TVET CERTIFICATE III in FOOD PROCESSING

Fruit sugar preserves processing technology

FOPFS302

Make fruit sugar preserves

Competence

Credits: 8

Learning hours: 80hours

Sector: Agriculture and Food Processing

Sub-sector: Food Processing

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Purpose statement

This module is intended for a trainee in Level 3 TVET, Certificate III, where trainee acquires Skills, knowledge and attitudes required to make jam, jellies, marmalade and Fruit paste. This Module covers the skills, knowledge and attitude required to properly make Jam/jellies/marmalade/fruit paste in the food processing industry. This module will Cover both jam, jellies and marmalade that are highly needed to the market both national and International levels. It will also focus on preparing raw materials mainly fruits, process Jam/jellies/marmalade/fruit paste and package fruit preserves which will be helpful also for the farmers.

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INTRODUCTION

Fruits are generally high in fiber, water, sugars, mineral, enzymes and their regular consumption in sufficient amount could help in reduction of risk of cancer, cardiovascular diseases, stroke etc. They are also important sources of vitamin C, which is necessary in human diet for activating the antibodies and combat diseases in the body.

Different food products like jam, jelly, and marmalade and Fruit paste are prepared from raw edible fruits. Fruit jams, jellies, marmalades and Fruit paste are made by cooking fruits (pieces, pulps and/or juice) with sugars, gelling agents (usually pectin) and edible (usually organic) acids, and concentrating the mixture until a characteristic and suitable consistency is obtained.

Jam is a type of fruit spread product made from whole, cut or crushed fruit boiled with sugar and/or added pectin. They can be made from single fruits or a combination of fruits.

Jelly

Jelly is defined as the semisolid fruit product made from fruit juice. It should be clear and free from any residual parts of fruit and firm to hold its shape.

Marmalade is a fruit finished product made from the juice and peel of citrus fruits boiled with sugar and water. It can be produced from lemons, limes, grapefruits, mandarins, sweet oranges, bergamots and other citrus fruits, or any combination thereof. It looks like a jelly.

Fruit paste is a product obtained in the same way as special non-gelified fruit marmalade but with a lower water content about 25%TSS (Total Soluble Salt)

Learning Unit 1: Prepare the Raw Materials

Learning Outcome 1.1: Select raw materials

Topic 1/ Storage of fruits used in Jam, Jelly, marmalade and fruits paste making

Introduction

It is estimated that in the tropics each year between 25 and 40% of stored agricultural products is lost because of inadequate farm- and village-level storage. The product may be spoiled by infection from fungi, yeasts or bacteria In order to minimize the losses during storage it is important to know the optimum environmental conditions for storage of the product.

Many factors can lead to loss of quality in fresh produce, hence the common description of these products as 'perishable'. Some of these factors are part of the life cycle of living produce that is over-ripening of fruits. These many factors are **physiological factor, Biological factor, Mechanical factor and Environmental factor.** As a consequence, normal factors such as transpiration and respiration lead ultimately to water loss and senescence of the product. The growth of pathogens or physical damage will cause direct loss of product quality through their visual impact but both also stimulate senescence.

1. Physiological factor

Physiological disorders are adverse quality changes that occur in fresh produce because of metabolic disturbances. These disturbances can be caused by internal factors such as mineral imbalances or may be due to non-optimal environmental factors such as inappropriate storage temperatures or atmosphere composition.

Physiological disorders refer to the breakdown of tissue that is not caused by either invasion by pathogens (disease-causing organism) or by mechanical damage.

a) Respiration

Fruits respiration is process by which fruits cells obtain chemical energy by consumption of oxygen and release of carbon dioxide, respiration uses stored carbohydrate (starch or sugar) and will stop when reserves of these are exhausted; ageing follows and the produce dies and decays. Fresh produce cannot replace carbohydrates or water after harvest.

Formula of respiration

$C_6H_{12}O_6 + O_2 \rightarrow H_20 + CO_2 +$ Energy (ATP)

- **Influencing respiration rate of fruits**

a. Temperature: the chemical reaction goes faster at a higher temperature though, when the temperature is too hot, enzymes will break down and respiration will stop**.**

b. Oxygen concentration: the reaction need oxygen, so if there is no oxygen, no respiration occurs. In general, less oxygen lead to a slower reaction rate**.**

c. CO2 Concentration: The influences of CO2 concentration depend strongly on the fruits or vegetables. Some might increase in respiration, whereas with others more CO2 might lead to slower reactions.

d. Stress in fruits and vegetables

Fruits and Vegetables can be stressed, for instance if they are cut/ or damage

e. Ripening: some fruits and vegetables continue to ripe after they have been harvested. During ripening the respiration rate might increase or decrease, depending on the product, this can also be linked with ethylene concentration.

b) Transpiration or the loss of water

Fruits transpiration is process of fruits loss of water through pores its evaporation from aerial parts, the pores on the fruits surfaces can open or close with changing atmospheric conditions to give a controlled rate of loss of water. Most fresh fruits produce contains from 65 to 95 percent water when harvested. Fresh fruits produce continues to lose water after harvest, but unlike the growing plant it can no longer replace lost water from the soil and so must use up its water content remaining at harvest. This loss of water from fresh produce after harvest is a serious problem, causing shrinkage and loss of weight.

c) Ethylene: (C_2 H_4)

Ethylene is a plant hormone that plays a key role in the ripening and senescence of fruits and vegetables. Mature but unripe fruits are placed in well ventilated rooms and exposed to

ethylene with acetylene. All plant cells produce low levels of ethylene; however, anything that causes stress to the plant tissues will stimulate ethylene synthesis. Stressors may include excessive water loss, physical damage or pathogenic attack. Climacteric fruits produce high levels of ethylene during initiation of ripening and the hormone is believed to stimulate and coordinate the physiological and biochemical changes which occur during ripening. Exposure to exogenous ethylene can lead to an acceleration of maturation and senescence while Carbon dioxide and temperature over 30^{o} C inhibit ethylene action.

d) Senescence

Senescence is the natural ageing of the plant tissues and is stimulated by the presence of ethylene and anything else that speeds up respiration rates. Senescence ultimately affects all aspects of quality, ending in the death of the product. Some senescence changes can specifically affect certain types of fresh produce processing, for example, changes to the chemical and physical structure of the cell wall.

