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

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Lecture 45
Condiments Technology

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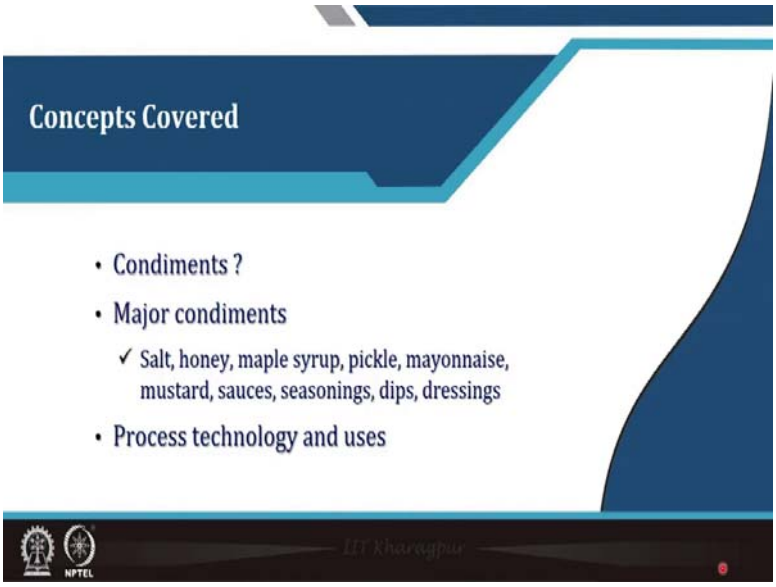

Hello, everybody. Namaskar. Today we will discuss Condiments Technology. The aspects that we will cover in today's lecture include what are the condiments, then major condiments like salt, honey, maple syrup, etc., and process technology for making the condiments and their food applications.

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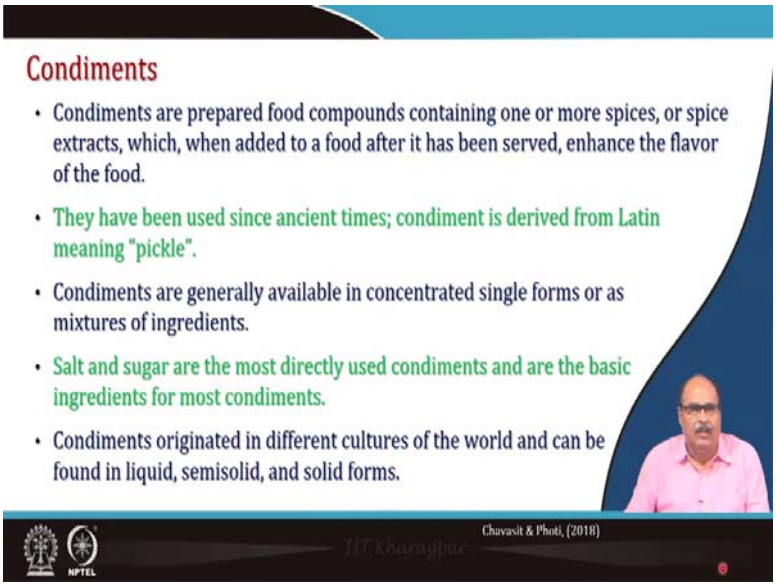

Condiments

So, let us see what the condiment means. Condiments are prepared food compounds containing one or more spices, or spice extracts, which when added to the food after it has been served, enhance the flavour of the food. Condiments have been used since ancient times. It is derived from the Latin word condiment, word condiment is derived from Latin, which means pickle.

Condiments are generally available in concentrated single forms or they are used as or they are available as a mixture of ingredients. Salt and sugar are the most directly used condiments and are the basic ingredients for most condiments. Condiments originated in different cultures of the world and can be found in liquid, semi-solid, and solid forms.

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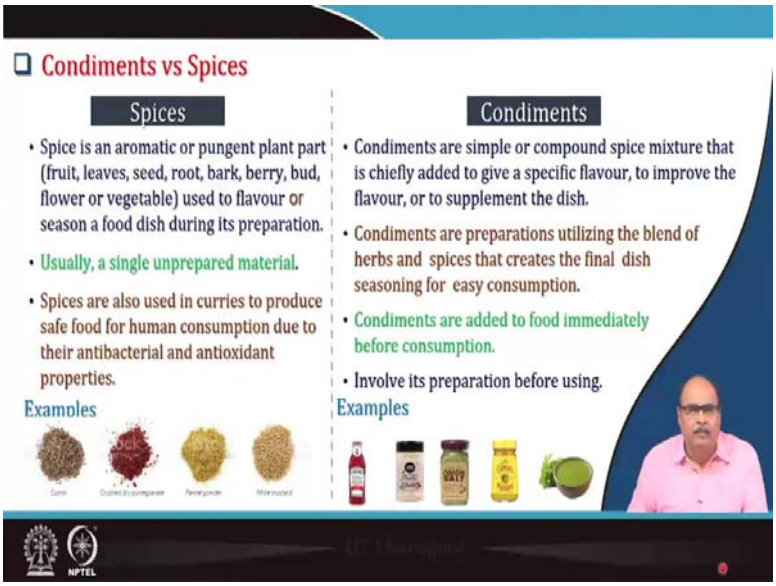

Condiment vs Spices

If we have a comparison between spices and condiments, in earlier classes we have seen that spice is an aromatic or pungent part of the plant, which is used to flavour or season a food dish during its preparation. Spice is usually a single unprepared material. Whereas condiments are simple or compound spice mixtures that it chiefly added to give a specific flavour, to improve the flavour, or to supplement the dish.

