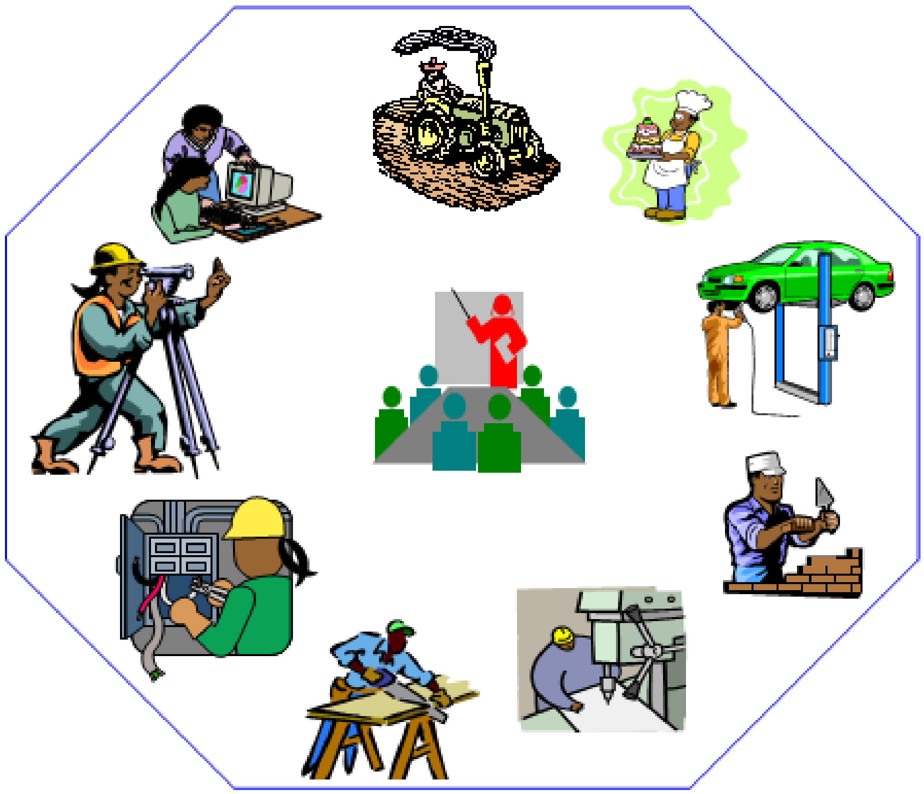
Fruit and Vegetabel Processing
Level-III

Based on May 2019, Version 2 OS and March 2021, V1 Curriculum



Module Title: - Applying Process Knowledge to Solve Production Problem

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LG #09	LO #1- Identify and respond to non-conforming ingredients/raw materials

Instruction sheet

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

- Identifying and reporting non-conformance in raw materials/ingredients
- Investigating and reporting causes of non-conformance.
- Determining and implementing corrective action
- Taking action to prevent recurrence of non-conformance
- Reporting action.

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 and report non-conformance in raw materials/ingredients
- Investigats and report causes of non-conformance.
- Determine and implemente corrective action
- Take action to prevent recurrence of non-conformance
- Report action.

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. 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.
3. Accomplish the "Self-checks" which are placed following all information sheets.
4. 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).
5. If you earned a satisfactory evaluation proceed to "Operation sheets

6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, ask your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Identifying and reporting non-conformance in raw materials/ingredients

1.1. INTRODUCTION

Non-conformance relates to a failure to comply with requirements or nonconformity (sometimes referred to as a defect) is a deviation from a specification, a standard, or an expectation. Nonconformities can be classified in seriousness multiple ways, though a typical classification scheme may have three to four levels, including critical, serious, major, and minor.

1.2. Basic composition and function of each main raw material/ingredient

1.2.1 Raw materials and ingredients

Raw materials, including ingredients, processing aids, and packaging, are the foundation of finished food products. As such, they must meet not only your specifications, but also regulatory requirements.

Some of raw Raw materials and ingredients are

- Fruit and vegetables
- Sweeteners such as sugar,salt,spices, food acids and other minor ingredients
- Water and steam
- Containers ,labels and packaging materials
- Detergents ,sanitizers and similar materials

1.2.2 Basic composition and function of main raw material/ingredient

Fruit and vegetables

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)

- ✓ Drymatter

Drymatter includes water soluble and water insoluble substances. Water soluble substances mainly include sugar,organic acid, pectin and tannin and water insoluble substances including cellulose,hemicellulose,protopectin and starch. Inaddtion to this fruit and vegetable contain vitamins,pigments,nitrogen containing substances and aronmatic substances.

Sweeteners

sugar

In fruit and vegetable processing, sugar is used only in its granulated form; this quality must be in the form of uniform crystals, white, shining and completely soluble in water

Salt

Salt is used in order to give to the finished products a specifically salty taste and as a preserving substance. From a chemical point of view the term salt means sodium chloride but in practice the product is never in a pure state. The presence of a significant quantity of magnesium chloride increases the hygroscopicity, gives a bitter taste and can induce corrosion of receptacles.

Food acids

Acetic acid is in use as solutions of various concentrations which are known under the generic name of vinegar and its important spicing and flavouring role, vinegar is used and acts as a preservation agent for some vegetables: cucumbers, acidified vegetables, etc.

Containers ,labels and packaging materials

The following are among the more important general requirements and functions of food packaging materials/ containers:

A they must be non-toxic and compatible with the specific foods;

B .sanitary protection;.

C. moisture and fat protection;

D. Gas and odour protection;

E. Light protection;

F. Resistance to impact;

G. Transparency;

H. Tamper proofness;

I. Ease of opening;

J. Pouring features;

K. Reseal features;

L. Ease of disposal;

M. Size, shape, weight limitations;

N. Appearance, printability

Water

Water is one of the essential raw matrial for processing fruit and vegetable; according to the final utilisation, water can be classified in three categories:

A. for technological utilisation (when it comes into direct contact with raw materials and enters in the finished product's composition)for washing and blanching,

- ✓ Drinking water standards

B. for steam generators

- ✓ Hardness has to be as low as possible, even zero

C. for receptacle cooling, washing of equipment and general hygiene.

- ✓ Drinking water standard.

1.3 Quality components and its measurement fruit and Vegetable

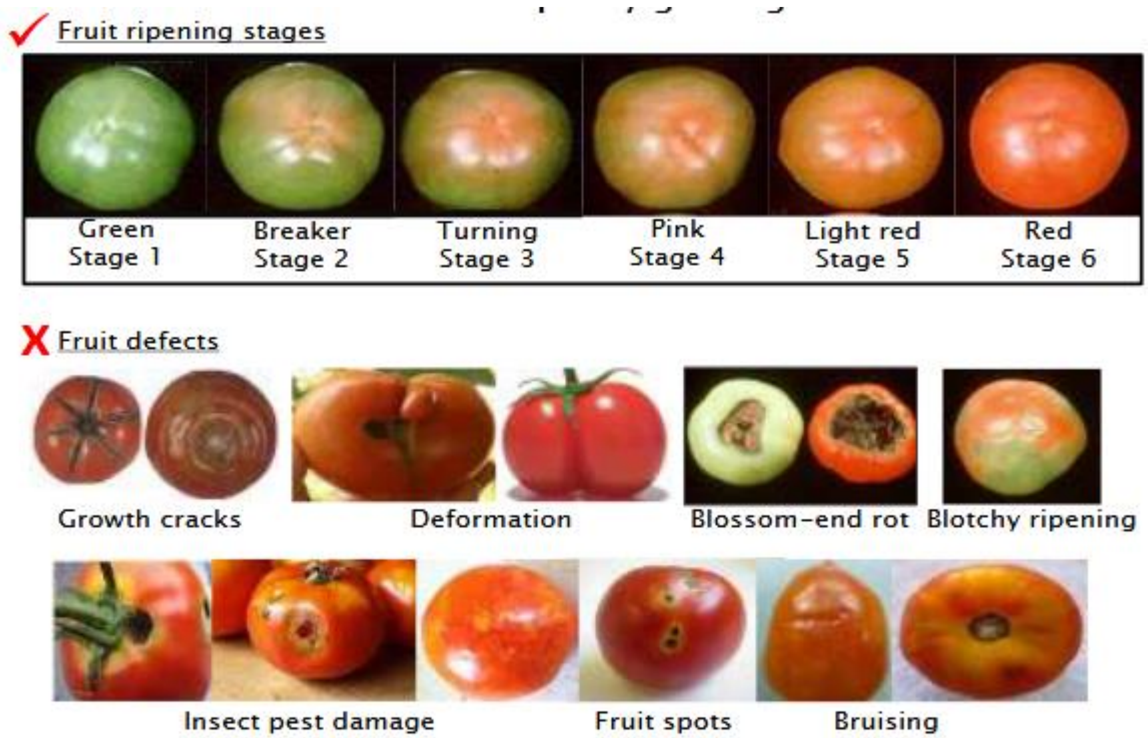
Quality components are

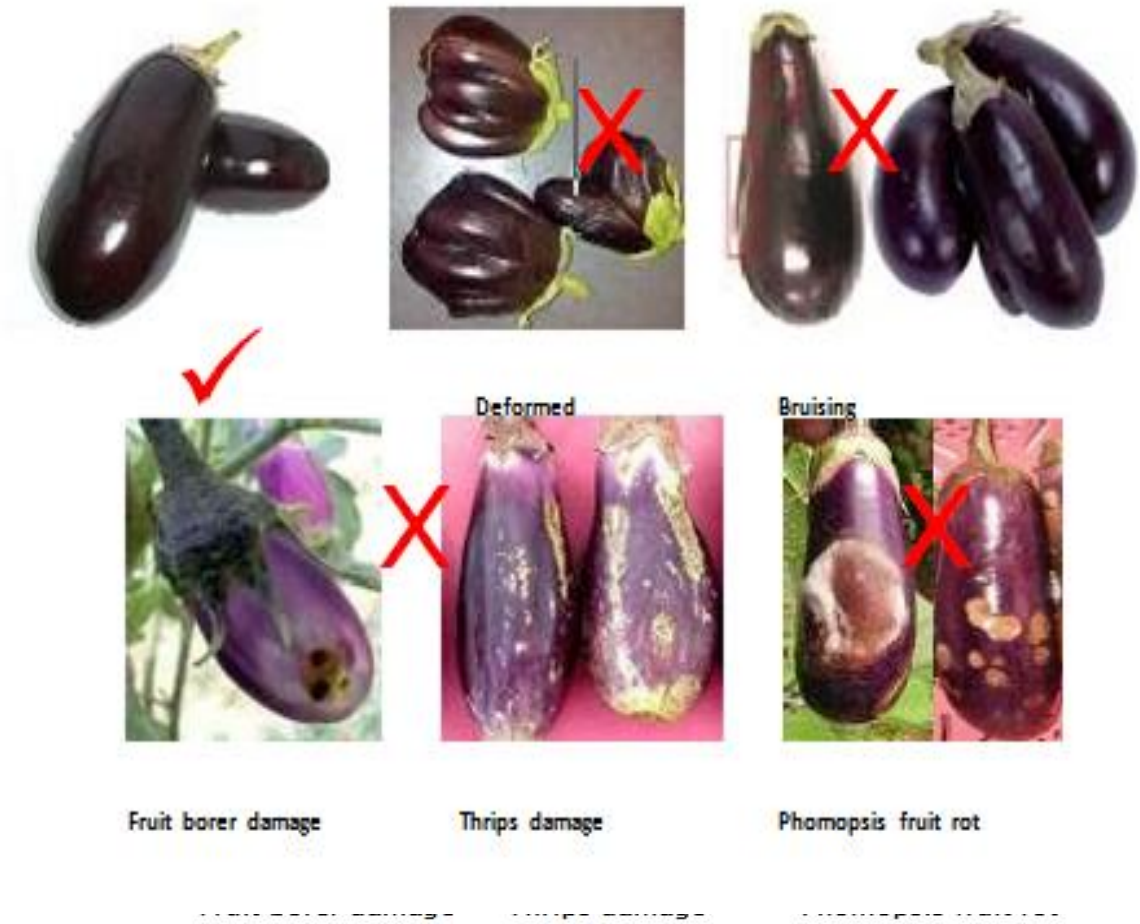
A. Appearance (visual) quality
B. Texture (feel)
C. Flavor (eating quality)

D. Nutritional quality
E. Food safety

A. Appearance (visual) quality - for fruit and vegetables it may include right maturity or color, right size and shape, glossy, and free of defects such as shriveling, spots or rots; for leafy vegetables fresh-looking, well-formed or well-shaped, right size, right maturity, right color, turgid or not wilted, free of defects such as rots, physical damage, yellowing or wilting.

