Fruit and Vegetable Processing -Level-II

Based on May 2019, Version 2 Occupational standards

Module Title: - Operating Heat Treatment Process
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LG #49	LO#1PREPARE THE HEAT TREATMENT PROCESS FOR OPERATION

Instruction sheet

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

- Confirming available materials to meet production/recipe requirements.
- Confirming available service
- Checking equipment
- Setting methods of heat treatment.

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

- Confirm available materials to meet production/recipe requirements.
- Confirm available service
- Check equipment
- Set methods of heat treatment.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Confirming available materials to meet recipe requirements.

1.1 Introduction

What fruit and vegetables can be processed? Practically any fruit and vegetable can be processed, but some important factors which determine whether it is worthwhile are:

- the demand for a particular fruit or vegetable in the processed form;
- the quality of the raw material, i.e. whether it can withstand processing;
- Regular supplies of the raw material. For example, a particular variety of fruit which may be excellent to eat fresh is not necessarily good for processing. Processing requires frequent handling, high temperature and pressure.

Many of the ordinary table varieties of tomatoes, for instance, are not suitable for making paste or other processed products. A particular mango or pineapple may be very tasty eaten fresh, but when it goes to the processing center it may fail to stand up to the processing requirements due to variations in its quality, size, maturity, variety and so on. Even when a variety can be processed, it is not suitable unless large and regular supplies are made available. An important processing center or a factory cannot be planned just to rely on seasonal gluts; although it can take care of the gluts it will not run economically unless regular supplies are guaranteed.

Fruit pulp and vegetable puree production steps

1. **Selection of fruits and vegetable**
    - Fruits and vegetables should be absolutely fresh.
    - Fruits should be ripe, but firm, and uniformly mature. Over-ripe fruits should be rejected because they are infected with microorganisms and give a poor quality product.
2. **Grading**

    The selected fruits and vegetables are graded according to size and colour to obtain uniform quality. This is done by hand or by machines such as screw grader and roller grader. Fruits like berries, plums and cherries are graded whole,

while peaches, pears, apricots, mangoes, pineapples, etc., are generally graded after cutting into pieces or slices.

3. **Washing**

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

4. **Peeling**

The objective of peeling is to remove the outer layer. Peeling may be done in various ways. (Hand peels, steam peeling, mechanical peeling, lye peeling, flame peeling).

5. **Cutting**

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

6. **Blanching for vegetable.**

It is also known as scalding, parboiling or precooking. Fruits are generally not blanched leaving the oxidizing enzyme system active. Sometimes fruit is plunged for a given time-from half to, say, five minutes, according to variety-into water at from 180°F to 200oF, and then immediately cooled by immersion in cold water. The object is to soften the texture and so enable a greater weight to be pressed into the container without damage to the individual fruit. Blanching is usually done in case of vegetables by exposing them to boiling water or steam for 2 to 5 minutes, followed by cooling.

7. Juice extraction/ Fruit pulp

Fig1.1 Fruit pulp

Fig 1.2 Vegetable puree

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)

1. List out fruit pulp and vegetable pure extraction process.
2. What it mean fruit grading?
3. What purpose we blanche vegetable?

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

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information Sheet 2- Confirming available service

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

Hot-water brushing is a recently developed postharvest treatment that is designed to remove postharvest pathogens from the fruit surface, and which often also results in a reduction in fruit shrinkage due to postharvest water loss, as well as a decrease in chilling injury in susceptible crops

2.2. Steam quality.

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

2.3 Energy Use in fruit and vegetable processing.

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

2.4.purpose of compressed air in fruit and vegetable processing:

The production facilities of the different segments within the food industry all have different applications for compressed air. These manufacturing plants are primarily engaged in the canning, freezing, and dehydrating of fruits and vegetables. This segment represents approximately 7.5% of the dollar value of shipments of the entire food industry In many fruit and vegetable processing plants, compressed air systems are used for air cleaning of containers prior to product filling, automated product sorting, and product packaging systems There are tens of thousands of factories operating in other segments of the food industry- all using compressed air. Many segments, like bakeries, use compressed air in blow-off applications. Other segments use compressed air to clean containers before filling the containers with food. Compressed air is also used to sort, cut, and shape food product The major end use of fuels in the typical fruit and vegetable processing facility is in boiler systems for the generation of steam, which can be used in a wide variety of process heating, water heating, and cleaning applications.

2.5. Purpose Vacuum and instrument air.

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

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 (6 point)

1. What are the uses of steam in food processing?
2. Describe the purpose of compressed air in fruit and vegetable processing?
3. List out at least four services for fruit and vegetable processing plants?

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

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

Information Sheet 3- Checking equipment

3.1. Checking Operational Characteristics

The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely with any deterioration detected and remedied before it results in a health and safety risk. The need for inspection and inspection frequencies should be determined through risk assessment. The purpose of inspection is to check whether the product is manufactured according to the standards. And specification by checking the products randomly. Quality check are measures aimed at checking, measuring, or testing of one or more product characteristics and to relate the results to the requirements to confirm compliance. Food processing equipment is typically designed and built with a particular function or unit operation in mind. However, the method in which these functions and operations are executed can vary depending on the design of the equipment, and additional components can be integrated to facilitate smoother operation.

3.2. Performance Checking

Performance includes the progress of the line to meet production targets and additionally it includes the monitoring of the production line in relation to organizational or customer specification, quality and compliance requirements. You must know how and be able to check tools, equipment and resources are used efficiently and effectively in line with regulatory and organizational requirements. You must be able to ensure quality and compliance specifications are adhered to, records are maintained and reports relating to the progress and performance of the production line are communicated to relevant colleagues.

3.3. Function Checking:

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

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

3.4. Develop the habit of regular maintenance

The daily maintenance of fruit juice processing machinery aims to keep the machine clean and shining, and ensure they are operating normally and neatly. This contribute to long-term steady production, and prolong the service life of fruit processing equipment. In a word, regular maintenance is a way to achieve better economic efficiency. The service life of a fruit processing machine depends on whether you have properly maintain it after using. Fruit processing equipment like fruit washer and fruit pulping machine are most frequently used. Any troubles emerging in fruit processing would cause great loss to the company. Therefore, frequent maintenance for fruit juice processing machine is of great necessity during every change of the seasons, we are supposed to pay more attention to fruit processing machinery maintenance. If not preserved properly, they will be vulnerable to the surroundings and likely to break down. This has great impact on the industrial production. Inspection to the complete machines when you receive them is indispensible. In particular, fruit processing equipment have more possibility to go wrong in fastening and lubrication during their run-in period..

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: Choose the best answer (5 point)

1. Describe equipment operational characters?
2. What is performance checking?

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

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

Information Sheet 4- Setting methods of heat treatment

4.1. Methods of heat treatment

In order to safely preserve foods using heat treatment, the following must be known:

- What time-temperature combination is required to inactivate the most heat resistant pathogens and spoilage organisms in one particular food?
- What are the heat penetration characteristics in one particular food, including the can or container of choice if it is packaged?

4.2.Canning or Bottling

Canning/bottling are a process where food is sealed in air-tight glass jars, to interrupt and delay the food's natural decay and spoilage. The jar's seal must be air-tight so that "no air can get in to re contaminate the food"

Canning is often referred to as bottling in New found land and Labrador. In the rest of this workshop the term canning is used alone for simplicity's sake and because most resources on the topic refer to canning.

However, when promoting your workshop, keep in mind that many people use the term bottling.

Canning and Bottling Methods

Two types of canners are commonly used to process fruit and vegetables.

These are the boiling water canner, and the pressure canner.

The choice of method depends on the acid content of the produce you are processing.

Boiling water bath

A water bath canner is a large pot with a loose cover and a rack to hold jars, off the bottom.

The pot should be deep enough to cover the canning jars by one to two inches and still have another inch of space to allow brisk boiling.

The diameter of the pot should be no more than four inches wider than the diameter of the stove's burner to ensure even heating.

Acidic foods such as fruits, tomatoes, pickles and relishes (pH < 4.5), and high sugar foods such as jams, jellies, syrups and mall11alades can be safely processed using a boiling water bath.

Pressure canning

A pressure canner is required for processing low acid foods such as vegetables (pH 4.5). A pressure canner is a specially made heavy pot with a locking lid. An inner rack and a steam vent in the lid. The vent can be adjusted using a weight, value or screw depending on the type of canner. A pressure gauge registers the air pressure inside the canner. A dial gauge gives a reading of the actual pressure. While weighted gauges 'will rock gently when the canner is at the proper pressure.

Ten pounds of pressure at l15 °C (240 ^{O}F) is recommended for canning 'vegetables at 0 to 1000 fit altitude.

