Fruit and Vegetable Processing
Level -II
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Module Title: Operate a Heat Treatment Process

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Introduction to the module

This module covers the knowledge, skills and attitude required to preparation and operation of a heat treatment process prepare the heat treatment process for operation, operate and monitor the aseptic sterilizer, operate De-aeration equipment, perform pasteurization process, shut down the heat treatment process, use workplace information.

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.

LG#35	LO1#- 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 availability of materials and service
- Checking equipment
- Setting methods of heat treatment.

This unit 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 and 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
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet-1

1.1. Confirm availability of materials and service

Variety control is needed in order to identify that the fruit belongs to an accepted variety as not all are suitable for different technological processes. Fruit maturity degree is significant as industrial maturity is required for some processing/preservation methods while for others there is the need for an edible maturity when the fruit has full taste and flavor. Special attention is given to size, appearance and uniformity of fruit to be processed, mainly in the form of fruit preserved with sugar using whole/half fruits ("with fruit pieces"

Fruit reception at the processing center is performed mainly for following purposes. fruit and vegetable processing center needs a good, specific preliminary study including, among other considerations, the following aspects:

- Raw material availability
- Raw material quality in adequate varieties for the types of finished products that will be manufactured
- Harvesting and transport practices and organization from the field to the processing center.
- Processing capacity related to raw material availability: quantities, season ability, etc.
- Checking of sanitary and freshness status
- Control of varieties and fruit wholeness
- Evaluation maturity degree
- Collection of data about quantities received in connection to the source of supply: outside growers/farmers, own farm.

Some laboratory control is also needed, even if it not easy to precisely establish the technological qualities of fruit because of the absence of enough reliable rapid analytical methods able to show eventual deterioration.

1.1.1. Temporary storage before processing

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

Some basic rules for this step are as follows:

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

Cold storage is always highly preferred to ambient temperature. For this reason, a very good manufacturing practice is to use a cool room for each processing center; this is very useful for small and medium processing units as well.

I. 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.



Figure 1.1. Selection of fruits and vegetable

A. Sorting and grading

The selected fruits and vegetables are graded according to size and color 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.





Figure 1.2. Sorting and grading of fruit and vegetable

https://youtu.be/V_m2HBKeOGA(access 02/12/2023)

B. 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.



Figure 1.3. Washing

https://youtu.be/CjZhlAMRoCY?t=62 (access 03/12/2023

C. 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).

D. Cutting

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

1.1.2. Confirming Fresh fruit and vegetables Quality analysis

Determination of moister, texture, TSS, acidity, flavor and aroma and appearance of fresh fruits and vegetables analysis is primarily concerned with measurement of the mechanical properties and some chemical properties of a product. They also relate to its sensory properties detected by humans. Analysis of these properties is performed by drying, compression, titration, and sensory properties; visual and by smelling. Texture analysis can tell us a lot about its tactile properties, such as firmness, fracture-ability, resilience, and other parameters. Texture analyzers perform this test by applying controlled forces to the product and recording its response in the form of force, deformation and time**.** In practice the soluble solids, also called degree of Brix, is measured in the juice of samples of fruit because it is much easier to measure. Usually, sugars are the soluble solids that are in the largest quantity in fruit, so measuring the soluble material in samples of the juice can give a reliable measure of its sugar content. The acidity of many types of fruit changes during maturation and ripening. In many fruit acidity progressively reduces as the fruit matures on the tree. The moisture content (MC) expresses the weight of water in a product as a proportion of its weight. The moisture content of food materials is the major factor that affects its shelf stability (storability). Food products of higher moisture contents are known to be stored only for few days and those with lower moisture can be stored for as long as a year or more. High moisture content will support spoilage pathogenic microorganisms and deteriorative activities of enzymes and metabolic activities of the products all leading to deterioration.

I. Determination of Moisture Content (MC) of fresh fruit/vegetable

Materials

- **Consumables**

✓ Fresh fruits and vegetables

- **Equipment and utensils**

✓ Analytical balance

✓ Aluminum foils

✓ Hot air oven



Figure 1.4. oven

Procedures

- Prepare clean aluminum foils of about 10 cm diameters and mold it like a bowl.
- Put the foils in a hot air oven at about 100°C for 20 minutes and then transfer the foils into desiccators and leave it for 5 minutes.
- Weigh the foils using analytical balance and record the weight as W_1.
- Put each foil on the balance; set the balance to zero and weigh grain sample and label this weight as W_2.
- Then load the sample into a hot air sample set at 100°C and keep for 90 minutes (or at 130°C for 60 minutes).
- Transfer the foils, and its contents, to desiccators and keep for about 10 minutes;

- Weigh the dried sample is record it as W_3.
- Calculate the moisture content:
  a. Wet weight basis (wb) using the formula:

$$MC(\%wb) = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

✓ Dry weight basis using the formula

$$MC(\%db) = \frac{W_2 - W_3}{W_3 - W_1} \times 100$$

II. Determination of texture of fruit/Vegetables

Materials

- Consumables
- Fruits/vegetables
- Texture analyzer)



Figure: 1.5. Texture analyzer

Procedures

- Randomly taking fruits
- Placing the fruit at the center of penetrator
- Recorded force required to penetrate in kg per cm2 or the

III. Determination of total soluble solids

- Fruits/vegetables
- Blender (food processor), Chopping-board, Knife, saucepan, homogenizer, Test tubes, Refractometer, centrifuge

Procedures

- Two fruits will be taken randomly from each treatment and
- macerated for juice
- 50ml extraction will be centrifuged for 15 minutes.
- placing 1 to 2 drops of clear juice on the prism
- Record Refractor-meter reading

IV. Determination of Flavor, Aroma and Appearance

- Fruits/vegetables in different physiological maturity
- Dishes

Procedure

- Clean the fruits/vegetables using potable water.
- Remove bruised or rotten fruits/vegetables
- Place Fruits/vegetables in different physiological maturity in different dishes
- Code each dish with samples
- Place the dishes with sample on sensory analysis table
- Give the direction or introduction to the panelists

1.1.3. Confirming available service

A. 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

B. Steam

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

C. Energy use in fruit and vegetable processing

Availability of utilities: electricity. 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.

