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Ministry of Labor and Skills

Fruit and Vegetable Processing

Level-I




Based on June 2021, Version 3 Occupational Standard

Module Title: - Identifying Fruit & Vegetable Characteristics in Production

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Introduction to the Module

Ethiopia is endowed with diverse climatic and edaphic conditions favorable for the production of quality horticultural produces. Fruit and vegetable production is an important part of horticulture that plays a pivotal role in the livelihoods and food and nutritional security of the community in the country. Due to the existence of large agro-climatic diversity, favorable soil conditions and ample water resources, different tropical, subtropical and temperate fruit and vegetable crops are grown in different parts of the country. Hence, a variety of fruits can be produced in the country making fresh produce available year-round. Ethiopia has also a comparative advantage for successful production of various fruit and vegetable crops due to its proximity to major markets (Europe and Middle East) and availability of young and easily trainable work force.

This module covers the knowledge, skills and attitude required to identify major stages in fruit and vegetable making, and identify fruit and vegetable sales and marketing strategies and processes

LG #4	LO #1 Identify Major Stages in Fruit and Vegetable Making

Instruction sheet

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

- Introduction to the module
- Identifying key activity of various fruit and vegetable production
- Identifying Sequence of operations and key equipment's
- Identifying Basic differences between various industrial fruit and vegetable
- Using industry terminology describing fruit and vegetable processing

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:

- Identify key activity of various fruit and vegetable production
- Identify sequence of operations and key equipment's
- Identify basic differences between various industrial fruit and vegetable
- Use industry terminology describing fruit and vegetable processing

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. Identifying key activity of various fruit and vegetable production

When fruit is ready for harvesting and subsequent processing a large amount of the harvesting of most fruit crops is still done by hand; this labor may represent about half of the cost of growing the fruit. Therefore, mechanical harvesting is currently one of the most active fields of research for the agricultural engineer, but also requires geneticists to breed fruit of nearly equal size, that matures uniformly and that is resistant to mechanical damage.

Harvesting is the process by which agricultural commodities are detached from their mother plants for consumption or sale or for other purposes. Or, Harvesting is the deliberate picking of the commodity from the plants.

1.1.1 Harvesting indices

It refers, the economic yield of a crop in comparison with the actual total yield. For the determination of optimal harvesting maturity, it is a necessary tool and for this maturity, indices should be known.

Harvesting of fruits should be done at the optimum stage of maturity. During harvesting operations, a high standard of field hygiene should be maintained. It should be done carefully at the proper time without damaging the fruits. The harvesting operation includes.

- Identification and judging the maturity of fruits.
- Selection of mature fruits.
- Detaching or separating the fruits from the tree.
- Collection of matured fruits.

1.1.2 Method of harvesting fruits and vegetables



Figure 1.1. Harvesting of fruits

Different kinds of fruit and vegetables require different methods of harvesting. The methods of harvesting are:

1. Manual Harvesting.
2. Mechanical Harvesting.

1. Manual Harvesting: Harvesting by one's own hand is called manual harvesting. Hand harvesting has a number of advantages over machine harvest. People can accurately determine product quality, allowing an accurate selection of mature products. This is particularly important for crops that have a wide range of maturity and need to be harvested several times during the season.

It is done in several ways:

- Ladder/bag picking method
- Poles/Clippers method
- Harvesting by means of cutting knives
- Harvesting by means of digging tools



Figure 1.2. Manual harvesting methods of fruits and vegetables

2. Mechanical Harvesting: In this method, a number of mechanical devices are used for harvesting the produce on a commercial scale. Mechanical harvest is currently used for fresh-market crops that are roots, tubers, or rhizomes and for nut crops. Vegetables that are grown below ground (radishes, potatoes, garlic, carrots, beets, and others) are always harvested only once and the soil can be used to cushion the product from machine-caused mechanical injury. Tree nuts and peanuts are protected by a shell and easily withstand mechanical handling.

1.1.3 Points to be considered during harvesting fruits and vegetables

- Produce should be collected with care to avoid injury and damage.
- Market demands in terms of size and stage of maturity should be considered.
- Containers and harvesting tools should be clean and free from rough edges.
- Stackable and nestable plastic crates should be used as field containers during harvest. Plastic crates are durable, reusable, and can easily be cleaned.
- The harvesters should be properly trained on harvesting methods and proper stages of maturity.
- Produce that has fallen or touched the ground should not be harvested.
- Shade should be provided over the harvested produced to prevent heat and sun damage and reduce the rate of nutrient degradation.

- Suitable time for harvesting horticultural produce is the early morning.
- The harvesting tools and equipment should be disinfected with chlorine water.

1.1.4 A correct manual harvesting includes some rules

- ✓ The fruit should be picked by hand and placed carefully in the harvesting basket; all future handling has to be performed carefully in order to avoid any mechanical damage;
- ✓ The harvesting basket and the hands of the harvester should be clean;
- ✓ The fruit should be picked when it is ready to be able to be processed into a quality product depending on the treatment, which it will undergo.