Canning Operations

- Receive raw products and packaging material
- Separation of edible portion
- Washing
- Size grading, Inspection
- Blanching, Peeling
- Size reduction
- Cleaning of can & lid
- Filling, pulling vacuum, closing
- Dud detection
- Container coding

4.3. Hot Filling:

Hot Fill Process is proven and recognized method of high acid foods (pH less than 4.6) that will be shelf stable at ambient temperatures. As the name implies, hot fill process is a food processing where product is filled in to the finished containers and capped the container when they are still hot, and then cooled. In this case “hot” is characterized by temperature that is high enough to assure that all products in container is at or above the minimum prescribed when the closure (lid) is applied.

Practice, product is heated (in a heat exchanger) ,sent to the filler hot , and then filled into container, capped, and the container is inverted (turn up side down) for 3 minutes and then may be cooled. Inverting the container is needed to make sure that the inner surface of the closure is exposed to the hot temperature for decontamination or microbial inactivation.

4.4. Pasteurization:

Pasteurization or pasteurization is a process in which packaged and non-packaged foods (such as fruit and vegetable) are treated with mild heat, usually to less than 100 °C (212 °F), to eliminate pathogens and extend shelf life. The process is intended to destroy or deactivate organisms and enzymes that contribute to spoilage or risk of disease, including vegetative bacteria, but not bacterial spores. Since pasteurization is not sterilization, and does not kill spores, a second "double" pasteurization will extend the quality by killing spores that have germinated.

The most common method of pasteurization are:

4.4.1. Low pasteurization or Low Temperature Long Time (LTLT). The temperature used is fairly low and the food is held at this temperature for several minutes.

4.2.2. High Temperature Short Time (HTST)

High temperature short time pasteurization has fewer damaging effects on the nutritional value, especially on the vitamin content of foods. However, it requires more accurate temperature control and slightly more sophisticated equipment. Depending on the pH of the food, the type of product and the result required, there are a number of

different combinations of time and temperature that are commonly used. 88°C for 1 minute 100°C for 12 seconds 121°C for 2 seconds

- **Ultra High Temperature (UHT),** involves heating the milk using commercially sterile equipment and filling it under aseptic conditions into hermetically sealed packaging

4.5. Sterilization /or aseptic processing

Aseptic processing is a processing technique wherein commercially thermally sterilized liquid products (typically food or pharmaceutical) are packaged into previously sterilized containers under sterile conditions to produce shelf-stable products that do not need refrigeration.

Aseptic processing is the processing of commercially sterile and cooled food products being filled into commercially sterile containers under aseptic conditions. The package is hermetically sealed to produce a shelf-stable product that can be stored at ambient conditions.

Sterilization is the process of killing all microorganisms (bacterial, viral, and fungal) with the use of either physical or chemical agents.

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: Choose the best answer (1o point)

1. Write types of heat treatment?
2. Describe aseptic processing
3. How and for what purpose we use hot filling ?

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

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

LG #50	LO#2 OPERATE AND MONITOR THE ASEPTIC STERILIZER

Instruction sheet

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

- Starting up aseptic sterilizer
- Monitoring and maintaining control points.
- Treating heat product
- Operating equipment and monitoring process.
- Identifying and reporting out-of-specification product and process equipment

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

- Startup aseptic sterilizer
- Monitor and maintain control points.
- Treat heat product
- Operate equipment and monitor process.
- Identify and report out-of-specification product and process equipment

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1 .Read the specific objectives of this Learning Guide.

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Information Sheet 1- Startup aseptic sterilizer

1.1 Introduction

Aseptic processing can be defined as the processing and packaging of a commercially sterile product into sterilized containers followed by hermetic sealing with a sterilized closure in a manner that prevents viable microbiological recontamination of the sterile product (Betta et al., 2011). The benefits of aseptic processing over conventional canning include longer shelf life, wider packaging sizes, wider container materials and improved nutritional and sensory properties.

The process for sterilizing the juices herein can be used on any fruit or vegetable juice. Fruits include apples, tomatoes, grapes, as well as the citrus juices such as orange, lemon, grapefruit and tangerine. Vegetable juices would include blends of vegetable juices such as juices obtained by puree or squeezing carrots, celery, etc. As used herein, juice encompasses fruit and vegetable juices. Aromatic beverages such as tea and coffee also can be included in the class of materials to which this technology is applicable.

Pulp or pectin may be present in juice during the process since the infusion process and manipulation does not destroy the particulate solids. Small particles of vegetables can also be present as in a creamed corn product. Microorganisms are destroyed by heat when the microbial proteins coagulate and the enzymes required for their metabolism are inactivated. The heat treatment necessary to kill microorganisms or their spores varies with the kind of organisms, the environment during heating, and state of the organisms.

However, as the temperature is increased so does the rate of the browning or Maillard reaction, i.e. the reaction of amino acids and proteins with reducing sugars to produce burnt, cooked or off-flavor. In addition, oxidation reactions also increase with increasing temperature. Therefore, it is necessary during the processing of foods containing these

materials, in particular fruit juice, to minimize the amount of residence time or contact time that the foods have with high temperatures. The length of time is of course dependent upon the temperature. Thus, a food can be maintained at 40°F for a much greater length of time, (measured in days) versus the time that it can be maintained at temperatures above 260°F which is measured in seconds.

A very important part of the processing parameters with respect to production of a sterilized food which does not have noticeable off-flavor, cooked flavor, browned flavor or oxidized flavor is the control of the residence time or contact time of the food with high temperatures. This total contact time is particularly important for citrus juices such as orange juice or grapefruit juice.

A more elegant aseptic system rapidly heats, holds the hot juice to implement pasteurization and cools the juice before filling into sterile laminated paper/plastic/foil containers which are literally formed around a cylinder of flowing sterile juice (Figure 8.6, Tetra Pak, 2000). The rapid heating and cooling of the product guarantees microbial and enzyme destruction. A major advantage of aseptic packs is its adaptability to many size containers from single serving 200 ml portions to thousands of litre bulk packs. It is absolutely essential to pasteurize or in some cases sterilize the product, cool adequately and pack into sterile containers in a sterile environment, since the presence of a single viable organism can spoil an entire lot of juice. The evolution from simple canning to aseptic processing has greatly improved processed juice quality, but at a price. Aseptic systems cost more than US$1 000 000 and require sophisticated control and maintenance.

Aseptic processing involves three primary steps: thermal sterilization of the product, sterilization of the packaging material, and conservation of sterility during packaging. To ensure commercial sterility, aseptic processing facilities are required to maintain proper documentation of production operations, showing that commercially sterile conditions were achieved and maintained in all areas of the facility. Any breach of a scheduled process for the processing or packaging system means that the affected product must be destroyed, reprocessed or segregated and held for further evaluation. In addition, the processing and packaging system must be cleaned and re-sterilized before processing and/or packaging operations can resume.

Self-check#1	Written test

Name…… ID…… Date…….

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

Test I: Choose the best answer (5 point)

1. What is aseptic sterilizer process?
2.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information Sheet 2- Monitoring and maintaining control points

2.1 control points

Control points refer to those key points in a work process that must be monitored and controlled. This includes:

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

Critical limit means the maximum or minimum value to which a physical, biological, or chemical parameter must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level the occurrence of the identified food hazard.

Hazard Analysis and Critical Control Points (HACCP) means a systematic approach to the identification, evaluation, and control of food safety hazards.

Hazard Analysis means the process of collecting and evaluating information on hazards associated with the food under consideration to decide which are significant and must be addressed in the HACCP plan.

Monitor means to conduct a planned sequence of observations or measurements to assess whether a process, point, or procedure is under control and to produce an accurate record for future use in verification.

- food safety (critical)
- quality and regulatory control points
- inspection points

All fruit and vegetable products should have a marketable quality and also be safe for consumers to eat. Even at the smallest scale of production, the processor should develop a Quality Assurance (QA) system to ensure this. The following steps are needed to develop a system

1. Look at every stage of the process, from raw material selection to distribution of products and identify the factors that could affect either product quality or safety
2. Develop procedures to monitor and control these factors so that they do not cause a problem

The basis of QA is to prevent problems from arising, rather than trying to cure them afterwards. Factors that should be examined include the ingredients, particularly any spices that might be contaminated with micro-organisms, the acidity or moisture content of the product and the amounts of any preservatives that are used. Additionally, any sources of contamination from buildings or water supplies should be included (Section 2). The stages in a process where an error could affect the safety of a product are known as Critical Control Points (CCPs) and these are the stages that should be given most attention.

