TVET CERTIFICATE III in Food Processing

JUICE MAKING

FOPJM302

MAKE JUICE

Competence

Learning hours: 70

Credits: 7

Sector: Agriculture and Food Processing

Sub-sector: Food Processing

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Purpose statement

This module covers the skills, knowledge and attitude required to properly make juice in food processing industry. Upon completion of this module, the trainee will be able to prepare workplace, tools, equipment and utensils for juice making, prepare the fruits process, the crude juice processes the diluted and syrup juice**.**

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INTRODUCTION

Juices are a product for direct consumption and are obtained by the extraction of cellular juice from fruits; this operation can be done by pressing or diffusion. It is a beverage made from the extraction or pressing of the natural liquid contained fruits or vegetables.

Classifications include ‘‘natural juice’’ products obtained from one fruit, and ‘‘mixed juice’’ products obtained from the mixing of two or three juices of different fruit species or by adding sugar. Juices obtained by removal of a major part of their water content by vacuum evaporation or fractional freezing are defined as ‘‘**concentrated juices.**’’

The extracted liquid is composed of water, soluble solids (sugars and organic acids), aroma and flavor compounds, vitamins and minerals, pectic substances, pigments, and, to a very small degree, proteins and fats. The various sugars, such as fructose, glucose, and sucrose, combined with a large number of organic acids (most important being citric, malic, and tartaric), help give the fruit its characteristic sweetness and tartness.

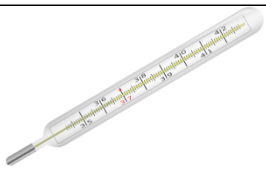
During ripening of fruits, a general decrease in **acidity and starch** as well as an increase in **sugars** is seen. Moreover, formation of odors, breakdown of **chlorophyll,** and hydrolysis of **pectic substances** also occur. It must be noted that plant tissues continue to ripen after harvest. Finally, senescence occurs, at a rate accelerated by the increase in **ethylene**

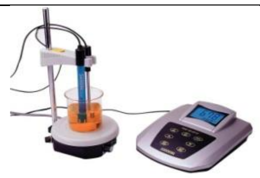
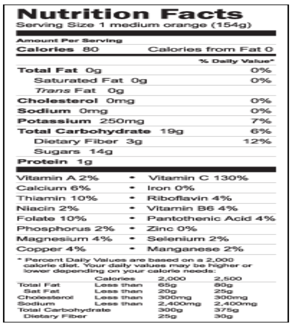
Learning unit1. Prepare raw materials, tools, equipment and utensils for juice making

LO1.Select materials, tools and equipment as per processing requirements

TOPIC 1: Major tools, Instruments, Utensils and equipment used in Juice making

Equipment, tools, instruments and utensils	**Picture**	**The use of equipment, tools, Instrument and Utensils,**
Knives		A knife is used to cut into small pieces or peel the produce
Cutters		It is used to cut fruits in small parts
Slicers		It is used to cut fruits in small parts
Blender		A blender works by using rapidly rotating blades to cut and break down the produce. However, when fruit or vegetables are put into a blender the output contains everything that went into the blender, i.e. the fruit and vegetable fibres including skin, seeds, pith, flesh etc.
Electronic balance		It is used to weigh fruits and other ingredients
Mechanic balance		It is used to weigh fruits and other ingredients

Juicer		A juicer cuts and breaks down the produce. There is a separation of the juice from the fibres,pulp, skin, seed,...
Mixer		It is used to mix juice to get homogenized product
Compressor		It is used to squeeze fruits in order to get juice
Saucepan		It is used to cook and mixing juice
wooden spoon for stirring		It is a stick made in wood used to mix juice
Sieves		It is to separate particles based on their size.
stainless steel fruit juice pasteurizer machine		A pasteurizer is a device which pasteurizes, treating a food product to kill disease-causing microorganisms such as bacteria.
Thermometer		It is used to measure temperature of juice especially during heating and cooling
Refractometer		It is used to determine the sugar content in a liquid

pH meter		A pH meter is an electronic device used for measuring the pH (acidity or alkalinity) of a liquid
Bottles		Are used for packaging juice
labels machine		It is used to use labels on packaging materials
Labels		It is a piece of paper which shows characteristics of a product it represents. It contains information like name of the product, name of the company and its address, list of ingredients normally in descending order and some claims if any.

LO 1.2 Prepare fruits and vegetables as per standards and product requirements

Topic1. Select raw materials

- **The selection of raw material basing mainly on Characteristics of good fruits for juice 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 characterized 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 freedom 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, oversoftening 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**

Postharvest 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 point, 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. Some typical maturity indexes are described in following section.

- ✓ **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 2. Storage fruits and vegetables used in Juice making

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.

- **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.

✓ **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 and vegetables**

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. Carbon dioxide (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.

- ✓ **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.

- ✓ **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.

