Post Harvest Operations and Processing of Fruits, Vegetables, Spices and Plantation Crop Products

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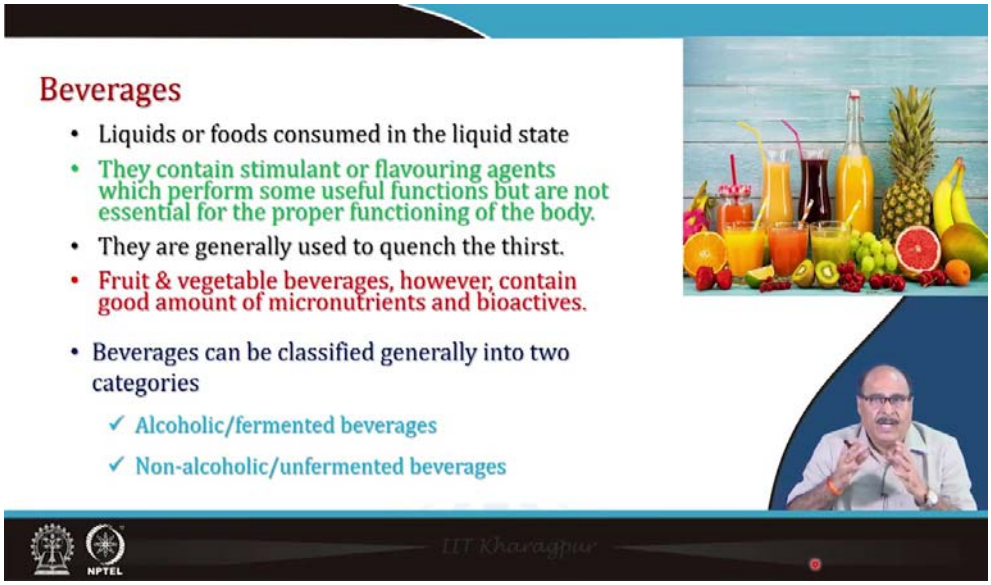
Lecture 29

RTS and RTD beverages

The lecture 29 is RTS and RTD Fruit & Vegetable Beverages.

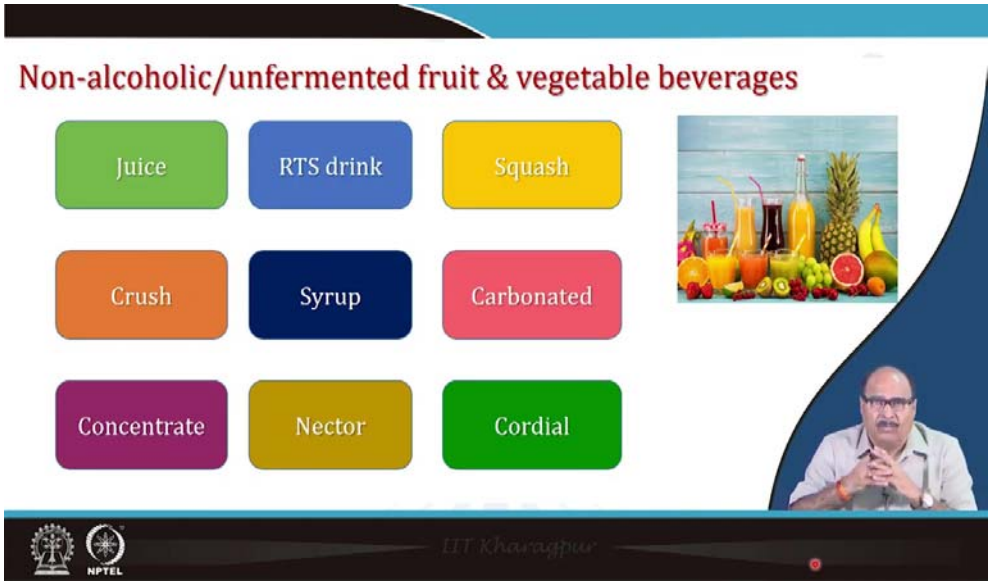
The concept covered in this lecture include fruit & vegetable beverages, their type and characteristics, ready to serve (RTS) drinks, squash, cordials, nectars, crush & fruits syrups, their manufacturing technologies and formulation, and carbonated fruit beverages.



Beverages

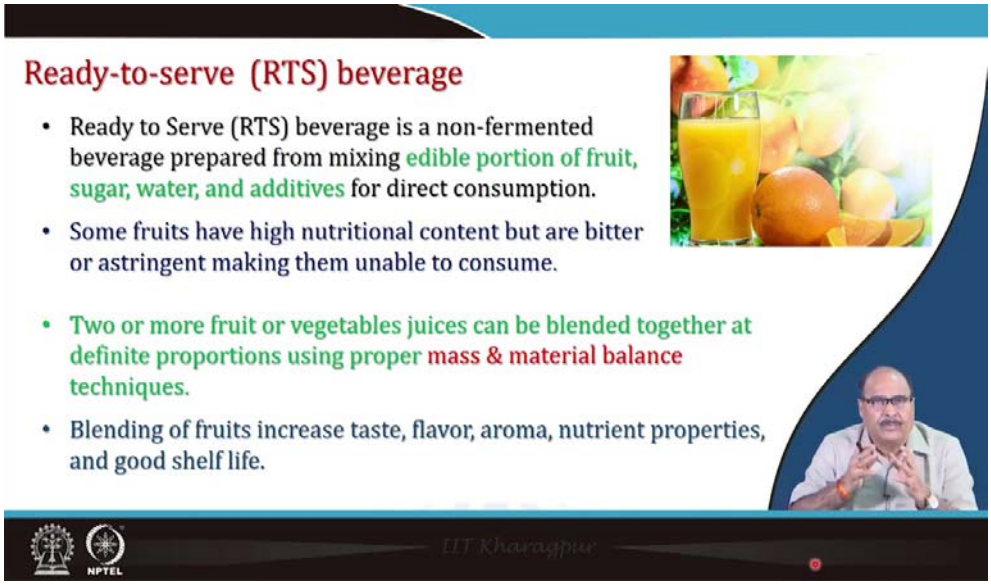
The liquids or foods consumed in the liquid state are considered beverage. They contain stimulant or flavoring agents, which perform some useful function in the body, but are not essential for proper functioning of the body. The soft drinks or soft beverages are generally used to quench the thirst. However, fruit and vegetable beverages contain good amount of micronutrients and bioactives and can be beneficial to health.

The beverages can be classified generally into two categories, alcoholic or fermented beverages, and non-alcoholic or unfermented beverages.



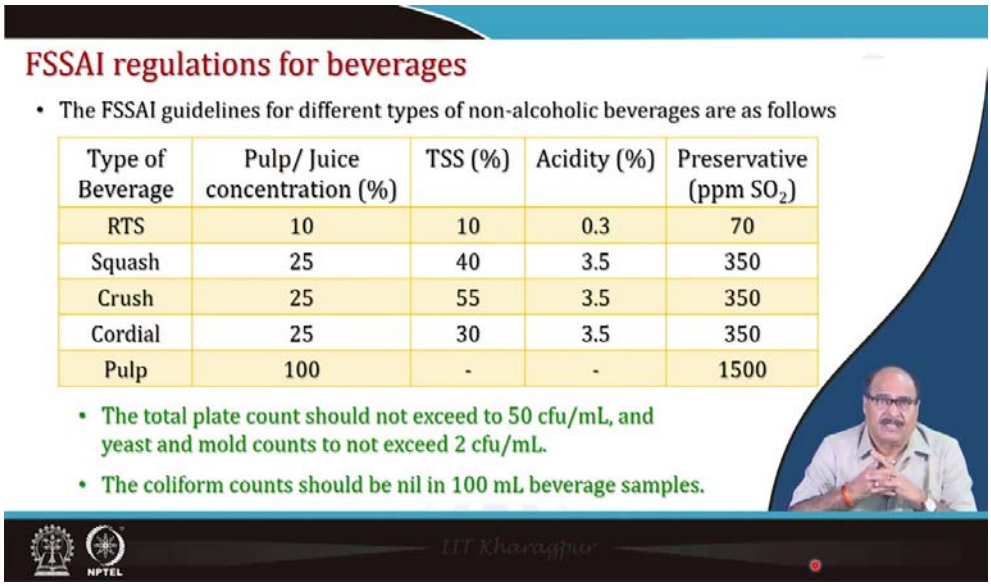
Non-alcoholic/unfermented fruit & vegetable beverages

Non-alcoholic beverages include different products available in the market like juice, ready to serve drink, squash, crush, syrup, cordial, concentrates, nectar, and carbonated beverages.