Table 2.1. Basic list of Critical Control Points identified by the QA system

Process	Monitoring by workers	Control point
Inspect	Remove mouldy, rotten, badly damaged raw materials and all foreign material, e.g., leaves, stems, stalks, sticks, and stones.	CCP Mouldy, rotten, badly damaged raw materials and foreign matter can contaminate finished product. Sticks and stones can also damage expensive processing equipment
Wash	Check that fruits are clean	CCP Water must be potable and clean. Do not use dirty water that could contaminate product.
Sort/grade	Check than no inedible parts are pulped	CCP A limit of zero stalks, insects, mouldy or unripe fruits (moulds could affect flavour and shelf life of product, extraneous matter

		could contaminate product)
Extract juice	Inspect juice, check for colour and any pieces of fruit on sieve/cloth. Colour compared to standard colour chart for the product	All juice passes through filter cloth. Juice having poor colour or insufficient sweetness either rejected or blended with other juices
Fill & seal	Check each bottle for cracks and cleanliness. Take a sample of bottles (e.g. every 50th bottle) and check fill-weight. Check cap is sealed properly	CCP - Reject any damaged or dirty bottles. The weight of juice in each bottle is higher than that declared on label. Poorly sealed caps are replaced (faults in glass could injure consumers, faulty seal could allow re-contamination
Pasteurizes	Use a thermometer to check temperature of heating water and a clock/watch to check time of heating	CCP - 90-95oC for 20 mins +/- 1 min (inadequate pasteurization results in spoilage during storage)

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: Choose the best answer (5point)

1. What control points?
2. Describe Critical limit?
3. What is fruit Pasteurizes (ccp) control temperature?

Test II: Short Answer Questions

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

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information Sheet 3- Treat heat product

3.1 Introduction:

Fruit and vegetable juices are generally preserved by thermal processing, currently being the most cost-effective means ensuring microbial safety and enzyme deactivation. However, thermal treatments may induce several chemical and physical changes that impair the organoleptic properties and may reduce the content or bioavailability of some nutrients; in most cases, these effects are strongly dependent on the food matrix. Moreover, the efficacy of treatments can also be affected by the complexity of the product and microorganisms.

3.2. Thermal Treatments

Thermal processes can be classified according to the intensity of the heat treatment (Miller and Silva 2012). HTLT (temperature ≥80 °C and holding times >30 s) is the most commonly used method in the processing of juices and beverages; it can be classified as pasteurization (temperature <100 °C), canning (temperature ca. 100 °C), or sterilization (temperature >100 °C) (Miller and Silva 2012). Juice pasteurization is based on a 5 log reduction of the most resistant microorganisms. This method relies on heat generated outside and then transferred into the food through conduction and convection mechanisms (Chen and others 2013b). Exposure to high temperatures (strong stresses) can induce a continuous increase in membrane permeability caused by time-dependent changes such as lipid phase transitions and protein conformation changes, eventually causing cell death. Membrane fluidity changes may differ significantly, according to the type of thermal stress (Gonzalez and Barrett 2010). Juices with pH > 4.5 require stronger treatments to achieve the desirable shelf life.

3.3. Sterilization (Retorting)

Sterilization destroys all pathogenic and spoilage microorganisms in foods and inactivates enzymes by heating. All canned foods are sterilized in a retort (a large pressure cooker) and called commercial sterilization which indicates that no viable organisms are present. This process enables food to have a shelf life of more than two

years. Foods that have a pH of more than 4.6, such as meat and most vegetables must undergo severe heating conditions to destroy all pathogens. These foods are heated under pressure to 121°C for varying times. Severe conditions are applied primarly to ensure that *Clostridium botulinum* spores are destroyed during processing. These spores produce the deadly botulinum toxin under anaerobic conditions (that is, where there's no oxygen). The spores are destroyed by heat or are inhibited at pH values of less than 4.6 Therefore, a food with a pH of less than 4.6 that is packaged anaerobically, such as spaghetti sauce, doesn't need to undergo such a severe heat treatment. The destruction of vegetative and spore forming organism and pathogens is secondary objective of commercially sterilized foods.

Nicolas Appert , a Parisian confectioner by trade, established the heat processing of foods as an industry in 1810. The food product is washed, sorted, and graded and then subjected to steam for three to five minutes. This last process called blanching, destroys many enzymes in the food product and prevents further cellular metabolism. The food is then peeled and cored, and diseased portions are removed. For canning, containers are evacuated and placed in a pressurized steam sterilizer, similar to an autoclave at 121°C. This removes especially *Bacillus* and *Clostridium* spores. If canning is defective, foods may become contaminated by anaerobic, bacteria which produce gas. These are species of *Clostridium*, and coliform bacteria (a group of Gram-negative non spore-forming rods which ferment lactose to acid and gas at 32°C in 48 hours).

High-acid fruits like strawberries require no preservatives to can and holding for only a short boiling cycle, whereas marginal fruits such as tomatoes require longer boiling and addition of other acidic elements. Many vegetables require pressure canning. Food preserved by canning or bottling is at immediate risk of spoilage once the can or bottle has been opened. Lack of quality control in the canning process may allow ingress of water or micro-organisms. *Clostridium botulinum* produces an acute toxin within the food and may lead to severe illness or death.

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: Choose the best answer (5 point)

1. Describe Sterilization (Retorting) process for fruit and vegetable heat treatments process?
2. What is thermal heating means

Test II: Short Answer Questions

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

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

Information Sheet 4- Operating equipment and monitoring process.

4.1. CONTROL CHART

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit. These lines are determined from historical data. By comparing current data to these lines, you can draw conclusions about whether the process variation is consistent (in control) or is unpredictable (out of control, affected by special causes of variation). This versatile data collection and analysis tool can be used by a variety of industries and is considered one of the seven basic quality tools.

Control charts for variable data are used in pairs. The top chart monitors the average, or the centering of the distribution of data from the process. The bottom chart monitors the range, or the width of the distribution. If your data were shots in target practice, the average is where the shots are clustering, and the range is how tightly they are clustered. Control charts for attribute data are used singly

4.3. Control chart using basic procedures:

1. Choose the appropriate control chart for your data.
2. Determine the appropriate time period for collecting and plotting data.
3. Collect data, construct your chart and analyze the data.
4. Look for "out-of-control signals" on the control chart. When one is identified, mark it on the chart and investigate the cause. Document how you investigated, what you learned, the cause and how it was corrected.

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: Choose the best answer (6 point)

1. List control chart procedures?
2. Write uses of control chart?

Test II: Short Answer Questions

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

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

Information Sheet 5- Identifying and reporting out-of-specification product and process equipment

5.1. INTRODUCTION:

Inspections of aseptic processing and packaging systems for Low Acid Canned Food (LACF) are some of the most complex inspections of food manufacturing operations. The major difference between aseptic processing and the more "conventional" types of LACF processing is that a process authority(s) must establish a process that ensures commercial sterility not only of the product but also for:

1. the product sterilization system (hold tube) and all equipment downstream from the holding tube including the filler;
2. the packaging equipment; and
3. The packaging material.

Documentation of production operations must be maintained by the firm showing that commercially sterile conditions are achieved and maintained in all these areas. Any breach of a scheduled process for the processing or packaging system means that the affected product must be destroyed, reprocessed or segregated and held for further evaluation. In addition, the processing and packaging system must be cleaned and re-sterilized before processing and/or packaging operations can resume.

Aseptic processing equipment sterilization procedures often use steam or hot water under pressure. Packaging equipment and packaging materials are sterilized with various medium or combination of mediums (i.e., saturated steam, superheated steam, hydrogen peroxide and heat and other treatments). Sterilization procedures are often validated by placing resistant microbial spores on adhesive strips at strategic locations in equipment or on container materials. Results of microbial validation studies are filed with CFSAN in support of scheduled process filings.

Aseptic processes are based on a continuous flow of product through a holding tube. This continuous flow relies on pumps, and as such, these pumps are critical in the design of the system.

5.2. Equipment and controls

Recording devices- In order to demonstrate that the required sterilization is accomplished, firms use automatic recording devices. During the inspection it is important to document the number, location, and type of sensors used. In a steam sterilization system, such as the Dole unit, the basic components of the system are:

1. container sterilizing section,
2. filling section,
3. cover or lid sterilizing unit, and
4. Container closing section.

Flow Meters: Some newer systems may use a flow meter to control the flow of product through the system. The flow meter may be used in conjunction with a fixed rate pump and a flow control valve or with a variable speed pump controlled by the flow meter. When these flow control systems are used it is extremely important to determine how the flow control system operates, the procedures used to validate the flow rate, and how the system is maintained.

