



FRUIT AND VEGETABLE PROCESSING -Level-II

Based on May 2019, Version 2 Occupational standards

Module Title: - Inspecting and Sorting Raw Materials

LG Code: IND FVP2 M10 LO (1-4) LG (33-36)

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LG #33

LO #1- Inspect materials to confirm fitness for use

Instruction sheet

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

- Confirming materials type and quality requirements
- Transferring materials to required location

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 requirement of materials
- Convey or transfer materials by materials transfer equipment.

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).



Information Sheet 1- Confirming materials type and quality requirements

1.1. Introduction

This module covers the knowledge, skills and attitude required to inspect and sort product and incoming materials ready for processing. Quality is fitness for purpose or use. It refers to the features and characteristics of a product that bears on its ability to satisfy the needs of the consumer. Defects and improper food quality may result in consumer rejection and lower sales, while food safety hazards may be hidden and go undetected until the product has been consumed. If detected, serious food safety hazards may result in market access exclusion and major economic loss and costs. Since food safety hazards directly affect public health and economies, achieving proper food safety must always take precedence over achieving high levels of other quality attributes. Once product quality has been undermined, it is virtually impossible to restore.

1.2. Quality Attributes of fresh produce

Quality attributes of fresh fruits and vegetables can be classified into three classes according to the occurrence of product characteristics when they are encountered or consumed:

Table 1.1. Quality attributes of fresh product

Class of attribute	Quality attribute	Measurement of quality attribute
External	Appearance (sight)	Visual evaluation of size, shape, gloss and colour May be accompanied by visual guides and colorimeters
	Feel (touch)	Manual evaluation of firmness and texture May be accompanied by mechanical texture analysis
	Defects	Visual evaluation of absence of defects or deterioration of colour May be accompanied by mechanical methods (e.g. ultrasound)



1.3. Quality control and assurance

Quality control (QC) is the process of maintaining an acceptable quality level to the consumer. Quality assurance (QA) is the system to assure that the overall QC job is being done effectively. Quality control starts in the field with the selection of the proper time to harvest until marketing.

1.4. Standardization and inspection of fresh produce

Food standards are used to maintain uniformity of product quality and safety, to gain market access and establish market presence, to provide different consumers with equal information about the product and to prevent economic fraud or market exclusion. Standardization allows for correct food labelling – the basis for consumer confidence

1.4.1. Inspection

The main purpose of inspection is to provide the client with objective, independent, and impartial information regarding the condition and safeness of the raw materials suitable for further processing. There are several reasons for inspection but the main focus is to achieve quality products which always an expectation both in business and in the world of work. Inspection is done either on a continuous basis (where inspectors frequent checks the quality of the commodity along the packing lines), or on a sample basis (where representative samples of a lot are randomly selected and inspected to determine whether the product meets the grade specification for which it is packed). When inspection is completed, confirming or certificating are applied by the inspector on the basis of applicable official standards.

To ensure uniformity of inspection: (1) inspectors are trained to apply the standards, (2) visual aids, (3) determining quality and maturity and (4) good working environments with proper lighting are provided.

In fruit and vegetable handling , if the fruit producer has followed GAPs and the harvest and handling have been accomplished effectively, fruit arriving at the processing plant should be reasonably sanitary and of optimum quality, thus simplifying succeeding operations. Nevertheless, quality cannot be taken for granted.

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In many cases the basis for payment is the condition of the fruit or vegetables as received. Hence sampling and analysis for composition and quality are mandatory.

Government norms, an industry association, or agreement between producer and processor in advance of the crop purchase can dictate applicable quality standards. Some agreements are seasonal or even ready before planting or harvest. A representative sample of the shipment may be drawn according to statistical procedures, thus, an inspection is conducted to see visible defects and foreign matter and then analyzed for microbial load, pathogens, pesticide residues, aflatoxin level, color, sugar, acid, flavor, or other important safety and quality attributes.

Rejection at this stage is a serious matter, since considerable time, effort and expense has already been invested in the suspect lot. If the defect is correctable (cleanup, resorting and inspection) a price penalty may be imposed or alternate processing required. However, if the lot cannot be corrected, contamination (microbial or chemical) or far off-standard composition/quality disposal costs and reputation damages, result. In either circumstance process flow is disrupted and plant operations suffer. Thus for reasons of quality and safety it is important that all the produce must undergo careful inspection to prevent wastage of any sort. Inspection can be manual, depending upon workers observing and removing defects or automatic, affected by computer controlled sensors to detect off color, shape or size. Sophisticated instrumentation operating at high speed is being increasingly employed in modern processing facilities, although the human eye, hand and mind still commonly make the final decision.

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Self-check 1

Written test

Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write three quality attributes of fresh produce (5 pts)
2. Define quality control and quality assurance (5 pts)

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____



Information Sheet 2- Transferring materials to required location

2.1. Material used in transferring fruit and vegetable

After the raw materials has been thoroughly inspected they will then be brought to the processing location using **conveyors or flumes pumped system**.