Condiments are preparations utilizing a blend of herbs and spices that creates the final dish seasoning for easy consumption. Condiments are added to food immediately before consumption. Whereas spices are also used in curries to produce safe food. Spices are added

during the cooking process of the food. But the condiments are generally added before the food is consumed and it involves its preparation of course before use.

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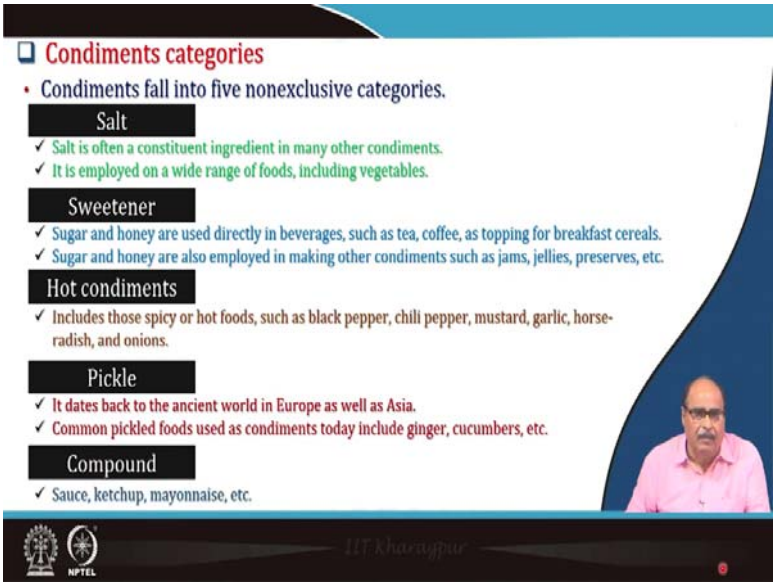

Condiment categories

The condiments categories if you see there are about five non-inclusive categories in condiments. One is salt, it is often a condiment ingredient in many other condiments. It is employed in a wide range of food including vegetables, and many other products. Sweetener is another type of condiment, where sugar and honey are used directly in the beverage, such as coffee, tea, toppings or breakfast cereals, sugar and honey are also employed in making other condiments, such as jam, jelly, preserves, etc.

Hot condiments include spicy or hot food such as black pepper, chilli pepper, mustard, garlic, horse radish, onions, and so on. The pickle dates back to the ancient world in Europe as well as in Asia. Common pickle food items such as condiments today include ginger pickle, cucumber, and so on. And then the compound condiments include sauces, ketchup, mayonnaise, etc.

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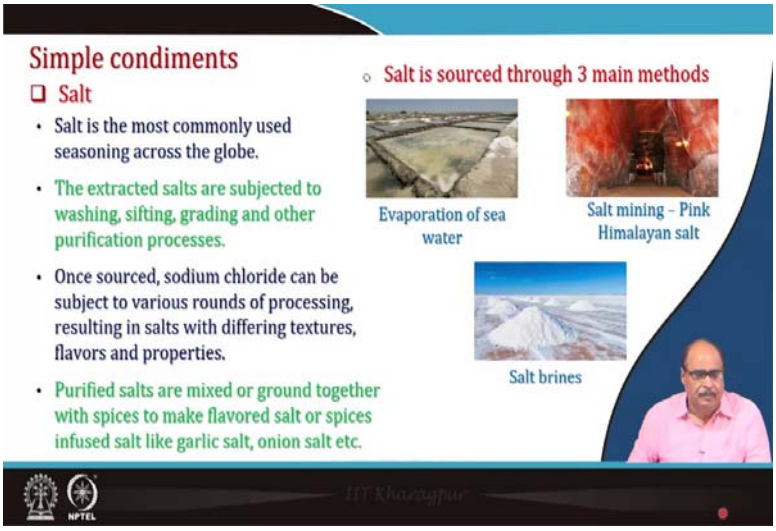

Simple condiments

Salt

Now, we will discuss briefly these condiments one by one. Salt is the most commonly used seasoning across the globe. The extracted salts are subjected to washing, shifting, grading, and other purification processes. The salt is sourced through three main methods the evaporation of seawater, salt mining, or salt brines.

So, once sourced, the sodium chloride can be subjected to various rounds of processing, resulting in salt with differing textures, flavours, and properties. Even purified salts are mixed or ground together with spices to make flavoured salt, or spice-infused salt like garlic salt, onion salt, etcetera.

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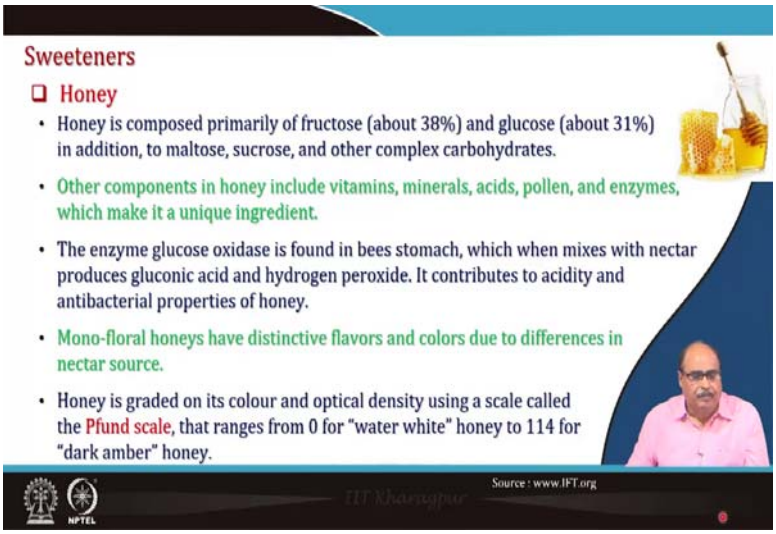

Sweeteners

Honey

Honey is another condiment that comes in the category of sweetener. It is composed primarily of fructose, that is about 38 percent of the honey is fructose and 31 percent glucose. In addition, that maltose, sucrose and other complex carbohydrates are also present in honey. The other component includes vitamins, minerals, acids, pollen, and enzymes, which make honey a unique ingredient in many food preparations.