Measurement: use of rating scales (e.g. visual quality rating, color index, and defects rating) with quality and color charts(Figure 1); colorimeter or Chromameter (quantitative color); gloss meter; weighing scale; caliper (Figure 2)





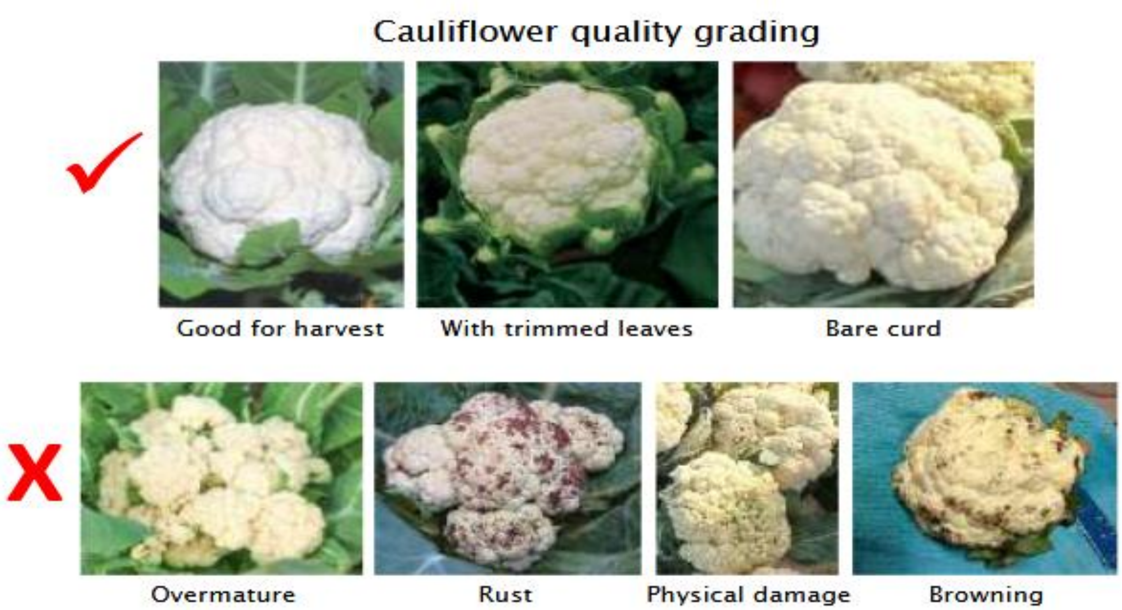


Figure 1 .Examples of quality grading and color charts.

Colorimeter to quantify color

Gloss meter

Caliper (top) and weight scale (bottom) for size and weight

Penetrometer (top) and electronic texture analyzer (right)

Refractometer, analog (top) and digital (bottom)

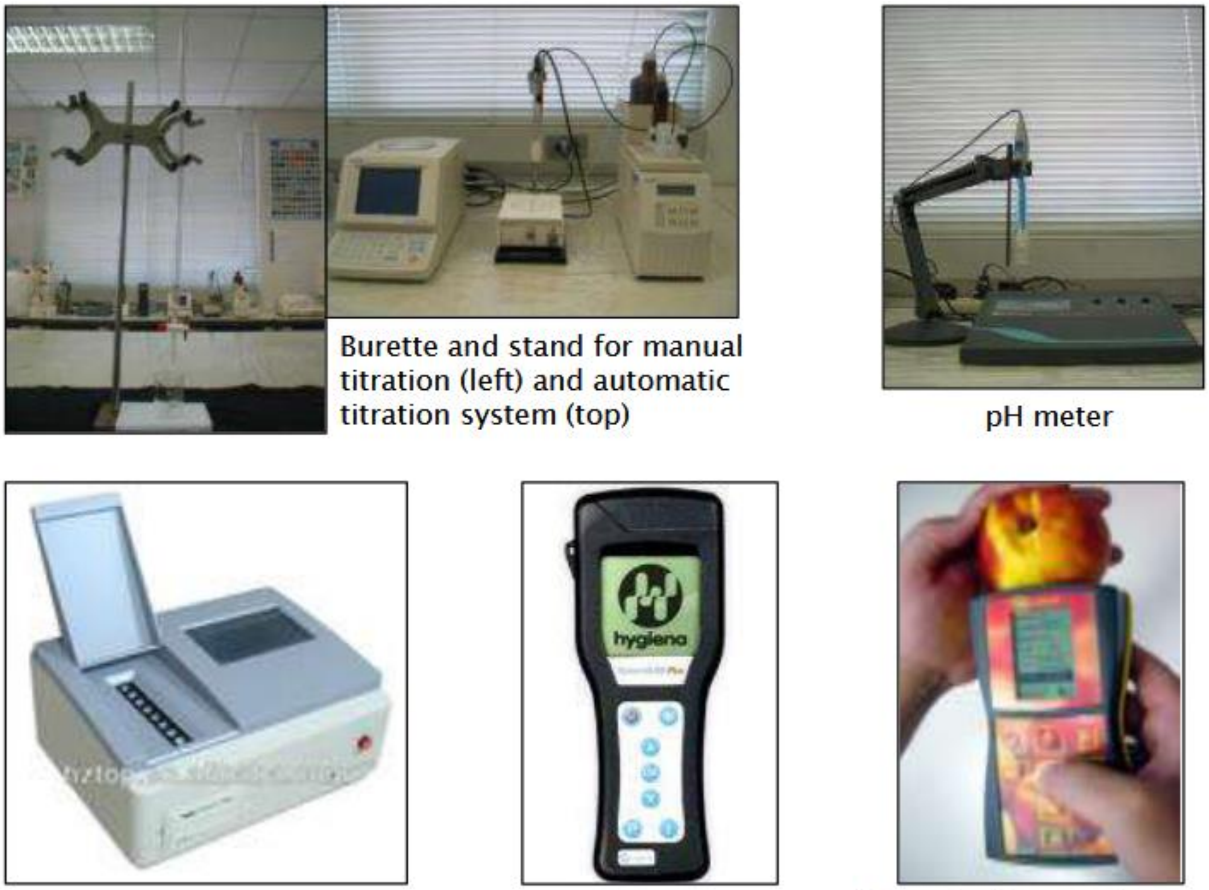


Figure 2. Some instruments for quality measurement.

B. Texture (feel) – firmness; tenderness, crunchiness, solidity or compactness (cauliflower, broccoli and cabbage) . Measurement: penetrometer; texture analyzer; finger feel with rating scale; curd arrangement in cauliflower and broccoli

C.Flavor (eating quality) – aroma, taste, sourness, spiciness

Measurement: sensory quality evaluation by panelists using hedonic scale or descriptive scoring; refractometer for soluble solids content; titration system for titratable acidity; pH meter; differential absorbance (DA) meter for non-invasive measurement of chemical attributes and firmness

Sensory testing is the only sure way to determine what the consumer thinks about vegetables. However, sensory evaluation is not suitable for routine use and the best way is to find objective measurements that correlate with sensory attributes.

D. Nutritional quality - vitamins, minerals, lipids, protein, carbohydrate, phytonutrients (antioxidants and flavonoids) and dietary fibers

E.Food safety - free from pesticide residues, microbial contamination, natural toxicants (e.g. oxalates and nitrates), natural contaminants (e.g. mycotoxins, bacterial toxins and heavy metals(e.g. lead, cadmium and mercury), and environmental pollutants

Measurement: ATP hygienemeter or standard plating methods for microbial enumeration;pesticide residue meter; standard chemical analysis

1.4. Appropriate handling and storage requirements for raw materials/ingredients

Produce is alive and breathing. At the time produce is harvested, the life of the product starts to decline. In a perfect produce world, one would need to have many storage areas with different storage temperatures to receive the maximum shelf life and quality desired. This would be quite a challenge as storage space and temperatures are limited However, there are variables that can be controlled that will enable food service staff to preserve the quality of produce and are also essential to optimizing produce quality, safety and yields. Key variables to maximize produce life include temperature, rotation, and storage practices.

1.4.1 **Storage and Transportation of Raw Material.**

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

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

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

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

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

Fruits and vegetables remain as living tissues until they are processed and the main aim is to reduce respiration rate without damage to the tissue. Young tissue such as shoots, green peas, and immature fruits have high respiration rates and shorter storage periods ,while mature fruits and roots ,and storage organs such as bulbs and tubers (e.g. onion, potatoes, sugerbeets)respire much more slowly ,and hence have longer storage periods.

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

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

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

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

1.4.2 Storage Environment.

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

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

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

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

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

Humidity: If the humidity of storage environment exceeds the equilibrium related humidity (ERH) of the food ,the food will gain moisture during storage and vice versa .The water activity or(AW) of most fresh foods ,for example; fruits, vegetables, meat, fish and milk is in the range (0.98-1.00) but they are frequently stored at a lower humidity .

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

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

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

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

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

The ideal storage temperature varies from product to product, and the temperature maintained in the storage area should be within 1°C of that level. Lower temperatures may cause chilling injury and higher ones can reduce the storage life of the product. If the temperature is allowed to fluctuate beyond the desired range, the produce may experience increased water loss and condensation may develop on the product from the surrounding air, leading to the growth of microorganisms. Temperature fluctuations can be prevented by using the proper equipment to refrigerate the storage room. Thus, there are three main control systems that may be used to obtain the desired gas concentrations: (a) O2 control systems, (b) CO2 control systems, and (c) C2H4 control systems

Table 1 Recommended storage conditions for various fruits and vegetables

Produce	Storage Conditions		
	Temperature	Humidity	Air composition
Apples	0°C to 5°C		1%–3% O_2, 1%–5% CO_2
Beans	8°C		2% to 3% O_2, 4% to 7% CO_2
Cabbage	0°C	92% RH	
Cantaloupes slip	2°C–5°C	95% RH	
full slip	0°C–2°C	95% RH	
Cauliflower	0°C	95%–98% RH	
Carrots	0°C to 2°C	95% RH	
Chinese cabbage	0°C	95%–100% RH	
Celery	0°C–5°C	90%–95% RH	2%–4% O_2, 3%–5% CO_2

Cucumbers	10°C–13°C	50%–55% RH	
Eggplant	8°C–12°C	90%–95% RH	
Garlic	0°C		
Grapes	1°C to 0°C	85% RH	
Kiwifruit	-0.5°C to 0°C	90%–95% RH	1%–2% O_2, 3%–5% CO_2 (C_2H_4 must be below 20 ppb)
Leeks	0°C	95%–100% RH	
Lettuce	0°C	95+% RH	
Mushrooms	Optimal at 0°C (0°C–5°C)		Normal O_2, 10%–25% CO_2
Nectarines	-0.5°C–0°C	90%–95% RH	
Okra	7°C–12°C	90%–95% RH	Normal O_2, 4%–10% CO_2
Onions	0°C	75% RH	
Peaches	-1°C to 0°C	85% RH	
Pears	-1.5°C to-0.5°C	90%–95% RH	
Peas green	0°C	95%–98% RH	
Peas southern	4°C–5°C	95% RH	
Peppers chili (dry)	0°C–10°C	32%–50% RH	
Peppers sweet	7°C–13°C	45%–55% RH	
Plums	-0.5°C–0°C	90%–95% RH	
Potatoes	3°C–10°C	90% RH	
Pumpkins (No precooling)	10°C–13°C	70% RH	
Spinach	0°C	95%–100% RH	
Strawberries	0°C	95% RH	5% to 10% O_2, 15% to 20% CO_2
Sweet Cherry	0°C–5°C		3%–10% O_2, 10%–15% CO_2
Sweet Corn	0°C	95% RH	
Sweet Potatoes (No precooling)	10°C–15°C	85% RH	

1.5 Fresh fruit and Vegetable ripening

Some fresh fruits continue to ripen after they have been harvested is known as climatric fruit while others do not is known as non-climatric fruit.

Whether or not a fruit continues to ripen is a key factor in determining its storage and shelf life.

Fruits that require additional ripening should be stored at room temperature until they become ripe. Fruits that do not ripen after harvesting should be stored in a cool area until they are used.

Table 1. Fruits that ripen and don't ripen after harvest

Fruits that ripen after harvest (climatric fruits)	Fruits that don't ripen after harvest (non-climatric fruits)
Apricots Avocados Bananas Cantaloupe Carambola Honeydew Kiwifruit Nectarines Papaya Peaches Pears Plantains Plums Tomatoes	Berries Cherries Grapefruit Grapes Lemons Limes Mandarins Oranges Pineapple Strawberries Watermelons Apples

Self-check 1	Written test

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

Test I Short Answer Questions (2 **points each)**

1. List and describe quality components of fruit and vegetable

2. Defrinciate fruits that don't ripen after harvest and ripen after harvest

3. List the main raw materials for processing fruit and vegetable

Test II Write true if the statement is correct and false if statement is incorrect

1. fruit and vegetable raw material is alive and breathing. (2 points)

Note: **Satisfactory rating - >4 points** **Unsatisfactory - below 4 points**

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

Score = ___________

Rating: ____________

Information Sheet 2- Investigating and reporting causes of non-conformance.