Temperature Indicating Device: Sterilizers or hold tubes must be equipped with at least one Temperature Indicating Devices (TID's) During the inspection, check that the device complies with the specifications which gives the parameters of the TID and how often it is checked for accuracy. If the system is equipped with only one temperature indicating device, the probe for this device is normally located in the vicinity of the temperature recording device. You should also know what critical factors are being monitored, e.g., temperature, sterilization media flow rate, etc...And determine if they are being recorded accurately. After identifying where the recording devices are, check to make sure equipment correspond in number and location to those on the filed scheduled process.

Operation :Determine the firm's procedure for ensuring that equipment is brought to a condition of commercial sterility, and that exposure of the sterile inner layer to the sterile zone at the beginning of the pre-sterilization cycle is performed in such a manner as to maintain the sterility of both the packaging material and the sterile form-fill-seal area (sterile tunnel).

Self-check #5	Written test

Name…… ID…… Date…….

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

Test I: Choose the best answer (4 point)

1. What is Temperature Indicating Device**?**
2. What is Flow Meters ?

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

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

LG #51	LO#3 OPERATE DE-AERATION EQUIPMENT

Instruction sheet

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

- Performing removal of oxygen using vacuum pumps
- Doing aroma recovery.
- Doing foam removal

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

- Perform removal of oxygen using vacuum pumps
- Do aroma recovery.
- Do foam removal

Learning Instructions:

1 .Read the specific objectives of this Learning Guide.

2 .Follow the instructions described below.

3 .Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

4. Accomplish the “Self-checks” which are placed following all information sheets.

5 .Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

1.1. De aeration

The process through which the dissolved gases are removed from juice is called "*DE aeration"*. The equipment, which is used in this method, is called "*DE aerator"*.

In the operations described crushing, comminution, pressing, shaker separation, centrifugation and filtration, the fruit and juice are subjected to considerable aeration. The inclusion of oxygen can promote enzymatic browning, destroy nutrients, modify flavor and otherwise damage quality. Therefore, care should be taken to perform these steps rapidly, at low temperature and/or protect the material from oxygen, if possible. Sometimes preheating to inactivate natural and/or added enzymes is useful, provided rapid cooling follows.

DE aeration can be accomplished by either flashing the heated juice into a vacuum chamber or saturating the juice with an inert gas. Nitrogen or carbon dioxide is bubbled through the juice prior to storing under an inert atmosphere. Clearly, once air is removed or replaced by inert gas, the juice must be protected from the atmosphere in all subsequent processing steps. DE aeration, especially flashing off at high temperature, can also remove some desirable volatile aroma, another compromise facing the juice technologist. In the operations described crushing, comminution, pressing, shaker separation, centrifugation and filtration, the fruit and juice are subjected to considerable aeration. The inclusion of oxygen can promote enzymatic browning, destroy nutrients, modify flavor and otherwise damage quality. Therefore, care should be taken to perform these steps rapidly, at low temperature and/or protect the material from oxygen, if possible. Sometimes preheating to inactivate natural and/or added enzymes is useful, provided rapid cooling follows.

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facing the juice technologist.The air bubbles mix with purée during the pulping. Mixing of air in the purée causes unwanted changes in colour, taste, aroma and further on the formation of a plug in the bottle. Processes for sterilizing and DE aerating fruit juices are well known; Sterilization is performed in order to eliminate problems linked to the development of microorganisms, and DE aeration is aimed at reducing the level of dissolved oxygen in the fruit juice which is treated. When manufacturing shelf-stable fruit juices, the reduction of the dissolved oxygen level is desirable in order to minimize the chemical oxidation processes that would otherwise develop in the fruit juice during the subsequent storage period, making it unfit for human consumption.

1.2. METHODS OF DEAERATION

There currently are multiple methods applied for the removal of gases from liquid food products.

- Ambient Vacuum Deaeration
- Hot Vacuum Dearation
- Hot Atmospheric Deaeration
- Gas-Stripping Deoxidation

Ambient Vacuum Deaeration:

Ambient vacuum DE aeration involves placement of a DE aeration system in a location in the processing system where the product remains at chilled or ambient temperature, typically just prior to thermal treatment. A typical flowchart showing placement of ambient DE aeration equipment in a continuous thermal processing line is shown in Figure:1

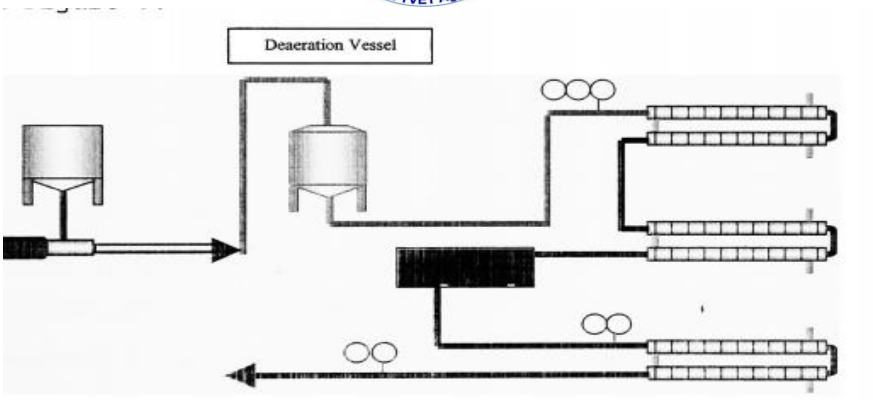

Fig3.1 DE aeration process.

This type of system, commonly supplied by the equipment company APV, relies on a large sealed tank to provide residence time and on a vacuum pump to reduce the partial pressure (PA) in the vapor phase above the liquid level. Sizing the vessel to maximize residence time allows for free and dispersed air bubbles to expand under vacuum and 26 rise to the surface where the gas is exhausted through the vacuum pump. Dissolved air is reduced through reduction in partial pressure in the headspace.

The benefits of this method are:

- Minimal loss of volatile flavor components because the temperature/pressure combination remains above the products boiling. Point.
- Uses simple control system. Application only requires control of the level of product in the vessel and start/stop of the vacuum pump

Self-Check#1	Written test

Name…… ID…… Date…….

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

Test I: Choose the best answer (5point)

1. What is De aeration process?
2. Write the uses of de aeration process?
3. What is the benefits of Ambient Vacuum DE aeration?

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

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

Information Sheet 2- Doing aroma recovery.

2.2. INTRODUCTION

The aroma recovery (flavor extraction) station combines various pieces of components in order to collect the fruit aroma which vaporized during the production of concentrates at the evaporation station. The device is embedded in the existing pipeline system. It consists of a bell column, in which the initial condensation of the aroma vapors takes place, and the aroma station where the aroma is condensed to an appropriate concentration level, and then cooled down. Cooling performs in two stages; the first section of the cooling process is performed using the cooling water and the second stage is carried out using the refrigeration unit. Its application has found a great interest in the food industry since it is known that the quality of fruit juices and alcoholic drinks can deteriorate during the production process. The compounds relevant for these products quality and aroma are alcohols, hydrocarbons, esters and aldehydes [51]; which are all volatile compounds that are present in low concentrations. By employing evaporation for their extraction and concentration, heat damage to these compounds does not occur, additional solvent are not necessary for the separation and there is only a minimum loss of aroma compounds. The device is embedded in the existing pipeline system. It consists of a bell column, in which the initial condensation of the aroma vapors takes place, and the aroma station, where the aroma is condensed to an appropriate concentration level, and then cooled. Cooling performs in two stages - the first section of the cooling process is performed using the cooling water, the second section is carried out using the refrigerating unit.

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(5 point)

1. What is aroma recovery?
2. Write aroma recovery process?

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

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

Information Sheet 3- Doing foam removal

Certain combinations in high-powered blenders can end up frothy, foamy, or with a mousse-like texture. Sometimes it's appealing, but other times you really don't want all the extra air bubbles whipped into your smoothie or soup. You can minimize bubble formation by blending for less time, but sometimes you want to get a really smooth consistency by blending for longer. Here's a somewhat surprising trick to remove bubbles and eliminate froth: turn the blender to its lowest setting and then slowly ramp it up until the top of the liquid just starts to circulate. In some cases the lowest speed is still too fast, in which case you can put it to the lowest speed and repeatedly briefly pulse it on. As you run it at this low speed, you will see bubbles coming out in the center. It's a bit hard to describe, so here's a video of bubbles coming out of a pumpkin pie smoothie: You'll notice at the end of the video the liquid starts to circulate faster because it's not as thick due to the loss of of bubbles/foaminess. If you want to keep removing bubbles you can turn down the speed so that it's just barely circulating again, and continue until you don't see any more bubbles coming out. It works surprisingly well. I've compared the volume before and after, and I've seen a half cup of air come out of a four-cup mixture!