2. Biological factor

Biological factors for fruits deterioration are microorganisms (bacteria fungi, viruses etc) and macroorganisms (insects, pests, rodent etc...) that can cause damage fruits or fruits deterioration.

3. Mechanical factor

Mechanic damage (Physical injury) is careless handling of fresh produce (fruits) cause internal bruising which results in abnormal physiological damage. Injury also allows water loss which compromises the quality of the fresh produce. Furthermore, physical injury stimulates ethylene production in fruits tissues, which can lead to premature yellowing or ripening of commodities

4. Environmental factor

Environmental factor is any factors abiotic or biotic that influence living organisms

Abiotic factors: it is factors which include physical condition and non- living resources that affect living organism in terms of growth, maintenance and reproduction. Examples: temperature, light, humidity, atmosphere, water and soil.

Biotic factors: it is factors which can be described as any living component that affect another organism or ecosystem. Examples: animals, trees bacteria, mould,...

a) Temperature

Temperature is physical quantity expressing hot and cold. The chemical reaction goes faster at a higher temperature until optimum temperature is reached, after which it decease due to break down enzyme and respiration will stop. Since fruits, vegetables, and flowers are alive after harvest, all physiological processes continue after harvest such as respiration and transpiration (water loss), and supply of nutrient and water is not possible since produce is no more attached to the parent plant. Respiration results in produce deterioration, including loss of nutritional value, changes in texture and flavor, and loss of weight by transpiration.

Lower temperatures slow respiration rates and the ripening and senescence processes, which prolongs the storage life of fruits and vegetables. Low temperatures also slow the growth of pathogenic fungi which cause spoilage of fruits and vegetables in storage.

b) Relative Humidity

The relative humidity of the air, expressed in percentage, is defined as the relationship between the weight of the water vapour contained in 1 kg of air and the weight of the water vapour contained in 1 kg of saturated air, at a given temperature:

$$\mathrm{RH\%} = \frac{\text{Weight of water vapour in 1 kg of air}}{\text{Weight of water vapour in 1 kg of saturated air}} \times 100$$

when: RH% = relative humidity of the air (in %).

Transpiration rates (water loss from produce) are determined by the moisture content of the air, which is usually expressed as relative humidity. At high relative humidity, produce maintains salable weight, appearance, nutritional quality and flavor, while wilting, softening and juiciness are reduced. Low relative humidity increase transpiration rates.

Measures to control RH

- ✓ Operating a humidifier in the storage area.
- ✓ Regulating air movement and ventilation in relation to storage room load.
- ✓ Maintaining refrigeration coil temperature within 2°F of the storage room air temperature.
- ✓ Wetting the storage room floor

Topic 2/Factor involves for controlling fruits deterioration

a) Precooling

Precooling is done to remove field heat of harvested produce, which is detrimental to keeping quality of fruits and vegetables and it is done to retard the ripening and senescence processes.

b) Air –cooling or Room cooling

The use of refrigerator air as precooling medium is widely used for precooling packed fruits, but the system is not widely used for vegetables. Pre-cooling with air can be accomplished in a conventional cold storage room, a special pre-cooling are funnel cooler, or forced air cooler. Cooling with air requires a longer time than cooling with water or vacuum.

Air cooling is done by placing the fruits in the cold room. Fruits are placed in well ventilated containers in order to achieve some air exchange.

c) Hydrocooling

The hydro-cooling is an old and effective pre-cooling method for fruits. Fruits are dipped in cold water or spray the cold water on the fruits. Some chemicals are also mixed with water in hydrocooling to prevent the shade and disease.

Cooling with cold water is rapid and effective method of pre-cooling used for cooling a wide range of fruits and vegetables in bulk before packing. Water is better than air at transmitting heat. This method is commonly used for stem vegetables, many leafy vegetables and some fruits like tomatoes and melons. Some crops cannot be cooled in this way, for example strawberry, because free water on the surface greatly increases the risk of disease. Proper sanitation (usually by chlorination) of the water is required to prevent the build-up of bacteria in the water and subsequent contamination of the produce.

d) Icing

Crushed or liquid icing may be used on a variety of fresh produce; icing is particularly effective for perishable items that cannot be readly cooled by others methods. Top icing a truck loaded with already cooled produce is good way to provide additional assurance that the load will arrive properly cooled. However, icing in any form is not recommended for all types of fresh fruits and vegetables. Some items like straw berries, blues berries...cannot tolerate wetting, others items, such as squash and tomatoes, can be injured by chilling to near freezing, some produce items that can be successfully iced.

e) Vacuum cooling

Leafy vegetables are commonly cooled by reducing atmospheric pressure in artificial hermitically sealed chambers. Reducing atmosphere pressure also reduces the pressure or water vapour in the chamber and thus cooling is affected.

It is one of the most rapid and a uniform method of cooling is vacuum cooling. This is most efficient with produce that has a large surface area to volume like leafy crops such as lettuce, spinach and cabbage

f) Surface coatings and wraps

Many fruits and vegetables benefit from a surface coating which can slow down the loss of water this is particularly true for crops which are washed, because hot water or the inclusion of detergents can remove natural waxes from the fruit surface. Coatings can also reduce the movement of O2 and CO2 in and out of the fruit, respectively. This internal atmosphere modification can slow down respiration; however, the layer must not be too thick or O2 levels may fall too low and lead to fermentation problems. Many of the coatings applied are derived from plant extracts, for example sugar cane waxes or polymers of sugar esters; however, petroleum-based products such as paraffin wax may be added to improve water loss control.

i) Control of humidity

Humidity: is the amount of water vapour present in the air. Water vapour is the gaseous states of water and invisible to the human eye. Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of fruits transpiration in cooling fruits by the reducing the rate of evaporation of moisture in fruits surface.

j) Controlled Atmosphere Storage

Controlled atmosphere (CA) storage involves altering and maintaining an atmospheric composition that is different from air composition (about 78% N_2, 21% O_2, and 0.03% CO_2); generally, O_2 below 8% and CO_2 above 1% are used.

Some Beneficial Effects of CA (optimum composition for the commodity):

i. Retardation of senescence (including ripening) and associated biochemical and physiological changes, ie., slowing down rates of respiration, ethylene production, softening, and compositional changes.

ii. Reduction of sensitivity to ethylene action at O_2 levels < 8% and/or CO_2 levels > 1%.

iii. Alleviation of certain physiological disorders such as chilling injury of avocado and some storage disorders, including scald, of apples.

g) Control of ethylene

The presence of ethylene can stimulate senescence and give rise to a number of disorders.