The enzyme glucose oxidase is found in bees' stomachs, which when mixed with nectar produces gluconic acid and hydrogen peroxide. It contributes to the acidity and antibacterial properties of honey. Mono-floral honey has distinctive flavours and colours due to differences in nectar sources. Honey is graded on the basis of its colour and optical density using a scale called the Pfund scale and this Pfund scale ranges from 0 to 114, i.e. scale of 0 is for water white honey as well as 114 scales of the Pfund is known as dark amber honey.

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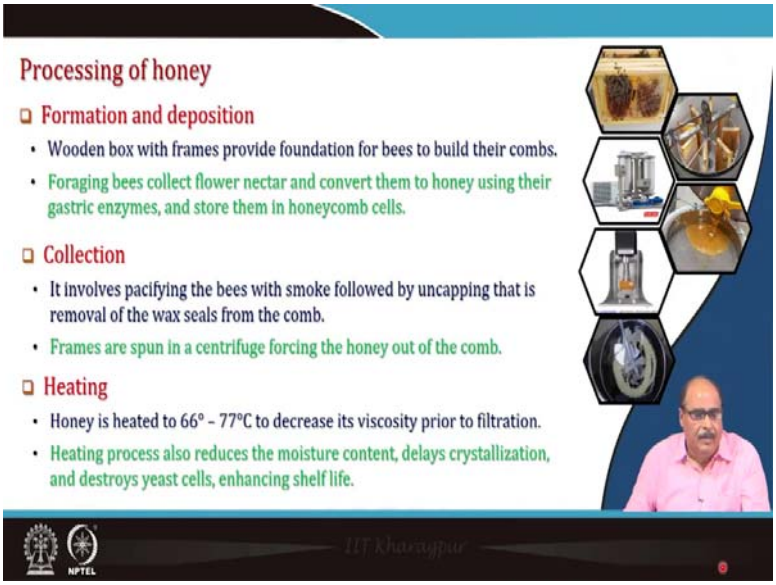

Processing of honey

In the processing of honey, there are various stages, first is the formation and the deposition. Here, wooden boxes with frames provide the foundation for bees to build their combs. Foraging bees collect the flower nectar and convert them to honey using their gastric enzymes and stored them in the honeycomb cells.

Then, these honeys are collected from these cells, it involves pacifying the bees with smoke followed by uncapping which is a removal of the wax seals from the comb. Frames are spun in a centrifuge forcing the honey out of the comb. Then the honey is heated to around 66 to 77 degrees Celsius to decrease its viscosity prior to filtration. The heating process also reduces the moisture content, delays crystallization and destroys yeast cells, enhancing the shelf life of honey.

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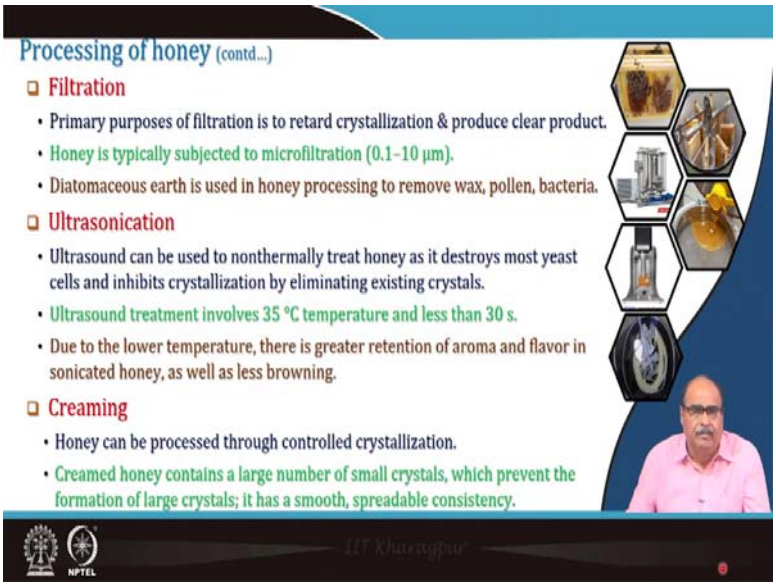

After it is heated then it is subjected to filtration treatment and the primary purpose of filtration is to retard crystallization and to produce a clear product. Honey is typically subjected to microfiltration, maybe using the microfiltration membrane of the pore size 0.1 to 10 microns. Even diatomaceous earth is also used in honey processing to remove wax, pollen, bacteria, etc.

Then, ultrasonication treatment also is given to the honey, here it destroys most yeast cells non-thermally and inhibits crystallization by eliminating the existing crystals. Ultrasound treatment involves a temperature of about 35 degrees Celsius and it treatment is given for a time maybe less than 30 seconds or so. Due to this, there is a lower temperature and a very short time duration there is greater retention of aroma and flavour in the sonicated honey as well as also there is less browning.

Creaming is another very important operation in honey processing, where the honey is passed through a controlled process for controlled crystallization. Creamed honey contains a large number of small crystals, which prevents the formation of large crystals. It has a smooth,

spreadable consistency. So, the honey is creamed or processed to get a controlled rate of crystallization and give a smooth consistency to the product.

