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Ministry of Labor and Skills

Fruit and Vegetable Processing

Level-II

Based on June 2021, Version 3 Occupational Standard



Module Title: - Pre-processing Fruit and Vegetable Raw Materials

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Ministry of Labor and Skills

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Introduction to the Module

This module covers the knowledge, skills and attitude required to prepare preprocessing equipment for operation, operate pre-processing, shut down the preprocessing equipment, use cold store material, use cold store material and use workplace information.

LG #18	LO #1 Prepare Preprocessing Equipment for Operation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Confirming type and quality of materials for pre-processing
- Loading and transferring materials into pre-processing
- Confirming available services for operation
- Checking equipment to confirm readiness for use

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Confirm type and quality of materials for pre-processing
- Load and transfer materials into pre-processing
- Confirm available services for operation.
- Check equipment to readiness for use.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the "LAP test"

Information sheet 1

1.1. Confirming type and quality of materials for pre-processing

1.1.1. Harvesting and preprocessing

Harvesting and pre-harvesting are crucial steps in ensuring the quality and safety of fruits and vegetables. Proper harvesting techniques can minimize post-harvest losses and extend the shelf life of produce. Fruit quality goes back to tree stock, growing practices and weather conditions. Closer to the shipper and processor, however, are the degrees of maturity and ripeness when picked and the method of picking or harvesting.

There is a distinction between maturity and ripeness of a fruit. Maturity is the condition when the fruit is ready to eat or if picked will become ready to eat after further ripening. Ripeness is that optimum condition when color, flavor and texture have developed to their peak .Some fruit is picked when it are mature but not yet ripe. This is especially true of very soft fruit like cherries and peaches, which when fully ripe are so soft as to be damaged by the act of picking itself. Further, since many types of fruit continue to ripen off the tree, unless they were to be processed quickly, some would become overripe before they could be utilized if picked at peak ripeness.

From a technological point of view, fruit characterization by species and varieties is performed on the basis of physical as well chemical properties: shape, size, texture, flavor, color/pigmentation, dry matter content (soluble solids content), pectin substances, acidity, vitamins, etc. These properties are directly correlated with fruit utilization. Fruit quality goes back to tree stock, growing practices and weather conditions. Closer to the shipper and processor, however, are the degrees of maturity and ripeness when picked and the method of picking or harvesting. There is a distinction between maturity and ripeness of a fruit. Maturity is the condition when the fruit is ready to eat or if picked will become ready to eat after further ripening. Ripeness is that optimum .Condition when color, flavor and texture have developed to their peak.

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be processed quickly, some would become overripe before they could be utilized if picked at peak ripeness.



Figure 1.1. Harvesting of fruits

To achieve a high quality processed product, it is important that the raw materials used in the product are also of high quality. Correct post-harvest handling and storage of fruits is therefore essential to ensure raw materials are top quality and to reduce losses through wastage. All fruits are different requirements in terms of storage temperature and humidity. Fresh fruits and vegetables are highly susceptible to mechanical injury owing to their tender texture and high moisture content. Poor handling, unsuitable packaging, and other improper packaging during transportation are the cause of bruising, cutting and other forms of injury in fresh fruits and vegetables.



Figure 1.2: Post harvest and pre-processing of fruits and vegetables
(https://www.youtube.com/watch?v=fi4kn3cP9zA, Accessed date: November 30, 2023)

It is worth emphasizing the fact that the proximity of the processing centre to the source of supply for fresh raw materials presents major advantages; some are as follows:

- ✓ Possibility to pick at the best suitable moment;
- ✓ Reduction of losses by handling/transportation;
- ✓ Minimizes raw material transport costs;
- ✓ Possibility to use simpler/cheaper receptacles for raw material transport.

Once it has left the tree, the organoleptic properties, nutritional value, safety and aesthetic appeal of the fruit deteriorates in varying degrees. The major causes of deterioration include the following:

- Growth and activity of micro-organisms;
- Activities of the natural food enzymes
- Insects, parasites and rodents
- Temperature, both heat and cold.
- Moisture and dryness
- Air and in particular oxygen, time and light

1.1.2. Reception quality and quantity

Fruit reception at the processing center is performed mainly for following purposes:

- Checking of sanitary and freshness status;
- Control of varieties and fruit wholeness;
- Evaluation maturity degree;
- Collection of data about quantities received in connection to the source of supply outside growers/farmers, own farm.

Variety control is needed in order to identify that the fruit belongs to an accepted variety as not all are suitable for different technological processes. The only reliable method for evaluating the quality is the combination of data obtained through organoleptic/taste controls and by simple analytical checks which are possible to perform in a small laboratory: percentage of soluble solids by refract meter, consistency/texture measured with simple penetrometers, etc.



Fugure 1.3: Safe Handling of raw produce and fresh-squeezed fruit and vegetable juices. https://www.youtube.com/watch?v=WbhudxB3W-M, Accessed date, December 30, 2023)

1.1.3. Temporary storage before processing

This step has to be as short as possible in order to avoid flavor losses, texture modification, weight losses and other deterioration that can take place over this period.

Some basic rules for this step are as follows:

- Keep products in the shade, without any possible direct contact with sunlight;
- Avoid dust as much as possible;
- Avoid excessive heat;
- Avoid any possible contamination;
- Store in a place protected from possible attack by rodents, insects, etc.

Cold storage is always highly preferred to ambient temperature. For this reason a very good manufacturing practice is to use a cool room for each processing center. This is very useful for small and medium processing units as well. Checks at each delivery/raw material a lot

- ✓ Color
- ✓ Texture
- ✓ Taste
- ✓ Flavor
- ✓ Appearance
- ✓ Refractometric extract
- ✓ number per kg
- ✓ Variety
- ✓ Sanitary evaluation
- ✓ Density
- ✓ Water content: oven method
- ✓ Total sugars, reducing sugars
- ✓ Total acidity



Figure 1.4. How to keep your fruits and vegetables fresh (https://www.youtube.com/watch?v=n2y8X8bh1qI;

https://www.youtube.com/watch?v=W2xK3zECFcQ, (Accessed date, December 30, 2023)

Before operating any preprocessing equipment, it is crucial to perform thorough pre-operational checks to ensure the equipment is in safe and proper working condition. These checks should include:

- Inspecting equipment for visible damage, loose parts, or malfunctioning components.
- Verifying that all safety guards and interlock devices are properly installed and functioning.
- Ensuring that electrical cords are undamaged and connected to properly grounded outlets.
- Checking lubrication levels and replenishing or replacing lubricants as needed.
- Cleaning and sanitizing equipment surfaces to prevent cross-contamination and maintain hygiene.

Follow proper safety procedures when operating preprocessing equipment

When operating preprocessing equipment, adhering to strict safety procedures is paramount to prevent accidents and injuries. Essential safety measures include:

- Wearing appropriate personal protective equipment (PPE), including gloves, safety glasses, and earplugs.
- Operating equipment only when authorized and trained to do so.
- Never bypassing safety guards or interlock devices.
- Keeping work areas clean and free of clutter to prevent accidents.
- Reporting any observed hazards or equipment malfunctions immediately.

1.1.4. The major causes of deterioration include the following:

Fruits and vegetables are living organisms that continue to undergo physiological and biochemical processes even after harvest. These processes can lead to deterioration, resulting in reduced quality, nutritional value, and shelf life. The major causes of deterioration for fruits and vegetables include:

i. **Respiration:** Fruits and vegetables continue to respire after harvest, consuming oxygen and producing carbon dioxide and water vapor. This process breaks down sugars and other organic compounds, leading to loss of nutrients, texture changes, and off-flavors.

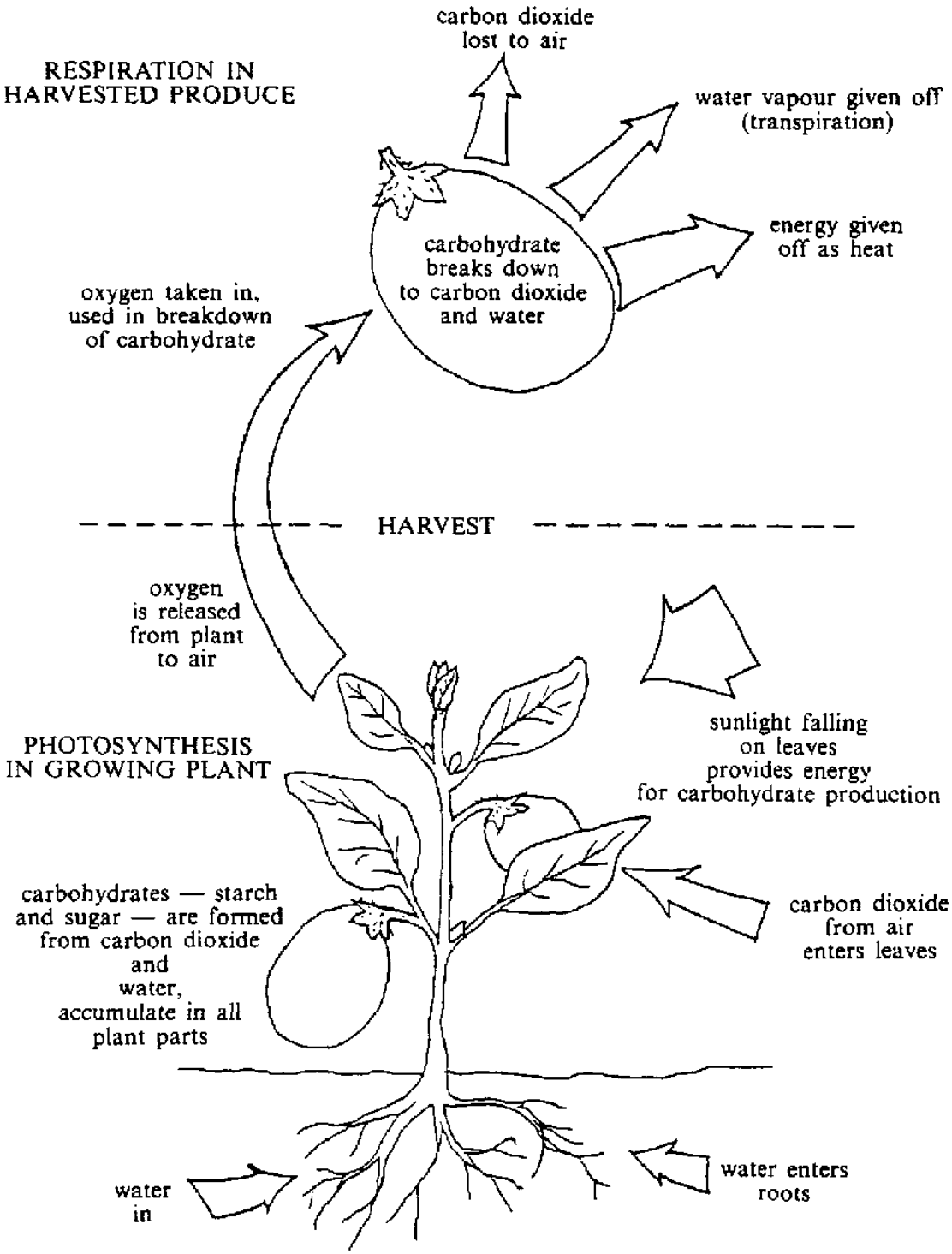


Figure 1.5. Respiration in fruits and vegetables (Source: https://www.fao.org/3/T0073E/T0073E02.htm, Accessed date: December 1, 2023)

ii. **Ethylene Production:** Ethylene is a plant hormone that plays a role in ripening and senescence. Fruits and vegetables produce ethylene naturally, and the rate of production

can increase in response to stress or damage. Elevated ethylene levels can accelerate ripening, leading to softening, discoloration, and spoilage.