Ready-to-serve (RTS) beverage

It is a non-fermented beverage prepared from mixing edible portion of a fruit, sugar, water and additives for direct consumption. Some fruits have high nutritional content, but they are bitter or astringent like tannins and such other polyphenols making them unable to consume directly. So, such fruits can be converted into these type of beverage by mixing other components and they can be consumed. Sometimes, two or more fruits or vegetable juices can be blended together at different proportions using proper mass and material balance techniques and also properly balancing their sensory characteristics like color, flavor, taste, etc. These blends can be made and the blending of fruit juices basically increases the taste, flavor, aroma and nutrient properties and also many a times they give good shelf life because the fruits and vegetable like vegetables are generally they are low acids making them more prone to contamination. Proper combination of vegetable & fruit which has more acid or which has more sugar are mixed together and can improve the taste, aroma, even shelf life also because acidity sugar content may help the vegetables.



FSSAI regulations for beverages

As per the FSSAI guidelines, different types of non-alcoholic beverages are given in this table i.e. type of beverage like RTS beverage, it should contain pulp or juice concentration up to 10 %, total soluble solids should be 10 %, its acidity should be 0.3 % and it should contain preservative sulfur dioxide up to 70 ppm. Squashes, normally they contain 25 % pulp or juice concentration, its TSS is 40 %, acidity 3.5 %, and they can have a preservative up to 350 ppm of sulfur dioxide. Crush contains 25 % pulp, about 55 % total soluble solids, its acidity is 3.5 % and it has around 350 ppm sulfur dioxide. Similarly, and pulps has 100 % pulp and it may contain up to 1500 ppm sulfur dioxide. The total plate count of all these products should not exceed to 50 cfu/ml that is 50 colony forming unit and yeast and mold counts should not exceed to 2 cfu/ml and the coliform counts should be nil in 100 ml beverage samples as per the FSSAI guidelines.

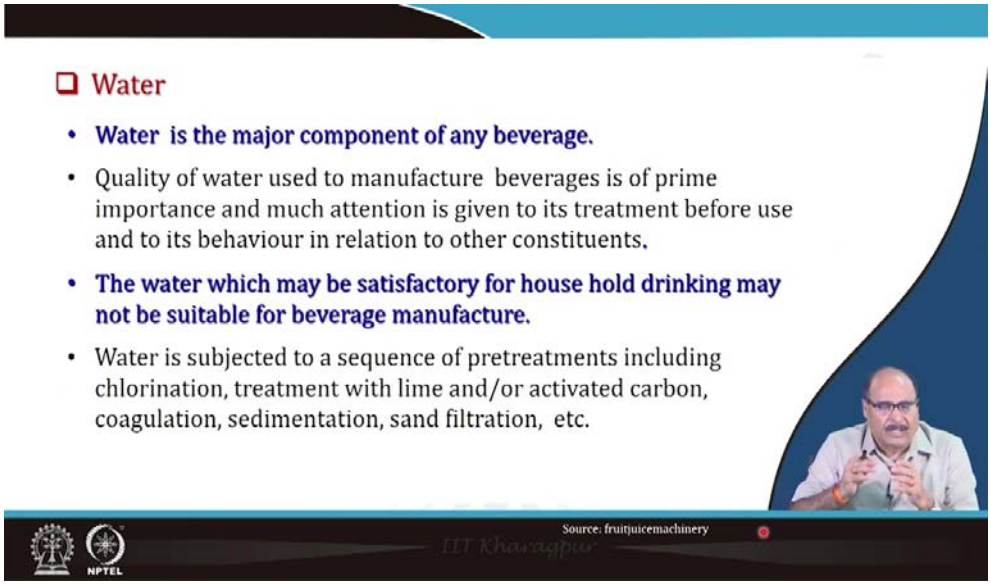
RTS mango drink

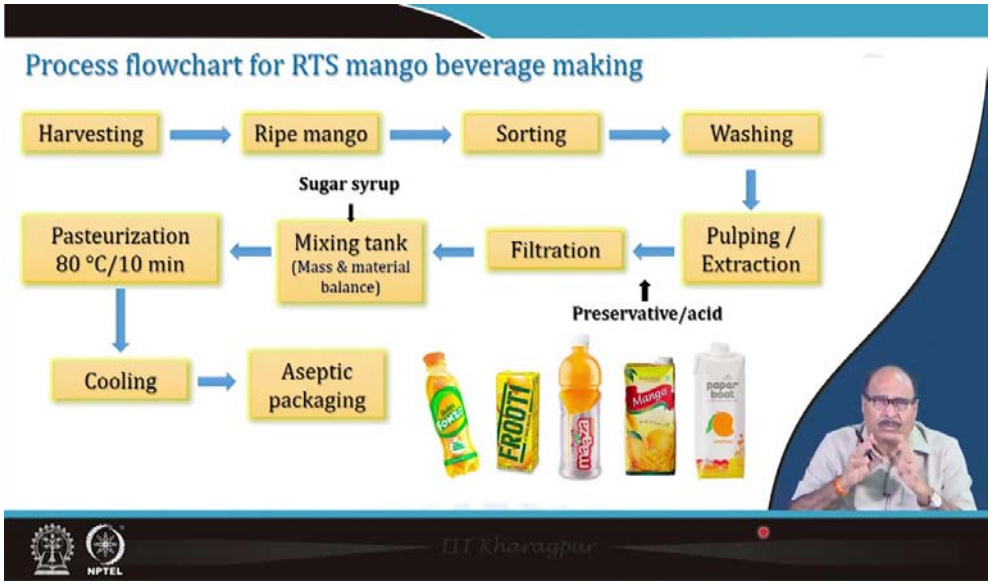
Mango is the most common tropical fruit found in India. Due to its rich flavor, fragrance and taste, it was liked by the people of all age groups and thus known as the king of fruits. Mango pulp tastes sweet, it is suitable for direct eating and drinking its juice. The various ingredients for the RTS mango drink are mango pulp, sugar, water, preservatives, and flavors.

Water

Water is the most important component of any beverage. The quality of water used to manufacture the beverage is of prime importance and much attention is given to its treatment before use and to its behavior in relation to the other constituents particularly the fruit juice or in the fruit pulp. The water should be free from any solid, sediment etc. The water which may be satisfactory for household purposes may not be suitable for beverage manufacture. Generally, extra pure water is used for any beverage preparation whether it is RTS mango beverage or any such other beverage. The water is subjected to a sequence of pretreatments including chlorination, treatment with lime and activated carbon, coagulation, sedimentation,

sand filters etc. The purpose is that it should not contain any suspended solids otherwise it may have unwanted reactions with the flavoring component, coloring components of the juices and can cause problem.