- ✓ **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.

- **Biological factor**

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

- **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

- **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,...

- **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.

- **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:

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

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
- **Factor involves for controlling fruits deterioration**
- ✓ **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.

- ✓ **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.

- ✓ **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.

- ✓ **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.

- ✓ **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

- ✓ **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.

- ✓ **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 reduce the effectiveness of fruits transpiration in cooling fruits by the reducing the rate of evaporation of moisture in fruits surface.

- ✓ **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 controlled atmosphere (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.

- **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 oxidising 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 CAS-low oxygen or high carbon dioxide
- ✓ Chemical removal-activated charcoal, potassium permanganate, UV lamps, etc

❖ **Storage conditions of some fruits used in juice making**

Product	**Optimum storage T°⁰F**	**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
Carrot immature	32^{0}F	98-100	-	-	4-6weeks
Carrot mature	32 ^{0}F	98-100			7-9 months
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
watermelon	55-70 ^{0}F	-	-	-	-
Passion fruits	41.6-44.6 ^{0}F	-	-	-	4-5 weeks

Topic3. Wash the fruits

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.

- **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 Micotoxins.

- **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.).

Figure 1: Fruits washing

LO 1.3: weigh raw materials as per product ratio requirements

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

Types of weighing scales

- ✓ Electronic balance
- ✓ Mechanical balance

Learning Unit. 2. Process the crude juice

LO 2.1 Peel / cut/core the fruits

- ✓ **Peeling (skin removal):** Although manual peeling is still used for certain large vegetables, the method is very expensive. 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	Pressure steam peeling make the peel blow off with pressure drop

peeling	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 or 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

LO 2.2 Extract juice according to protocol

- **Techniques of crude juice extraction**

✓ **Pressing**

Most systems for extracting juices from apples and similar fruit pulps use some method of pressing juice through cloth of various thicknesses, in which pomace is retained. These systems, called filter presses, include: (i) rack and cloth press, (ii) horizontal pack press, (iii) continuous belt press, and (iv) screw press.

✓ **Centrifugation**

Both cone and basket centrifuges have been used in producing fruit juice. Both systems have resulted in high levels of suspended solids and a high investment cost for a given yield. Horizontal decanters are presently used for juice clarification

✓ **Diffusion extraction**

This was adapted from the method used for the extraction of sugar from sugar beet. Extraction is a typical countercurrent-type process. It is desirable to retain the same driving force DC (concentration of soluble components in solids versus concentration of soluble components in liquids).

The diffusion extraction process is influenced by a number of variables, **including temperature, thickness, water, and fruit variety.** Slices from extractors pass through a conventional press system, and the very dilute juice is returned to the extractors. It is seen that the extra juice yield from diffusion extraction compensates the extra energy cost involved for concentration

- ✓ **Addition of press aids.**

Hydraulic pressing does not usually require addition of press aids, unless exceptionally overmature fruit is used. For continuous screw presses however it is usually necessary to add 1% (w/w) or more of cellulose. Mixing of cellulose and fruit occurs in the mill and subsequent pumping to press. Pumping is commonly performed with a Moyno-type moving cavity food pump.

- **Maximization of fruits extraction: By adding additives; (enzymes eg: pectinase), and application of heating treatments.**

Juice is present in vacuole of fruits and this and for getting juice the cell wall for fruits have to be broken so that juice can be released. Cell wall is made of many compounds including pectin. in order to maximize extraction pectinase is added to enhance breaking down of pectin. In some fruit like banana when pectin is not broken down juice fails to come out

LO 2.3: Filtrate juice in accordance with juice filtration procedure

Filtration is a mechanical process designed for clarification by removing insoluble solids from a high-value liquid food, by the passage of most of the fluid through a porous barrier, which retains most of the solid particulates contained in the food. Filtration is performed using a filter medium, which can be a screen, cloth, paper, or bed of solids. Filter acts as a barrier that lets the liquid pass while most of the solids are retained. The liquid that passes through the filter medium is called the filtrate and the separated solids are the filter cake. There are several filtration methods and filters including:

Types of Pressure Filters

Pressure filters usually found in the food industry are:

a. Filter press,

Two commonly used pressure filters are the batch ***plate-and-frame filter press*** and **the *shell-and-leaf pressure filter***.

- ✓ **In the plate-and-frame design, cloth or paper filters** are supported on vertical plates. Feed liquor is pumped into the press and liquid passes through the filter cloths and flows down the grooved surfaces of the plates to drain through an outlet channel in the base of each plate. A layer of cake builds up on the cloths until the space between the plates is filled
- ✓ **The shell-and-leaf pressure filter**is used to overcome the problems of high labour costs and lack of convenience of plate-and-frame presses. It consists of mesh 'leaves', which are coated in filter medium and supported on a hollow frame which forms the outlet channel for the filtrate. When filtration is completed, the cake is blown or washed from the leaves

b. Vacuum Filters

Vacuum filters are simple and reliable machines widely used in the fruit industry. Among the different types of vacuum filter (drum, disk, horizontal belt, tilting pan, and table filters) drum filters are most commonly utilized in the food industry.