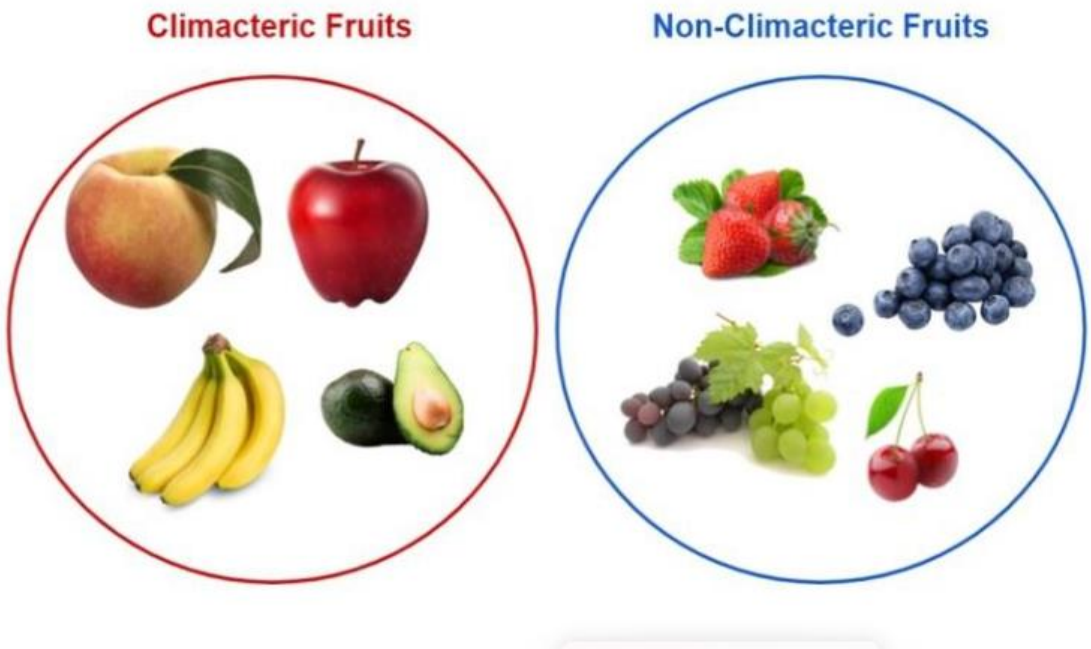


Figure 1.6: Examples of climacteric fruits and non-climacteric fruits (Soutrce: Annabelle Capino , and Macarena Farcuh, 2022)

iii. **Microbial Growth:** Fruits and vegetables provide a moist, nutrient-rich environment that can support the growth of microorganisms, such as bacteria, fungi, and yeast. These microorganisms can cause spoilage, discoloration, and off-flavors. The risk of microbial growth is increased by factors such as high temperature, humidity, and physical damage.



Figure 1.7. Microbial growth on fruits and vegetables

iv. **Enzymatic Browning:** Enzymatic browning occurs when enzymes come into contact with phenolic compounds in fruits and vegetables. This reaction leads to the formation of brown pigments, which can affect the appearance and quality of the product. Enzymatic browning is often triggered by bruising or cutting.



Figure 1.8. Enzymatic browning on apples

v. **Water Loss:** Fruits and vegetables are about 80-90% water, and water loss can significantly affect their quality. Transpiration, the natural loss of water through stomata, is a major cause of water loss in fruits and vegetables. Wilting, shriveling, and loss of firmness are common consequences of water loss.

vi. **Mechanical Damage:** Physical damage, such as bruising, cutting, and puncturing, can provide entry points for microorganisms and accelerate deterioration. Mechanical damage can also lead to enzymatic browning and water loss.

vii. **Temperature and Humidity:** Temperature and humidity play a crucial role in the deterioration of fruits and vegetables. High temperatures can accelerate respiration, ethylene production, and microbial growth, while low temperatures can cause chilling injury, leading to discoloration, textural changes, and loss of flavor. High humidity can promote microbial growth and condensation, while low humidity can increase water loss.

Table 1.1. Susceptibility of fruits and vegetables to chilling injury at low but non-freezing temperatures (Source: https://www.fao.org/3/T0073E/T0073E02.htm)

Commodity	**Approximate lowest safe temperature °C**	**Chilling injury symptoms**
Avocados	5-13	Grey discoloration of flesh
Bananas (green/ripe)	12-14	Dull, gray-brown skin color
Beans (green)	7	Pitting, russeting
Cucumbers	7	Pitting water-soaked spots, decay
Grapefruit	10	Brown scald, piking, watery breakdown
Lemons	13-15	Pitting, membrane stain, red blotch
Limes	7-10	Pitting
Mangoes	10-13	Grey skin scald, uneven ripening
Melons: Honeydew	7-10	Pitting failure to ripen, decay
Watermelon	5	Pitting, biker flavour
Okra	7	Discoloration, water-soaked areas, piking

Oranges	7	Pitting brown stain, watery breakdown
Papaya	7	Pitting failure to ripen, off-flavour, decay
Pineapples	7-10	Dull green colour, poor flavour
Potatoes	4	Internal discoloration, sweetening
Pumpkins	10	Decay
Sweet peppers	7	Pitting *Alternaria* rot
Sweet potato	13	Internal discoloration, piking, decay
Tomatoes: Mature green	13	Water-soaked softening, decay
Ripe	7-10	Poor colour, abnormal ripening, *Alternaria* rot

viii. **Storage Conditions:** Improper storage conditions, such as poor ventilation, exposure to light, and overcrowding, can exacerbate the deterioration of fruits and vegetables. Proper storage practices, such as maintaining optimal temperature and humidity levels, providing adequate ventilation, and storing fruits and vegetables separately to prevent cross-contamination, can extend their shelf life and maintain their quality.

Furthermore, the causes of deterioration can be:

- Growth and activity of micro-organisms;
- Activities of the natural food enzymes;
- Insects, parasites and rodents;
- Temperature, both heat and cold;
- Moisture and dryness;
- Air and in particular oxygen;
- Light and
- Time.

1.5. Factors reducing this quality:

- Mechanical damage-Browning reaction
- Diseases
- Loss of freshness-Wilting of leafy vegetables
- Yellowing of green leafy vegetables
- The main objectives of fruit and vegetables processing is to supply**:**

1.2. Loading and transferring materials into pre-processing

1.2.1. Preparation of the load

Prepared raw materials should have enough postharvest life for the trip and subsequent marketing after it reaches its destination, otherwise it should not be included in the load. Produce/ stored before shipping will have a shorter shelf life for transportation and at destination. Most transport refrigeration systems do not have the refrigeration or airflow capacity to rapidly cool produce which should be cooled to its optimum storage temperature before stowing. Precooling is a process in which heat is rapidly removed from the produce immediately after harvest. The four most common precooling methods are forced-air cooling, hydro cooling, vacuum cooling and liquid icing



Figure 1.9. Fruit loading machine

1.2.2. Unloading

Unloading vegetables and fruits from vehicles is a very delicate operation and can be done by hand with a box tipper or with the aid of a forklift. Generally, vegetables and fruits are stacked on pallets to ease the unloading process and to prevent damage to the product. Exported crops arrive at the unloading port in bulk containers are unloaded directly into the storage container with the aid of conveyor belts connected from the vehicle to the container.



Figure 1.10. Indutrial fruit washing machine



Figure 1.11. Industrial vegetable washing machine

Pallets: Platform with enough clearance beneath its top surface (or face) to enable the insertion of forks for subsequent lifting purposes Materials: Wood (most common), paper, plastic, rubber, and metal

Size of pallet is specified by its depth (i.e., length of its stringers or stringer boards) and its width (i.e., length its duckboards)—pallet height (typically 5in.) is usually not specified

Orientation of stringers relative to duckboards of pallet is specified by always listing its depth first and width last.

Skids: Platform (typically metal) with enough clearance beneath its top surface to enable a platform truck to move underneath for subsequent lifting purposes

Forks can also be used to handle skids since the clearance of a skid is greater than that of a pallet



Figure 1.12: fruit sorting and di stoning processing

Compared to a pallet, a skid is usually used for heavier loads and when stacking is not required

A metal skid can lift heavier loads than an equal-weight metal pallet because it enables a platform truck to be used for the lifting, with the platform providing a greater lifting surface to support the skid as compared to the forks used to support the pallet

Slip sheets: Thick piece of paper, corrugated fiber, or plastic upon which a load is placed.

Handling method: tabs on the sheet are grabbed by a special push/pull lift truck attachment.

Advantages: usually used in place of a pallet for long-distance shipping because their cost is 10–30% of pallet costs and their weight and volume is 1–5% of a pallet

Disadvantages: slower handling as compared to pallets; greater load damage within the facility; special lift truck attachment reduces the vehicle's load capacity

Bags: Disposable container used to unitize and protect bulk materials

Typically used for distribution

Polymerized plastic ("poly") bags available from light weight (1 mil.) to

Heavy weight (6 mil.) in flat and gusseted styles Dimensions of bag specified as: Width Length, for flat bags, and Width Depth (half gusset)×Length, for gusseted bags10.

Bulk load containers: Reusable container used to unitize and protect bulk materials

Includes barrels, cylinders, etc. Used for both distribution and in-process handling

Crates: Disposable container used to protect discreet items typically used for distribution



Figure 1.13. Slip sheets

Tote pans: Reusable container used to unitize and protect loose discrete items

Typically used for in-process handling. Returnable totes provide alternative to cartons for distribution Can be nested for compact storage when not in use.

Pallet/skid boxes: Reusable containers used to unitize and protect loose items for fork/platform truck handling Pallet box sometimes referred to as a "bin pallet".

Cartons: Disposable container used to unitize and protect loose discrete items



Figure 1.14: Harvesting packing and transporting vegetables

(https://www.youtube.com/watch?v=urpuV3NBxRg, Accessed date: December 30, 2023)

1.3 Confirming available services for operation

1.3.1. Quality and distribution of water

Water of various qualities may be used at different points in most food processing operations and it is common for water to be reused. Water with obvious turbidity is often satisfactory for soaking root vegetables or for fluming fruit which is to be chemically peeled, but only water which is suitable for human consumption should be used for the final washing of the product or as an ingredient, e.g. in brines or syrups. Only properly chlorinated clean water should be used for cooling canned products after the heat sterilization process.

Steam quality: Steam also comes into contact with fruits and vegetables in some processing operations. These include some lye-peeling systems, steam-heated exhaust boxes, steam-flow closers, steam blanchers, and water blanchers which are heated by direct injection of steam. Quality control staff should determine that either the steam that comes into contact with the product is not contaminated by boiler additives or that the additives are not harmful, or both. Quality control staff should also ensure that condensate and the products of corrosion that may accumulate in the pipework of the steam distribution system during shut-downs are removed by purging the system before food processing operations start. It is also important to determine that steam traps and strainers are maintained in good condition to help ensure that clean steam is delivered to processing points.

1.3.2. Energy Use in fruit and vegetable processing

Electricity is used throughout the typical fruit and vegetable processing facility to power motors, conveyors, compressed air systems, and pumps, as well as building lighting and heating, ventilation, and air conditioning.

1.3.3. Purpose of compressed air in fruit and vegetable processing

The production facilities of the different segments within the food industry all have different applications for compressed air. These manufacturing plants are primarily engaged in the canning, freezing, and dehydrating of fruits and vegetables. This segment represents

approximately 7.5% of the dollar value of shipments of the entire food industry In many fruit and vegetable processing plants, compressed air systems are used for air cleaning of containers prior to product filling, automated product sorting, and product packaging systems

There are tens of thousands of factories operating in other segments of the food industry- all using compressed air. Many segments, like bakeries, use compressed air in blow-off applications. Other segments use compressed air to clean containers before filling the containers with food. Compressed air is also used to sort, cut, and shape food product The major end use of fuels in the typical fruit and vegetable processing facility is in boiler systems for the generation of steam, which can be used in a wide variety of process heating, water heating, and cleaning applications.