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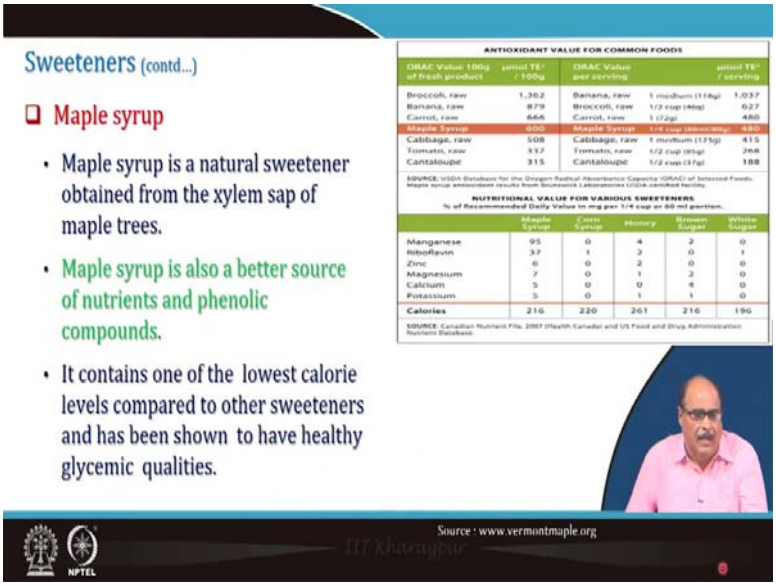

Maple syrup

We will see another sweetener condiment popularly used maple syrup. Maple syrup is a natural sweetener which is obtained from the xylem sap of maple trees. Maple syrup is also a better source of nutrients and it is a very good source of phenolic compounds. You can see here in the table, the antioxidant potential of maple syrup, it has the tocopherol equivalent in micromoles maybe 400 micromoles per 100 grams.

It has a good antioxidant potential. It contains one of the lowest calorie levels compared to the other sweeteners and has been shown to have healthy glycemic qualities i.e. its glycemic value is lower it is healthy, it can be consumed even by people who are having a little higher level of glucose.

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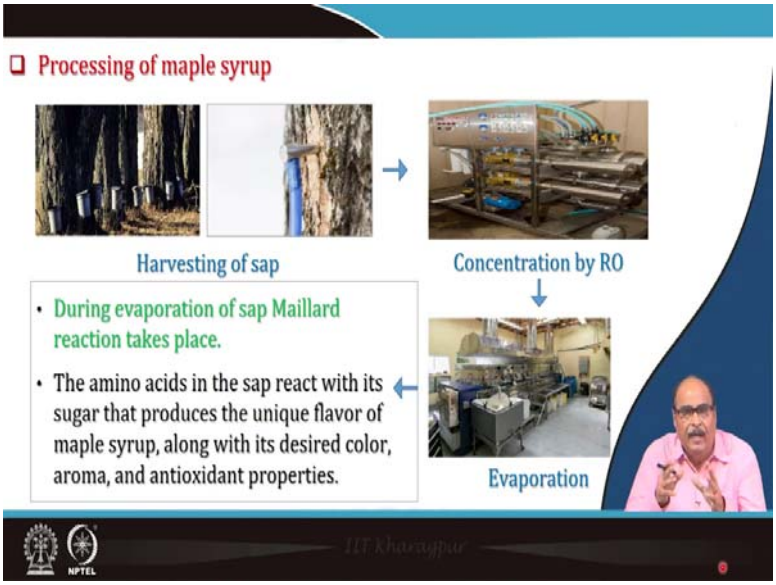

Processing of maple syrup

As far as the processing of the maple syrup is concerned, you see that the first step is the harvesting of the sap of the maple tree, you can see in the figure, that just from the tree this shape is collected and then these are collected sap is concentrated by suitable processes most commonly that is recommended process is the reverse osmosis followed by evaporation. So, during the evaporation of the sap, the Millard reaction takes place. The amino acid in the sap reacts with its sugar which produces the unique flavour of maple syrup, along with its desired colour, aroma and antioxidant properties.

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Compound condiments

Pickled food

Let us discuss the compound condiments and there are pickled foods. Pickling is defined as the process of preserving food by either anaerobic fermentation in brine or immersing it in vinegar. Pickling can add a special flavour to food by themselves mixed with other foods, the process of pickling is also known as brining, and the resulting food is known as a pickle.

Pickles usually refer to vegetable products, but sometimes even fish, egg, meat or other such products are also subjected to the pickling process. It is basically a process to extend the shelf life of the product by controlling or increasing the acidity or lowering down the pH. So, achar and kimchi are Indian and Korean variations of pickled foods, which include many other spices along with the salt and the fermentation process.