Good store management is needed to ensure that ripening fruit is not stored together with unripe fruit or other produce which is sensitive to ethylene. Exhaust gases from vehicles contain ethylene and must be kept well apart from produce stores. For fruits and vegetables which only produce low levels of ethylene, adequate ventilation from a clean air source is usually sufficient to keep ethylene at safe levels. Where ventilation is not sufficient to manage ethylene levels, ethylene can be destroyed by oxidation. Store air can be passed over the oxidizing compound, potassium permanganate held on an inert substrate. Alternatively, ultraviolet (UV) light is in use commercially to destroy ethylene.

Briefly Measures to control effects of Ethylene:

- ✓ Eliminate sources of ethylene
- ✓ Ventilation one air charge per hour
- ✓ Inhibiting ethylene effects by Control atmosphere Storage, low oxygen or high carbon dioxide
- ✓ Chemical removal-activated charcoal, potassium permanganate, UV lamps, etc.

Storage conditions of some fruits used in Jam, Jelly, marmalade and fruits paste making

Product	Optimum storage $T^{o0}F$	Optimum humidity	Ethylene production	Sensitive to ethylene	Storage time
Apples	30-40 ^{0}F	90-95	high	yes	1-12month
Banana green	62-70 ^{0}F	85-95	low	yes	
Banana ripe	56-60^{0}F	85-95	Medium	no	1 week
Grapes fruits	55-60 ^{0}F	90-95	Very low	no	
Guava	45-50 ^{0}F	90-95	Medium	yes	2 weeks
Lemons	52-55 ^{0}F	90-95	Very low	no	1-4 months
Mangoes	50-55 ^{0}F	85-95	Medium	yes	
Oranges	40-45 ^{0}F	90-95	Very low	no	6month
Papaya	50-55 ^{0}F	85-95	Medium	yes	1-2weeks
Pineapples	50-55 ^{0}F	85-95	Very low	no	3-4weeks
Straw berries	32 ^{0}F	90-95	Very low	no	3-7 days
Passion fruits	41.6-44.6 ^{0}F				4-5 weeks

Topic3/ Selection of raw materials

The selection of raw material basing mainly on Characteristics of good fruits for jam, jelly, marmalade and fruits paste making include:

Appearance

Appearance is the key factor for consumers in making purchases of fresh produce. As the multiple retail sectors has come to dominate food retailing in many countries, consumers have come to expect fresh produce to have near perfect visual appearance. Displays of fruits and vegetables are characterised by uniformity of size, shape and colour. Vital components of visual quality include colour and colour uniformity, glossiness, and absence of defects in shape or skin finish and free from disease, Many fruits and vegetables undergo colour changes as part of the ripening process. Unripe fruit is usually green (the so-called 'ground colour')

and in many types of fruit, the green colour becomes lighter during ripening and maturation owing to breakdown of chlorophyll, for example in apples, grapes, papaya

Texture

Quality characteristics of fruits include a complex of textural properties which are not readily defined or measure.

Degree of softening is required for optimal quality in fruit, over softening is undesirable and is a sign of senescence or internal decay. The maintenance of textural quality is often critical in certain types of processing, for example in canning and freezing.

Flavour and aroma

Flavour is a complex of taste and aromatic components. Total flavour can rarely be assessed by the consumer prior to purchase but it is critical in the repeat purchase of a particular product or product cultivar. Key taste components in fresh produce are sweetness, acidity, astringency and bitterness. Sweetness of some fruits may increase dramatically during ripening owing to starch, to sugar conversions, for example in apples, bananas, mangoes and pears. Sugar levels of fruits are often measured to determine whether produce has reached the required ripeness for marketing.

Sugar levels do not usually fall significantly during storage; however, maintaining the sugar to acid balance can be important to the fruit flavour balance, for example, in citrus species and grapes.

Acid levels generally decrease during storage. If the acid/sugar ratio falls too low, the product can become bland and lose acceptable eating quality. This will also be of importance in processed products in which extra sugars or acids are not added. Bitter components can develop in various fruits and vegetables under certain storage conditions

Maturity index

Post-harvest physiologists distinguish three stages in the life span of fruits: maturation, ripening, and senescence. **Maturation** is indicative of the fruit being ready for harvest, At this points, the edible part of the fruit is fully developed in size, although it may not be ready for immediate consumption. **Ripening** follows or overlaps maturation, rendering the produce

edible, as indicated by taste. **Senescence** is the last stage, characterized by natural degradation of the fruit or vegetable, as in loss of texture, flavour, etc.

Skin Color

This factor is commonly applied to fruits, since skin colour changes as fruit ripens or matures. Some fruits exhibit no perceptible colour change during maturation, depending on the type of fruit or vegetable.

Shape

The shape of fruit can change during maturation and can be' used as a characteristic to determine harvest maturity. For instance, a banana becomes more rounded in cross sections and less angular as it develops on the plant. Mangoes also change shape during maturation

Size

Changes in the size of a crop while growing are frequently used to determine the time of harvest. For bananas, the width of individual fingers can be used to determine harvest maturity.

Aroma

Most fruits synthesize volatile chemicals as they ripen. Such chemicals give fruit its characteristic odor and can be used to determine whether it is ripe or not. These odors may only be detectable by humans when a fruit is completely ripe

Abscission

As part of the natural development of a fruit an abscission layer is formed in the pedicel. For example, in cantaloupe melons, harvesting before the abscission layer is fully developed results in inferior flavoured fruit, compared to those left on the vine for the full period.

Firmness

A fruit may change in texture during maturation, especially during ripening when it may become rapidly softer. Excessive loss of moisture may also affect the texture of crops. These textural changes are detected by touch, and the harvester may simply be able to gently squeeze the fruit and judge whether the crop can be harvested.

Juice Content

The juice content of many fruits increases as the fruit matures on the tree. To measure the juice content of a fruit, a representative sample of fruit is taken and then the juice extracted in a standard and specified manner. The juice volume is related to the original mass of juice, which is proportional to its maturity.

Sugars

In climacteric fruits, carbohydrates accumulate during maturation in the form of starch. As the fruit ripens, starch is broken down into sugar. In non-climacteric fruits, sugar tends to accumulate during maturation. A quick method to measure the amount of sugar present in fruits is with a brix hydrometer or a refractometer.