2.1.1. conveyor

Conveyor is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials.



Figure 2.1. Conveyor

Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Some of basic characteristics of conveying equipment's are:-

- Transporting material from one place to another over stationary structure.
- Carries material in continuous stream with its distinct feature such as endless chain or belt.
- Can be done horizontally, vertically or inclined.

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- When the equipment does horizontal conveying, it is known as conveyor and when it does vertical, it is known as elevator.
- Conveying are mainly used in mining, construction and in some of the industries.

The Advantage of using conveyors are as follows:-

- It increases the output.
- It facilitates continuity in operation.
- It results in time saving.
- There are no waiting periods

2.1.2. Flumes pumped system

Conveying foods in water using shallow inclined troughs (or flumes) and pipes finds application for the simultaneous washing and transporting of small particulate foods, such as peas, sweet corn, etc. The main advantage is reduced power consumption as water flows under gravity, especially at factory sites located on hillsides. Water is re-circulated to reduce costs and is filtered and chlorinated to prevent a buildup of micro-organisms.

2.1.3. Mechanical or pneumatic system

Every pneumatic system, makes use of pipes or ducts called transportation lines that carry mixture of materials and a stream of air. These materials can be transported conveniently to various destinations by means of a stream of high velocity air through pipe lines. Products are moved through various tubes via air pressure, allowing for extra vertical versatility. Pneumatic conveying is routinely used to move solids of all sizes within process plants. On account of the compressibility of the conveying gas, the pneumatic conveying of solids is quite different from the pumping of liquids or slurries. The selection of many of the components that comprise a conveying system such as rotary valves, feed chutes, conveying pipe, and air movers is examined, especially as it relates to reliable operation of a conveying system.

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Self-check 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What are the basic characteristics of conveying equipment's (5pts)
2. What is the advantage of using conveyors (5pts)

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____
Rating: _____



LG #34

LO #2- Sort materials

Instruction sheet

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

- Meeting material inspection and sorting
- Identify and report unacceptable quality requirements
- Maintaining work area
- Conducting work

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:

Meet material inspection and sorting to confirm quality requirements.

- Identify and report unacceptable quality requirements
- Maintain work area according to housekeeping standards.
- Conduct work in accordance with workplace environmental guidelines

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after



you finished answering the Self-checks).

Information Sheet 1- Meeting material inspection and sorting

1.1. Raw Material inspection and sorting

All food raw materials are inspect and sort before processing. The purpose is obviously to remove contaminants, which range from innocuous to dangerous. It is important to note that removal of contaminants is essential for protection of process equipment as well as the final consumer. At the time of harvest most foods are likely to contain contaminants. It is therefore necessary to perform one or more of the unit operations such as cleaning, sorting and grading.

1.1.1 Cleaning

Cleaning is the unit operation in which contaminating materials are removed from the food and separated to leave the surface of the food in a suitable condition

1.1.2. Grading

It strictly means “the assessment of overall quality of a food using a number of attributes”. For example, apples are graded with the assistance of color cards that show the required characteristics of different grades in terms of color distribution across the fruit, surface blemishes and size and shape of the fruit.

1.1.3. Sorting

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A preliminary sorting of produce should remove unmarketable pieces and foreign matters, such as plant debris, soil and stones, before the produce passes on to further operations. All discarded material should be quickly hauled away from the packing place. Raw materials are sorted on the basis of:

1. Weight Sorting
2. Size Sorting
3. Color Sorting
4. Shape Sorting

Weight sorting: Weight is usually the most precise method of sorting, as it is not dependent on the geometry of the products. Eggs, fruit or vegetables may be separated into weight categories using spring-loaded, strain gauge or electronic weighing devices incorporated into conveying systems. Using a series of tipping or compressed air blowing mechanisms set to trigger at progressively lesser weights, the heavier items are removed first, followed by the next weight category and so on. These systems are computer controlled and can additionally provide data on quantities and size distributions from different growers. An alternative system is to use the 'catapult' principle where units are thrown into different collecting chutes, depending on their weight, by spring-loaded catapult arms. A disadvantage of weight sorting is the relatively long time required per unit; and other methods are more appropriate with smaller items such as legumes or cereals, or if faster throughput is required. Fruits such as apples, pears and citrus fruits, vegetables such as potatoes, carrots and onions are sorted by weight.