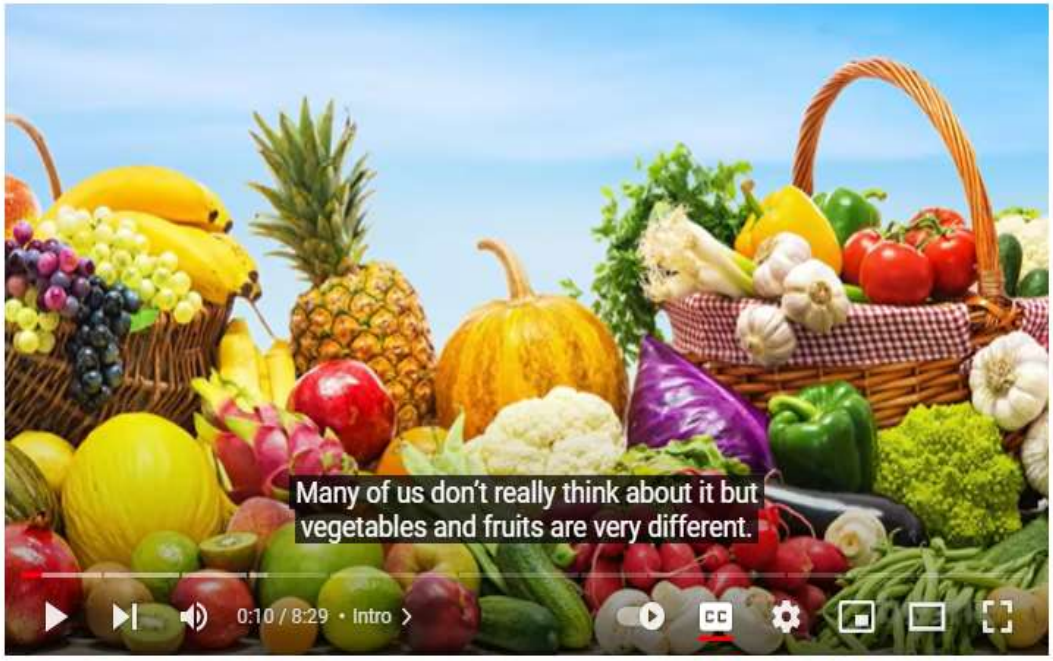


Figure 1.3: Fruit and vegetable characteristics
(https://www.youtube.com/watch?v=sAbgVd6XwTc, Accessed date: January 20, 2023)

The processing center 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 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 etc.

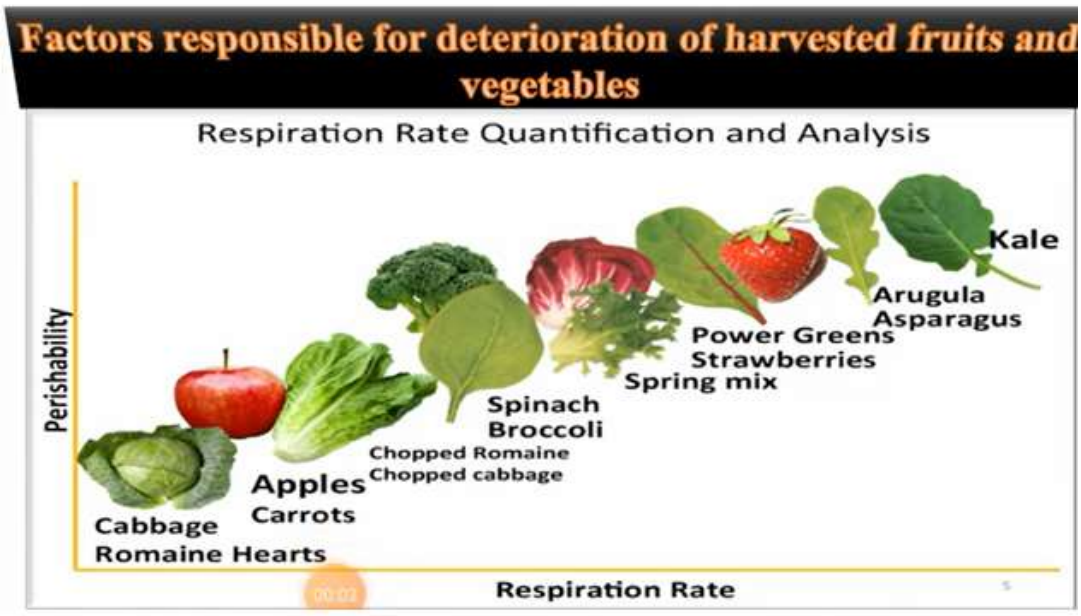


Figure 1.4: Factors for deterioration of harvested fruits and vegetables

(https://www.youtube.com/watch?v=sBDWeZrlXJo, Accessed date: January 20, 2023)

1.1.5 Fruit and vegetables production

Fruit and vegetables are the main raw materials for the production of Fruit and vegetable product. The technological flow chart of fruit and vegetable product processing line depends largely on the chemical composition of the fruit and vegetables.