2.1 Nature of fruits and vegetables

Owing to high moisture content and tender nature vegetable and fruit pose characteristics post-harvest problem. High moisture content makes it difficult and expensive to conserve vegetables and fruit as dry products. They bruise easily and are metabolically active then the durables. The characteristics significantly limit the storage life of vegetables and fruit post-harvest life may therefore, only a few days.

2.2. Common causes of contamination/unacceptable quality of raw materials/ ingredients

Causes of contamination/ deterioration of raw materials materials are gruped to to two

A. Primary causes of contamination/ deterioration of raw materials

- i) Mechanical causes:
- ii) Physio- biochemical causes:
- iii) Microbial causes:
- iv) Physical causes:

B) Secondary Causes of contamination/ deterioration

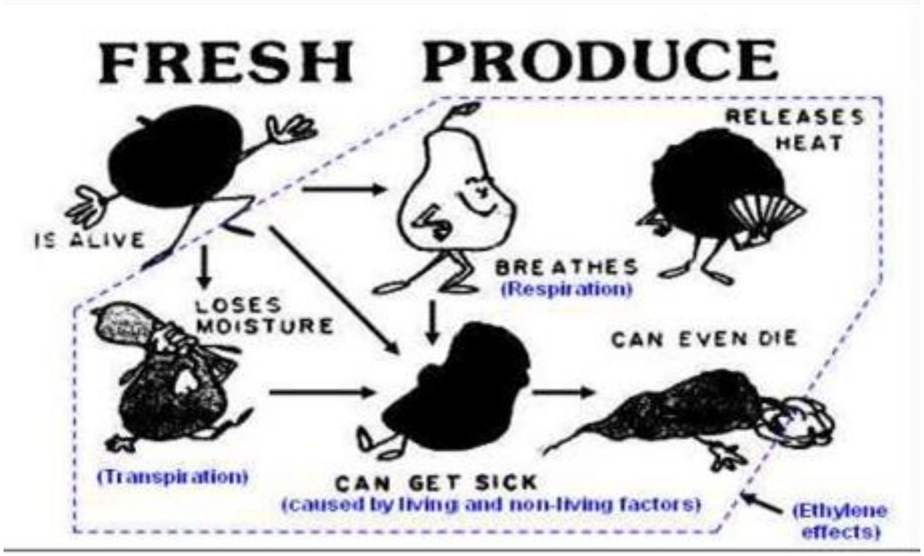
i) Mechanical causes

Besides causing damage, bruising and cracking make the vegetable and fruit more prone to attack by organisms and significantly increase of water loss and gaseous exchange. Many a times, the mechanical received by the vegetable and fruit due to the pressure thrust during transportation, though not visible, leads to rupture of inner tissues and cells

And such produce is degraded faster during the natural senescence process. Processing operations such as spillage, abrasion, excessive polishing, peeling or trimming add to the loss of the commodity. Puncturing of the containers and defective seals amount to mechanical spoilage.

ii) Physio- biochemical causes:

In fresh vegetables, transpiration and respiration and sprouting of tuber and bulb vegetables lead to direct food loss. The loss is accounted towards senescence process and represents major component of post harvest losses. The process is unavoidable. Post –harvest rooting in tuber vegetables, seed germination greening of potatoes leading to production of harmful compounds, and toughening and spongyness in green beans, sweet corn, carrot, radish that represents physiological loss through are not significant components of post harvest loss, down the quality of the vegetables. The undesirable chemical reactions between compounds presents in food such as Maillard reaction, fat autoxidation energy catalyzed reactions lead to significant losses. Contamination of vegetables with harmful substances such as pesticide or obnoxious substances makes the whole, lot inconsumable. Chemical reaction between canned vegetables and fruit the container lead to spoilage of the pack.

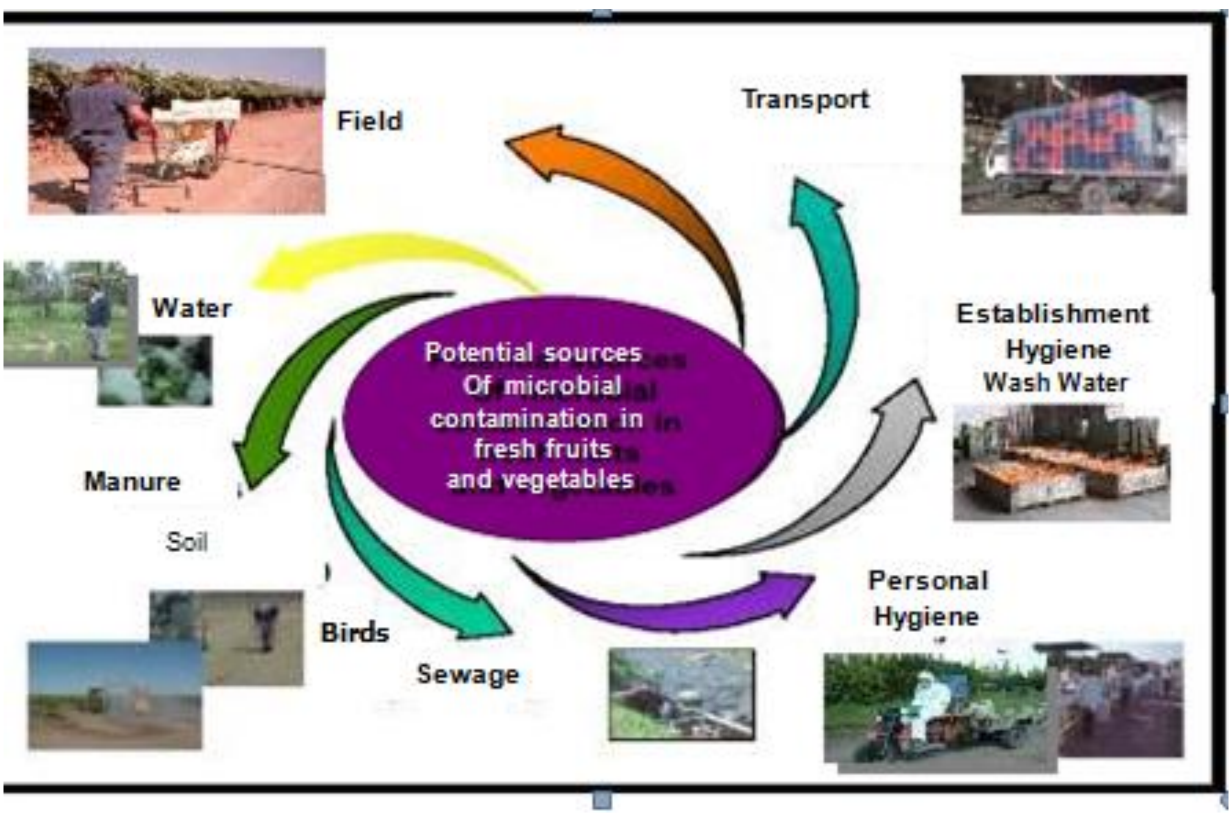


Figer 3. Physio- biochemical causes

iii) Microbial causes

Like any other food, vegetables and fruits are prone to microbial spoilage caused by fungi, bacteria, yeasts and moulds. A significant portion of losses of vegetables and fruit during post harvest is attributing to disease caused by fungi and bacteria. Succulent natures of the vegetables make them easily invadable by the organism. Besides attacking fresh vegetables, the organism also caused damaged to canned and processed products. Many serious post-harvest diseases of fresh vegetables occur rapidly and cause extensive breakdown of the commodity sometimes spoilage the entire package. It is estimated that 36% of the vegetable decay is caused by soft rot bacteria.

Obviously, the source of infection is soil in the field, water used for cleaning and surface contact with equipment and storage environment. The most common pathogens causing rots in vegetables are fungi such as Alternaria , Botrytis, Diplodia, Monilinia, Phomopsis, Pencillium , Rhizphus, and Fusarium and Bacteria, Erwinia and Ceratocystis



Figer 4 . Potential sources of microbial contamination of fresh vegetables

iv) Physical causes:

Post-harvest technological requirement like refrigerated storage, temperature and relative humidity, composition and proportion of gases in controlled atmosphere storage, type of wrapper or packaging and others changes with the nature of the vegetables to be handled. Chilling injury by low but non-freezing temperature is observed common with tropical and sub tropical vegetables. The fruit vegetables such as beans, cucumber, okra, pepper and tomato are affected commonly. The symptoms of chilling injury may not be evident while the vegetable is held at chilling temperature but becomes noticeable only after the vegetables is transferred to room temperature (220C). Each vegetable has specific heat requirement during processing, improper cold undesirable gaseous composition of controlled atmosphere storage lead to physical damage to tissue breakdown i.e. Storage disorders.

B) Secondary Causes:

Inadequate harvesting transportation, storage and marketing and legislation lead to condition favourable for primary causes of losses. But inadequate harvesting facilitates and rough handling during harvesting result in bruising and increase possibilities of contact of the produce with the soil that leads to contamination with organisms. A prolonged time taken for harvesting and grading in field leaves the produce with field heat for longer time which causes faster senescence subsequently. Besides use of improper machinery and equipment in mechanical harvesting cause serious losses.

In Potato, for example many tubers are pushed around the side of the digger blade and are left in the field. These potatoes must be considered as lost. In addition to the produce left in the field, a substantial quantity is lost during harvesting and preparation of market. Mechanical harvesting of tomato has been reported to result in more cracking 33% than hand picking 10%.

Harvesting of vegetables during or immediately after rains creates condition favourable for decay organism. Harvesting during hotter part of the day leaves higher field heat in the produce that result in faster senescence , shrivelling and wilting of the vegetables as compared to those harvested in the early morning or late afternoon.

Self-Check – 2	Written test

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

Test I: Short Answer Questions **(3point)**

1. What are Causes of contamination/ deterioration of raw materials in processing..

Test II: Write true if the statement is correct and false if the statement is incorrect .

1.Mechanical harvesting result more cracking than hand picking. **(2point)**

2. In controlled atmosphere storage composition and proportion of gases is high O_2 and low CO_2. **(3point)**

***Note:* Satisfactory rating - >4 points Unsatisfactory - below 4 points**

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

Score = ___________

Rating: ____________

Information Sheet 3- Determining and implementing corrective action

3.1 Corrective and preventive action

Corrective and preventive action consists of improvements to eliminate causes of non-conformities or other undesirable situations.

Corrective action: Action taken to eliminate the causes of non-conformities or other undesirable situations, so as to prevent recurrence.

Preventive action: Action taken to prevent the occurrence of such non-conformities, generally as a result of a risk analysis. To ensure that corrective and preventive actions are effective, the systematic investigation of the root causes of failure is pivotal.

Corrective actions are implemented in response to customer complaints, unacceptable levels of product non-conformance, issues identified during an internal audit, as well as adverse or unstable trends in product and process monitoring such as would be identified by statistical process control (SPC). Preventive actions are implemented in response to the identification of potential sources of non-conformity.

Some of corrective and preventive action include the following;

Harvesting at proper maturity for each fruit and vegetabels and harvesting with hand to reduces macanical damage. Avoid harvesting during or immediately after rains and during hotter part of the day

Reduceing excessive polishing, peeling or trimming

Adjesting or controlling storage temperature and relative humidity, composition and proportion of gases in storage.

Do not transport fruit and vegetable rough road

Properly inspecting raw materials and additives

3.2 Reasons for the detentions/reject

Reasons given for the detentions/reject include:

- Noncompliance with labeling requirements;
- Decomposition;
- Insect and animal filth and damage;
- Use of prohibited additives;
- Heavy metal contamination;
- Excessive levels of pesticide residues;
- Excessive levels of mycotoxin;
- Mould infestation;
- Microbiological contamination;
- Swollen and otherwise faulty cans

Self-Check – 3	Written test

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

Test I: Short Answer Questions (3 points each)

1. What are the basic deference between Corrective and preventive action

2. What are the Reasons for the detentions/rejection of raw material

***Note:* Satisfactory rating - 3 points Unsatisfactory - below 3 points**

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

Score = ___________

Rating: ____________

Information Sheet 4- Taking action to prevent recurrence of non-conformance

Careful inspecting and checks on incoming fruit and vegetable should include the following:

- ✓ Colour.
- ✓ Size.
- ✓ Maturity (over-ripe or under-ripe).
- ✓ Visible mould or rots.
- ✓ Serious bruising or cuts.
- ✓ Presence of foreign material.
- ✓ Percentage of rejects.

