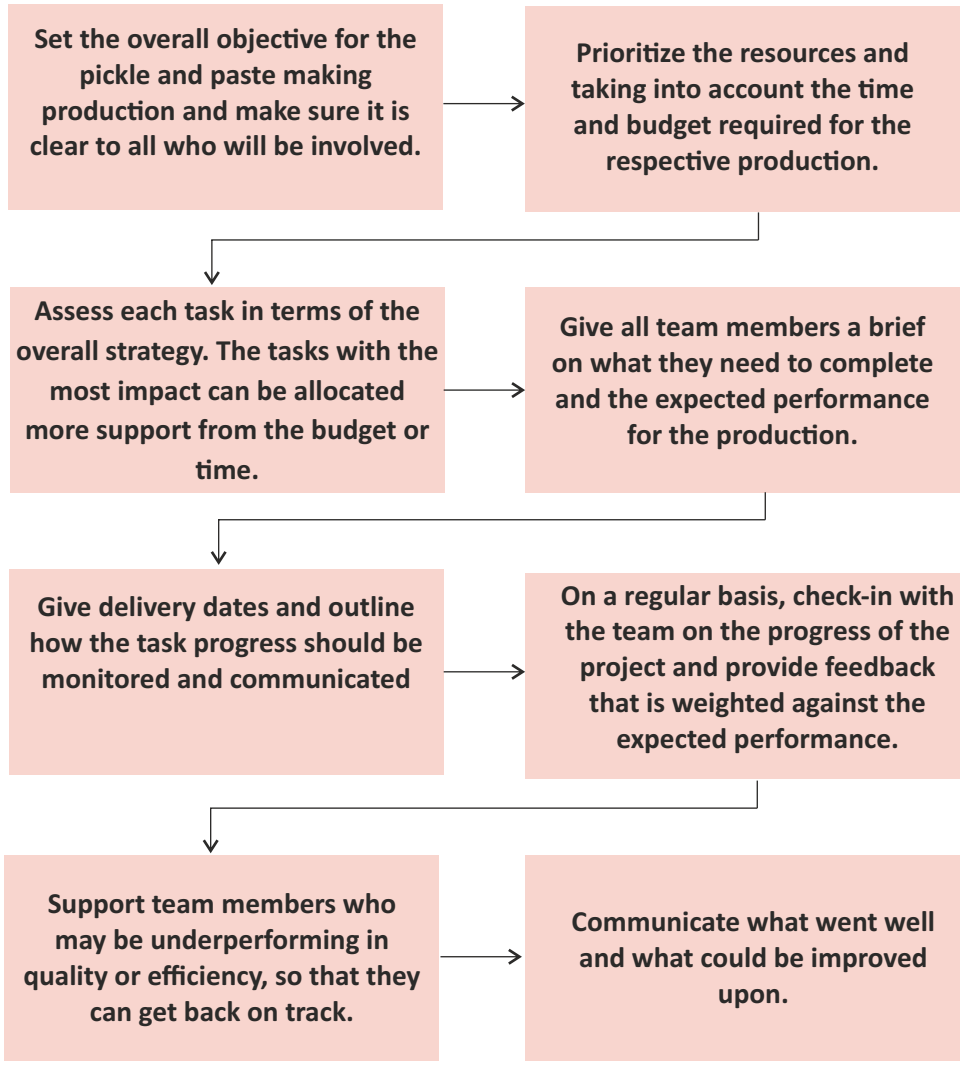

Fig.2.7 Planning and allocation of work for Pickle and Paste Making Production

2.1.3 Significance of Resource Planning and Estimation

Resource management is the process of pre-planning, scheduling, and allocating resources to maximize optimization and efficiency. It determines which resources are needed, in what quantities, and when to complete the production. This process not only helps to determine how the production process will be completed but also helps to estimate the costs and timeline associated with it.

Below are the steps for creating an effective resource management plan for pickle and paste making.

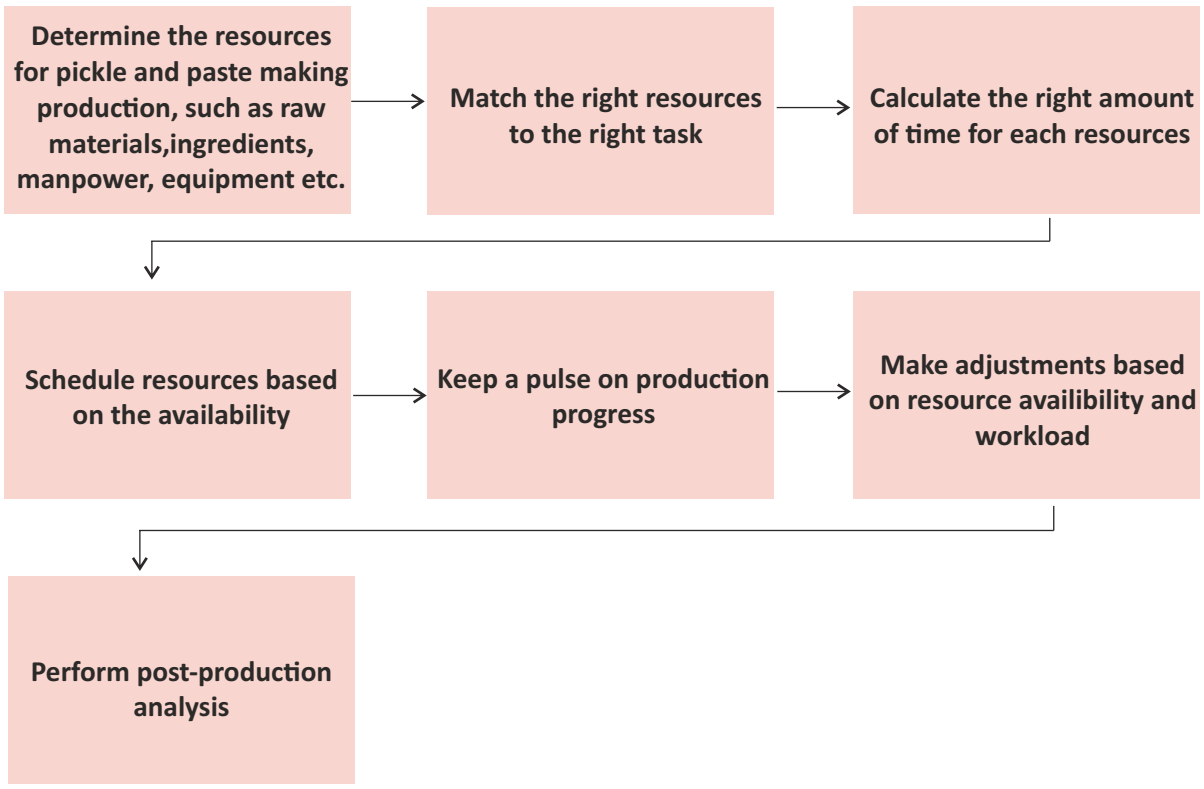

Fig.2.8 Process of Resource Planning for Pickle and Paste Making Production

2.1.3.1 Importance of Resource Planning

Wastage of resources can be fatal in production; therefore, every food production industry needs effective Planning. Here's why resource planning is vital for the pickle and paste making production process.

- The resource plan is prepared according to the product's delivery timelines and helps keep the production on track.
- Effective Resource planning lays the foundation of a successful production process.
- It set realistic expectations for the production deliverables among clients and other stakeholders.
- It helps to estimate production costs and profit margins accurately.
- Resource planning offers improved insight into actual costs and the overall profitability of the production.
- It prevents over-working or under-utilizing of the manpower ,which leads to increased employee satisfaction.
- It leads to optimal utilization of resources to prevent over-burdening and at the same time ensures that the food processing industry makes the most of the resources.
- Hiring decisions taken based on resource planning analysis are usually in the benefit to the production.
- A successful resource plan can be treated as a fool-proof formula for future production.

2.1.3.2 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 pickle and paste 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 pickle and paste making as per production requirements. It is calculated as follows:

Raw Materials Inventory = Beginning Inventory + Raw Materials Purchased - Cost Of Goods Sold

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

Opening Inventory = (Cost Of Goods Sold + Ending Raw Materials Inventory) - 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.

Ending Inventory = (Raw Materials Purchased + Beginning Raw Materials Inventory) - Cost Of Goods Sold

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

Raw Materials Purchased = (Ending Inventory – Beginning Inventory) + Cost Of Goods Sold

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

Cost of goods sold = Begining inventory + Purchases – ending inventory

Note:-

- **Beginning Inventory -** Value of a company's inventory at the start of an accounting period.
- **Ending Inventory -** Value of goods still available for sale and held by a company at the end of an accounting period.
- **Raw Materials -** Vegetable, fruits, ingredients, spices, oil etc.
- **Good Sold -** Accumulated total of all costs used to create a product which has been sold.

To calculate **manpower** requirements for pickle and paste 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.

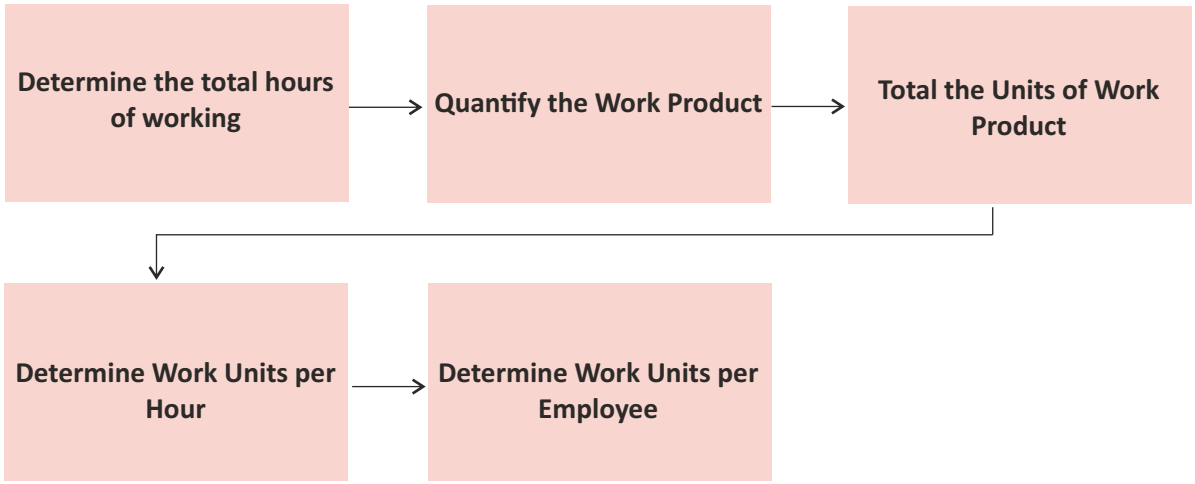

Fig.2.9 Steps to Calculate Manpower Estimation for Production

2.1.4 Capacity Utilization

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

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

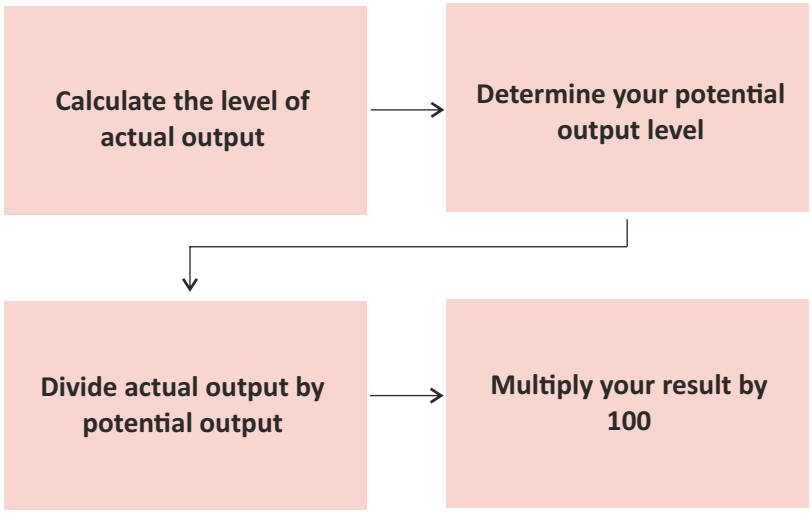

Fig.2.10 Steps to calculate Capacity utilization

The capacity utilization formula gives you the capacity utilization rate:

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

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

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

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

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

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

Unit 2.2 Cleaning And Maintenance

Unit Objectives

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

1 List the materials and equipment used in cleaning and maintenance of the work area

2 List the sanitizers used in cleaning work area and machineries

3 Identify different kinds of waste material and comprehend the ways to dispose them safely

4 Specify the inspection procedure for inspecting the tools, equipment, and machinery used in the job

5 State the importance of reporting information such as faulty tools and equipment to the concerned authority

2.2.1 Cleaning and Sanitizing Work Area and Machinery

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. **Pickle and paste-making industries** need to be kept spotlessly clean to ensure compliance with standard regulations and prevent contamination. Everything from random debris to flakes of rust and paint needs to be kept clear from foodstuff to make sure the product is entirely safe for consumption, so frequent cleaning is vital to pickle and paste processing operations.

Though the entire process is quite tricky because of the complexity of the machinery and equipment used for pickle and paste making, it can also introduce additional difficulty by creating a wet environment. The equipment for pickle and paste 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. Also, if there is oil on the floor, perform cleaning on time to avoid slips or falls. The wet environment 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. 2.11 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 pickle and paste making work area are divided into two categories:

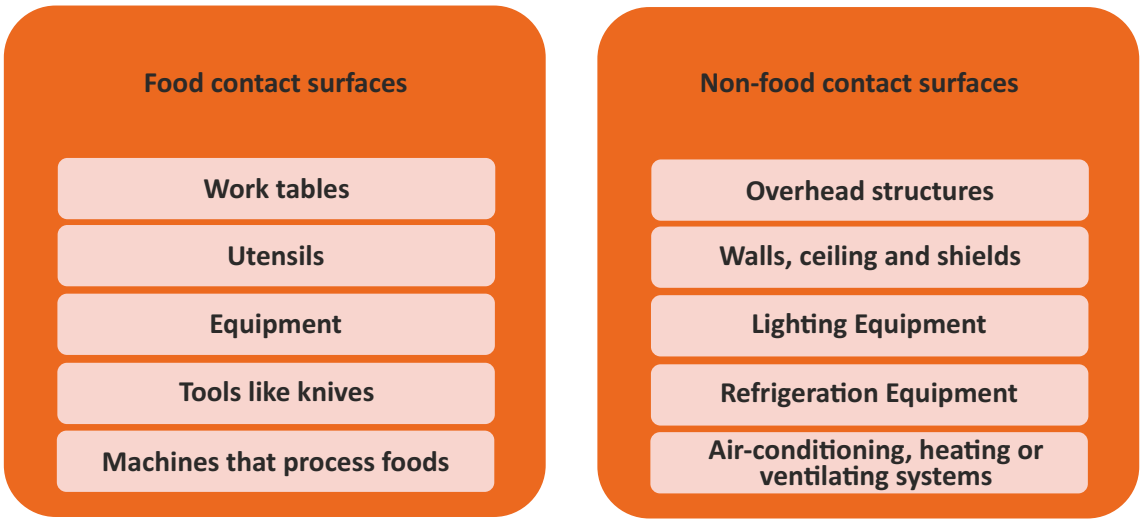

Fig. 2.12 Cleaning Work Area Categories

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 pickle and paste products 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.

2.2.1.1 Types of Cleaning Equipment & Materials for Work Area & Machinery

Cleaning equipment is divided in to two sub-categories:

1. **Manual cleaning equipment –** Depends upon operation and energies of the employees and requisite the staff's maximum effort and techniques for cleaning.
2. **Automatic cleaning equipment –** Requires electricity or battery power for the operation. These cleaning machines ease labor and save a lot of time.

Microfiber Cloth

Abrasives

Different types of cleaning brushes - e.g. hard and soft floor brushes, scrubbing brushes.

Brooms

Vaccum Cleaner

Polishing Machine

Floor Scrubber

Steam Vapour Machine

High Pressure Sprays

Fig. 2.13 List of Equipment and Materials for Cleaning Work Area

2.2.1.2 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: • Caustic soda • Caustic potash • Coronate • Silicate, • Phosphate	**Acids:** • Phosphoric • Nitric • Citric • Glycolic	**Chelates:** • EDTA • NTA • Gluconate • Glucoheptonate, citrate • Polymeric	**Solvents:** • Isopropanol • Propylene • Butyl diglycol • Ethers	**Surfactants:** • Anionic • Cationic • Non-ionic • Amphoteric
Inhibitors: • Organic • Inorganic	**Enzymes:** • Protease • Lipase • Amylase	**Oxidising agents:** • Hypochlorite • Isocyanurates	**Stabilisers**	**Viscosity modifiers**

Fig. 2.14 Various Ranges of Detergents

There are three acceptable types of sanitizer solutions for use in the food processing industry.

Chlorine (Bleach) Concentration: 50 to 100 ppm	• They are inexpensive and commonly used sanitizers that are effective against all bacteria. • Bleach is less effective in hot water and works best at a temperature range of 12.78°C-23.89°C. • Do not use splashless, scented or non-chlorine/color safe bleach.
Quaternary Ammonia (QUAT, QAC) Concentration: As per manufacturer's instruction	• These come in diluted form and are oderless, colorless and nontoxic. • They are stable at high temperatures, and are more effective in the presence of organic materials than chlorine. • It takes longer time to sanitize against some common spoilage bacteria.
Iodine Concentration: 12.5 to 25 ppm	• Iodine compounds or iodophors are fast-acting and effective against all bacteria. • They are relatively nontoxic, non-irritating to skin, and stable.

Fig. 2.15 List of Sanitizers for Work Area and Machineries

2.2.1.3 Effective Practices for Sanitization and Cleaning

It is compulsory to follow the manufacturer's instructions provided on the label for effective and safe use of a sanitizer.

- 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 depending on the job.
- Check the dilution, contact time, safety precautions, shelf life, and storage of all chemicals before use.

Cleaning and sanitization take time and cost money. However, well-designed and organized food processing businesses can reduce the time needed for thorough cleaning with proper planning. In some cases, the combined operation of cleaning and sanitization are performed using a sanitizer which has the features of both a detergent and a sanitizer. Still, the two-stage approach is more consistent and effective than the single-stage sanitizer approach. In the pickle and paste-making processing industry, non-scented chemicals are used in operations due to the risk of taint. When cleaning and sanitizing work areas and equipment, the following practices must be followed:

There are three acceptable types of sanitizer solutions for use in the food processing industry.

Plan the cleaning sequence to avoid re-soiling the cleaned area	Implement and display a cleaning schedule so all staff know their cleaning and sanitizing responsibilities.	Wear personal protective equipment required for the cleaning methods and materials being used
All items must be stored off the floor. Allowing clearance from the floor gives plenty of room for cleaning beneath shelving and equipment.	All the machinery used for processing is "SWITCH OFF"	Keep only what you need at the food processing premises.
Use the right materials for cleaning while considering risk, time, efficiency and type of stains	Wipe out the chemical spill properly in the work area, with care and caution	Use a high volume, low pressure hose for equipment and surfaces. High pressure hoses can splash and spray dirt onto surfaces and create aerosols that may contain and spread pathogens.
Use a vaccum cleaner or at least a damp cloth to clean the dust from surfaces around the work area	Remove the residues, coarse dirts oily substances and scraps from the surface area	Undertake regular maintenance, for example filling holes and replacing damaged tiles.
Wipe down tools, equipment and surfaces as per specified standards	Dispose any waste or chemicals used in an appropriate manner	

Fig. 2.16 Standard Practices for Cleaning the work area and equipment

Cleaning and sanitization 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, which is usually a legal and 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 pickle and paste-making processing facility is:

Fig.2.17 Steps for Cleaning Work Area

The following chart explains workflow process of cleaning and maintenance of pickle and paste-making machinery and equipment.

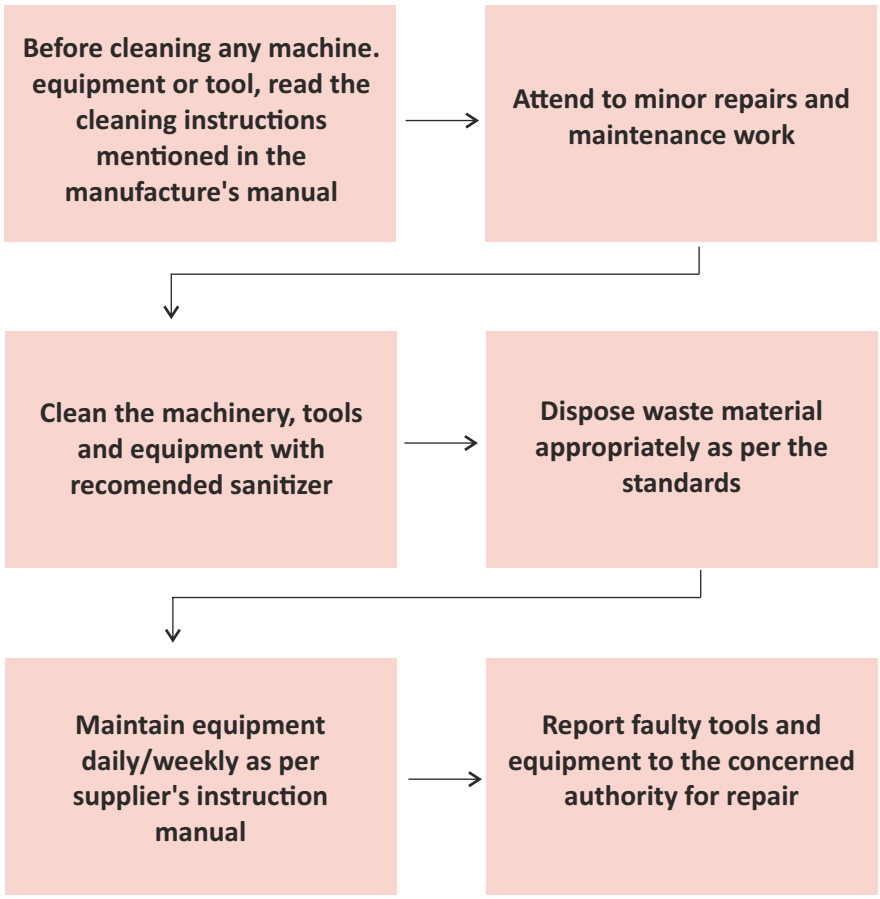

Fig.2.18 Cleaning Process for Pickle and Paste-making Machinery and Equipment

It is important to report faulty tools and equipment to the concerned authority, as it minimizes the possible risks and hazards related to equipment and prevents major failures and serious injuries or mishaps. The following figure explains the significance of reporting to the concerned authority:

Fig.2.19 Importance of Reporting Faulty Tools and Equipment

2.2.2 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:

- It keeps the production running smoothly.
- It helps to prevent any contamination and ensure food safety.
- It reduces product losses.
- 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:

- **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.
- **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.
- **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.