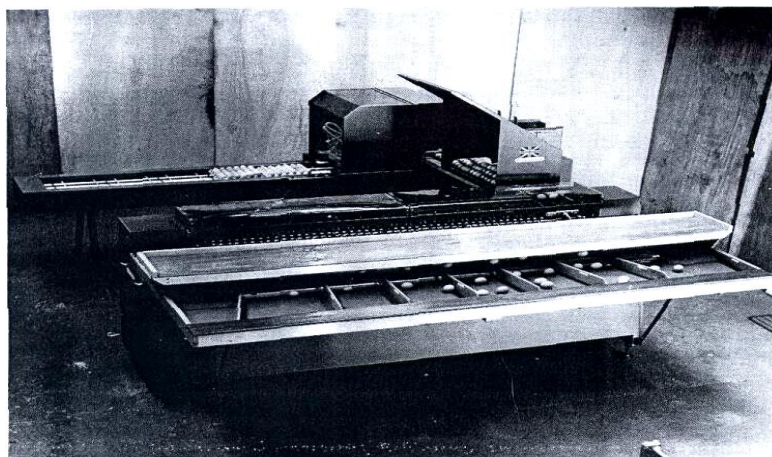


Figure 1.1. Weight sorter



Size Sorting by Hands: Size sorting is less precise than weight sorting, but is considerably cheaper. The size and shape of food units are difficult to define precisely. Size categories could involve a number of physical parameters, including diameter, length or projected area. Diameter of spheroidal units such as tomatoes or citrus fruits is conventionally considered to be orthogonal to the fruit stem, while length is coaxial. Therefore rotating the units on a conveyor can make size sorting more precise. The main categories of screens are fixed aperture and variable aperture designs. Flatbed and rotary screens are the main geometries of the fixed bed screen and a number of screens may be used in series or in parallel to sort units into several size categories simultaneously. The problem with fixed screens is usually contacting the feed material with the screen, which may become blocked or overloaded. Fixed screens are often used with smaller particulate foods such as nuts or peas. Variable aperture screens have either a continuous diverging or stepwise diverging apertures. These are much gentler and are commonly used with larger, more delicate items such as fruit. In our homes fixed aperture screen (sieve) are used for size sorting and in food industry screens of different dimensions are used

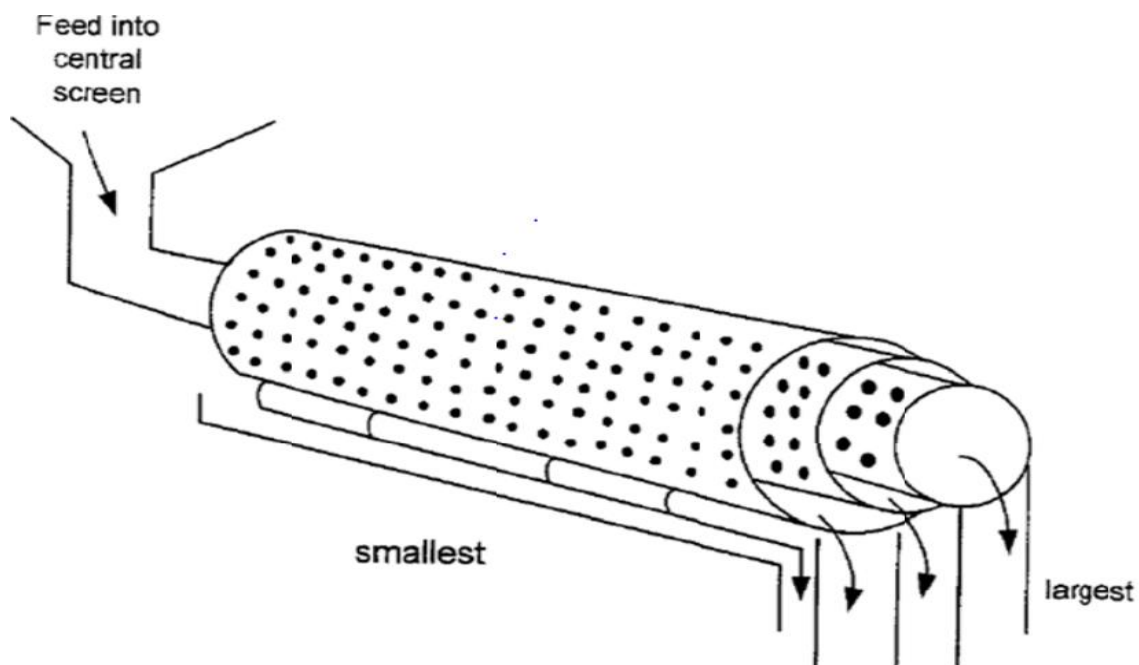


Figure 1.2. Fixed screens machine



Figure 1.3. Manually size sorting by hands

Colour Sorting: Extremely high throughputs have been reported. By using more than one photocell positioned at different angles, blemishes on large units such as potatoes can be detected. Colour sorting can also be used to separate materials which are to be processed separately, such as red and green tomatoes. It is feasible to use transmittance as a basis for sorting although, as most foods are completely opaque, very few opportunities are available. The principle has been used for sorting cherries with and without stones and for the internal examination, or ‘candling’, of eggs.