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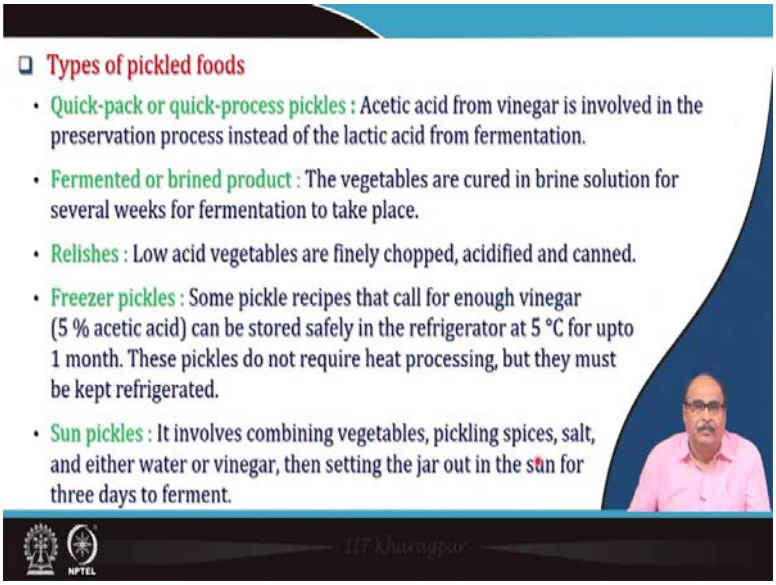

Types of pickled foods

So, type of pickled foods, there are various categories. One is the quick-pack or quick-process pickles, here acetic acid from the vinegar is involved in the preservation process instead of the lactic acid fermentation. So, the commodity may be added to the acetic acid directly. Fermented or brined products, the vegetables are cured in the brine solution for several weeks for fermentation to take place.

In relishes, low-acid vegetables are finely chopped, acidified and canned. Freezer pickles include some pickle recipes that call for enough vinegar maybe 5 percent acetic acid. This can be stored safely in the refrigerator at 5 degrees Celsius for up to 1 month. These pickles do not require heat processing but they must be kept refrigerated. These are known as freezer pickles. Sun pickles, that it involves combining vegetables, pickling spices, salt, and either water or vinegar and then setting the jar out in the sun for about 3 days to ferment.

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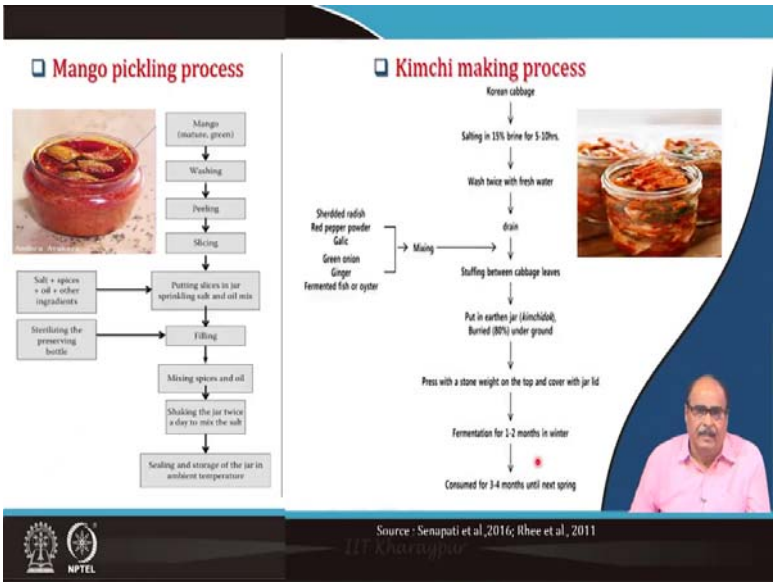

Here the process of mango pickle manufacture as well as kimchi making is shown in this slide. In the mango pickles, mature green mangoes are taken after washing and peeling, they are sliced suitably and then slices are put into the jar where there are mixed with the sprinkling salt and oil, etc. Salt, spices, oil another ingredient, all those things are mixed as a smear in the sliced mango and then this is filled into glass bottles or glass jars. These glass bottles or jars are obviously previously sterilized. So, after filling, spices and oils are added into the bottle or jar. They are shaken well twice a day and mixed with salt, etc. The jar or bottle is sealed and stored at the ambient temperature so it takes some time for the development of the proper flavour and texture of the pickle.

In the kimchi-making process, Korean cabbage is taken. It is salted in 15 percent brine for 5 to 10 hours, then washed twice with fresh water and the water is drained. The material & other spices like shredded reddish, red pepper powder, garlic, green onion, ginger or even sometimes fermented fish or oyster are mixed in this salted cabbage or the cabbage leaves are stuffed.

These stuffed cabbage leaves with spices are put in jars which are called *kimchidok*. Here this container or dock pot or the pot is buried 80 percent almost underground, only the top portion is there above the ground and the top portion is pressed with a stone weight and covered with a jar lid and left in an open environment. Fermentation takes place for about 1 to 2 months in the winter season and then it is consumed for the next 3 to 4 months until the next spring. So, this whole process of kimchi production is very popular in Korea.

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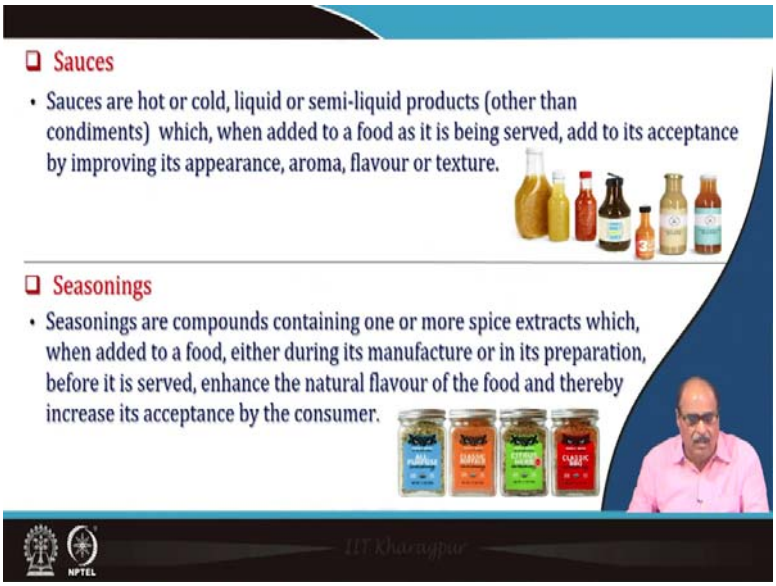

Sauces

The other condiments include sauces, which are hot or cold, and liquid or semi-liquid products, which when added to foods, as it is being served, add to their acceptance by improving their appearance, aroma, flavour or texture. There are various types of sauces, as you can see in the picture available in the market.