To obtain high quality of fruit and vegetable product it is necessary to understand the chemical components of fruit and vegetable and changes in the chemical components of fruit and vegetable during the processing, so as to more targeted control of the production process.

Generally the chemical components of fruit and vegetable are divided in to

- ✓ Water

The water content in fruit and vegetable is 70-90% including free water and bound water (colloid bond water)

- ✓ Dry-matter

Dry matter includes water soluble and water insoluble substances. Water soluble substances mainly include sugar, organic acid, pectin and tannin and water insoluble substances including cellulose, hemi cellulose, proto pectin and starch. In addition to this fruit and vegetable contain vitamins, pigments, nitrogen containing substances and aromatic substances.

1.2 Identifying sequence of operations and key equipment's

Fruit and vegetable production begins with the preparation of the raw fruit and vegetables thorough a variety of methods including cleaning, trimming and peeling to reduce the product to a uniform size before cooking, canning, drying or freezing, as well as pulping and filtration to make soft drinks. Preparatory operations of fruits and vegetable processing includes the following steps:

i. Reception of raw materials
ii. Inspection
iii. Cleaning and washing
iv. Sorting and grading
v. Peeling
vi. Size reduction
vii. Blanching

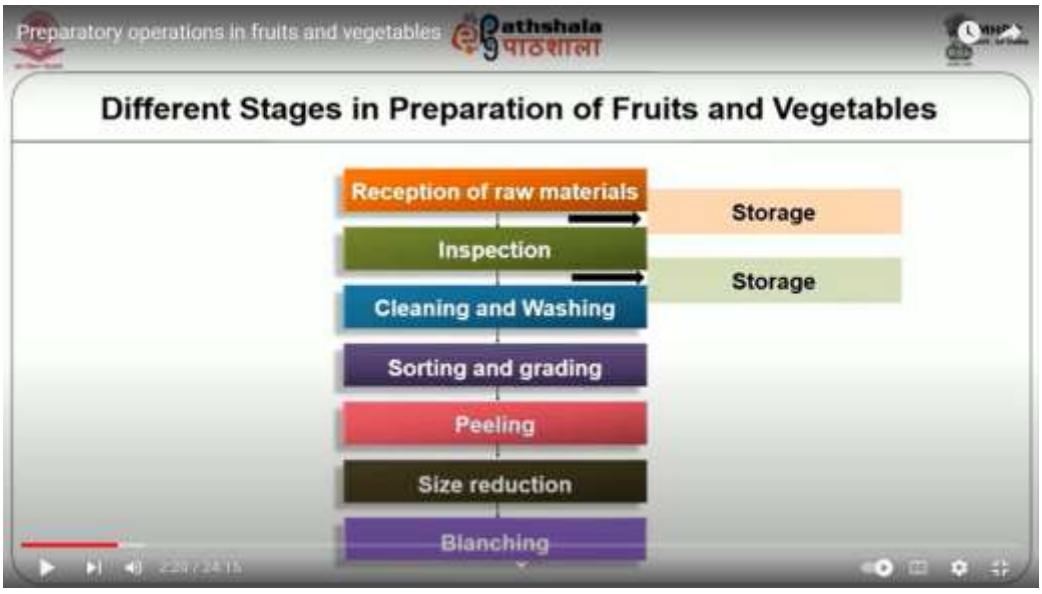


Figure 1.5. Preparatory operations in fruits and vegetables
(https://www.youtube.com/watch?v=SV0YSbZRLUc, Accessed date: January 22, 2023)

The process culminates with the packaging and transport of the final product. There are two major sub-sectors including fresh packed products and processed products. Processed products involve other unit operations such as cooking, evaporating, drying etc to provide product diversity and increase shelf-life. Common examples of processed fruit products are dried fruits, jams and jellies, and fruit purees for use in the food industry. Examples of processed vegetable products include canned beans and frozen peas, as well as vacuum packed beetroot.



Figure 1.6. Fruits and vegetables process equipment's

(https://www.youtube.com/watch?v=a02wf6Q-LwM&t=4s, Accessed date: January 22, 2023)

Major equipment's required for operating fruit and vegetables processing activity includes packing equipment, weighing equipment, cleaning equipment's, process control equipment and IT equipment. Some examples of commercially available machines used for processing operations are described in the following table and figure.