Acidity

In many fruits, the acidity changes during maturation and ripening, and in the case of citrus and other fruits, acidity reduces progressively as the fruit matures on the tree.

Specific Gravity

Specific gravity is the relative gravity, or weight of solids or liquids, compared to pure distilled water at 62°P (16.7°C), which is considered unity. Specific gravity is obtained by comparing the weights of equal bulks of other bodies with the weight of water.

Topic 4/ Sorting and grading

Fruit sorting covers two main separate processing operations:

(1) Removal of damaged fruit and any foreign substance; and

(2) Qualitative sorting based on organoleptic criteria and maturity stage.

The most important initial sorting is performed for variety and maturity. However, for some fruits and in special processing technologies, it is advisable to carry out a manual dimensional sorting (grading). Sorting may be performed by different ways, such as those listed in Table below.

Fruits sorting methods

Sorting method	Description
By size	Rollers (cherries), diverging belts, reels with holes
By weight	Fruits sorters are used to differentiate fruits grades based on individual fruits weight
By texture	To measure firmness or hardness of fruits system
By color	color sorter or chat are used to measure green to yellow ratio (depending on ripening colour of fruits)

Sorting Criteria:

Ripening, free of diseases, free of mechanical damage, maturity index, size, shape and color

Grading

This is probably the most important. It consists of sorting product in grades or categories of quality. Two main systems exist: static and dynamic.

Static systems, the product is placed on an inspection table where sorters remove units which do not meet the requirements for the grade or quality category.

Dynamic system; here product moves along a belt in front of the sorters who remove units with defects. Main flow is the highest quality grade.

Grading criteria:

Density

Size

Ratios of ingredients

Ratio of ingredients amount of each ingredient in proportion to other ingredients and it varies from brand to brand or company to company.

Learning Outcome 1.2 Accurate weighing of raw materials

Topic1/Weigh the raw materials

Accurately weighing of ingredients is done according to the recipe. The recipe is prepared according to the type of fruit used. It is done by using electronic or mechanical balance.

Types of weighing scales

Electronic balance

Mechanical balance

Reasons for weighing fruits:

Price setting

Payment of farmer

Calculating cost

Learning Outcome 1.3: Wash the fruits

Washing fruits not only helps remove dirt, bacteria, and stubborn garden pests, but it also helps remove residual pesticides. Under running water, rub fruits quickly with your hands to remove dirt and surface microorganisms.

Topic1/Purpose of washing

The harvested fruit is washed to remove soil, microorganisms, and pesticide residues. Spoiled fruits should be discarded before washing in order to avoid contaminating the washing tools and/or equipment and the contamination of other fruits during washing. Washing efficiency can be estimated by the total number of microorganisms present on fruit surface before and after washing.

Topic2/Washing techniques according to the types of fruits

Fruits require heavy spray applications and rotary brush wash to remove any rot. Many fruits such as mechanically harvested berries are air cleaned on mesh conveyors or vibrators passing over an air jet. Washers are conveyor belts or roller conveyors with water sprays, reel (cylinder) type with internal spray, brushes and/or rubber rolls with or without studs.

Vibratory-type washers are very effective for berries and small fruits. Brushes are effective in eliminating rotten portions of fruits, thus preventing problems with mycotoxins.

Topic3/The washing products

Some usual practices in fruit washing are:

- ✓ Addition of detergents or 1.5%-HCl solution in washing water to remove traces of insecticides and fungicides;
- ✓ Use of warm water (about 50^0C) in the prewashing phase;
- ✓ Higher water pressure in spray/shower washers.

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

Learning Unit 2: Process the Jam/ Jellies/ Marmalade/ Fruit Paste

Preparation and processing of fruit products is extremely important for maintaining the quality of finished product. Some common methods of preparing jam, jelly, marmalade and fruit paste from fruits are discussed here.

Topic1/Fruit jam making flowchart

Jam is prepared as per the standard protocol and modified as follow:

Collection of fruit

⇩

Washing

⇩

Extract fruit pulp

⇩

Boil and add sugar

⇩

Addition of pectin and citric acid

⇩

Judging the end point (70°B)

⇩

Packing in a sterilized jar

⇩

Cooling and storing

Topic2/Fruit Jelly making flowchart

The standard procedure follows the jelly production at the industrial level and it is modified as follow:

Collection of fruit

⇩

Washing

⇩

Extract the juice

⇩

Boil in a pot and add pectin

⇩

Addition of sugar

⇩

Addition of citric acid

⇩

Judging the end point (66°B)

⇩

Packing (filled the hot jelly into clean and dry sterilized jar)

Cooling

Storing

Topic 3/Fruit Marmalade making flowchart

Marmalade can be prepared as following procedure.

Collection of fruit

Washing

Peeling of the fruits

Chopping the peel

Juice separation from pulp

Boiling the juice, peel and pulp

Addition of sugar

Packing and storing

Topic4/The main steps in paste making are:

1. The procuring of suitable fruit

2. The separation of the pulpy portion of the fruit from the juice,seeds, and skins

3. The addition of the proper quantity of sweetening

4. The cooking of the paste until it is at the right degree of stiffness or concentration

5. The drying of the product

Learning Outcome 2.1: Peel and/or cut, coring and crush the fruits

Topic1/Techniques of peeling and/or cutting/coring

Peeling (skin removal): When required, fruits are usually peeled by removing skin. In general, loss increases with surface to volume ratio and decreases with fruit size. Mechanical methods are the worst, with up to 30% loss, while chemical (caustic) methods reduce loss to 10%.

Trimming: This is usually a manual operation that precedes cutting, in order to eliminate few defective pieces.

Cutting: Many special cutters are available, including sector cutters for apples, berry slicers, dicers, etc. it consists of reducing size of fruits.

Coring: is the removal of inner solid or stone like part of fruit

Peeling methods

Method	Description
Mechanical peeling	**By abrasion:** It is used in batch with rotating abrasive base and water wash. This method is inefficient, with excessive losses. **Abrasive roll peelers:** This is a continuous method that combines rolls and brushes. **Blade type:** The fruit rotates and mechanized knives separate the peel. **Live knife:** Incorporates hydraulic control of the knife pressure. Good for apples and pears.