Ÿ **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.

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

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

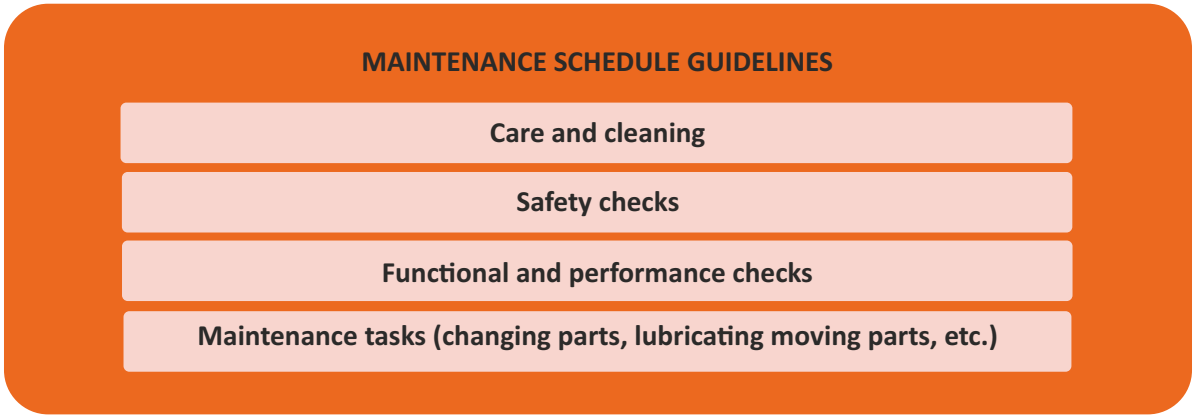

Fig.2.20 Maintenance Schedule Guidelines

Checklist for Planning Maintenance

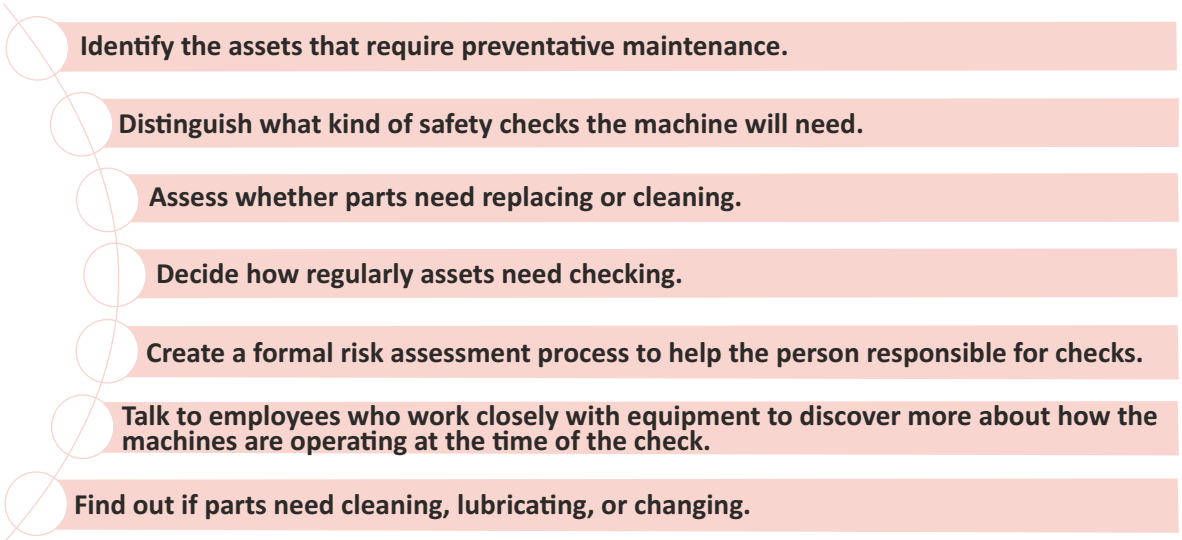

Fig.2.21 Maintenance Checklist

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

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

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

Note:-

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

2.2.3 Inspection Methods for Tools, Equipment, and Machinery

Regular inspections ensure the safety of your workers. The inspection occurrence should be determined through risk assessment and calculation, taking justification of the manufacturer's recommendations, industry advice, and your own experience. Machinery and equipment that is exposed to conditions causing deterioration, could result in a dangerous situation should be inspected at suitable intervals, and after every event, liable to jeopardize its safety.

Following are the inspection methods for tools, machinery, and equipment:

1. **Start-up Inspection:** An excellent countermeasure to avoid start-up risk is thorough and continuous inspection along with condition monitoring. Respect all potential areas of danger. Examine as many of these hazards as possible until operational stability is reinstated. These include:

- Temperature (all critical zones, components, and surfaces)
- Vibration
- Balance and alignment
- Gauge readings (based on temperature, pressure, vacuum, flow, speed, proximity, etc.)
- Differential filter pressure
- Magnetic plug collections
- Oil level, color, and clearness at all sight glasses
- Leak zones

2. **Stop Inspection:** Stop inspections allow accessing the hard-to-reach machine conditions and frictional surfaces. Also, avoid all unnecessary invasions that can introduce a root cause for failure.
3. **Repair inspection:** Repair inspections present a valuable opportunity that too often goes untapped. It is to assess what failed, why it failed and what can be observed while performing the inspection.

Checklist for inspection

- **Inspect tools for any damage prior to each use.**
- **Inspect cords, plugs and switches for defects**
- **If a tool is defective, remove it from service, and tag it clearly "Out of service for repair".**
- **Replace damaged equipment immediately – do not use defective tools "temporarily".**
- **Have tools repaired by a qualified person – do not attempt field repairs.**
- **Inspect the machinery after installation and before first use, and after reassembly at any new site / location**

Fig.2.22 Inspection Checklists

Equipment inspection can be carried out by someone who has adequate knowledge and experience of it to enable them to know:

- **What to look at**
- **What to look for**
- **What action to be taken incase of a problem**

The inspection is varied according to the necessary level of equipment's competence and its types, and how / where it is used. The nature of these inspections does not have to be determined by the same individual who commences them, provided that person is competent. This can often be done in-house by an experienced team, taking into account of:

- **The manufacturer's recommendations**
- **Industry advice**
- **Experienced Staff who has sufficient knowledge of machine operations**

2.2.4 Waste Disposal

Waste generation is often a natural consequence of food processing plants. As environmental regulations become increasingly severe, appropriate management of food wastes has become a vital part of present food processing management. The amount of waste generation and the manageability of waste generated by a process have become benchmarks for assessing the applicability of the process.

The most common wastes generated in pickle and paste industries are vegetable peel, wastewater, soil, etc. Various types of food waste are generated in many steps of the production process, packaging, and distribution.

Ÿ Solid Waste - Plastic, Paper, Metals, Glass, etc.
Ÿ Liquid Waste - Waste water, Organic liquids, Rainwater, etc.
Ÿ Organic Waste - Food shells and residue, Spoil food products, etc.
Ÿ =Hazardous Waste - Chemical and toxic solutions, Filter oil, Flammable products

That is where the concept of waste minimization becomes a must for every employee to understand. There are several ways to explain waste minimization. In its broadest sense, waste minimization all practices including waste prevention, reuse, and recycling that reduce the amount of waste entering the environment.

Fig.2.23 Waste Minimization

Waste Segregation

In general, waste is segregated as **dry and wet waste.** Dry waste includes wood, paper, plastic, glass, etc., related products that can be recycled, and wet waste refers to organic and biodegradable waste. The waste can be segregated using color-coded dustbins.

1. Green Bin

The green-colored bin is used to dump biodegradable waste. In addition, this bin is used to dispose of wet/organic material, including cooked food/leftover food, vegetable/fruit peels, eggshell, rotten eggs, chicken/fish bones, tea bags/coffee grinds, coconut shells, and garden waste, including fallen leaves/twigs or the puja flowers/garlands.

2. Blue bin

The blue-colored bin is used for segregating dry or recyclable left over. This category includes waste like plastic covers, bottles, boxes, cups, toffee wrappers, soap or chocolate wrappers, and paper waste, including magazines, newspapers, tetra packs, cardboard cartons, pizza boxes, or paper cups/plates, metallic items like tins/cans, foil paper, and containers.

Fig 2.24 Dry &Wet Waste Bins

The most commonly used methods of waste disposal are:

Landfill

Incineration

Waste Compaction

Biogas Generation

Composting

Vermicomposting

Fig 2.25 Waste Disposal Methods

Summary

- The Production supervisors play a significant role in the pickle and paste manufacturing process, where the overall aim is to maintain and improve the production processes of an organization through managing teams and other resources.
- Supervisors' work instructions are vital for pickle and paste making production or manufacturing process as it provides instruction and guidance for work tasks in day-to-day operations, non-standard tasks, and emergencies.
- Production is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value, following the policies communicated by management.
- The production planning for pickle and paste making consists of various plans related to routing, selection of vendors, selection of desired vegetables and fruits for pickle and paste preparation, availability of other raw materials that are required in producing pickle and paste like desired oil, spices filling the inventory with desired packaging material, inspection of production line for any maintenance etc.
- The Production Plan for pickle and paste making begins with collecting data on any current or proposed food processing and storage operation. It consists of various charts, manuals, production

budgets, etc., based on information received from management.

- Work allocation needs to be done fairly to operate the team based on equality.
- Resource management is the process of pre-planning, scheduling, and allocating resources to maximize optimization and efficiency. It determines which resources are needed, in what quantities, and when to complete the production.
- The resource plan is prepared according to the product's delivery timelines and helps keep the production on track.
- There are two subdivisions of raw materials: direct and indirect materials.
- Beginning inventory value is obtained from the previous accounting period balance sheet as the closing inventory whereas closing inventory value is the inventory on hand at the close of an accounting period. The value is revealed on the balance sheet.
- To calculate manpower requirements for pickle and paste 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.
- The capacity utilization percentage provides an insight into a food processing industry's operational efficiency and can vary based on consumer and market demand.
- Pickle and paste-making industries need to be kept spotlessly clean to ensure compliance with standard regulations and prevent contamination.
- Cleaning and sanitizing (disinfecting) are usually two separate processes.
- Detergents are chemicals that eliminate dirt and grease. However, it does not kill bacteria and other microorganisms.
- For cleaning purposes, the pickle and paste making work area are divided into two categories: food contact surfaces and non-food contact surfaces.
- Cleaning equipment is divided in to two sub-categories: manual and automatic cleaning equipment.
- It is important to 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.
- It is important to report faulty tools and equipment to the concerned authority, as it minimizes the possible risks and hazards related to equipment and prevents major failures and serious injuries or mishaps.
- An effective maintenance routine ensures that operations are continued, repair costs are minimized, and downtime is reduced.
- It is essential to have a schedule for preventative maintenance of each piece of machinery and equipment used in the production.
- 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.
- Regular inspections ensure the safety of your workers. The inspection occurrence should be determined through risk assessment and calculation, taking justification of the manufacturer's recommendations, industry advice, and your own experience.
- In general, waste is segregated as dry and wet waste. Dry waste includes wood, paper, plastic, glass, etc., related products that can be recycled, and wet waste refers to organic and biodegradable waste. The waste can be segregated using color-coded dustbins such as green bin for bio-degradable waste and blue bin for segregating dry or recyclable left over.
- The most commonly used methods of waste disposal are landfill, incineration, waste compaction, biogas generation, composting and vermicomposting.

Exercise

Answer the following questions:

1. Why is it important to follow the supervisor's work instructions during production?

_____
_____
_____
_____

2. Write a note on

   A. Estimation of raw material

_____
_____

   B. Capacity utilization

_____
_____

   C. Allocation of Work

_____
_____

   D. Prioritization of Workload

_____
_____

3. What is resource planning?

_____
_____
_____

4. Explain cleaning and sanitization process of the work area.

_____
_____
_____

5. What is waste disposal?

_____
_____
_____

6. Explain planning and allocation of work.

_____
_____
_____

7. List down any two methods for inspecting equipment, machinery, and tools.

_____

_____

_____

3. Carry out Production of Various Types of Pickles and Pastes

Unit 3.1 - Standard procedure for rinsing and drying the fruits and vegetables
Unit 3.2 - Mechanism of peeling and slicing fruits and vegetables
Unit 3.3 - Identify spoilage in fruits and vegetables
Unit 3.4 - Method of preparing pickle, paste, and murabba using essential machine
Unit 3.5 - Packaging and post-production activities

FIC/N0135
(Part of - FIC/Q0204)

Key Learning Outcomes

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

1 Discuss the process for preparing different types of pickles, pastes, and murabba from fruits and vegetables

2 Demonstrate the standard work practices followed to produce various types of pickles and pastes

Unit 3.1 Rinse And Dry The Fruits And Vegetables

Unit Objectives

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

1 Recall the procedure of sampling to test the water quality and verifying the water level

2 Discuss the significance of drying line conveyor and sorting line conveyor

3.1.1Check the Water Quality and Verify Water Level

Potable water is essential in all fruit and vegetable processing, as an ingredient in some products, and for washing the equipment. It is recommended to carry out water testing from a reputed testing laboratory before setting up a food processing facility. Nowadays, RO (Reserve Osmosis) plants are installed to meet the water requirement of the food processing industry.

Fig.3.1 Reserve Osmosis System

The **quality of water** is determined by making measurements or taking samples of water and testing them for acidity (pH, TDS and hardness), color, dissolved oxygen, and turbidity (a measure of the suspended particles in the water). Such tests give a water utility operator a basic, and general interpretation of the conditions of a water source.

Fig.3.2 Water Testing

A **pressure transmitter** is used to determine the **water level** in a tank. The pressure at the bottom of a liquid-filled vessel is directly related to the height of the liquid. The transmitter measures this hydrostatic head pressure and provides the result of the liquid level.

Fig.3.3 Pressure Transmitter

3.1.2 Wash, Sort & Dry the Fruits and Vegetables

- **Wash** - Fruit and vegetables are generally washed with water to remove dust, dirt, and adhering surface micro-flora. Different washing methods include soaking or agitating in water, washing with cold or hot water sprays, etc.

Fig.3.4 Pressure Cleaning

1. Mechanical washers comprise stirring or tumbling the products on moving belts or rotating screens while they are absorbed in water or subjected to water sprays.
2. Washing using high-pressure sprays is most satisfactory.
3. Detergents are frequently used in the wash or rinse water.
4. Vegetables may be soaked in a dilute solution of potassium permanganate or chlorine (25-50 ppm) for disinfection.
5. The water temperature should be kept low to keep the fruit firm and to reduce leaching losses.
6. High-pressure sprays should not injure the fruits.


Fig.3.5 Washing Fruits & Vegetables

- **Sort -** Sorting, and grading ensure the removal of an inferior or damaged commodity. For sorting, an inspection belt can be used, in addition to trained staff who detect poor quality produce unsuitable for pickle-making. Automatic colour sorters can be used for sorting to reduce labour costs. After the preliminary sorting process, the fruit and vegetables are graded to get consistent quality for size, color, etc. Grading process can be performed either manually or with the help of grading machines. For machine-driven grading, the fruit and vegetables are passed over screens with holes of different diameters.


Fig.3.6 Sorting Fruits & Vegetables

- **Dry -** Drying refers to the removal of a small amount of moisture from a solid or nearly solid material by evaporation to a predetermined level. Drying involves heat and mass transfer operations—and complete removal of moisture content to bone dry condition.

3.1.3 Drying Line and Sorting Line Conveyor

Drying line Conveyors - Drying line conveyors are used for drying fruits and vegetables. In its simplest form, fruits and vegetables are placed on a conveyor that passes through a series of hot air zones. The conveyor is designed to let the air be blown upward or downward through the conveyor and product. Multiple passes through different conveyor/band driers are standard, and the product may be piled into deeper beds as the moisture content drops.

Fig.3.7 Drying line conveyor for fruits and vegetables

- **Impact of drying line conveyor in the food processing industry**

Fast drying speed and high evaporation	**Suitable for drying for fruits and vegetables in bulk**	**Eliminate or minimize manual labour**
Reduce the risk of accidents	**Increase efficiency and productivity**	**Ensure food safety and maintain quality standards**
Fully automatic and adjustable functions to control the water content and temperature according to the requirement.	**Continuous operation and easy to clean**	**Removal of fine contaminants**

Fig.3.8 Impact of Drying Line Conveyor

Sorting Line Conveyor- Sorting Line Conveyor is used to separate fruits and vegetables from the in-feed conveyor line. The sorting of products based on weight, shape, line capacity, and more is easily achieved and can significantly increase the output.

Fig.3.9 Sorting line conveyor for fruits and vegetables

- **Impact of sorting line conveyor in the food processing industry**

Less walking and double-handling of orders	Overall reduced labor costs	Optimized picking strategy	Improved order accuracy
Faster order processing	Increased order volumes without adding proportional	Fewer accidents	Less broken or
More efficient use of floor space	Possibility of reclaiming unused vertical space (depending on model)	Higher productivity	Lower production costs.

Fig.3.10 Impact of Sorting Line Conveyor

The simple chart below depicts the process of washing and sorting fruits/vegetables in the drying line and sorting line conveyor.

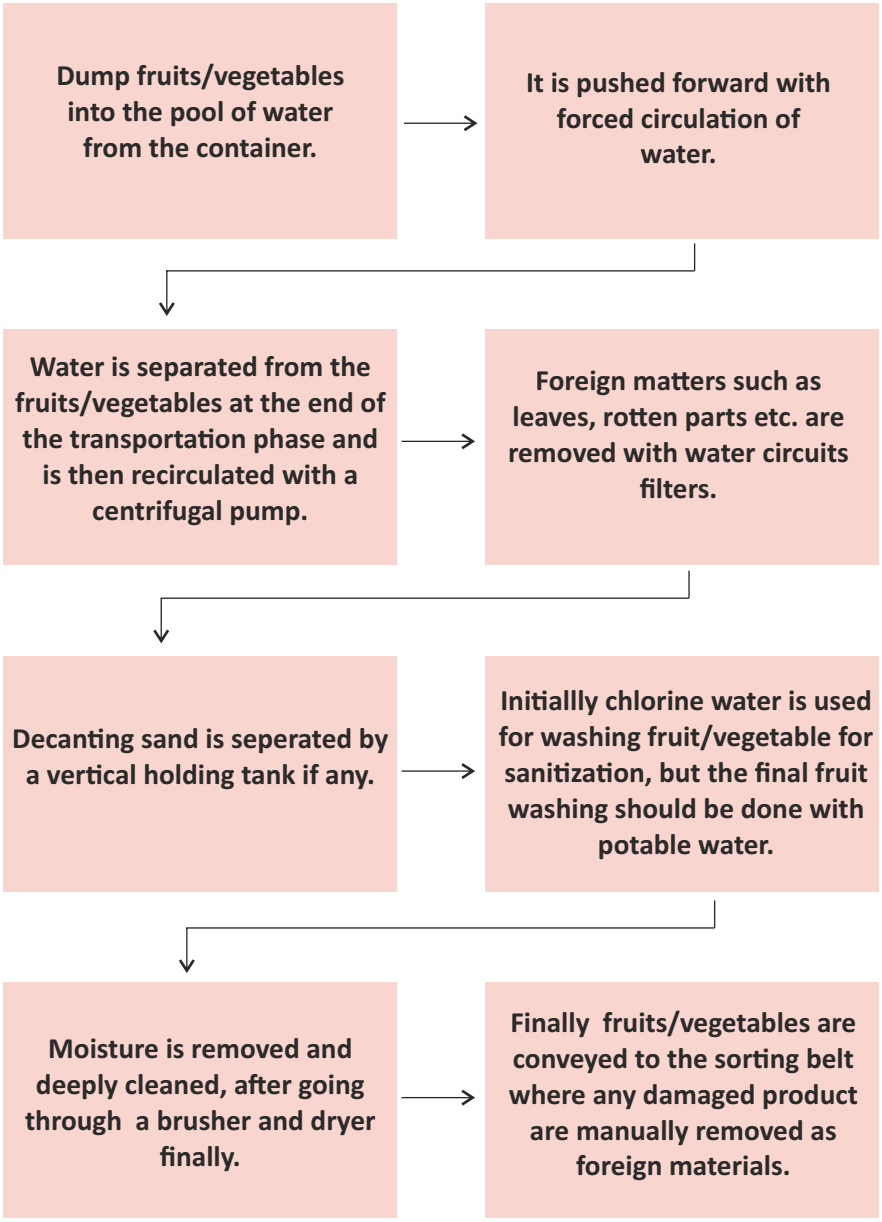

Fig.3.11 Process of drying and sorting line conveyor

Unit 3.2 Mechanism of Peeling And Slicing Fruits and Vegetables

Unit Objectives

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

1 Explain the mechanism of peeling and slicing fruits and vegetables

2 Describe the operation of a peeling machine

3.2.1 Peel and Slice Fruits and Vegetables

- **Peeling** – Peeling is the primary unit of operations for preparing fruit and vegetables for the pickle-making process. Depending upon the type of commodity, peeling and coring methods are selected, such as:

Ÿ by hand or knife

Ÿ by machine

Ÿ by heat treatment

Ÿ by using lye solution. Cores and pits in fruits like apple, mango, peach, apricot, etc. are removed by hand or machine (de-corer).