Process flowchart for RTS mango beverage manufacturing

RTS mango juice of various brands commercially available in the market are shown in the figure. Mango was harvested, ripe mangoes are sorted and washed, followed by pulping and extraction of juice as discussed earlier. After getting the pulp or juice of desired soluble solids, it is filtered or clarified and then clarified was mixed with the already prepared sugar syrup in the mixing tank. The mixing tank is the most important stage as it decides the final output based on proper material and mass balance.

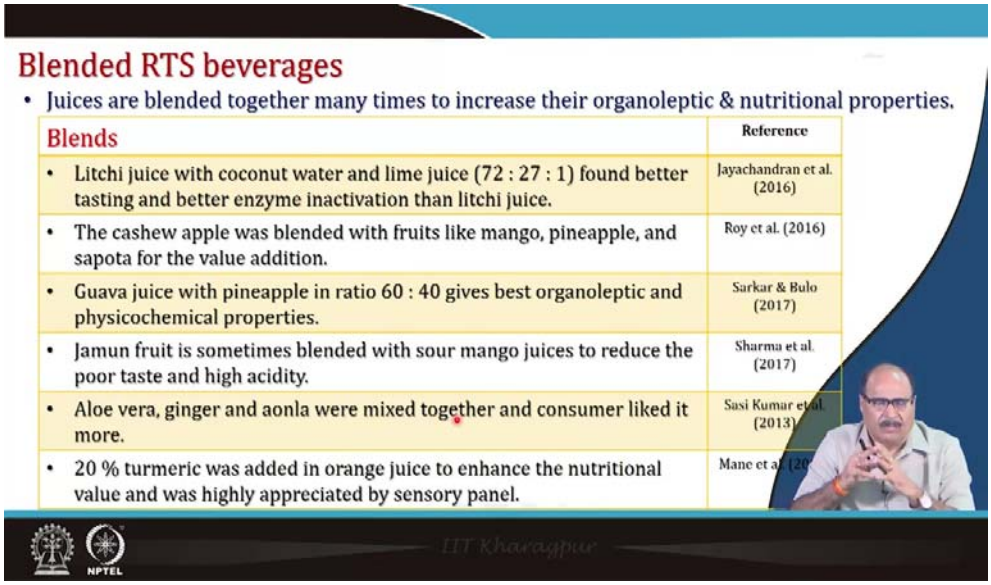
For example, a pulp having 20 % total solids and want it to make a juice having 5 % total solids. The total water required to be added can be calculated. Accordingly, based on the sweetness or concentration required, sugar solution need to be mixed can be calculated. The

important thing is that it is not only just material balance, one should also take care that while doing the material balance at least sensory characteristics are maintained to the desired level. The rest thing is common for any beverage. After mixing, this RTS mango beverage is pasteurized at 80 °C for 10 min, then cooled down and sent to the aseptic packaging line.

These is the process line for developing RTS mango beverage.

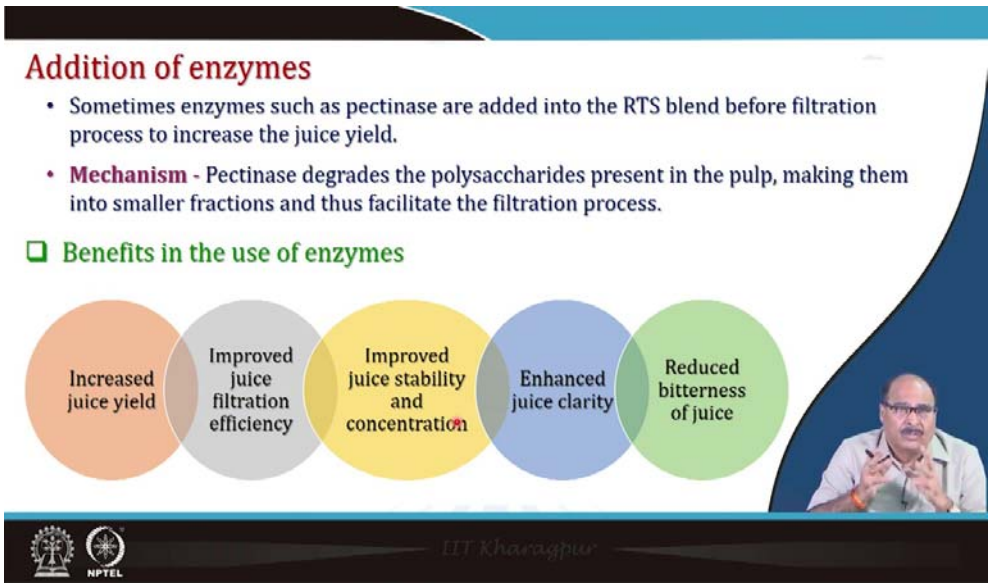
Machinery used in RTS mango beverage manufacturing

These are the equipment which are used for manufacturing of RTS mango beverage. These equipment can be used for others such fruits and vegetables as well like elevator, sorter, brush and spray cleaner, peeler, pulper, juice extractor or juice fine filter, pasteurizer and then aseptic packaging on it. So, almost all the fruits and vegetable juice processing and packaging line there may be single little bit here and they have some additional relation depending upon the particular characteristics of the fruit or vegetable otherwise these are the most common.



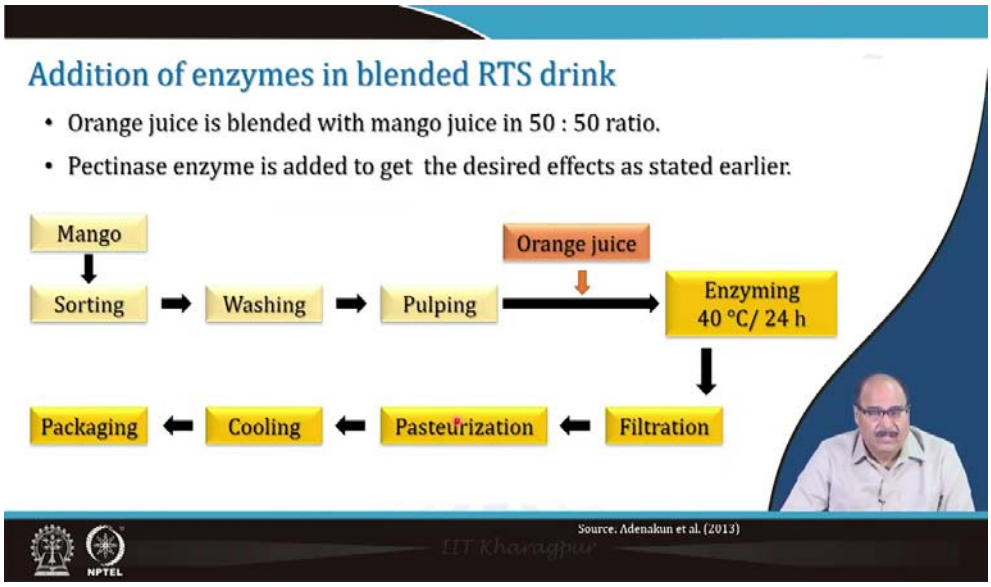
Blended RTS beverages

In the given table, the literature report for RTS juice blends has been provided. Jayachandran et al. (2016) reported that Litchi juice with coconut water and lime juice (72:27:1) found better tasting and better enzyme inactivation than litchi juice. Roy et al. (2016) reported that the cashew apple was blended with the fruits like mango, pineapple and sapota for the value addition. Sarkar & Bulo (2017) mixed guava juice with pineapple in the ratio of 60:40 and got best organoleptic and physicochemical properties. Sharma et al. (2017) blended Jamun fruit with sour mango juice to reduce the poor or sour taste of the mango juice and high acidity. Many authors have reported that blending of juices was much more beneficial either in sensory or in nutrition. There are many such even now this blended RTS beverages are available in the market also.