Table 1.1. Key equipment used for fruit and vegetable processing (Source: https://kronitek.com/)

Name of the machine	Function	Photo
Food Processing Machine S40	The machine is perfectly suited for small and middle-sized companies who are looking for a general machine that can reliably meet all their vegetable processing needs. Mainly it is for cutting cabbages, but it also can be extremely valuable for processing large amounts of other types of vegetables	
Vegetable Processing Line S55	This is an extremely powerful vegetable processing machine that takes up compact space and provides maximum efficiency. The machine can output 2,000 – 3,500 kg/h – to enable high productivity for processing companies.	
Cabbage Processing Line S65	This is a manual cabbage processing line with a capacity of about 5000 kg/h. It can be equipped with 2 separate cabbage core drills, cabbage sliders with covers for additional safety, a salting vat and a transporter.	
Automatic Cabbage Processing Line S80	The machine helps to prepare shredded cabbage intended for fermentation or for salads. It is incredibly efficient and can reach a capacity of 8 t/h.	

Industrial Food Dicing Machine	A high-performance cube cutting machine, can operate as a separate cutting machine or can be connected in a line. Thanks to the large rotating cylinder, it is possible to process large products such as sweet potatoes, iceberg lettuce, large potatoes, roots, carrots.	
Apple slicing machine	The machine is designed for apple coring and wedge slicing. The number of slices per apple can be modified according to customer request by changing the cutting tool.	
Belt Cutting Machine	This is a multifunctional vegetable cutter with high yield and high efficiency, which can cut fruits and vegetables into strips or slices. The body is made of high-quality stainless steel, durable, anti-corrosion and hard.	
Vegetable destoning machine	Soaking elevator is for soaking, washing and elevating potatoes and it is the first machine in potato processing line.	

Semi Automatic Cabbage Destalker	The KU-2400 automatic cabbage core drill combines electric and pneumatic power to provide excellent cabbage coring and stalk crushing capabilities that are useful for cabbage or sauerkraut.	
Commercial Potato Peeler Machine	The industrial knife potato peeler KPM-400 can finely peel your potatoes within 2-5 minutes flat. The machine is designed to deliver a uniform distribution of peeling action, getting you more consistency and less waste as a result.	
Industrial Food Drum Mixer	Perfectly constructed 100-liter drum, rotated by a 1.5 kW inverter motor, ideal for gently stirring sensitive products.	
Semi-automatic packaging machine for sauerkraut, salads and vegetables	The SK-1200 is a tough machine made from acid-resistant stainless steel that doesn't leave any residue whatsoever. It is used for filling products that tend to stick together such as sauerkraut, kimchi, and the like – something that is very difficult to do with other methods.	

Hydraulic Juice Press for Fruit and Vegetable	A fruit crusher with a pressing press is used to crush fruits such as apples, pears and vegetables e.g. carrots, celery, etc., and then mousse pressing to obtain juice. The device's efficiency when grinding and pressing juicy apples is about 160 liters per hour.	
Industrial Food Dehydration Machine	High-temperature food dehydrator fruit and vegetable dryer can dry the moisture on the surface of the food and retain its original color and taste.	
Vegetable and Salad Spin Dryer	The body is made of SUS304 stainless steel, which has a delicate appearance. It is equipped with a basket for dehydration, which is more convenient to store.	
Hydraulic Box Tipper	The tipper for jumbo boxes is used for emptying pallets with maximum base dimensions of 100 cm x 120 cm, 100 cm high and with max. weight of 700 kg.	

Industrial Inspection Table For Vegetable And Fruit	Selecting conveyor is for picking waste products out manually and it is a part of fruit and vegetable processing line.	
Vegetable preparation table	• 6 chopping boards made by sanitary nylon material. Movable design is easy for cleaning. • 4 waste funnels for collecting waste vegetables. Movable design is easy for cleaning. • Upper belt is connected with vegetable cutting machine. Speed is adjustable manually. Effective width is 170mm. • Lower belt is for collecting waste vegetables. Speed is fixed. Effective width is 230mm.	

The following video will also show the fruits and vegetables processing line at factory level.



Figure 1.7. Fruits and Vegetables Processing Line
(https://www.youtube.com/watch?v=lGTH3rwN4Ns, Accessed date: January 22, 2023)

1.3 Identifying basic differences between various industrial fruit and vegetable

Fruit and vegetables have many similarities with respect to their compositions, methods of cultivation and harvesting, storage properties and processing. In fact, many vegetables may be considered fruit in the true botanical sense. Botanically, fruits are those portions of the plant which house seeds. Therefore such items as tomatoes, cucumbers, eggplant, peppers, and others would be classified as fruits on this basis.

However, the important distinction between fruit and vegetables has come to be made on an usage basis. Those plant items that are generally eaten with the main course of a meal are considered to be vegetables. Those that are commonly eaten as dessert are considered fruits. That is the distinction made by the food processor, certain marketing laws and the consuming public, and this distinction will be followed in this document.

Food processing is the transformation of agricultural products into food, or of one form of food into other forms. The main objective of fruit and vegetable processing is to supply wholesome, safe, nutritious and acceptable food to consumers throughout the year.

Processing (canning, drying, freezing, and preparation of juices, jams, and jellies) increases the shelf life of fruits and vegetables. Processing steps include preparation of the raw material (cleaning, trimming, and peeling followed by cooking, canning, or freezing. The four common ways to preserve fruits and vegetables are freezing, canning, pickling and drying or dehydrating.