C. 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.

E. Vacuum and instrument air

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

1.2. Check equipment

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. 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.

1.2.1. 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.

1.2.2. Important of 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
- Production distribution equipment includes wrapping and palletizing systems

1.3. Setting methods of heat treatment

It is the process of selecting method of heat treatment based on type and parameters in order to safely preserve foods using heat treatment. The basic purpose for the thermal processing of foods is to reduce or destroy microbial activity, reduce or destroy enzyme activity and to produce physical or chemical changes to make the food meet a certain quality standard. e.g. gelatinization of starch & denaturation of proteins to produce edible food. There are a number of types of heat processing employed by the food industry

I. The following criteria must be known

- Time-temperature combination is required to inactivate the most heat resistant pathogens and spoilage organisms in one particular food.

- Heat penetration characteristics in one particular food, including the can or container of choice if it is packaged.

II. Objective of heat treatment

- To destroy pathogenic/ disease-causing and all forms of microorganisms
- To inactivate enzymatic activities of vegetables

1.3.1. Methods of heat treatment

In the food industry, heat treatment methods are commonly used for fruit and vegetable processing to ensure food safety, extend shelf life, and enhance flavor and texture. Here are some commonly employed heats treatment methods:

I. Blanching: This process involves briefly immersing fruits or vegetables in boiling water or steam. Blanching is typically used to inactivate enzymes, remove skin or peel, and enhance color retention. It is commonly used before freezing, canning, or drying fruits and vegetables.

Procedure

- Have ready a large bowl of ice water (known as an ice bath), a slotted spoon, and a plate lined with a cloth or paper towel.
- Bring a large pot of water to boil over high heat.
- Meanwhile, prepare the vegetables (wash and slice). Doing this just before blanching prevents oxidation.
- Just before blanching the vegetables, add couple of tablespoons of salt to the boiling water. Salt helps to maintain color and improve flavor, but it may be omitted if you wish.
- Add the sliced vegetables to the water bath in small batches so that the water continues to boil. If blanching more than one type of vegetable, blanch each one separately and blanch lighter colored ones first, as darker colored ones will tinge the water and subsequent vegetables.
- After about 30 seconds, test for doneness. Remove one piece; dip it into the bowl of ice water, and taste. Keep tasting every 30-60 seconds until the vegetables are cooked to your liking. Most vegetables take between 2-5 minutes.

- When the vegetables are done, quickly remove them from the boiling water with a slotted spoon and plunge them into the ice bath to stop the cooking process. (This is called "shocking.")
- When the vegetables are completely cool, remove them from the ice bath and drain on the towel-lined plate.

II. Pasteurization: Pasteurization is a heat treatment method that involves heating the fruit or vegetable product to a specific temperature for a set period to destroy harmful microorganisms while retaining the product's quality. It is commonly used for fruit juices, purees, and sauces. The pasteurization temperature and time depend on the specific requirements of the product.
Its main benefits include:

- Creating changes in texture, composition, and color of the food.
- Tenderizing the food and making it easier to digest.
- Enhancing the food's palatability.
  It is necessary to clarify that when applying pasteurization, certain calculations must be made (in terms of time and temperature) to avoid excessive exposure of the food, which could result in a loss of nutritional qualities.

Additionally, this type of treatment has specific objectives depending on the type of food. For highly acidic food, the goal is stabilization, while for low-acid food, the goal is pathogen destruction.

Process. Initially, a heat treatment is applied to create a shock. Then, chemical additives can be applied to extend the food's shelf life and maintain product stability.

The choice between batch processing (packaging the product first and then pasteurizing) or continuous processing (pasteurizing first and then packaging) can impact the selection of the packaging type.



Figure:1.6- Pasteurization of fruit and vegetable

III. Canning: Canning involves heat processing fruits or vegetables in sealed containers to kill bacteria, yeast, and molds that could cause spoilage. The product is heated to a specific temperature, depending on the type of food, to ensure it is commercially sterile and can have an extended shelf life.

A. Canning and Bottling: Canning and bottling involve sealing fruits and vegetables in containers and subjecting them to heat to destroy microorganisms, enzymes, and other spoilage-causing agents. The product is heated to a specific temperature based on the type of food and container used. The sealed containers help maintain the product's quality and extend its shelf life.

B. Hot Fill: Hot fill is a method where hot fruits or vegetables are directly filled into containers, such as bottles or jars, and sealed. The high temperature of the product, combined with the heat-resistant containers, helps in achieving microbial control and product preservation. This method is commonly used for products like sauces, jams, and pickles.

IV. Aseptic Processing: Aseptic processing involves sterilizing the fruit or vegetable product separately from the packaging material. The product is rapidly heated to a high temperature using methods like flash heating or continuous flow heat exchangers. It is then cooled and transferred into sterilized containers under aseptic conditions. This method helps in preserving the product without the need for refrigeration and extends its shelf life.

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.