Steam peeling	Pressure steam peeling makes the peel blow off with pressure drop coming out of peeling chamber. May be combined with dry caustic peeling system
Chemical peeling	Caustic peeling is extremely common. The simplest type involves immersion on a pocketed paddle wheel, with hot NaOH (20%), followed by scrubbing and washing. Tomatoes, peaches, and apples are peeled by this method. KOH is preferred because of its tissue penetration and disposal properties
Hot gas peeling	When hot gas contacts a vegetable on the belt or roller conveyor, the skin is blown off by the steam formed. It is generally not used in fruits
Freeze–thaw peeling	Fruit is frozen in a low temperature medium (40^0C) for few seconds and then warmed in water (40^0C). As a result of freezing the immediate subpeel cells are disrupted, releasing pectinases, which free the peel. Peeling loss is reduced to a minimum

Learning Outcome 2.2: Mixing the ingredients and cooking

Topic1/Ingredients used in jam/jelly/marmalade and fruit paste

Sugar

Water

Pectin

Citric acid

Potassium sorbate

Sodium benzoate

Sugar

Sugar helps in gel formation, serves as a preserving agent, and contributes to the flavor of the jellied product. It also has a firming effect on the fruit, a property that is useful in making jams. Sugar is a very important factor in determining the shelf life of preserved fruit products. Corn syrup, honey, other nutritive sugars, and low-calorie sweeteners may not be substituted one for one for sugar in recipes. If you wish to use these sweeteners, it is best to use recipes specifically designed for them.

Pectin

Pectin jellies and jams are recognizable because they are thick and gelatinous. This state is reached by a combination of fruit with three ingredients: pectin, acid and sugar. Most fruit jellies and jams contain about one percent pectin. It is naturally occurring and found in many fruits, some containing enough natural pectin to make finished product. Many others require added pectin, especially when making jelly. Pectin are complex chemicals whose jelling ability is standardized in products made for use in jelly and jam. However, the ability of these products to jell is gradually lost if stored too long before use, or if the mix is heated too long before it is filled into jars. The amount of pectin recommended may vary from brand to brand. Unused pectin should be stored in a cool, dry place so they will keep their gel strength. Most pectin only work when using a large amount of sugar although some low sugar varieties of pectin are available. They are designed for use with one-third less sugar than the standard pectin. Other pectin will jell without any sugar.

Acid

Cooked fruit products made with pectin have a pH between 3.0 and 3.3. Below 3.0, the jelly weeps or forms droplets of water on its surface. If above 3.3 pH, the jelly will be weak and increasingly runny. Acid is needed for flavor and for gel formation by increasing acidity. The acid content varies in fruits and is higher in under ripe fruits. Nearly all fruits need added acid. Commercial pectin products also contain acids. **Citric acid** is mainly used.

Antimicrobial growth

Sodium benzoate and potassium sorbate are used to inhibit growth of microorganisms and increasing shelf life.

Topic2/Mixing techniques (maceration)

One of favorite tricks used is macerating the fruit first. Macerating is the process of coating the fruit in sugar and letting it rest for a few hours or overnight, which pulls some of the juice out of the fruit and creates syrup with the sugar. Macerated fruit starts to break down and meld with the sugar, so the jam is already on its way before even put it over heat.

Topic3/Cooking

Cooking parameters

Temperature

Time

Sugar concentration

Viscosity

Cooking aims at evaporating the required water quantity, to facilitate the formation of pectin-sugar-acid gel and partially invert sugar (about 40% from total sugar).The boiling operation can be carried out in open kettles or in evaporators under vacuum. Boiling at atmospheric pressure affects not only the appearance but also the nutritional value of the products.

- **Cooking techniques**

Pour the batch into a stainless steel boiling pan and heat as quickly as possible with constant stirring to prevent the product burning onto the pan. It is important to use stainless steel to prevent the acids in the preserve reacting with the pan and causing off-flavours. For jam, the mixture is boiled until the sugar content reaches 68%. A sugar thermometer (68% sugar corresponds to a jam temperature of 129°C).

Topic 4 Jam

Cooking should be done rapidly, as quick cooking improves both the flavor and colour of the jam. Cooking time for jam is 5-15 mins, depending on fruit type. The cooked jam is cooled to 90^{o}C or 60-70^{o}C, respectively and depending on the pectin quality and depending on the type of packaging material, filled into package with a screw or piston loader.

Topic5/Jelly

Fruit jelly is bright and transparent. A good jelly gelatinizes on cooling and is firm enough to hold the shape of the container. It must be soft enough to quiver upon shaking, but must not flow. It must be clear, shiny and transparent and should retain the flavor of the fruits.

Jelly is strictly defined as a semisolid food, made from not less than 45parts by weight of fruit juice ingredient and 55 parts by weight of sugar. This mixture is concentrated to not less 66%

soluble solids. Three substances are essential for the preparation of normal fruit jelly: pectin, acid and sugar.

Jellies are usually manufactured from juice obtained from a single fruit species only. It is made by a similar process to that used for making jam, with the additional steps of adding extra liquid and filtering out the fruit pulp after the initial cooking.

Technology of fruit jellies

Technological flow-sheet for jellies manufacturing covers two categories of operations: those to obtain gelifying juices and those related to the manufacturing of jelly itself.

a) Production of gelifying juices:

Sorting, washing, cutting, juice separation and clarification are carried out in usual conditions;

b) Manufacturing of jellies

BASIC RECIPE SETTING is done starting with equal parts in weight of sugar and juice (for example 1000 g juice and 1000 g sugar). As final jelly has to contain about 60% added sugar, weight of finished product must be of about 1600 g, by evaporation of about 400 g water.

BOILING is carried out as following: juice is boiled up to removal of about half of the water that has to be evaporated, then the calculated sugar quantity is added gradually; the remainder of the water is evaporated until a concentration in soluble substances (refractometric extract) of 65-67% is reached, in which is incorporated also the sugar from juice.

During boiling it is necessary to remove foam / scum formed. Product acidity must be brought to about 1% (malic acid) corresponding to pH > 3. Any acid addition is performed always at the end of boiling.

For juices rich in pectin, gelification will occur without pectin addition. If at the trial boiling test the gelification has not occurred, because of pectin absence, in this case 1-2% powder pectin will be added by operating as indicated: pectin is mixed with 10-20 fold sugar quantity and is introduced directly in the partially evaporated juice and then boiling is conducted

rapidly up to final point. Evaluation of final point is done not only by refractometry but also by gelifying test.

A rapid test for evaluation of juice pectin content is possible by mixing a small sample of juice with an equal volume of 96% alcohol; the apparition of a compact gelatinous precipitate indicates sufficient pectin content for gelification.