Controlling quality may be achieved by:

- Inspection of raw materials to ensure that no poor quality ingredients are used.
- Carrying out checks on the process to ensure that the weights of the ingredients and temperature and time of processing are correct.

Identify basic Causes of contamination/ deterioration early and takeing action fastly as mach as possible.

Self-Check – 4	Written test

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

Test I: Short Answer Questions(2point)

1. What are the basic action to reduce non –conformance in raw material?

Test II: Write true if the statement is correct and false if the statement is incorrect(2 point each)

1. Inspection of raw materials to ensure that no poor quality ingredients are used
2. Identify basic Causes of contamination/ deterioration is not any role in reducing recurrence of non-conformance

***Note:* Satisfactory rating - 3 points Unsatisfactory - below 3 points**

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

Score = ___________

Rating: ____________

Information Sheet 5- Reporting action.

Report means convey information about an event or situation or in this manual report convey information about selection criteria of all raw materials and ingredients,handleing method ,storage ,basic defects of raw materials .

Work places and workplace reqirements

Work places must be clean,healthy,safe, accessible and well maintained so work can be carried out with out risk to worker health and safety

Basic information to be reported are;

- ✓ Quality of raw materials and ingerident
- ✓ Causes of contaminationof raw materials and its reason and mechanism to reduce contamination
- ✓ A mount of raw materials recived
- ✓ Farm information raw material collected
- ✓ handling method of fruit and vegetable raw materials

Self-Check – 5	Written test

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

Test I: Short Answer Questions(3 point each)

1. Define report ?
2. What are the basic information to be reported about raw material handling ?

Test II: Write true if the statement is correct and false if the statement is incorrect

1.Farm histry do not have any role on final product quality and shilfe life of raw materials**.(2 point)**

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

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

Score = ___________
Rating: ____________

operation Sheet 1– Determination of the juice content

Objectives , To confirm raw material/ingredient by of juice content of fruits and vegetables

List of Materials needed

- Extractor or juice press
- Filter (muslin cloth, fine filter or strainer)
- Scale
- Beaker

procedure for determination of the juice content

Step1. Wear personal protective equipment

Step 2 .preparing materials to test or adjusting scale

Step 3. Take a sample of at least 2 kg of fruits each size at random from the reduced sample.

Step 4. Cut the fruit in half crosswise and squeeze each half to extract all the juice with an extractor or a juice press.

Step 5. The extracted juice is then filtered through muslin cloth, fine filter or strainer.

Step 6. Measure the extracted juice

Calculation of juice content

Juice percentage = Total weight of juice (in g) – beaker weight (in g) X 100 divided by

total weight of fruit (in g)

Step 7. Compare the results with the standard

LAP TEST	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 **3** hour. The project is expected from each student to do it.

Task 1. Determine juice content of fruit and vegetable

LG #10	LO #2- Identify and respond to non-conforming product and processes

Instruction sheet

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

- Monitoring Processing parameters, stages and changes.
- Identifying and taking corrective action on Non-conformance in processing handling and storage
- Investigating and reporting Causes of non-conformance
- Determining and implementing Corrective action.
- Taking action to prevent recurrence of non-conformance.
- Reporting action.
- Conducting work with workplace environmental guidelines.

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**:

- Monitore Processing parameters, stages and changes.
- Identify and take corrective action on Non-conformance in processing handling and storage
- Investigate and report Causes of non-conformance
- Determine and implemente Corrective action.
- Take action to prevent recurrence of non-conformance.
- Report action.
- Conducte work with workplace environmental guidelines.

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- Monitoring Processing parameters, stages and changes.

1.1 INTRODUCTION

non-conforming product

There are many attributes that can define a non-conforming food product. Depending on the type of food business that you operate these can include:

- ✓ Product is contaminated with microbiological, chemical or physical hazards.
- ✓ Finished product weight issues (generally underweight product)
- ✓ Quality attributes do not meet the required finished product specification. For example what it looks like, how it tastes, what it smells like and how it feels.

1.3. Primary and Secondary processing of fruits and vegetables

1.3.1 Primary processing of fruits and vegetables

The processing that occurs after harvesting to make food ready for consumption or use in other food products.

Primary processing ensures that foods are:

• Easily transported

• Ready to be sold

• Ready to be eaten

• Ready to be processed into other products

(e.g. after the primary processing of peeling and chopping, an apple can be stewed)

Steps involved in primary processing

Cleaning/ Washing

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

Some usual practices in fruit washing are:

 Addition of detergents or 1.5% HCl solution in washing water to remove traces of insect-fungicides; water to remove traces of insect-fungicides;

 Use of warm water (about 50°C) in the pre-washing phase;

 Higher water pressure in spray/shower washers.

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

Sorting/Grading

Fruit sorting covers two main separate processing operations:

a. Removal of damaged fruit and any foreign bodies (which might have been left behind after washing);

b. Qualitative sorting based on organoleptic criteria and maturity stage.

Mechanical sorting for size is usually not done at the preliminary stage. The most important initial sorting is for variety and maturity. However, for some fruit and in special

initial sorting is for variety and maturity. However, for some fruit and in special initial sorting is for variety and maturity. However, for some fruit and in special technologies it is advisable to proceed to a manual dimensional sorting (grading).

Trimming and peeling (skin removal)

This processing step aims at removing the parts of the fruit which are either not edible or difficult to digest especially the skin.

Up to now the industrial peeling of fruit and vegetables was performed by three procedures:

a. Mechanically;

b. By using water steam;

c. Chemically; this method consists in treating fruit and vegetables by dipping them in a caustic soda solution at a temperature of 90 to 100° C; the concentration of this solution as well as the dipping or immersion time varying according to each specific case.

Cutting

This step is performed according to the specific requirements of the fruit processing technology. (e.g. after the primary processing of peeling and chopping, an apple can be stewed)

Blanching:Treatment of fruit and vegetables with boiling water or steam for short periods followed by immediate cooling prior to canning is called blanching.

The basic objectives of blanching are as under:

•To inactivate enzymes

•To clean the product initially to decrease the microbial load and to preheat the product before processing

•To soften the tissue to facilitate compact packing in the can

•To expel intracellular gases in the raw fruit to prevent excessive pressure built up in the container

.•To allow improved heat transfer during heat processing

•To ensure development of vacuum in the can and to reduce internal can corrosion.

Blanching is carried out either by hot water or using live steam. Water blanching is generally of the immersion type or spray type as the product moves on a conveyer. Only soft water should be used for blanching as hard water toughens the tissue and destroys the natural texture.

1.3.2 Secondary processing

Secondary processing converts primary processed food into other food products.

Secondary processing ensures that foods:

• Can be used for a number of purposes

• Do not spoil quickly

• Are available all year (e.g. seasonal foods)

Juice extraction: Common equipment used for juice extraction of juice are fruit grater or mill, basket or hydraulic press, screw type juice extractor, rosing or burring machine, fruit pulper etc. There are two types of extraction methods i.e., single and double operation system.

a) **Single operation:** In single operation, screw type, plunger type or roller type press is generally used to crush and press the prepared fruit to extract the juice. Citrus fruit segments are fed through a hopper, passed through conical screws and the juice flows out through the perforations while the pomace comes out at the end of the conical jacket. The screw type extractor is operated either manually or electricity. Removal of rind is required to avoid bitterness. Finally, the juice is strained through a thick cloth or a sieve to remove seeds.

b) **Double operation:** In this system, the fruits are crushed and then pressed separately .Fruit like apple, *aonla*, berries, grapes, *jamun*, *phalsa* etc., are crushed in fruit grater or crusher and the crushed mass is pressed by means of basket press and hydraulic press.

Deaeration: Freshly extracted juice contains appreciable quantity of oxygen, which may affect the quality of juice. Most of the air is removed by subjecting the fresh juice to high vacuum. This process is called as deaeration and the equipment is known as the deaerator. Heating of juice during heat processing also helps in removal of the air.

Clarification of juice: Fruit and vegetable juices are clarified by using different methods like straining or screening, settling or sedimentation and filtration.

a) Straining or screening: Un=clarified fruit juices contain varying amounts of suspended matter (broken fruit tissue, seed, skin, pectic substances, protein). Seeds and skin which adversely affect the quality of juice are removed by straining through a muslin cloth or power operated screening system or filter press.

b) Finishing: Citrus juices need finishing for separating cloudy but otherwise clear juice from pulp, rag and seeds. The finisher separates the pulpy matter from the juice by the action of a rotating auger inside a cylinder screen. Screen hole size range from approximately 0.020 to 0.030 inch in diameter, depending on the condition and softness of the fruit. Finishing is judged by the pulp content in the orange fruit juice.

c) Decantation: Decantation is the simplest method of clarification, in which the juice containing solids is allowed to settle down and then clear juice is decanted or siphoned off. Keep juice at low temperature for long periods to facilitate clarification

d) Centrifugation: The clouding particles can be separated by centrifugal action. The juice containing solids is fed into a basket or disc type centrifuge, where the centrifugal force separates the light and dense components in each layer. The clear juice is collected and unwanted solids are separated

e) Enzymes: The plant carbohydrates, pectin, starch and proteins make the colloidal suspension in the freshly extracted fruit juice. The pectinol enzyme is widely used for better juice recovery and clarification of fruit juices as it breaks pectin into soluble form thereby freeing the suspended particles which settle down and leaves the juice clear

Addition of sugars: All juices are sweetened by adding sugar, except those of grapes and apple. Sugar can be added directly to the juice or as syrup made by dissolving it in water. Fruit squash, cordial, syrups are made by adding appropriate quantity of sugar into the pulp or juice using cane sugar.

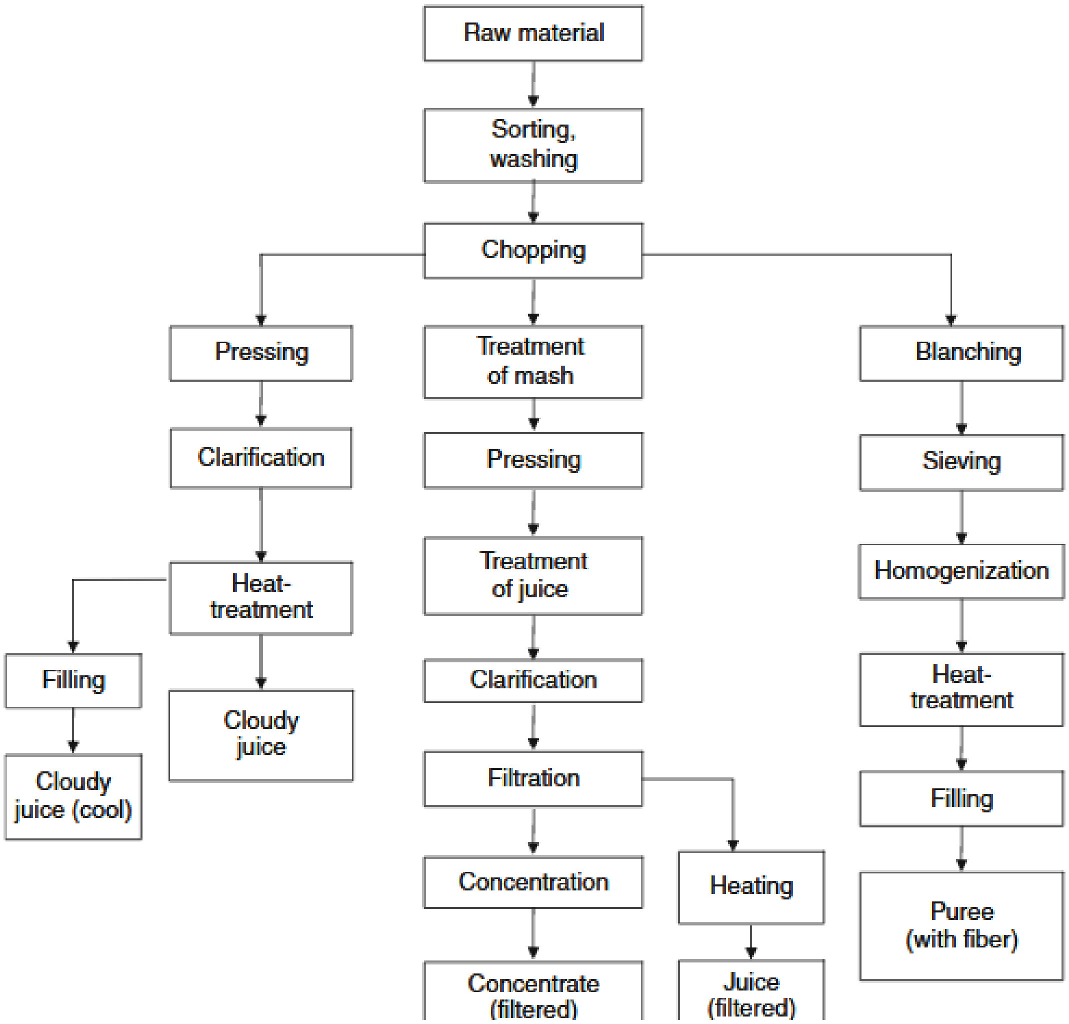
Preservation of juices

a) Pasteurization: It is a process in which juice is heated to 100oC or slightly below for a sufficient time to inactivate/kill the micro-organisms causing spoilage. Usually juices are pasteurized between 75 and 880C for 30 sec to 30 min depending on the type of heating system, nature of the juice and size of the container. Pasteurization can be performed at low temperature for a long time (LTLT) or high temperature for short time (HTST

b) Aseptic processing and packaging of fruit juices: Aseptic processing and packaging is defined as the process in which a commercially sterile product is packed into pre- sterilized container in a sterile environment. The system makes use of HTST sterilized container in a sterile environment. The system makes use of HTST sterilization in the temperature range of 90-110oC for acid products (pH<4.6) and ultra-high temperature (UHT) sterilization 121oC and above for low acid foods (pH>4.6). Products with better nutritional value and excellent sensory quality are produced. Juices in tetra pack are processed commercially using aseptic processing, e.g., apple

c). Preservation with chemical: Benzoic acid (benzoates) and sulphur dioxide (Sulphites) are commonly used preservatives in juices.