The advantages and disadvantages of vacuum filtration compared to other separation methods are:

- ➢ **Advantages**: Continuous operation, very effective polishing (finishing) of solutions (on a precoat filter), and easy control of operating parameters such as cake thickness.
- ➢ **Disadvantages:** Higher residual moisture in the cake and difficulty in cleaning (as required mainly for food-grade applications)

❖ **Others Techniques of clarification of juice**

a. Centrifugation

- Centrifugation is a process which involves the use of the centrifugal force for the sedimentation of heterogeneous mixtures with a centrifuge, used in industry and in laboratory settings. This process is used to separate two immiscible liquids. Suggested that cloud particles which are less than 3µm in diameter are subject to Brownian movement and do not sediment. Therefore the homogenization which reduces particle size has an effect on the cloud stability of the juice.

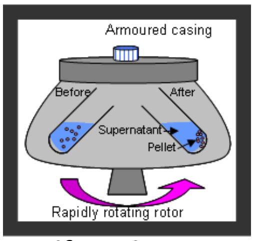


Figure 2: Centrifugation

b. Application of Enzyme

Examples: Pectin Esterase, Polygalacturonase, Cellulase and Hemicellulase

Pectic enzymes: it is used for break down the cellular structure of fruits. Homogenous distribution of cloud particles or fruit pulp throughout the bottled volume without sedimention during the required shelf-life is expected by the consumer, whilst especially products with a clear phase above sediment at the bottom are rejected. Hydrocolloid addition besides homogenization treatments have been suggested for various cloudy juice products. In contrast to juices from all other fruit species, the addition of pectin (E 440) at least 3 g/l juice resulting in cloud stabilization.

c. Decantation

Decantation is a process for the separation of mixtures, by removing a layer of liquid, generally one from which a precipitate has settled.

The purpose may be either to produce a clean decant, or to remove undesired liquid from the precipitate (or other layers).

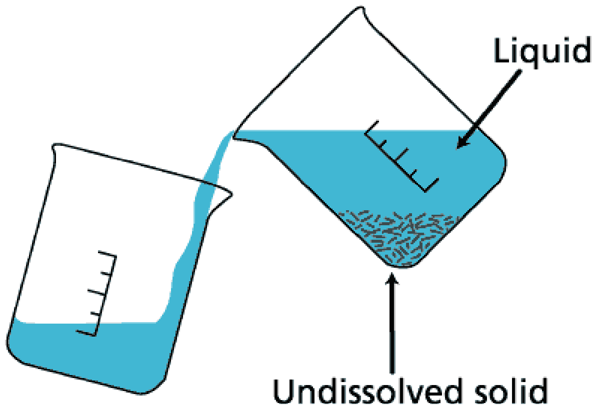


Fig 3: Decantation

learning unit 3. Process the diluted and syrup juice

LO 3.1: Measure Ingredient and water in accordance with product standards

Topic.1 Measurement of the brix of the crude juice

- **Brix or degree Brix**

It is the percentage of total dissolved solids expressed on weight basis as determined by a refractometer calibrated at 20 ^{0}C or by a calibrated hydrometer. It expresses the percentage concentration, by mass, of juice solution at 20 ^{0}C

- **Brix (total soluble solids:** The soluble solids are primarily sugars; sucrose, fructose, and glucose. Brix is reported as "degrees Brix" and is equivalent to percentage. For example, a juice which is 12 degrees Brix has 12% total soluble solids. Instrument used for measuring sugar content is called **Refractometer**

    - **Refractometer** measures TSS as °Brix in 0.1% graduations. There are hand-held refractometers as well as digital battery/mains-operated models available. All models apply similar principles. However, the manufacturers' instructions must always be followed.

Some refractometers automatically compensate for changes in temperature, whereas others may be calibrated to read accurately at a fixed temperature (usually 20°C). To obtain accurate readings at temperatures other than 20°C it is necessary to refer to the International Temperature Correction factor.

- ✓ **Use of the refractometer**

Depending on the purpose of the analysis, several drops of distilled water, sucrose solution or juice are placed on the prism surface. The liquid on the prism plate should be free from bubbles or floating particles of pulp or other matter.

- **Hand-held model**: The prism lid is closed. To get proper readings, the instrument is turned towards the light. If necessary the eye piece is focused until a clear image appears. The position at which the demarcation line between the light and dark regions crosses the vertical scale gives the percentage soluble solids reading.

- **LCD Digital model**: Push the button to get the soluble solids reading in percent

- **Determining soluble solids content (% sugar or °Brix) by using - Hand-held model**:

Determining the total soluble solids (Brix) is an important measurement taken in a wide range of crops. These soluble solids are primarily sugars; sucrose, fructose, and glucose.