Addition of enzymes

Enzymes are added sometimes into the RTS juice or blends before filtration process to increase the juice yield as well as to clarify the juice. The pectinases degrades the polysaccharides present in the pulp, making them into smaller fractions and thus facilitates the filtration process. Similarly, other enzymes as well can be used depending upon what are the different contents present in the juice or in the pulp. The benefit of adding the enzyme is many fold for example, there is increased juice yield, improved juice filtration efficiency, improved juice stability and concentration, enhanced juice clarity, and reduced bitterness of the juice.

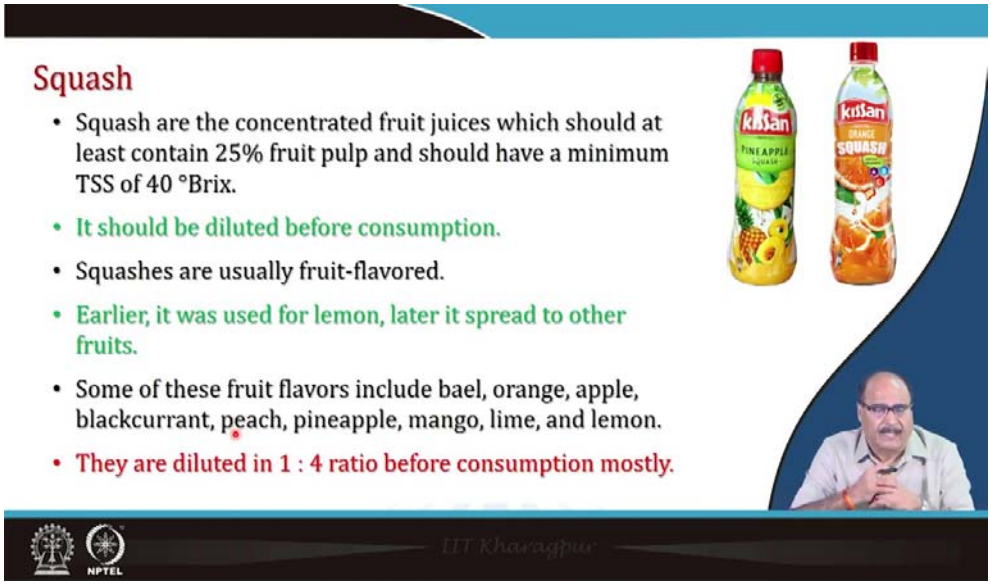


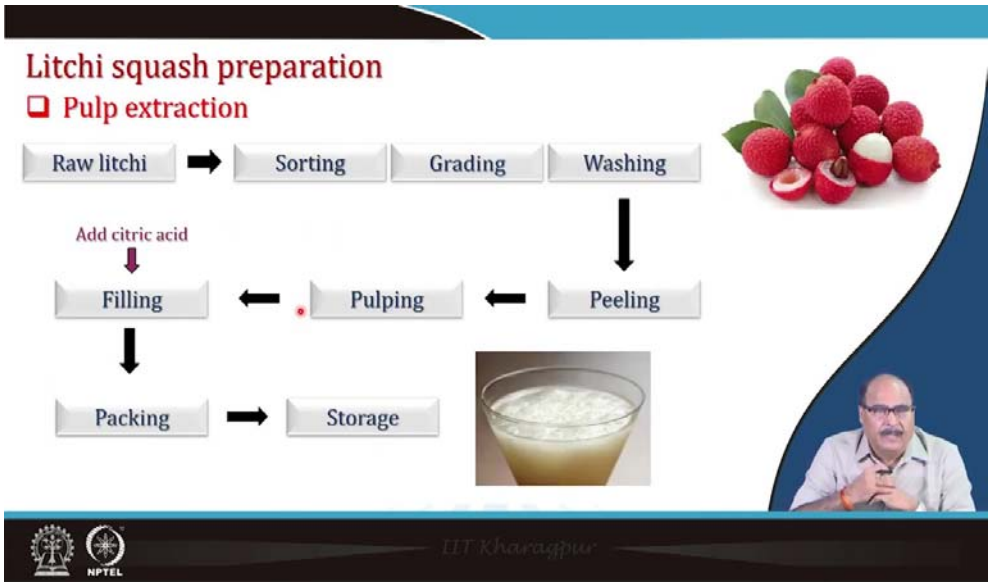
Addition of enzymes in blended RTS drink

The orange juice is blended with mango juice in 50-50 ratio and then the pectinase enzyme is added in appropriate amount and temperature is maintained around 40 °C for 24 hours i.e. proper time is given for the enzyme to act. The suspended polysaccharides present in the juice are dissolved by these enzymes and then they brought them into soluble components and hydrolyzed them and then it is removed by the filtration. They filled the juices then filtered, pasteurized, cool and packaged using either aseptic packaging line or other line.

Squash

Another category of the fruit beverage is squash. Squashes are the concentrated fruit juices which should at least contain 25 % fruit pulp and should have a minimum 40 % TSS. So, it should be diluted before consumption. Squashes are usually fruit flavored. Earlier, it was used for lemon, but now it has spread to other fruits as well. Some of these fruit flavors include bael, orange, apple, blackcurrant, pineapple, mango, lime, and lemon. They are diluted in the ratio of 1:4 before consumption.