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 (5 point)

1. What is foam removal from heated juice?
2. Write the uses of foam removal from juice?.

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

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

LG #52	LO#4 PERFORM PASTEURIZATION PROCESS

Instruction sheet

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

- Performing pasteurization process
- Controlling pasteurization temperature.
- Differentiating type of pasteurization

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

- Perform pasteurization process
- Control pasteurization temperature.
- Differentiate type of pasteurization

Learning Instructions:

1.Read the specific objectives of this Learning Guide.

2 .Follow the instructions described below.

3.Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

4. Accomplish the “Self-checks” which are placed following all information sheets.

5.Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets

7.Perform “the Learning activity performance test” which is placed following “Operation sheets” ,

8 .If your performance is satisfactory proceed to the next learning guide,

9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Performing pasteurization process

1.1 Pasteurization:

Pasteurization or pasteurization is a process in which packaged and non-packaged foods (such as fruit and vegetable) are treated with mild heat, usually to less than 100 °C (212 °F), to eliminate pathogens and extend shelf life. The process is intended to destroy or deactivate organisms and enzymes that contribute to spoilage or risk of disease, including vegetative bacteria, but not bacterial spores. Since pasteurization is not sterilization, and does not kill spores, a second "double" pasteurization will extend the quality by killing spores that have germinated.

Most liquid products are heat treated in a continuous system where heat can be applied using a plate heat exchanger or the direct or indirect use of hot water and steam. Due to the mild heat, there are minor changes to the nutritional quality and sensory characteristics of the treated foods pasteurization or high pressure processing (HPP) and pulsed electric field (PEF) are non-thermal processes that are also used to pasteurize foods.

Bottling juice requires specialized equipment. Cans can be roughly handled, but bottles are fragile ("bruising" not visible to the eye can cause breakage later) and susceptible to thermal shock. Temperature changes of greater than 7°C should be avoided. Bottles must be cleaned before filling then heated (steam jets) within 7°C of the fill temperature. The best filler draws the liquid into the bottle by evacuating the bottle, thus reducing oxidation. Bottle closures can be screw caps, crown caps or vacuum caps. The vacuum caps have the advantage of allowing less headspace; if the contents ferment only the cap will blow off rather than the bottle exploding. Bottles also must be cooled. This can be accomplished in a special cooler that sprays hot water on them and decreases the temperature as the bottles move along. At the end, they emerge close to 38°C, still warm enough to dry.

Pasteurization is a mild heat treatment of liquid foods (both packaged and unpackaged) where products are typically heated to below 100 °C. The heat treatment and cooling process are designed to inhibit a phase change of the product. The acidity of the food determines the parameters (time and temperature) of the heat treatment as well as the duration of shelf life. Parameters also take into account nutritional and sensory qualities that are sensitive to heat. In acidic foods (pH <4.6), such as fruit juice and beer, the heat treatments are designed to inactivate enzymes (pectin methyl esterase and polygalacturonase in fruit juices) and destroy spoilage microbes (yeast and lactobacillus). Due to the low pH of acidic foods, pathogens are unable to grow. The shelf-life is thereby extended several weeks. In less acidic foods (pH >4.6), such as milk and liquid eggs, the heat treatments are designed to destroy pathogens and spoilage organisms (yeast and molds). Not all spoilage organisms are destroyed under pasteurization parameters, thus subsequent refrigeration is necessary

1.2. Heating Juice to Pasteurize procedures

1. **Pasteurize any raw juice.** Raw juices can carry bacteria that can make you sick, particularly *E. coli*. To counteract the effect, you should pasteurize any juice that is labeled as raw. However, if the juice says "pasteurized" on the label, it's safe to drink as

2. Pour the juice into a large pot. Start with a clean pot large enough to hold the juice with some extra room at the top for bubbling. Place the pot on the stove. Pour the juice into the pot.

3. Heat the mixture over high heat. Turn the burner on high, and let the mixture heat. You need to keep an eye on the mixture while it heats, You're waiting for it to simmer so you can time it and check the temperature. Stir the mixture often while it heats.

You may want to use a double boiler. A double boiler is one pot placed over another pot, and the bottom pot has water in it. The water provides heat to the top pot, but it is gentler than a typical burner.

4. Check the temperature once the juice starts simmering. The juice needs to reach 160 °F (71 °C) for it to be considered pasteurized. Use a candy thermometer to check the juice once it's simmering, but don't touch the sides of the pan with the thermometer, as that will give you a bad reading.

It only needs to stay at this temperature for about a minute.

The juice should be simmering but not boiling when it's at the correct temperature. You can eyeball it, but using a thermometer is the best method.

Cleaning Jars for the Juice

1. Wash the jars. You can use mason jars or any glass jar that can be sterilized for this process. Wash the jars out in hot water and soap, and then rinse them clean to prepare for the sterilization process.

2. Boil the jars. Place the jars in a water-bath canner. You can also use a large pot. Fill the pot or canner with water, and submerge the jars. Place the pot over high heat, and let the water come to a boil.[6]

When using a pot, a rack can help you pull the jars out later.

If you use tongs, make sure they're sterilized, too.

3. Let the jars boil for fifteen minutes. Once you see steam coming up from the pot, cover the pot with a lid. Let it boil for fifteen minutes before turning off the heat. The jars can sit in the pot to keep warm.

You'll also need to boil the lids for five minutes.

4. Use tongs to pull the jars out. You can place the jars upside down on a towel to drip water.[8] However, since you're just filling them with juice, you can also shake most of the water out and move on to filling them.

5. Pour the juice in. Fill the containers with the hot juice. The jars need to be hot, as well, or they could break when pouring in hot juice. Screw on the clean lids to preserve the pasteurization.

Don't let the juice cool down before you bottle it, as that reduces its shelf life.

Juice can be canned or bottled in cans, glass or plastic. Cans used are enamel or lacquer lined to resist corrosion from the juice. As the cans travel the canning line, they must pass through a can washer, be filled from filling machines and immediately sealed on a can-closing machine. After closure cans should be positioned or inverted so that the hot fill will be in contact with the lid and thus, pasteurize it. From here, the cans must be removed to a cooling room where they will be cooled to near 38°C to stop the effect of high heat on the contents. If cooled to a temperature lower than 35°C, the labels will tend to detach, the can will not dry and will be susceptible to surface rusting.

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(10 points)

1. How long does pasteurized juice last?
2. What long term preservatives can I use for this?
3. List out Pasteurization process?
4. What is Pasteurization temperature for juice heating?

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

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information Sheet 2- Controlling pasteurization temperature

2.1. Pasteurization temperature

High temperature-long time (HTLT): Thermal processes can be classified according to the intensity of the heat treatment (Miller and Silva 2012). HTLT (temperature 80 °C and holding times >30 s) is the most commonly used method in the processing of juices and beverages; it can be classified as pasteurization (temperature 100 °C) (Miller and Silva 2012). Juice pasteurization is based on a 5 log reduction of the most resistant microorganisms. This method relies on heat generated outside and then transferred into the food through conduction and convection mechanisms (Chen and others 2013b). Exposure to high temperatures (strong stresses) can induce a continuous increase in membrane permeability caused by time-dependent changes such as lipid phase transitions and protein conformation changes, eventually causing cell death. Membrane fluidity changes may differ significantly, according to the type of thermal stress (Gonzalez and Barrett 2010). Juices with pH > 4.5 require stronger treatments to achieve the desirable shelf life. Table 2 provides a comprehensive summary of the most important outputs on HTLT thermal treatments.

High temperature-short time (HTST) : In order to avoid the drawbacks of the traditional thermal technologies, ensure product safety, and maintain the desired bioactive compounds, HTST thermal pasteurization (temperature 80 °C and holding times 30 s) has been proposed and tested (Table 3), because temperature dependency is more significant for microorganism destruction than for nutrient degradation (Achir and othe

Mild temperature-long time (MTLT) : Over the last years, some researchers studied MTLT heat treatments (temperature 30 s) to improve the shelf life of minimally processed products. MTLT can provide: (1) the increase of total phenolic content in black jamun juice (Saikia and others 2015); (2) a good preservation of color in cucumber juice (Wang and others 2013); (3) high retention of ascorbic acid and other

phenolic compounds in pineapple juice (4) an increase of color stability and viscosity in prickly pear juice

2.2. Technological principles of pasteurization

Physical and chemical factors which influence pasteurization process are the following:

b. Temperature and time;
c. Acidity of the products;
d. Air remaining in containers.

Pasteurization processes. In pasteurizing certain acid juices for example, there are two categories of processes

Pasteurization temperature and time will vary according to:

- nature of product; initial degree of contamination;
- Pasteurized product storage conditions and shelf life required.

In this first category of pasteurization processes it is possible to define three phases:

- heating to a fixed temperature;
- maintaining this temperature over the established time period (= pasteurization time);
- Cooling the pasteurized products: natural (slow) or forced cooling.