1.3.4. Purpose Vacuum and instrument air

Increasing consumer awareness on consumption of safe, nutritious and quality food has led to the evolution of minimally processing in food preservation. Vacuum technology plays a vital role in fruits and vegetable processing right from precooling of fresh commodity till their final products. Even though generating vacuum is quite costly, studies have shown that unit operation in combination with a vacuum has brought the product with excellent quality attributes (Color, taste, flavor, nutritive value, etc.) by minimizing the heat-induced deterioration reactions. Among the perishable commodity, this technique has not only retains their quality but also enhanced their shelf life by inhibiting the post-harvest enzymatic and microbial reactions. They serve to be the greatest advantage in case of packaging of meat products and in frying for reducing the oil consumption. Vacuum technology has been emerging in combination with a various unit operation for improving the quality of process and product.

1.4. Checking equipment to confirm readiness for use

1.4.1. Checking Operational Characteristics

The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely with any deterioration detected and remedied before it results in a health and safety risk. The need for inspection and inspection frequencies should be determined through risk assessment. The purpose of inspection is to check whether the product is manufactured according to the standards. And specification by checking the products randomly. Quality

check are measures aimed at checking, measuring, or testing of one or more product characteristics and to relate the results to the requirements to confirm compliance. Food processing equipment is typically designed and built with a particular function or unit operation in mind. However, the method in which these functions and operations are executed can vary depending on the design of the equipment, and additional components can be integrated to facilitate smoother operation. Some characteristics of food processing equipment to consider include:

- Batch vs. continuous processing
- Manual vs. automatic operation
- Integration of analytical or quality control units
- Integration of ergonomic or safety components

Sizing Checking

There are several factors which help determine the optimal size for food processing equipment, but ultimately, the goal is to balance the material and resources used for each unit operation and the required production output.

Function Checking

The particular function for which a piece of equipment is intended largely determines the general type of equipment employed. For example:

- Material handling equipment includes conveyors and tube systems
- Preparation equipment includes sterilizers or wash systems
- Heat processing equipment includes ovens and fryers
- Preservation equipment includes freezers and dehydrators
- Product distribution equipment includes wrapping and palletizing systems

There are a number of instruments used in food laboratories that can be applied to assure food quality which applies to solids as well as beverages. Some of the most common examples of these instruments and their use are described below.

Pesticide detection instruments – detects the presence of pesticides in food samples.

Electron Spin Resonance Spectrometers – also known as electron paramagnetic resonance (EPR), these instruments can be used to test the purity of products without physically destroying or altering samples.

Incubators – are used to provide a controlled environment (i.e. temperature, humidity, CO_2 level) for food safety testing.

Magnetic analyzers – detect low levels of iron in food samples by measuring the imbalance in resonance between two air core coils which can be translated into a signal that reflects the level of iron present in the sample.

Moisture analyzers – also known as moisture balances, these devices are used to establish the percentage of moisture in a food sample, either by weighing the sample before and after an evaporation process or by using an absorption spectrometer to analyze the gas emitted during evaporation to establish its content.

Refractometers – are devices that measure the angle of refraction from light that is passed through a liquid, gel, or solid substance and using that to establish parameters such as the salinity and sugar content.

Measurement and Control: Measurement and control equipment is used to ensure that the food processing equipment operates correctly, and the food processing stages proceed as specified.

Other equipment – additional equipment often employed in food quality applications includes ovens, centrifuges, water baths, and dry bath

1.5. Setting the process to meet production requirements

In the fruit and vegetable processing industry, establishing an efficient and effective preprocessing operation is crucial for meeting production requirements and ensuring product quality. To achieve this goal, several key factors need to be considered:

i. Raw material quality and quantity:

- Assess the quality and quantity of incoming raw materials to ensure they meet production specifications.
- Implement proper receiving and inspection procedures to identify and address any quality issues promptly.
- Maintain consistent communication with suppliers to anticipate variations in raw material supply and adjust production plans accordingly.

ii. Preprocessing equipment selection and maintenance

- Select appropriate preprocessing equipment based on the type, volume, and desired characteristics of the fruits and vegetables being processed.
- Implement a comprehensive preventive maintenance program to ensure equipment is in optimal working condition and minimize downtime.
- Regularly calibrate and test equipment to maintain accuracy and precision in preprocessing operations.

iii. Process parameters and optimization

- Establish and monitor critical process parameters, such as washing times, sorting criteria, and peeling methods, to achieve desired product quality.
- Continuously evaluate and optimize process parameters to enhance efficiency, reduce waste, and improve product consistency.
- Implement statistical process control (SPC) techniques to monitor and control variations in preprocessing operations.

iv. Production planning and scheduling

- Develop accurate production schedules that align with raw material availability, processing capacity, and customer demand.
- Consider factors such as product type, processing time, and equipment availability when scheduling production runs.

- Implement effective communication and coordination between departments to ensure smooth production flow and timely order fulfillment.

v. Quality control and monitoring

- Establish a robust quality control system to monitor product quality throughout the preprocessing process.
- Implement sampling and testing procedures to identify and address any quality deviations promptly.
- Maintain detailed records of quality control measures to ensure product traceability and compliance with regulatory standards.

vi. Employee training and safety

- Provide comprehensive training to employees on preprocessing procedures, equipment operation, and safety protocols.
- Emphasize the importance of following safety guidelines and using appropriate personal protective equipment (PPE) to prevent accidents and injuries.
- Conduct regular safety audits and training sessions to reinforce safety awareness and maintain a safe working environment.

By effectively managing these factors, fruit and vegetable processing operations can achieve consistent production output, maintain high product quality, and meet customer demands while adhering to safety and sustainability standards.

Here is a table summarizing the key factors to consider when setting the process to meet production requirements for fruit and vegetable processing:

Self-check 1	Written test

Name: _____ ID: _____ Date: _____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer

1. Factors reducing this quality
   A. Mechanical damage-Browning reaction
   B. Diseases
   C. Loss of freshness-Wilting of leafy vegetables
   D. Yellowing of green leafy vegetables.
   E. All
2. The major causes of deterioration?
   A. Moisture and dryness.
   B. Insect/ Growth and activity of micro-organisms.
   C. Activities, parasites and rodents.
   D. Temperature, heat and cold.
   E. All.
   F. None
3. Which of the following is NOT a cause of fruit deterioration?
   A. Respiration
   B. Ethylene production
   C. Microbial growth
   D. Sunlight exposure
4. Which of the following is the most common method of precooling fruits and vegetables?
   A. Forced-air cooling
   B. Hydrocooling
   C. Vacuum cooling
   D. Liquid icing
5. Which of the following is the primary purpose of using compressed air in fruit and vegetable processing?
   A. Air cleaning of containers
   B. Automated product sorting
   C. Product packaging systems

D. All of the above

6. Which of the following is NOT a common instrument used in food laboratories for quality assurance?
    A. Pesticide detection instruments
    B. Electron Spin Resonance Spectrometers
    C. Incubators
    D. Magnetic analyzers
    E. Refractometers
7. Which of the following is NOT a key factor to consider when setting the process to meet production requirements for fruit and vegetable processing?
    A. Raw material quality and quantity
    B. Preprocessing equipment selection and maintenance
    C. Process parameters and optimization
    D. Employee training and safety
    E. Product branding and marketing

Test II short answer

1. What is the difference between maturity and ripeness of a fruit?
2. What are the major causes of deterioration for fruits and vegetables?
3. What are the main objectives of fruit and vegetable processing?
4. What are the factors to consider when selecting preprocessing equipment for fruits and vegetables?
5. What are the key elements of a robust quality control system for fruit and vegetable processing?
6. Write the guidelines for selecting fruits? (5points)
7. Write the main objectives of fruit and vegetable preprocessing. (5points).
8. List out fruit and vegetable loading materials
9. Write all necessary materials used for loading fruit and vegetable?
10. What is the purpose of compressed air used in fruit and vegetable processing?
11. What purpose is water used in fruit and vegetable processing?
12. What purpose we use Refractometers?
13. Which equipment is used for heat processing?
14. Define the uses of Moisture analyzers?

LG #19 LO #2 Operate Pre-Processing

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Starting up process
- Monitoring control points (monitoring functions*)* with in specification.
- Monitoring pre-processing materials meet specification equipment
- Identifying and reporting product, process and equipment performance

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Startup process
- Monitor control points (monitoring functions*)*
- Monitor pre-processing materials to meet specification equipment
- Identify and report product, process and equipment performance

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the "LAP test"

Information sheet 2

2.1. Starting up process

2.1.1. Sorting

The purpose of sorting is to separate the ripe fruits from the under ripe fruits. At the same time, parts of damaged fruit shall be removed. Some fruits are cut in two to check the inside. Once the raw material is clean, it must then undergo the selecting phase. At this stage, the material that will really be used in the process will be separated from material presenting some sort of defect, which will become second-choice and will be used for a different purpose, or will simply be eliminated.

In case of a semi-mechanized small-scale plant, the selection is carried out on a table suitable for this process or on a conveyor belt. Such a process will entail the removal of all of the fruit and vegetables that do not uniform characteristics compared to the rest of the lot, in terms of ripeness, color, shape and size, or which present mechanical or microbiological damage.

Fruit sorting covers two main separate processing operations: Removal of damaged fruit and any foreign bodies (which might have been left behind after washing); Qualitative sorting based on organoleptic criteria and maturity stage.

Mechanical sorting for size is usually not done at the preliminary stage. The most important initial sorting is for variety and maturity.

Significance of Sorting

Sorting is an essential step in the fruit and vegetable processing chain for several reasons:

i. Quality Control: Sorting removes fruits and vegetables that exhibit defects, such as blemishes, bruises, or signs of spoilage. This ensures that only the highest quality produce is used for further processing or direct sale.

ii. Safety Enhancement: Sorting helps prevent the spread of microbial contamination by removing fruits and vegetables that are bruised, damaged, or show signs of decay. These

damaged areas provide entry points for microorganisms that can cause foodborne illnesses.

iii. Consistency and Uniformity: Sorting ensures consistency in size, shape, and color, creating a more visually appealing and uniform product. This consistency is particularly important for pre-packaged goods where consumers expect a consistent appearance.

iv. Value Optimization: By removing defective or low-quality produce, sorting maximizes the value of the overall harvest. This optimization reduces waste and enhances the overall profitability of the processing operation.

Sorting Methods

Various sorting methods are employed in fruit and vegetable processing, each tailored to the specific characteristics and processing needs of the produce. Common sorting methods include:

1. Manual Sorting: This traditional method involves manual inspection and sorting by trained workers. While labor-intensive, manual sorting is well-suited for sorting based on subtle defects or specific characteristics.

2. Mechanical Sorting: Mechanical sorters utilize various technologies, such as size grading, optical sorting, and color sorting, to automate the sorting process. These sorters can handle large volumes of produce efficiently and consistently.

3. Electronic Sorting: Electronic sorters employ advanced technologies, such as X-rays and near-infrared (NIR) spectroscopy, to detect internal defects, assess ripeness, and identify foreign material. These sorters provide superior precision and accuracy.



Figure 2.1. Automatic Vegetable & Fruit Grading Machine

(https://www.youtube.com/watch?v=qhlEgmVG5Cg, Accessed date: December 30, 2023)

2.1.2. Washing

Fruit washing is a mandatory processing step; it would be wise to eliminate spoiled fruit before washing in order to avoid the pollution of washing tools and/or equipment and the contamination of fruit during washing. Washing efficiency can me gauged by the total number of micro-organisms present on fruit surface before and after washing - best result are when there is a six fold reduction. The water from the final wash should be free from moulds and yeast; a small quantity of bacteria is acceptable. Fruit washing can be carried out by immersion, by spray/ showers or by combination of these two processes which is generally the best solution: pre-washing and washing.