Knife Peeling

Mechanical Peeling

Steam Peeling

Lye Peeling

Coring

Slicing

Fig.3.12 Peeling, Coring and Slicing Fruits and Vegetables

- **Slicing** - After peeling, the fruits/vegetables are halved or cored manually or with the help of machines. However, peeled fruit should always be submerged in either water, containing 1-2 % salt solution or acid to avoid enzymatic browning.

Notes

Scan the QR Code to watch the related video

https://youtu.be/C-6kF52qtOA

3.2.2 Operation of Peeling Machine

- A peeling machine is used for peeling various kinds of ball-shaped fruits and vegetables for pickle and paste making. It is equipped with rotating soft and hard brushes which thoroughly clean and peel the fruits and vegetables.
- **Operation -** Peeling machine works on the principle of conversion of electrical energy from the electrical motor into mechanical energy in terms of the rotating shaft. A 2 HP motor is used to rotate the shaft at 900 rpm, around which approximately 70 rubber pads are fixed. These machines are high in performance and can be modified as per the requirements. Furthermore, it is very easy to clean and maintain.

Fig.3.13 Peeling Machine

The following flow-chart shows process of the peeling machine:

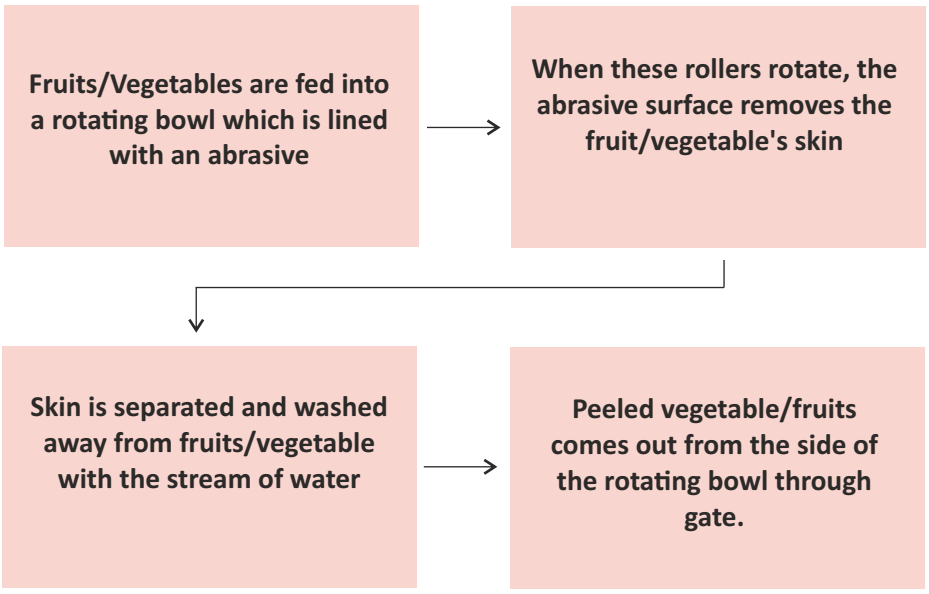

Fig. 3.14 Process of Peeling Machine

Unit 3.3 Identify Spoilage in Fruits and Vegetables

Unit Objectives

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

1. Explain how to inspect the vegetables and fruits to identify spoilage

3.3.1 Operation of Peeling Machine

Fruits and vegetables being a part of fresh produce, contain high moisture which makes them highly perishable foods and hence more prone to spoilage. Microorganisms gain entry into fruits/vegetables from various sources. These sources include:

- Soil
- Water
- Diseased plant
- Harvesting and processing equipment
- Food Handlers
- Packaging and packing material
- Contact with spoiled vegetables

Because of the spoilage, it becomes harmful and unsuitable for human consumption.

Fig. 3.15 Spoiled Fruits and Vegetables

3.3.2 Types of Spoilage in Fruits/Vegetables

Fruit and vegetable spoilage is predominantly of the following types:

Types of Spoilage	Description
Microbial Spoilage	
Spoilage due to pathogens	Infect stem, leaves, roots, flowers, and other parts of the fruit/vegetables themselves.
Spoilage due to saprophytes	Organisms under certain conditions grow on these fruits/vegetables and spoil them
Bacterial Soft Rot	Breaks down pectin, giving rise to a soft, mushy consistency, sometimes a bad odour and water-soaked appearance.
Fungal spoilage	Caused by *Botrytis cinera* in vegetables. Favoured by high humidity and warm temperature
Chemical Spoilage	Caused by Pesticide residue, detergents, etc.
Physical Spoilage	Damage to Fruits and Vegetables from Mechanical Parts of the Machines etc.

Table 3.1 Types of Spoilage

3.3.3 Process of Fruit/Vegetable Spoilage

The following process chart shows how fruits and vegetable spoilage take place:

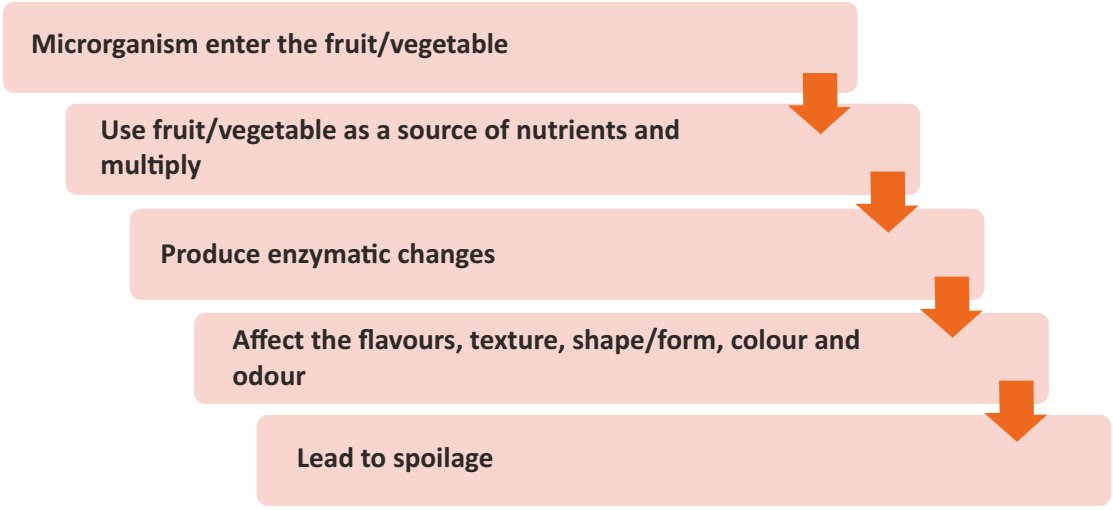

Fig. 3.16 Process of Spoilage

3.3.4 Criteria to Check Fruits/Vegetable Spoilage

The following chart shows the parameters to check the spoilage in fruits and vegetables:

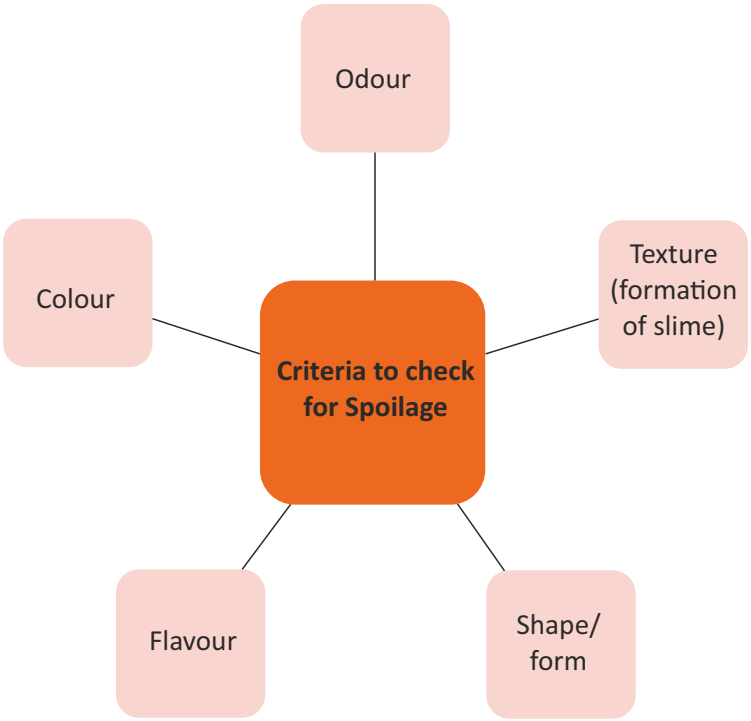

Fig. 3.17 Parameters to check Spoilage

Notes

Scan the QR Code to watch the related video

https://youtu.be/FS5MMx4uI6Q

Unit 3.4 Prepare Pickle, Paste, And Murabba Using Essential Machines

Unit Objectives

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

1 Elucidate the need for brine solution and fermentation process

2 State the importance and use of vinegar, brine, and oil solution for pickle making

3 Demonstrate the process of preparing pickle, murabba, and paste using necessary machines

3.4.1 Process of Pickle Making

Pickling is the process of preserving fruit and vegetables in salt and vinegar. Pickles may be prepared in two ways; without fermentation or with partial or complete fermentation. Spices, edible oil, sugar/jaggery, etc. are also added to improve the taste and palatability of the product. Pickles are a good appetizer and help in digestion by stimulating the flow of gastric juices.

The manufacturing of pickles has developed as an industry in the country. **Mango pickle, cauliflower, turnip, carrot (mixed vegetable), amla, lime/lemon pickle, etc.**, are the commercial products available in the market.

Pickling **is the process of fermentation** by lactic acid-forming bacteria, present on the surface of commodities. Lactic acid bacteria (active at 30 degrees Celsius) convert fermentable sugar in the food to lactic acid and volatile acids. The acid and brine act upon vegetable tissues to produce a distinctive taste and aroma of a pickle. The salt and lactic acid are formed to preserve the pickle by preventing the growth of putrefactive bacteria, provided oxygen is excluded. Common examples of fermented pickles are cucumber and olive pickles.

The following process is needed for the preparation of pickle making.

- **Curing or Fermentation with Dry Salting –** The dry salt is added to the prepared vegetables, extracts the juice from the vegetables, and forms the brine. The brine is subsequently fermented by bacteria that produce lactic acid, which serves the purpose of pickling. This method is called dry salting.
- **Fermentation in a brine solution -** The vegetable or unripe fruits like mangoes are immersed in salt-solution of known concentration for a certain length of time is called brining. Brining is generally used for pickling cucumber, olives, raw mangoes, and similar other vegetables, which do not contain sufficient juice to form brine with dry salt. Preparation of brine is done by dissolving common salt in water and filtering through a muslin cloth. The amount of brine required to cover the vegetable is approximately equal to about half the volume of the material to be fermented. Example: - For each barrel of 100 liters, about 50 liters of brine is required. Brining might take up to 4-5 weeks.
- **Salting without fermentation -** In this method, vegetables/fruits like raw mango slices are packed with a large quantity of salt to inhibit fermentation. Generally, 25 kg salt is mixed with 100 kg of prepared vegetable/fruit The excess salt is removed from the cured vegetables by soaking them in cold or warm water. After the removal of salt, the vegetables are stored in plain vinegar with 10% (100 grain) strength. This treatment lowers the tendency of the vegetable to shrivel when packed in sweetened and spiced vinegar and also aids in the absorption of vinegar by the vegetable tissues.

Notes

Scan the QR Code to watch the related video

https://youtu.be/AIWN5rTf9RI

3.4.2 Raw Material used in Pickling

Salt	Free from impurities and salts such as lime, iron, magnesium, and carbonates.
Vinegar	Good quality should contain at least 4% acetic acid. Synthetic vinegar or low-quality vinegar is not suitable for pickle preparations. Usually, malt or cider vinegar is used. To ensure good keeping quality pickle, the final concentration of acetic acid in the pickle should not be less than 2%. Acetic acid is also used because it is highly concentrated.
Sugar	It is used in the preparation of sweet pickles and should be of high quality.
Spices	These are added practically to all pickles. The quantity depends upon the kind of fruit or vegetable taken and the kind of flavour desired. The spices generally used are bay leaves, cardamom, chilies, cinnamon, cloves, coriander, dill herb, ginger, mace, mustard, black pepper, cumin, turmeric, garlic, mint fenugreek, asafoetida, etc.
Water	Only potable water should be used for the preparation of brine. Hard water contains salts of Ca, Na, Mg, etc., which interfere with the standard salt curing of the vegetable. If hard water is to be used, a small quantity of vinegar should also be added to the brine to neutralize its alkalinity. Iron should not be present in the water in any appreciable amount as it causes the blackening of the pickle.
Cooking utensils	Metallic vessels should be non-corrodible. A vessel made of iron or copper is not suitable. Glass-lined vessels and stainless steel vessels are preferred. The ladles, spoons, and measuring vessels should also be made on non-corrodible materials. At present pickles are prepared with salt, vinegar, oil or with a mixture of salt, oil, spices, and vinegar.

Table 3.2 Raw materials used in pickling

3.4.3 Types and Methods of Pickle Making

1. Preservation with salt: Salt improves the taste and flavour, hardens vegetables' tissues, and controls fermentation. Vegetables do not ferment when packed with a large quantity of salt, bringing their final concentration in the material from 15-20%. Mould and even lactic acid-producing bacteria cannot thrive at this high salt concentration. This preservation method applies only to vegetables that contain very little sugar because sufficient lactic acid cannot be formed by fermentation to act as a preservative. Some fruits, such as lime, mango, etc., are also preserved using salt for pickle making.

The following flow chart shows the process of preparing lime pickles with the preservation of salt.

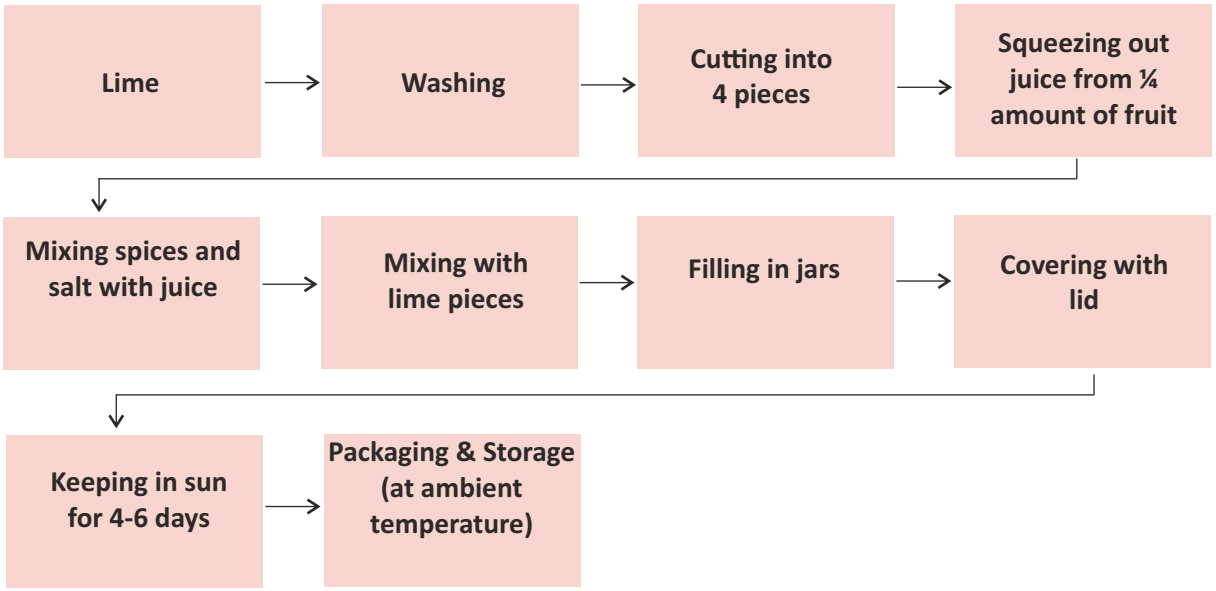

Fig. 3.18 Preparation of lime pickle

2. Preservation with vinegar: In vinegar pickles, vinegar acts as a preservative. The final acid concentration should be no less than 2% in the finished pickle. To prevent vinegar dilution below this strength by the H2O liberated from the tissues, the vegetables or fruits are usually placed in strong vinegar of around 10% acidity for several days before the final packing. This treatment aids in the removal of gases trapped in the intercellular spaces of vegetable tissues. Papaya, pears, onion, garlic, chili, mango, and cucumber pickles are prepared using the vinegar preservation method.

The following flow chart shows the process of preparing cucumber pickles with the preservation of vinegar.

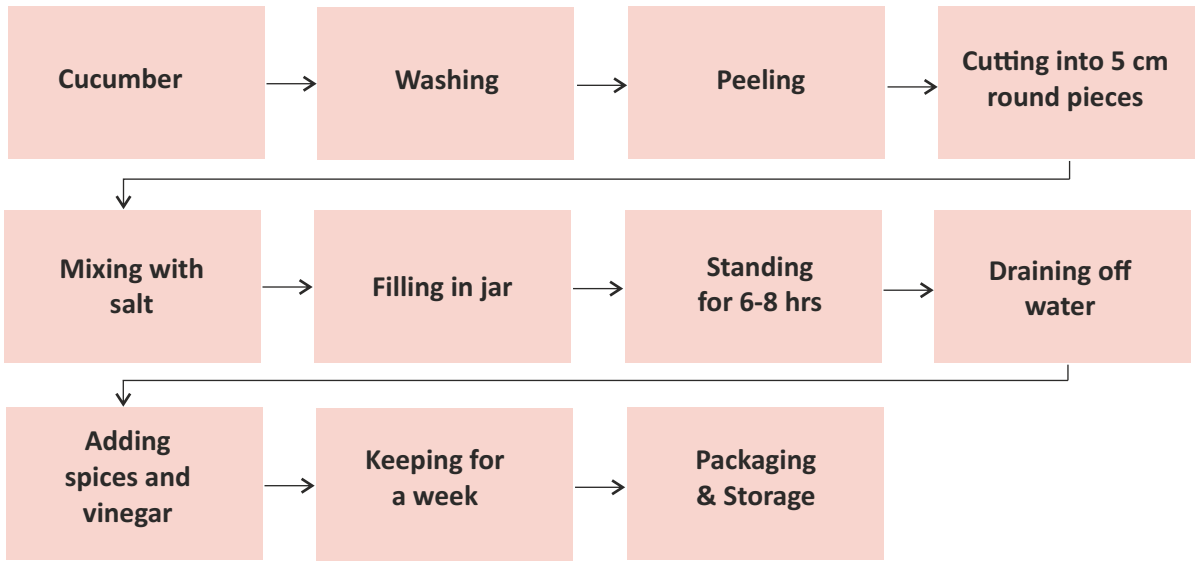

Fig. 3.19 Preparation of cucumber pickle

3. Preservation with oil: In oil-based pickles, oil acts as a barrier for air and creates an anaerobic condition that is utilized by the native bacteria for the production of lactic acid. Oil also prevents the growth of spoilage yeasts and moulds. Generally, mustard oil is used. It helps the seasonings adhere better to the fruits and vegetables. The fruit or vegetable should be wholly immersed in the edible oil. Cauliflower, lime, mango, amla, karonda, bitter gourd, brinjal, turnip pickles are prepared from this method.

The process of preparing chili pickle with the preservation of oil is shown below:

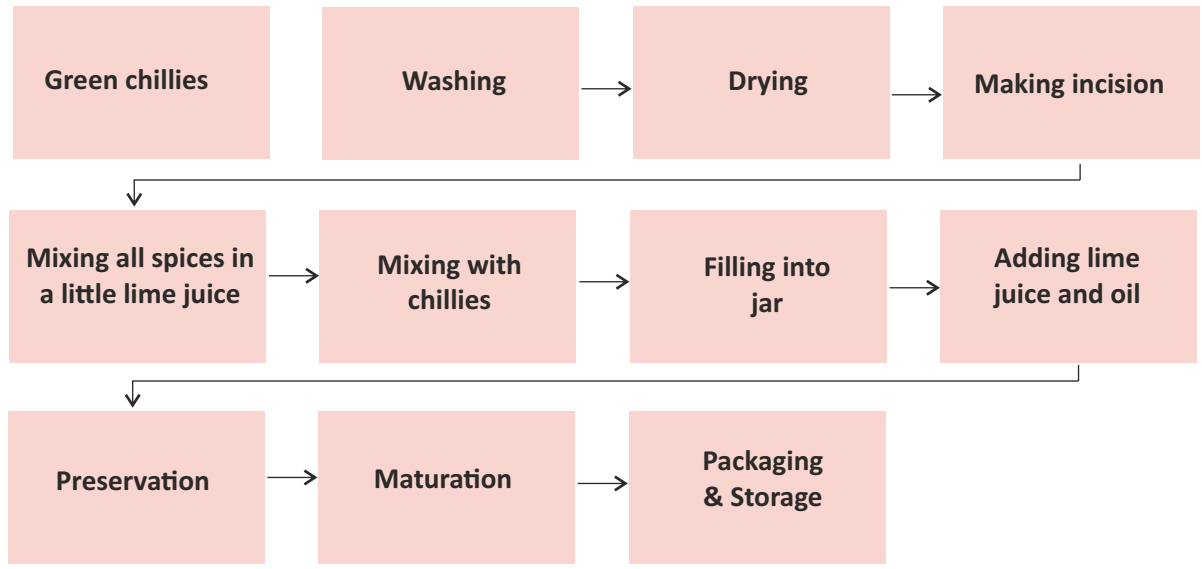

Fig. 3.20 Preparation of chili pickle

3. **Preparation with a mixture of salt, oil, spices, and vinegar:** E.g., Cauliflower, carrot, jackfruit, mixed vegetable pickle, etc.
The process of preparing tomato pickle with the mixture of salt, oil, spices, and vinegar is shown below:

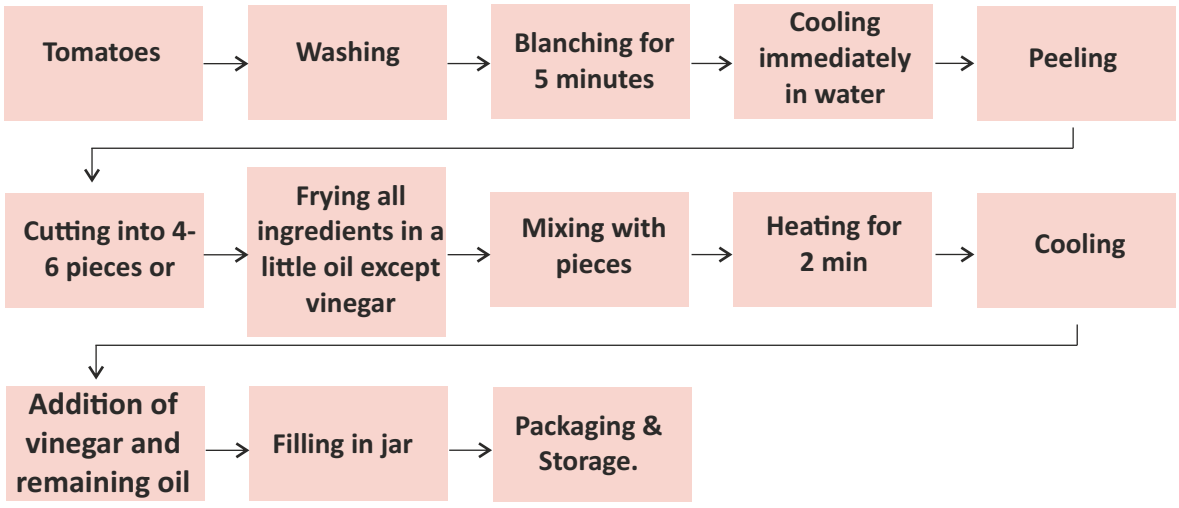

Fig. 3.21 Preparation of tomato pickle

Please note: Blanching is a food preparation method in which food is briefly immersed in hot liquid, for e.g. boiling water, often but not always as a prelude to cooking it further. Fruits, vegetables, are frequently blanched for pickle and paste making. Sometimes it is used for softening, or to loosening of the skin to make peeling it easier, or simply to brighten its color of it.