Mostly, Food colors that’s his appearance attract the consumers so there is a higher price for the product. Manually labor on inspection belts or electric color sorter that scan the color are used in industry. Color sorters are used for food processing industry, such as coffee, nuts, and oil crops. The goal is the separation of items that are discolored, toxic (such as ergot), not as ripe as required, or still with hull after dehulling such as sunflower seed. Compared with manual sorting: machines saving labor and time, with higher high efficiency, and lower processing costs



Figure 1.4. Colour sorting

Shape Sorting: Shape sorting is useful in cases where the food units are contaminated with particles of similar size and weight. Shape sorting is mostly done for the removal of contaminants from the raw material. For example: Wheat is passed through shape sorters, so that all the contaminants must be removed having the same size or weight but a different shape.



Self-check 1	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write three unit operation used in food processing (5pts)
2. Write types of sorting of raw material (5pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____



Information Sheet 2- Identifying and reporting unacceptable quality requirements

2.1. Quality of fruit and vegetable

Quality is fitness for purpose or use. Features like shape, dimension, composition, finish and colour. Quality control is systematic control of these variables encountered in manufacturing process which affect the excellence of the end product. Quality control is that technique or group of techniques of industrial management by means of which products of uniform acceptable quality are manufactured.

2.2. Quality variation

When the quality of any fruit and vegetable is given by industry, then it is responsible for any variation from the standard. Quality variation occurred when contaminants with:

- Unwanted parts of the plant, such as leaves, twigs, husks;
- Soil, sand, stones and metallic particles from the growing area;
- Insects and their eggs;
- Animal excreta, hairs etc.;
- Pesticides and fertilisers;
- Mineral oil;
- Microorganisms and their toxins.
- **Unacceptable quality indication in fruit and vegetable are:**
 - ✓ Sprouting
 - ✓ Water loss and decay
 - ✓ Loss of green colour
 - ✓ Mechanical injury
 - ✓ Water loss and decay
 - ✓ Discoloration
 - ✓ Bruising and other mechanical injury
 - ✓ Water loss and decay

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✓ Over-ripeness at harvest

Self-check 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Define quality(5pts)
2. Write the steps of quality controlling (5pts)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Answer Sheet

Score = _____
Rating: _____



Information Sheet 3- Maintaining work area

3.1. Maintaining work area according to housekeeping standards

Good housekeeping is the foundation of a safe, healthy and pleasant workplace. It is essential that all areas be kept clean, orderly, and with all necessary things in the proper places. Employees should be aware of hazards arising from poor housekeeping. Good housekeeping improves safety, efficiency and quality at the same time.

- **Housekeeping activities**

- ✓ Keep work areas neat and clean.
- ✓ Place tools, equipment and supplies in their correct places.
- ✓ Implementing cleaning schedules for the area
- ✓ Removing wrapping and packaging waste
- ✓ Storing all product as soon as possible after delivery
- ✓ Remove potential hazards
- ✓ Keep the area clear for future deliveries
- ✓ Keeping stores area well and ventilated to deter pests and allow for easy identification of product items and problem issues
- ✓ Keeping shelves, benches, pallets, bins and other storage containers in good order and inspecting the area and fittings on a regular basis for signs of damage or deterioration or other problems such as stability, security and pest infestation
- ✓ Maintaining all equipment and storage areas in accordance with the relevant occupational health and safety requirements.
- ✓ Checking the temperature of refrigerated food storage areas
- ✓ Initiating preventative maintenance servicing for plant and equipment in the stores area before servicing them

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- ✓ Developing and implementing a proper cleaning schedule for the stores areas including ensuring supplies of all necessary chemicals and equipment exist to get the job done

Self-check 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is the good housekeeping? (5 point)
2. List at least 5 housekeeping guideline?(5)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Answer Sheet

Score = _____
Rating: _____



Information Sheet 4- Conducting work

4.1. Conduct work in accordance with environmental policies and procedures

The maintenance of cleanliness in a working area requires frequent or continuous cleaning as well as a clean-up at the end of each day. The purpose of this is to keep waste from accumulating during the operating day. It involves:

- careful organization
- training work scheduling and
- the best available equipment
- method and materials.

Hazard Analysis Critical Control Point (HACCP): HACCP allows processors/regulator to look at what happens during the process to ensure safety.