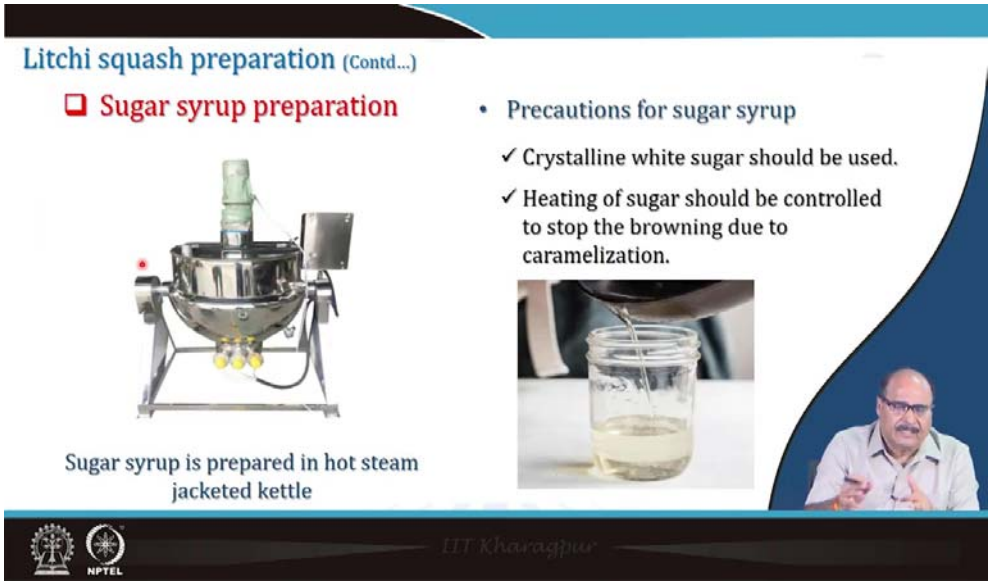


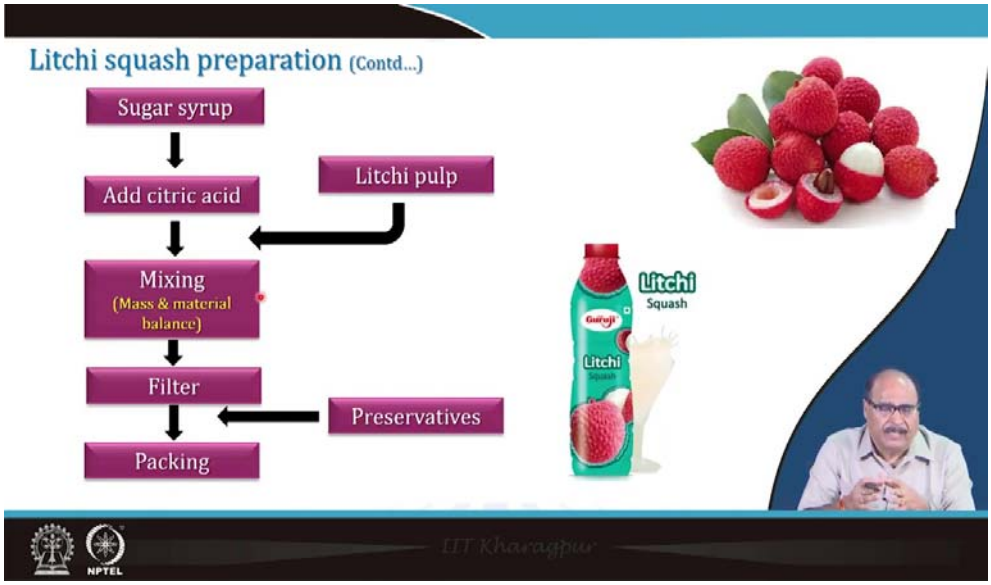


Litchi squash preparation

The raw litchis are sorted, graded, and washed before peeling. The first step is the conversion of whole litchi into pulp then citric acid as a preservative is added in the pulp the filled and packed. Similarly, any pulpy fruit can be used to make squash using the standard technology.

The sugar syrup is prepared separately in a hot steam jacketed kettle. Some precautions should be taken care of during the preparation of sugar syrup such as (i) crystalline whites sugar should be used for preparation of the super syrup, and (ii) heating of the sugar should be controlled so as to avoid browning or caramelization otherwise it will adversely affect the color of the beverage squash.

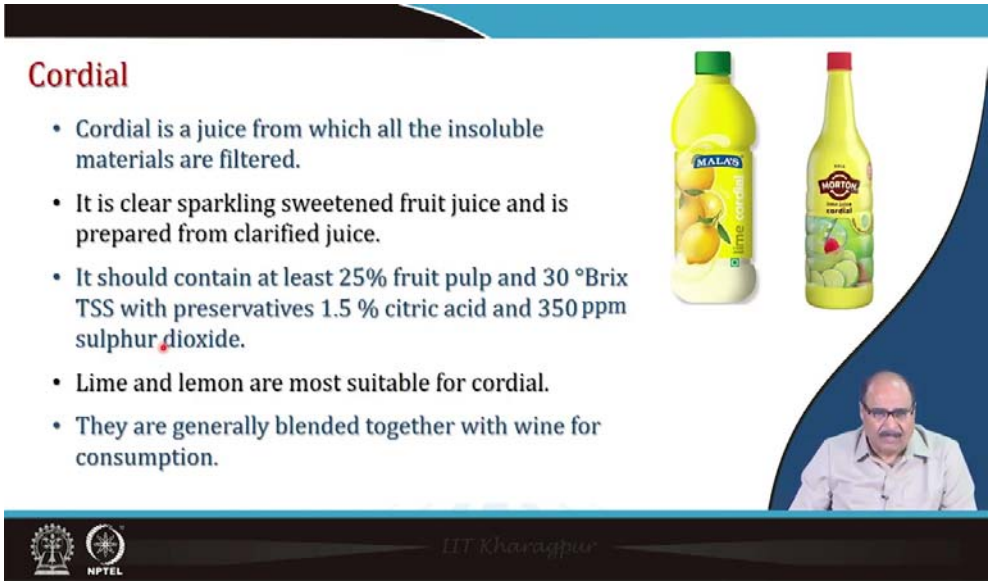


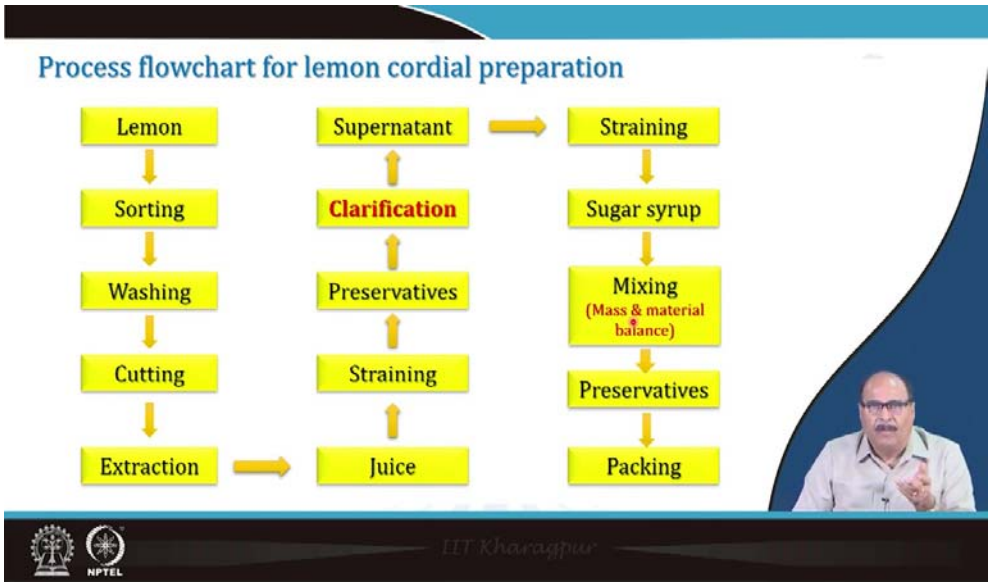


For the preparation of litchi squash, citric acid added sugar syrup is used and pulp is added here and it is mixed and proper mass and material balance was maintained based on sensory as well as FSSAI guidelines. It is followed by filtration, preservatives maybe added before packaging and then aseptic processing.

Cordial

Cordial is another category, it is a juice from which all the insoluble material are filtered. It is clear sparkling sweetened fruit juice and is prepared from clarified juice. It should contain about 25 % fruit pulp and 30 °Brix TSS with preservatives about 1.5 % citric acid, and 350 ppm sulfur dioxide. Lime and lemon are the most suitable for cordial making. They are generally blended together with wine for consumption.