Procedure

- Open the lid of the autoclave and check that there is sufficient amount of distilled or demonized water in it. If necessary, refill.
- Place the correctly packaged materials (e.g. laboratory equipment, culture medium, food sample in a flask) into the chamber of the autoclave.
- Close the lid of the autoclave and make sure that the bleeder valve is open.
- Turn on the heating of the autoclave (the indicator lamp is lit).
- If an intense (a thick, milky white) steam outflow can be detected through the outlet tube of the bleeder valve (100°C on the built-in thermometer), wait for 4-5 minutes and close the bleeder valve (venting).
- With the help of a built-in thermometer and manometer, check the temperature and pressure increase inside the chamber of the autoclave.
- The sterilization time (15 minutes or more) begins only when the temperature equalization (to 121°C) in the chamber has occurred. It is important that the operator stays with the device and controls the process of sterilization from the time it is turned on until the end of the sterilization period.
- Turn off the power switch of the autoclave when the sterilization cycle/period has ended.
- Allow the device to cool down to at least 60-70°C.
- For decompression, slowly open the bleeder valve. Thereafter, carefully open the lid of the autoclave and remove the sterilized materials, using heat-proof gloves.

Self-check-1	Written Test

Name…… ID…… Date…….

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

Test I: Choose the best answer

1.What is the objective of heat treatment

A. Destroy pathogenic C. For preservation

B. Inactivate enzymatic D. All

2.Which one of the following is main benefits

A. Creating changes in texture, composition, and color of the food

B. Tenderizing the food and making it easier to digest

C. Enhancing the food's palatability D. All

3.Selection of fruits and vegetable should be

A. absolutely fresh. B. Normal ripe C. firm, and uniformly mature D.All

Test II: Short Answer Questions

1. Write types of heat treatment?
2. Describe aseptic processing
3. How and for what purpose we use hot filling?
4. List out fruit pulp and vegetable pure extraction process.
5. What it means fruit grading?
6. What purpose us Blanche vegetable?
7. What are the uses of steam in food processing?

Operation sheet -1

Operational title: performing pasteurization process

Purpose: To practice and demonstrate the knowledge and skill required pasteurization process

Instruction: given necessary raw materials, tools and equipment you are required to perform the following tasks. The project is expected from each student to do. For this operation you have 2hours

Materials, tools and equipment required:

- Thermometer
- Pasteurizer
- Jar
- Oven
- Packing materials
- Filler
- Tongs

Procedures in doing the task:

- Wear personal protective equipment
- Prepare fruit and vegetable juice
- pour juice in to large pot
- Heat the juice over high temperature
- checks temperature once needs to reach
- Use candy thermometer to checks once it's simmering
- Stay at a temperature for about a minute
- Cleaning jars for the juice
- Wash the jars; you can use any jars.
- Boils jars, place jars into water bath canner
- Let jars boil for 15 minutes.
- Use tongs to pull the jars out.
- Pour juices in fill the containers with hot jars.

LAP Test -1	Performance test

Name……..... ID……. Date……

Time started: _____ Time finished: _____

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

Task 1-Perform pasteurization

LG#36	LO#2-Operate and monitor the aseptic sterilizer

Instruction sheet

This unit 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 out-of-specification product and process equipment

This unit 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:

- Start-up aseptic sterilizer
- Monitor and maintaining control points.
- Treating heat product and monitoring process.
- Identify out-of-specification product and process equipment

Learning Instructions:

Read the specific objectives of this Learning Guide.

1.Follow the instructions described below.

2.Read the information written in the information Sheets

3.Accomplish the Self-checks

4. Perform Operation Sheets

5. Do the “LAP test”

Information sheet-2

2.1. Starting up aseptic sterilizer

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.

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. The benefits of aseptic processing over conventional canning include longer shelf life, wider packaging sizes.

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.



Figure 2.1. Aseptic sterilizer



Figure:2.2. - Aseptic processing

2.2. Monitor and maintaining control points

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. Control points refer to those key points in a work process that must be monitored and controlled for the purpose of food safety, hygiene and quality. This includes:

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

The seven principle of hazard analysis

A. 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. Hazards may be physical, chemical and biological.

B. Critical control point (CCP)

Is 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.

C. Critical limit

Is 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.

D. Establish a monitoring system for each CCP

Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. By observation the process, monitoring workers activity, controlling the process…etc

E. Establish corrective actions

Corrective action is any procedure applied to a critical operation where deviation or problem has happened. Therefore, corrective actions should include the following elements: -

- Determine and correct the cause of non-compliance
- Determine the disposition of non-compliant product and
- Record the corrective actions that have been taken.

F. Establish verification procedures

Verification is defined as those activities, other than monitoring, that determine the validity of the HACCP plan and that the system is operating according to the plan.

G. Establish record-keeping and documentation procedures

Generally, the records maintained for the HACCP System should include the following: - Description of the food, its distribution, intended use, and consumer, verified flow diagram, the concern of hazard, critical limits, corrective actions taken, verification procedures and schedule.

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

- 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
- Develop procedures to monitor and control these factors so that they do not cause a problem

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

Process	Monitoring by workers	Control point
Inspect	Remove moldy, rotten, badly damaged raw materials and all foreign material, e.g., leaves, stems, stalks, sticks, and stones.	CCP Moldy, 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, moldy or unripe fruits (molds could affect flavor and shelf life of product, extraneous matter could contaminate product)
Extract juice	Inspect juice, check for color and any pieces of fruit on sieve/cloth. Color compared to standard color chart for the product	All juice passes through filter cloth. Juice having poor color 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)

2.3. Heat treating product and monitoring process

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

Thermal processes can be classified according to the intensity of the heat treatment. 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 100 °C), or sterilization (temperature >110 °C). Sterilization destroys all pathogenic and spoilage microorganisms in foods and inactivates enzymes by heating. Severe conditions are applied primarily to ensure that *Clostridium botulinum* spores are destroyed during processing. The destruction of vegetative and spore forming organism and pathogens is secondary objective of commercially sterilized foods.