How is there sugar in the fruit? As the flesh of fruit forms it deposits nutrients as starch that, as the fruit ripens, transform to sugars. The percentage sugar, measured in degrees Brix (^{0}Brix), indicates the sweetness of the fruit by measuring the number of soluble solids in the juice

The ratio of the Brix to total acid reading must be above a certain tolerance level. Oranges need the sugar level for sweetness and the acid for sour taste and preservation of the fruit.

- **The following procedure will allow you to calculate the Brix.**

1. Collect a refractometer and should be handled carefully
2. Ensure the refractometer prism surface is clean and dry.
3. Place a small amount of fresh juice (a couple of drops is sufficient) onto the prism of the refractometer.
4. Look through the eyepiece while pointing the prism in the direction of good light (not directly at the sun).
5. Focus and take the reading of where the base of the blue colour sits on the scale and record the % percentage sugar (°Brix).
6. Clean the refractometer immediately with a damp tissue, and dry thoroughly

Topic.2 Determination of Percentage Juice Content

Percentage of Juice Content: Juice content is an important measure of internal quality. Under or over-ripe fruit tend to be less juicy, which directly affects eating quality. The juice content is determined by weighing components of the whole fruit and the juice.

The test to determine the '**Percentage Juice Content'** is important to determine the quality of the fruit. If the fruit is under or over-ripe there can be less juice, which affects eating quality and the amount of money a farmer will receive for their crop.

The following procedure can be used to determine the Percentage Juice Content.

Equipment:

- ✓ Scales
- ✓ Fruit juice, juice only - no rind
- ✓ Fine plastic strainer
- ✓ 100 mL conical flask
- ✓ 1 to 2 L jug

➢ **Procedure**

a) Collection of fruit sample: A minimum of three fruits, representative of the variety to be harvested, must be collected. This does not mean selecting the biggest and best fruit to test. Select fruit that are of similar size and colour to as those that you would pick for market.

b) Weigh the three representative fruit and record the combined weight in grams.

c) Weigh the empty jug and record the weight in grams.

d) Cut the fruit in halves and extract the juice from the three sample fruit using a juicer (this will ensure you collect as much juice as possible from the fruit).

e) Strain the juice into the weighed jug.

f) Weigh the juice and record the weight in grams.

g) Calculate the percentage of juice.

Example Calculation

Gross fruit weight = 600 g

Gross juice weight = 450 g

Jug weight = 150 g

Net juice weight = Gross Juice weight - jug weight

Net juice weight: 450 g - 150 g = 300 g

% juice: $\frac{\text{Juice weight net x 100}}{\text{Fruit weight}}$

% juice: $\frac{300 \times 100}{600}$ = 50%

Topic 3. Determining acidity (citric acid content) and pH

- **pH measurement**

Juice is normally acidic food which means that its pH should be below 4.6 and this delays the deteriorative effect by microorganism.

pH is the measure of H+ activity, it measures active acid. PH may be determined by measuring electrode potential between glass and reference electrode; ph meter is standardized using pH buffer.

- **Acidity**

Citric acid, and small amounts of malic and tartaric acid, give citrus its tartness and unique taste. The levels of acid are at the highest concentrations early in the season and they decrease as the fruit mature.

The amount of acid present in the juice is reported as percent citric acid. To calculate this value we use a titration with sodium hydroxide.

- **Materials**
  - ✓ 50 mL burette
  - ✓ Burette stand and clamp
  - ✓ 10 mL pipette and pump
  - ✓ 1 L volumetric flask
  - ✓ 0.1 M sodium hydroxide (NaOH)
  - ✓ 1% Phenolphthalein indicator
  - ✓ 100 mL conical flask
  - ✓ Pipette
  - ✓ Distilled water
  - ✓ Fresh Juice
  - ✓ Gloves, safety glasses and lab coat (ensure all students are wearing)

- **Procedure of Titration**

1. Pipette 10 mL of juice into a clean conical flask

2. Clean pipette immediately

3. Pipette 10 mL of distilled water into the conical flask containing the juice

4. Add six drops of phenolphthalein indicator to flask

5. Carefully swish mixture

6. Fill the burette with 0.1 M sodium hydroxide solution.

7. Open burette tap and allow a trickle of sodium hydroxide NaOH to run into a beaker. This is to ensure no air is in the burette prior to titration

8. Refill the burette, making sure that it reads zero at the top of the scale.

9. Hold the conical flask containing the juice mix under the burette and while swirling, slowly add the sodium hydroxide to the juice.

10. Keep adding sodium hydroxide to the flask while swirling until the solution just starts to change color to pink/purple.

This is the end point and you should now record how much sodium hydroxide you have added to the flask.