Rapid, high or flash pasteurization is characterized by a pasteurization time in the order of seconds and temperatures of about 85° to 90° C or more, depending on holding time. Typical temperature/time combinations are as follows:

- 88° C (190° F) for 1 minute;
- 100° C for 12 seconds;
- 121°C for 2 seconds.

While bacterial destruction is very nearly equivalent in low and in high pasteurization processes, the 121° C/2 seconds treatment give the best quality products in respect of flavor and vitamin retention. Such short holding times, however, require special equipment which is more difficult to design and generally is more expensive than the 63-65 ° C/30 minute's type of processing equipment.

In flash pasteurization the product is heated up rapidly to pasteurization temperature, maintained at this temperature for the required time, then rapidly cooled down to the

temperature for filling, which will be performed in aseptic conditions in sterile receptacles.

Taking into account the short time and rapid performance of this operation, flash pasteurization can only be achieved in continuous process, using plate heat exchangers.

2.3. Industrial applications of pasteurization:

Processes are mainly used as a means of preservation for fruits and vegetable juices and especially for tomato juice.

Thermo penetration

The thermo penetration problem is extremely important, especially in the case of the pasteurization of products packed in glass containers_because it is the determining factor for the success of the whole operation.

During **pasteurization** it is necessary that a sufficient heat quantity is transferred through the receptacle walls;

- ✓ This is in order that the product temperature rises sufficiently to be lethal to micro-organisms throughout the product mass.

The most suitable and practical method to speed up thermo penetration is the movement of receptacles during the pasteurization process.

Rapid rotation of receptacles around their axis is an efficient means to accelerate heat transfer, because this has the effect, among others of rapidly mixing the contents.

The critical speed of for this movement is generally about 70 rotations per minute (RPM). This enables a more uniform heating of products, reducing heating time and organoleptic degradation.

Heating may precede or follow packaging. These principles of different temperature time combinations very largely determine the design parameters for heat preservation equipment and commercial practices.

The food processor will employ no less than that heat treatment which gives the necessary degree of micro-organism destruction. This is further ensured by periodic inspection by local sanitary authorities or by the importing countries sanitary services. However, the food processor also will want to use the mildest effective heat treatment to ensure highest food quality

Pasteurization of packaged foods

- Fruit juices and purees are usually pasteurized after filling in to containers.
- Hot water is normally used if the food is packaged in glass, to reduce the risk of cracking the glass.
- The maximum temperature differences between the container and the water are 20°C for heating and 10°C for cooling.

Metal or plastic containers are pasteurized using steam and air as there is less risk of the containers breaking.

The food is then cooled to about 40°C to evaporate any surface water and minimise corrosion to the container of cap.

Hot water pasteurizer's may be batch or continuous.

- The simplest form of batch equipment is a hot water bath in which crates of packaged food are heated to a pre-set temperature and held for the required length of time.
- Cold water is then pumped in to cool the product.
- A continuous version contains a conveyer belt that carries the bottles through heating and cooling stages.

Equipment for pasteurization

The simplest form of pasteurizer is a hot water bath in which bottles are immersed.

A more advanced pasteurizing unit includes:-

- Plate heat exchangers
- Tubes through which the liquid to be pasteurized passes.

This is quite expensive and usually recommended for large-scale operations.

Benefits & problems

- Juice is pasteurizes within the bottle so the chance for re-contamination of the juice is reduced.
- Difficult to ensure the internal temperature of the bottles reaches the desired pasteurizing temperature.
- No need for large stainless steel pans for pasteurization.

Pasteurization and Sealing

The problem of spoilage is evident throughout the pickle making process. Cucumber can spoil during brining process and even during packing if they are exposing to air for too long.

For this reason, the pickle is pasteurized. In order to pasteurize the pickle, they are typically exposed to high temperatures for an extended period. Depending on how long the pickles are heated, pasteurization can either kill off the entire acetic acid tolerant organism or inactivate all of the enzymes in the vegetable. In both cases, pasteurization increases the shelf life of the pickles.

Most pickles are vacuum packed which means the air is removing from the jar before it sealed. This helps maintain the pickles taste and prevent contamination by microorganism. In order to vacuum-packed the pickles, air in the jar is replaced with steam just before the sealed.

When the steam cools and condenses, it creates a vacuum, reducing the amount of free oxygen present in the jar. The vacuum seal is responsible for the familiar pop that is heard when a jar pickles is open.

The jars are next moved along a conveyor to a labeling machine. Label is automatically affixed and a freshness date is stamp on the jar.

From here the jars are move out to automatic packing machine which put them in cardboard boxes.

They are transferred the pallets and shipped out to the local retailers.

A safer method of sterilizing heat-sensitive items is plasma sterilization. This method uses reactive ions, electrons and neutrons to sterilize items in about 45 minutes at temperatures as low as 122 ºF.

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 (5 points)

1. Write down benefits & problems of Pasteurization?

2. What is rapid, high or flash pasteurization temperature?

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

Information Sheet 3- Differentiating type of pasteurization

3.1. Introduction:

Pasteurization is a heat treatment process applied to a product with the aim of minimizing public health hazards arising from pathogenic microorganisms associated with juice consistent with minimal chemical, physical and organoleptic changes in the product.

There are two methods of pasteurization: LTLT (Low Temperature, Long Time) and HTST (High Temperature Short Time). The LTLT or holder method of pasteurization involves heating fruit to 63˚C and holding at such temperature for 30 minutes. The HTST method of pasteurization involves heating fruit at 72-75˚C for 15-20 seconds before it is cooled.

The primary pasteurization is done as soon as possible after juice extraction, or as a first step in the evaporator. This pasteurization is commonly done at 95–98°C for 10 to 30 seconds. The main objective is to inactivate enzymes from the fruit, but microorganisms also are inactivated during the pasteurization. Inactivation of enzymes generally requires more intensive pasteurization conditions than what is required to destroy microorganisms.

The second pasteurization is carried out prior to filling the juice in its container. The purpose is to destroy the microorganisms that occur as re contaminants in the fruit juice after bulk storage (NFC juice) or in juice reconstituted from concentrate. The pasteurization conditions currently recommended by Tetra Pak for the second pasteurization of fruit juices with a pH below 4.2 are a temperature of 95°C and a holding time of 15 seconds.

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(points)

1. List out all Pasteurization types?
2. What second juice pasteurization?
3. List types of pasteurization?

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

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

Operation Sheet 1 -Performing pasteurization process

Procedures for performing pasteurization process

Step1- wears personal protective equipment

Step2-prepare fruit or vegetable juice

Step3-pour the juice into a large pot

Step4-heate the mixture or juice over high temperature

Step5-check the temperature once the juice needs to reach 160 °F (71 °C)

Step6- Use a candy thermometer to check the juice once it's simmering.

Step7- stays at this temperature for about a minute.

Step8- Cleaning Jars for the Juice

Step9-wash the jar: You can use mason jars or any glass jar that can be sterilized

Step10-Boil the jars. Place the jars in a water-bath canner.

Step11- Let the jars boil for fifteen minutes.

Step12-Use tongs to pull the jars out.

Step13-Pour the juice in. Fill the containers with the hot juice.

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

Task-1 perform /do pasteurization process

LG #53	LO#5 SHUT DOWN THE HEAT TREATMENT PROCESS

Instruction sheet

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

- Shutting down equipment
- Collecting, treating and disposing or recycling waste

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

- Shut down equipment
- Collect, treat and dispose or recycling waste

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. 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).

2.1. Shutdown Procedures

The shutdown operation of a boiler plant specially requires a sophisticated operating procedure with various constraints, and can be classified into the following three categories.

1. Normal shutdown: a shutdown for maintenance, retrofitting, ending a batch, etc.

2. Emergency shutdown: an unexpected shutdown that can be caused by process variables exceeding the safety limits or failure in the unit or utility

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

Shutting down to a standby condition: when a unit is to be shut down for a short period of time for maintenance on auxiliary equipment, the unit is shut down to a standby condition. A standby shutdown allows a quick startup of the unit after maintenance is completed in order to minimize lost production time and off spec material.

A typical standby condition may include:

- recirculating material upstream and downstream
- reduced heating or cooling (sufficient to maintain a safe process condition)
- slow-rolling compressors
- venting process gases to flare
- Diverting process streams to temporary storage

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)

1. What is Emergency shutdown?
2. Write shut down procedure for Normal shutdown?

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

Information Sheet 2- Collecting, treating and disposing or recycling waste

2.1. Ensuring safety in waste management:

Activities of entities in waste management must ensure safety to lives and health of citizens and environment. Activities of entities may be restricted, suspended or stopped in the established manner in case of violation of requirements of the legislation on waste management resulting in damages to lives and health of citizens or environment as well in case of generation of hazardous waste due to lack of technical or other potentials in ensuring safety to lives and health of citizens, environment.