This last process called blanching, destroys many enzymes in the food product and prevents further cellular metabolism.

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.

Table: -2.2. Causes and Possible Solutions for Problems with Fruit and vegetable Products

Problem	Cause	Prevention
Formation of crystals	• Excess sugar.	Use a tested recipe and measure ingredients precisely
	• Undissolved sugar sticking to sides of saucepot.	• Dissolve all sugar as jelly cooks.
	• Tartrate crystals in grape juice.	• Extract grape juice and allow tartrate crystals to settle out by refrigerating the juice overnight. • Strain juice before making jelly.
	• Mixture cooked too slowly or too long.	Cook at a rapid boil. Remove from heat immediately when jellying point is reached.
Bubbles	• Air became trapped in hot jelly.	• Remove foam from jelly or jam before filling jars. • Ladle or pour jelly quickly into jar. • Do not allow jelly or jam to start gelling before jars are filled.
	• May denote spoilage. If bubbles are moving, do not use.	• Follow recommended methods for applying lids and processing.
Too soft	• Overcooking fruit to extract juice.	• Avoid overcooking as this lowers the jellying capacity of pectin.
	• Using too much water to extract the juice.	• Use only the amount of water suggested in the instructions.
	• Incorrect proportions of sugar and juice.	• Follow recommended proportions.
	• Undercooking causing insufficient concentration of sugar.	• Cook rapidly to jellying point.

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

	• Improper storage.	• Store processed jars in a dark, dry, cool place. Refrigerate after opening.
Too stiff or tough	• Overcooking.	• Cook jelly mixture to a temperature 8°F higher than the boiling point of water or until it "sheets" from a spoon.
	• Too much pectin in fruit.	• Use ripe fruit. Decrease amount if using commercial pectin.
	• Too little sugar which requires excessive cooking.	• When pectin is not added, try ¾ cup sugar to 1 cup juice for most fruits.
Not a characteristic fruit flavor	• Overcooked or scorched.	• Should be stirred frequently when mixture begins to thicken to prevent sticking. Cook only to jellying point.
	• Poor quality fruit used.	• Select only sound, good flavored fruit of optimum maturity.
Tough product	• Starting the cooking of fruit in syrup that is too heavy (too much sugar).	• Cook each fruit according to directions; by evaporation the syrup concentration will gradually increase.
	• Not plumping fruit properly.	• Fruit should plump at least 24 hours covered in syrup before canned.
	• Overcooking.	• Cook according to directions.
Sticky, gummy product	• Overcooking.	• Follow recommended directions for each product.
Darker than normal color	• Cooking too large of quantities at one time.	• It is usually best to cook not more than 2 to 4 pounds of prepared fruit at a time.
	• Cooked too slowly.	• A better color is usually produced if the product is cooked rapidly.
	• Overcooked.	• Cook only until syrup is quite thick and the fruit is fairly translucent.
Loss of color	• Improper storage.	• Store processed jars in a dark, dry, cool place.
Mold or Fermentation (Denotes spoilage; do	• Imperfect sealing.	• Use new flat lids for each jar and make sure there are no flaws. Pretreat the lids per manufacturer's

not use.)		directions. Use ring bands in good condition – no rust, no dents, no bends.

2.4. Identifying and reporting out-of-specification product and process equipment

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:

- The product sterilization system (hold tube) and all equipment downstream from the holding tube including the filler.
- The packaging equipment.
- 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.

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.

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: **Mach column "A" with column "B"**

1.Formation of crystals	A. Too much pectin in fruit
2.Sticky, gummy product	B. Excess sugar
3.Too stiff or tough	C. Overcooking.
4.Loss of color	D. Imperfect sealing.
5.Mold	E. Improper storage

Test II: Short Answer Questions

1. What is Temperature Indicating Device**?**
2. What is thermal heating means
3. Describe Critical limit?
4. What is aseptic sterilizer process?

LG#37	LO#3: Operate De-aeration equipment

Instruction sheet

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

- Performing oxygen removal
- Performing aroma recovery
- Performing foam Removal

This unit 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 oxygen removal
- Perform aroma recovery
- Perform foam removal

Learning Instructions:

Read the specific objectives of this Learning Guide.

1.Follow the instructions described below.

2.Read the information written in the information Sheets

3.Accomplish the Self-checks

4. Perform Operation Sheets

5. Do the “LAP test”

3.1. Performing oxygen removal

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"*.

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, especially flashing off at high temperature, can also remove some desirable volatile aroma, another compromise facing the juice technologist.

The oxygen-containing make-up water, preheated to 40-90 °C, is conducted to the upper section of the deaeration tank. In order to optimize the removal of oxygen, the deaeration tank is equipped with fillers for division of the water into fine particles.