11. Calculate % of TTA according to the formulas:

$$\%\mathbf{TTA}\ \left(\frac{\mathbf{g}}{\mathbf{l}}\right) = \frac{\mathbf{volumeof\ NaOH\ \times 0.1N\ of\ NaOH \times F \times 1000}}{\mathbf{sample\ volume(ml)}}$$

F: Multiplication factor

<u>Multiplication Factors of principal's acid</u>

Principal acid	**Factor**	**Food sample**
Citric acid	0.0064	Citrus fruit, Straw berries, Pineapples Passion fruits, Melon
Malic acid	0.0067	Apples, unripe fruits, apricot
Tartaric acid	0.0075	Grapes

Note: the end point of the titration may be very difficult to tell at the start until you get used to the procedure. If you look closely you will see the juice mix slowly lighten in colour and then change to a green colour. This is the point just before the end of the titration and a few extra drops will see the solution change colour to pink. If you go past this point, and the solution becomes a deep purple/orange, you have gone too far.

Topic.4. Determination of sugar/acid ratio

It is **the sugar/acid ratio** which contributes towards giving many fruits their characteristic flavor and so is an indicator of commercial and organoleptic ripeness. At the beginning of the ripening process the sugar/acid ratio is low, because of low sugar content and high fruit acid content, this makes the fruit taste sour. During the ripening process the fruit acids are degraded, the sugar content increases and the sugar/acid ratio achieves a higher value. Overripe fruits have very low levels of fruit acid and therefore lack characteristic flavor.

Titration is a chemical process used in ascertaining the amount of constituent substance in a sample, e.g. acids, by using a standard counter-active reagent, e.g. an alkali (NaOH). Once the acid level in a sample has been determined it can be used to find the ratio of sugar to acid.

There are two methods specified for the determination of the titratable acidity of fruits:

- Method using a coloured indicator;

- Potentiometric method, using a pH meter, which should be used for very coloured juices.

The °Brix value of the fruit concerned must also be obtained before calculation of the sugar/acid ratio is possible. The calculations for determining the sugar/acid ratios of all produce are the same, but as some products contain different acids the appropriate multiplication factor must be applied to each calculation. Some products may contain more than one type of acid; it is the primary acid that is tested.

The sugar acid ratio = $\frac{{}^{0}\text{Brix value}}{\%\ \text{acid}}$

- To determine the sugar / acid ratio you need to divide the sugar concentration (°Brix) by the citric acid concentration.

Examples Calculation

Sugar concentration = 15.2°Brix

Citric Acid concentration = 1.55 g per 100mL

$$\text{Sugar/acid ratio} = \frac{\text{Sugar concentration (°Brix)}}{\text{Citric acid concentration}} = X:1 \text{ sugar/acid ratio}$$

$$\text{Sugar/acid ratio} = \frac{15.2}{1.55}$$

Sugar/acid ratio = 9.8:1

LO3.2: Mix ingredients as per Methods

Topic.1 Select ingredients

a) Sugars

Sugars with less than 2% moisture and they include sucrose, dextrose anhydrous, glucose, fructose, may be added to all products. Syrups like liquid sucrose, invert sugar solution, invert sugar syrup, fructose syrup, liquid cane sugar, glucose and high fructose syrup may be added only to fruit juice from concentrate.

b) Stabiliser:

- ✓ **Thickening agents:** Xanthan gums, gur gum and carboxyl methyl cellulose. Are used to as thickening agents in juice in order to prevent synersis to coor.
- ✓ **Pectic enzyme:** pectinase, pectorase

c) Preservatives

i) Acidifying agents:

Edible acids are added to increase acidity of juice; addition of lemon juice, citric acid, for the purposes of:

- ➢ **Product fortification**, essential nutrients (e.g. vitamins, minerals) may be added to juice.
- ➢ **Acidity regulation:** Citric acid is used to increase acidity they by preventing microorganisms to grown in food

ii) Antimicrobial growth

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

- **Common chemical preservatives used in juice**

Ingredient	Use	Maximum Level
Sulphur Dioxide	Retards microbial and enzymatic activity	350mg/l
Sodium Benzoates	Antimicrobial pH <4.5	250 mg/kg
Potassium Sorbates	Antimicrobial pH <6.5	1000 mg/kg
Carbon Dioxide	pH reduction, anaerobic atmosphere	Limited by GMP
Citric acid	Acidity regulation	Adjust pH between 2.8-4.2
Ascorbic Acid	Retards enzymatic browning	Limited by GMP

Topc.2: Mix ingredients accordance to the type of juice

- **Mixing ingredient for Fruit nectar**

Unfermented pulpy product, intended for direct consumption, obtained by blending the total edible part of sound and ripe fruit(s), concentrated or unconcentrated, with water and sugars, and preserved exclusively by physical means except ionizing radiation. It is juice obtained by mixing syrup, water and with or not adds sugar and additives accordance with product standard

- **Adjusting ingredient for concentrated fruit juice**

It is fruit juice where water has been physically removed in an amount sufficient to increase the Brix level to a value at least 50% greater than the Brix value established for reconstituted juice from the same fruit.