Seasonings

Seasonings are compounds containing one or more spice extracts, which when added to food either during its manufacture or in its preparation before it is served, enhance the natural flavour of the food and thereby increase the acceptance of the food by the consumer.

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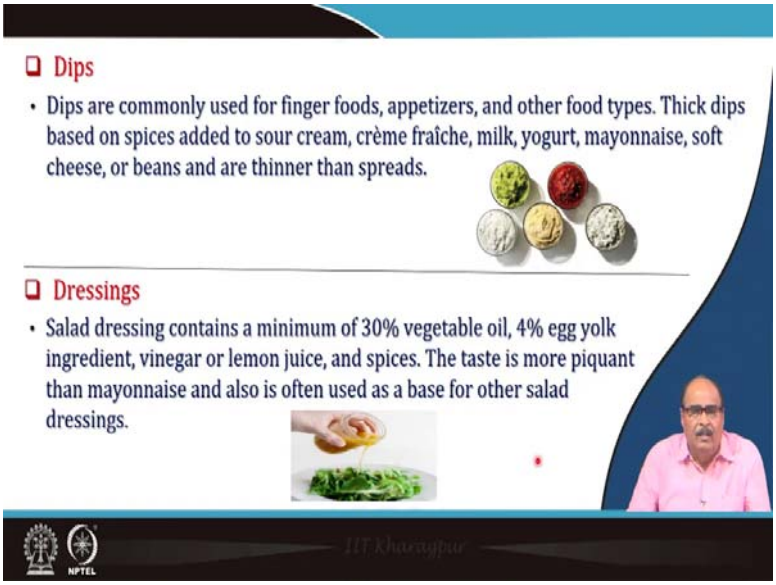

Dips

Dips are commonly used for finger foods, appetizers and other food types. Thick dips based on spice are added to sour cream, milk, yogurt, mayonnaise, soft cheese, or even beans and they are thinner than the spreads.

Dressings

Dressings like solid dressing contain a minimum of 30 percent vegetable oil, 4 percent egg yolk ingredients, vinegar or lemon juice, and spices. The taste is more piquant than mayonnaise and also is often used at the base for other solid dressings.

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Mayonnaise

Mayonnaise is a smooth, creamy, semi-solid emulsified dressing, consisting of vegetable oil i.e. about 65 percent vegetable oil and eggs, acidified with vinegar or lemon juice and delicately spiced. No other emulsifiers are allowed in this product. It is often used as a base for other dressings.

Mustard

The name mustard is derived from the Latin word must which was an unfermented grape wine made potent and fiery with the addition of ground mustard seed. So, that is the mustard sauce.

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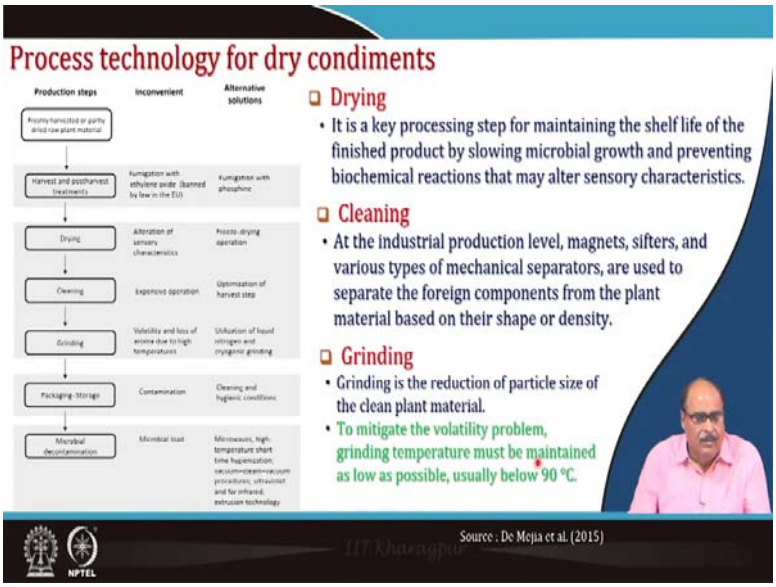

Process technology for dry condiments

The major operations include drying, cleaning, and grinding. Drying is a key processing step we have discussed in earlier classes. Drying enhances the shelf-life of the finished product by slowing down microbial growth and preventing biochemical reactions that may alter sensory characteristics.

Cleaning is an important operation at the industrial production level, magnet, sifters, and various types of mechanical separators are used to separate the foreign compound from the plant material based on their shape and density. Grinding using appropriate size reduction equipment, the material is ground to fine particle size. To mitigate the volatility problem

during grinding that care should be taken so that the temperature of the material does not exceed 90 degrees Celsius during the grinding process.