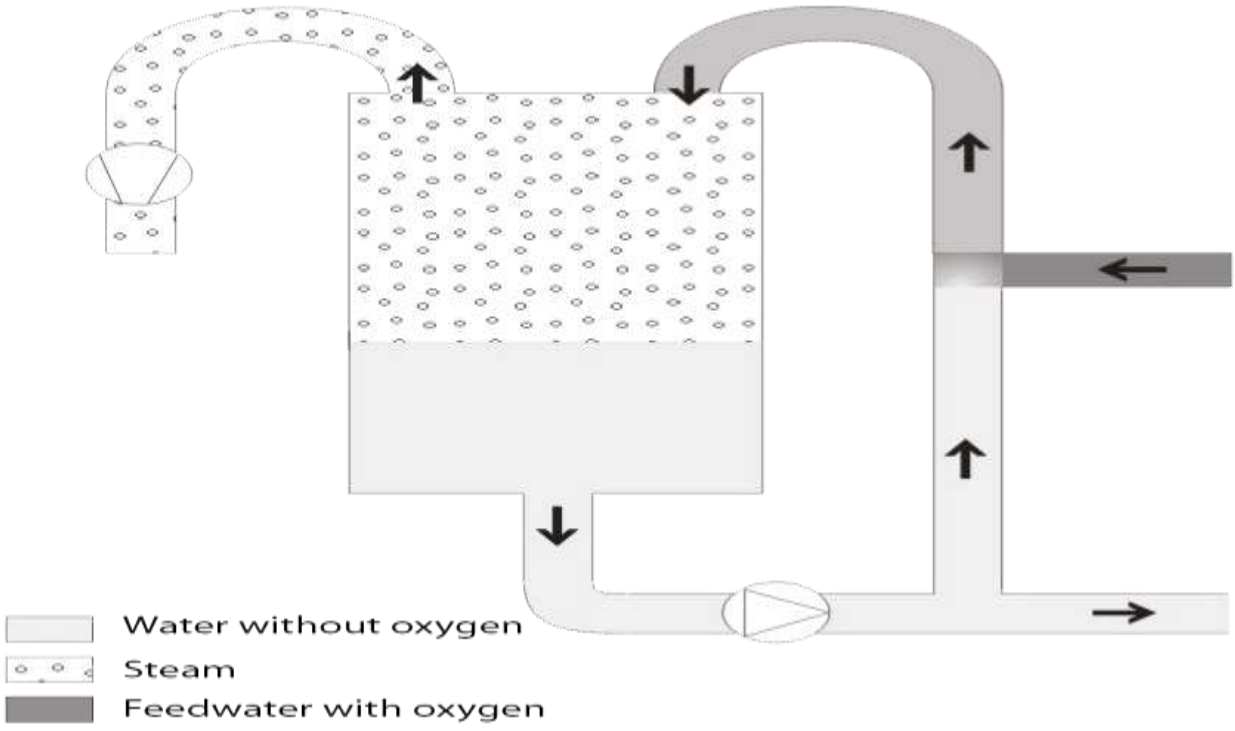


Figure:3.1. Process of oxygen removal

3.1.1. Methods of Deaeration

DE aeration is the removal of air or oxygen from liquid food product. There are multiple methods applied for the removal of gases from liquid food products.

- Ambient Vacuum deaeration
- Hot Vacuum de-aeration
- Hot Atmospheric deaeration
- Gas-Stripping deoxidation



Figure:3.2. vacuum pressure

https://youtu.be/2fyhvrfMXK8

3.2. Performing aroma recovery

Aroma recovery the process of obtaining the aroma or flavor of juice. 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. It covers the collection of aromas from different fruits and vegetables concentrates or juices through boiling, condensation and freezing methods.

Aroma: include the essence from the material or main fruit/ vegetable that could be extracted and collected using the state of the art of modern recovery or extraction process.

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.