- **Mixing ingredient for Fruit squash**

Squash is a concentrated form of fruit drink obtained by adding sugar to crude juice in an amount sufficient to standard the Brix level. They can be served as a beverage by just adding water.

- **Mixing ingredient for fruits Cocktail juice:** it is made from a mixed blend of two or more fruits juice**.** They can be mixed water, sugar and additives accordance with products standard

LO 3.3 Heat treated syrup/ diluted juice as per heating procedures

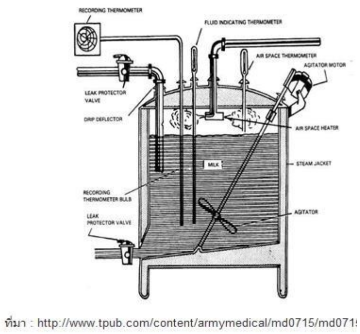
Topic1. Heating techniques (pasteurization and concentration)

- **Traditional thermal pasteurization**

Thermal processing is the most widely used technology for pasteurization of fruit juices and beverages. Juice pasteurization is based on reduction of the most resistant microorganisms of public health significance. The process could be accomplished by different time-temperature combinations.

- **Low temperature long time (LTLT)**

Fruit juice has been traditionally pasteurized by batch heating at 63-65°C for relatively long time 30 minutes. This method has been replaced by high temperature short time treatment due to the undesirable quality changes during this process



- ✓ **High temperature short time (HTST)**

HTST treatment could minimize those undesirable quality changes made by batch heating due to the much less duration of heat treatment. Currently, HTST pasteurization is the most commonly used method for heat treatment of fruit juice. For example, orange juice is processed by HTST at 90 to 95°C for 15 to 30 seconds. And apple juice is treated by HTST at 77 to 88°C for 25 to 30 seconds.

Figure: **High temperature short time (HTST)**

LO 3.4: Cool syrup/ diluted juice in accordance with cooling requirement

After heating , cooling at 50-60ºC before adding preservatives and other ingredients , the bottles are cooled to room temperature by immersing them in clean cold water. If the bottles are cooled too quickly they will crack and break.

Learning unit 4. Package, label and store juice

LO 4.1: Prepare containers as per hygienic requirements

- **Techniques of sterilization packaging material (by irradiation, hot water)**
  - ✓ **Sterilization** is defined as the process where all the living microorganisms, including bacterial spores are killed. Sterilization can be achieved by physical, chemical and physiochemical means. Chemicals used as sterilizing agents are called chemisterilants

- ✓ **Factors affecting sterilization by heat are:**

- Nature of heat: Moist heat is more effective than dry heat
- Temperature and time: temperature and time are inversely proportional. As temperature increases the time taken decreases.
- Number of microorganisms: More the number of microorganisms, higher the temperature or longer the duration required.
- Nature of microorganism: Depends on species and strain of microorganism, sensitivity to heat may vary. Spores are highly resistant to heat.
- Type of material: Articles that are heavily contaminated require higher temperature or prolonged exposure. Certain heat sensitive articles must be sterilized at lower temperature.
- Presence of organic material: Organic materials such as protein, sugars, oils and fats increase the time required.

- **Hot air oven:**

This method was introduced by Louis Pasteur. Articles to be sterilized are exposed to high

Temperature (160^0 C) for duration of one hour in an electrically heated oven.

Since air is poor conductor of heat, even distribution of heat throughout the chamber is achieved by a fan. The heat is transferred to the article by radiation, conduction and convection. The oven should be fitted with a thermostat control, temperature indicator, meshed shelves and must have adequate insulation. Articles to be sterilized must be perfectly dry before placing them inside to avoid breakage.

- **Moist heat:**

- ✓ **Boiling:** Boiling water (100oC) kills most vegetative bacteria and viruses immediately. Certain bacterial toxins such as Staphylococcal enterotoxin are also heat resistant. Some bacterial spores are resistant to boiling and survive; hence this is not a substitute for sterilization. The killing activity can be enhanced by addition of 2% sodium bicarbonate. When absolute sterility is not required, certain metal articles and glasswares can be disinfected by placing them in boiling water for 10-20 minutes. The lid of the boiler must not be opened during the period.

- ✓ **Steam at 100°C:** it is process is known as tyndallisation (after John Tyndall) or fractional sterilization or intermittent sterilization. Hence they are exposed to free steaming for 20 minutes for three successive days. The vegetative bacteria are killed in the first exposure and the spores that germinate by next day are killed in subsequent days. The success of process depends on the germination of spores.