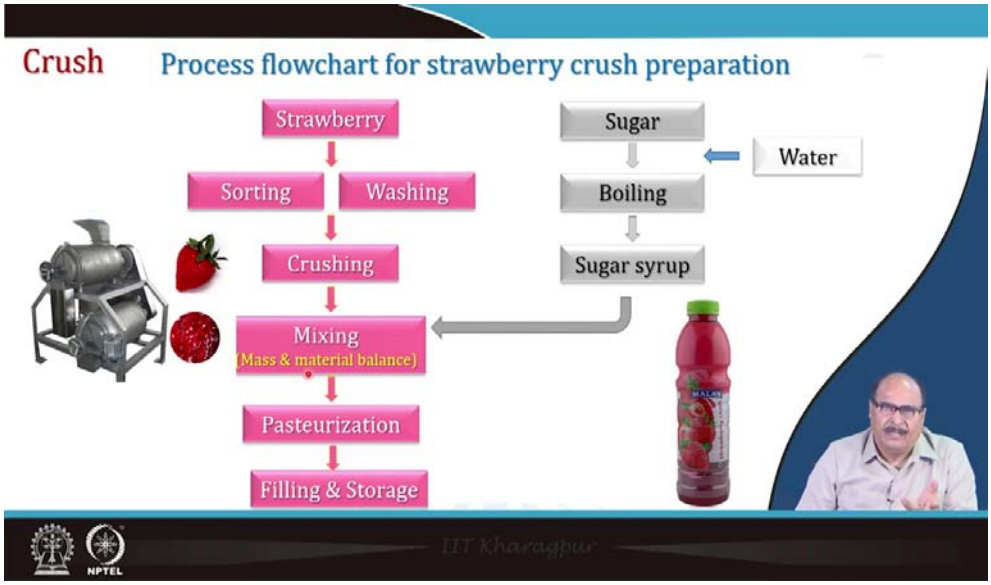


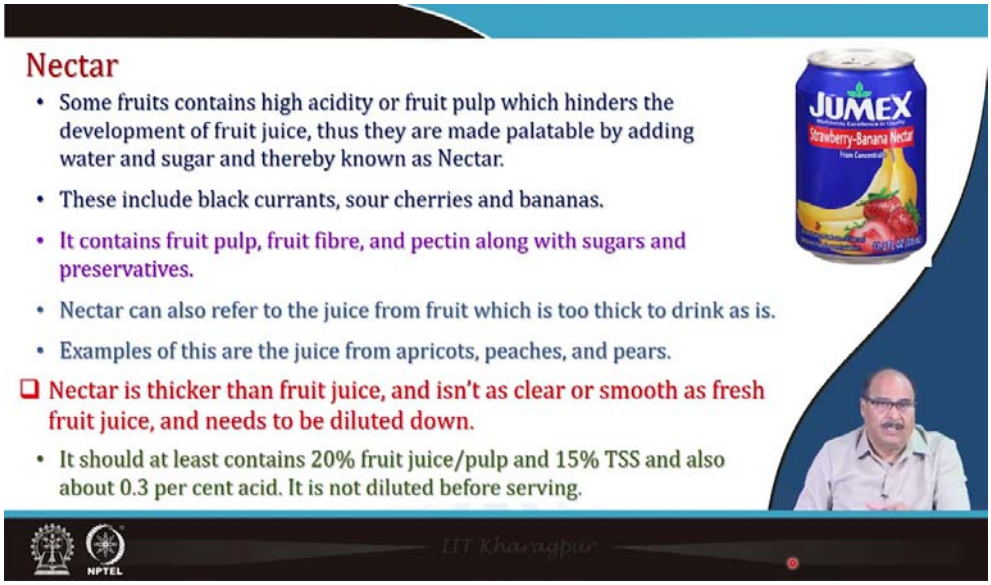
Process flowchart for cordial preparation

Lemon is used and juice was extracted then this juice is strained, preservatives are added. These are then clarified, normally it is stored in a container for 10 days. This clear juice supernatant is taken and sediments etc. are filtered away and then finally strain then sugar syrup is added and mixed, preservatives are added and it is packaged.

Crush

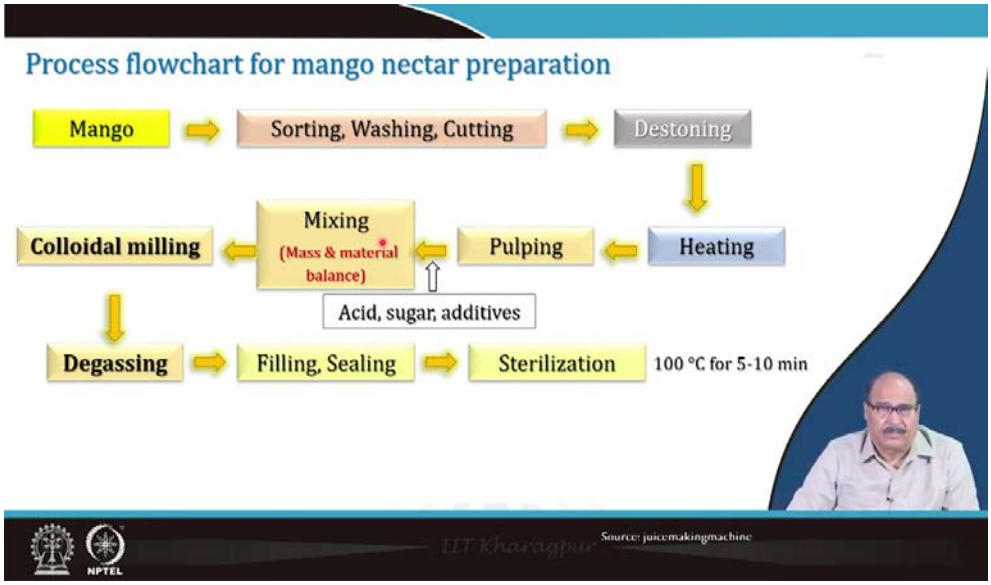
Crush is another product, the process flowchart for strawberry crush is shown. Strawberry is sorted, washed, and then crushing was done. The sugar syrup was prepared separately and was mixed in proper proportion according to the requirement to get the desired level of solids as well as total soluble solids and then it is pasteurized, filled and packaged.