The goal of processing is to deter microbial spoilage and natural physiological deterioration of the plant cells. Generally, the techniques include blanching, dehydrating, canning, freezing, fermenting and pickling, and irradiating. Fruit can go through numerous types of processing, including canning, drying, and juicing. Some types of processed fruit are fruit preserves, canned fruit, and fruit juices. Processed fruit is generally not as healthy as fresh, raw fruit. Washing, drying, and packaging fruit is usually not considered processing.

- **The difference between fruits and vegetables**
  - ✓ Fruits and vegetables are classified from both a botanical and culinary standpoint.
  - ✓ Botanically, fruits and vegetables are classified depending on which part of the plant they come from.

- ✓ A fruit develops from the flower of a plant, while the other parts of the plant are categorized as vegetables.
- ✓ Fruits contain seeds, while vegetables can consist of roots, stems and leaves.
- ✓ From a culinary perspective, fruits and vegetables are classified based on taste. Fruits generally have a sweet or tart flavor and can be used in desserts, snacks or juices.
- ✓ Vegetables have a more mild or savory taste and are usually eaten as part of a side dish or main course.

- **How do fruits and vegetables compare nutritionally?**

  - ✓ Fruits and vegetables have a lot of similarities in terms of nutrition.
  - ✓ Both are high in fiber as well as vitamins, minerals, antioxidants and plant compounds.
  - ✓ Fruits and vegetables are also naturally low in sodium and fat.
  - ✓ As you might expect given their sweet taste, fruits tend to have a higher amount of natural sugar and calories compared to most varieties of vegetables.
  - ✓ One cup of apples, for example, contains 65 calories and 13 grams of sugar, while one cup of broccoli has just 31 calories and 2 grams of sugar.
  - ✓ Compared to vegetables, some types of fruits may also contain more fiber per gram. The fiber content per 100 grams for fruit ranges from 2–15 grams, while leafy vegetables supply 1.2–4 grams of fiber for the same weight.
  - ✓ The water content is also highly variable. Leafy vegetables may be composed of 84–95% water, while fruits contain slightly less, with between 61–89%.



Figure 1.8. The difference between industrial fruits and vegetables (https://www.youtube.com/watch?v=sAbgVd6XwTc&t=10s; https://www.youtube.com/watch?v=a6nKRTG-L4k, Accessed date: January 22, 2023)

1.4. Using industry terminology describing fruit and vegetable processing.

Industry description and practices processing (canning, drying, freezing, and preparation of juices, jams, and jellies) increases the shelf life of fruits and vegetables. Processing steps include preparation of the raw material (cleaning, trimming, and peeling followed by cooking, canning, or freezing. Plant operation is often seasonal. To make food available throughout the year, humans have developed methods to extend the storage life of products to preserve them. The rotting process can be postponed by

- ✓ Adding preservatives,
- ✓ Optimizing storage conditions, or
- ✓ Applying modern techniques

Most fruits and vegetables are edible for a very short time as they are seasonal, unless they are promptly and properly preserved. Insects can cause a lot of damage, not only by eating the products, but also by passing on microorganisms.

Self-check 1	Written test

Name…… ID…… Date…….

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

Part I: Short answer

1. What is fruit and vegetable process
2. Why process fruit and vegetable?
3. Fruit and vegetable main processing steps include?
4. What is the difference between manual and mechanical harvesting?
5. Write the major causes of deterioration?
6. What the basic objective is to choose the location fruit and vegetable processing?
7. What is the difference and similarities between fruit and vegetable?

Part II: Choice the best answer

1. Humans have developed methods to extend the storage life of products to preserve them. The rotting process can be postponed by
   A. Adding preservatives,
   B. Optimizing storage conditions,
   C. Applying modern techniques
   D. All
   E. None the above

Operation Sheet -1

1.1. Identifying sequence of operations and key equipment's for fruits and vegetable processing

A. **Tools and equipment's**

- Fruit and vegetable processing machines include
  - ✓ Slicing machine
  - ✓ Belt Cutting Machine
  - ✓ Vegetable destoning machine
  - ✓ Semi-automatic Cabbage Destalker
  - ✓ Peeler Machine
  - ✓ Packaging machine
  - ✓ Hydraulic Juice Press
  - ✓ Dehydration Machine
  - ✓ Vegetable and Salad Spin Dryer
  - ✓ Industrial Inspection Table
  - ✓ Vegetable preparation table
- Personal Protective Equipment (PPE) such as overall, Boats, Gown, helmets and Hand glove.

B. **Procedures for sequence of operations and identification of key equipment's for fruits and vegetable processing**

i. Reception of raw materials
ii. Inspection
iii. Cleaning and washing
iv. Sorting and grading
v. Peeling
vi. Size reduction
vii. Blanching

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** hour. The project is expected from each student to do it.