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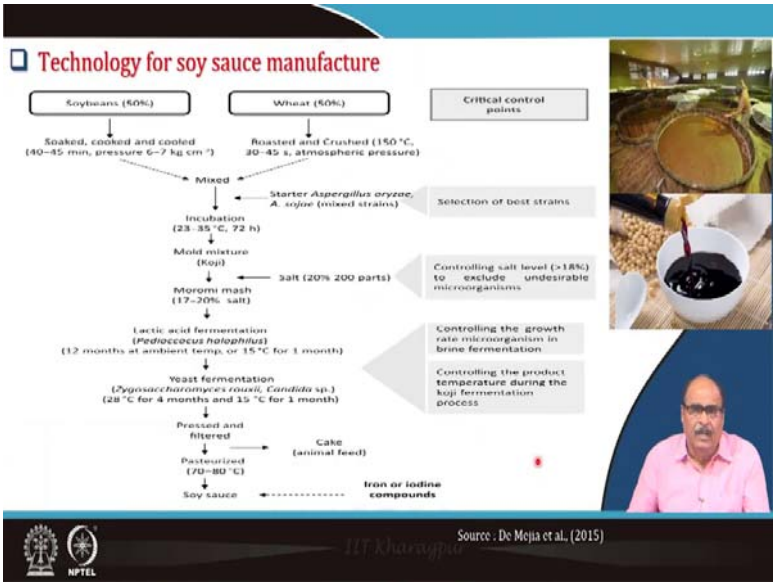

Technology for soy sauce manufacture

It is another very popular condiment. In soy sauce, soybeans are about taken 50 percent and wheat 50 percent are taken. Soybean is first soaked, cooked and cooled i.e. soaking for about 40 to 45 minutes and then cooked in a pressure cooker for 6 to 7 kg per centimetre square. On another hand, the wheat is roasted at 150 degrees Celsius for 30 to 45 seconds and then crushed at atmospheric pressure.

So, you have roasted wheat flour and soaked, cooked and cooled soybeans. These are mixed in 50-50 ratio and this mixture is the starter. A mixed culture of starter of a molds *Aspergillus oryzae* and *A. sojae* are added into the mixed wheat and soybean, incubated at around 23 to 35 degrees Celsius for about 72 hours and then, it develops into some sort of mold mixture koji. Here, salt of about 20 percent is added to 200 parts. The mixture is called moromi mash, which means it is properly mixed or sprinkled with salt as a sprinkling. It contains approximately 17 to 20 percent salt. So, it is the mold with koji, the salt is sprinkled, and then the lactic acid bacteria*, pedioccocus halophilus* causes the lactic acid fermentation. It may take about 12 months at ambient temperature or even 1 month at 15 degrees Celsius.

After this bacterial fermentation, the yeast fermentation is allowed to continue where *zygosaccharomyces rouxil* or *candida sp.* yeast etc. are inoculated for 4 months at 28 degrees

Celsius or 1 month at 15 degrees Celsius. Finally, the fermented material is pressed and filtered and pasteurized at 70 to 80 degrees Celsius and obtain soy sauce is obtained.

The residue remaining after pressing and filtration is the cake which is used as animal feed. So, the critical control points in soy sauce manufacturers include first in the selection of the best strains of the microorganism, controlling the salt level which should be more than 18 percent during the koji preparation to exclude undesirable microorganisms, controlling the growth rate of the microorganisms in brine fermentation and control of the product temperature during the koji fermentation process. So, by this proper control, we get the desired characteristics of the soy sauce, as you can see here in the picture.

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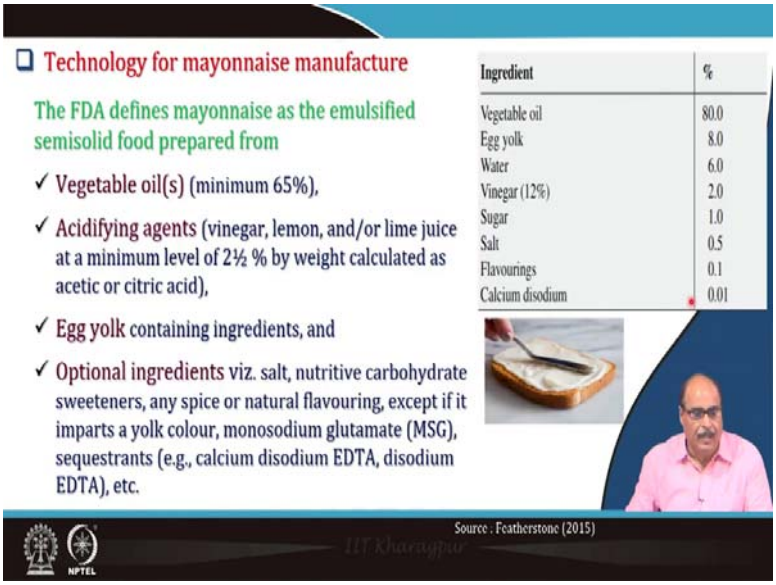

Technology for mayonnaise manufacture

The FDA defines mayonnaise as the emulsified semi-solid food prepared from vegetable oil i.e. minimum of 65 percent, acidifying agents like vinegar, lemon, and lemon juice and the minimum level should be two and a half percent by weight, calculated as the acetic or citric acid, egg yolk or egg yolk containing ingredients and finally, there may be also optional ingredients like salt, nutritive carbohydrates, sweeteners, any spice or natural flavouring, etc. can be added. Even, monosodium glutamate or some sequestrants, etc. can be added. The ingredient formulation given in the table is used in making the mayonnaise.