Filling and Processing: Bottles are thoroughly washed with hot water and filled leaving1.5-2.5 cm headspace. The bottles meant for heat processing are sealed by using crown corks



Process flow diagram of fruit and vegetable processing stage

1.4 . Processing parameters and its effect on fruits and vegetables processing

Processing parameters are

- **Temperature**
- **Time**
- **Flow rate**
- **Pressure**

Processing parameters can affect food safety and quality attributes of fruit and vegetable based products

Safety

When developing a process, one first has to assure that it will result in safe products, both at the microbial and the bio-chemical level

High pressure/high temperature processing exerts a broad range of effects on different safety aspects. While it has positive effects on the inactivation of some food allergens, the mitigation of acrylamide and does not affect the carotenoid content, it can have a detrimental effect on overall flavour and some water soluble health related compounds. However, to make a fair comparison with conventional thermal processing, the effect on quality and (bio)chemical safety needs to be evaluated on an equivalent basis with regard to microbial safety. HP/HT processing is most likely to be used in-pack processing rather than for processing of liquids

Bio-chemical reactions occurring under conditions of high pressure and high temperature that affect the safety of the food, scch as food allergens and acrylamide formation

Acrylamide formation

Thermal processing of carbohydrate-rich foods, such as potato and cereal products can lead to the formation of the potential human carcinogen acrylamide, predominantly through the Maillard reaction between the amino acid asparagine and a reducing sugar. The Maillard reaction is also responsible for the formation of desired as well as undesired color and flavour compounds and is therefore considered one of the most important chemical reactions in determining the quality of heated foods.

The retarding effect of high pressure on the overall Maillard reaction was demonstrated, although the rate at which acrylamide was formed strongly depended on the buffer system used and the temperature and pressure dependence of its acid dissociation constant.

High water content products are relevant for high pressure processing applications, the that acrylamide formation is not expected to pose a major hazard to this type of products

Allergens

Allergens pose another safety risk for susceptible consumers. It is known that the secondary and tertiary structure of food allergens is crucial to their allergenic potential. Therefore, processing techniques affecting this structure, such as HP treatment, have the potential to reduce the allergenicity of foods. Several studies have been performed on the effect of HP at ambient to moderate temperature on different allergens from plant origin.

Quality

Once processing conditions have been established that render a safe product, it is key to optimize the process with regard to product quality, as this will be the criterion by which the technology will be evaluated by the consumer, who always expects to be eating a safe product.

1.4.1 Quality attributes affected by processing parameters

Texture

Texture is one of the key quality attributes of fruit and vegetable based products, yet as a term, it is quite broad. It covers the structural and mechanical properties of a food and how these are perceived by vision, hearing and touching. In edible fruits and vegetables, texture is mainly determined by the structure of their parenchyma cells which are weak and non-specialized. The structural integrity of the primary cell wall and middle lamella, in addition to the turgor pressure generated within the cells due to osmosis determine the texture of such tissues. Loss of this structural integrity, for instance during processing, can mainly be attributed to depolymerisation of cell wall pectic polysaccharides, leading to weakened cell adhesion. During processing, pectin, particularly abundant in the middle lamella, is susceptible to both chemical and biochemical conversions that can either be beneficial (demethoxylation) or detrimental (depolymerisation) to the texture of the fruit or vegetable

colour

At higher temperature (65°C), HP processing (300-700 MPa) only slightly changes the colour of strawberry juice at its natural pH 3.7, suggesting that anthocyanins are only slightly affected.

Flavour

Flavour is the sensory impression of a food that is determined mainly by taste and smell. Even small changes in the flavour-active components can alter the overall flavour of the fruit or vegetable to a large extent. High-pressure as such is considered to have a limited effect on low-molecular-weight flavour compounds, but as on health-related compounds, high-pressure processing may result in undesired changes in the overall flavour of plant-based foods for example during storage if enzyme inactivation has been incomplete.

Loss of nutrients

High pressure processing enhances reactions that are associated with a volume decrease. As the change in volume upon breaking of covalent bonds is small, its effect on low-molecular mass compounds such as vitamins is expected to be limited. This is corroborated by many studies, as reviewed by Oey et al. (2008b). Nevertheless, loss of nutritional value during consecutive storage occurs, for instance due to limited enzyme inactivation by high pressure.

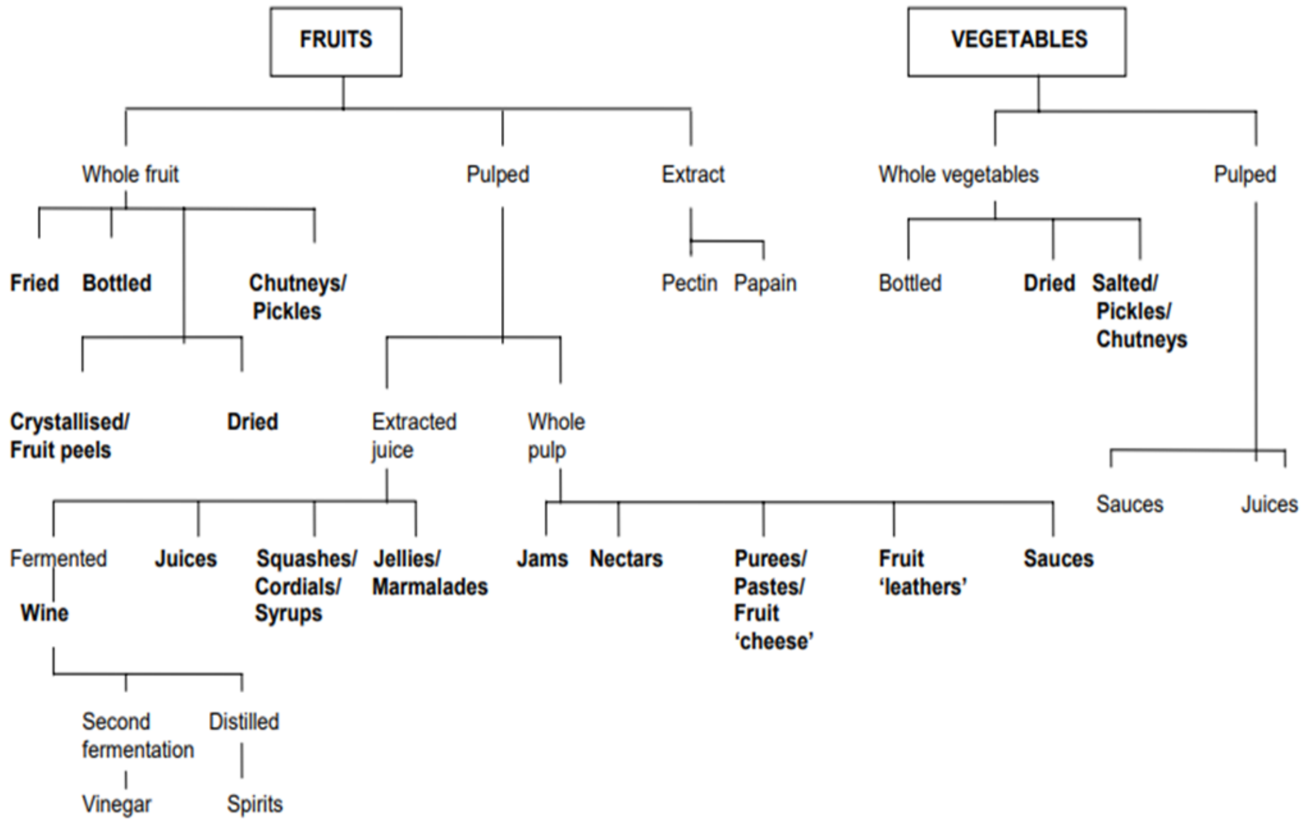


Figure 3 Fruit and vegetable products

1.5 Quality criteria of processed fruit & vegetable products

Processed fruit and vegetable product quality is determined by the quality of the raw materials utilized(e.g. cultivar, maturity, cultural practices) and the efficiency and care taken during handling, processing, storage and distribution.

Processed fruit and vegetable quality evaluation often includes determination of the following attributes:

- Brine or syrup concentration and specific gravity
- Titratable acidity or pH
- Flavor, odor and color, by subjective or instrumental means
- Size, shape and symmetry
- Maturity/character or soluble/total solids
- Texture, viscosity or consistency
- Defects such as soft, overripe or underripe, discol- ored, insect damaged or moldy fruit

- Enzymes responsible for flavor, odor, color or textural changes

1.6 Factors that influence shelf life

Shelf life is the period of time, established under intended conditions of distribution, storage, retail and use, that the food would remain safe and suitable.
Shelf life testing requires foods to be stored under the expected conditions of storage and distribution for a period of time to determine at what point chemical changes, deterioration and/or spoilage of the food occurs.
Shelf-stable food is food of a type that, because of its composition (low moisture, high salt or sugar content) does not require to be refrigerated for storage or a food which would normally be stored refrigerated but which has been processed so that it can be safely stored in a sealed container at room temperature for a usefully long shelf life.

Even if two products look similar, their shelf life can be quite different. It is not safe to take the shelf life from one and apply it to the other. You need to know what has occurred during manufacture and understand the factors that will influence its storage characteristics before being able to arrive at an appropriate shelf life for your food. Factors that influence the shelf life are either:

A. Intrinsic; the product characteristics, e.g. acidity, moisture content, etc.; or

B. Extrinsic; external characteristics, e.g. storage temperature, packaging, etc.

A. Intrinsic factors or characteristics of the food itself

The intrinsic factors that impact on its shelf life include:

- **The nature and quality of the raw materials.** Good quality raw materials with low numbers of microorganisms present will help ensure products with a consistently acceptable shelf life. If raw materials could sometimes be heavily contaminated, this needs to be taken into account during processing.

- **Product formulation** including the use of preservatives. Mould and bacterial growth can be inhibited or slowed down by removing moisture. Removing, substituting or modifying ingredients in some way may allow microorganisms to grow where previously they were inhibited. Replacing sugar with an artificial sweetener .

- **Product structure.** Liquids and semi-solid foods will usually have a homogeneous composition, but many products do not, including composite foods. Moisture and flavours will migrate between layers, while coatings and surface treatments can either restrict or enhance spoilage

- **Oxygen availability and redox potential within the food .** This can have a major effect on which sorts of spoilage and pathogenic microorganisms will grow on the food. This also impacts on oxidation-reduction reactions which cause rancidity, loss of vitamins, browning and flavour changes resulting in product deterioration. Moulds need oxygen to grow and so are usually found on food surfaces but will grow in crevices within food.

B.External factors (i.e. extrinsic) to the food

These will also have an impact on shelf life and include

- **Processes applied to the food.** It is important to validate the process using the worst case conditions, because the more bacteria in the raw materials, the greater the number of bacteria that will survive and shorten shelf life. While retort processes can be used to inactivate the most heat resistant organisms, milder heat processes will inactivate only some bacteria and a proportion will survive. Generally the more intense the process, the longer the shelf life .