Wash the fruits in clean Washing is an operation that generally is the point of departure of any fruit and vegetable production process. In a small-scale operation, this activity is normally carried out in basins with recirculating water, or simply with still water that is continuously replaced.

Thorough washing of fruits and vegetables is an essential step in food safety and preparation. It helps remove dirt, debris, pesticides, and surface contaminants that can potentially harm your health.

Table 2.1. General washing guidelines

Guideline	Description
Wash before peeling or cutting	Washing before peeling prevents dirt and bacteria from transferring from the knife onto the fruit or vegetable's flesh.
Rinse under running water	Hold the produce under running water, rubbing it gently with your hands to remove dirt and debris.
Use a clean vegetable brush	For firm-skinned produce like melons, cucumbers, or potatoes, use a clean vegetable brush to scrub away stubborn dirt.
Pay attention to crevices and folds	Wash carefully around stems, leaves, and areas where dirt can accumulate.
Don't use soap or harsh detergents	Soap can leave a residue and alter the taste of the produce.
Dry thoroughly	After washing, pat the produce dry with a clean paper towel or cloth to prevent the growth of bacteria.

The operation is composed of eliminating the dirt sticking to the material before it enters the processing line, thus avoiding complication deriving from the possible contamination of the raw material. The washing must be performed using clean water, which should be as pure as possible. And if necessary should be made potable by adding sodium hypochlorite, 10 ml of 10% solution for every 100 liter of water.

It is advisable to use implements that allows for an adequate cleaning of the material, so that no traces of dirt are left in the subsequent phase.

However, some types of vegetables, including broccoli, lettuce .Leaves, or spinach, often require additional attention and cleaning. If you have packaged produce labeled "ready-to-eat," “washed” or “triple washed,” do not re-wash



Figure 2.2. Fruit and vegetable washing machines

2.1.3. Peeling

This operation is performed on a regular basis. It consists of the removal of the skin of the fruit or vegetables. It may be performed by using physical devices like knives or similar instruments, by using heat or chemical methods. Such methods basically aim to bring about the decomposition of the walls of the external cells of the skin, so that the skin is removed as a result of the tissue's loss of integrity.

Peeling is an operation that allows for a better presentation of the product, and at the same time fosters sensory quality, for the material with a firmer and rougher texture is eliminated. Moreover, the skin often presents a color that has been affected by the thermal processes normally used in processing methods.

Peeling facilitates the operation of cutting raw material into pieces or into slices before processing. Peeling is an operation that allows for a better presentation of the product, and at the same time fosters sensory quality, for the material with a firmer and rougher texture is eliminated. Moreover, the skin often presents a color that has been affected by the thermal processes normally used in processing methods.

Peeling facilitates the operation of cutting raw material into pieces or into slices before processing

Trimming and peeling (skin removal): This processing step aims at removing the parts of the fruit which are either not edible or difficult to digest especially the skin.

Up to now the industrial peeling of fruit and vegetables was performed by three procedures: mechanically; by using water steam; chemically; this method consists in treating fruit and vegetables by dipping them in a caustic soda solution at a temperature of 90 to 100° C; the concentration of this solution as well as the dipping or immersion time varying according to each specific case.



Figure 2.3. How to easy peel and cut fruits and vegetables

(https://www.youtube.com/watch?v=BtYh71C1jjk, Accessed date: December 30, 2023)

2.1.4. Cutting

Cutting is an operation that is usually included in the different preservation process. This operation makes it possible to achieve different objectives, like an even penetration of heat in thermal processes, uniform drying and a better package appearance, since the packed material is

more even in terms of its shape and weight. In the specific case of drying, cutting enhances the surface/volume ratio, which increases the efficiency of the process.

When performing the cutting operation, special care must be taken to fulfill two conditions. First of all, the cutting tools or devices must produce clean and clear cuts not involving more than a few layer of cells, to the extent possible. In other words, they must not cause excessive damage to the tissue, to avoid detrimental effects like change of color, and subsequently in the change of product's flavor. Moreover, the cutting must be performed in such a way as to allow for a viable industrial performance. A way must always be found for the cutting operation to supply the greatest possible amount of usable material.

2.1.5. Blanching

Blanching is a slight treatment, using hot water or stream that is applied to fruits and vegetables before canning or freezing. Immersing fruits do it and vegetable in water at a temperature of 90-95 degree C. the result is that fruits become soft and the enzymes are inactivated. Blanching is done before a product is dried or sometimes before fruits are processed in order to prevent unwanted color and odor changes and excessive loss of vitamin

Purpose of blanching

- It naturally kills off 99.9 % of bacteria and microbes; thereby reducing the chance of food-borne illness.
- To inactivate enzymes.
- To remove air intracellular spaces of a fruit or vegetable.



Figure 2.5. Bleaching of fruits and vegetables
(https://www.youtube.com/watch?v=Hy5oPXndJ9E, Accessed date: December 30, 2023)

2.2. Monitoring control points (monitoring functions)

2.2.1. Process description for quality control

One of the most important specifications of a product is its safety in terms of microbial contamination, freedom from hazardous chemicals and absence of foreign materials such as metal pieces, non-edible parts such as pits or woody stem material and dirt, insect parts or other extraneous material.

The microbial safety of processed fruits and vegetables is of prime importance from a quality viewpoint. The following analysis is to provide a description of a process to help ensure that microbial safety can be achieved with a minimum opportunity for failure of the finished product to meet specifications.

Process operations Food processing steps require a detailed description when microbial safety is a concern. The reason for this is that ingredients, packages, equipment, and the surroundings all potentially can contaminate the final product with pathogenic or spoilage microorganisms. Further, if the conditions of pH (acidity), temperature, moisture and nutrient level are suitable, rapid microbial growth is possible on processing equipment and in the food itself. Thus while microbiological specifications can be written for incoming ingredients, actual microbial counts can increase during each process step if the process is not designed properly. One of the first requirements for the description of a process is to determine if an individual process step will

increase (+), decrease (-) or result in no change (=) in the microbial content of food undergoing the processing step. This can be determined from the chemical and physical conditions of the food and surroundings in each processing step.

Raw materials and ingredients:

- Must be inspected and sorted to insure that they are clean, wholesome and fit for processing into human food;
- Must be stored under conditions that will protect against contamination and minimize deterioration;
- Must be washed or cleaned to remove soil and other contamination:
- Water used for washing, rising or conveying food products must be of sanitary quality;
- Water must not be reused for washing, rinsing or conveying if contamination of food may result;
- Containers and carriers (such as trucks or railcars) should be inspected to assure that their condition has not contaminated raw ingredients;
- Raw materials shall not contain levels of microorganisms that may produce food poisoning or other disease, or they shall be pasteurized or otherwise treated during manufacturing operations so that the product will not be adulterated;
- Materials susceptible to contamination with natural toxins, e.g., aflatoxin, shall comply with national and international official levels before they are incorporated into the finished food;
- Materials susceptible to contamination with pests, undesirable microorganisms, or extraneous material, shall comply with national and international regulations, guidelines and defect action levels;
- Materials shall be stored in containers, and under conditions which protect against contamination;
- Frozen materials shall be kept frozen. If thawing is required prior to use, it shall be done in a manner that prevents contamination

Fruit and vegetable quality monitoring is an essential process for ensuring that consumers receive safe, high-quality produce. It involves a variety of methods to assess the physical,

chemical, and microbiological properties of fruits and vegetables at various stages of the supply chain, from harvest to consumption.

Importance of fruit and vegetable quality monitoring

There are several reasons why fruit and vegetable quality monitoring is important:

- Food safety: It helps to identify and remove fruits and vegetables that are contaminated with harmful bacteria, viruses, or parasites.
- Quality assurance: It ensures that fruits and vegetables meet the desired standards for appearance, taste, texture, and nutritional value.
- Loss reduction: It helps to minimize losses due to spoilage, damage, and improper handling.
- Consumer satisfaction: It helps to ensure that consumers are satisfied with the quality of the fruits and vegetables they purchase.

2.2.2. Methods of fruit and vegetable quality monitoring

There are a variety of methods used to monitor the quality of fruits and vegetables. These methods can be broadly classified into three categories:

i. Physical methods

These methods assess the physical characteristics of fruits and vegetables, such as size, shape, color, texture, and weight. Common physical methods include:

- Visual inspection: Fruits and vegetables are visually inspected for defects such as blemishes, bruises, and decay.
- Size grading: Fruits and vegetables are sorted by size using machines or manual methods.
- Color sorting: Fruits and vegetables are sorted by color using electronic sensors.

ii. Chemical methods

These methods assess the chemical properties of fruits and vegetables, such as sugar content, acid content, and pesticide residues. Common chemical methods include:

- Refractometry: Measures the sugar content of fruits and vegetables.
- Titration: Measures the acid content of fruits and vegetables.
- Gas chromatography-mass spectrometry (GC-MS): Detects pesticide residues on fruits and vegetables.

iii. Microbiological methods

These methods assess the microbiological quality of fruits and vegetables, such as the presence of harmful bacteria, viruses, and parasites. Common microbiological methods include:

- Agar plate count: Counts the number of bacteria on fruits and vegetables.
- Polymerase chain reaction (PCR): Detects the presence of specific pathogens on fruits and vegetables.
- Enzyme-linked immunosorbent assay (ELISA): Detects the presence of specific toxins on fruits and vegetables.

2.2.3. Factors affecting fruit and vegetable quality

Several factors can affect the quality of fruits and vegetables, including:

- Variety: Different varieties of fruits and vegetables have different quality characteristics.
- Growing conditions: Environmental factors such as temperature, rainfall, and sunlight can affect the quality of fruits and vegetables.
- Harvesting practices: Proper harvesting practices can help to preserve the quality of fruits and vegetables.
- Post-harvest handling: Proper handling and storage practices can help to extend the shelf life of fruits and vegetables.

2.3. Monitoring pre-processing materials meet specification equipment

2.3.1. Preprocessing material with processing equipment specification

- Equipment should be designed to hold the product with minimum spills and overflow.
- Surfaces in contact with food should be inert and non-toxic, smooth and non-porous.
- No coatings or paints should be used that could possibly chip, flake or erode into the product stream.
- Equipment should be designed and arranged to avoid having pipes, mechanisms, drives, etc., above the open product streams.
- Bearings and seals must be located outside the product zone or sealed and self-lubricating.
- Proper design avoids sharp or inaccessible corners, pockets, ledges so that all parts can be reached and cleaned easily. Build so that units are easy to take apart if necessary.
- Loose items like locking pins, clips, handles, gates, keys, tools, fasteners, etc. that could fall into the product stream should be eliminated.
- Equipment and utensils must be designed and constructed so that they are adequately cleanable and will not adulterate food with lubricants, fuel, metal fragments, contaminated water, etc.
- Equipment should be installed so that it, and the area around it, can be cleaned;
- Food contact surfaces shall be made of nontoxic materials and must be corrosion-resistant;
- Seams on food contact surfaces shall be smoothly bonded, or maintained in order to minimize the accumulation of food particles, dirt and organic matter;
- Equipment in processing areas that does not come into contact with food shall be constructed so that it can be kept clean;
- Holding, conveying and manufacturing systems, including gravimetric, pneumatic, closed and automated systems, shall be maintained in a sanitary condition;
- Each freezer and cold storage compartment shall have an indicating thermometer, temperature measuring or recording device, and should have an automatic control for regulating temperature, or an automatic alarm system to indicate a significant temperature change.

Instruments and controls used for measuring, regulating or recording temperatures, pH, acidity, water activity, etc. shall be adequate in number, accurate and maintained.