Task-1: Perform sequence of operations and identification of key equipment's for fruits and vegetable processing

LG #5	LO #2 Identify Fruit and Vegetable Sales and Marketing Strategies and Processes

Instruction sheet

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

- Identifying standard of fruit and vegetable packaging and labeling requirement
- Identifying range and purpose of labeling information
- Identifying major fruit and vegetable processing in Ethiopia
- Describing key features and market expectations of fruit and vegetable products in Ethiopia

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:

- Identify standard of fruit and vegetable packaging and labeling requirement
- Identify range and purpose of labeling information
- Identify major fruit and vegetable processing in Ethiopia
- Describe key features and market expectations of fruit and vegetable products in Ethiopia

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. Identifying standard of fruit and vegetable packaging and labeling requirement

Fresh fruits and vegetables are a source of essential nutrients. These are water, carbohydrates, fats, proteins, fibers, minerals, organic acids, vitamins, antioxidants and others. The nutritional value of fresh fruits and vegetables depends on their composition, and it depends on the species, variety, degree of ripeness soil and climatic conditions and their fertilization.

Food labeling (including for fresh fruits and vegetables) is regulated in the Ordinance on the requirements for the labeling and presentation of foodstuffs and in Regulation (EU) No 1169/2011. According to the Ordinance on the requirements for the labeling and presentation of foodstuffs and Regulation (EU) No 1169/2011 it is obligatory to indicate the following information, written in preferred language:

- ✓ The name of the food;
- ✓ A list of the constituents in the composition
- ✓ All ingredients or accompanying compounds, including those causing allergies or intolerance, that are used in the production or preparation of food and are still present in the product, even in the modified form;
- ✓ The quantity of certain ingredients or categories of ingredients; (e) net weight – in the case of pre-packed foods;
- ✓ Minimum durability or shelf life or the label "use before" – a specific date is indicated on foods that, from a microbiological point of view, are subject to rapid deterioration; (g) special storage conditions and / or conditions of use;
- ✓ The name or business name and address of the producer or of the person packing the food or of the seller established within the community;
- ✓ Country of origin or place of provenance;
- ✓ Instructions for use – in the absence of such instructions, it would be difficult to use the food properly;
- ✓ Nutrition declaration;
- ✓ A marking to identify the batch to which the food belongs;

- ✓ In the case of imported food, the country of origin shall be indicated, and where in another country the food has undergone a process which causes a change in its nature, the country of origin shall be indicated on the label as the country of origin.



Figure 2.1. Packaging for processed foods

2.2. Identifying range and purpose of labeling information.

Prepackaged food shall not be described or presented on any label or in any labeling in a manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect.

Prepackaged food shall not be described or presented on any label or in any labeling by words, pictorial or other devices which refer to or are suggestive either directly or indirectly, of any other product with which such food might be confused, or in such a manner as to lead the purchaser or consumer to suppose that the food is connected with such other product.

- **To help avoid confusion,**

Regulatory bodies create standardized ways of presenting this information to potential buyers in required fields within the label. For chemical products, that means adhering to the Globally Harmonized System of Classification and Labeling of Chemicals (GHS.)

- **Tracking Products from Production to Consumption**

Labels make it possible to track containers across their entire lifecycle, from initial production to disposal by the consumer, and can assist in addressing issues that may arise during a product's life: Labels help organize the warehousing system by keeping track of the location and quantity. Shipping labels and bills of lading make it easy to keep a package moving through a logistics system. These labels often include machine-readable barcodes and plain text so that workers and equipment can identify the container.

- **Labels as a Safeguard against Counterfeiting**

Custom labels also provide an effective way to protect your brand by combating counterfeit products. A label can help identify genuine goods through the use of serial numbers, random lot numbers, destructible labels, and hard-to-replicate label details. Branding products with registered logos and trademarks also gives you legal leverage to take counterfeits off of the market. Taking these steps helps resellers and buyers identify counterfeit goods, and it also helps protect your company from liability and public relations issues when counterfeit goods cause harm to consumers.

Labeling of fresh fruits and vegetables is regulated in Ethiopian quality control authority and (543/2011 / EU: Implementing Regulation (EU) No 543/2011). Fresh fruits and vegetables are labeled according to the marketing requirements, depending on the type of product concerned. The information which must be clearly visible on the package itself or on a label, an integral part of the package or permanently affixed to it is including name and country of origin of the product; quality class, variety and commercial type. In the case of fruit and vegetables carried in bulk, the dates must be given in the accompanying documents or in a prominent place in the vehicle.

The requirements towards labeling of fresh fruit and vegetables are reflected in parts of Implementing Regulation (EU) No 543/2011, which is divided into two sections. Part one of the first section of the common marketing standard provides information on the origin of fresh fruit

and vegetables. Part 2 of the Specific Marketing Standards section provides information on the labeling of various fresh fruits and vegetables. Each package must bear the following particulars, in legible and indelible characters, grouped on the same side of the packaging and visible from the outside: identification – the name and address of the packer and / or dispatcher (or equivalent abbreviations); the origin of the product for all fresh fruit and vegetables must be indicated – country of origin and, optionally, region of production (national, regional or local name); commercial characteristics – quality class; size, expressed as minimum and maximum diameter (in, mm) or minimum and maximum weight (in g) or category code.