- **Radiation**:

Two types of radiation are used, ionizing and non-ionizing. Non-ionizing rays are low energy rays with poor penetrative power while ionizing rays are high-energy rays with good penetrative power. Since radiation does not generate heat, it is termed "cold sterilization.

- **Chemical methods of disinfection**

Disinfectants are those chemicals that destroy pathogenic bacteria from inanimate surfaces. Some chemical have very narrow spectrum of activity and some have very wide. Those chemicals that can sterilize are called chemisterilants.

LO4.2: Package juice according to the code of practice

Juice packaging: is the enclosing of juice to protect it from any damage contamination spoilage, pest attacks and tempering during transport, storage and retail sale

The package is often labelled with information such as amount of content, ingredients, Nutritional content, cooking or serving instruction if relevant and shelf life.

Packaging is a coordinated system of preparing food for storage, transportation, retailing, and convenient use which ensures safe delivery of food to ultimate consumer in a sound condition at minimal cost while maximizing sales and hence profits to the manufacture

Predictors for the general acceptability of the selected packaging materials are based on the following criteria, namely; the local food and drug agency label requirements, appearance including color, convenience including the ease in opening, ease of disposal of the package material, economics and protection against physical and chemical contamination.

Topic.1 Types of packaging material

This review looks at package performance primarily in terms of protecting product quality. Realistic shelf life and recyclability of the packages are also taken into consideration. For shelf stable fruit beverages the packaging must in all cases prevent microbiological contamination

The most important package properties in regards to maintaining quality of the product are:

- ✓ Gas barrier
- ✓ Light barrier
- ✓ Aroma barrier

Most fruit-based beverages are sensitive to oxidation, which results in losses of vitamins and unfavourable changes in taste and colour. The rate of oxidation, and thus quality degradation, is not only determined by the gas barrier properties of the container itself, but by the total oxygen exposure. This includes:

- ✓ Permeation through spout or closure
- ✓ Oxygen in head space
- ✓ Permeability of container walls
- ✓ Oxygen desorbed from the container
- ✓ Oxygen dissolving into the beverage during filling Process

- **Examples of packaging materials**
  - ✓ **Glass Bottles**

Glass bottles provide excellent protection thanks to perfect gas and aroma barriers. Insufficient tightness around the metal closure is a potential source of oxygen ingress, but can be minimized by various liner solutions. Visible light and part of the ultraviolet light spectra penetrate through clear glass, as well as PET, and may affect photosensitive compounds, such as certain vitamins. Addition of UV absorbers to the glass will protect the bottle content against ultraviolet rays.

Shelf life is usually 12 months, or more, for fruit beverages in glass. They are commonly hot-filled, notwithstanding a number of installations for cold aseptic filling. Oxygen should be minimized to limit oxidation at the high filling temperatures.

- ✓ **Aseptic Carton**

Aseptic cartons deliver juice in a shelf-stable form that requires no refrigeration. They are multilayer containers made of an inner layer of LDPE, an aluminum layer, paperboard and an outer layer of LDPE. The paperboard in aseptic cartons often contains some recycled material, although as previously noted for paperboard gable top cartons, we assumed no postconsumer content. Some aseptic cartons are available with plastic "flip-top" pour spouts.

The laminated cardboard carton, like the “drink-box”, is currently the most common package for fruit beverages. Although features like openings and package shape matter dearly to consumers, differences in filling system and packaging material have a greater influence on product quality. Most shelf stable fruit beverages in cartons are filled aseptically at ambient temperature. Cartons typically permit shelf life of 12 months for juice beverages.

- ✓ **PET Bottles**

To consumers, PET bottles offer several advantages compared to glass: they are lower weight, unbreakable, and have an attractive, glossy appearance.

For producers of juices and drinks the picture is more complex. PET, polyethylene terephthalate, provides a good aroma barrier and a relatively high oxygen barrier. Nevertheless, it is not sufficient to protect quality of oxygen sensitive beverages, both in terms of maintaining sensorial properties and nutritional content, during extended storage. Furthermore, visual changes, such as browning or fading colours, become more apparent in thin wall PET bottles than in glass bottles.

To improve gas barriers for PET containers. Continued developments aim to refine the existing systems and to find more cost-effective solutions. Barrier material in preforms is applied either as a direct blend with PET (mono-layer) or as one, or more, separate layers between PET (multi-layer). Mono-layer barrier performs have the advantage of being manufactured on

Standard equipment while multi-layer solutions require more complex injection moulding systems. There is a risk of haziness in the mono-layer bottles, however, especially

At high barrier concentrations. The barrier materials are of two different types, often used in combination:

• **Active barriers**

These are oxygen scavengers that react with oxygen migration through the bottle wall. They offer a very effective barriere – until the scavenger is depleted.