Boiling of jellies is performed in small batches (25-75 kg) in order to avoid excessively long boiling time which brings about pectin degradation.

COOLING is optional and is carried out up to 85 deg. C, in double wall baths with water circulation.

FILLING is performed at a temperature not below 85 deg. C in receptacles (glass jars, etc.), which must be maintained still about 24 hours to allow cooling and product gelification.

Topic 6/Marmalade

Marmalade is a semisolid or gel –like product prepared from fruit ingredients together with one or more sweetening ingredients and may contains suitable acids and food pectin, the ingredients are concentrated by cooking to such a point that the TSS of the finished marmalade is not below 65%.Unlike jam, a large quantity of water and citrus peel are added to the fruit in marmalade, the extra liquid being set by the high-pectin content of the fruit. In this respect it is like a jelly, but whereas the fruit pulp and peel is strained out of a jelly to give it its characteristic clarity, it is retained in marmalade.

Grading of marmalades

Three categories can be defined:

- fine marmalade, manufactured from one fruit;
- superior marmalade, obtained from a mix of fruit in which 30% are "noble" species (cherries, strawberries, apricots, etc.) and 70% from other species;

- marmalade from fruit mixes; apples, pears, plums, quinces, ungrafted apricots and wax cherries may be used, with the optional addition of "superior" fruit which was rejected at sorting but which was sound.

The content in total soluble substances (refractometric extract) of marmalades must be 64% minimum; the acidity must be between 0.5% and 1.8% expressed as malic acid.

BASIC RECIPE SETTING

For a normal composition - marmalade without pectin addition the following is a basic recipe:

100 kg semi-processed fruit product

(10% refractometric extract) …… 10 kg soluble substances

55 kg sugar …….. 55 kg soluble substances

155 kg 65 kg soluble substances

55 kg water to be evaporated

100 kg marmalade with 65% refractometric extract

This marmalade satisfies many standards and at same time has a good shelf-life since it contains less than 35% water. Semi-processed fruit products must have a minimum 8% refractometric extract; in this case the recipe should use 125 kg of raw material, with 80 kg water to be evaporate.

The use of semi-processed fruit products with a low refractometric extract presents the following drawbacks:

a. higher water quantity to be evaporated;
b. longer boiling times with negative impact of pectin degradation;
c. loss of flavour and
d. lower equipment efficiency.

Pectin addition in marmalade manufacture produces the following advantages:

a. improvement of gelification,
b. economy in fruit;
c. shorter boiling time; this maintains taste and flavour and produces higher equipment efficiency.

Pectin addition makes it possible to obtain the "fine" type of marmalade from "noble" fruits which do not contain enough pectin (cherries, peaches, apricots, etc.). In marmalades from fruit mixes, low pectin content can be compensated by addition of semi-processed fruit products which are rich in this component (for example apples).

When pectin is to be added, the above recipe should be modified as follows:

80 kg semi-processed fruit product

(10% refractometric extract) …… 8 kg soluble substances

55 kg sugar …… 55 kg soluble substances

10 kg pectic extract (10 % R.E.) ……. 1 kg soluble substances

145 kg 64 kg soluble substances

45 kg water to be evaporated

100 kg marmalade with 64% refractometric extract

Pectin can be added as pectic extract with about 10% refractometric extract (R.E.) in the recommended proportion or in the form of a powder considered with 100% dry matter (e.g. 100% soluble substances) in a quantity of about 1%.

The technological flow for marmalade production is the following: fresh fruit after sorting on control belt (1) is washed in a washing machine (2) is brought to the continuous boiling equipment (3) then to the pulper (4); the semi-finished mark is passed on to the storage tank

(6). Pulps are boiled and desulphited in continuous boiling equipment (3), then are brought to pulper (4) and to the storage tank (6).

BOILING aims at evaporating the required water quantity, to facilitate the formation of pectin-sugar-acid gel and to partially invert sugar (about 40% from total sugar). The boiling operation can be carried out in open kettles or in evaporators under vacuum.

In the latter case, the warm "mark" from storage tank (6) is aspirated in a concentrator (7) in a vacuum and submitted to a partial boiling up to removal of half of water quantity which needs to be evaporated; the calculated sugar quantity is then added by aspiration, keeping the boiling on.

After this the pectin extract or powder pectin which has previously been dissolved in warm water, is added; when the final concentration is reached, as indicated by refractometric control, the required quantity of acid is added. Sugar is added in proportion of 55% in finished product, pectic extract (10% refractometric extract) at a level of about 10-15% and the acid (citric, tartaric, lactic) in a quantity needed to obtain a finished product acidity of about 1%.

Boiling at atmospheric pressure affects not only the appearance but also the nutritional value of the products, mainly if these contain proteins, as some albuminoids coagulate even at 60°C.

Food products for which flavour is an essential property as for example fruit juices, etc., are also affected by the action of heat. Heat treatment has an impact on vitamin losses, mainly of vitamin C, in the presence of oxygen as is the case at concentration in open vessels.

Sugars are generally less damaged by heat at temperatures below 100° C; as the boiling point is increasing above 100° C, a risk of partial sugar caramelization exists.

The length of the heating period also has a major influence because in many cases it is preferable to concentrate the liquid at a relatively high temperature in a short time avoiding the drawbacks of lower temperatures acting during a long time.

In order to maintain the food value and organoleptic properties, it is necessary that concentration take place at a low temperature which can be achieved by concentration under partial vacuum, taking into account that boiling point decreases when the residual pressure decreases, respectively with the increase of vacuum degree.

Advantage of concentration under partial vacuum are the following:

- lowering of boiling point;
- the total time needed for concentration of food products under a residual pressure of about 200 mm Hg is about half as compared to the that of concentration by boiling at atmospheric pressure;
- by lowering the concentration temperature and time, organoleptic properties and of nutritional value are maintained better particularly as far as the vitamins are concerned;
- when products are concentrated in a vacuum, it is possible to recover volatile aromatic substances by using adequate installations.

Technical procedures of concentration by vaporisation can be classified in:

a) concentration at atmospheric pressure: continuous or discontinuous;

b) concentration under partial vacuum: discontinuous (in vacuum equipment with simple or multiple effect) or continuous (in vacuum installations with continuous action or in thin film vaporisation installations).