2.3.2. Manufacturing operations

Fruit and vegetable processing equipment must be keep in a sanitary condition through frequent cleaning and, when necessary, sanitizing. If necessary, such equipment must be taken apart for thorough cleaning. It is necessary to process, package and store food under conditions that will minimize the potential for undesirable microbiological growth, toxin formation, deterioration or contamination. To accomplish this may require careful monitoring of such factors as time, temperature, humidity, pressure, flow rate, etc. The object is to assure that mechanical breakdowns, time delays, temperature fluctuations or other factors do not allow the foods to decompose or become contaminated.

- Fruit and vegetable processing shall be held under conditions that prevent the growth of undesirable microorganisms as follows:
  - ✓ Refrigerated fruits shall be maintained at 45° F or below;
  - ✓ Frozen foods shall be maintained in a frozen state;
  - ✓ Acid or acidified foods to be held in hermetically sealed containers at ambient temperatures shall be heat-treated to destroy mesophyllic microorganisms;
- Measures such as sterilizing, irradiating, pasteurizing, etc., shall be adequate to destroy or prevent the growth of undesirable microorganisms; Work-in-process shall be protected against contamination;
- Equipment, containers and utensils shall be constructed, handled and maintained to protect against contamination; Measures, e.g., sieves, traps, metal detectors, shall be used to protect against the inclusion of metal or other extraneous material in food;
- Food or materials that are adulterated shall be disposed of in a manner that prevents other food from being contaminated;
- Mechanical manufacturing steps such as washing, peeling, etc., shall be performed to protect against contamination by providing adequate protection from contaminants that may drip, drain or be drawn into the food, by adequately cleaning and sanitizing all food-

contact surfaces and by using time and temperature controls at and between each manufacturing step;

- Heat-blanching should be done by heating the food to the required temperature, holding it at this temperature for the required time, and then either rapidly cooling the food or passing it to the next manufacturing step without delay;
- Filling, assembling, packaging, and other operations shall be performed in such a way that the food is protected against contamination by:
- Use of a quality control operation in which the Critical Control Points are identified and controlled during manufacturing;
- Adequate cleaning and sanitizing of all food-contact surfaces and food containers;
    - ✓ Using materials for food containers and food-packaging materials that are safe and suitable;
    - ✓ Providing physical protection from contamination, particularly airborne contamination;
    - ✓ Using sanitary handling procedures.

2.4. Identifying and reporting product, process and equipment performance

2.4.1. Equipment Performance

The ideal cycle time is the time taken to produce one unit at rated speed, while the actual cycle time is the machine's operating time divided by the number of units produced. To work out the performance score for a machine, divide the ideal cycle time by the actual cycle time

Report and maintain records on production progress

1. Report within agreed timescales on production issues affecting progress, quality, compliance or additional organizational
2. Source positive and negative feedback from customers and relay to colleagues
3. work within the limits of your authority to ensure feedback is acted upon
4. Complete production and equipment records and documentation within agreed timescales to organizational
5. Check that relevant people have access to current and accurate production information
6. Communicate performance and productivity to relevant colleagues on the production line

7. File records in the appropriate place

2.4.2. Influence of minimal processing operations/equipment on quality changes

The equipment required for minimal processing of fresh produce perform different functions during the various processing steps (*i.e*. de-coring, peeling, cutting, shredding, washing, drying, *etc*.), influencing the final quality of the product. Each step operations may alter the integrity of the raw material, especially in the cut products, making them more prone to deterioration. Also, different unit operations may provide opportunities for cross-contamination, as a small lot of contaminated product may affect a large lot during the processing steps the main risk factors for product quality and safety are related to the temperature during processing, water quality and sanitation, hygienic design and hygienic status of equipment, as well as employee hygiene and training

Self-check 2	Written test

Name: _____ ID: _____ Date: _____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Give short and answer

1. What are the three main categories of methods used to monitor fruit and vegetable quality?
2. Describe the process of blanching fruits and vegetables.
3. What are some of the benefits of sorting fruits and vegetables?
4. What are some of the factors that can affect the quality of fruits and vegetables?
5. What is the importance of identifying and reporting product, process, and equipment performance in fruit and vegetable processing?
6. What is trimming and peeling process?
7. What is main aim of controlling function?
8. Define the process operation of food safety controlling?
9. What is the Influence of minimal processing operation/equipment on quality changes?

Test II: Choose the best answer

1. What is the Purpose of blanching?
    A. It naturally kills off 99.9 % of bacteria and microbes; thereby reducing the chance of food-borne illness.
    B. To inactivate enzymes
    C. To remove air intracellular spaces of a fruit or vegetable
    D. All
    E. None
1. Instruments and controls used for measuring, regulating or recording about?
    A. Ttemperatures
    B. pH acidity
    C. Water activity

D. All

2. Food shall be held under conditions that prevent the growth of undesirable microorganisms as follows
   A. Refrigerated foods shall be maintained at 45° F or below
   B. Frozen foods shall be maintained in a frozen state
   C. Acid or acidified foods to be held in hermetically sealed containers at ambient temperatures shall be heat-treated to destroy mesophyllic microorganisms;
   D. All
   E. None
3. Which of the following is NOT a purpose of sorting fruits and vegetables?
   A. Removing damaged fruit and any foreign bodies
   B. Ensuring consistency in size, shape, and color
   C. Increasing the value of the overall harvest
   D. Enhancing the flavor of the produce
4. Which of the following methods is NOT commonly used for sorting fruits and vegetables?
   A. Manual sorting
   B. Mechanical sorting
   C. Electronic sorting
   D. Taste testing
5. What is the purpose of blanching fruits and vegetables?
   A. To remove dirt and debris
   B. To inactivate enzymes
   C. To soften the texture of the produce
   D. All of the above
6. What is one factor that can affect the quality of fruits and vegetables?
   A. Variety
   B. Growing conditions
   C. Harvesting practices
   D. All of the above
7. Which of the following is a critical control point (CCP) in fruit and vegetable processing?
   A. Washing
   B. Peeling
   C. Cutting
   D. Blanching

Operation Sheet 1	

1.1. Starting up pre-processing of fruits and vegetables

A. Tools and Equipment

- Fresh ripe Fruit

B. Procedures

Step 1 - Wear personal protective equipment

Step 2 - Select ripped and non-damage fruit.

Step 3 - Sort/ grade fruit according to the size and color

Step 4 - Wash fruit in portable water**.**

Step 5 - Peel fruit by hand /or mechanical peeling

Step 6 - Cut fruit and remove seeds

Step 7 - Slice and pack fruit for the next operation

LAP test 1	**Performance Test**

Name: _____ ID: _____ Date: _____

Time started: _____Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1:30** hour. The project is expected from each student to do it.

Task- 1 Perform pre-processing for fruit and vegetables

LG #20	LO #3 Shutdown the Preprocessing Equipment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Shutting down the processes
- Collecting, treating and recycling or disposing waste

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Shut down the processes
- Collect, treat and recycle or dispose waste

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the "LAP test"

Information sheet 3

3.1. Shutting down the processes

3.1.1. Introduction

The point of a shutdown is to create a plan for a complete cessation of all plant activities in order to perform necessary maintenance, repairs, equipment replacements, and to perform internal maintenance. The shut-down procedure is just as important as the start-up procedure for both a preprocessing machine. By properly shutting down the equipment, the start-up will be much quicker and most effective. Shut down the line can have a major impact on your capacity to restart production promptly. In an upcoming article, we will help you restart your machinery, taking the best steps and precautions.

The Standard Operating Procedures for each type of equipment must be adhered to when shutting a unit down.

a) Scheduled shutdown
b) Maintenance shutdown
c) Emergency shutdown
d) Shutting down to a standby condition

a) Scheduled shutdown.

A scheduled shutdown is initiated by the operator during normal operation of the unit when:

- maintenance is required
- Feed supply is low or exhausted.

The shutdown procedure will depend on the type of equipment and the process chemistry.

Emergency shutdown is initiated in the event of a fire, major spill, instrument failure, power failure, or total loss of control of chemical or physical processes.
Emergency shutdown procedures must be followed during a shutdown sequence.

Trips

Shutdown of a unit can be initiated by the automatic shutdown system. The systems may be shut

down automatically because of temperatures, fluid levels, pressures or flows that are above or below trip points.

b) Maintenance shutdown

When maintenance to the unit equipment is required, the equipment may need to be entered so that work can take place.

The shutdown should be a scheduled or planned shutdown as per Standard Operating Procedures where equipment is:

- Isolated (process, mechanical and electrical)
- Cooled and depressurized
- Purged and gas freed
- Cleaned
- Gas tested on a continuous basis prior to and during entry.

Preventive maintenance:

Whether the shutdown affects all of your manufacturing lines or just a portion, we recommend you use the disruption as an opportunity to perform preventive maintenance on your equipment. The manufacturer's operation and maintenance manual is the best source for guidance on how to care for your equipment and how to identify issues that need repair. Dealing with repair needs today will help you to be better able to restart quickly. It is also advisable to ensure that you have critical parts and components that need frequent replacement beforehand. Lead times to supply your parts can be unpredictable, so we suggest that you make a list of parts that need changing and share it with your suppliers to anticipate when the product will be available.

3.1.2. Collecting, treating and recycling or disposing waste

- **Fruit Waste Management**

It is believed that in undeveloped economies, the amount of waste generated exceeds the environment's waste processing potential. A sustainable development requires reduction in waste generation, recycling, and reuse of an increasing proportion of the waste.

The aim of waste management is to achieve rational management of resources and minimize the amount of waste disposed into the environment. The main areas of waste management include prevention and decrease of waste formation, reutilization, recovery, waste selection, waste handling, waste transformation or destruction, waste placement, and storage.

- **Procedures for the Management of Fruit Processing Waste**

Slurry treatment has two aims, decreasing the amount of slurry and slurry processing to develop the structure and composition that is suitable for placement. This latter can be performed by stabilization and disinfection.

The decrease of slurry quantity practically means water removal, which is carried out by mechanical procedures or heat treatment or by the combination of both. Taking the general composition of slurry into consideration, it can be seen that 90% of the water content, which is pore water and capillary water, can be removed by thermal separation procedures. The main steps of slurry treatment and placement are as follows:

- Slurry concentration;
- Slurry conditioning;
- Disinfection;
- Water removal;
- Aerobic stabilization;
- Anaerobic stabilization;
- Combustion;
- Final placement and waste deposition.

The goal of slurry concentration is the decrease of easily removable water content and thus the decrease of slurry quantity. The most frequently applied procedures are gravitational and flotation-based slurry condensation devices, slurry centrifuges, and membrane separation techniques. Depending on the construction, the following dry matter levels can be achieved by

different water removing procedures: gravitational condensation 4–5%, centrifuges 10–20%, and membrane separation 30–40%.

The aim of slurry conditioning is to decrease the water content, stabilize organic substances, and reduce the number of microorganisms. Physical conditioning can be performed by pasteurization, thermal conditioning, and washing. Washing means the elimination of colloid organic contaminants from the slurry, which are then driven back for biological cleaning.



Figure 3.1: Fruit and vegetable waste

Steps to reduce fruit and vegetable processing waste

1. Select Fruits and Vegetables Wisely

- Buy just what you need. Beware of bulk discounts, since fresh produce has a limited shelf life.
- Embrace produce imperfections, but steer clear of vegetables or fruits that are overly bruised or damaged.