- **Cooling methods** applied to heat treated products. Some spoilage and pathogenic bacteria produce spores that may not only survive but may be activated during the heating process

- **Type of packaging** including the gaseous environment. Packaging will have a primary role of protecting a food after processing but may also be used to extend the shelf life. If the gaseous environment is changed, e.g. vacuum packing or gas flushing, this will favour the growth of certain pathogenic bacteria and spoilage bacteria, while inhibiting the growth of microorganisms that require oxygen (including moulds).
- **Storage temperature** (i.e. ambient, chilled or frozen). While frozen storage will stop the growth of all but a very few spoilage microorganisms, chilling will only slow growth. A number of spoilage microorganisms and cold-tolerant bacteria will actively grow under chilled conditions. Their growth will usually be slower than would occur during ambient storage.
- **Conditions during distribution, storage, retail display and storage by the consumer .** At any point in the product's shelf life, it may be exposed to conditions that will lead to the food showing signs of deterioration and a shortened shelf life. These conditions include elevated or fluctuating temperatures, U.V. light, high humidity, freezer burn, vibrations, etc.

Self-Check – 1	Written test

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

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

Test I: Short Answer Questions(4 point each)

1. What are the basic quality characteristics in fruit and vegetable processing products?
2. What are the primery and secondary fruit and vegetable processing stages?
3. List at list sex products of fruit and vegetable?what are the two factors affecting shelf life of fruits and vegetables

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Type of packaging is Intrinsic factors or characteristics affecting shelf life of the products **(3 point each)**

2. Processed fruit and vegetable product quality is determined by the quality of the raw materials utilized **(3 point each)**

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

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

Score = ___________

Rating: ____________

Information Sheet 2- Identifying and taking corrective action on Non- conformance in processing, handling and storage

2.1 Non-Conforming products are identified during

- Incoming Inspection / Verification of Product
- Storage of shelf life items
- Product & Process audit
- Analysis of Customer Returned Product

There are many attributes that can define a non-conforming food product. Depending on the type of food business that you operate these can include:

- Product is contaminated with microbiological, chemical or physical hazards.
- Finished product weight issues (generally underweight product)
- Quality attributes do not meet the required finished product specification. For example what it looks like, how it tastes, what it smells like and how it feels.

BIOLOGICAL CONTAMINATION

Biological contamination occurs when food becomes contaminated by living organisms or the substances they produce. This includes biological matter produced by humans, rodents, insects and microorganisms.

Bacteria and other pathogens thrive in foods that are:

- moist
- high in protein or starch
- neutral in acidity Skip to main content

PHYSICAL CONTAMINATION

Physical contamination occurs when a physical object enters food at some stage of the production or preparation process.

Common examples of physical contaminants in food businesses include:

- hair
- fingernails
- bandages
- jewellery
- broken glass, staples
- plastic wrap/packaging
- dirt from unwashed fruit and vegetables
- pests/pest droppings/rodent hair

To minimize the risk of physical contamination fruit and vegetables occurring in your food business, always:

- ✓ wear hair neatly tied back or wear a hair/beard net
- ✓ keep jewellery to a minimum
- ✓ when necessary, wear brightly coloured bandages that can be easily seen if they fall off
- ✓ throw out and replace cracked, chipped or broken dishware, glassware and equipment
- ✓ use a plastic or metal scoop for ice (never use the glass!)
- ✓ wash fruits and vegetables thoroughly
- ✓ establish pest prevention and control procedures as part of your Food Safety Plan

CHEMICAL CONTAMINATION

Chemical contamination occurs when food comes into contact with or produces toxic chemicals, which can lead to chemical food poisoning. Chemical contaminants fall into one of two categories: natural and artificial.

Common chemical contaminants include:

- cleaning products (e.g. detergent, sanitizer)
- pesticides/herbicides
- toxic chemicals in metals and plastic
- preservatives
- naturally occurring toxins

Cause chemical contamination if they:

- don't store cleaning products and other chemicals properly
- use too much detergent or sanitizer to clean food preparation surfaces, glassware, dishes or cutlery (follow the manufacturer's instructions!)
- don't rinse surfaces, glassware, dishes or cutlery properly after cleaning and sanitizing (if applicable)
- don't properly wash fruits and vegetables to remove pesticides
- use kitchen equipment or containers made from materials that are not suitable for food or not designed to be reused (use only food-grade plastic and metals)
- use pest control products (e.g. spray, poisonous bait) improperly

To minimize the risk of chemical contamination occurring in your food business, always:

- label and store chemicals separately from food
- use the appropriate chemical for the job you're doing
- follow the chemical manufacturer's instructions with regards to dilution, contact time and water temperature
- use chemical pest control products with extreme care or outsource pest eradication to a professional pest control service

Self-Check – 2	Written test

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

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

Test I: Short Answer Questions (3potint each)

1. when Non-Conforming products are identified ?
2. Identifying and taking corrective action on Non-conformance in processing, handling and storage?

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Product is contaminated with microbiological, chemical or physical hazards. (3potint)
2. To minimize the risk of chemical contamination occurring in your food business, always label and store chemicals separately from food. (3potint)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

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

Score = ___________

Rating: ____________

Information Sheet 3- Investigating and reporting Causes of non-conformance

3.1 Causes and Possible Solutions for Problems with Fruit and vegetable Products

Table 3 . Causes and Possible Solutions for Problems with Fruit and vegetable Products

Problem	Cause	Prevention
Formation of crystals	1. Excess sugar.	1. Use a tested recipe and measure ingredients precisely
	2. Undissolved sugar sticking to sides of saucepot.	2. Dissolve all sugar as jelly cooks. If necessary, wipe side of pan free of crystals with damp cloth before filling jars.
	3. Tartrate crystals in grape juice.	3. Extract grape juice and allow tartrate crystals to settle out by refrigerating the juice overnight. Strain juice before making jelly.
	4. Mixture cooked too slowly or too long.	4. Cook at a rapid boil. Remove from heat immediately when jellying point is reached. Make small batches at a time; do not double tested recipes.
Bubbles	1. Air became trapped in hot jelly.	1. Remove foam from jelly or jam before filling jars. Ladle or pour jelly quickly into jar. Do not allow jelly or jam to start gelling before jars are filled.
	2. May denote spoilage. If bubbles are moving, do not use.	2. Follow recommended methods for applying lids and processing. (See Mold or Fermentation, below.)
Problem	**Cause**	**Prevention**
Too soft	1. Overcooking fruit to extract juice.	1. Avoid overcooking as this lowers the jellying capacity of pectin.
	2. Using too much water to extract the	2. Use only the amount of water suggested in the instructions.

	juice.	
	3. Incorrect proportions of sugar and juice.	3. Follow recommended proportions.
	4. Undercooking causing insufficient concentration of sugar.	4. Cook rapidly to jellying point.
	5. Insufficient acid.	5. Lemon juice is sometimes added if the fruit is acid deficient.
	6. Making too large a batch at one time.	6. Use only 4 to 6 cups of juice in each batch of jelly.
	7. Moving product too soon.	7. Do not move jellied products for at least 12 hours after they are made.
	8. Insufficient time before using.	8. Some fruits take up to 2 weeks to set up completely; plum jelly and jellies or jams made from bottled juices may take the longer time.
Syneresis or "weeping"	1. Excess acid in juice makes pectin unstable.	1. Maintain proper acidity of juice.
	2. Storage place too warm or storage temperature fluctuated.	2. Store processed jars in a cool, dark, and dry place. Refrigerate after opening.
Darker than normal color	1. Overcooking sugar and juice.	1. Avoid long boiling. Best to make small quantity of jelly and cook rapidly.
	2. Stored too long or at too high of temperature.	2. Store processed jars in a cool, dry, dark place and use within one year. Refrigerate after opening.
Cloudiness	1. Green fruit (starch).	1. Use firm, ripe fruit, or slightly underripe.
	2. Imperfect straining of homemade juice.	2. Do not squeeze juice but let it drip through jelly bag.
	3. Jelly or jam allowed to stand before it was poured into jars or poured too slowly.	3. Pour into jars immediately upon reaching gelling point. Work quickly.
Problem	**Cause**	**Prevention**
Mold or Fermentation (Denotes spoilage; do not use.)	1. Yeasts and mold grow on jelly.	1. Process in a boiling water canner. Test seal before storing. Pre-sterilize jars when processed less than 10 minutes in boiling water.
	2. Imperfect sealing. (Common also with paraffin-covered jellies.)	2. Use new flat lids for each jar and make sure there are no flaws. Pretreat the lids per manufacturer's directions. Use ring bands in good condition – no rust, no dents, no bends. Wipe sealing surface of jar clean after filling, before applying lid.

	3. Improper storage.	3. Store processed jars in a dark, dry, cool place. Refrigerate after opening.
Too stiff or tough	1. Overcooking.	1. Cook jelly mixture to a temperature 8°F higher than the boiling point of water or until it "sheets" from a spoon.
	2. Too much pectin in fruit.	2. Use ripe fruit. Decrease amount if using commercial pectin.
	3. Too little sugar which requires excessive cooking.	3. When pectin is not added, try ¾ cup sugar to 1 cup juice for most fruits.

Problem	Cause	Prevention
Not a characteristic fruit flavor	1. Overcooked or scorched.	1. Should be stirred frequently when mixture begins to thicken to prevent sticking. Cook only to jellying point.
	2. Poor quality fruit used.	2. Select only sound, good flavored fruit of optimum maturity.
Shriveled product	1. Syrup is too heavy.	1. Follow instructions for the type of fruit being preserved.
Tough product	1. Starting the cooking of fruit in syrup that is too heavy (too much sugar).	1. Cook each fruit according to directions; by evaporation the syrup concentration will gradually increase.
	2. Not plumping fruit properly.	2. Fruit should plump at least 24 hours covered in syrup before canned.
	3. Overcooking.	3. Cook according to directions.
Sticky, gummy product	1. Overcooking.	1. Follow recommended directions for each product. (Cook only until syrup is quite thick and fruit is fairly translucent.)
Darker than normal color	1. Cooking too large of quantities at one time.	1. It is usually best to cook not more than 2 to 4 pounds of prepared fruit at a time.
	2. Cooked too slowly.	2. A better color is usually produced if the product is cooked rapidly.
	3. Overcooked.	3. Cook only until syrup is quite thick and the fruit is fairly translucent.
Loss of color	1. Improper storage.	1. Store processed jars in a dark, dry, cool place.
Mold or Fermentation (Denotes spoilage; do not use.)	1. Imperfect sealing.	1. Use new flat lids for each jar and make sure there are no flaws. Pretreat the lids per manufacturer's directions. Use ring bands in good condition – no rust, no dents, no bends. Wipe sealing surface of jar clean after filling, before applying lid.

	2. Yeast or mold growth.	2. Process in a boiling water canner. Test seal before storing. Pre-sterilize jars when processed less than 10 minutes in boiling water.
	3. Improper storage.	3. Store processed jars in a dark, dry, cool place. Refrigerate after opening.

3.2 Causes of spoilage of canned/bottled products

Food is mostly subjected to physical, chemical and biological changes which lead to quality deterioration and ultimately spoilage.

1. Chemical spoilage: Hydrogen swell is the important type of chemical spoilage of canned food. The hydrogen gas formed inside the can, by the action of food acid on the iron of the can causes the can to swell which is termed as Hydrogen swell. Major causes of hydrogen swell are:

- Presence of high acid in the can.
- Storage at high temperature.
- Imperfections in tinning and lacquering inside of the can.
- Insufficient exhausting during canning.
- Presence of soluble sulphur and phosphorus in the can contents.
- Interaction between steel base of can and contents of the food leading to chemical spoilage and may also cause following defects:
- discolouration of the food
- discolouration inside the can
- production of off flavour in the food
- cloudiness of liquors or syrups or brines
- corrosion or perforation of the metal and loss of nutritive quality.

2 .**Biological spoilage:**

Biological spoilage in the canned food is caused by either survival of organisms after heat treatment or entry of micro-organisms through leakage of the container after heat processing. The types of micro-organisms involved in spoilage of canned foods are thermophilic bacteria and mesophilic micro-organism and kind of spoilage brought about by these groups is characterized and discussed further in this chapter.