• **Passive barrier materials**

These reduce oxygen permeation rate through bottle wall during the entire shelf life. Polyamides and EVOH are commonly used for these passive barriers. Technologies for adding extra barrier to blown bottles are primarily plasma coating, which entails the deposit of a very thin barrier layer on the interior bottle surface, or spray coating of a barrier material onto the exterior. Both methods provide passive barrier

- ✓ **Others Plastics Bottles**

There are several alternative polymer materials to PET for bottles, such as bio-plastics, clarified polypropylene and polycarbonates. Their attractiveness depends on many factors, including consumer preferences and economics.

Topic 2. General Characteristics of a good packaging material for Juice product

i. It should protect the commodity from physical damage and hazard handling and transportation
ii. It should protect the commodity from the microbiological damage and chemical change
iii. It should be light weight, attractive, water resistant, temperature tolerant printable
iv. It should be non toxic and non reactive with the product
v. It should retain the quality and quantity of the produce
vi. It should be transparent, low cost and temper proof
vii. It should be environment friendly and biodegradable
viii. It should not carry any unethical value
ix. It should have desired barrier properties (impermeability for individual gases and gas mixture)
x. Closure of packaging should be heat sealable

Topic.3. Fill and seal

At the small-scale, containers can be filled simply using a funnel and a jug. For larger scale operations a range of filling machines are available. The juice containers should be thoroughly washed and sterilised before filling. Bottles that are recycled should be checked for cracks and chips. Only new caps should be used for sealing the bottles**.**

Tamper evidence: Are breakable caps for glass package, film wrapper for polypropylene package and cannot be re-closed film wrap for Cartons package

LO4.3: Label juices products

Labeling is defined as the process of attaching a descriptive word or phrase to someone or something about a product on its container, packaging, or the product itself.

Applied labeling: it is type of labeling at which all information is pointed on the paper which is applied on the bottle

Direct labeling: it is type of labeling at which all information is printed on the package

- **Present information in label is:**
  - ✓ **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

LO 4.4: Store juice as per storing condition

Juice is kept in a cold room; it is the juice extracted from Fruits that can be marketed by bottling into sterilized bottles or can. The reduction in pH on storage is expected because juice spoilage is mainly by yeast fermentation which is characterized by higher tendency towards acidity. The acidity tendency of the pH is equally evident in an increasing titratable acidity value with time. The total titratable acidity which is expressed as citric acid is much higher in the package juice and this correlates with the pH values as well. The higher acidity could be as a result of added organic acids such as citric, malic and sometimes ascorbic acid as acidifying agents and flavoring agents by some commercial producers. For all the freshly prepared juices, the total solids value is considerably higher than the packaged juice and this may be attributed to the fine filtration methods used commercially as opposed to filtration with muslin cloth. Vitamin C content is the attribute that affected by storage time and temperature most as indicated by reaction rate constant and activated energy. Storage of non-thermally pasteurized and clarified fruits juice at 4 °C is the most suitable since it allows the best quality preservation.

Topic.1. Parameters that varies during juice storage

- **Sugar variation in fruit juices during storage**

The fruit juice contains various reducing and non-reducing sugars which tend to change during storage due to various interconversion processes. The increase in total sugars could be result of hydrolysis of polysaccharides like pectin, cellulose and starch into simple sugars.

They had proposed that an increase in reducing sugar during storage may be due to gradual conversion of non-reducing sugar and acids into reducing sugars.

- **pH variation in fruit juices during storage**

The pH of fruit juice is negative function of natural acidity in the juice, thus increase in pH is accompanied with decrease in acidity of fruit juice during storage.

The increase of pH with prolonged storage time may be caused by the acid hydrolysis of the poly-saccharides into mono-saccharides and di-saccharides which are responsible for increase in sweetness and decrease in sourness.

- **Acidity variation in fruit juices during storage**

The titratable acidity of fruits or fruit juice includes the organic acids predominantly present in fruits. These organic acids are of high nutritional values and are useful in extending shelf life of fruit juice during storage. However, these are highly sensitive to temperature, storage condition and duration. The organic acids undergo degradation during storage which might be due to conversion of acids into sugar and salt

- **Ascorbic acid variation in fruit juices during storage**

Ascorbic acid degradation is common in all consumable items during storage and can occur aerobically as well as anaerobically. However rate of aerobic degradation is 100 to 1000 times faster than anaerobic degradation. Vitamin C is light and heat sensitive, the concentration of Vitamin C follows first order kinetics and thus storage time affects Vitamin C content.

Topic.2. The shelf life of Juice

The shelf life of a juice represents the period in which the product remains in good sensory and microbiological for consumption, without harming the taste or health. These are dependent on physical, chemical and microbiological that occurs during storage, which depends on the nature of the product, packaging and storage conditions (temperature, relative humidity, light).

Topic.3. Storage condition

- ✓ Not direct to sun light
- ✓ Store at room temperature
- ✓ Dry place
- ✓ Appropriate packaging material

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