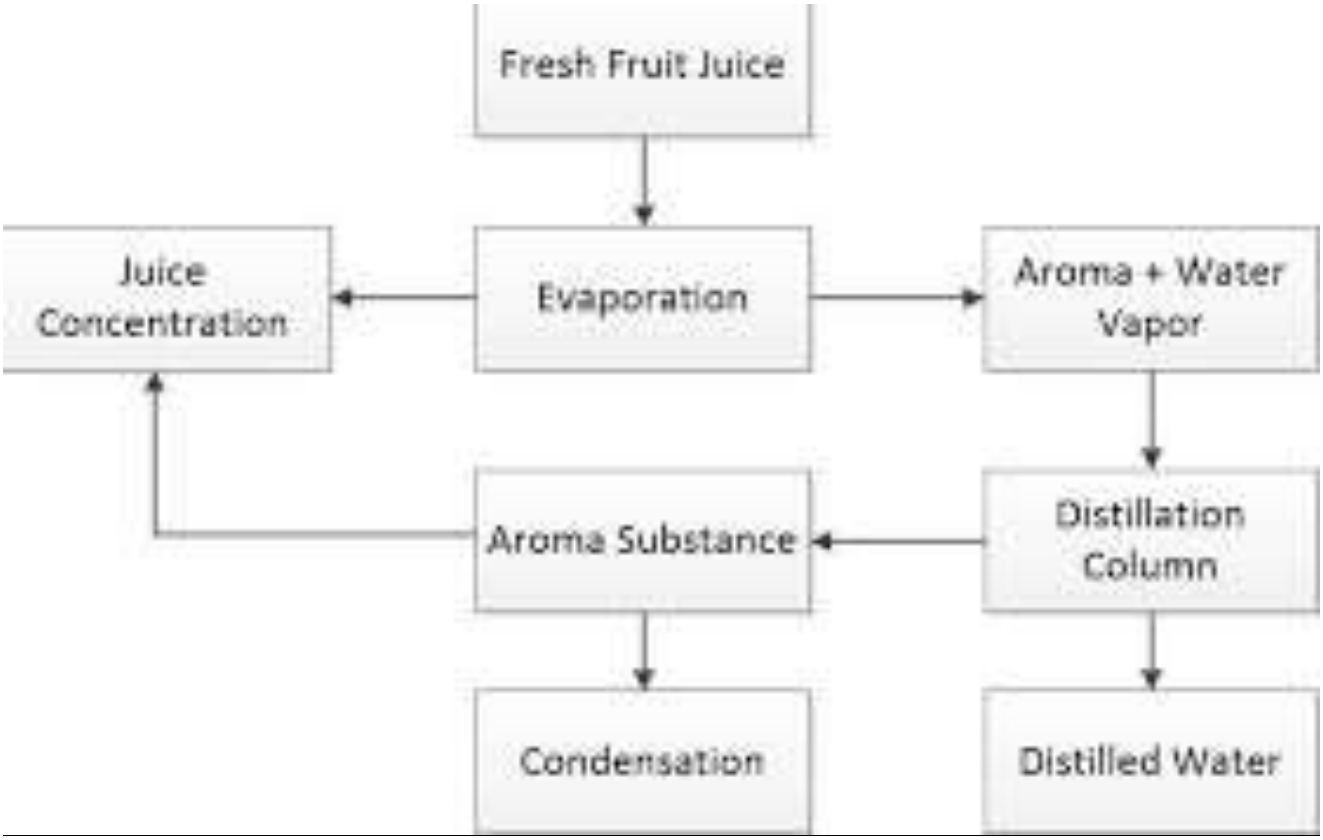


Figure 3.3. ways of aroma recovery

3.3. Performing foam removing

It is the process of removing foam from juice. Certain combinations in high-powered blenders can end up frothy, foamy, or with a mousse-like texture. The foam that occurs is due to the reaction of insoluble fiber with oxygen. You can strain the juice once to remove some of the foam. The higher the revolution per minute of the juicer, the more air is mixed into the juice. This is what creates foam. You can minimize bubble formation by blending for less time.

The method to stop foaming: -

- Use clarified juice
- Reduce rpm (revolution per minute)
- Adding small amount of salt
- Chilling the blender itself
- Remove insoluble fiber
- Use antifoaming agent



Figure 3.4. Foam removal formation

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

1.Which of the following are not the methods removal of gases from liquid food products.

A. Ambient Vacuum deaeration B. Hot Vacuum de-aeration C. Hot Atmospheric deaeration D. none

2. Which one of the methods are removal of foaming from fruit and vegetable processing?

A. Use clarified juice B. Adding small amount of salt C. Chilling the blender itself D. all

3.The foam can be occurring is due to the reaction of insoluble fiber with oxygen

A. True B. False

Test II: Short Answer Questions

1.What is De aeration process?

2.Write the uses of de aeration process?

3.What is aroma recovery?

4.Write aroma recovery process?

5.Write the uses of foam removal from juice?

LG#38	LO#4: Operate De-aeration equipment

Instruction sheet

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

- Performing pasteurization process
- Control/adjust pasteurization temperature and equipment
- Type of pasteurization

This unit 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/adjust pasteurization temperature and equipment
- 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

4.Accomplish the Self-checks

5.Perform Operation Sheets

6.Do the “LAP test”

Information Sheet-4

4.1.Perform pasteurization process

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 polygalacturonate 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. purpose of heat treatment is

- Destroy micro-organisms which could affect the health of the consumer.
- Destroy micro-organisms which could alter the properties of the food.
- Deactivate any enzyme action.
- Optimize the retention of quality factors at minimum cost

4.1.1. Heating pasteurization

- **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
- **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.
- **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; 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.
- **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.

4.1.2. Cleaning Jars for the Juice

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.

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.

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

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

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.

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

4.2. Adjust pasteurization of equipment and temperature

The food is generally decomposed by the presence of microorganisms and can be prevented by killing them. The heat preservation is one of the most important methods of killing / inactivation of microorganism as well as enzymes which are already present in the food. Heat application kills the microorganisms because of denaturation of proteins. Different microorganisms have different heat resistance. This can be shown by their thermal death time (TDT) at a particular temperature.

4.2.1. Temperature and Time

The heat treatment in respect of time and temperature is governed by the nature of food product and size of the container. Thus, we can enlist below certain factors, which affect the heat resistance of cells or spores.

- Initial concentration of spores
- The time-temperature relationship
- The type and nature of microorganisms
- Composition of substrates such as moisture content, pH or acidity, fat, protein, pectin, etc.

Microorganisms can multiply very quickly if food is stored at room temperature. By holding food at temperatures below 5°C or above 60°C their growth is slowed down or stopped