Major Concepts of HACCP

1. A preventive system of control particularly on biological hazards
2. A system approach for estimating the risk in producing a food product
3. Universally recognized system as the most effective way to prevent food borne illness
4. Science - based systematic, identified specific hazards and measures for their control to ensure food safety
5. Capable of accommodating change, such as advances in equipment design, processing procedures, or technological developments that can be applied throughout the food chain from the primary producer to the final consumer

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6. Applicable to establishments that produce, process, treat, pack, trade, transport, serve, or involve in food production

Seven (7) HACCP Principles

1. Hazard analysis
2. Identify critical control points
3. Establish Control limits
4. Monitor critical limits
5. Establish corrective actions in case of deviation from established critical limits
6. Establish verification procedure to ensure that the system is consistent
7. Establish record keeping procedures

General Hazards Characteristics

- The product contains sensitive ingredients, which can be assumed as potential sources of contamination under normal circumstances.
- The manufacturing process does not contain controlled processing steps that effectively destroy harmful bacteria.
- There is substantial potential for microbiological abuse in distribution or in consumer handling that could render the product harmful when consumed.
- Product is subject to contamination after processing and before packaging.
- No terminal heat process after packaging.

HACCP Pre-Requisite Programs

1. Good Manufacturing Practices (GMP): GMPs are systems put in place to ensure that food prepared in a plant is sound and free of contamination. GMPs include:
 - Plant grounds and building facilities emphasize pest control;
 - Equipment design provides ease in cleaning and maintenance;
 - Personal hygiene practices and facilities are set;
 - Storage and warehousing are free from contamination.
2. Sanitation Standard Operating Procedures (SSOP): SSOP are components of GMP that emphasize sanitation procedure. They include:
 - Safety of water that gets in contact with food and food surfaces;

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- Measures to prevent contamination;
- Employee hygiene practices;
- Control of employee health conditions that could result in contamination of food and food surfaces;
- Protection of food and food contact surfaces from adulteration with toxic and other harmful components;
- Proper labelling and storage and use of toxic; and Control of pests.

Self-check 4	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is HACCP? (4 point)
2. What are the 7 principle of HACCP?(5)
3. What are Sanitation Standard Operating Procedures (SSOP) include?(5)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 7 points

Unsatisfactory - below 7 points

Answer Sheet

Score = _____

Rating: _____



LG #35

LO #3- Perform washing activities

Instruction sheet

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

- Performing washing emersion procedures
- Doing rinsing by plate water
- Conducting washing with brushes

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:

- Perform washing by emersion procedures
- Do rinsing by plate water
- Conduct washing with brushes

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Performing washing by emersion procedures

1.1. Fruit and vegetable washing by emersion method

Emersion is the process of immersing the fruit and vegetables in hot water at 85–95°C. Procedure of emersion fruit and vegetable are:

1.1.1. Selection of fruits and vegetables

Fruits and vegetables should be absolutely fresh. Fruits should be ripe, but firm, and uniformly mature. Over-ripe fruits should be rejected because they are infected with microorganisms and give a poor quality product. Unripe fruits should be rejected because they generally shrivel and toughen on canning. All vegetables except tomatoes should be tender. Tomatoes should be firm, fully ripe and of deep red

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colour. Fruits and vegetables should be free from dirt. They should be free from blemishes, insect damage or mechanical injury

1.1.2. Grading

The selected fruits and vegetables are graded according to size and colour to obtain uniform quality. This is done by hand or by machines such as screw grader and roller grader. Fruits like berries, plums and cherries are graded whole. While peaches, pears, apricots, mangoes, pineapples, etc., are generally graded after cutting into pieces or slices

1.1.3. Washing

It is important to remove pesticide spray residue and dust from fruits and vegetables. One gram of soil contains 10¹² spores of microorganisms. Therefore, removal of microorganisms by washing with water is essential. Fruits and vegetables can be washed in different ways. Root crops that loosen in soil are washed by soaking in water containing 25 to 50 ppm chlorine (as detergent). Other methods of washing are spray washing, steam washing, etc.

1.1.4. Peeling

Many fruit and vegetables are peeled and cut by hand with the help of peeling knives. The peeling knife with a curved blade and a special guard to regulate the depth of peeling can be used for uniform peeling in case of irregular fruit shapes. The objective of peeling is to remove the outer layer. Peeling may be done in various ways:

- Hand Peeling
- Steam Peeling
- Mechanical Peeling
- Lye Peeling



1.1.5. Cutting

Pieces of the size required for canning are cut. Seed, stone and core are removed. Some fruits like plum from which the seeds cannot be taken out easily are canned whole.

1.1.6. Emersion

Emersion the fruit and vegetables in hot water following cooling, after emersion the fruit and vegetables are dipped in cold water for better handling and keeping them in good condition.

1.2. Tools and Utensils Used in Food Processing and their Uses

Measuring cup: is a kitchen utensil used primarily to measure the volume of liquid or cooking ingredients such as water and juice, flour, etc. Measuring cups can be in plastic, glass and stainless.



Weighing scale: A weighing scale (or weighing balance) is a device used to get the weight of food like vegetables, fruits,



Knife: is a tool with a sharp blade and a handle used for cutting fruit and vegetables

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Ladles: A ladle is a type of spoon used to lifting liquid out of a pot or other vessel and conveying it to a bowl



Tongs: are a type of tool used to grip and lift objects instead of holding them directly with hands. There are many forms of tongs adapted to their specific use.