Fig. 3.22 Blanching

3.4.4 Preparation of Murabba and Pastes

- Murabba - In India, preserves or murabba of various kinds are used for taste as well as for medicinal purposes. It is acclaimed to impart energy to the heart, brain, and liver. It is also reported that it stops diarrhea and is helpful as a remedy for giddiness. The below chart explains the preparation in brief.

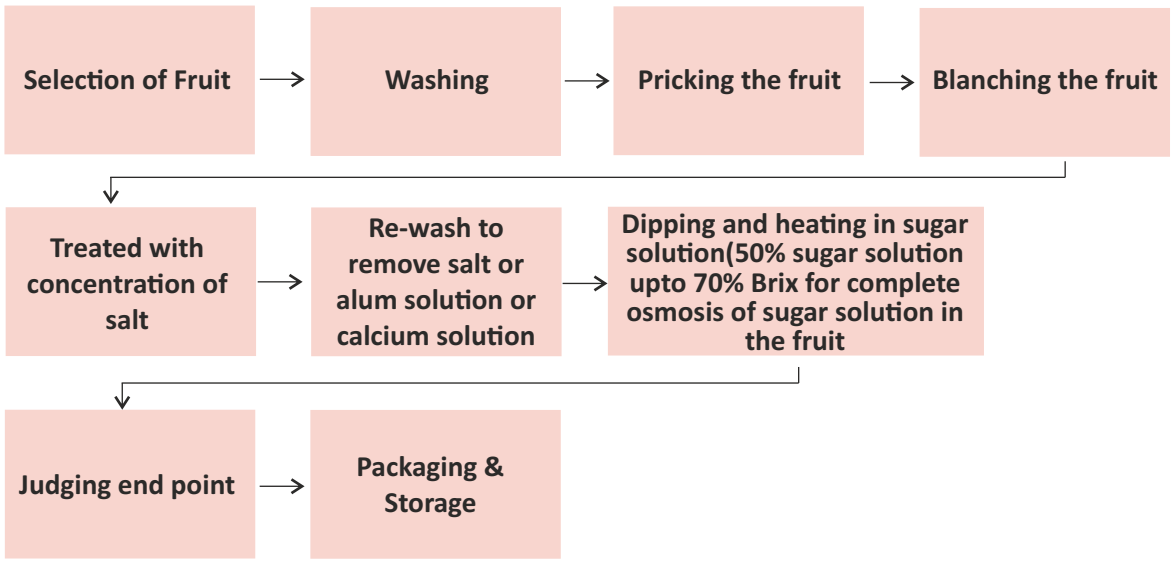

Fig.3.23 Preparation of Amla Murabba

Please note:

Brix is a measure of the number of dissolved solids in a liquid via its specific gravity and is used specially to measure dissolved sugar. One-degree Brix is 1 gram of sucrose in 100 grams of solution. Brix

measurement is commonly used in the food industry for measuring the approximate amount of sugars in fruits, vegetables, juices, wine and soft drinks.
Osmosis refers to the movement of fluid through a membrane in response to different concentrations of solutes on the dual sides of the membrane. Osmosis has been used since ancient times to preserve foods by dehydration with salt or sugar. The elimination of water from the tissue by salt was referred to as imbibition.

Below are a few pictures of Amla Murabba's preparation for a better understanding.

Sorting and grading of Amla

Washing of the Amla fruit with high pressure spray

Final Amla sorting

Tray dryers

Pricking the fruit with punching machine

Blanching the fruit

Preparation of sugar syrup

Dipping the Amla fruits in Sugar syrup

Fig.3.24 Visual Representation of Amla Murabba Preparation

- Pastes- The busier lifestyle has prompted the consumer to use ready-to-cook paste for cooking. Also, with the changing purchase dynamics and the growing need for quality branded products, many food manufacturing companies have forayed into the cooking paste segment.

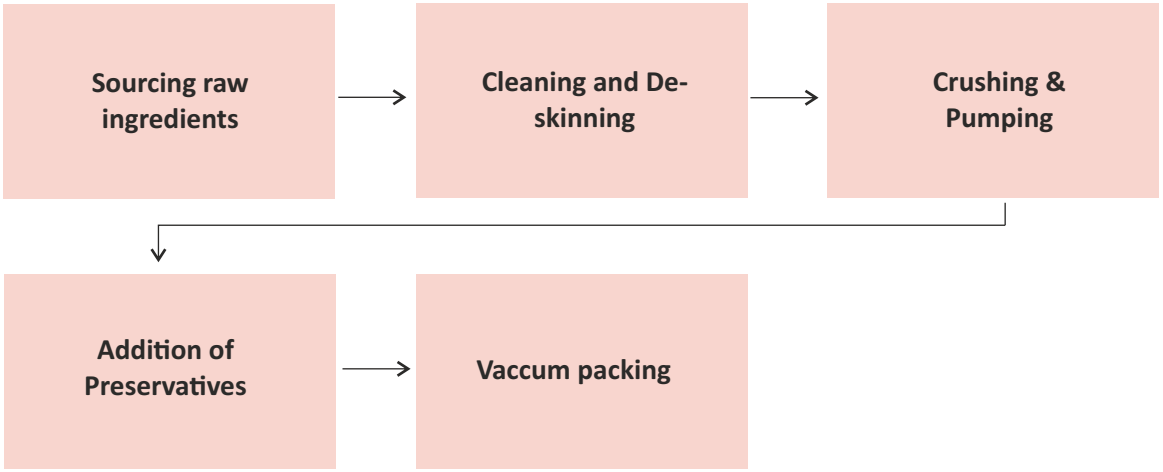

Fig.3.25 Preparation of fruit/vegetable pastes

Please note:

- **Vacuum packing** is a method of packaging in which the air is removed from the product before it gets sealed. This method comprises (manually or automatically) placing items in a plastic film package, extracting air from inside, and sealing the package.

Fig.3.26 Vacuum Packing

3.4.5 Finished Product Analysis

It is an optimum standard maintained continuously as per the company standard norms to produce a quality product and specific guidelines as per the government. If the quality standards are not maintained, then it could lead to fatal consequences. Processed food free from contamination will not cause any harm to the customers.

Every step involved in the process requires monitoring, inclusive of food safety and personal hygiene. For example, in pickles and pastes a quality check is done based on technical specification and organoleptic, which differ from fruit to fruit. Following are the parameters for quality check:

- **PH –** a numeric scale to check acid levels in pickles. Each fruit or vegetable has its own acidity level. The processing company maintains it as per their requirement.

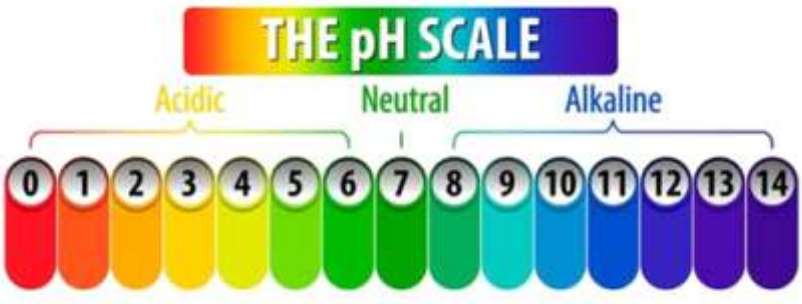

Fig.3.27 pH Scale

- **TSS (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.
- **Viscosity -** Viscosity is a measure of a fluid's resistance to flow. It is measured by refractometer as per the need.

Fig.3.28 Refractometer

- **Taste/flavour, colour, and texture –** it is checked by tasting the product.
- **Determination of drained weight -** The sample is drained on a standard mesh sieve. The weight of the material remaining on the sieve is expressed as percentage of the total weight of the can.

Fig.3.29 Sieve and Weighing Scale

- **Determination of sodium chloride in brine -** Direct titration of sodium chloride in brine with standard silver nitrate solution is adequate for routine analysis.

Unit 3.5 Packaging And Post-Production Activities

Unit Objectives

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

1 Explain the packaging and postproduction activities

2 Describe the standard practices to replace defective material and to follow the process of disposing them safely

3 Discuss the impact of various kinds of hazardous material on the production process

3.5.1 Steps for Packaging of the Processed Food

Level of Packaging -The finished product is filled in a container meant for packaging. Depending on the demand, the market and size of the industrial packaging are categorized as follows:

Primary Packaging

- **It is the type of packaging that comes in direct contact with food. E.g. Pouches, bottles, sachets, drums**

Secondary Packaging

- **It is the type of packaging that comes in contact with the primary packing. E.g. Cartons(filled with bottles)**

Tertiary Packaging

- **It is the type of packing that used to protect the secondary packaging. Eg. shipping box**

Fig.3.30 Level of Packaging

- **Selecting Packaging material –** When selecting the packaging material to pack the finished products, one must ensure that the packaging material is:

Non-toxic and compatible with food	**Offers sanitary protection**	**Protect the product from moisture, gas, and odor**
Protects the product from light, temperature, humidity, and rain	**Protects the product from insects, mites, bacteria, rodents, and birds**	**Is transparent and tamper-proof**
Offers ease of opening, pouring, resealing, and disposing	**Is compatible with the size, shape, and appearance standards set by the organization**	**Is low on cost**

Fig.3.31 Tips for Packaging Material Selection

- **Methods of Storing Finished Products –** The pickle processing industry follows the JIT (Just-In-Time) system. Here, the finished product is dispatched to the distributor, retail Industry, or institution as soon as the products are ready. A carton of processed pickles can be stored for a maximum of 2 days in the storehouse. In the case of cured pickles, where the flavors and oils are mixed as and when the demand arises, stock rotation systems Ike FIFO and FEFO are applied.

1. FIFO (First In First Out) is a stock rotation system that dispatches processed food depending on the order in which is produced.
2. FEFO (First Expired-First Out) is a stock rotation system wherein products that need to be consumed earlier are shipped first.

Scan the QR Code to watch the related video

https://youtu.be/-Wrk4zAANpo

3.5.2 Post Production Cleaning and Maintenance

Cleaning and sanitization are extremely important for every food-handling operation. Every organization in the food processing industry follows a weekly, monthly, or yearly cleaning schedule. There are several common types of cleaners and sanitizing agents to clean the food contact and non-food contact surfaces. The table below lists the typical cleaning agents and their appropriate usage, risks, and safety measures that should be taken while using these agents.

Cleaning agents	Used for	Risk	Safety measures
Hypochlorite like · **potassium hypochlorite,** · **sodium hypochlorite, and** · **calcium hypochlorite**	Cleaning stainless steel food contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained
Liquid chlorine	Internal cleaning of stainless steel equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained
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 3.3 Different types of cleaning agents, related risk factors, and safety measures

1. **Clean-In-Place (CIP)**
   CIP is a method used for the internal cleaning of machinery. It is done without dismantling pipes, vessels, process equipment, filters, or fittings. In this process, a sanitizing agent is circulated through the whole processing unit with the assistance of a twig ball. The turbulence created removes soil, ensuring the removal of bacteria and chemical residues.

Fig 3.32 Tips for conducting an effective CIP process

2. **Clean-Out-Place (COP)**

COP is conducted at a cleaning station. This method generally includes the dismantling of the equipment. In this process, equipment and Units are scrubbed with soap in COP tanks. After this, to remove residual detergent or chemicals the tanks are rinsed again. Heat treatment or sanitizing agents are used to sanitize again the reassembled equipment and units.

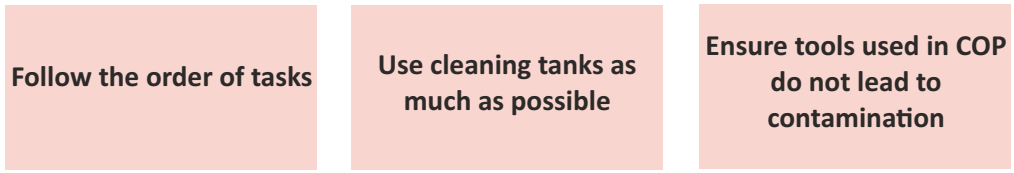

Fig 3.33 Tips for conducting an effective COP process

Fig 3.34 Food processing equipment and Units that undergo the COP process

3. **Sterilizing-In-Place (SIP)**

SIP is the process through which equipment is sanitized after the CIP process. It helps in eliminating any residual microbiological contamination. SIP is an amalgamation of three processes viz. sterilization, disinfestation, and sanitization.

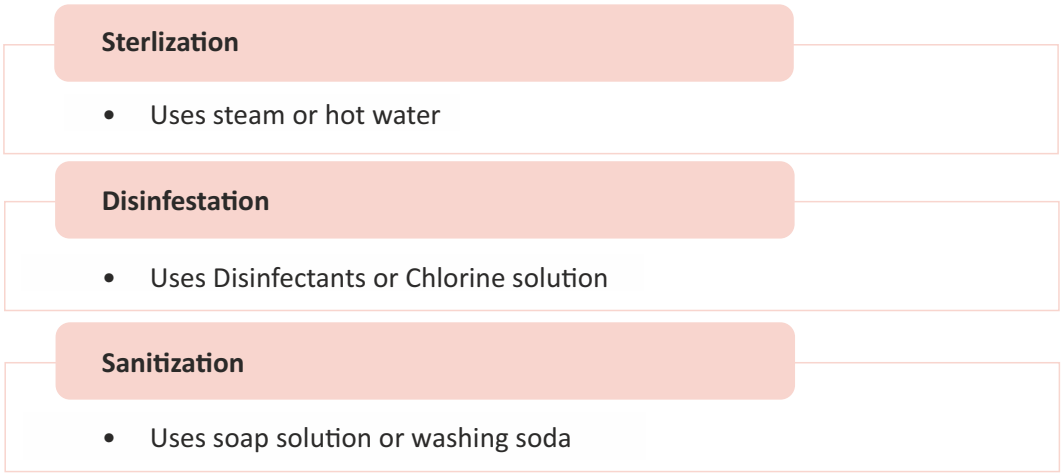

Fig 3.35 Sterilizing-in-place (SIP) process

The following chart explains the process of cleaning after production:

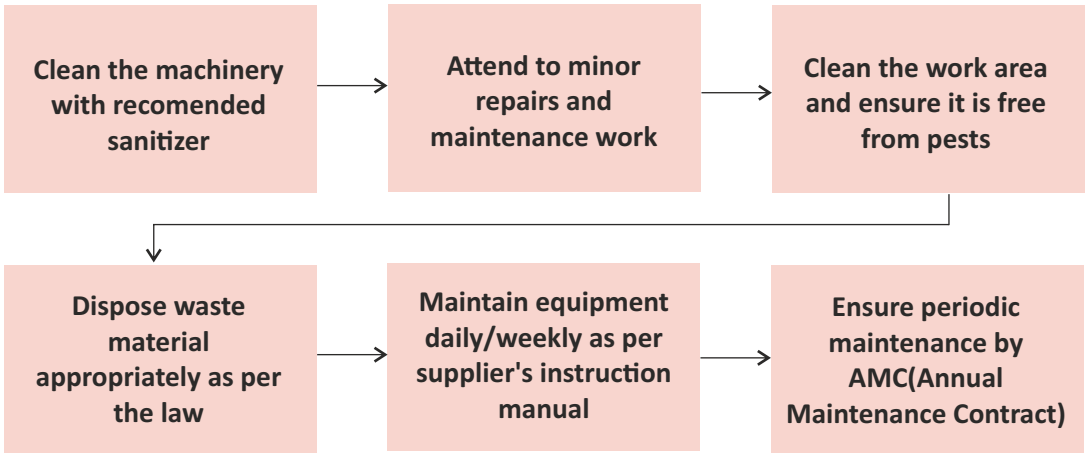

Fig 3.36 Post-Production Cleaning Process

3.5.3 Standard Practices and Procedures of Waste Disposal

Large quantities of both liquid and solid wastes are produced every year by the pickle and paste processing industry. These waste materials contain predominantly biodegradable organic matter and disposal of them creates severe environmental problems. Systems should be placed in such a way that the waste materials are identified, collected, removed, and disposed of in a manner that prevents contamination of products or production areas.

Below are the standard practices of waste disposal safely in the food processing industry.

- Provision shall be made for the segregation, storage, and removal of waste.
- Provide wheel based dustbin of adequate size and with a cover and foot operated opening mechanism in the premises for collection of waste with a mechanism for opening it without having to touch it.
- Have the dustbin emptied and washed daily with disinfectant and dried before next use
- Separate liquid and solid waste at the time of placing them in the bins.
- Accumulation of waste, non-edible by-products, and other refuse shall not be allowed in food- handling or storage areas.
- Labelled products, or printed packaging designated as waste shall be disfigured or destroyed to ensure that trademarks cannot be reused and removal shall be carried out by approved disposal contractors.
- Keep all waste in covered containers, get it removed at regular intervals as per local law.
- Follow the rules and regulations including those for plastic wastes and other non environment friendly materials.
- Ensure that stored waste and inedible material does not contaminate potable water, equipment used for food preparation, or building/premises.
- Ensure there is no pest and rodent access to waste of inedible material.
- Mark waste trolleys and bins with defining symbols or have different colours for biodegradable and non-biodegradable waste/refuse bins.

Fig.3.37 Standard practices for Waste Disposal

Fig.3.38 Colouful Coded Dustbin for Waste Segregation

3.5.4 Impact of Various Kinds of Hazardous Material on Production Process

Hazardous materials are substances or property which may cause a food to become unsafe for human consumption in the absence of its control. These dangerous materials or substances can affect badly the whole manufacturing process.

Following are the impact of various hazardous material on the production process:

Increase Food risk and contamination	**Substandard food quality and defective products**	**Certain hazardous substances also have the potential to explode or cause a fire**
Possible injuries and illness among the workers	**Possible damage of equipment and machinery**	**Low productivity**
Material and resources wastage	**Loss of time, money and goodwill**	**Economic consequences of recall and outbreak**

Fig.3.39 Impact of Hazardous Material in Production Process

Manufacturers of hazardous substances must provide warning labels and safety guidelines with their products. Employers must ensure that the safety guidelines for each hazardous substance used in the workplace are available to employees and warning labels on hazardous substances should feature:

- Hazard Pictograms
- Signal Words (e.g. Danger and Warning)
- Hazard Statements (e.g. Fatal If Swallowed)
- Precautionary Statements (e.g. Wear Protective Gloves).

The Safety guidelines must include important information on handling the product safely, including:

- Potential Health Effects
- Precautions for Use
- Safe Storage Suggestions
- Emergency First Aid Instructions
- Contact Numbers for Further Information.

Summary

- Potable water is essential in all fruit and vegetable processing, as an ingredient in some products, and for washing the equipment and is recommended to carry out water testing from a reputed testing laboratory before setting up a food processing facility.
- The quality of water is determined by making measurements or taking samples of water and testing them for acidity (pH, TDS and hardness), color, dissolved oxygen, and turbidity (a measure of the

suspended particles in the water).