A) Spoilage by mesophilic organisms: This type of spoilage is caused by spore forming bacteria of genera Bacillus and Clostridium growing in the food as a result of under processing. Besides, spoilage of lightly heated food like acidic foods can also be caused by non-spore forming bacteria or even yeasts or moulds. Spoilage by mesophilic Clostridium & Bacillus sp. and sugar fermenting species of Clostridium like Clostridium butyricum and Clostridium pasteurianum cause the butyric acid type of fermentation in acid or medium-acid foods. This lead to swelling of container due to the production of hydrogen gas and carbon-dioxide gas. The mesophilic organisms responsible for spoilage are as under:

- Putrefactive anaerobes
- Butyric anaerobes
- Aciduric Flat sour and Lactobacilli
- Yeast
- Moulds

i) Putrefactive anaerobes: The species of Clostridium like C. sporogenes, C. putrefaciens and C. botulinum are proteolytic or putrefactive causing decomposition of proteins with the production of off odorous compounds such as hydrogen sulphide, and ammonia. Besides, putrefactive anaerobes also produce carbon dioxide and hydrogen gas, thus causing the can to swell. The spores of some putrefactive anaerobes are very heat resistant thus putrefaction along with flat sour and TA (thermophilic anaerobes) spoilage constitutes the major type of biological spoilage of canned foods resulting from under processing. Putrefactive anaerobes grow best in the low acid canned foods like peas, corn, meats, fish and poultry. C. botulinum is main putrifier causing food poisoning.

ii) Butyric anaerobes: The spores of saccharolytic Clostridia commonly called as butyrics having comparatively low heat resistance, cause spoilage of canned foods which have been processed at 100oC or less such as commercially canned acid foods processed by hot water or steam. Canned acid foods such as pineapple, tomato and pears are generally spoiled by Clostridium pasteurianum. The spoilage by Saccharolytic bacteria is characterized by the production of butyric acid, carbon dioxide and hydrogen. Similarly, canned peas, asparagus, spinach, peach and tomatoes can be spoiled by aerobacilli or gas forming Bacillus species (B. polymyxa and B. macerans) by entering possibly through the leakage in the container. The heat resistance of Bacillus sp. is same as that of Clostridium pasteurianum.

iii) Aciduric flat sour and Lactobacilli: It is also referred as spoilage by non-spore forming bacteria. The presence of viable non-spore forming bacteria in the canned food indicates that the product has received either a very mild heat treatment or the bacteria entered through a leakage in the container. Common micro-organisms found in under processed fruit products such as tomato and pear includes acid forming Lactobacillus and Leuconostoc species. Some thermoduric bacteria which can withstand pasteurization are Streptococcus thermophillus, some species of Micrococcus, Lactobacillus and Microbacterium. An important bacterium found in cooling water is coliform bacteria, which produce gas and cause the can to swell. However, spore forming bacteria can also enter the can through the leakage. Further non-spore forming and non-gas forming bacteria that may enter the can through leakage include those in the genera Pseudomonas, Alcaligenes, Micrococcus, Flavobacterium, Proteus etc.

iv) Spoilage by yeast: Detection of yeasts and their spores in the canned foods is the result of either gross under processing or leakage as the yeasts and their spores are readily killed by most heat processing methods. Canned fruits, jams, jellies, fruit juices, syrups etc are generally spoiled by fermentative yeasts, with swelling of the cans owing to the production of carbon dioxide. Presence and growth of film yeasts on the pickles, olives etc. indicates contamination, lack of heat processing and poor evacuation.

v) Spoilage by moulds: Growth of moulds is the common cause of spoilage of high sugar containing processed and canned foods as they enter through a leak in seal of the container. Though jams, jellies and marmalade having sugar concentration as high as 70% with normal acidity of 0.8 to 1.0%, practically removes the risk of mould spoilage yet sometimes mould growth can be seen on the surface of the product. Strains of Aspergillus, Penicillium and Citromyces found growing in jellies and canned fruits are able to grow in sugar concentration up to 67.5 percent but can be killed by heating the food at 90oC for 1 minute. Some moulds are fairly resistant to heat like Byssochlamus fulva, a pectin fermenting moulds which resist the heat processing.

B) Spoilage by thermophilic organisms

Major cause of spoilage of heat processed foods by thermophilic spore is due to under processing as their spores are more heat resistant than those of mesophilic bacteria. Spoilage by thermophiles includes flat sour, TA spoilage and sulphide spoilage.

i) Flat sour spoilage: In this kind of spoilage, the ends of the can of food remain flat during souring or during the development of lactic acid in the food by the flat sour bacteria. Due to normal appearance of the can, this type of spoilage can not be detected by the examination of the unopened can. Flat sour spoilage occurs in low-acid foods such as peas, lima bean and corn etc and is caused by species of Bacillus which form acid without production of gas. They include mesophiles, facultative thermophiles or obligate thermophiles. In acidic foods like tomato and tomato juice, flat sour is caused by facultative thermophilic species such as Bacillus coagulans. The spores of mesophiles being least heat resistant are killed by heat processing and are therefore not involved in flat sour spoilage of low acid foods, but the spores of thermophiles are considerably more heat resistant and survive the heat process to cause flat sour spoilage.

ii) TA spoilage: TA is a nick name for the bacterium thermophillic anaerobe not producing hydrogen sulphide or for Clostridium thermo-saccharolyticum causing this type of spoilage. This bacterium is a thermophilic spore-forming anaerobe that forms acid and gas in foods. The gas (mixture of CO_2 and H_2) developing inside the container cause the can to swell and when cans are stored for too long at high temperature they may result in bursting. The spoiled food has sour or cheesy odour. The source of bacteria for both flat sour and TA spoilage is starchy/sugary foods.

iii) Sulphide spoilage: TA spoilage producing H2S and cause sulphide spoilage. The micro-organism responsible for sulphide spoilage is Desulfotomaculum nigrificans and is found in low acid foods like peas and corn. The spores of this bacterium are less heat resistant than those of flat sour and TA bacteria; as such the appearance of sulphide spoilage in canned food is the indication of gross under-processing.

C). **Classification of microbial spoilage on the basis of acidity**

The low acid food with pH above 5.3 is subject to flat sour spoilage and putrefaction. Medium acid foods with pH between 5.3 and 4.5 are likely to undergo TA spoilage. Acid food with pH between 4.5 and 3.7 are spoiled by special flat sour bacterium or by saccharolytic anaerobe. However, high acid food with a pH below 3.7 generally does not undergo spoilage by bacteria, but in the cans it may result in hydrogen swell. The type of the spoilage in the canned food can be classified on the basis of acidity of the food

Table 4. Classification of microbial spoilage based on acidity of the food

Type of food	Foods involved	Type of spoilage
Low acid pH $\geq$ 5.4 Medium acid pH 5.3-4.6	Meat and fish products milk, vegetables like corn, lima beans, peas, meat and vegetable mixers.	i) Thermophilic flat sour group. (*Bacillus sterothermophilus*, *B. coagulans*). ii) Sulphide spoilage (*Clostridium nigrificans*, *C. bifermentans*). iii) Gas formers (*Clostridium thermosaccharolyticum).* iv) Mesophilic spoilage like putrefactive anaerobe. v) Spoilage and toxin production by *Clostridium botulinum*.
Acid food pH	Fruits, pears, figs, tomato	i) Thermophilic spoiler *Bacillus coagulans*

3.7-4.6	etc.	ii) Mesophilic spoiler *B. polymyxa*, *Clostridium pasteurianum*, *C. butyricum*, *Lactobacilli* etc.
High acid pH<3.7	Fruits like grape fruit, citrus, rhubarb etc and products like sauerkraut, pickles etc.	Non-spore forming mesophiles, yeast, mould and/or lactic acid bacteria.

Discolouration of fruit and vegetable products

Besides microbial spoilage, the processed products may experience discolouration, which may be caused by various reactions brought by the action of enzymes, metallic contamination or through the reaction between different components.

i) Enzymatic browning: Browning of cut and peeled apples, potatoes and pears is caused by the oxidation of phenolic compounds brought about by the action of oxidase enzyme (Polyphenol oxidase) in the presence of air. The browning can be checked by placing the cut and peeled fruit in 2-3% NaCl solution until used for canning.

ii) Non-enzymatic browning: Browning of fruit products brought out by the reactions other than enzymes is called as non-enzymatic browning. The changes in colour of fruit products may be caused by reactions between

i) nitrogenous matter and sugar
ii) nitrogenous matter and organic acids
iii) sugar and organic acids and
iv) organic acids among themselves like ascorbic acid degradation and sugar degradation. The browning reactions between nitrogenous matter and sugar are known as Maillard reactions.

iii) Metallic contamination: The browning of canned fruit products is generally caused by the presence of iron and copper salts. Important metallic contaminations in fruit products include ferric tannate, iron sulphide, copper sulphide etc.

a) Ferric tannate: The natural tannins present in fruit and vegetables react with the iron of the tinplate of can to form ferric tannate which make the product black and spoils the appearance of the canned product.

b) Iron sulphide: Sulphur dioxide may be formed inside the can due to decomposition of protein in the product or it may come from the sulphited sugar used in canning. The SO2 may react with hydrogen formed by the fruit acid acting on the tin plate and get reduced to H2S, which in turn may react with the iron of the can and form the black iron sulphide. Ferrous sulphide releases obnoxious smell of H2S, besides spoiling the appearance of product.

c) Copper sulphide: The copper from the plant and equipment made of copper or brass may find its entry into the product and such product when comes in contact with H2S formed inside the can may form black copper sulphide, which causes discolouration of the product.

d) Black deposit in canned pumpkin. The amino compounds present in the pumpkin react with the iron of the can forming deposits in the canned product.

e) Discoloration in canned corn. Canned corn turns grey in colour. This is due to the formation of sulphides of iron and copper as a result of corrosion of the tin plate and tarnishing of the metal of the equipment, respectively. To prevent it only ‘C-enamel’ cans should be used.

f) Black deposit in canned fruits. In the case of fruits canned in syrups prepared from sugar, which sometimes contain sulphur dioxide, cause blackening of the tin plate due to the formation of iron sulphide.

g) Pink discoloration in canned pears, guava and peaches. Pears, peaches and guava turn pink, if the cans are not cooled properly after sterilization.

Thus major cause of spoilage of canned products are under processing, cooling of cans in contaminated water, defects in seaming operation, use of non-lacquered cans in some products etc which may be avoided during processing of canned products.

Vibration and bumping

Vibration and bumping when they are carried on trucks, especially on unmade rural roads. Where possible transport by train or by riverboat is a better option for protecting fruit because of the reduced vibration.

Self-Check – 3	Written test

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

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

Test I: Short Answer Questions (3point each)

1. List the causes and possible Solutions for problems with fruit and vegetable products?

2. List Classification of microbial spoilage based on acidity of the food

Test II: Write true if the statement is correct and false if the statement is incorrect

1.Acid food with pH between 4.5 and 3.7 are spoiled by special flat sour bacterium or by saccharolytic anaerobe. **(3point)**

2.Browning of canned fruit products is generally caused by the presence of iron and copper salts. **(3point)**

3. Overcooked or scorched can change a characteristic fruit and vegetable products flavor. **(3point)**

4.Biological spoilage in the canned food is caused by either survival of organisms after heat treatment or entry of micro-organisms through leakage of the container after heat processing. **(3point)**

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

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

Score = ___________

Rating: ____________

Information Sheet 4- Determining and implementing Corrective action

4.1. Respond to non-conformances:

A food safety program enables food establishments to ensure food production methods are safe, hygienic and that they comply with food regulations and legislation. The food safety program systematically identifies the food safety hazards that may be reasonably expected to occur in your workplace. It identifies where and how each hazard can be controlled, describes how these controls are to be monitored, the corrective action required if control conditions are not met, and information to be recorded.In order to evaluate the activity of enzymes important to a particular product, it may be of interest to evaluate activity in the raw and processed products.

Collect and analyses food safety data

Collecting and analyzing food safety data is an essential component of any food safety program. You should collect and analyses data on an ongoing basis to enable any breaches of food safety procedures to be identified and corrected.

Sources of food safety data

The systems, procedures and support programs that assist with the implementation of food safety programs not only give direction and advice to staff implementing the program, but also provide information and data to supervisors through the use of monitoring forms such as check sheets.

As a supervisor, you will be required to collect this data and analyse it to identify any irregularities and noncompliance with regulations. The data may also highlight areas where improvements could be made to ensure that food quality is maintained.

Standard operating procedures (SOPs)

Standard operating procedures cover all areas of production and support functions, which contribute to the production (and safety) of the final product. Standard operating procedures must comply with the Food Safety Standards and any relevant industry codes. They give staff clear direction for following sound hygiene procedures and often have associated check sheets that provide a range of data.

The Standard operating procedure identifies:

- The staff responsible for the activity (e.g. receiver and stores staff)
- The nature of their responsibilities (e.g. to ensure acceptable goods are received and nonconforming goods returned following correct procedures)
- Check sheets or reporting sheets that must be completed as part of the procedure.

  Standard operating procedures may include:

  1. Cleaning schedules
  2. Pest control programs
  3. Maintenance schedules
  4. Calibration of equipment
  5. Supplier standards
  6. Staff training schedules.

Non-conformance is when the control measures identified in the food safety manual are not being applied or critical limits are not being met. Non-conformance may lead to the food becoming contaminated either by physical, chemical or biological means which can lead to a breach of food safety legislation.

Control measures Control Measure: Any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level. Control measures are established to prevent, control and eliminate food safety hazards. Control measures describe how to keep food safe and will also improve food quality. Control measures do not work in isolation they are all closely linked

Control measures for each production step ensure that actions of staff:

- Do not cross-contaminate food through poor personal hygiene, poor standards of cleanliness or the presence of pests
- Do not expose food to chemical or physical contamination
- Do not expose food to the danger zone for sufficient time enabling the growth of food poisoning bacteria.