Even if open kettle equipment is less expensive than evaporators in a vacuum, it is necessary to take into account that boiling under vacuum has the following advantages:

a) low boiling temperature (60-70° C), depending the degree of the vacuum; this give the fruit better taste and flavour-keeping qualities;

b) easy feeding with raw and auxiliary materials;

c) shorter boiling time;

d) better working conditions (vapour elimination in condensed water and not in open air).

There are small size evaporators under vacuum which can be well suited to the needs of medium size operations in developing countries.

COOLING of marmalade to about 50-60°C can even be done in a vacuum evaporator by closing the heating steam and maintaining vacuum degree or by discharge in storage tanks (8).

FILLING in receptacles (boxes, jars, glasses, etc.) is done preferably with filling machines (9) followed by labelling(10). Small packages can be closed warm or after complete cooling; big packages (boxes, etc.) must be closed only after cooling, e.g. 24 hours after processing.

STORAGE of marmalade must be done in dry rooms (air relative humidity at about 75%), well ventilated, medium cool places (temperature 10-20 degrees C), disinfected and away from direct sunlight and heat. These measures are necessary because marmalade is a hydroscopic product and, by water absorption, favourable conditions for mould development are created.

Topic7/Fruit paste

Fruit paste is a product obtained in the same way as a special non-gelified fruit marmalade but with a lower water content about 25%TSS (Total Soluble Salt)

Lowering water content could be achieved by continuing boiling of the product or by drying the product by natural or artificial drying.

A typical example of fruit paste without sugar added is the apricot paste - "pistil", etc. which is a concentrated special non gelified fruit marmalade poured in thin layers and sun dried.

An example of fruit paste with sugar added is quince paste which is a marmalade concentrated by evaporation. Sugar content must be 65%; soluble substances content, 7075 % refractometric extract and acidity at least 0.5% expressed as malic acid. Packing is done usually in polyethylene sheets and then in boxes or tins; storage conditions are similar to those for marmalade.

Making fruit pastes.

To make fruit pastes, simmer the fruit in a small amount of water, then puree and de-seed (if required). Then simmer the fruit mixture with the sugar and spices over a long period (often 1-3 hours) until as thick as possible. The higher the water content of the fruit, the longer it will take to reduce, and a higher pectin fruit will thicken quicker than those naturally lower in pectin (such as berries). Adding a green apple or two will boost the pectin content and help the fruit paste to thicken. If using low acid fruit such as berries, add some lemon juice for extra acidity.

Storing fruit pastes.

- Water bath canning

If fruit paste is too thick, add a little bit of fruit juice and heat though fruit paste until hot. Pack hot fruit paste into hot glass jars and process in a water bath canner for 15 minutes. Once cooled overnight, store your jars of fruit paste in a cool, dark and dry place for 12 months or more. Use wide-mouth jars if you wish to remove the fruit paste from the jar before serving.

- Oven-dry and refrigerate

Spread fruit paste onto a lined oven tray. Dry on low heat in the oven to your liking, then cool. Cut fruit paste, wrap tightly in plastic wrap (or store in containers) and keep in the refrigerator or freezer.

Learning Outcome 2.3 Conditioning of jam/jellies/marmalade/fruit paste

Topic 1/Addition of sugar

The methods employed vary considerably, sometimes the fruit is boiled a long time and slowly, and the sugar added towards the end of the process but more frequently the sugar is boiled first with little water, and the fruit added afterwards

Cane sugar in proportion of 45:55 (fruits part: sugar) is added during boiling. Finished jam should contain 30-50%ofinvert sugar or glucose to avoid crystallization of cane sugar during storage.

Topic 2/Addition of pectin and acid

Jam sare solid gel made of fruit pulp or juice, sugar and added pectin. It recommended value is 68^{o} Brix. The pH value of the jam should be adjusted to a value of 2.8-3.2 by adding citric acid. The pectin and citric acid to be added is generally about 0.3%-0.5% depending on the original pectin and acid content of the fruit.

Topic 3/Addition of preservatives

Sodium benzoate and potassium sorbate are the preferred forms given greater solubility of the salts. Both function best below pH 4.0. U.S. Federal regulations limit benzoates to 0.1 percent and they are most effective against yeast and mould. Building on the hurdle principle, antimicrobials can effectively extend shelf life.

Topic 4/Addition of colours and essences

These are added towards the end of boiling/products preparation. Colour should be dissolved in minimum quantity of water and poured drop wise over the almost finished Jam with constant stirring.

Topic 5/End point determination

Although the end point can be judged easily with the increase in experience, but for the beginners the following methods can used

Drop test:

This method can be used where no facility for any types of measurement is available.

A small quantity of product is taken in a spoon during cooking and is allowed to air cool for some time. One drop of the air cooled jam is put into a glass of water.

If the drop settles at bottom of the glass without disintegration, the product is ready . If it disintegrates and splits apart, it may be cooked for some more time.

Weighing test:

At the end point, the weight of the jam is about 1.5times the weight of the added sugar. For using this method, the weight of the boiling pan and sugar are to be noted down before

starting cooking. The boiling mixture is weighed along with the pan for determination of end point.

Learning Outcome 2.4 Control the quality

The correct sugar content is critical for proper gel formation, repeated checks with a refractometer or thermometer are needed to make sure that the sugar level reaches 68% (otherwise mould will grow on the product or a gel will not form), 68% sugar is not exceeded by a large amount (otherwise the product will crystallise).
The sugar concentration increases rapidly at the end of boiling and particular care is needed.

Topic1/Standards of the jam, jelly, marmalade and fruit paste

Fruit preserves that are not prepared with the correct sugar content and thoroughly cooked can allow harmful microbes to grow.
Containers and lids that are not adequately cleaned and sterilized can carry harmful microbes.
Fruit preserves that are not prepared properly can contain foreign objects that could injure people.
Damaged packaging (eg cracked or chipped jars) can injure people
Testing methods (organoleptic, physic-chemical properties of the products)

Temperature Test

Take the temperature of the jelly with a candy or jelly thermometer. When done, the temperature of the jelly should be 220°F, 8°F above the boiling point of water, if you are at sea level.

Spoon or sheet test

Dip a cool metal spoon into the boiling jelly mixture and lift the spoon out of the steam so the syrup runs off the side. When the mixture first starts to boil, the drops will be light and syrupy. As the syrup continues to boil, the drops will become heavier and will drop off the spoon two at a time. When the two drops form together and "sheet" off the spoon, the jellying point has been reached.