2.3. Identifying major fruit and vegetable Processing in Ethiopia.

Although there are many similarities between fruits and vegetables, there is one important difference that affects the way that these two types of crop are processed: Most fruits are more acidic than most vegetables. Currently, the winery receives fresh grapes from Guder, Nura Era, Merti and Zewai Vineyard. Grape production in a great volume for the domestic winemaking plant is, therefore, an attractive area of investment in the country.

This is important because food poisoning bacteria cannot grow in more acidic fruit products. Even if a processor makes a mistake in processing, fruit products cannot cause food poisoning. If the mistake allows molds and yeasts to grow, they produce obvious signs of spoilage, which stops consumers eating the food. If a contaminated product is eaten, yeasts and moulds rarely cause food poisoning.

Table 1.2. Different levels of acidity in fruits

Very acidic fruits **pH<3.7**	**Moderately acidic fruits** **pH3.7-4.5**	**Less acidic fruits** **pH >4.5**
Grapefruit	Guava	Banana
Lemon	Mango	Breadfruit
Lime	Passion fruit	Melon
Orange	Pineapple	Papaya
Tamarind	Strawberry	Squash

Tangerine	Tomato	

Some types of bacteria produce poisons in the food without signs of spoilage and consumers may be unaware of the contamination and eat the poisoned food. It is therefore especially important that vegetable processors carefully follow the correct processing methods and pay strict attention to hygiene and sanitation to reduce the risk of harming their customers.

- **Characteristics of fruits and vegetables**

After harvest, micro-organisms and naturally occurring enzymes rapidly change the color, flavor and texture of fruits and vegetables.

- ✓ Most fruits and vegetables are seasonal. For a business to operate throughout the year, crops must be either part-processed for temporary storage, or a succession of crops must be processed as they come into season
- ✓ Raw materials have to be bought during a relatively short harvest period when prices are lowest. There is therefore the need to have sufficient cash available to buy a year's supply of crop.

Table 1.3. Time before spoilage starts in selected fruits and vegetables in Ethiopia

Time available between harvest and processing before spoilage begins		
A few days	**A few weeks**	**1-2 months**
Fruits	**Fruits**	**Fruits**
Banana (dessert)	Avocado	Gourd (bottle)
Mango	Banana (cooking)	Lemon
Papaya	Breadfruit	Lime
Pineapple	Grapefruit	Orange
Strawberry	**Vegetables**	Tangerine
Watermelon	Cabbage	**Vegetables**
Vegetables	Pumpkin	None
Cauliflower	Soybean	

Cucumber Green bean Leek Lettuce Okra Peppers Spinach Onion	Squash	

- **Production Facilities**

This section summaries the facilities needed in a small fruit and vegetable processing unit..

- ✓ **The Site**

Because fresh fruits and vegetables are both bulky and spoil rapidly, it is better to locate a processing unit in the area where they are grown. This reduces transport costs and also reduces the amount of handling, which means that crops are more likely to be in good condition when they arrive at the processing unit. If they are in good condition, they can be stored for a few days before they have to be processed. Too much handling bruises them and they will spoil quickly. This increases the cost to the processor, because the spoiled food has already been paid for.

Processed fruit and vegetable products are likely to be sold in different markets and there is less reason to locate the unit near to customers (in contrast to bakeries for example). An ideal site is close to a fruit and vegetable growing area and near to a main road leading to an urban centre.
The location of the processing unit in a rural area means that there may be problems with:

- ✓ Reliable electricity
- ✓ Adequate supplies of potable water.
- ✓ Contamination of supplies
- ✓ Access for workers and staff (public transport, distance down an access road)
- ✓ Quality of the road (dry season only, potholes that may cause damage to glass containers)

- ✓ Absence of other facilities (e.g. schools, medical facilities, shops and entertainment) that make working there less attractive than an urban location

Each of these should be assessed before choosing a site. In rural locations there is usually more land available for waste disposal compared to urban sites, but there may be problems caused by insects and birds or straying animals getting into the building. It is therefore important to have a site with cleared and fenced land, preferably having short grass, which helps to trap airborne dust.

- ✓ **The building**

All fruit and vegetable processing businesses should have a hygienically designed and easily cleaned building to prevent contamination of products. Buildings in rural areas may cost more to construct because of higher transport costs for building materials, but rents in rural areas are usually lower than urban centers. The investment in construction or the amount of rent paid should be appropriate to the size and expected profitability of the business.