2. Store produce properly

- Store any perishable fresh produce, such as berries and leafy greens, in a clean refrigerator set to 40°F or below. If produce is refrigerated at a grocery store, it generally should be refrigerated at home to maintain quality.
- Some fruits produce a large amount of ethylene gas during ripening, which can ripen other produce when stored together. Produce that release this gas include avocados, unripe bananas, nectarines, peaches, tomatoes, apples, apricots, cantaloupe, figs, kiwis and plums. In the refrigerator, store these fruits in a no-vegetables-allowed crisper drawer and away from fruit that doesn't need to be quickly ripened. Some vegetables also can leave distinctive odours that fruits absorb, affecting overall quality.
- Some produce has a short lifespan once ripened. Plan to use fruits such as apricots, blackberries, raspberries and strawberries and vegetables such as herbs, sprouts, corn, cucumbers, eggplant, green beans, leafy greens, lima beans, mushrooms, peas and summer squash within a couple days of purchase.
- Fresh produce with a longer shelf-life can wait to be consumed until after most of the other fruits and vegetables. This includes apples, pears, beets, carrots, garlic, onions, potatoes and winter squash. Eating foods with a short shelf life first, can be helpful in reducing food waste.
- Consider using bags or storage containers designed for produce to help prevent spoilage of other foods. However, don't store fresh produce in regular, air-tight plastic storage bags or containers as this can start the decaying process and promotes bacterial and mold growth.

3. Prepare fruits and vegetables cleverly

- Rinse or scrub and use the entire fruit or vegetable when possible, including all edible skins and seeds. Just cut away any bruises and blemishes.
- Have a plan, then prepare only what you need. Make half portions or develop a plan for using leftovers to help reduce excess food that might go to waste.
- If you're unable to enjoy all of the fresh produce you have on hand, make your own frozen food. Cut fruit and blanch vegetables before placing in air-tight containers for freezing. Blanching vegetables before freezing helps to slow down the spoiling process and preserve the colour and texture of these foods.

Reuse waste by composting:

Composting can help put food scraps to use and reduce methane emissions in landfills. Fruits, vegetables, coffee and tea all are good materials for compost. By taking care of produce from purchase to plate, you can make a noticeable difference in the amount of food wasted in your home.

Recyclable valuable fruit waste

The myriad of ways in which waste from the fruit sector can be reused and recycled include:

- As a source of flavor or aroma compounds, antioxidants, natural colorants and dietary nutrients.
- Depending on the type of fruit, as a source of starch, pectin and cellulose that can be used in baking or for the generation of bio-ethanol.
- As a source of fiber and pulp for the production of composite materials, textiles and paper.
- For the removal of heavy metals and dyes from wastewater.
- For processing into bricks used in boilers or domestic fireplaces.
- As a growth substrate for the cultivation of fungi and bacteria. These organisms can produce value-added products during growth such as enzymes used in the production of biofuel or fine chemicals.
- As a source of organic acids typically used in food, natural bio control agents such as natural pesticides, and bio plastics for the manufacture of bio-degradable container.

Self-check 3	Written test

Name _____ID: _____ Date: _____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is the aim of fruit and vegetable waste management?
2. List out the Steps to Reduce Waste?
3. What is shut down process?
4. Write down Steps to follow for proper shutdown?
5. Write the main goal of shut down process?

Test II: choose the best answer

1. Which of the following is NOT a type of shutdown?

   A. Scheduled shutdown
   B. Emergency shutdown
   C. Preventive maintenance shutdown
   D. Startup shutdown

2. What is the goal of slurry treatment?

   A. To increase the amount of slurry
   B. To decrease the amount of slurry and develop a suitable structure and composition for placement
   C. To increase the water content of the slurry
   D. To decrease the amount of solid matter in the slurry

3. What is the goal of slurry conditioning?

   A. To decrease the water content, stabilize organic substances, and reduce the number of microorganisms
   B. To increase the water content, destabilize organic substances, and increase the number of microorganisms

C. To decrease the water content, destabilize organic substances, and decrease the number of microorganisms
D. To increase the water content, stabilize organic substances, and increase the number of microorganisms

4. What is one step that can be taken to reduce fruit and vegetable processing waste?

A. Buy more bulk produce
B. Store produce in a warm, humid environment
C. Use only part of a fruit or vegetable and discard the rest
D. Plan to use fruits and vegetables within a couple days of purchase

5. What is one way that fruit waste can be recycled?

A. As a source of flavor or aroma compounds
B. As a source of starch, pectin, and cellulose
C. As a source of fiber and pulp for the production of composite materials, textiles, and paper
D. All of the above

LG #21 | LO #4 Use Cold Store Material

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Storing pre-processed raw material in a freezing storage area.
- Maintaining appropriate temperature store
- Cleaning and sanitizing Cold room facilities.
- Setting specifications.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide**, you will be able to**:

- Store pre-processed raw material in a freezing storage area.
- Maintain appropriate temperature store
- Clean and sanitizing Cold room facilities.
- Set specifications

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the "LAP test"

Information sheet 4

4.1. Storing pre-processed raw material in a freezing storage area

4.1.1. Storage and Transportation of Raw Material.

Storage of food is necessary at all points of the food chain from raw materials, thorough manufacture, distribution, retailers, and final purchasers. Today's consumers expect a much greater variety of products, including non- local materials, to be available throughout the year.

Effective transportation and storage system for raw materials are essential to meet this need. Storage of marterials whose supply or demand fluctuate in a predictable manner, specially seasonal produce, is necessary to increase availability .It is essential that processors maintain stocks of raw materials: therefore storage is necessary to buffer demand.

However, storage of raw materials is expensive for two reasons: stored goods have been paid for and may therefore tie up quantities of company money, and secondly, warehousing and storage space are expensive .All raw materials will deteriorate during storage. The quantities of raw materials held in store and the times of storage vary widely for different cases, depending on the above considerations. The" just in time "approaches used in other industries are less common in food processing.

The primary objective is to maintain the best possible quality during storage. And hence avoided spoilage during the storage period. Spoilage arises through three mechanisms:

1. **Living organisms such** as vermin**,** insects, fungi; and bacteria-these may feed on the food and contaminant it.
2. **Biochemical activity** within the food leading to quality reduction, such as respiration in fruits and vegetables; staling of baked products; enzymatic browning reactions; rancidity development in fatty food.
3. **Physical processes**, including damage due to pressure or poor handling; physical change such as dehydration or crystallization .The main factors that govern the quality of stored foods are temperature, moisture/humidity, and atmospheric composition. Different raw materials provide very different challenges.

Fruits and vegetables remain as living tissues until they are processed and the main aim is to reduce respiration rate without damage to the tissue. Young tissue such as shoots, green peas, and immature fruits have high respiration rates and shorter storage periods ,while mature fruits

and roots ,and storage organs such as bulbs and tubers (e.g. onion, potatoes, sugerbeets)respire much more slowly ,and hence have longer storage periods.

Cold Storage of Fruits and Vegetables: Temperature is the single most important factor affecting the deterioration rate of harvested commodities. The rate of deterioration is proportional to the respiration rate of the commodity, which is temperature-dependent. For each 10°C reduction in temperature, the respiration rate of a wide range of produce can be reduced by a factor of 2 to 4.. Therefore, cooling and refrigeration are important to preserving the quality of fresh fruits and vegetables and to extending their storage lives.

Controlled Atmosphere Storage(CA): CA storage implies precise control of the gas concentrations inside the storage room. Modification of atmospheric gas levels may reduce the respiration rate of fresh produce, as well as control the level of ethylene (C_2H_4) and thus retard ripening. The gas concentrations of ambient air are 78.08% N_2, 20.95% O_2, and 0.03% CO_2. In most CA storage systems, the O_2 level is decreased and/or the CO_2 level is increased. Either generally causes a decrease in product respiration rate.

Underground Storage: Underground storage is good for keeping produce cool but not for removing field heat.

Ethylene Control Systems: Ethylene (C_2H_4) induces ripening in many fruits and can also cause some physiological disorders in vegetables. The amount of C_2H_4 produced by the commodity can be reduced by decreasing the surrounding O_2 level and increasing the CO_2 level. Low temperature levels, 0°C to 4.4°C, can prevent the production or inhibit the action of C_2H_4.

4.1.2. Maintain appropriate temperature store

- **Storage Environment**

The vegetables can be stored, in some specific natural conditions, in fresh state, that is without significant modifications of their initial organoleptic properties. Fresh vegetable storage can be short term; this was briefly covered under temporary storage before processing. Also fresh vegetable storage can be long term during the cold season in some countries and in this case it is an important method for vegetable preservation in the natural state.

In order to assure preservation in long term storage, it is necessary to reduce respiration and transpiration intensity to a minimum possible; this can be achieved by:

- maintenance of as low a temperature as possible (down to 0° C)
- air relative humidity increased up to 85-95 % and
- CO2 percentage in air related to the vegetable species

Vegetables for storage must conform to following conditions: they must be of one of the autumn or winter type variety; be at edible maturity without going past this stage; be harvested during dry days; be protected from rain, sun heat or wind; be in a sound state and clean from soil; be undamaged.

Temperature: The rate of biochemical reactions is related to temperature, such that lower storage temperatures lead to slower degradation of foods by biochemical spoilage, as well as reduce growth of bacteria and fungi. There may also be limited bactericidal effects at very low temperatures. The freezing point is the limited factors for many raw materials, as the tissues will become disrupted on thawing .Other foods may be subject to problems at temperature above freezing. Fruits and vegetables may display physiological problems that limit their storage temperature, probably as a result of metabolic imbalance leading to a buildup undesirable chemical species in the tissues. Temperature of storage is also limited by cost refrigerator storage is expensive especially in hot countries . Precooling to remove ‘’field heat’ ’is an expensive strategy to reduce the period of high initial respiration rate in rapidly respiring produce prior to transportation and storage .Hydro cooling obviously reduce water loss.

Humidity: If the humidity of storage environment exceeds the equilibrium related humidity (ERH) of the food ,the food will gain moisture during storage and vice versa .The water activity

or (AW) of most fresh foods ,for example; fruits, vegetables, meat, fish and milk is in the range (0.98-1.00) but they are frequently stored at a lower humidity .

Ethylene The effects of ethylene on harvested horticultural commodities can be desirable or undesirable, thus it is of major concern to all produce handlers. Ethylene can be used to promote faster and more uniform ripening of fruits picked at the mature-green stage. On the other hand, exposure to ethylene can be detrimental to the quality of most non-fruit vegetables and ornamentals.

Light: Exposure of potatoes to light should be avoided because it results in greening due to formation of chlorophyll and solanine (toxic to humans). Light-induced greening of Belgian endive is also undesirable.

Ambient Storage: Evaporative Cooling In some parts of the world, the climate is suitable for the use of evaporative cooling to provide some or all of the necessary refrigeration for cooling or storage. Evaporative cooling is a very economical and energy efficient technique. For evaporative cooling to be effective, the air used should have a relative humidity lower than 65%.

Nighttime Cooling: In some parts of the world there is a large diurnal temperature swing, and, where the nighttime temperature is low enough, outside air may be used as a source of refrigeration. Nighttime cooling is especially useful on commodities that are stored at moderate temperatures (5°C–12°C) such as pumpkins, potatoes, onions, sweet potatoes, and hard-rind squash. Natural ventilation during the night is usually sufficient if the outside temperature is below the required range for 5 to 7 h each day.

Altitude Cooling: The temperature of air drops about 10°C for every 1000-m increase in altitude. This can be useful for cooling produce if the situation warrants. For example, produce that must be transported into a nearby mountainous area, either to be distributed or to reach its final destination, may be stored in that area to take advantage of the lower temperature.