Refrigerator/Freezer Test

Pour a small amount of boiling jelly on a plate, and put it in the freezing compartment of a refrigerator for a few minutes. If the mixture gels, it should be done. During this test, the rest of the jelly mixture should be removed from the heat.

Topic2/Jams and Jellies: Problems and Solutions

Problems	Causes	Prevention
Formation of sugar crystals	Excess sugar Undissolved sugar sticking to sides of kettle Mixture cooked too slowly or too long Mixture cooked too little	Follow recipe exactly. Wipe side of pan free of crystals with damp cloth before filling jars. Cook at a rapid boil. Remove from heat immediately when jellying point is reached. Cook until sugar has completely dissolved and mixed with fruit juice. Products are safe to eat.
Syneresis or "weeping"	Excess acid in juice makes pectin unstable Storage place too warm or storage temperature fluctuated Product was sealed with paraffin	Maintain proper acidity of juice. Store in a cool, dark, dry place. Seal with lids and process. "Weepy" products are safe to eat
Too soft	Overcooking fruits to extract juice Incorrect proportions of sugar and juice Undercooking causing insufficient concentration	Avoid overcooking as this lowers the jellying capacity of pectin. Follow recommended instructions. Cook rapidly to jellying point.

	Insufficient acid Making too large a batch at one time	Avoid using fruit that is overripe. Add lemon juice if needed. Use only 4 to 6 cups of juice in each batch of jelly. Products are safe to eat.
Too stiff or tough	Overcooking Too much pectin in fruit	Cook jelly mixture to a temperature 8 degrees higher than the boiling point of water for jelly Use ripe fruit. Products are safe to eat.
Cloudy	Fruit was green Imperfect straining Jelly allowed to stand before it was poured into jars and poured too slowly If product does not have airtight seal, may denote spoilage. If there are moving bubbles, do not use	Use firm,ripe fruit, or slightly under ripe. Do not squeeze juice; let it drip through jelly bag. Hold kettle close to top of jar and pour jelly quickly into jar. Follow recommended methods to get airtight seal. Cloudy products are safe to eat unless there are moving bubbles or product appears spoiled.

Mold (denotes spoilage; do not use	Imperfect seal Paraffin seal not airtight, reusing paraffin Lack of sanitation Too little sugar	Seal with lids and process in boiling water bath. Do not use paraffin; use 2-piece lids and process in boiling water bath. Sterilize jars if processing time is less than 10 minutes. Following processing recommendations for low-sugar jellied products. Moldy jams and jellies are not safe to eat and should be discarded
Fading	Storage place too warm or too light Storage too long	Store in cool, dark, dry place 35-50°F. Use oldest products first. Products are safe to eat
Fruit floats in jam	Under ripe fruit Not thoroughly crushed Undercooking Improper packing in jars	Use ripe fruit. Crush fruit uniformly. Cook rapidly following instructions. Products are safe to eat.

Topic3/Cooling

Cooling to about 50-60^{o}C can even be done in a vacuum evaporator by closing the heating steam and maintaining vacuum degree or by discharge in storage tank.

Learning Unit 3: Package the Jam / Jellies / Marmalade / Fruit Paste

Learning Outcome 3.1: Bottle the jam, jellies, marmalade, fruit paste

Topic 1/Types of packaging material

Glass: Glass bottles provide excellent protection thanks to perfect gas and aroma barriers

Metal cans

Plastic bottle: PET bottles offer several advantages: they are lower in weight, unbreakable, and have an attractive, glossy appearance.

Small boxes

Cartons

Bags

Envelopes

wrappers

Topic 2/Filling/Bottling

The temperature at filling should be controlled to between 85-95^{o}C.This is to ensure optimum conditions for settling, distribution of fruit, minimization of weight variation through density changes and to obtain a sterile product.

They are filled into jars should be heated at 95-100^{o}Cfor a short time.In the case of wooden or plastic packages, the product must be preserved by preservatives(0.15% benzoic acid,0.1%sorbic acid, or their Na or K salts, respectively)

It is important to avoid getting preserve around the rim of the jar as this may prevent a vacuum forming, and will look unsightly and attract insects. The preserve should be hot-filled into suitable containers which are then sealed with a lid.

Topic3/Methods of packaging/ procedure

Wash containers in hot water with detergent and rinse well prior to using, or wash in a dishwasher.

Sterilize the jars by submerging them in boiling water or heating in an oven for 10 minutes. If you use the boiling water method, allow each item to drain on a clean surface. Keep hot until you are ready to fill them.

Carefully fill containers with hot jam in a way that prevents the container rim and lid seal becoming contaminated.

Leave an air space between the top of the jam and the lid. Put the lid on the container while the jam is hot.

Allow jars to cool and check they are sealed. One way to check this is the "button" on pop lids has sucked down by the vacuum created inside the jar.

Learning Outcome 3.2: Label the package

Topic1/ Present information in label

- ✓ **Product name:** the product should be named for its identification
- ✓ **Quantity of product / Net quantity**: the quantity of product to the label is very crucial as its even justifies its price
- ✓ **List of ingredients** in descending order
- ✓ **Company location/ producer location:** food processing company should be located such that anyone can know it. Its name should be in well-known to everybody
- ✓ **Shelf life information:** including production date, expiration date or best before date
- ✓ **Company/ produce address:** company address plays a critical functions as it is helpful in knowing company and getting different information about is that will attract many customers
- ✓ **Batch number:** it is a number given to food product by food processing company which helps in product traceability
- ✓ **Allergens content(if any):** the food manufacturer have to clearly identify and explain the allergens content if they are present for helping clients to whom they are allergic
- ✓ **Nutritional information**
- ✓ **Instruction of use:** instruction about the product utilization or usage is very important to achieve its effectiveness

- ✓ **Storage conditions:** identification of product storage conditions are very important to contribute to product quality and safety

Others

- ➢ Lot number or batch number, Bar code
- ➢ Universal product card/barcode
- ➢ Advertising: sealed for freshness, aroma etc……..
- ➢ Direction for use
- ➢ Nutritional information
- ➢ Serving quantity

Learning Outcome 3.3 Store the jam, jellies, marmalade, fruit paste

Storage must be done in dry room (air relative humidity about75%), well ventilated, medium cool places (temperature 10-20^{o}C), disinfected and away from direct sunlight and heat and used within 6 to 12 months of making.

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