2.4. Describing Key features and market expectations of fruit and vegetable products in Ethiopia

Although horticultural crops are important for health and economy the amount and mode of production is still weak in Ethiopia. Horticultural crops can be differentiated as fruit (permanent crops) and vegetables (short season crops). Accordingly permanent crops are long term crops that occupy the field planted for a long period of time and largely harvested every year and do not have to be replanted for several years after each harvest. These include tree crops such as coffee, Enset, Chat, oranges, Mangoes, Bananas, papaya, Avocados…etc. The trees that yield fruits like orange, Mangoes, Papayas, and others are known as fruit trees (CSA, 2001/02).

Diversification into horticultural crops is becoming attractive for many poor farmers around the world. Worldwide production of fruit and vegetable crops has grown faster than that of cereal crops, albeit from a much lower base. Between 1960 and 2000, the area under horticultural crops worldwide has more than doubled. There are several reasons for the global increase in production and trade of fruit and vegetable crops. Horticultural production is profitable. Farmers involved in horticultural production usually earn much higher farm incomes as compared to cereal producers and per capita farm income has been reported up to five times higher (Lumpkin *et al.*, 2005).

Ethiopia has a variety of vegetable crops grown in different agro ecological zones produced through commercial as well as small farmers both as a source of income as well as food. However, the type is limited to few crops and production is concentrated to some pocket areas. In spite of this, the production of vegetables varies from cultivating a few plants in the backyards for home consumption up to a large-scale production for domestic and export markets (Dawit *et al*., 2004).2 In a country like Ethiopia where the amount, timing and distribution of rain fall is irregular,

Fresh and processed Fruits and vegetables have a large domestic market in Ethiopia, significantly higher than the exported volumes. The size of the Ethiopian population is currently estimated at about 128 million. This is a strong indication of the existence of large potential demand for fresh fruit and vegetable crops in the country. The other customer of Ethiopian fresh fruits and vegetables is processing plants, i.e., wineries, tomato processing plants and vegetable canning

factories which require grapevine, tomato and various types of vegetables for processing. Processing of fruit juice into concentrate near the source of the fruit either for export markets or to the local manufacturers is also an area of investment available in the country

Ethiopia exports fresh fruits and vegetables to the international markets. The major markets for Ethiopian fresh fruits and vegetables are the European Union, the Arab countries and the regional markets. Ethiopia is very well known in some parts of Europe especially for her green beans, climbing beans, cut flowers, okra, melon and passion fruits. Thus, there is a reliable demand for these Ethiopian products during a particular period and a great volume is re-exported. Therefore there is strong business image for Ethiopian vegetables and flowers in the European markets. The demand for Ethiopian wine is also high both in domestic and export markets.

Self-check 2	Written test

Name…… ID…… Date…….

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

Short answer

1. What is the purpose of labeling fruit and vegetable?
2. List the major requirements for the labeling and presentation of foodstuffs and regulation?
3. Why the nutritional value of fresh fruits and vegetables depends on their composition?
4. Each packages of processed fruits and vegetables must fulfill the standard requirements and should provide information on the labeling of the processed fruit or vegetable. Explain the reason why?
5. What are the uses of labeling fruit and vegetable?
6. List some the facilities needed for small fruit and vegetable processing industry?
7. What are the major sources of vegetable and fruit production risks?
8. List examples of fresh fruits and vegetables processing in Ethiopia.
9. The major exports markets for Ethiopian fresh fruits and vegetables are?

Reference Materials

Books:

- Singh, R. Paul and McLellan, . Mark R. (2021, April 14). fruit processing. Encyclopedia Britannica. https://www.britannica.com/topic/fruit-processing
- Singh, R. Paul and Jen, . Joseph J. (2021, May 13). vegetable processing. Encyclopedia Britannica. https://www.britannica.com/technology/vegetable-processing
- Myhrvold, N. (2022, February 11). *decaffeination*. *Encyclopedia Britannica*. https://www.britannica.com/topic/decaffeination

Web addresses

- http://ecoursesonline.iasri.res.in/mod/page/view.php?id=807
- https://www.fao.org/3/V5030E/V5030E0w.htm
- https://cias.wisc.edu/curriculum-new/module-iv/module-iv-section-a/
- https://www.britannica.com/topic/fruit-processing
- https://www.britannica.com/technology/vegetable-processing/Fresh-and-minimally-processed-vegetables
- https://www.fao.org/3/y4358e/y4358e05.htm
- https://www.youtube.com/watch?v=sBDWeZrlXJo
- https://www.youtube.com/watch?v=sAbgVd6XwTc
- https://agriculturistmusa.com/method-of-harvesting-fruits-and-vegetables/
- https://www.jbtc.com/foodtech/products-and-solutions/solutions/fruit-and-vegetable-processing/
- https://www.youtube.com/watch?v=lGTH3rwN4Ns
- https://www.youtube.com/watch?v=a02wf6Q-LwM&t=4s
- https://www.youtube.com/watch?v=SV0YSbZRLUc
- http://ecoursesonline.iasri.res.in/mod/page/view.php?id=17104
- https://www.youtube.com/watch?v=sAbgVd6XwTc&t=10s
- https://www.youtube.com/watch?v=a6nKRTG-L4k

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