Before taking corrective actions it is very important identify hazards. So that to keep the food safety it is important to take corrective action / manage hazards according to the sever and extent of hazards**.**

Self-Check – 4	Written test

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

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

Test I: Short Answer Questions (3point each)

1. List sources of food safety data?
2. List the standard operating procedures

Test II: Write true if the statement is correct and false if the statement is incorrect

1.A food safety program enables food establishments to ensure food production methods are safe, hygienic and that they comply with food regulations and legislation **(2point)**

2.Control measures are not established to prevent, control and eliminate food safety hazards. **(2point)**

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

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

Score = ___________

Rating: ____________

Information Sheet 5- Taking action to prevent recurrence of non-conformance

5.1 Responding recurrence of non-conformance

From time to time a food processor will create or receive product that does not meet quality or food safety standards. It is the responsibility of the processor to remove the product from the logistics chain.

This responsibility includes discarding the non-conforming product, or perhaps reworking the non-conforming product to create an acceptable product that can safely be sold. It is also the responsibility of the processor to accurately record the handling of this type of product.

If the decision is made to discard the non-conforming product it must be disposed of in a manner that would reduce or prevent the inadvertent use. For instance, the processor would not place discarded product in a dumpster, where someone might come and remove the product from the dumpster and consume. Proper handling might include keeping the dumpster containing the product behind a locked fence, or in an area that is covered by security.

The processor must conduct a reasonable search to determine the reason that a non-conforming product is produced. This search would include a review of purchasing procedures and working with suppliers to determine if the materials received had some type of issue that is causing the problem. The processor may need to research all the way back to the farmer's field where the materials were grown or produced. In the processor's kitchen, sanitation processes should be reviewed as well as the performance of equipment used in the food production process. The processor would need to make the necessary repairs and corrections. In the case of equipment, it may need to be repaired or replaced.

Dispositions or actions taken on a nonconforming work Process and/or product are:

• **Use as is**: approving the use of nonconforming process/service/product without rework or redoing. A disclaimer is made that the process/service/product was accepted.
• **Unable to use**: action taken if unable to resolve the problem. The receiver is notified that the process/service/product is discarded and/or made obsolete.
• **Reworked or reprocessing** products are reviewed to verify that they comply with specifications.

5.2 . Apply food safety procedures

Raw fruits and vegetables contain harmful germs that can make you and your family sick, such as Salmonella, E. coli, and Listeria. CDC estimates that germs on fresh produce cause a large percentage of foodborne illnesses.

The safest produce is cooked; the next safest is washed. Enjoy uncooked fruits and vegetables while taking steps to avoid foodborne illness, also known as food poisoning.

- ❖ At the store or market:

Choose produce that isn't bruised or damaged.

Keep pre-cut fruits and vegetables cold by choosing produce that is refrigerated or kept on ice.

Separate fruits and vegetables from raw meat, poultry, and seafood in your shopping cart and in your grocery bags.

- ❖ At home:

Wash your hands, kitchen utensils, and food preparation surfaces, including chopping boards and countertops, before and after preparing fruits and vegetables.

Clean fruits and vegetables external icon before eating, cutting, or cooking, unless the package says the contents have been washed.

Wash or scrub fruits and vegetables under running water—even if you do not plan to eat the peel. Germs on the peel or skin can get inside fruits and vegetables when you cut them.

Washing fruits and vegetables with soap, detergent, or commercial produce wash is not recommended external icon. Do not use bleach solutions external icon or other disinfecting products on food.

Cut away any damaged or bruised areas before preparing or eating.

Dry fruit or vegetables with a clean paper towel.

Keep fruits and vegetables separate from raw foods that come from animals, such as meat, poultry, and seafood.

Refrigerate fruits and vegetables within 2 hours after you cut, peel, or cook them (or 1 hour if the outside temperature is 90° or warmer). Chill them at 40°F or colder in a clean container.

Self-Check – 5	Written test

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

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

Write true if the statement is correct and false if the statement is incorrect

1. Raw fruits and vegetables contain harmful germs so that it must be cooked or washed ? **(4 points)**
2. what are the dispositions or actions taken on a nonconforming work Process and/or product ? **(4 points)**

Note: Satisfactory rating - 4 points Unsatisfactory - below 4 points

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

Score = ___________

Rating:

1.

Information Sheet 6- Reporting action.

Reporting action

At a minimum the information should include technical and food safety information, including:

- The name of the product and the supplier's item number.
- Components or composition of the material.
- The presence of regulated or customer-recognized food allergens.
- Organoleptic information (appearance, flavor, and aroma).
- Pertinent physical, chemical, and microbiological information.
- Shipping and storage information.
- Shelf life.
- Handling directions.

Product Name

General name

Material identification can be general for commodity-type products or those with a standard of identity, General names or descriptors ease use and sharing specifications,

Material-specific name

A product-specific name or number may be assigned by the supplier when the item is a unique or proprietary material (such as with most flavors).

Item number

This is the number you assign to the purchased item in order to track materials within your system.

Components

The ingredient/material composition is listed in decreasing order of presence or as outlined in labeling regulations. For packaging materials, the specific composition of the packaging material would be specified, such as glass, polyethylene (PET), polypropylene (PPE), and so forth.

Food Allergens

It is not unusual for material containing an allergen; however there may be tolerable level .If you are controlling more than these, ensure you receive written confirmation of the presence/absence of the allergens you are managing.

Organoleptic Information

Organoleptic characteristics are tested with your senses, including visual appearance, aroma, and flavor. This brief description is typically used during the receipt or pre-use at the plant to confirm that basic expectations are met or identify issues that can be readily checked by appearance (puree rather than whole fruit), aroma (off odors such as musty or chemical), or flavor (caramelization with high fructose corn syrup or rancidity with oils).

Analytical Information

Analytical characteristics typically require testing with instruments rather than your senses. For example, an organoleptic description of a product could be "red liquid" and the analytical information would be the colorimeter reading.

Characteristics to be outlined include those affiliated with functionality, quality, and food safety. You do not necessarily need a Certificate of Analysis or in-house testing for all of the listed characteristics, rather, these characteristics are outlined as an agreement about what you are purchasing and as a basis for discussion if concerns are identified.

As described earlier, determining the key biological, chemical, and physical parameters and plant management to review historic information about the material, regulatory requirements, and the supplier history, as well as how the material will be handled in-house.

Food safety parameters or tolerances could include biological, chemical, or physical characteristics.

- Biological – Microbiological limits for pathogens, such as *Salmonella* and *Listeria monocytogenes*.
- Chemical – Fortification levels, sulfite levels, heavy metal content, etc.
- Physical – Size and foreign material (rocks, glass, metal, bones, etc.)

Functionality or quality parameters would include characteristics that can impact the functionality of the material or adversely impact your product.

- Biological – Microbiological limits for spoilage organisms or indicators of poor sanitation, including total plate count, yeast, mold, and coliform.
- Chemical – Characteristics such as concentration levels or purity.
- Physical – Characteristics such as viscosity, color, granulation size, insect parts, crush strength, physical measurements, etc.

Outline the appropriate conditions for shipping and storing the material. Include any special storage or handling directions, such as “do not freeze” or “store in a flame-resistant cabinet.”

Following the supplier’s storage recommendations, describe the product’s shelf-life (the supplier’s safety and quality guarantee for the product).

Determine if there are special directions for handling the material, such as if employees need to wear a face mask or other personal protective equipment (PPE) or if the material needs to be shaken before use.

Self-Check – 6	Written test

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

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

Short Answer Questions

1. List and discuses the basic technical and food safety information of fruit and vegetable products ? **(6 points)**

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

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

Score = ___________

Rating: ____________

Information Sheet 7- Conducting work with workplace environmental guidelines.

7.1 General environmental health and safety (EHS) Guidelines

The General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors

Occupational Health and Safety

Occupational health and safety issues during the operational phase include:

- Chemical hazards
- Environmental hazards
- Physical hazards
    - Confined space entry
    - Electrical hazards
    - Risk of fire and explosion
    - Noise

Essential tools for managing impacts while optimizing water, energy, and resource use and improving working practices involve the adoption of industry-specific good-manufacturing practice, quality management systems (including ISO 9000 series, ISO 22000), risk management systems (e.g., Hazard Analysis Critical Control Points, HACCP), and environmental management standards (e.g., ISO 14000).

Environmental issues in food and beverage processing facilities primarily include the following:

- Solid waste
- Waste water
- Energy consumption
- Emissions to air

While conducting work in food safety program the following are very important points to be considered. Some of them are:

Pollution Prevention and Control

Reductions in wastewater volumes of up to 95 percent have been reported through implementation of good practices. Where possible, measures such as the following should be adopted. Procure clean raw fruit and vegetables, thus reducing the concentration of dirt and organics (including pesticides) in the effluent. Use dry methods such as vibration or airjets to clean raw fruit and vegetables; drypeeling methods also reduce the effluent volume (by up to 35%) and pollutant concentration (organic load reduced by up to25 percent).

- Separate and recirculate process wastewaters.
- Use counter current systems where washing is necessary.
- Use steam instead of hot water to reduce the quantity of wastewater going for treatment (this needs to be balanced with the increase in energy).
- Minimize the use of water for cleaning floors and machines.
- Remove solid waste without the use of water.
- Reuse concentrated wastewaters and solid wastes for production of by-products. As an example recirculation of process water from onion processing reduces the organic load by 75% and water consumption by 95%. Similarly, the liquid waste load (in terms of biochemical oxygen demand (BOD) from apple juice and carrot processing can be reduced by 80%.

Good water management should be adopted, where feasible, to achieve the following levels of consumption:

Solid wastes, particularly from processes such as peeling and coring, typically have a high nutritional value and may be used as animal feed.

Material safety data sheets (MSDS)

The MSDS is a detailed informational document prepared by the manufacturer or importer of a hazardous chemical. It describes the physical and chemical properties of the product.

MSDS's contain useful information such as:

- Flash point,
- Toxicity,/contaminants
- Procedures for spills and leaks and
- Product handling, processing and Storage guidelines.

Information included in a Material Safety Data Sheet aids in the selection of safe products, helps you understand the potential health and physical hazards of a chemical and describes how to respond effectively to exposure situations

OHS standards and procedures

Specifications for tools, equipments and materials in controlling safety food requirements.

Standard Operating Procedures (SOP)

It is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine operations. SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations

Verbal directions from manager or supervisor

Work instructions and standards

Work notes.

Instructions and directions provided by supervisor must be followed and if we have any question we can ask when necessary. And also employee must observe and follow Enterprise policies and procedures in relation to workplace practices in the handling and disposal of materials.

Self-Check – 7	Written test

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

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

Short Answer Questions

1. what about general environmental health and safety (EHS) Guidelines? **(3pts)**
2. What are ehs guidelines in processing fruit and vegetable? **(3pts)**
3. How to reduce wastewater volumes in fruit and vegetable processing ? **(4pts)**

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

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

Score = ___________
Rating: ____________

Operation Sheet 1– Quality control of processed products:

Objectives; to understand major quality characteristics in fruit and vegetable processing

List of Materials needed:

- Sampling prove
- Test tube
- Microscop

Following procedures are followed for quality control of processed products:

Step 1. Identify the critical points in the process flow sheet which contributes to the major quality characteristics.

Step 2.Sample each critical point (batch or continuous operation) and identify what is being sampled and to what extent it is critical.

Step 3.Evaluate and relate quality at critical successive stages to costs and its application in field.

Step 4.Relate costs to deviation from specified levels.

Step 5.Evaluate data collected against standards and legal requirements.

Step 6.Provide consistent system for the orderly continuous evaluation of quality from the selection of raw material through different stages of processing.

Step 7.Diagnose problems and predict troubles before they occur.

Step 8.Determine the extent of drifts and shifts in production and minimize or localize deficiencies.

Step 9.Evolve a system to determine how well the quality control program is succeeding.

Operation Sheet 2– Determination of total soluble solids

Objective: To determine the total soluble solids in fresh and processed fruit and vegetable products.

List of Materials needed:

- Hand Refractometer
- Abbe-Refractometer

Procedure for estimation of total solubule solid

1. Calibrate the refractometer with a drop of distilled water, adjust the scale to 0 %
2. Wipe the prism with a cotton swab.
3. i) Cut a piece of fruit and squeeze a drop of juice on the prism of the refractometer.

ii) Place a drop of juice/squash/syrup on the prism.

iii) Place small quantity of jam/jelly in muslin cloth and squeeze and place on the prism.

LAP TEST	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 **6** hour. The project is expected from each student to do it.

Task 1. Determine basic quality characteristics in fruit and vegetable processing products?

Task 2: Determination of Total Soluble Solids

Reference Materials

Book

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