The ideal storage temperature varies from product to product, and the temperature maintained in the storage area should be within 1°C of that level. Lower temperatures may cause chilling injury

and higher ones can reduce the storage life of the product. If the temperature is allowed to fluctuate beyond the desired range, the produce may experience increased water loss and condensation may develop on the product from the surrounding air, leading to the growth of microorganisms. Temperature fluctuations can be prevented by using the proper equipment to refrigerate the storage room. Thus, there are three main control systems that may be used to obtain the desired gas concentrations: (a) O2 control systems, (b) CO2 control systems, and (c) C2H4 control systems

Table 4.1: Recommended storage conditions for various fruits and vegetables

Produce	Storage Conditions		
	Temperature	Humidity	Air composition
Apples	0°C to 5°C		1%–3% O_2, 1%–5% CO_2
Beans	8°C		2% to 3% O_2, 4% to 7% CO_2
Cabbage	0°C	92% RH	
Cantaloupes slip	2°C–5°C	95% RH	
full slip	0°C–2°C	95% RH	
Cauliflower	0°C	95%–98% RH	
Carrots	0°C to 2°C	95% RH	
Chinese cabbage	0°C	95%–100% RH	
Celery	0°C–5°C	90%–95% RH	2%–4% O_2, 3%–5% CO_2
Cucumbers	10°C–13°C	50%–55% RH	
Eggplant	8°C–12°C	90%–95% RH	
Garlic	0°C		
Grapes	1°C to 0°C	85% RH	
Kiwifruit	-0.5°C to 0°C	90%–95% RH	1%–2% O_2, 3%–5% CO_2 (C_2H_4 must be below 20 ppb)
Leeks	0°C	95%–100% RH	
Lettuce	0°C	95+% RH	
Mushrooms	Optimal at 0°C (0°C–5°C)		Normal O_2, 10%–25% CO_2
Nectarines	-0.5°C–0°C	90%–95% RH	
Okra	7°C–12°C	90%–95% RH	Normal O_2, 4%–10% CO_2
Onions	0°C	75% RH	
Peaches	-1°C to 0°C	85% RH	
Pears	-1.5°C to-0.5°C	90%–95% RH	

Peas green	0°C	95%–98% RH	
Peas southern	4°C–5°C	95% RH	
Peppers chili (dry)	0°C–10°C	32%–50% RH	
Peppers sweet	7°C–13°C	45%–55% RH	
Plums	-0.5°C–0°C	90%–95% RH	
Potatoes	3°C–10°C	90% RH	
Pumpkins (No precooling)	10°C–13°C	70% RH	
Spinach	0°C	95%–100% RH	
Strawberries	0°C	95% RH	5% to 10% O_2, 15% to 20% CO_2
Sweet Cherry	0°C–5°C		3%–10% O_2, 10%–15% CO_2
Sweet Corn	0°C	95% RH	
Sweet Potatoes (No precooling)	10°C–15°C	85% RH	

4.1.3. Cleaning and sanitizing cold room facilities

- **Procedures for sanitize and cleaning cold room facilities**

1. Sanitize surface using a sanitizing solution mixed at a concentration specified on the manufacturer's label. (20g sodium metabisulphite : 20 liters water)
2. Soak items in sanitizing solution for 10 minutes
3. Place wet items in a manner to allow air drying.
4. Spray tables with sanitizing solution and allow to air dry
5. Clean basins for washing fresh produce with cleaning detergent
6. Rinse basins with sanitizing solution

- **3.2. Washing and Sanitizing Processing Tools**

Purpose: To prevent food borne illness by ensuring that all processing tools (knives, graters, strainers, bowls) used for processing fresh fruits are properly cleaned and sanitized.

Scope: This procedure applies to employees involved in processing fresh fruits as well as those responsible for cleaning, washing and sanitizing processing tools.

Instructions:

1) Train production and other employees on using the procedures in this SOP.
2) Rinse and sanitize all processing tools before use.
3) Wash, rinse, and sanitize processing tools:
4) After each use
5) Any time contamination occurs or is suspected
6) Wash, rinse, and sanitize processing tools using the following procedure:
7) Wash with detergent solution and designated sponge.
8) Rinse in clean running tap water till no trace of soap/detergent is present.
9) Sanitize using a sanitizing solution mixed at a concentration specified on the manufacturer's label (chlorine or sodium metabisulphite) (Make sanitizing solution of 50g sodium metabisulphite : 50 liters water). Soak in solution for 5- 10 minutes
10) Place processing tools on designated table to allow air drying.

4.1.4. Set specifications

Specifications convey critical information about a product or a device. A review of specifications is crucial when assessing the applicability of a product to an application, and ultimately to the decision of whether or not to purchase the product. In this sense, specifications indicate expected performance in addition to other important product characteristics.

The process for setting specifications must attempt to meet the various needs of those that rely on the information the specifications communicate. It is important that the specifications accurately describe performance. An overly conservative specification that underestimates actual product performance may lead to rejecting the product for a specific application when, in fact, it is suitable. For the manufacturer, an overly aggressive specification can lead to increased manufacturing and warranty costs. Ideally, the specification setting process produces specifications that accurately describe performance, support making product comparisons, are measurable and are valid over variations in the external environment.

Definitions Specifications, as described in this paper, relate specified tolerances to the expected performance of a product. Characterizing a sample of products, usually the first products built just before full-scale production of the product begins, provides an estimate of expected performance. Characterizing product performance requires a calibration procedure. The role of calibration, however, is much larger than characterizing a product to set specifications. Calibration is necessary for monitoring performance over time, for interlaboratory comparisons and for estimating product reliability. Additionally, the measured result from calibration may be used to correct or adjust the performance and is central when assessing conformance.

Self-check 4	Written Test

Name: _____ ID: _____ Date: _____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: give short answer questions

1. Define setting specification?
2. Write uses of setting specification in manufacturing?
3. List out Washing and Sanitizing Processing Tools procedures?
4. Write all instruction for Washing and Sanitizing tools?
5. List the storage environment of fruit and vegetables?
6. Explain Temperature on fruit storage area?
7. What means Nighttime Cooling?

Test I: choose the best answer questions

1. Fruit and vegetable spoilage arises through three mechanisms
   A. Living organisms such
   B. Biochemical activity
   C. Physical processes
   D. All
   E. None
2. How physical process food spoilage arises?
   A. Damage due to pressure or poor handling
   B. Dehydration or crystallization
   C. A and B.
   D. None

Operation sheet 2	

2.1. Sanitizing and cleaning cold room facilities

A. Tools and Equipment

- **20g sodium metabisulphite**
- **20 liters water**
- **Spray bottle**
- **Cleaning detergent**
- **Bucket**
- **Gloves**

B. Procedures

Step 1 - Sanitize surface using a sanitizing solution mixed at a concentration specified on the manufacturer's label. (20g sodium metabisulphite: 20 liters water)

Step 2 - Soak items in sanitizing solution for 10 minutes

Step 3 - Place wet items in a manner to allow air drying.

Step 4 - Spray tables with sanitizing solution and allow to air dry

Step 5 - Clean basins for washing fresh produce with cleaning detergent

Step 6 - Rinse basins with sanitizing solution

LAP test 2	**Performance Test**

Name: _____ ID: _____ Date: _____

Time started: _____Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2:00** hour. The project is expected from each student to do it.

Task- 1 Perform sanitizing and cleaning cold room facilities

LG #22 | LO #5 Use Workplace Information

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Doing standard operating procedure (SOPS).
- Setting specifications.
- Doing production schedule and instruction.
- Cleaning and maintaining manufacturing devices.
- Recording standard forms and report

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide**, you will be able to**:

- Do standard operating procedure (SOPS).
- Set specifications.
- Do production schedule and instruction.
- Clean and maintain manufacturing devices.
- Record standard forms and report

Learning Instructions:

1) Read the specific objectives of this Learning Guide.
2) Follow the instructions described below.
3) Read the information written in the information Sheets
4) Accomplish the Self-checks
5) Perform Operation Sheets
6) Do the "LAP test"

Information sheet 5

5.1. Doing standard operating procedure (SOPS)

5.1.1. Introduction

The provision of quality products especially for export is paramount in the success of every food processing business. The products of every organization in this case a factory has to be of good quality and meeting international standards. Meeting international standards means taking internationally recognized healthy steps in terms of actions and provisions need to be adhere to and such best practices should be made available for factory staff to comply during their operations. Before Staffs are allowed to start working, they will have to undergo medical examination by a recognized health center to test for TB, Semolina Thyphyi, Hepatitis A and Hepatitis B with report endorsed by a certified Health practitioner.

5.1.2. Best practices for food processing:

To be able to produce internationally accepted products, processing has to be done in an internationally accepted manner. There are many international standards available but the preferred and mostly accepted internationally is the Hazard Analysis Critical Control Point System (HACCP). This system has steps that are to be strictly adhered to. These steps should not be compromised as it may affect the quality standards of produce.

5.1.3. Hazard Analysis Critical Control Point System (HACCP)

HACCP as a technique system is internationally recognized as the most effective means to assure the manufacturer of safe product. It is a technique/ process or a management system for the assurance of food and safety. HACCP system identifies, evaluates and control hazards to ensure food safety. It can be applied throughout the food chain from primary production to final consumption. HACCP is selected and used in our case as the best practices as it is needed in the success of food processing business. It is needed because legislation recommends it, it is one of the ways of doing business, and it is an insurance against food bourn incidents and diseases. HACCP has numerous benefits which include:

1. Instills awareness in food safety.
2. Set a preventive system for food safety assurance, increase producer and consumer confidence in product safety
3. It is a cost-effective method because defects are preventable

4. One loses less controls are set up and prevents end product to contaminate
5. Reduces loss and waste
6. It has a record system that is part of due diligence.

HACCP Standard Operating practices (SOPs)

Purpose: To prevent contamination of fruits by employees.

Scope: This procedure applies to employees who handle fresh fruits, prepare fresh fruits for drying, or package dried/processed products.

Procedures:

1. Train production employees on using the procedures in this SOP.
2. Follow the Employee Health Policy.
3. Report to work in good health, clean, and dressed in clean attire.
4. Change apron when it becomes soiled.
5. Wash your hands before starting work in the morning, after lunch or after using the toilet
6. Wash your hands after clearing dirty area.
7. Wash hands properly, frequently, and at the appropriate times.
8. Wash your hands with soap before and after eating.
9. Keep fingernails (short) trimmed, filed, and maintained so that the edges are cleanable and not rough. 10.Avoid wearing artificial fingernails and fingernail polish.
10. Do not wear any jewelry on fingers (including wedding ring) or wristband.
11. Do not wear long or hanging earrings to work.
12. Cover a lesion containing pus with a bandage. If the lesion is on a hand or wrist, cover with an impermeable cover such as a finger cot or stall and a single-use glove. Inform management of the condition.
13. Do not smoke anywhere on the premises.
14. Wear suitable and effective hair cover/net while in the production, drying and packaging areas.

5.2. Setting specifications

5.2.1. Introduction

To ensure food safety, it is necessary for standardized processes and procedures within the company's operations. Additionally, there should be comprehensive rules and regulations framed by regulators that companies must follow when it comes to manufacturing, handling, packaging, transporting and storing products.

Food specification management can be challenging. It isn't enough for companies to have a record of the processes they follow. They should have access to various sources of information – ingredient lists, organic certifications for ingredients, chemical formulas used, details of temperate settings used for heating and cooling, and so on. Only when companies have easy access to such information are they able to exert proper control over food safety and quality.

5.2.2. Essentials point for Food Specification Management

i. **Purchasing Decisions:** Companies must decide whether they wish to manufacture certain ingredients such as chemicals and inks or purchase them from another company

ii. **Leveraging the Information from Production Reports:** Production reports help managers understand the nuances of food manufacturing. They also help control costs and quality. Acting on the information in the production report will help companies rectify problems immediately and ensure the quality and safety of the product in the long run.

iii. **Setting up Control and Measuring Systems:** Control systems and certifications such as the ISO 22000 Certification and the Safe Quality Food certification schemes help companies keep track of how their operations are being conducted and whether changes are needed to ensure the elimination of product contamination at any stage.

iv. **Inventory Management:** Stale or contaminated inventory can impact the quality of the end-product by utilizing control systems companies can measure the quality of inventory available and ensure their final products are safe for consumption. Furthermore, inventory management helps keep track of important information such as the manufacturing date, expiration date, and so on.

v. **Sanitation in storage:** Storage and transportation are the sources of the greatest potential for contamination due to pests and the external environment. Whether the company sets up its' own storage and transportation or hires them from a third-party-vendor, it's essential there is a thorough inspection of the premises and processes used. This helps control the quality of the product.