- A pressure transmitter is used to determine the water level in a tank.
- Different washing methods include soaking or agitating in water, washing with cold or hot water sprays, etc.
- Drying refers to the removal of a small amount of moisture from a solid or nearly solid material by evaporation to a predetermined level.
- Sorting, and grading ensure the removal of an inferior or damaged commodity. For sorting, an inspection belt can be used, in addition to trained staff who detect poor quality produce unsuitable for pickle-making.
- Drying line conveyors are used for drying fruits and vegetables where, fruits and vegetables are placed on a conveyor that passes through a series of hot air zones.
- Sorting Line Conveyor is used to separate fruits and vegetables from the in-feed conveyor line. The sorting of products based on weight, shape, line capacity, and more is easily achieved and can significantly increase the output.
- Peeling is the primary unit of operations for preparing fruit and vegetables for the pickle-making process and are done by various method such as by using knife, machine, heat, and steam peeling treatment.
- Ensure that peeled/sliced fruit are always submerged in either water, containing 1-2 % salt solution or acid to avoid enzymatic browning.
- Peeling machine is equipped with rotating soft and hard brushes which thoroughly clean and peel the fruits and vegetables.
- Fruits and vegetables being a part of fresh produce, contain high moisture which makes them highly perishable foods and hence more prone to spoilage.
- Pickling is the process of fermentation by lactic acid-forming bacteria, present on the surface of commodities.
- There are various method of pickle making such as curing or fermentation with dry salting, fermentation in brine solution, salting without fermentation.
- The various raw materials used in pickling includes vinegar, sugar, spices and salt etc.
- Blanching is a food preparation method in which food is briefly immersed in hot liquid, for e.g. boiling water, often but not always as a prelude to cooking it further.
- Brix is a measure of the number of dissolved solids in a liquid via its specific gravity and is used specially to measure dissolved sugar.
- Vacuum packing is a method of packaging in which the air is removed from the product before it gets sealed.
- The finished product is filled in a container meant for packaging. Depending on the demand, the market and size of the industrial packaging are categorized into primary, secondary and tertiary packaging.
- The pickle processing industry follows the JIT (Just-In-Time) system. Here, the finished product is dispatched to the distributor, retail Industry, or institution as soon as the products are ready.
- CIP is a method used for the internal cleaning of machinery whereas COP is conducted at a cleaning station.
- SIP is the process through which equipment is sanitized after the CIP process.
- Standard practices for safe disposal must be followed and proper systems should be placed in such a way that the waste materials are identified, collected, removed, and disposed of in a manner that prevents contamination of products or production areas.

- Hazardous and dangerous materials or substances can affect badly the whole manufacturing process.
- Manufacturers of hazardous substances must provide warning labels and safety guidelines with their products.

Exercise

Answer the following questions:

1. How do you check the quality of water?

_____

_____

_____

2. Explain the operation of the peeling machine.

_____

_____

_____

3. Explain any two types of pickles and their method of preparation.

_____

_____

_____

4. What are the criteria for checking spoilage in fruits and vegetables?

_____

_____

_____

5. Explain the following terms:

(1) Sorting line conveyor

_____

_____

_____

(2) Fermentation in a brine solution

_____

_____

_____

(3) Tertiary packaging

_____

_____

_____

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

FICSI
Food Industry Capacity and Skill Initiative

4. Ensuring Food Safety and Personal Hygiene

Unit 4.1 - Introduction to Food Safety
Unit 4.2 - Schedule IV requirements of FSSAI
Unit 4.3 - Personal Hygiene
Unit 4.4 - Health Safety

FIC/N9901
(Part of - FIC/Q0204)

Key Learning Outcomes

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

1. Identify the hazards, types of hazards (Physical, chemical, biological and Allergenic) and risks at workplace
2. HACCP , TACCP, VACCP , Control measures , CCP, Critical limit
3. Explain the preventions of product contamination
4. Discuss the factors affecting food spoilage and food storage techniques
5. Describe Schedule IV requirements of FSSAI
6. Discuss cleaning and sanitization process, needs and importance and storage of sanitizing materials
7. Discuss health and safety policies and procedures
8. Discuss Employee health do's and don'ts, Food borne illness and preventive health checkups

UNIT 4.1: Introduction To Food Safety

Unit Objectives

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

1. Identify types of hazards and risks at workplace

4.1.1 Food Safety

Food safety refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.

4.1.2 Food Safety Hazard and Risk

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

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

Types of hazards and risks at work place

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

Food Safety Hazard

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

Microbiological hazards

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

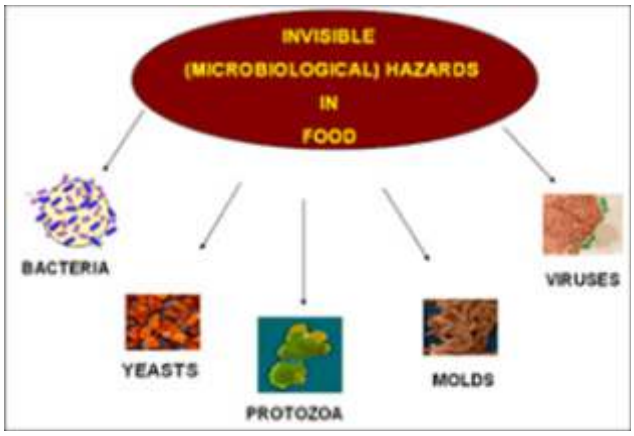

Fig. 4.1: Microbiological Hazards

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

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

Fig. 4.2: Food Spoilage

FAT TOM- This is a term used commonly in food industry to describe the six favorable conditions required for the growth of the food borne pathogens/micro-organisms.

Fig. 4.3: FATTOM Food Safety

Physical Hazards

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

Fig. 4.4: Physical Hazards

Chemical Hazards

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

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

Allergen

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

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

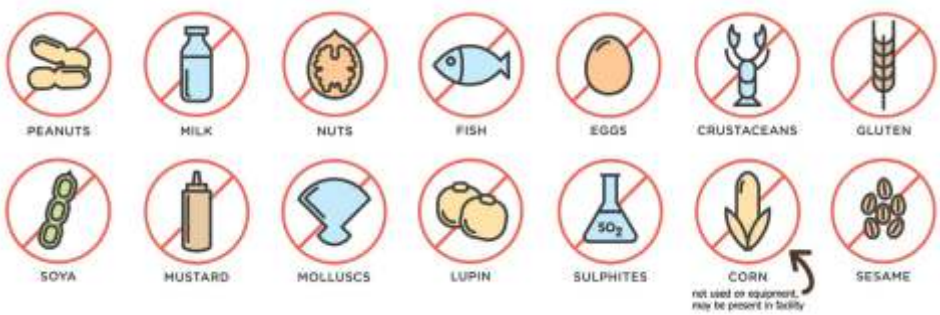

Fig. 4.5: Allergens

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

What Are the Most Common Food Allergens?

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

What Are the Signs & Symptoms of a Food Allergy?

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

Handling of Allergenic Foods:

1. Allergen-containing ingredients should be kept separate from non-allergen-containing products. Also, finished products containing that ingredient should be kept separate from non-allergenic products.
2. Allergen-containing products should be run at the end of the day or shift or isolated to a specific production line to avoid contact with non-allergen products.
3. Post-production, effective cleaning, and sanitizing must be performed to remove all allergen-containing products.
4. Sampling and testing of food products should be performed by the quality assurance staff or specially trained personnel to detect allergens in food products and on equipment surfaces.
5. Ensure that appropriate and correct information is provided in the labeled packaging of the food product.
6. Proper employee training should be given to to prevent allergen contamination.

4.1.3 Contamination, Cross Contamination and Prevention

Contamination: The presence of unwanted materials such as dust and particles during the manufacturing and transportation time is called contamination. The term contaminants include any unwanted matter that is found in the product. These contaminants affect the quality of the product or the process.

The most common types of contaminant include:

- Physical contaminant Examples: fiber material, particles, chips from your pill press tooling.
- Chemical contaminant. Examples: vapor, pesticides, grease. detergents, and so on.
- Biological contaminant Examples: fungus, bacteria, virus.

Cross contamination is possible when the unwanted matter is introduced or brought from one process to the next during manufacturing.

A leak in the holding containment would contaminate the product inside it; this would be an example of physical contamination.

Certain metals standing to be more advantageous to health, like iron, appearing to be globally added to some foods, involving infant formulas as well as breakfast cereals, to highlight their dietary advantages.

For biological contamination, bacteria may thrive if the container is not properly cleaned and dried. The contaminated container will then affect the product and microbes may thus be introduced to the batch.

Prevention of Contamination:

Determine the cause of the contamination

Anticipate the effect

Eliminate the source material

- To remove the contaminant carrier:
  - Reduce human involvement
  - Regulate the use of the equipment
  - Regulate the use of air
  - Regulate the use of water
- To reduce human carrier risk:
  - Ensure that proper attire is worn when coming and going from the production area
  - People frequently touch their eyes, nose, and mouth without even realizing it. Germs can get into the food through their contaminated unwashed hands.
- To reduce water as carrier:
  - As water is the number one source for cross contamination, it is important to reduce and prevent water contamination
  - Water borne contaminants: particulates (such as minerals) and pathogens (e. coli, salmonella, etc.)
  - Use of preventive measure such as filtration devices, distillation or reverse osmosis, UV treatments
- To reduce air as carrier:
  - Control air flow through AHUs (Air Handling Unit)
  - Use of air locks
  - Installation of HEPA (High Efficiency Particulate Absorbing Filters) filters
  - Ultra-Low Particulate Air

4.1.4 Storage (Importance of Storing Food at Specified Temperature)

Storage temperature is one of the most important factors in the preservation of food because microorganisms have been found to grow in almost all temperature.

Food storage is a major issue when keeping food safe. Food which is not correctly stored can spoil or become contaminated, which can make people sick. There are very specific rules regarding the temperatures that food must be stored at, cooked to and reheated to and if not followed, the risk of becoming ill as a result of contamination increases.

Room Temperature Food Storage

Keep dry storage areas clean with good ventilation to control humidity and prevent the growth of

Keep dry storage areas clean with good ventilation to control humidity and prevent the growth of mold and bacteria. 21°C is adequate for dry storage of most products. One of the first things to check regarding food which has been stored in the 'use-by' or 'best-before' dates printed on the packaging.

These dates will give you the most accurate indication of a food's shelf life, however, when a packet or can is opened, the expiry date almost always changes.

Refrigerating and Freezing Food

To reduce the risk of bacterial contamination, many foods must be stored in the refrigerator and thus kept below 5°C. These foods are often classified as 'high-risk foods' and include – meat, poultry, dairy, seafood, eggs, small goods and cooked rice and pasta. This also refers to ready-to-eat foods that have high-risk foods as ingredients and include – casseroles, quiche, pasta salad, pizza, sandwiches and many cakes.

By keeping these high-risk foods under 5°C it stops them from entering the 'danger-zone' – temperatures between 5°C and 60°C. The danger-zone is the temperature zone which provides bacteria with the perfect environment to rapidly grow and multiply to numbers that cause food poisoning.

By freezing food its longevity is increased because the water content of the food freezes – this prevents bacteria from multiplying and food spoiling. Food should be kept frozen at –18°C; when thawing, it should be stored in a refrigerator that reaches no more than 5°C until it is ready to be prepared.

4.1.5 Transportation

Selling fresh and high-quality produce is essential in groceries and retail food businesses. That's why the transport and storage of foods is so important, and refrigerated transport is essential to achieve this.

Refrigerated Transportation

Refrigerated transportation is a shipping cargo with advanced temperature adjustment features. It is built and designed mainly for climate-sensitive goods such as vegetables, fruits, meat, all-prep meals, bread, etc. in which the freight is loaded with ice and salt to maintain the food's quality at a particular temperature.

Fig. 4.6: Refrigerated Transportation

Ambient Temperature for Shipping

When it comes to cold chain logistics, maintaining ambient temperature tends to mean maintaining a temperature between 15°C to 25°C or 59°F to 77°F. These temperatures fall in the range of comfortable room temperature instead of being on one extreme and of temperature ranges.

4.1.6 HACCP, TACCP, VACCP, Control Measures, Critical Control Point, Critical Limit

HACCP (Hazard Analysis Critical control point): It is a systematic approach in identification, evaluation and control of food safety hazards and it's written documented plan based on HACCP principles known as HACCP Plan. It has 12 steps and 7 principles as:-

- Assembly of HACCP Team
- Describe Product
- Identify indent use
- Draw Flowchart / Diagram
- Verify Flowchart/ Diagram
- Conduct a hazard analysis (Principle 1)
- Determine critical control points (CCPs) (Principle 2)
- Establish critical limits (Principle 3)
- Establish monitoring procedures (Principle 4)
- Establish corrective actions (Principle 5)
- Establish verification procedures (Principle 6)
- Establish record-keeping and documentation procedures (Principle 7)

VACCP (Vulnerability Analysis Critical control points):

It focuses on food fraud as well, and widens the scope to include systematic prevention of any potential adulteration of food, whether intentional or not, by identifying the vulnerable points in a supply chain. It is especially concerned with economically motivated adulteration (EMA). Examples include product substitutions, unapproved product enhancements, counterfeiting, stolen goods and others.

TACCP (Threat Analysis Critical control points): generally requires a wider range of employee involvement than HACCP, as it covers issues such as manufacturing plant and transportation security, IT security, and employee background checks. Some points will overlap with HACCP, such as tamper-proof seals and various quality control checks.

Reduce the likelihood (chance) and consequence (impact) of a deliberate attack;

Protect organizational reputation;

Reassure customers and the public that proportionate steps are in place to protect food;

Demonstrate that reasonable precautions are taken and due diligence is exercised in protecting food.

Control: It is means to prevent, eliminate, or reduce hazard.

Control measures: It is means of any action or activity that is used to prevent, reduce to acceptable levels, or eliminate a hazard.

Critical limit: it is means a point, step, or procedure in a food process at which a control measure can be applied and at which control is essential to prevent, reduce to an acceptable level, or eliminate an identified food hazard.

UNIT 4.2: Schedule IV Requirements of FSSAI

Unit Objectives

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

1. Identify requirements in Schedule IV in FSSAI

4.2.1 Schedule IV Requirements of FSSAI

To provide assurance of food safety, Food businesses must implement an effective Food Safety Management System (FSMS) based on Hazard Analysis and Critical Control Point (HACCP) and suitable pre- requisite programmes by actively controlling hazards throughout the food chain starting from food production till final consumption.

As per the condition of license under FSS (Licensing & Registration of Food Businesses) Regulations 2011, every food business operator (FBO) applying for licensing must have a documented FSMS plan and comply with schedule 4 of this regulation. Schedule 4 introduces the concept of FSMS based on implementation of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) by food businesses and is divided into five parts as under:.

Schedule 4	General Requirements
Part 1	General hygienic and sanitary practices to be followed by food business operators applying for registration - Petty food operators and Street food vendors
Part 2	General hygienic and sanitary practices to be followed by food business operators applying for license- Manufacturing/ processing/ packaging/storage/distribution
Part 3	General hygienic and sanitary practices to be followed by food business operators applying for license- Milk and milk products
Part 4	General hygienic and sanitary practices to be followed by food business operators applying for license- Slaughter house and meat processing
Part 5	General hygienic and sanitary practices to be followed by food business operators applying for license- Catering

Table 4.2.1: Five Parts of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP)

Part II: General hygienic and sanitary practices to be followed by food business operators applying for license- Manufacturing/ processing/ packaging/storage/distribution

- **Location and Surroundings**
- Location shall be:
  - away from environmentally polluted areas
  - away from industrial activities which produce:
  - Disagreeable or obnoxious odor,
  - Fumes
  - Excessive Soot
  - Dust

Fig. 4.7: Location and Surrounding factors

- Smoke
- Chemical or biological emissions
- Pollutants
- Layout and Design of Food Establishment Premises

Facility in good condition leads to clean, pest free environment	• Repaired or replaces holes, broken tiles missing ceiling panel etc. • Sealed/grated sewer grids less than 1/4 inch
Hole free exterior walls	• Louvers in exterior wall fans that close tightly when turned off • Screened pipes & windows • Sealed outside pipe
Striped or sealed gaps around all doors	• Use of screen door, air curtains & other mechanisms • Sealed cracks to prevent insect harborage

Fig. 4.8: Layout and Design factors

- **Equipment and Containers**
  - made up of non-corrosive / rust free material
  - smooth, free from any grooves
  - easy to clean and maintain
  - non-toxic and non-reactive
  - of food grade quality

Fig. 4.9: Equipment and Container factors

- **Facilities**
  - **Water supply**
    - Only potable water meeting BIS (Bureau of Indian Standards) standards
    - Appropriate facilities for storage and distribution of water
    - Periodic cleaning of storage tanks and its record
    - Non-potable water, if used, only for cooling of equipment, steam production, fire fighting
    - Distinguished non-potable water pipes

Colour coding of water pipes to avoid contamination

Fig. 4.10: Water Supply

- Drainage and waste disposal
  - Disposal of sewage and effluent in conformance with the requirements of Factory
  - Designed and constructed to reduce risk of contamination to food and potable water
  - Separate waste storage area
  - Covered containers for waste storage
  - No accumulated waste in food handling, food storage or other working areas
  - Periodic disposal of waste/refuse
  - Pedal operated adequate size bins for waste collection
  - Waste bins emptied and washed daily with a disinfectant and dried before next use

Sr. No.	Material	Dustbin Colour	SYMBOL
1	Oily Cotton Waste	Red	
2	Paper	Green	
3	Plastic Jars, Sampling Bottles	Blue	
4	Plastic Bags	Yellow	
5	Polish Filter	Grey	
6	Food Waste	Orange	
7	Glass Bottles	Black	

Fig. 4.11: Waste Disposal

Fig. 4.12: Drainage System

- Personnel facilities and toilets
  - Facilities for washing and drying hands
  - Supply of hot and cold water
  - Separate lavatories of appropriate hygiene design for males and females separately
  - Suitably located Changing facilities for personnel
  - No direct opening of such facilities in food processing, service or storage area

Fig. 4.13: Personal facilities

- **Ventilation and Lighting**
  - Air quality and ventilation:
    - Natural / mechanical ventilation system including air filters, exhaust fans
    - Designed and constructed as such air does not flow from contaminated areas to clean areas
  - Lighting
    - Adequate Natural /artificial lighting
    - Protected lightings to avoid contamination by breakages

Fig. 4.14: Ventilation and Lighting

- **Food Operations And Controls**
  - **Procurement of raw materials**
    - Quality raw materials (free of parasites, micro-organisms, pesticides etc.)
    - Raw material conforming to the regulations under the act
    - Records of raw material as source of procurement

Fig. 4.15: Procurement of raw materials

  - **Storage of raw materials and food**
    - Adequate food storage facilities to protect food from contamination
    - Cold storage facilities according to requirement
    - Segregation of storage area for raw and processed food, recalled materials, packaging materials, stationary, cleaning materials/ chemicals
    - Separate cold storage of raw food like meat/poultry/seafood product away from the area of WIP (Work in Progress), processed, cooked and packaged products.
    - Monitoring of temperature and humidity
    - FIFO First received (In) materials must move out first
    - Non –toxic containers for food storage
    - Stored on racks or pallets well above the floor and away from the wall

Fig. 4.16: Storage of raw materials and food

Review Of Product Label /Packaging Usage And Control

Labels should be reviewed allergens are mentioned don it prior to their receipt for their accuracy. Line Personnel should be trained to ensure labelling is changing when a changeover takes place.

Food Processing / Preparation, Packaging and Distribution / Service

- **Storing at appropriate temperature:** The Food Business shall develop and maintain the systems to ensure that time and temperatures are controlled effectively where it is critical to the safety and suitability of food. Such control shall include time and temperature of receiving, processing, cooking, cooling, storage, packaging, distribution and food service till it reaches the consumer, as applicable.
- **Food Packaging:** Packaging materials shall provide protection for all food products to prevent contamination, damage and shall accommodate required labelling as laid down under the FSS Act & the Regulations there under.
- **Transportation:** All critical links in the supply chain need to be identified and provided for to minimize food spoilage during transportation. Processed / packaged and / or ready-to-eat food shall be protected as per the required storage conditions during transportation and / or service.
- **Management and Supervision**
  - Provision of resources to implement & maintain Food Safety
  - Developing SOPs for processing, packing, dispatch & storage of food
  - Competent Technical Managers & Supervisors:
    - having skills on food hygiene principles & practice
    - taking appropriate preventive & corrective action
    - ensure effective monitoring and supervision.
- **Maintaining Process related records (e.g. production records)**
- **Sanitation And Maintenance of Establishment Premises**
  - Facilities should permit effective cleaning.
- **Cleaning Program**
  - areas to be cleaned,
  - cleaning frequency,
  - procedure,
  - equipment,
  - cleaning material and method

Visualizing for HK material


Kamishibai Board for maintaining HK


Hanging of Flexible pipes for ease of cleaning

Fig. 4.17: Cleaning Program

- **Maintenance**
  - Preventive and Corrective Maintenance
  - Lubricants and heat transfer fluids shall be food compatible Procedure for releasing maintained equipment back to production
  - Maintenance personnel shall be trained in the product hazards associated with their activities

Fig. 4.18: Maintenance

- **Pest Control Systems**
  - Report pest infestations immediately.
  - Do not use pesticides/insecticides in food processing area.

Fig. 4.19: Fly Catcher and Rodent Traps

- **Personal Hygiene**
  - Health Status
    - Personnel suffering from disease or illness shall not be allowed to enter in food handling area
    - System to report illness or symptoms of illness to management
    - Medical examination of food handlers/ employees once in a year
    - Records of medical examination
    - Factory shall be compulsorily inoculated against the entire group of diseases and recorded
    - In case of epidemic, all workers to be vaccinated irrespective of the yearly vaccination.
  - **Personal Cleanliness**
    - High degree of personal cleanliness by food handlers
    - Food business shall provide to all food handlers;
    - Protective clothing
    - Head covering
    - Face mask
    - Gloves
    - Foot wear

Fig. 4.20: Personal Cleanliness

- **Visitors Generally**
  - Generally visitors should be discouraged to go inside the food handling areas
  - The food business shall ensure visitors to its food manufacturing/ handling areas shall;
  - Wear protective clothing
  - Footwear
  - Adhere to personal hygiene provisions envisaged in the respective section
- **Product Information And Consumer Awareness**
  - Batch Identification
    - Identifies producer
    - Product recall
    - Effective stock rotation - FIFO
  - Product Information
    - Adequate information & enables other person in food chain to handle, display, store, prepare & use the product safely & correctly
  - Labeling
    - Should confirm to Legal Requirements
- **Consumer Education**
- **Training**
  - Awareness & responsibilities
  - Training Programmes
    - Nature of food
    - Control Spoilage
    - Handling of food
    - Storage
  - Training Records
  - Instruction & supervision
    - Periodic assessment of training & effectiveness
  - Refresher training
- **Good Manufacturing Practices For Whole Premise**

  Good Manufacturing Practices* (GMPs) are the basic operational and environmental conditions required to produce safe foods. They ensure that ingredients, products and packaging materials are handled safely and that food products are processed in a suitable environment.