2.2. Hazardous By-products

In fruit and vegetable processing process industry a certain %age of solid by-products are considered hazardous. For example, residues from fertilizers or pesticides may be in peelings, pulp after pressing or other by-products from fresh produce. Chemicals used in fruit and vegetable processing plants for treatment, bleaching or cleaning of produce may also generate by-products with toxic, hazardous wastes.

Incineration

The incineration of waste is a hygienic method of reducing its volume and weight which also reduces its potential to pollute. Generating electricity or producing hot water or steam as a by-product of the incineration process has the dual advantages of displacing energy generated from finite fossil fuels and improving the economics of waste incineration, which is the most capital-intensive waste disposal option. Residues from incineration processes must still be land filled, as must the non-combustible portion of the waste stream, so incineration alone cannot provide a disposal solution.

But not all wastes are suitable for combustion. If the moisture content is very high (above 65-70%) it will be non-efficient and not profitable.

2.3. Advantages and Disadvantages of waste incineration method

Advantages of waste incineration

- Can convert a large proportion of the calorific value of waste into usable energy
- Reduces volumes of waste by up to 90% and the weight of waste by 70%
- 3Reduces demand for landfill and other waste management capacity
- Stabilize putrescible waste, reducing the potential of leachate and landfill gas production at landfills

- More effective energy recovery than anaerobic digestion and landfill gas

Disadvantages of waste incineration

- Potential for polluting gaseous and liquid (wet scrubbing systems only) emissions to atmosphere
- Produce fly ash and air pollution control residue that are special wastes
- Potential for dust and odour problems during storage of waste prior to incineration
- Changes in calorific value of the waste can cause changes in the operational costs
- Negative public perceptions lead to planning problems
- A high level of commitment to incineration may inhibit waste minimization and recycling
- Not suitable for wastes with high water content.

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(5 points)

1. Write disadvantages of Land spreading waste?
2. What is Incineration waste processing?

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

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

LG #54	LO#6 USE WORKPLACE INFORMATION

Instruction sheet

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

- Recording workplace information
- Identifying out of specification standards and maintaining quality
- Maintaining quality specification
- Following standard operating procedure
- Reporting standard forms and work place procedure

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**:

- Record workplace information
- Identify out of specification standards and maintain quality
- Maintain quality specification
- Follow standard operating procedure
- Report standard forms and work place procedure

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Recording workplace information

6.1. Recording workplace information

Reporting and recording are important tasks for people in many jobs. In the food and drink industry legislation demands that organizations keep accurate and detailed records. These records are particularly important to protect food safety and comply with internal and external quality checks and audits. You will need to know and be able to record and report on operational activities. Complying with and understanding health and safety, food safety and organizational requirements are essential features of this standard.

Record operational activities

- identify information and data that needs to be reported
- identify the method of recording information and data in accordance with company procedures
- record information and data you have collected
- complete records in accordance with company procedures
- process and store records in accordance with company procedures
- be designed to achieve the required food temperatures as rapidly as necessary
- allow temperatures to be monitored and controlled and where necessary,
- storing refrigerated or frozen foods,
- monitoring food temperatures, and when necessary,
- Controlling ambient temperatures to ensure the safety and suitability of food.

Control of operations: Controlling process inputs and operations in terms of

- correct temperature,
- pressure,
- humidity
- water activity (aw)
- pH levels

Self-Check 1	Written test

Name…… ID…… Date…….

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

Test I: Choose the best answer (5 point)

1. Controlling process inputs and operations in terms of

   A/ pressure,

   B/ humidity

   C/ water activity (aw)

   D/ pH levels

   E/ All

Test II: Short Answer Questions (5points)

2. list out Record operational activities

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

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

Information Sheet 2- Identifying out of specification standards and maintaining quality

2.1 Pasteurization of the juice can be performed in two methods:

1. Batch or Vat Method: often used by small processors. Heat is applied to one large lot or batch in an open kettle or vat where it is held long enough to achieve a validated 5-log reduction. The juice is cooled after pasteurization. This method requires proper mixing and time/temperature monitoring.

2. High Temperature Short Time (HTST) system using either plate or tubular heat exchanger:

a. Plate heat exchangers (PHEs): Similar to those used in dairy pasteurizers, and commonly used for no citrus juices (e.g. apple cider/juice). If PHEs are used for processing pulp products, the plates should be dismantled for inspection.

b. Tubular heat exchangers (THEs): Commonly used for citrus juices, because the turbulent flow prevents the pulp of citrus juice from depositing on the surface of the tubes.

Whether you use batch pasteurization equipment or continuous HTST pasteurization equipment, both the juice temperature and juice heating time shall be designated as critical limits in your HACCP plan and should be continuously monitored to ensure that your process is achieving the 5-log pathogen reduction. If the HTST equipment you use (e.g. the positive displacement timing pump and holding tube length, volume and slope) is designed to deliver a controlled flow rate of the juice through the heat exchanger to ensure that it is heated for the minimum required time, the heating time may not need to be monitored continuously. In this case, as a monitoring procedure for flow rate may be a periodic visual check of the set point of the positive displacement pump to ensure that it is at the point that has been documented to deliver the proper flow rate. However, as

a verification procedure, it is recommended to perform testing of the timing pump and check the actual flow rate at least once annually or prior the cider production season (or whatever is needed to ensure that it is effectively controlling the flow rate). A magnetic flow-based timing system is another type of flow rate timing system for an HTST pasteurizer. In such a system, the flow rate (heating time) and the juice temperature should be continuously monitored. Other considerations may include paying close attention to tube slope, accuracy of temperature and pressure measuring instruments, effectiveness of flow diversion valves, proper flow of juice in the WARNING: This product has not been pasteurized and, therefore, may contain harmful bacteria that can cause serious illness in children, the elderly, and persons with weakened immune systems. Poor design, lack of maintenance or misplacement of equipment and parts in the system (e.g. plates integrity, tube slope, pumps, instruments, valves, meters, etc.) may cause introduction of other hazards that would compromise the proper pasteurization of the juice. There are key control points to focus on when evaluating your whole system to assure the necessary controls are in place that address any identified hazard that could possibly be introduced and or reasonably likely to occur.

- Are the heating parameters (time/temperature) scientifically based/validated to achieve 5-log reduction of the pertinent microorganism in juice?
- Are the heating requirements for temperature met and continuously monitored? Are recording charts accurate and records kept? Are indicating thermometers verified and calibrated?
- Are the holding time requirements met, verified and properly monitored?
- Is the timing system (pump) properly set and verified/ tested to ensure proper flow delivery and rate? Is it being monitored?
- Is the holding tube properly constructed (proper slope)?
- Are vacuum breakers, that help maintain pressure differential in the regenerator section, are installed properly and working? (possible cross-contamination hazard)
- Is equipment shared? (possible Allergen hazard)
- Are there any other possible hazards that might be introduced due to inadequate equipment design, maintenance or verification? (e.g. timing pump should always

be placed downstream from the raw regenerator to ensure proper pressure differential between raw-pasteurized juice sides).

High Pressure Processing Systems (HPP): High pressure processing, a technology in which pressure (up to 600 MPa or 87000 psi) is the principal anti-microbial agent, has been shown to be effective in reducing vegetative pathogens. Both semi continuous and batch processes have been developed using high pressure processing. We recommend that the process parameters including time, pressure be monitored as critical limits for both types of processes. In certain circumstances, based on the process validation, pH may also be monitored as a critical limit if pH was a parameter taken into consideration by the process authority.

Note: HPP is widely used for acidic juices. HPP alone as a control measure in low acid juices (e.g. carrot juice) is proven not to be sufficient to inactivate bacterial spores of Clostridium botulinum. Critical control measures for such juices are likely to involve multiple control measures, e.g., a combination of a process step to destroy the non-proteolytic spores of Clostridium botulinum and measures to ensure the treated juice is kept under refrigeration throughout the post-processing steps as well as measures to ensure the statement "Keep Refrigerated" is included in labeling.

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(5 points)

1. What is specification**?**
2. Explain High Pressure Processing Systems (HPP)

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

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information Sheet 3- Maintaining quality specification

3.1 Maintaining quality

Canned Foods: The safety and s storage stability of canned foods, including heat-processed foods in drums, glass containers, flexible and semi-rigid containers, depend on the product being heated at a specified temperature for a specified time. The most commonly used heating media are hot water, sometimes under a superimposed pressure, and air-free saturated steam. Quality control staff should ensure that the primary control instruments for heat-sterilization processes, the thermometer and clock, are accurate and maintained in good condition. Mercury-in-glass thermometers, or temperature-measuring instruments of at least the same accuracy and reliability, should be calibrated at least twice a year or more frequently if their settings appear to have been disturbed (see "Calibration of thermometers for processing equipment", p.30).