Colanders: is a kitchen utensil used to strain foods to rinse vegetables.



Thermometers: Thermometers indicate the degree of hotness or coldness of a thing or body. It measures how high or how low the temperature



Chopping board: A cutting board (or chopping board) is a durable board on which to place material for cutting.



Self-check 1	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Define emersion of fruit and vegetable(5pts)
2. Write the procedure of emersion fruit and vegetable(5pts)



You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Information Sheet 2- Doing rinsing by plate water

2.1. Washing of fruit and vegetables using plate water

Fruit and vegetables are generally washed with water to remove dust, dirt and adhering surface micro-flora. Fruits like peach, apricot etc. are lye peeled so not washed before peeling. On the other hand, washing after peeling removes vitamins



and minerals and should be discouraged. Different methods of washing include soaking or agitating in water, washing with cold or hot water sprays etc.

- Mechanical washers involve agitating or tumbling the commodity on moving belts or revolving screens while they are immersed in water or subjected to water sprays.
- Washing by using high pressure sprays is most satisfactory.
- Detergents are frequently used in the wash or rinse water.
- Vegetables may be soaked in dilute solution of potassium permanganate or chlorine (25-50 ppm) for disinfection.
- The water temperature should be kept low to keep the fruit firm and to reduce leaching losses.
- High pressure sprays should not injure the fruits.

Bacteria and other contaminants can accumulate in the wash water and hence appropriate cleaning and chlorination practices be followed. Packaged fruits and vegetables labelled as being previously washed and RTE are not required to be washed.

Self-check 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Write true if the statement is right and false if the statement is wrong



1. Packaged fruits and vegetables labelled as being previously washed and RTE are not required to be washed (5pts)

Test I: Short Answer Questions

1. Write method of washing fruit and vegetables (5pts)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- Conducting washing with brushes

3.1. Fruit and Vegetable Washing Brushes

Washing must be done before the fruit is cut in order to avoid losing high-nutritive value soluble substances (vitamins, minerals, sugars, etc.).

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3.2. Brush Type Vegetable and Fruit Cleaning Machine

3.2.1. Rotary brush roller cleaning machine

The fruit and vegetable raw materials are making irregular rotation under the effect of rotary brush roller to carry out spraying and brushing simultaneously. The brush is made of high temperature resistant nylon wire through two kinds of technologies such as hair planting and stainless steel winding.

- Brush fruit cleaning machine for apple and fruits
- Brush clearing machine for watermelon
- Brush cleaning machine for carrot vegetable
- Brush cleaning machine for citrus fruit



Figure 3.1. Rotary brush roller Machine

3.2.2. Roller with brush cleaning machine

The equipment is mainly composed of water cabinet, material turning device, fan and lifter etc. It is widely used for soft washing of fruit and vegetable raw materials. The lifter can be made of complete stainless steel and engineering plastic. It can be additionally provided with spray cleaning device.



Figure 3.2. Roller with brush cleaning machine

The fruit washing equipment consists of a roller with brush washing (cleaning) machine for washing fruits and vegetables. Roller with brush washing machine is made up of stainless steel tube and brush. The brush is made of polyethylene, and will make revolution as the movement of stainless steel chain. Fruits are driven to circumsolve and washed by brush. At the same time, the bad or rejected fruits are picked up by manual and then sent away by scrap conveying device.

3.2.4. Rolling drum brush washing machine

The fruit washing equipment consists of a rolling drum brush washing (cleaning) machine for washing root vegetables. Rolling drum brush washing machine is made up of electric motor, water pump, roller drum, supporter, riding wheel, brush, water spraying tubes, feeding funnel, cover board, water box, transmission shaft, supporter for motor, electric control switches, and other parts. Roller drum is driven to rotate by chain wheel of electric motor through stainless steel chain. When materials enter into the rotating roller drum, they are washed by spraying water and brush. There are two water boxes in our rolling drum brush washing machine. One is used to hold fresh water, and the other with filtering net in it is to recycle water.



Figure 3.3. Rolling drum brush washing machine

Self-check 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write two brush type vegetable and fruit cleaning machine(5pts)

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2. Write two fruit and vegetable type that cleaning by brush

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Operation sheet – 1

Perform washing activities

Operation title: Perform washing by emersion

Purpose: To perform washing of fruit and vegetable by emersion process

Materials required:

- **Materials:**



✓ Fruits like tomato, peaches and water

• Utensils:

- ✓ Measuring cup
- ✓ Measuring spoon
- ✓ Weighing scale
- ✓ Knife
- ✓ Chopping board
- ✓ Ladles
- ✓ Tongs
- ✓ Colanders
- ✓ thermometer

Procedures for emersion of fruit and vegetable:

Step 1. Wear protective clothing

Step 2. Select fruit and vegetable

Step 3. Perform washing, peeling, slicing and chopping,

Step 3. Use a steamer or make a steamer out of a kettle with a tight-fitting lid.