  GMPs address the hazards associated with personnel and environment during food production. They provide a foundation for any food safety system. Once GMPs are in place, processors can implement a Hazard Analysis Critical Control Point (HACCP) system to control hazards that may affect the ingredients and packaging material during food processing.

GMPs Address:

Fig. 4.21: GMPs Address

- **Environmental control (premises):** Location, design and construction of the building and its interior, equipment, water supply.
- **Personnel practices:** Personal hygiene, hand washing, clothing/footwear/headwear, injuries and wounds, evidence of illness, access and traffic patterns, chemical use.
- **Shipping, receiving, handling, storage:** Inspection procedures for transport vehicles; loading, unloading and storage practices; inspection procedures for incoming products; shipping conditions; returned and defective products; allergen control; chemical storage; waste management.
- **Pest control:** Monitoring procedures for the exterior and interior of the building (ex: surveillance, fumigation) and the use of pesticides.
- **Sanitation:** Cleaning and sanitizing procedures and pre-operational assessment.
- **Equipment maintenance:** Procedures describing preventive maintenance and calibration of all the equipment and instruments that can affect food safety (ex: thermometers, thermocouples, metal detectors, scales, pH meters)
- **Recall and traceability:** Procedures that ensure final products are coded and labeled properly; incoming materials; in-process and outgoing materials are traceable; recall system is in place and tested for effectiveness (ex: procedures for mock recalls).
- **Water safety:** Water safety monitoring procedures for water, ice and steam, and water treatment procedures that ensure it is potable for use in food processing

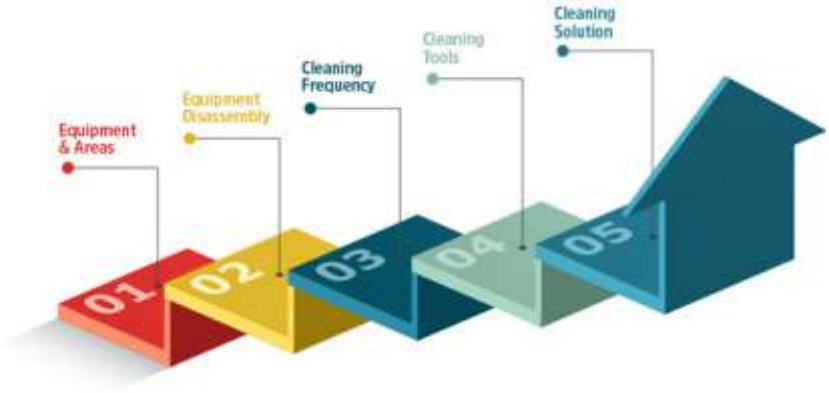

Fig. 4.22: Storage of sanitizing materials

Where and How to Store Your Cleaning Supplies

- **Clean, Cool, Dry:** Store your cleaning supplies in an area that is clean and free of debris. Make sure that there aren't any temperature extremes in the area where your cleaning supplies are stored. Another thing to make sure of is that the area is dry.
- **Original Containers:** Keep cleaning supplies in their original containers. If you mix your own cleaners, make sure you use new clean bottles and label them to avoid a mixup.
- **Safe Storage:** Be sure to keep your cleaning supplies stored in places where your children and/or pets will not be able to get to them. Consider higher storage or locked storage options to protect small children and pets.

Cleaning and Sanitization Process, Need and Importance

Workplace Sanitation: Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.

Cleaning Procedures and Schedules: Cleaning with soap and other detergents is just one step of the cleaning procedure. It is also necessary to sanitize. Cleaning will remove any dirt or grease, but will not necessarily kill any bacteria or other pathogens. Only a sanitizer will kill bacteria and ensure the area is safe for food preparation. Leading sanitizers used in the food service industry are chlorine solutions (bleach), quaternary solutions (quarts), and iodine. Use these materials according to the manufacturer's instructions that accompany the product and that are found on the material safety data sheet (MSDS) using the appropriate personal protective equipment.

A sanitation plan is important in any food service preparation area. It ensures that all surfaces are cleaned on a regular basis and reduces the risks of transferring bacteria or other pathogens from an unclean surface to clean equipment such as cutting boards or tools. A sanitation plan has two components:

- A list of cleaning and sanitizing agents or supplies with instructions on their safe use and storage
- A cleaning schedule, outlining how each item needs to be cleaned, who is responsible, and how frequently it happens

Routine Equipment Maintenance

Refer to the manufacturer's instructions and training provided by your employer or instructor on how to do this safely. Some equipment is intended to be cleaned in place. This should be identified in your sanitation plan and cleaning schedule.

All equipment must be routinely cleaned and inspected. Older equipment may have nooks and crannies where dirt and bacteria can hide, which can be difficult to clean effectively. Proper cleaning procedures must be established and followed at all times with regular review to ensure that procedures are working. If equipment is replaced or cleaning materials change, the process may have to be adjusted. If you notice any safety concerns with the equipment while cleaning it, such as a frayed cord, missing guard or loose parts, let your supervisor know immediately.

- **Good Food Hygiene Practices**
  - Cleaning
    - Food areas and equipment between different tasks, especially after handling raw food shall be cleaned.
    - The surface shall be thoroughly cleaned in case if somebody spills food / water / drink.
  - Raw materials
    - Raw materials shall be purchased from reliable and known dealers and checked for visible deterioration & off-odour, physical hazards and foreign body contamination.

Fig. 4.23: 8 Principles based on eight quality management principles

- Cooking
  - The preparation/ processing/ cooking should be adequate to eliminate and reduce hazards to an acceptable level which might have been introduced at the raw food level.
  - The preparation/ processing/ cooking methods should ensure that the foods are not re-contaminated.
  - The preparation/ processing/ cooking of veg. & non-veg. products should be segregated.
  - Whenever cooking or reheating of food is done, it should be hot all the way through, it is especially important to make sure that food is cooked thoroughly.
  - Re-use of cooking oil should be avoided.
  - In case of reheating of oil use maximum three times to avoid the formation of Trans fat. It is ideal to use once if possible.
- Chilling
  - Semi cooked or cooked dishes and other ready-to-eat foods such as prepared salads and desserts having short shelf life should not be left standing at room temperature.
  - Chilled food intended for consumption should be cold enough.
  - Food items that need to be chilled should be put straight away into the fridge.
  - Cooked food should be cooled as quickly as possible and then put it in the fridge.
  - Chilled food should be processed in the shortest time possible.
  - Fridge and display units should be cold enough and as per requirement. In practice, fridge should be set at 5°C to make sure that food is kept in chilled condition. Also, fridge and display units should be maintained in good working condition to avoid food spoilage and contamination.
- Cross-contamination

  Following should be done to avoid cross-contamination.
  - Separation of each crop/species and also processed and unprocessed foods.
  - Hands should be thoroughly washed after touching.
  - Work surfaces, chopping boards and equipment should be thoroughly cleaned before the preparing of food starts and after it has been used.

- **Personal Hygiene**
  - High standards of personal hygiene should be maintained.
  - All employees handling food should wash their hands properly:
    - before preparing food
    - after touching raw food or materials, specially meat/poultry or eggs
    - after breaks
    - after using the toilet after cleaning the raw materials or utensils / equipments
  - Street shoes inside the food preparation area should not be worn while handling & preparing food.
  - Food handlers should ensure careful food handling & protect food from environmental exposure.
- **Transportation and Handling Of Food**
  - Food shall be adequately covered during transportation to assure food safety.
  - Transportation vehicles
    - Vehicle inspection
    - Shall not contaminate foods & packaging
    - Should be easy to clean and maintain

- Provide effective protection from dust & dirt
- If required maintain temperature, humidity, atmosphere
- If required allow monitoring of temperature, humidity, etc.
- Should be used only for carrying food.
- Regular maintenance of vehicles is required.
- Appropriate supply chain to minimize food spoilage
- Non-toxic, clean, well maintained food containers during transportation
- Temperature and humidity control during transportation
- Dedicated vehicles for food transportation
- Effective cleaning and sanitation of vehicles between loads carrying high risk foods as fish, meat poultry to avoid cross contamination

Fig. 4.24: Transportation and handling of food

- **Storage**
  - It is very important to store food properly for the purpose of food safety. Following things must be ensured:
    - Raw meat/poultry should be stored separately from other foods
    - Storage temperature of frozen food should be -18°C or below.
    - Storage instructions over food packaging should be followed.
    - Dried foods (such as grains and pulses) should be stored off the floor, ideally in sealable containers, to allow proper cleaning and protection from pests.
    - Store commercial ice cream at temperatures below 0°F.
    - Store biscuit, brownie, and muffin mixes at room temperature.

Stock rotation

The rule for stock rotation is FIFO (first in, first out) to make sure that older food is used first. This will help to prevent wastage. Older product will have nearer shelf life expiry, so older product should be moved out first, but new products will have time to move out since expiry is so far. That's why a rule of FEFO does also exist which means First Expiry First Out. It is called Good Distribution Practice.

UNIT 4.3: Personal Hygiene

Unit Objectives

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

1. Identify types of health and safety policies and procedures

4.3.1 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.

4.3.2 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. 1.3.1 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.

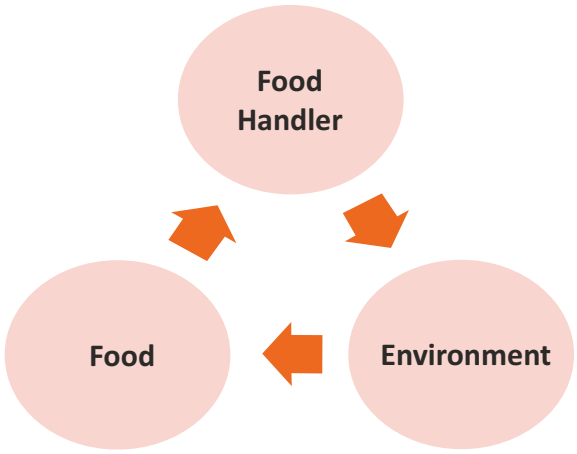

Fig. 4.25: Importance of Personal Hygiene

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

Fig. 4.26: Personal hygiene

4.3.3 Hand Washing

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

Fig. 4.27: Methods of washing hand

How to Use Sanitizer?

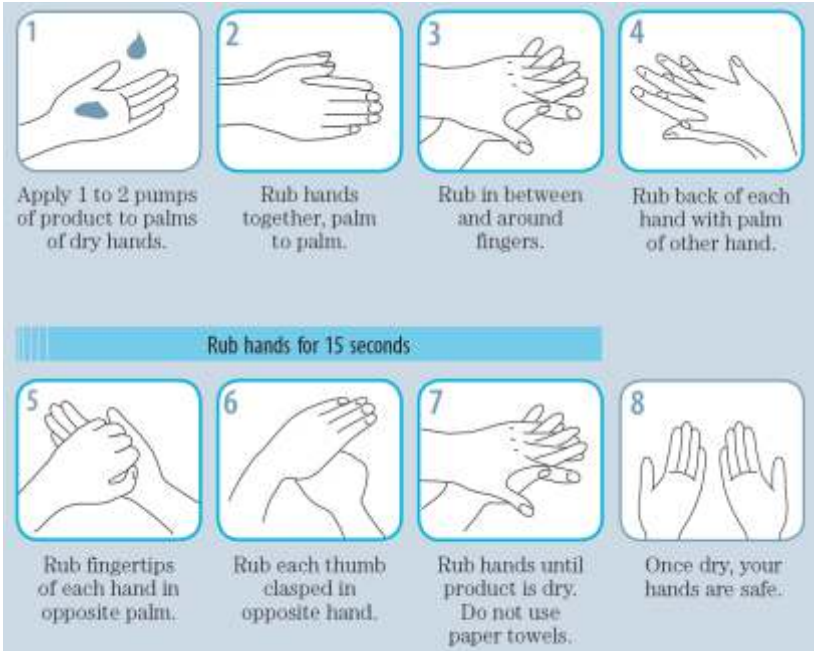

Fig. 4.28: Usage of Sanitizer

When to Wash and Sanitize Hand?

Fig. 4.29: 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.

4.3.4 Good personal hygiene can prevent food poisoning.

Bacteria that cause food poisoning can be on everyone – even healthy people. You can spread bacteria from yourself to the food if you touch your nose, mouth, hair or your clothes, and then food.

Good personal hygiene also makes good business sense. Customers like to see food-handling staff who take hygiene seriously and practice safe food handling.

- Personal hygiene is important to prevent food poisoning.
- When handling food, wash your hands thoroughly and often.
- If you are sick, do not go to work, because you can contaminate food more easily.
- Food handlers should be properly trained in safe food handling.

Food handling businesses ensure the following factors are considered to ensure personal hygiene:

- **Hand Washing —** ensure effective hand washing techniques are followed at appropriate times
- **Minimise hand contact with food —** try to minimise direct hand contact with raw food by using appropriate utensils and safe use of disposable gloves
- **Personal cleanliness —** cover hair; do not sneeze or cough over food; cover cuts and sores; and do not wear jewellery
- **Wear protective clothing —** wear suitable clean protective clothing and handle appropriately to prevent cross contamination
- **Exclude ill staff —** staff must report illnesses; exclude staff with vomiting or diarrhoea

UNIT 4.4: Health Safety

Unit Objectives

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

1. Illustrate the concept of health safety
2. Understand the hazards of health safety
3. Explain the health and safety policies and procedures
4. Describe the personal protective equipment
5. Discuss the types of personal protective equipment

4.4.1 Health Safety

The term Health and Safety is generally used to describe Occupational Health and Safety, and relates to the prevention of accidents and ill health to employees and those who may be affected by their work.

4.4.2 Health Safety Hazards

Safety hazards exist in every workplace, but how do you know which ones have the most potential to harm workers? By identifying hazards at your workplace, you will be better prepared to control or eliminate them and prevent accidents, injuries, property damage, and downtime.

First of all, a key step in any safety protocol is to conduct a thorough safety hazard assessment of all work environments and equipment

In a safety hazard assessment, it is important to be as thorough as possible because after all, you can't protect your workers against hazards you are unaware of and unprepared for. Avoid blind spots in your workplace safety procedures by taking into consideration these 3 types of workplace hazards:

- **Safety hazards**

  Safety hazards are number one on the list of 3 types of workplace hazards. These hazards play an effect on employees who work directly with machinery or in construction sites. Safety hazards are unsafe working conditions that that can cause injury, illness, or death.

  

  Fig. 4.30: Safety hazards

  Safety hazards are the most common workplace risks. They include:

  - Anything that can cause spills or trips such as cords running across the floor or ice
  - Anything that can cause falls such as working from heights, including ladders, scaffolds, roofs, or any elevated work area.
  - Unguarded and moving machinery parts that a worker can accidentally touch.
  - Electrical hazards like frayed cords, missing ground pins and improper wiring
  - Confined spaces

- **Ergonomic hazards**

  Ergonomic safety hazards occur when the type of work, body positions, and working conditions put a strain on your body.

  Ergonomic Hazards include:

  - Improperly adjusted workstations and chairs
  - Frequent lifting
  - Poor posture
  - Awkward movements, especially if they are repetitive
  - Having to use too much force, especially if you have to do it frequently
  - Excessive vibration

Fig. 4.31: Ergonomic Hazards

- **Work organization hazards**

Safety hazards or stressors that cause stress (short-term effects) and strain (long-term effects). These are hazards associated with workplace issues such as workload, lack of control and/or respect, etc.

Examples include:

- Workload demands
- Workplace violence
- High intensity and/or pace
- Respect (or lack thereof)
- Flexibility
- Control or say about things
- Social support or relations
- Sexual harassment

4.4.3 Health and Safety Policies and Procedures

Overview

The law says that every business must have a policy for managing health and safety.

A health and safety policy sets out your general approach to health and safety. It explains how you, as an employer, will manage health and safety in your business. It should clearly say who does what, when and how.

4.4.4 What is Personal Protective Equipment?

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

4.4.5 Types of PPE

Head protection

Examples of head protection equipment:

- Helmets
- Hard hats
- Hair nets

Hand protection

Examples of hand protection equipment

- Work gloves and gauntlets
- Wrist cuff arm nets

Eye and face protection

- Safety glasses and goggles
- Eye and face shields

Fig. 4.32: Eye and face protection

Respiratory Protection

This type of PPE must be present when being in contact with large amounts of gases, powders, dust and vapors.

Fig. 4.33: Types of Respirators

Hearing protection

Examples of hearing protection equipment:

- Earplugs and defenders
- Noise meters
- Communications sets
- Acoustic foam

Foot protection

As examples of foot protection equipment can be pointed out the following ones:

- Safety boots and shoes
- Anti-static and conductive footwear

Height and access protection

As examples of height and access protection equipment can be mentioned in the following ones:

- Fall-arrest systems
- Body harnesses
- Lowering harnesses
- Rescue lifting
- Energy absorbers and others

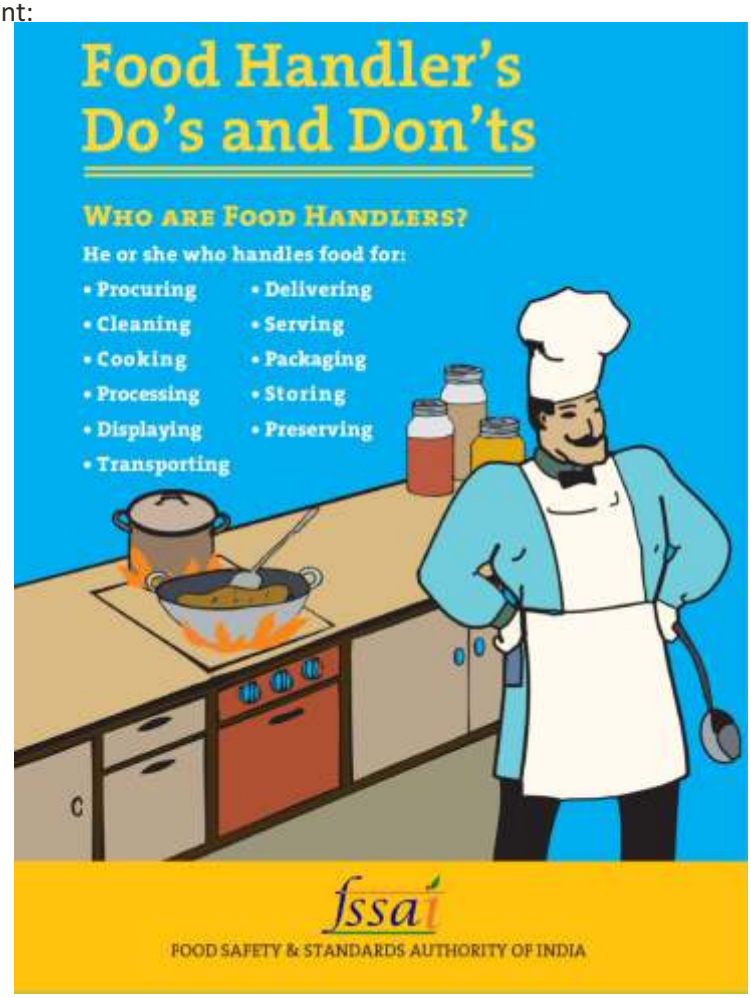

Fig. 4.34: FSSAI dos and don'ts for food handlers

First aid kit

The kit should be kept in an accessible location and /or close to areas where there is a higher risk of injury or illness. The first aid kit should provide basic equipment for administering first aid.

Pictograms

Not only is preparing your workshop for accidents a smart thing to do, it is even smarter to organize your workshop in such a way that no serious accidents can take place. A simple way to make your workshop safer is to use pictograms: indicating flammable materials, the necessary use of hearing protection, indicating emergency exits.

Health and Safety Policy

FBO is committed to the goal of providing and maintaining a healthy and safe working environment, with a view to continuous improvement. This goal is only achievable by adherence to established objectives striving to exceed all obligations under applicable legislation, and by fostering an enthusiastic commitment to health, safety and the environment.

In particular:

Management, working in cooperation with the Joint Health and Safety Committee, will strive to take all reasonable steps to reduce workplace hazards to as low as reasonably achievable.

Supervisors and managers are held accountable for the health and safety of all employees under their supervision. This includes responsibility for applicable training and instruction, appropriate followup on reported health and safety concerns, and implementation of recommended corrective action.

FBO is committed to providing all necessary training and instruction to ensure that appropriate work practices are followed on the job, and to promote their use off the job.

Health, safety, the environment and loss control in the workplace are everyone's responsibility. Company expects that everyone will join in our efforts to provide a healthy and safe working environment on a continuous day to day basis.

Importance of Preventive Health Checkups

No matter what age group you are a part of, regular preventive health tests are essential for each one of us.

Whether one is feeling fit from within or is still in his early years of life, a preventive health checkup is an important practice that one must inculcate in his or her daily life.

- It can detect developing disease and prevent them
- Increase better chances for treatment and cure
- Can identify health issues early and prevent them
- It helps to improve lifestyle and increase productivity at work

FSSAI Format for health check up

PERFORMA FOR MEDICAL FITNESS CERTIFICATE FOR FOOD HANDLERS

(FOR THE YEAR .....)

(See Para No. 10.1.2, Part- II, Schedule - 4 of FSS Regulation, 2011)

It is certified that Shri/Smt./Miss..... employed with M/s....., coming in direct contact with food items has been carefully examined* by me on date ..... Based on the medical examination conducted, he/she is found free from any infectious or communicable diseases and the person is fit to work in the above mentioned food establishment.