Specifications must be based on a scientifically sound rationale. This discusses the influence of the factors involved in the setting of specifications, including reducibility in terms of process capability, process performance, measurement uncertainty and stability. Correspondence between release and specification limits is established. These limits must be established for all relevant parameters.

The role of calibration, however, is much larger than characterizing a product to set specifications. Calibration is necessary for monitoring performance over time, for interlaboratory comparisons and for estimating product reliability. Additionally, the measured result from calibration may be used to correct or adjust the performance and is central when assessing conformance. Therefore, it is necessary that a product's performance be measurable, either directly or indirectly, and the results must be repeatable and reproducible

Setting good specifications is essential to delivering customer value. Using this guide can help you identify what your customers really value and optimize your supply chain to deliver it.Improving quality specifications is one of the priority actions commonly identified to reduce food waste. Updating specifications can boost supply chain efficiency and relationships by making specs shorter, identifying provisions that are out of date and making them easier for suppliers to implement

5.3. Doing production schedule and instruction

5.3.1. Definitions

Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

- Forward scheduling is planning the tasks from the date resources become available to determine the shipping date or the due date.
- Backward scheduling is planning the tasks from the due date or required-by date to determine the start date and/or any changes in capacity required.

5.3.2. The benefits of production scheduling

- Process change-over reduction
- Inventory reduction, leveling
- Reduced scheduling effort
- Increased production efficiency
- Labor load leveling
- Accurate delivery date quotes
- Real time information

A key character of scheduling is the productivity, the relation between quantity of inputs and quantity of output. Key concepts here are:

- Inputs: Inputs are plant, labor, materials, tooling, energy and a clean environment.
- Outputs: Outputs are the products produced in factories either for other factories or for the end buyer. The extent to which any one product is produced within any one factory is governed by transaction cost.

In manufacturing, the purpose of scheduling is to minimize the production time and costs, by telling a production facility when to make, with which staff, and on which equipment. Most major factories ask for scheduling to smooth flow production, level the production, keep safety stock, keep cycle time, or keep assigning jobs to auto-machines or lines as the next priority.

The invention is operable in an intelligent manufacturing system including a process for converting raw materials to a product, a process control system including one or more sensors capable of generating an alarm in response to an event that results in one of waste, machine delay, or decrease product quality, a data logger associated with the process control system for obtaining event parameters associated with the event, a database on a server for recording event parameters obtained by the data logger, and a reporting system cooperatively associated with the database for reporting productivity parameters regarding the process derived at least in part from the event parameters. The method includes displaying a report user interface to a user. The user interface defines a plurality of time periods and a plurality of financial report types. The method also includes receiving from the user a selected time period corresponding to one or more of the time periods and a selected report type corresponding to one or more of the report types. The method retrieves report data associated with the selected report type for the selected time period from the data in the database in response to a user command.

5.4. Cleaning and maintaining manufacturing devices

5.4.1. Introduction

An effective sanitation program for fruit and vegetable processing facilities requires hygienic design of facilities and equipment, training of sanitation personnel, use of appropriate cleaning compounds and sanitizers, adoption of effective cleaning procedures, and effective administration of the sanitation program-including evaluation of the program through visual inspection and laboratory tests Effective sanitation starts with reduced contamination of raw materials, water, air, and supplies. If the facility and equipment are hygienically designed, cleaning is easier and contamination is reduced. One of the main aims of hygienic design is to make it easier to clean fruit and vegetable processing equipment, avoiding nooks and crannies in machinery design and taking into account the following aspects:

- Choice of surfaces. The material type, its roughness, and waterproof nature all need to be considered.
- Eliminate angles, corners and dead spaces.
- Quality soldering and watertight joins.
- In-plant distribution and separating areas of different hygienic degrees.
- Accessible equipment.

Cleaning and sanitizing steps

1. Remove heavy debris from floors with brooms or shovels and dry clean processing equipment, if needed
2. Pre-rinse the equipment with adequate quality water
3. Clean remaining debris from floor
4. Rinse floor and drains with adequate quality water using a low pressure hose
5. Use dedicated brushes to scrub floor and drains with an effective cleaner, applying adequate quality water as needed
6. Foam and scrub the equipment with an effective cleaner and scrub using dedicated brushes
7. Thoroughly rinse the equipment, floors, and drains with adequate quality water using a low pressure hose
8. Remove excess water from floors

9. Sanitize (according to manufacturer directions) the equipment and floors

Clean industrial work equipment procedures

- ✓ Assess suitability of equipment for cleaning
- ✓ Select appropriate cleaning equipment and chemicals
- ✓ Select the protective clothing and equipment to be used
- ✓ Prepare equipment for cleaning
- ✓ Clean equipment as identified
- ✓ Tidy work site
- ✓ Dispose of waste
- ✓ Clean, check and store cleaning equipment and chemicals

Maintain industrial work areas and equipment procedures

1) Identify maintenance tasks to be undertaken
2) Perform maintenance tasks, as required
3) Report problems and faults that require additional attention
4) Store maintenance items and equipment
5) Perform required administrative tasks
6) Assist in special projects, where required
7) Liaise with external contractors

5.5. Recording standard forms and report

5.5.1. Introduction

Standard forms: Food processors need to create a standard form to be used for all procedures and work instructions. The standard should also include either a header or footer to indicate the procedure number, the date it was adopted, who created the document, and whether it is an original document or has been revised. One element many processors fail to do when developing procedures is include corrective actions. If product safety is potentially compromised, the corrective action needs to address how that product will be handled. For example, calibration is an essential program for ensuring that monitoring devices are working properly. If an instrument

such as a temperature monitoring device is found to be out-of-calibration, there is a chance product safety was compromised. The calibration procedure must address that concern.

Developing, documenting, implementing, and maintaining the necessary documentation to properly maintain a food safety management system (FSMS) is an integral part of doing business for food processors, ingredient manufacturers, and packaging suppliers large and small. Yes, even the very small operator who might not be mandated to have such programs will, most likely, be asked to show it has a food safety system in place for its customers. Documented system that includes procedures, work instructions, and the necessary recordkeeping forms for all elements of the food safety plan. Creating procedures and implementing them is not easy nor is something that can be accomplished overnight.

5.5.2. Documents and Records

Documents are written policies, process descriptions, and procedures used to communicate information. They provide written instructions for HOW TO do a specific task. Blank forms are also considered documents. Forms are used to capture data or information from performing a procedure.

Ensuring Good Data

- Understanding the data: Staff should know exactly what information is needed.
- Recording the data every time: After providing services to the client, use the appropriate form.
- Recording all the data: All the information requested on the monitoring forms should be completed.
- Recording the data in the same way every time: Consistently use the same definitions.

Work place information related to maintaining food quality may include

- Standard Operating Procedures (SOPs),
- Specifications and production
- Quality specification
- Log sheets

- Basic data
- Standard forms
- Written and verbal instruction

What is an SOP? Standard Operating Procedures (SOP) are also documents, and contain written step-by step instructions that laboratory staff should meticulously follow when performing a procedure. A laboratory will have many SOPs, one for each procedure conducted in the laboratory. It is a good idea to standardize the formats of SOPs so staff can easily recognize the flow of the information.

Log sheets: In simple terms, a log sheet is a blank sheet on which various logs are entered. ... The only way to do so would be to use a log. In fact, most companies even use logs to keep a record of the attendance of the employees, the tasks completed and those still underway, the hours worked and so on.

Specifications and production: A manufacturing specification contains all the information that is needed to make the product. It describes the stages of manufacture and the materials needed, using flowcharts, diagrams, notes and samples. A manufacturing specification is done once the final product has been developed.

A product specification (also referred to as "product specs") is a document with a set of requirements that provides product teams the information they need to build out new features

Record Keeping

There are four sets of records that should be kept by the owner of a small fruit and vegetable processing unit:

- Financial records
- Production records
- Quality assurance records
- Sales records

Production records. Recipes Raw materials and ingredients received and suppliers Wastage % at different stages of the process Stock levels for each ingredient Production volumes and measurements Maintenance programs and schedules

Quality assurance records. Target amounts of ingredients and any changes made to recipe Measurements made at process control points Batch numbers and product code numbers Cleaning procedures and schedules

Sales records. Names of customers and amounts sold to each Weekly and monthly sales volumes

Self-check 5	Written Test

Name: _____ ID: _____ Date: _____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: give short answer questions

1. List out HACCP principles
2. Uses of working in HACCP principles?
3. Why set specification related with customer value
4. Define specification for manufacturing process?
5. List out five essential food Specification Management
6. Define scheduling?
7. Write industrial work areas Cleaning procedures
8. List Maintain industrial work areas and equipment procedures
9. List out Work place information related to maintaining food quality ?
10. Define log sheets
11. What is Standard Operating Procedures (SOPs)?
12. What is Specifications and production?

Test II: Choose the best answer

1. All are the benefits of production scheduling except

   A. Process change-over reduction
   B. Inventory reduction, leveling
   C. Reduced scheduling effort
   D. Increased production efficiency
   E. Labor load leveling
   F. Monitoring

2. Which of the following is NOT a benefit of production scheduling?

A. Reduced scheduling effort
B. Increased production efficiency
C. Improved product quality
D. Labor load leveling

3. Which of the following is NOT a step in the cleaning and sanitizing process?
   A. Remove heavy debris from floors with brooms or shovels and dry clean processing equipment, if needed
   B. Pre-rinse the equipment with adequate quality water
   C. Foam and scrub the equipment with an effective cleaner and scrub using dedicated brushes
   D. Sanitize (according to manufacturer directions) the equipment and floors
4. Which of the following is NOT a characteristic of hygienic design?
   A. Choice of surfaces
   B. Eliminate angles, corners and dead spaces
   C. Quality soldering and watertight joins
   D. Difficult-to-clean surfaces
5. Which of the following is NOT a type of record that should be kept by a food processor?
   A. Financial records
   B. Production records
   C. Quality assurance records
   D. Employee attendance records
6. Which of the following is NOT a step in developing a documented food safety management system?
   A. Creating procedures
   B. Implementing procedures
   C. Maintaining records
   D. Maintaining equipment

Operation Sheet 3	

3.1. Cleaning industrial work equipment's

A. Tools and Equipment

- Inspection checklist
- Cleaning agent
- Cleaning cloths
- Brushes
- Scrapers
- Safety data sheets (SDSs)

B. Procedures

Step 1 - Assess suitability of equipment for cleaning

Step 2 - Select appropriate cleaning equipment and chemicals

Step 3 - Select the protective clothing and equipment to be used

Step 4 - Prepare equipment for cleaning

Step 5 - Clean equipment as identified

Step 6 - Tidy work site

Step 7 - Dispose of waste

Step 8 - Clean, check and store cleaning equipment and chemicals

3.2. Maintaining industrial work areas and equipment's

A. Tools and Equipment

- Inspection checklist
- Maintenance schedule
- Maintenance log

B. Procedures

Step 1 - Identify maintenance tasks to be undertaken

Step 2 - Perform maintenance tasks, as required

Step 3 - Report problems and faults that require additional attention

Step 4 - Store maintenance items and equipment

Step 5 - Perform required administrative tasks

Step 6 - Assist in special projects, where required

Step 7 - Liaise with external contractors

LAP test 3	**Performance Test**

Name: _____ ID: _____ Date: _____

Time started: _____Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2:00** hour. The project is expected from each student to do it.

Task- 1 Perform **c**leaning industrial work equipment's

Task- 2 Maintain industrial work areas and equipment's

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