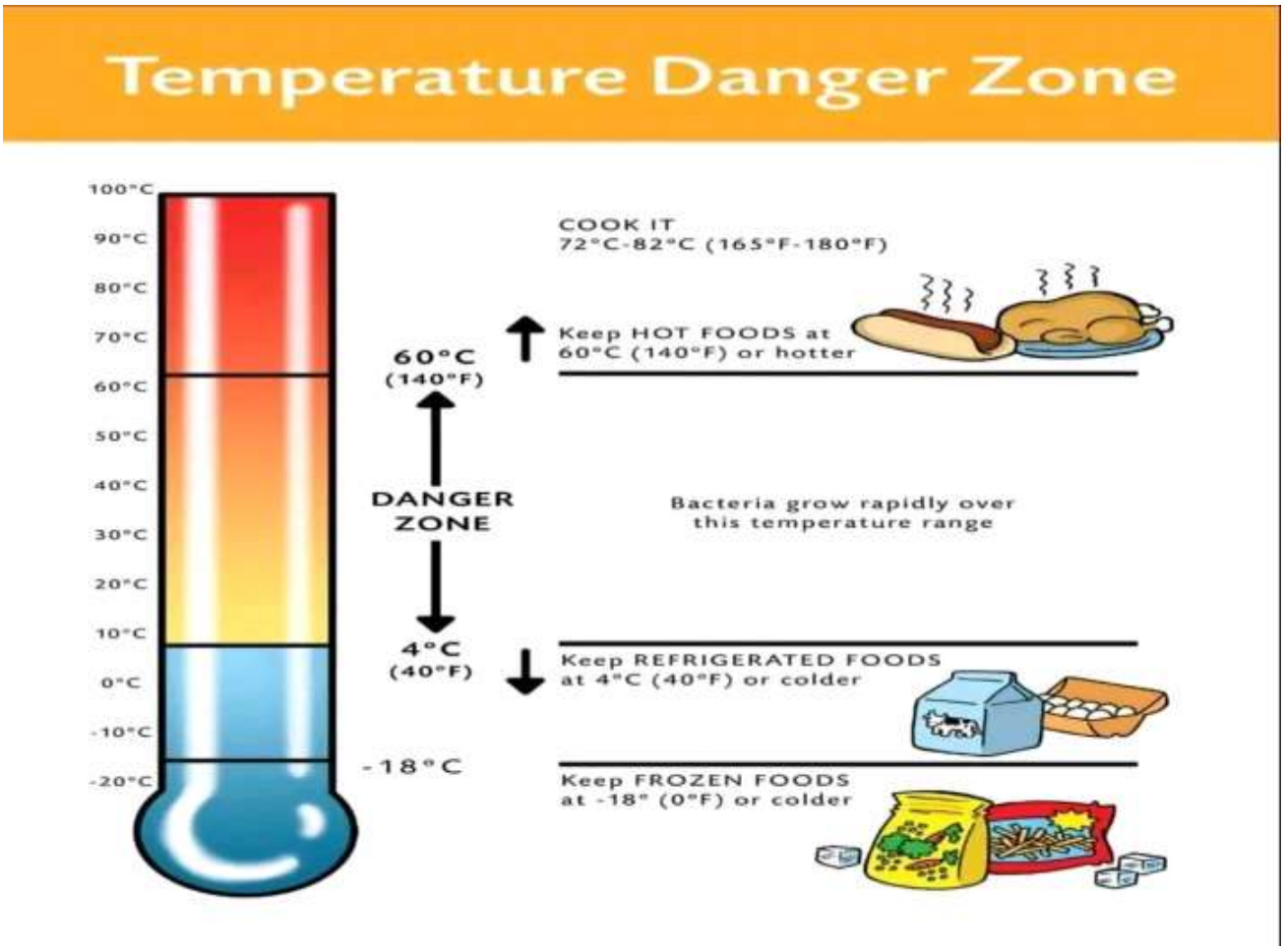


Figure 4.1. Temperature

4.3. Type of pasteurization

A. Vat Pasteurization or low temperature

- Vat pasteurizer consists of a temperature-controlled, closed vat. Additionally, it is called batch pasteurization or low-temperature, or prolonged pasteurization.
- The food product is brought to a temperature between 62 °C to 64 °C and maintained there for about 30 minutes, and then swiftly cooled.
- The shelf life of pasteurized food in a refrigerator is two to three weeks.
- The raw material is added into the pasteurization vat, heating it to the required temperature, maintained for the required period, utilizing cooling technology, and finally pumping the material out of the vat.
- Today, smaller businesses and items other than milk are the main uses for vat/batch pasteurization. However, significant corporations occasionally use it (e.g., fruit juices).

B. High Temperature/Short Time (HTST)

- HTST pasteurization is also referred to as flash pasteurization or the continuous method.
- HTST pasteurization stands for high-temperature, short-time processing.
- It is currently one of the most popular pasteurization techniques.
- The liquid is heated to temperatures between 71.5 °C to 74 °C for approximately 15 to 30 seconds or between 74°C to 76°C for 15 to 20 seconds.
- It targets harmful bacterial spores that are resistant (*Clostridium botulinum* spores).
- The HTST pasteurization should eliminate nearly all yeasts, mold, common spoilage, and harmful bacteria

Advantages

- The color and flavor are better preserved.
- Suitable for milk products, juice/puree-based goods, and legged beer products.

Disadvantages

- This approach can be used in fewer manufacturing facilities.
- It is pretty expensive.

C. Ultra pasteurization (UP)

- In the same way as the HTST process, ultra-pasteurization is also carried out at a higher temperature using slightly different tools.
- UP pasteurized products have a longer shelf life but still require refrigeration.

D. 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.

E. 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.

H. 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.

4.3.1. 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 pasteurizing 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.

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

1.Which one of the following are the advantage of High Temperature/Short Time

A. Used in fewer manufacturing facilities. C. It is pretty expensive

B. The color and flavor are better preserved D. None

2._____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

A. Rapid pasteurization B. flash pasteurization C. Ultra pasteurization D. A$ B

3.At what temperature Microorganisms can multiply very quickly

A. Room temperature. B. High temperature C. low temperature D. All

Test II: Short Answer Questions

1.Write and explain type of pasteurization?

2. List and explain the factors, affect the heat resistance of cells or spores. ?

3. Justify Vat Pasteurization or low temperature?

4. Write the difference between pasteurization and sterilization?

5.Explain the adjust of equipment and temperature in pasteurization?

LG#39	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

4.Accomplish the Self-checks

Information Sheet -5

5.1. Shutting down equipment

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

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

5.2. Collecting, treating and disposing or recycling waste

I. Waste Management

Suitable provision must be made for the removal and storage of waste. Waste must not be allowed to accumulate in food handling, food storage, and other working areas and the adjoining environment except so far as is unavoidable for the proper functioning of the business

II. Waste stores must be kept appropriately clean

Adequate drainage and waste disposal systems and facilities should be provided.