Name and Signature with Seal
of Registered Medical Practitioner /
Civil Surgeon

***Medical Examination to be conducted:**

1. Physical Examination
2. Eye Test
3. Skin Examination
4. Compliance with schedule of Vaccine to be inoculated against enteric group of diseases
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination.

Fig. 4.35: Format for health check up

Medical examination to be concluded –

1. Physical examination
2. Eye Test
3. Skin examination
4. *Compliance with schedule of vaccine to be inoculated against enteric group of diseases
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination

* Vaccine to be inoculated against enteric group of diseases shall be decided by the medical practitioners in accord to remove the ping to the list as declared by the municipal corporation of that area.

Summary

- Food safety refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.
- It is important to be aware of food allergens in food industry as this is the risk associated with the unintended presence of allergen due to cross contamination and should take this a matter of serious concern. Food allergies can cause serious and even deadly reactions.
- The presence of unwanted materials such as dust and particles during the manufacturing and transportation time is called contamination. The term contaminants include any unwanted matter that is found in the product. These contaminants affect the quality of the product or the process.
- Refrigerated transportation is a shipping cargo with advanced temperature adjustment features. It is built and designed mainly for climate-sensitive goods such as vegetables, fruits, meat, all-prep meals, bread, etc. in which the freight is loaded with ice and salt to maintain the food's quality at a particular temperature.
- The retail food industry plays a significant role in assuring a safe food supply for its consumers. At the retail level, activities to control food safety risks can be divided into four key areas: the supplier and source of foods and food ingredients; in-store practices and procedures; education and training of employees and food handlers; and consumer engagement.
- Good Manufacturing Practices (GMPs) are the basic operational and environmental conditions required to produce safe foods. They ensure that ingredients, products and packaging materials are handled safely and that food products are processed in a suitable environment.
- Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.
- The rule for stock rotation is FIFO (first in, first out) to make sure that older food is used first. This will help to prevent wastage. Older product will have nearer shelf life expiry, so older product should be moved out first, but new products will have time to move out since expiry is so far. That's why a rule of FEFO does also exist which means First Expiry First Out. It is called Good Distribution Practice.
- The expression "food hygiene" is often associated to personal hygiene, being many times limited to the care of washing hands. The concept of food hygiene really refers to the general cleanliness state of the food handlers' body and clothes.
- Health and Safety is a term that generally covers the legal requirements that fall under the Health and Safety at Work Act etc. 1974. The term Health and Safety is generally used to describe Occupational Health and Safety, and relates to the prevention of accidents and ill health to employees and those who may be affected by their work.

Exercise

A. Answer the following questions by choosing the correct option:

1. _____ refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption.
   a. Food Safety
   b. Fire Safety
2. _____ is a factor or agent which may lead to undesirable effects like illness or injury in the absence of its control, whereas, risk refers to the probability that the effect will occur.
   a. Threat
   b. Hazard
3. The presence of _____ materials such as dust and particles during the manufacturing and transportation time is called contamination.
   a. wanted
   b. unwanted
4. _____ is one of the most important factors in the preservation of food because microorganisms have been found to grow in almost all temperature.
   a. Storage temperature
   b. Hazard temperature
5. Selling fresh and _____ produce is essential in groceries and retail food businesses.
   a. low-quality
   b. high- quality

B. Answer the following questions briefly.

1. What are the most common types of contaminant?
2. Outline the layout and design of food establishment premises.
3. Explain VACCP
4. What are the facilities provided by water supply?
5. What are the two components of the sanitation plan?

Notes

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

FICSI
Food Industry Capacity and Skill Initiative

5. Prepare Jam and Jelly

Unit 5.1 Production process of preparing Jam and Jelly

FIC/N0111
(Part of - FIC/Q0204)

Key Learning Objectives

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

1. Perform the tasks to prepare jam and jelly
2. Discuss the process of preparing jam and jelly

Unit 5.1 Production process of Jam and Jelly

Unit Objective

At the end of this module, the trainees 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, jackfruit, pineapple, banana, guava, and pears** are used to prepare jam.

Fig. 5.1 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 65per cent. by weight and not less than 60 per cent. by weight in case of jellies.

Fig. 5.2 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 color and flavor 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 color and flavor. 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.

- 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.
- Acid is required both for gel formation and flavor. 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.
- 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 microorganisms. 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*
Sugar: fruit juice ratio = 1:1	Sugar: fruit juice ratio = 0.6 to 0.75:1	Sugar: fruit juice ratio = 0.5:1

Table 5.1 Pectin and acid contents of fruits

5.1.3 Equipment used in making Jam and Jellies

Basic equipment/ accessories

- Cutting Knife (SS), coring knife, pitting knife, peeling knife
- Cutting and Chopping equipment
- Cooking Vessels/VAT
- Refractometer, pH meter
- Heat production system
- Other various machines

Types of Equipment And Tools	Description
Fig.5.3 Cooking Kettle 	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. **Operation of Cooking Kettle** "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: - • a spherical tank • vapor-liquid separator • condenser • agitator • receiving tank, etc. 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.
Fig.5.4 Peeler 	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.
Fig.5.5 Pulper machine 	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.

Types of Equipment And Tools	Description
Fig.5.6 Filter/Sieve *(Source: https://rdpf.co.in/ss-in-line-filter-supplier-in-mumbai-india/)* 	A sieve is equipment used to separate the passage of granular materials according to particle size.
Fig.5.7 Plate Heat Exchanger/Pasteurizer 	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.
Fig.5.8 Refractometer 	Refractometer measures total soluble solids (TSS) as °Brix, which corresponds to % sugar.
Fig.5.9 Weighing balance 	Weighing balance is used to weigh small amounts of ingredients or laboratory chemicals, ingredients and products, and fruit and vegetables, respectively.
Fig.5.10 Crown corking/capping machine 	The crown corking/capping machine is used for sealing the caps/corks of the jars/bottles.

Table 5.2 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.

- **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.
- **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.
- **Pulping:** Fruits are pulped using a Pulper.
- **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 flavor and undesirable color 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.
- **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.5.11 Inspection Table for Jam/Jelly Test

- **Refractometer method Test:** Before placing a drop on the Refractometer glass, cool the jam immediately as the reading is calibrated at 20°C.
- **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.
- **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.
- **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.
- **Labeling and packaging:** The sealed jam jars are conveyed through the labeling 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.

Scan the QR Code to watch the related video

https://www.youtube.com/watch?v=ZozA1gHNoDA

Apple jam Processing

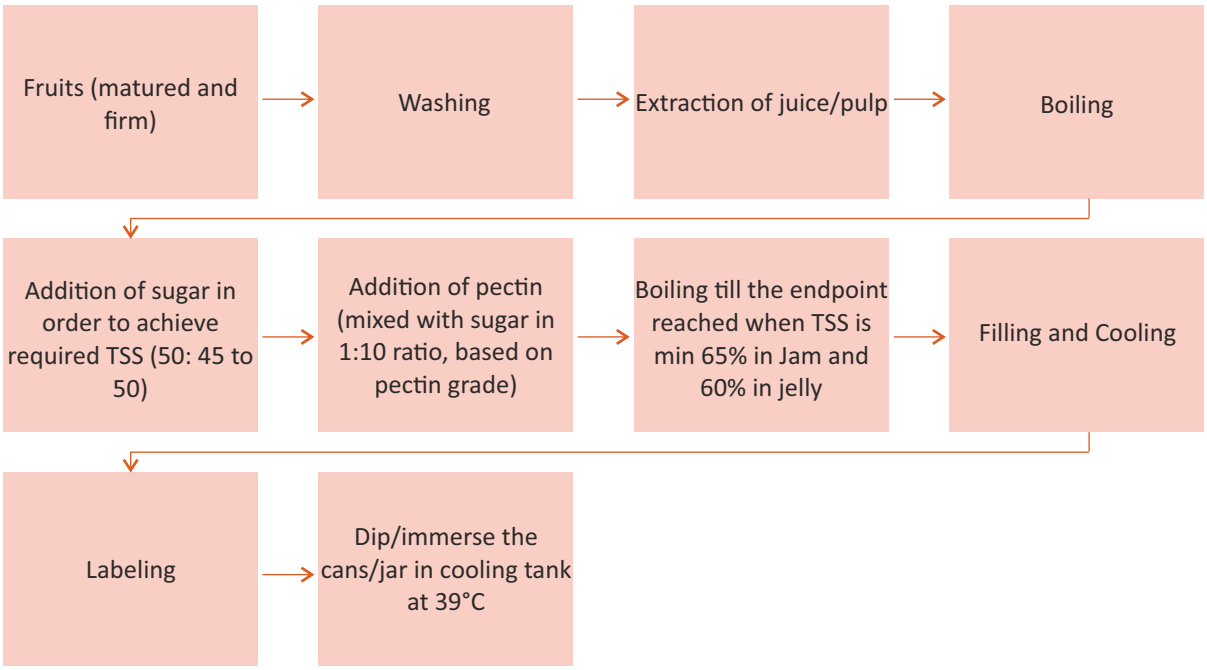

Fig.5.12 Process flowchart for preparation of jam

Problems in the jam production

- **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.
- **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.
- **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.
- **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.
- **Microbial spoilage:** During the storage, there may be mold growth in the jam, which can be prevented by storing jam in 80% humidity.
- **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 FSSA, 2011 regulation.

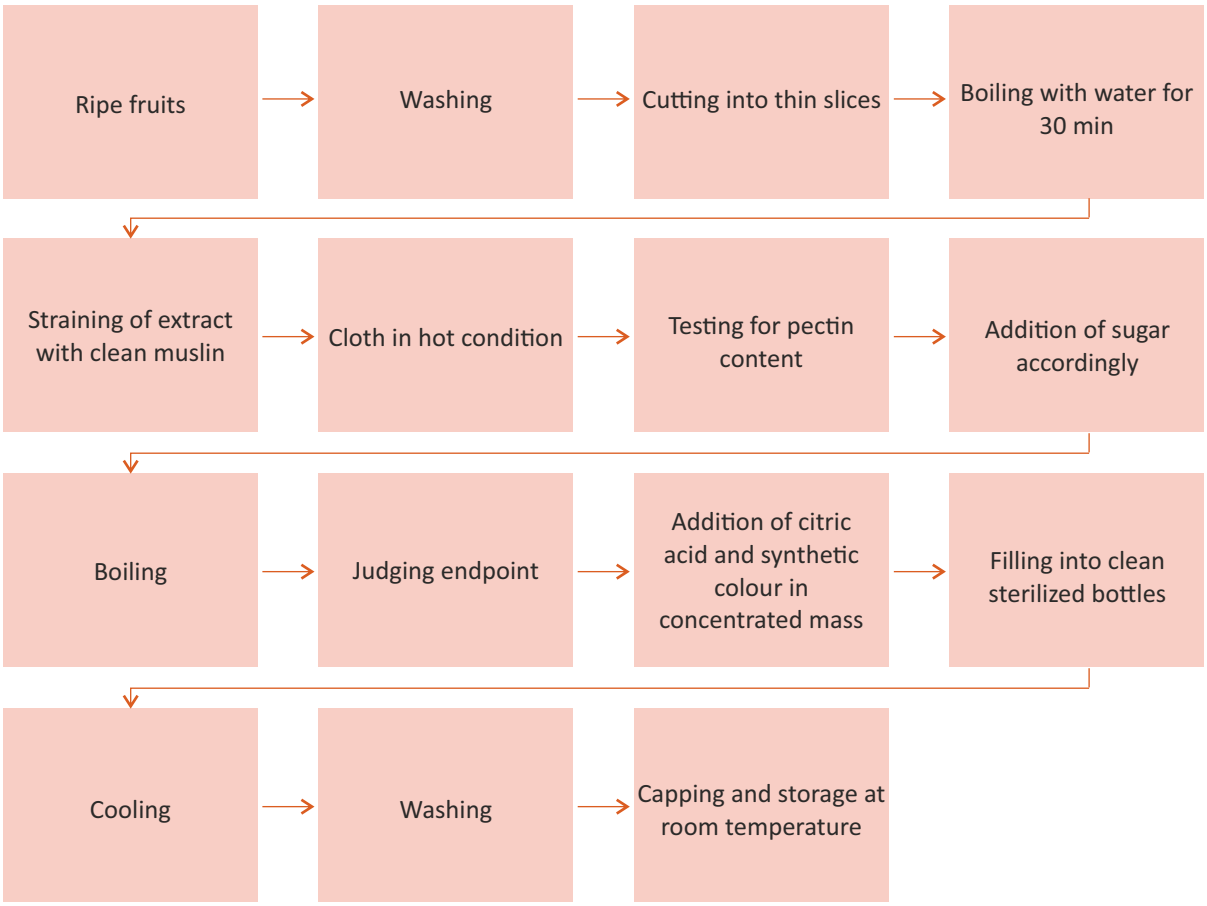

Fig.5.13 Process flowchart of preparing jelly

Testing of pectin quality

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

- **Alcohol test:** One part of extracted fruit juice or filtered pulp is mixed with three parts of95% 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.
- **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.
- **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 jellying point is reached.
- Refractometer test: The endpoint is determined with the refractometer to 68 Brix.

Problems in jelly making:

- **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.
- **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.
- **Colour changes:** Darkening at the top of the jars can be caused by storing them in warm a place or an imperfect jar seal.
- **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.
- **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 undercooking. Tartarate crystals can be formed in grape jelly if the juice is left to stand in the cold for several hours before being used.

- **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.
- **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.
- **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.
- **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.

5.1.5 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:

- **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.

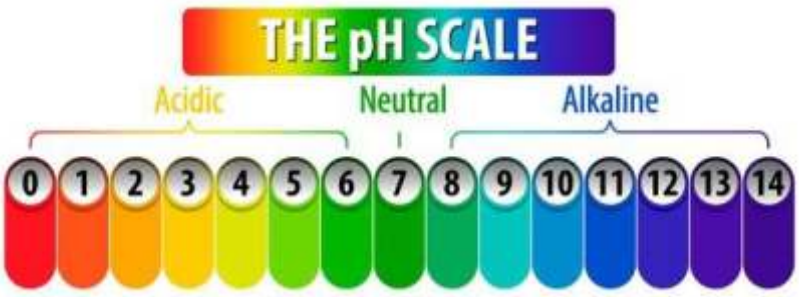

Fig.2.14 pH Scale

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.

Fig.2.15 Pectin in Fruit

5. **Titratable Acidity -** It measures the total acid concentration in fruit and is determined by exhaustive titration of intrinsic acids with a standard base. Titratable fruit acidity is expressed as g/100 mL of the predominant acid.
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.

Scan the QR Code to watch the related video

https://www.youtube.com/watch?v=zThmD6nrrRA

Orange jelly processing

Exercise

I. Answer the following questions:

1. Explain the operation of the cooking kettle.

2. List the ingredients of jam and jelly.

3. What is pectin?

4. List any three problems in making jelly.

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

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

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6. Prepare the Ketchup

Unit 6.1 Process of Preparing Ketchup

FIC/N0111
(Part of - FIC/Q0204)

Key Learning Objectives

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

1. Perform the tasks to prepare ketchup
2. Explain the procedure of preparing ketchup

Unit 6.1 Production Process of Preparing Ketchup

Unit Objective

At the end of this module, the trainees 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

6.1.1 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 20ºC which the sealed container is capable of holding when completely filled.

Fig 6.1 Ketchup

6.1.2 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.
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.

Methods of using ingredients for the production of Ketchup	
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 6.1 List of ingredients used in the following way during the production of ketchup

Notes

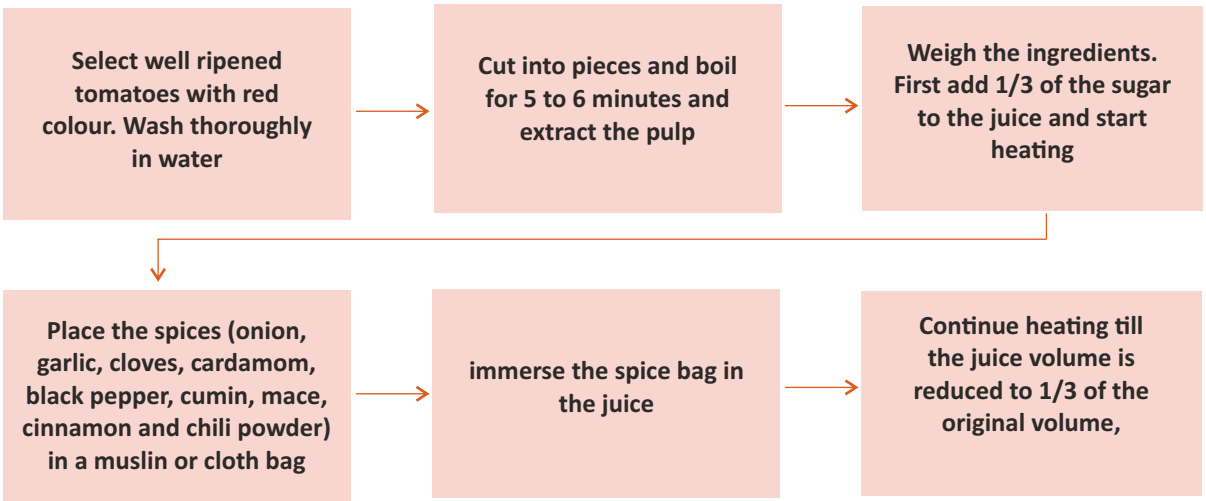
6.1.3 Procedure to prepare ketchup

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

Cooking & Concentration	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.
Bottling & Packaging	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 88^{o}C 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 (30-35^{o}C) under dry places.
Pasteurization	The hot-filled bottles are pasteurized in hot water (85-88°C) for 30-35 minutes. Caremust 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.

Table 6.2 Processing of ketchup

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



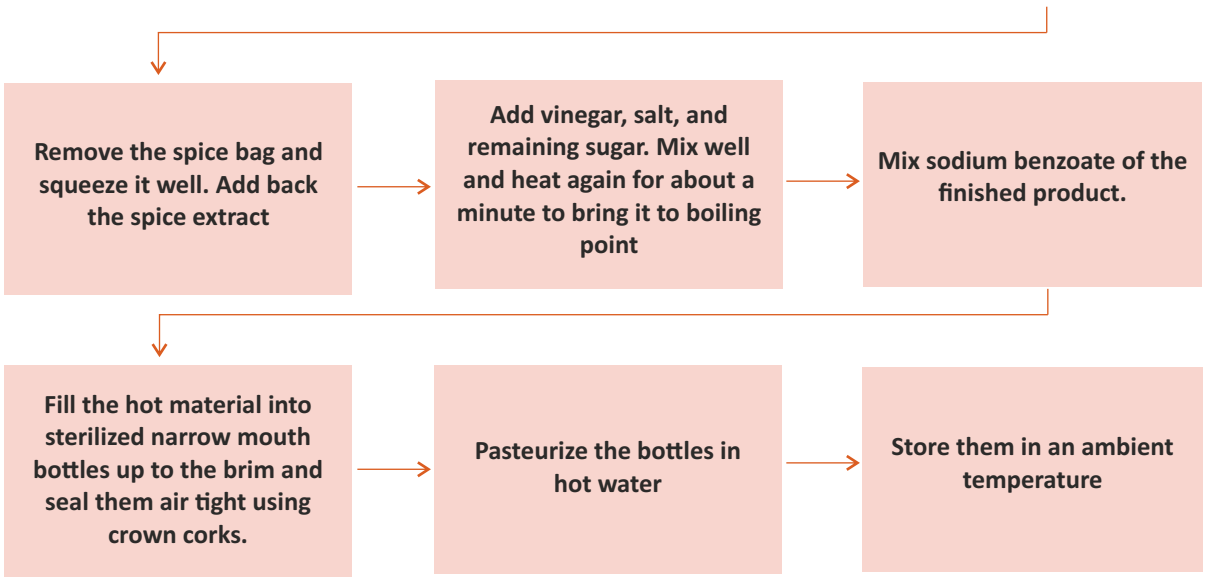


Fig. 6.2 Processing of ketchup

Fig 6.3 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 850C.
- 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.

6.1.4 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 (), which is equivalent to 1 kg m1 s1. 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

Fig 6.4 Bostwick Consistometer

(Source: https://www.cscscientific.com/consistometer/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 6.3 Methods to test the Viscosity of Ketchup

Scan the QR Code to watch the related video

https://www.youtube.com/watch?v=eIqc7aqx_IA

Tomato ketchup processing

Exercise

I. Answer the following questions:

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

_____
_____
_____

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

_____
_____
_____

3. What is a black neck?

_____
_____
_____

4. What is a viscometer?

_____
_____
_____

5. Explain the process flow of ketchup making.

_____
_____
_____

7. Fill and Pack Jam, Jelly, and Ketchup

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Unit 7.1 Operating packaging machine

Unit 7.2 Labelling and Coding

FIC/N0111

(Part of - FIC/Q0204)

Key Learning Objectives

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

1. Perform the tasks to fill, pack and store the jam, jelly, and ketchup
2. Describe the reporting procedure regarding any discrepancy in the packing of jam, jelly, and ketchup

Unit7.1 Operating Packaging Machine

Unit Objective

At the end of this unit, the trainees 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

7.1.1 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:

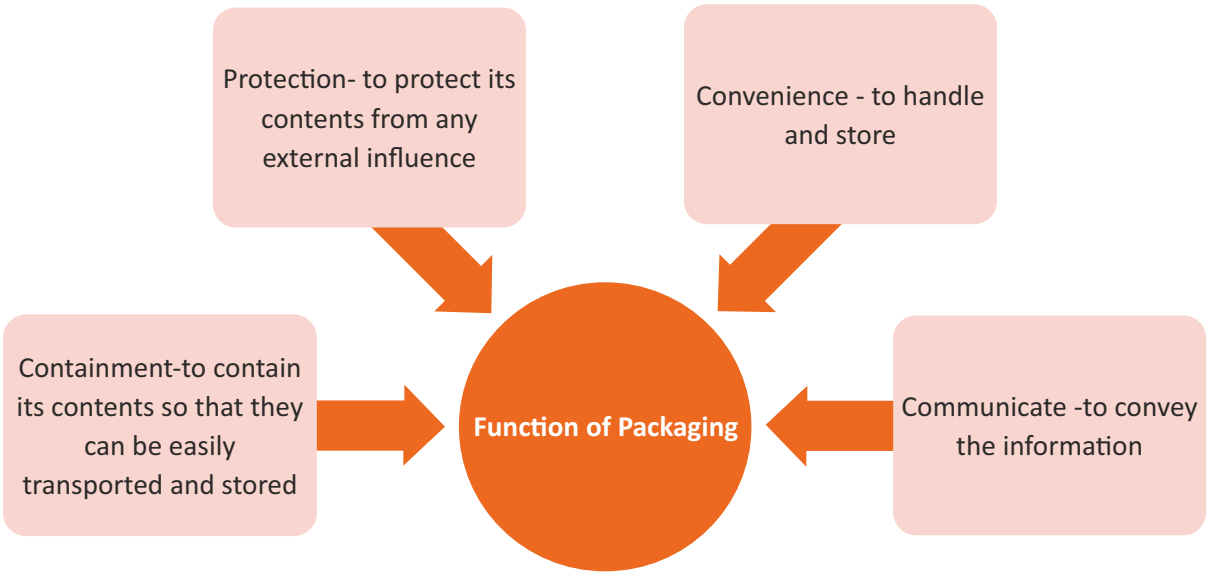

Fig. 7.1 Functions of packaging

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

- The suitability of the machine for the purpose
- The output speed required
- 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 7.1 Purpose of packaging

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

- **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.
- **Form Fill Seal or FSS** 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 filing 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.
- **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.
- **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.