Step 4. Add 5 cm of water to the kettle and heat it to boiling.

Step 5. Place the fruit and vegetable on a colander, wire basket, or sieve.

Step 6. Putting the container in the steamer and cover it tightly, and continue boiling

Step 7. Transfer to an ice bath immediately.

Step 8. Cooling

Step 9. Make the fruit or vegetable for drain and set aside either to use in a recipe or to process for canning, drying, or freezing.

Lap Test	Perform washing activities
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Name..... ID..... Date.....

Time started: _____ Time finished: _____



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

Task-1 Perform washing by emersion

LG #36

LO #4- Apply blanching

Instruction sheet



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

- Maintaining blanching and set material.
- Applying blanching procedures
- Following blanching objectives.

Following blanching objectives. 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:

- Maintain blanching and set material.
- Apply blanching procedures depends upon specificity vegetables
- Follow blanching objectives and subsequent processing /preservation methods.

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Maintaining blanching and set material

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1.1. Blanching

Blanching is achieved in hot water for a short period of time or in an atmosphere of steam. In water blanching, the product is moved through water usually maintained at a temperature between 88 and 99°C. Blanching is used to destroy enzymatic activity in vegetable and some fruits prior to other processing like freezing or dehydration or canning or thermal processing. It is a pre-treatment by mild heat for a specific time followed by rapid cooling or passing immediately to the next processing stage. The time and temperature combination varies from product to product, the condition and size of product.

The following factors are affecting blanching time:

- The type of fruit or vegetable.
- The size of the pieces of food.
- The blanching temperature and
- The method of heating

1.3. Processing Conditions for Blanching

It is essential to control the processing conditions accurately to avoid loss of texture, weight, colour and nutrients. All water-soluble materials, including minerals, sugars, proteins and vitamins, can leach out of the tissue, leading to nutrient loss. In addition, some nutrient loss (especially ascorbic acid) occurs through thermal lability and, to a lesser extent, oxidation.

Ascorbic acid is the most commonly measured nutrient with respect to blanching, as it covers all eventualities, being water soluble and hence prone to leaching from cells, thermally labile, as well as being subject to enzyme breakdown by ascorbic acid oxidase during storage. Wide ranges of vitamin C breakdown are observed, depending on the raw material and the method and precise conditions of processing.

The following factors must be considered for deciding processing conditions of blanching:

- Fruit or vegetable properties, especially thermal conductivity, which will be determined by type, cultivar, degree of maturity etc

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- Overall blanching effect required for the processed product, which could be expressed in many ways including: achieving a specified central temperature, achieving a specified level of peroxidase inactivation, retaining a specified proportion of vitamin C.
- Size and shape of food pieces
- Method of heating and temperature of blanching medium

Time/temperature combinations vary very widely for different foods and different processes and must be determined specifically for any situation. Holding times of 1–15 minutes at 70–100 °C are normal.

Self-check 1	Written test
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Name..... ID..... Date.....

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Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What are the factors which influence blanching time (5 pts)
2. What are the factors must be considered for deciding processing conditions of blanching(5 pts)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Information Sheet 2- Applying blanching procedures

2.1. Methods of Blanching

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The two most widespread commercial methods of blanching involve passing food through an atmosphere of saturated steam or a bath of hot water. Both types of equipment are relatively simple and inexpensive. Microwave blanching is not yet used commercially on a large scale. There have been substantial developments to blanchers in recent years to reduce the energy consumption and also to reduce the loss of soluble components of foods, which reduces the volume and polluting potential of effluents and increases the yield of product.

Conventional steam blanching consists of conveying the material through an atmosphere of steam in a tunnel on a mesh belt. Uniformity of heating is often poor where food is unevenly distributed; and the cleaning effect on the food is limited.

However, the volumes of waste water are much lower than for water blanching. Fluidised bed designs and 'individual quick blanching' (a three-stage process in which vegetable pieces are heated rapidly in thin layers by steam), held in a deep bed to allow temperature equilibration, (followed by cooling in chilled air) may overcome the problems of no uniform heating and lead to more efficient systems.

The two main conventional designs of hot water blancher are *reel* and *pipe* designs. In reel blanchers, the food enters a slowly rotating mesh drum which is partly submerged in hot water. The heating time is determined by the speed of rotation. In pipe blanchers, the food is in contact with hot water recirculating through a pipe. The residence time is determined by the length of the pipe and the velocity of the water. There is much scope for improving energy efficiency and recycling water in either steam or hot water systems. Blanching may be combined with peeling and cleaning operations to reduce costs.