They should be designed and constructed so that the risk of contaminating food or the potable water supply is avoided.

https://youtu.be/XIbURpyCAO4?t=15 (access 03/12/2023)

Ensure that waste materials are

- Identified
- Collected
- Removed
- Disposed of in a manner which prevents contamination of products or production areas.

III. 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.

IV. Waste disposal

- Containers for waste

✓ Clearly identified for their intended purpose;

✓ Located in a designated area;

✓ Constructed of impervious material which can be readily cleaned and sanitized;

✓ Closed when not in immediate use;

✓ Locked where the waste may pose a risk to the product.

- ✓ Drains shall be designed, constructed and located so that the risk of contamination of materials or products is avoided.



Figure 5.1. waste disposal

V. 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.

VI. 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.

A. **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%
- Reduces 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

B. 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 odours 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-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

1._____is initiated in the event of a fire, major spill, instrument failure, power failure, or total loss of control of chemical or physical processes.

A. Emergency shutdown B. Shutting down to a standby condition **C.** Normal shutdown D. All

2.Ensure that waste materials are

A. Identified B. Collected C. Removed D. All

3.Waste disposal containers are

A. Clearly identified B. Located in a designated area C. Constructed of impervious material D. All

4.The incineration of waste is a hygienic method of reducing its volume and weight which also reduces its potential to pollute

A. True B. False

Test II: Short Answer Questions

1.Justify advantages and disadvantages of waste incineration?

2.Justify waste management?

3.Waste disposal?

LG#40	**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 and maintaining quality
- 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
- Follow standard operating 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

4.Accomplish the Self-checks

5.Perform Operation Sheets

6.Do the “LAP test”

Information Sheet -6

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

6.2 Identifying out of specification standards and maintaining quality

Out-of-specifications during heat treatment of fruits and vegetables refer to instances where the processing conditions or the final product deviate from the predefined specifications or standards. These deviations can occur at various stages of the heat treatment process and may impact the safety, quality, or characteristics of the treated fruits and vegetables. Here are some potential out-of-specification scenarios:

I. Temperature Deviation

- **High Temperature:** Exceeding the specified maximum temperature can lead to overcooking, loss of nutritional value, changes in texture, and potential safety hazards.
- **Low Temperature:** Failing to reach the minimum temperature may result in inadequate pasteurization or sterilization, posing risks of microbial contamination.

II. Time Deviation

- **Undercooking:** Insufficient processing time may lead to incomplete destruction of microorganisms, compromising product safety.
- **Overcooking:** Excessive processing time can cause the product to lose desirable attributes such as color, flavor, and nutritional value.

III. Humidity Control Issues

- **Excessive Humidity:** High humidity levels may contribute to undesirable texture changes, spoilage, or microbial growth.
- **Insufficient Humidity:** Low humidity levels can result in product dehydration, affecting overall quality.

IV. Improper Cooling

- **Slow Cooling:** If the cooling process is too slow, it may allow for the growth of bacteria or other microorganisms, compromising product safety.
- **Rapid Cooling:** Extremely fast cooling may impact texture and quality attributes.

V. Equipment Malfunctions

- **Sensor Calibration Issues:** Inaccurate temperature or humidity readings due to faulty sensors or calibration errors.
- **Equipment Failure:** Mechanical breakdowns or malfunctions in heat treatment equipment that can disrupt the process.

VI. Product Contamination

- **Cross-Contamination:** Unintended mixing of different products during the heat treatment process.
- **Foreign Material Contamination:** Introduction of foreign objects into the product.

VII. Packaging Defects

- **Sealing Issues:** Inadequate sealing of packaging may lead to contamination or loss of product integrity.
- **Package Integrity:** Compromised packaging integrity can result in exposure to external contaminants.

VIII. Non-Compliance with Regulations

- **Failure to Meet Regulatory Standards:** Deviations from regulatory requirements and industry standards for heat treatment processes.

IX. Color, Flavor, or Texture Changes:

- **Undesirable Changes:** Alterations in the color, flavor, or texture of the product beyond acceptable limits.

X. Microbial Testing Results:

- **Presence of Pathogens:** Testing indicating the presence of harmful microorganisms after heat treatment.

XI. PH Deviation:

- **pH Fluctuations:** Variations in pH levels that may affect the stability and safety of the product.

6.3 Maintaining quality specification

- **Specifications in fruit and vegetable processing**

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 In Standards

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

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.

6.4 Following standard operating procedure

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.

Procedures for Standard Operating Procedures (SOPs

- Train school nutrition employees on using the procedures in this SOP. Refer to the Using and Calibrating Thermometers SOP.
- Follow state or local health department requirements.
- 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.
- 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
- 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
- Reheat all foods rapidly. The total time the temperature of the food is between 41ºF and 165ºF may not exceed 2 hours.
- Serve reheated food immediately or transfer to an appropriate hot holding unit

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:

- Temperature and time;
- Acidity of the products;
- Air remaining in containers.

6.5 Reporting standard forms and work place procedure

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-6	Written Test

Name…… ID…… Date…….

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

Test I: Choose the best answer

1.Controlling process inputs and operations in terms of

A. Correct temperature B. Pressure C. Water activity D. All

2.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

3.Record operational activities

A. Identify information and data that needs to be reported

B. Identify the method of recording information and data

C. Record information and data you have collected

D. All

Test II: Short Answer Questions

1.list out Record operational activities?

2.What is specification**?**

3.What is maintaining quality specification?

4.What are Standard Operating Procedures (SOPs)?

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Web address

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