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

7.1.2 Workflow process of Jam, Jelly, and Packaging Machine

- 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

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

Fig. 7.2 Cleaning and Sterilizing Machine

2. Bottle Unscrambler - for Container/bottle feeding
3. Linear piston filler - for filling dense and semi-dense products
4. Filling Area – where jars/bottles are placed

Fig. 7.3 Filling Machine

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

Fig. 7.4 Cooling Machine(left) & Capping Machine(Right)

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

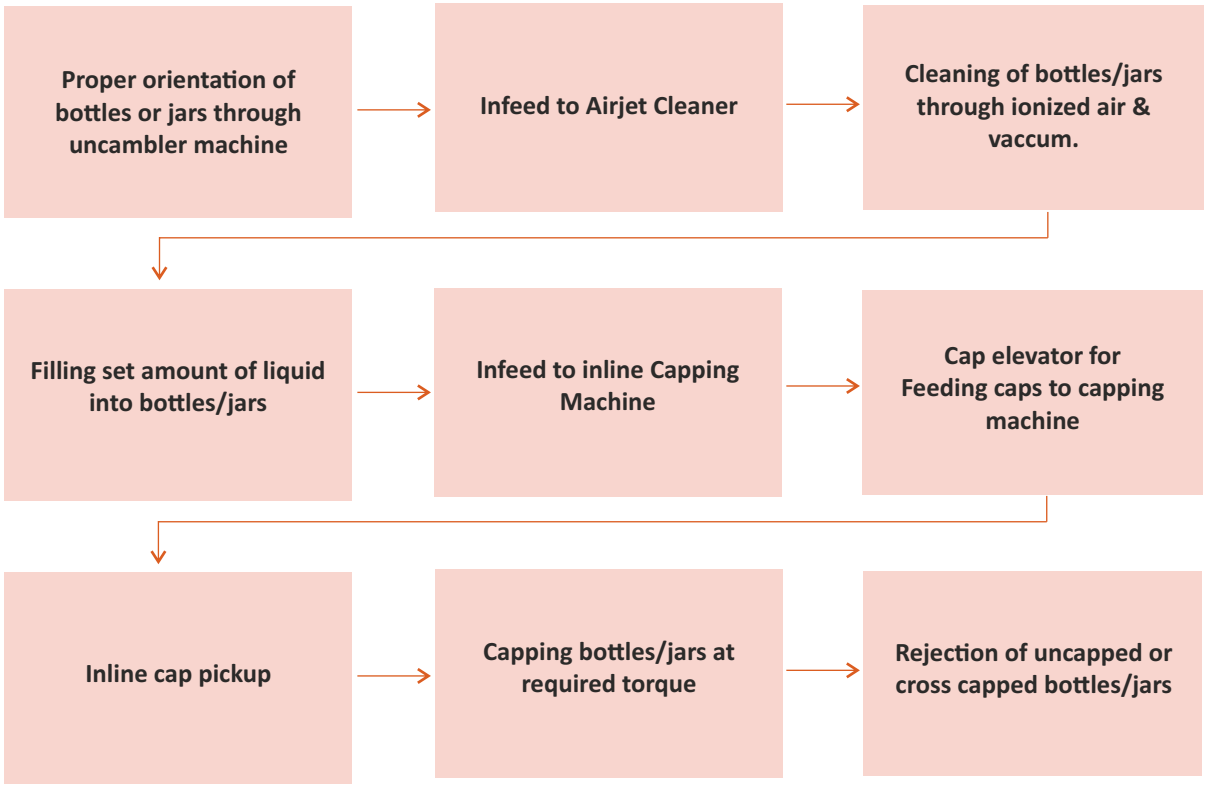

Fig. 7.5 Workflow process of Jam, Jelly and Ketchup packaging line

Notes

- 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.

Unit 7.2 Labelling and Coding

Unit Objective

At the end of this unit, the trainees 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.

7.2.1 Standard procedure to load labels in labeling machine

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

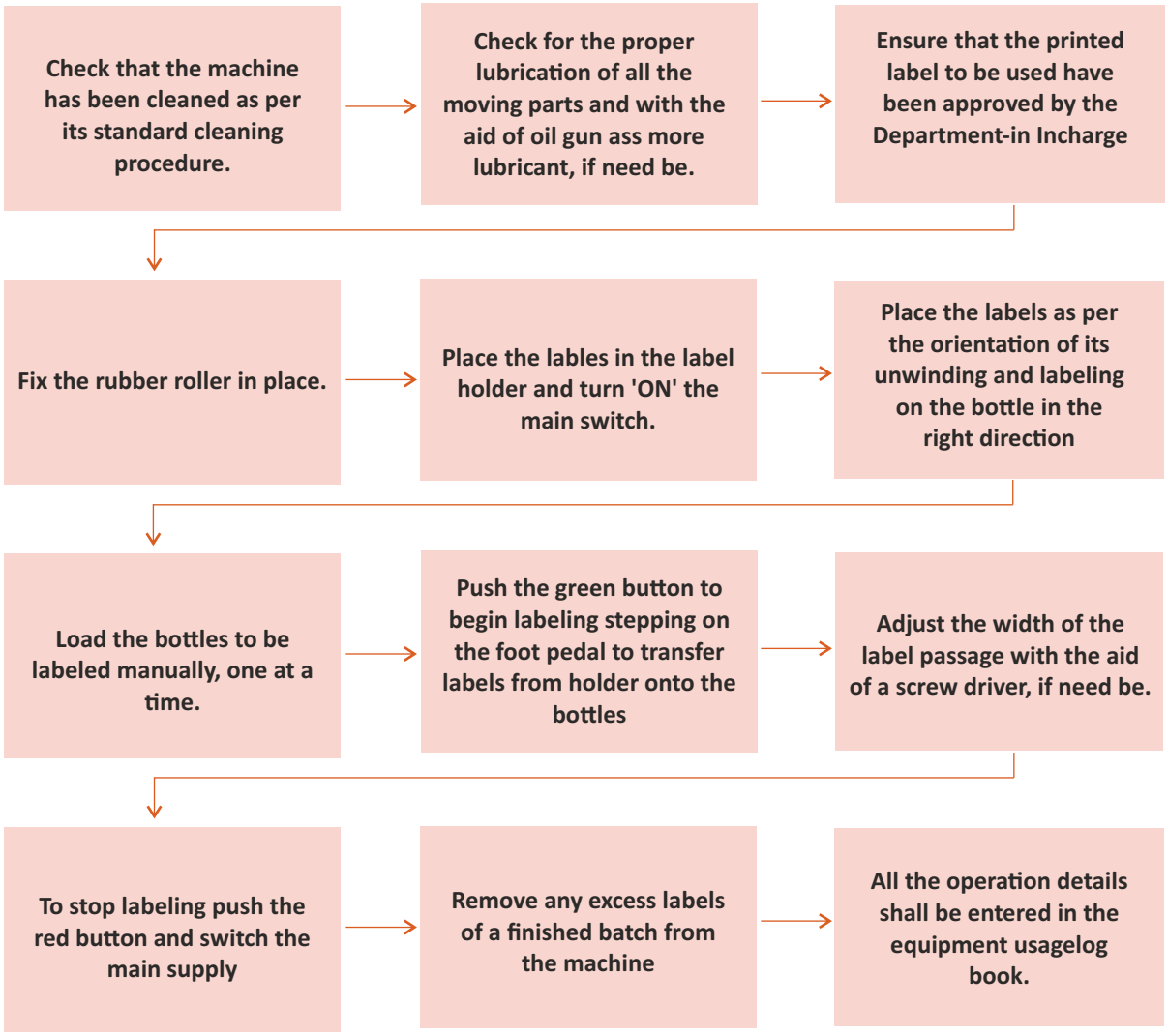

Fig.7.6 Standard Procedure to load labels in labelling machine.

Fig.7.7 Labelling Machine

(Source: https://foodscienceuniverse.com/tomato-ketchup-production-process/)

7.2.2 Standard procedure to proceed to set date coding 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 stereos 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 stereos 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.7.8 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.

   _____
   _____
   _____

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8. Post Production Cleaning and Regular Maintenance

Unit 8.1 Cleaning Activities and Maintenance Check

FIC/N0111
(Part of - FIC/Q0204)

Key Learning Objectives

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

1. Describe the post-production cleaning activities of tools and equipment required
2. Perform the tasks to maintain the tools and equipment regularly

Unit8.1 Cleaning Activities and Maintenance Check

Unit Objective

At the end of this unit, the trainees 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

8.1.1 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. 8.1 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:

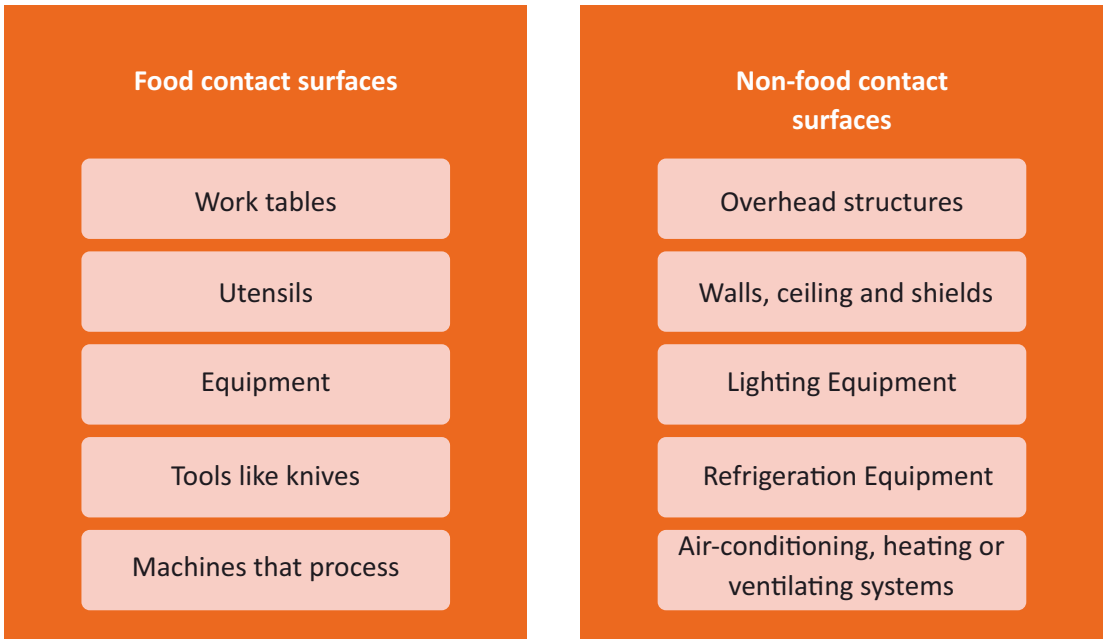

Fig. 8.2 Cleaning Work Area Categories

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.

8.1.2 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: • Caustic soda • Caustic potash • Coronate • Silicate, • Phosphate	**Acids:** • Phosphoric • Nitric • Citric • Glycolic	**Chelates:** • EDTA • NTA • Gluconate • Glucoheptonate, citrate • Polymeric	**Solvents:** • Isopropanol • Propylene • Butyl diglycol • Ethers	**Surfactants:** • Anionic • Cationic • Non-ionic • Amphoteric
Inhibitors: • Organic • Inorganic	**Enzymes:** • Protease • Lipase • Amylase	**Oxidising agents:** • Hypochlorite • Isocyanurates	**Stabilisers**	**Viscosity modifiers**

Fig. 8.3 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 • potassium hypochlorite, • sodium hypochlorite, and • calcium hypochlorite	Cleaning stainless steel food contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained
Liquid chlorine	Internal cleaning of stainless steel equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained
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 8.1 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.

All items must be stored off the floor. Allowing clearance from the floor gives plenty of room for cleaning beneath shelving and equipment.	**Undertake regular maintenance, for example filling holes and replacing damaged tiles.**	**Keep only what you need at the food processing premises.**
Implement and display a cleaning schedule so all staff know their cleaningand sanitizing responsibilities.	**Wipe down tools, equipment and surfaces as per specified standards**	**If hosing down equipment and surfaces, use a high-volume, low pressure hose. High pressure hoses can splash and spray dirt onto surfaces and create aerosols that may contain and spread pathogens.**

Fig. 8.4 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.

8.1.3 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.

- **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.

- **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.

- **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.

- **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.

- **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 dirts 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 vaccum cleaner or at least a damp cloth to clean the dust from surfacesaround the work area

Fig.8.5 Standard Practices for Cleaning the work area and equipment

8.1.4 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

- 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

- 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

- 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.

Post-Rinsing

- 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.

Disinfection

- 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.

Terminal Rinsing

- 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.

Fig.8.6 Sequence for Cleaning Machinery and Equipment

The following chart explains the process of cleaning machinery and equipment after the production cycle is over.

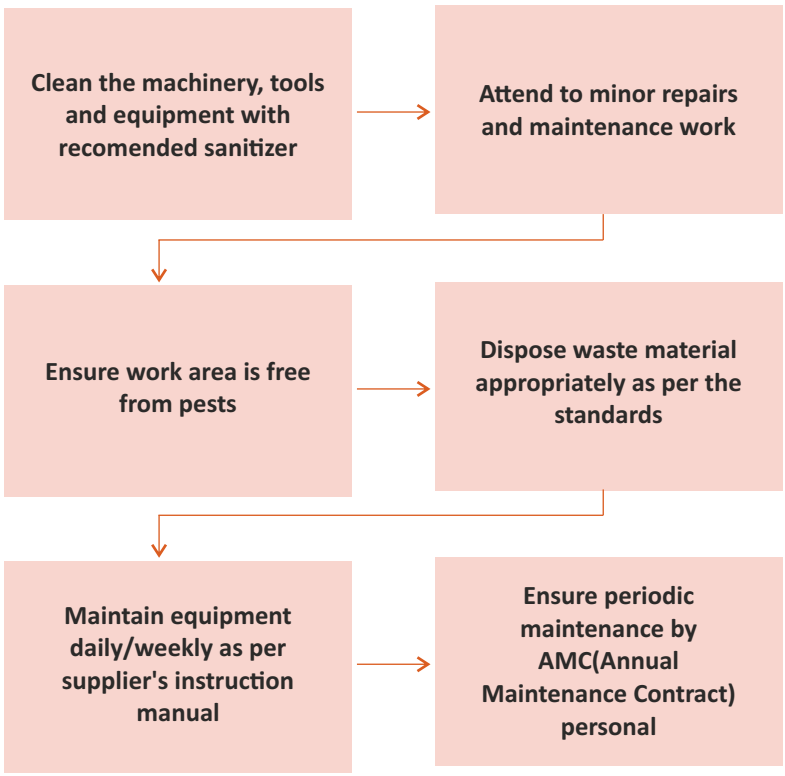

Fig.8.7 Sequence for Cleaning Machinery and Equipment

8.1.5 Types of Maintenance and Checks

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

- It keeps the production running smoothly
- It helps to prevent any contamination and ensure food safety
- It reduces product losses
- Maintain 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:

- 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.
- 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.
- 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.
- 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.

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

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

These schedules provide simple guidelines for all types of equipment, covering the duties to be undertaken in the following areas:

MAINTENANCE SCHEDULE GUIDELINES

Care and cleaning
Safety checks
Functional and performance checks
Maintenance tasks (changing bulbs, lubricating moving parts,

Fig.8.8 Maintenance Schedule Guidelines

Checklist for Planning Maintenance

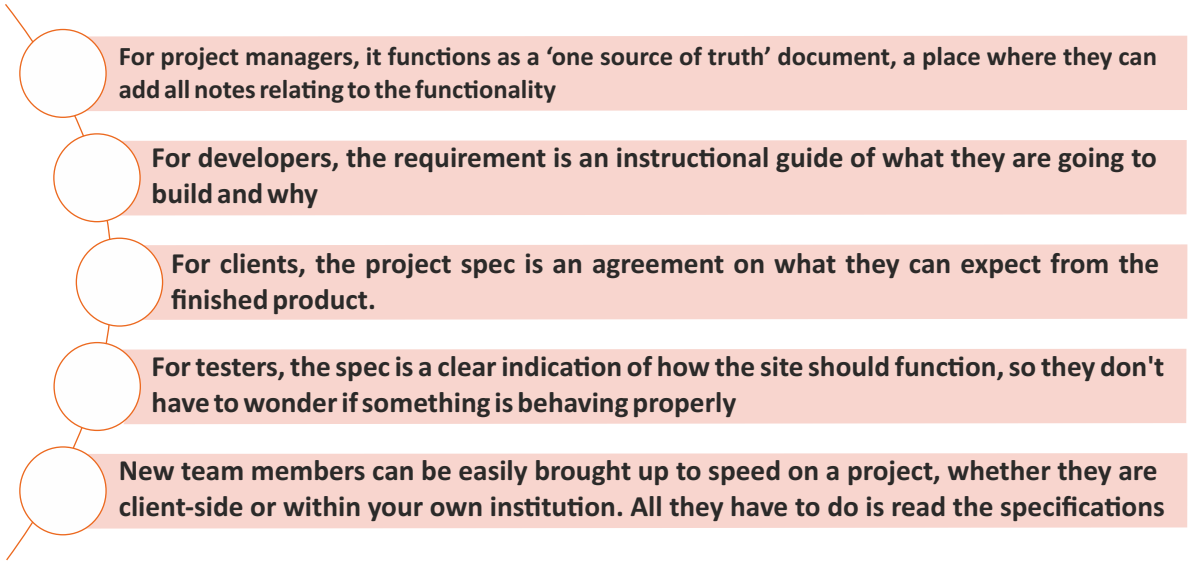

Fig.8.9 Maintenance Checklist

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.

Exercise

Answer the following questions:

1. List any two reasons for cleaning and sanitizing the work area.

_____
_____
_____

2. What are the standard cleaning practices?

_____
_____
_____

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

_____
_____
_____

4. Describe the importance of equipment maintenance and check.

_____
_____
_____

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10. Annexures

Annexure I : QR Codes

ANNEXURE - QR Codes

Chapter No.	Unit No.	Topic Name	Page No.	QR code(s)	URL
Chapter - 1 Introduction to Food Processing Sector and the Job of 'Pickle and Paste Making Technician	Unit 1.1 Introduction to Food Processing Industry	1.1.3 India's Food Processing Industry	5		https://youtu.be/wMu0EpUgCd4
	Unit 1.1 Introduction to Food Processing Industry	1.1.4 Overview of the Fruit and Vegetable Sector	6		https://youtu.be/iacTHJtrXIE
	Unit 1.2 Roles and Responsibilities of Pickle and Paste Making Technician	1.2.1 Roles and Responsibilities of 'Pickle and Paste Making Technician	11		https://youtu.be/GlvfUzTXAdg
	Unit 1.2 Roles and Responsibilities of Pickle and Paste Making Technician	1.2.5 Standard Practices for Handling Hazards and Cleaning Work Area	14		https://youtu.be/j9HIFj-g2x4
Chapter 3 Carry out Production of Various Types of Pickles and Pastes	Unit 3.2 Mechanism of Peeling And Slicing Fruits and Vegetables	3.2.1 Peel and Slice Fruits and Vegetables	53		https://youtu.be/C-6kF52qtOA
	Unit 3.3 Identify Spoilage in Fruits and Vegetables	3.3.4 Criteria to Check Fruits/Vegetable Spoilage	57		https://youtu.be/FS5MMx4uI6Q

Serial No.	Module No.	Unit Number	Topic Name	Page No.	URL	QR Code
3.	Unit 3.4 Prepare Pickle, Paste, And Murabba Using Essential Machines Unit 3.5 Packaging And Post-Production Activities		3.4.1 Process of Pickle Making 3.5.1 Steps for Packa-ging of the Processed Food	59 68	https://youtu.be/AIWN5rTf9RI https://youtu.be/Wrk4zAANpo	
5.	Module-5 Prepare Jam and Jelly	Unit 5.1 Production process of preparing Jam and Jelly	Apple jam Processing	145	https://www.youtube.com/watch?v=ZozA1gHNoDA	
6.			Orange jelly processing	149	https://www.youtube.com/watch?v=zThmD6nrrRA	
7.	Module-6 Prepare the Ketchup	Unit 6.1 Process of Preparing Ketchup	Tomato ketchup processing	151	https://www.youtube.com/watch?v=eIqc7aqx_IA	
8.	Employability Skills - 30 Hours			165	https://eskillindia.org/NewEmployability	

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