Following the microwave heating, the vegetable material is subjected to blanching comprising heat treating in a current of hot air at temperature 100 to 150°C. The heating is conducted in an environment which prevents loss of water from the vegetable material and this may readily be achieved by introducing steam into the oven.

2.2. Equipment for Blanching

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2.2.1. Steam Blanchers

At its simplest a steam blancher consists of a mesh conveyor belt that carries food through a steam atmosphere. The residence time of the food is controlled by the speed of the conveyor. In conventional steam blanching, there is often poor uniformity of heating in the multiple layers of food. To overcome this Individual Quick Blanching (IQB) was introduced which involves blanching in two stages. In the first stage food is heated in single layer to a sufficiently high temperature. In the second stage a deep bed of food is held for sufficient time to allow the temperature at the centre of each piece to increase to that needed for enzyme inactivation.

2.2.2. Hot Water Blanchers

There are a number of different designs of blanchers each of which retains the food in hot water at 70 – 100°C for a specific time and thus removes it to a dewatering-cooling section. It has three sections:

- Pre-heating stage
- Launching stage
- Cooling stage.

The food is preheated with water that is circulated through a heat exchanger. After blanching a second re-circulation system cools the food. The two systems pass water through the heat exchanger and this heats the pre-heat water and simultaneously cools the cooling water. A re-circulated water-steam mixture is used to blanch the food and final cooling is done by cold air.

Self-check 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

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1. Define blanching (5pts)
2. Write method of blanching(5pts)
3. Write procedure of steam or hot water(5pts)
4. What are the factors which influence blanching time (5 pts)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 10 points

Unsatisfactory - below 10 points

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- Following blanching objectives

3.1. Purpose and Objective of Blanching

The purpose of blanching is to achieve several objectives.

- To soften the tissue to facilitate packaging.

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- To avoid damage to the product.
- To eliminate air form the product.
- To preserve the natural colour.
- To destroy or retard certain undesirable enzymes.
- To help preserve natural flavour.

The major purpose of blanching is frequently to inactivate enzymes, which would otherwise lead to quality reduction in the processed product. For example, with frozen foods, deterioration could take place during any delay prior to processing, during freezing, during frozen storage or during subsequent thawing. Similar considerations apply to the processing, storage and rehydration of dehydrated foods. Enzyme inactivation prior to heat sterilization is less important as the severe processing will destroy any enzyme activity, but there may be an appreciable time before the food is heated to sufficient temperature, so quality may be better maintained if enzymes are destroyed prior to heat sterilisation processes such as canning.

It is important to inactivate quality-changing enzymes that is enzymes which will give rise to loss of colour or texture, production of off odours and flavours or breakdown of nutrients. Many such enzymes have been studied, including a range of peroxidases, catalases and lipoxygenases. Peroxidase and to a lesser extent catalase are frequently used as indicator enzymes to determine the effectiveness of blanching. Although other enzymes may be more important in terms of their quality-changing effect, peroxidase is chosen because it is extremely easy to measure and it is the most heat resistant of the enzymes in question. More recent work indicates that complete inactivation of peroxidase may not be necessary and retention of a small percentage of the enzyme following blanching of some vegetables may be acceptable.

Blanching causes the removal of gases from plant tissues, especially intercellular gas. This is especially useful prior to canning where blanching helps achieve vacuum in the containers, preventing expansion of air during processing and hence reducing strain on the containers and the risk of misshapen cans and/or faulty seams. In addition, removing oxygen is useful in avoiding oxidation of the product and

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corrosion of the can. Removal of gases, along with the removal of surface dust, has a further effect in brightening the colour of some products, especially green vegetables.

Shrinking and softening of the tissue is a further consequence of blanching. This is of benefit in terms of achieving filled weight into containers, so for example it may be possible to reduce the tin plate requirement in canning. It may also facilitate the filling of containers. It is important to control the time/temperature conditions to avoid over processing, leading to excessive loss of texture in some processed products. Calcium chloride addition to blanching water helps to maintain the texture of plant tissue through the formation of calcium pectate complexes. Some weight loss from the tissue is inevitable as both water and solutes are lost from the cells.

A further benefit is that blanching acts as a final cleaning and decontamination process. It also removes pesticide residues or radionuclides from the surface of vegetables, while toxic constituents naturally present (such as nitrites, nitrates and oxalate) are reduced by leaching. Very significant reductions in microorganism content can be achieved, which is useful in frozen or dried foods where surviving organisms can multiply on thawing or rehydration. It is also useful before heat sterilization if large numbers of microorganisms are present before processing.

Self-check 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.



Test I: Write true if the statement is right and false if the statement is wrong

1. Hot-water blanching causes loss of some nutrients and gives rise to large volumes of waste water (5pts)

Test II: Short Answer Questions

1. Write objectives of blanching of vegetables (5pts)

You can ask you teacher for the copy of the correct answers

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Reference

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The trainers who developed the learning guide

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