Most heat-sterilizing equipment should also be fitted with chart recorders which give a permanent graphical record of the temperature of the heating medium and, with batch processes, a record of the duration of heating. This record should be used by quality control staff at the end of each shift to check that the specified processes were applied and to confirm the processing details recorded in the log book maintained by the operators of the heat-processing systems.

FILLING: Quality control staff should monitor the filling operation to ensure that each container receives at least the nominated amount of the product and that the container is not excessively filled. Excessive fills are commercially wasteful and in some instances they may be hazardous. For example, the double seams of canned foods may be damaged if the can is overfilled because the product expands more than the metal of the can during the heat sterilization process. The fill may be checked by weighing or by measuring the volume of the product. The headspace, i.e. the distance between the top of the open can and the surface of the product, may also be measured

CLOSING AND SEALING OPERATIONS: Many processed fruit and vegetable products must be hermetically sealed in their primary package if they are to be safe and shelf-stable. Quality control staff, preferably with assistance from production staff, should inspect filled containers, loose ends and caps as they arrive at the closing machines or heat-sealers, and some of the closed containers as they leave the closing operation.

Operators of can closers should inspect the finished double seams for defects such as droops, spurs, cut-overs and false seams. At regular intervals, depending on the rate of production, detailed examinations should be made of the closures on sample containers taken from each head of the closing machines. Samples should also be examined after the machine is adjusted and after accidents that may have altered the settings of the closing machines and the quality of the seals The assessment of heat seals should be mainly based on visual examinations during production but the seals should be pressure tested when the sealing machines are being adjusted before processing starts or after accidents that may alter their performance

Quality control staff should also check that the correct date, product name and manufacturer's codes are being applied in legible form to the primary containers, and that the appropriate codes are changed frequently enough to allow production batches to be identified and isolated if there is evidence that they are defective.

CLEANING, SANITATION AND WASTE DISPOSAL: Quality control staff should monitor all operations that contribute to the manufacturing process being carried out under satisfactory hygienic conditions. The food processing equipment that handles the product during and after the last steps of the preparative operations should be kept at least as clean as the a well-run process. Quality control staff should inspect the processing lines before manufacturing starts to determine that they are clean and free of waste food, foreign materials and insect infestation. The lines should also be inspected after they are cleaned at the end of the shift. During production quality control staff should inspect the line for evidence of accumulated dirt and waste material, and for any product which has been delayed or by-passed on the line. Special attention should be given to canned foods immediately after the heat sterilization process; the outside

surface of the containers must be kept as free of microbial contamination as possible reduce the risk of organisms gaining entry to the product through the wet closures which at that stage may not have formed an hermetic seal. Wet containers should not be manually handled or contaminated by contact with wet and dirty mechanical equipment. Quality control staff should require can handling equipment to be dry, or if it must be wet it should be regularly sanitized. There is little value in taking microbiological swabs of fruit and vegetable processing equipment to assess the effectiveness of cleaning operations; it is usually sufficient to inspect the equipment, to search for off-odours, to feel metal surfaces for sliminess and to wipe the surfaces with a clean tissue to detect residual dirt

Quality control staff should also inspect all other areas of the processing plant and the immediate outside areas for evidence of waste, insects, rodents and other animals, birds and other materials that may present a risk to the production of safe, wholesome processed fruit and vegetable products.

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(6 points)

1. What is canned food?
2. Write the uses of canning food
3. What is maintain quality specification?

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

Information Sheet 4- Following standard operating procedure

4.1. Introduction

A **standard operating procedure** (**SOP**) 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.

4.2. Procedures for Standard Operating Procedures (SOPs

1. Train school nutrition employees on using the procedures in this SOP. Refer to the Using and Calibrating Thermometers SOP.

2. Follow state or local health department requirements.

3. Heat processed ready-to-eat foods from a package or can, such as canned green beans or prepackaged breakfast burritos, to an internal temperature of at least 135 º F for 15 seconds for hot holding.

4. Reheat the following products to 165ºF for 15 seconds: • Any food that is cooked, cooled, and reheated for hot holding • Leftovers reheated for hot holding • Products made from leftovers, such as soup • Precooked, processed foods that have been previously cooled

5. Reheat food for hot holding in the following manner if using a microwave oven: • Heat processed, ready-to-eat foods from a package or can to at least 135ºF for 15 seconds • Heat leftovers to 165ºF for 15 seconds • Rotate (or stir) and cover foods while heating • Allow to sit for 2 minutes after heating

6. Reheat all foods rapidly. The total time the temperature of the food is between 41ºF and 165ºF may not exceed 2 hours.

7. Serve reheated food immediately or transfer to an appropriate hot holding unit

4.3. Specifications in fruit and vegetable processing.

In food product design there are constant practical trials as the products develop and consumer views are sought, and it is normal to have different specifications. As development continues a more precise specification can be drawn up until the final product is perfected and a manufacturing specification is possible. The specification defines the requirements of the product, with details such as the required sourcing of

the product, the required properties of the product (such as, size, level of ripeness, amount of fat, and so on), and allowable defects levels. Each of the Suppliers is then required to accept or sign up to this specification prior to supply.

- Design Specification
- Manufacturing Specification
- Product Specification
- Product Standards

Good Manufacturing Practices (GMPs)are general statements regarding sanitation, facilities, equipment, processes and controls. Current Good Manufacturing Practices (GMPs) are included in FDA regulations for the food industry (21 CFR 110) and have been stressed in the proposed mandatory HACCP rule for fruit and vegetable juice and juice products.

Standard Operating Procedures (SOPs) are more specifically written and detailed, and are tailored to individual operations. FSIS mandatory HACCP regulations for meats and poultry (61 FR 38805), require that facilities develop, implement, and maintain written SOPs for sanitation which are termed Sanitation Standard Operating Procedures (SSOPs).

Technological principles of pasteurization

Physical and chemical factors which influence pasteurization process are the following:

a. temperature and time;
b. acidity of the products;
c. Air remaining in containers.

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: Choose the best answer.(6 points)

1. Physical and chemical factors which influence pasteurization process

A/ Temperature and time;

B/ Acidity of the products;

C/ Air remaining in containers.

D/ All

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

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

Information Sheet 5- Reporting standard forms and work place procedure

5.1. What is a Standard Operating Procedure (SOP)

Standard Operating Procedures (SOPs) are the documented processes that a company has in place to ensure that services and products are delivered consistently every time**.** SOPs are often used to demonstrate compliance with the regulation or operational practices and to document how tasks must be completed at your organization.

An SOP is a procedure specific to your operation that describes the activities necessary to complete tasks in accordance with industry regulations, provincial laws or even just your own standards for running your business. Any document that is a “how to” falls into the category of procedures. In a manufacturing environment, the most obvious example of an SOP is the step by step production line procedures used to make products as well train staff. An SOP, in fact, defines expected practices in all businesses where quality standards exist. SOPs play an important role in your small business. SOPs are policies, procedures and standards you need in the operations, marketing and administration disciplines within your business to ensure success These can create:

- efficiencies, and therefore profitability
- consistency and reliability in production and service
- fewer errors in all areas
- a way to resolve conflicts between partners
- a healthy and safe environment
- protection of employers in areas of potential liability and personnel matters
- a roadmap for how to resolve issues – and the removal of emotion from troubleshooting – allowing needed focus on solving the problem
- a first line of defense in any inspection, whether it be by a regulatory body, a partner or potential partner, a client, or a firm conducting due diligence for a possible purchase
- value added to your business should you ever wish to sell it

There are benefits for having written SOPs and ensuring they are followed. Day-to-day variations in product can be minimized; one of the benefits of SPC. There can be less product output with being put on hold or on quarantine, or having to be reworked or reprocessed. Potential for product contamination can be minimized. There can be more efficient use of time, personnel and material resources. Clearly, an SOP specifying detailed cleaning at product changeovers between allergen containing product and non-allergens could eliminate potential customer health problems and prevent costly litigation.

The ultimate goal of every 'Procedure' is to provide the reader with a clear and easily understood plan of action required to carry out or implement a policy. A well-written procedure will also help eliminate common misunderstandings by identifying job responsibilities and establishing boundaries for the jobholders.

Hazards identified during day to day activity must be reported to the appropriate manager. If the hazard can be remedied immediately, the manager should take appropriate action in consultation with the Health and Safety Representative.

Self-Check # 5	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions(4 points)

2 What are Standard Operating Procedures (SOPs)?

3 Define the benefits of reporting quality?

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

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

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