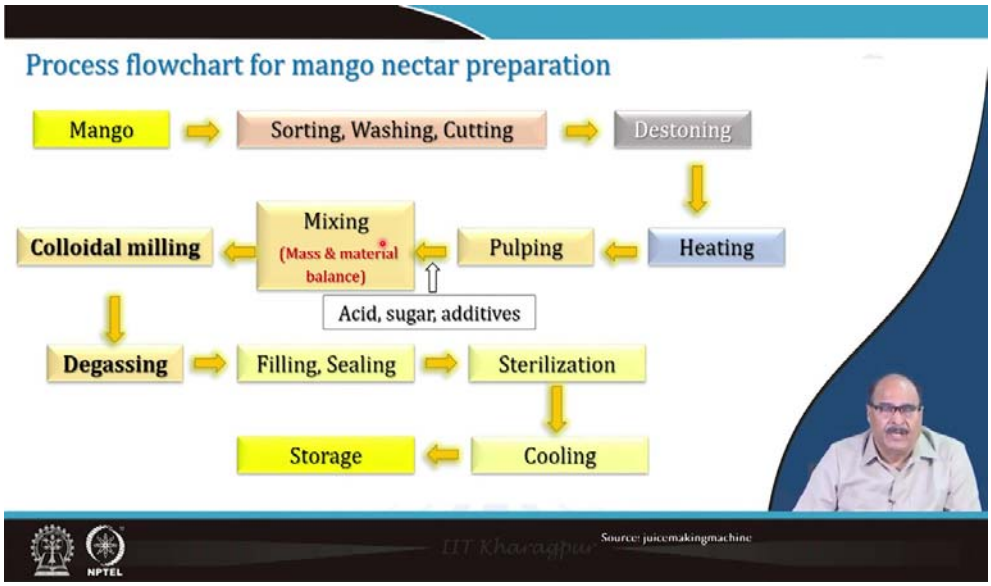




Nectar

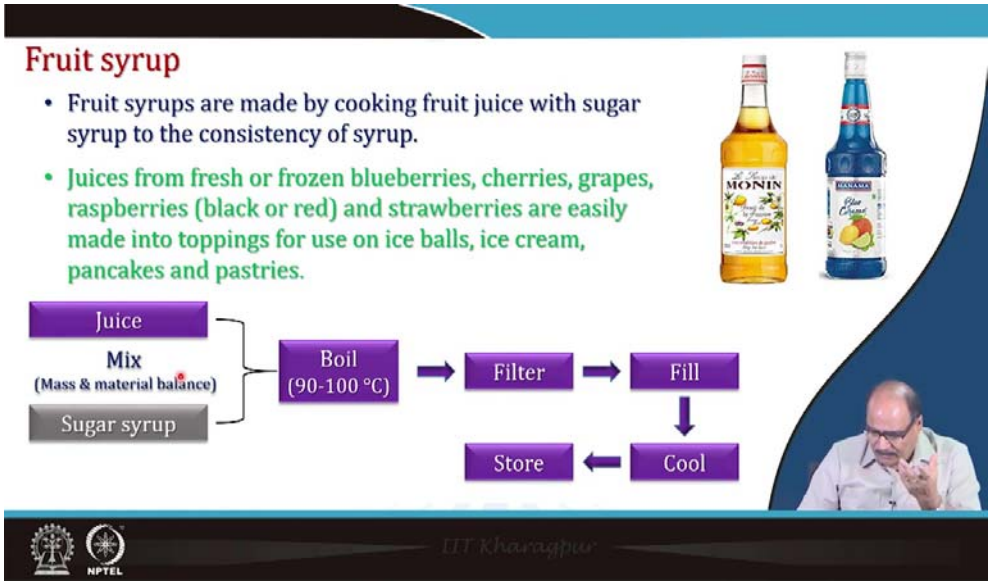
Some fruits contains high acidity or fruit pulp which hinders the development of fruit juice, and thus they are made palatable by adding water and sugar and they are known as nectar. These include black currants, sour cherries and bananas. It contains fruit pulp, fruit fiber, and pectin along with the sugars and preservatives. Nectar can also refer to the juice from fruit which is too thick to drink as it is. Examples of these are the juices from apricot, peaches and pears. Nectar is thicker than fruit juice and isn't as clear or smooth as fresh fruit juice and is needed to be diluted down. It should contain at least 20 % fruit juice or pulp, 15 % TSS and also about 0.3 % acid. It is not diluted before serving so it is made in this proportion.





Process flowchart for mango nectar preparation

The mango is sorted, washed, cleaned, and destoned. The destoned mango was heated and pulp was separated then sugar additives and acid etc. are added and mixed by adjusting the material and mass and total soluble solids and these sugars should be added to ensure the proper sweetness, acids and sugar, all these balancing is done. Then colloidal milling is used for uniform homogeneous suspensions to get the smooth product. Degassing is done to prevent oxidation, after that it was filled at around 65 °C and sealed where there should not be any gas in the head space of the container. Otherwise it may create oxidation problem. Finally, it is sterilized at 100 °C for 5 to 10 min and then cooled and storage. So, this is the process flowchart for the mango nectar preparation.



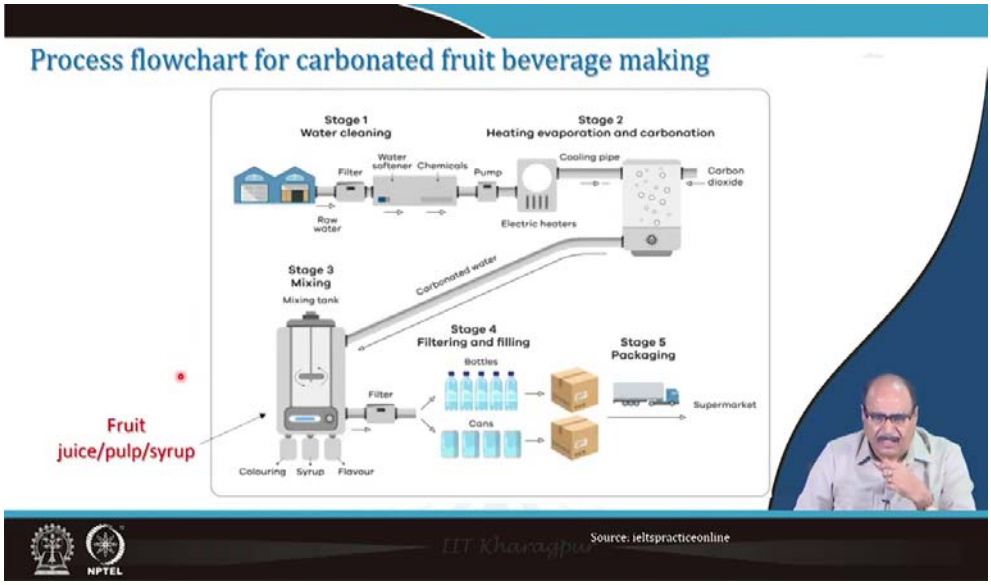
Fruit syrup

Fruit syrups are made by cooking fruit juice with sugar syrup to the consistency of syrup. Juices from fresh or frozen blueberries, cherries, grapes, raspberries (black or red), and strawberries are easily made into toppings for use on ice balls, ice cream, pancakes and pastries. This is the process flowchart for fruit syrup where juice and sugar syrup were mixed in appropriate proportion, then this mixture is boiled to around 90 to 100 °C, filtered, filled and cooled, packaged and stored.

Carbonated fruit beverages

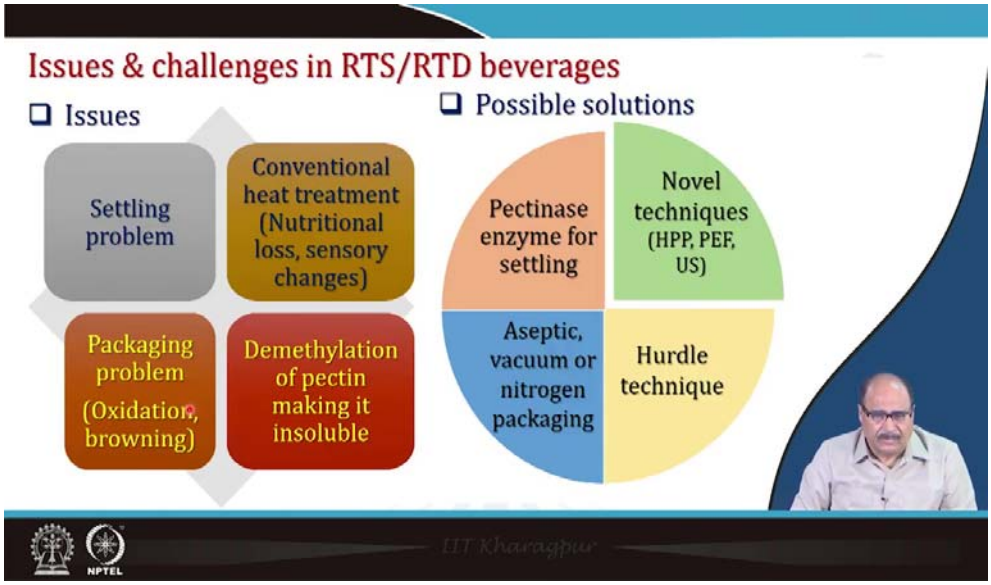
Carbonated soft drinks are thirst quenching and have refreshing properties, but they lack nutrition. FSSAI in 2016 regularized the use of fruit pulps (minimum 5 %) in the carbonated beverages to make them carbonated fruit drinks. The purpose of carbonation is the enhancement of organoleptic properties without affecting the nutritional value of the fruit used. The major challenge is to match the carbonation with fruit taste making them better.

The taste of the fruits should go side by side, so bitter fruits like aonla, jamun, lime etc. may be better suited for use in the carbonated fruit beverages. Spices can also be used to enhance the sensory properties. The beverage could contain peel, oil, and fruit essence.



Process flowchart of the carbonated fruit beverage making

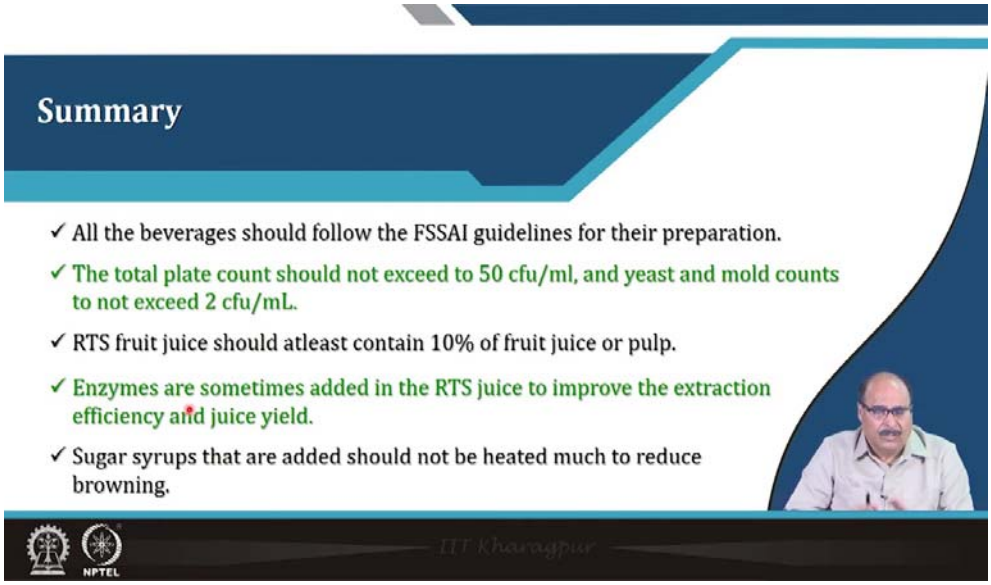
This is a process line of the making of any carbonated soft drink. For making carbonated soft drink, sugar syrup is taken and synthetic flavors and synthetic colors and preservatives are added. So, a sugar emulsion is made, flavor, color and preservative emulsion is made separately and added into the sugar syrup and concentrated sugar syrup was developed which was diluted using a carbonated water or diluted with water and then carbonation was done under pressure of 1 to 5 volume carbon dioxide. But this synthetic flavors, now as per the regulations are replaced with natural fruit flavors i.e. either fruit syrup/fruit pulp/fruit juice and the rest of the process remains unchanged. However, there are certain challenges i.e. the amount of fruit used and there should not be any unwanted reaction with the carbon dioxide and the flavoring or coloring components of the fruit juices and they should have proper shelf life i.e. during storage, the problems related to oxidation etc. should be avoided.



Issues and challenges in RTS/RTD beverages

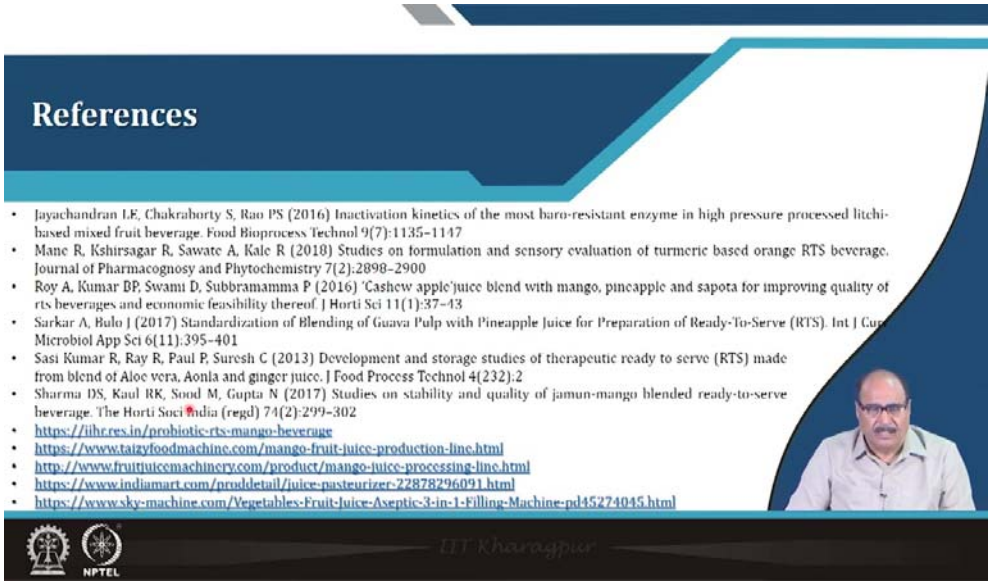
There are many issues like settling problem due to improper inactivation of enzymes such as pectinase or pectin methyl esterase enzymes. These pectinase or pectin methyl esterase during the storage of the juice works on the pectin and demethylates it. This demethylated pectin is becomes insoluble and settles. The other problem may be the conventional heat treatment for making beverage. It may have adverse effects on nutritional quality, sensory characteristics, and bioactive components. The packaging problem can lead to oxidation & browning if the packaging material is not appropriately selected.

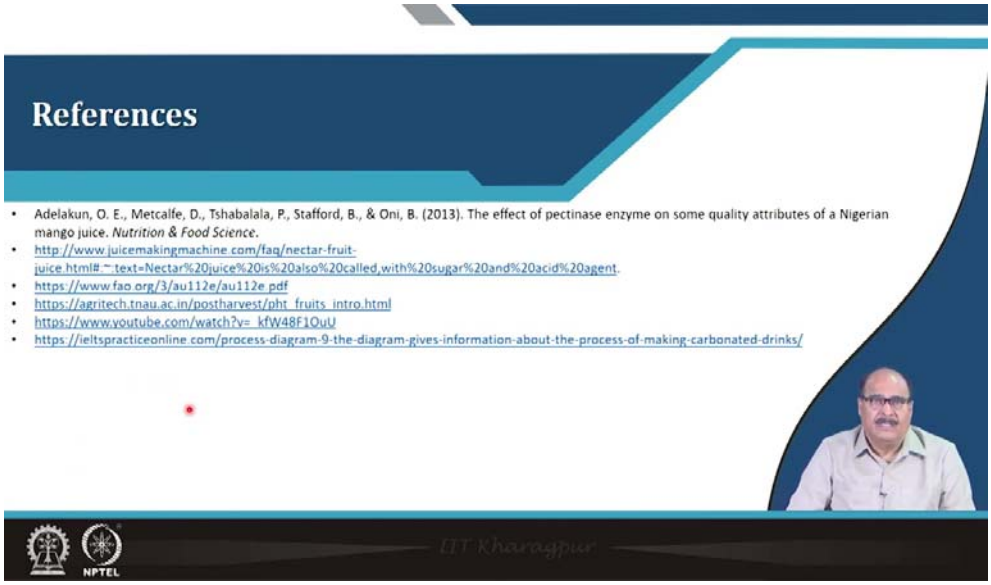
There are some appropriate hurdle technology or other arrangements for activating or deactivating the enzyme to make ensure that the product quality is maintained. Then aseptic or vacuum or nitrogen packaging should be encouraged to avoid the oxidation or browning or packaging related problems. In order to have a better bioactives retention, better nutritional characteristics, better sensory characteristics in the product, the novel techniques such as high pressure processing, PEF, ultrasound etc. should be encouraged during the extraction process as well as during the subsequent process further that is the sterilization and aseptic system and the packaging maybe modified here in the case of juices and beverages.



Summary

The fruits and vegetables can be used to develop RTS, RTD beverages and they are the hub of the nutrition. Nowadays, many countries and people are going towards the healthy carbonated drinks instead of the soft drinks which are harmful to health. In this healthy carbonated drinks category, minimal processing should be considered so as to retain the maximum nutrients. A properly processed carbonated drink has sufficient shelf-life to have a commercial value. At the same time, it must has a good sensory characteristics and good bio actives and health components.





These are the references for further study. Thank you.