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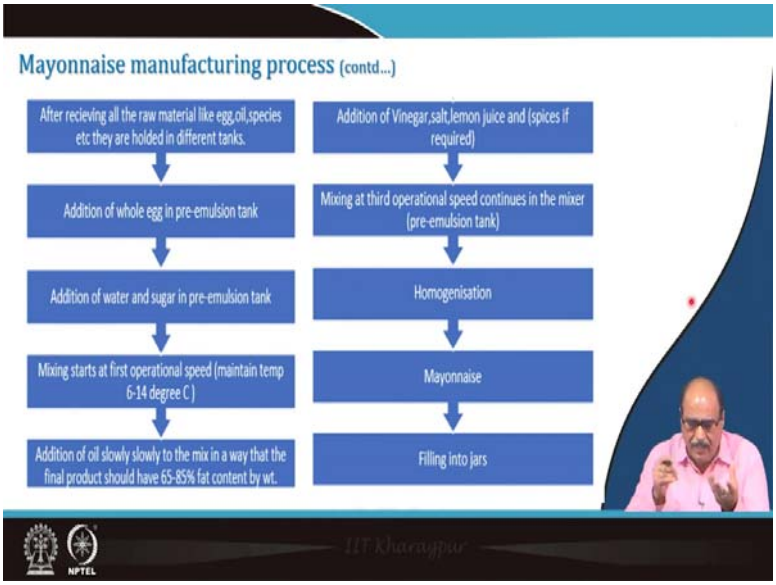

Mayonnaise manufacturing process

After receiving all the raw materials like eggs, oils, spices, etc. are held in the different tanks followed by the addition of whole egg in the pre-emulsion tank, addition of water and sugar in the pre-emulsion tank. Mixing starts at the first operational speed, maintaining the temperature at about 6 to 14 degrees Celsius. Then it is followed by the addition of oil slowly and slowly to the mix in a way that the final product should have around 65 to 85 percent fat content by weight. The vinegar, salt, lemon juice, etc. are added, and even spices if required are added. These are all finally properly mixed. Mixing at the third operation speed continues in the mixer, and then it is sent to the homogenization where it is properly homogenized and the mayonnaise is filled into the jar.

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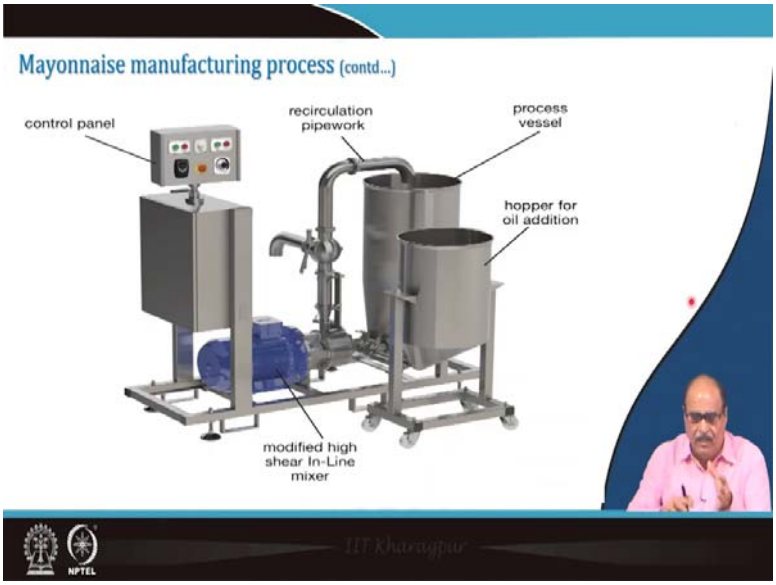

So, this is a setup machine where in these tanks various ingredients such as liquid and solid ingredients are mixed at a controlled rate. The Control panel is used for setting and controlling the parameters.

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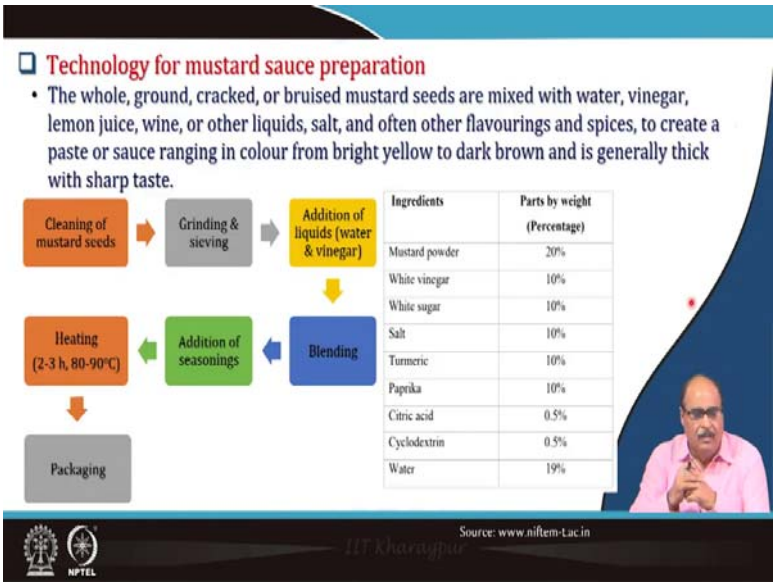

Technology for mustard sauce preparation.

Mustard sauce is whole, ground, cracked, or bruised mustard seeds. These are mixed with water, vinegar, lemon juice, wine or other liquids, salt and often flavourings and spices. These are all mixed to create a paste or sauce ranging in colour from bright yellow to dark brown and are generally thick with a sharp taste.

The ingredients include by weight or a percentage like mustard powder maybe 20 percent, white vinegar to 10 percent, white sugar to 10 percent, salt, turmeric, paprika, etc. to 10 percent, citric acid to 0.5 percent and cyclodextrin 0.5 percent and water 19 percent. All ingredients are added into the cleaned mustard seeds, then blended followed by the addition of seasoning, heating for 2 to 3 hours at 80 to 90 degrees centigrade, and packaging.

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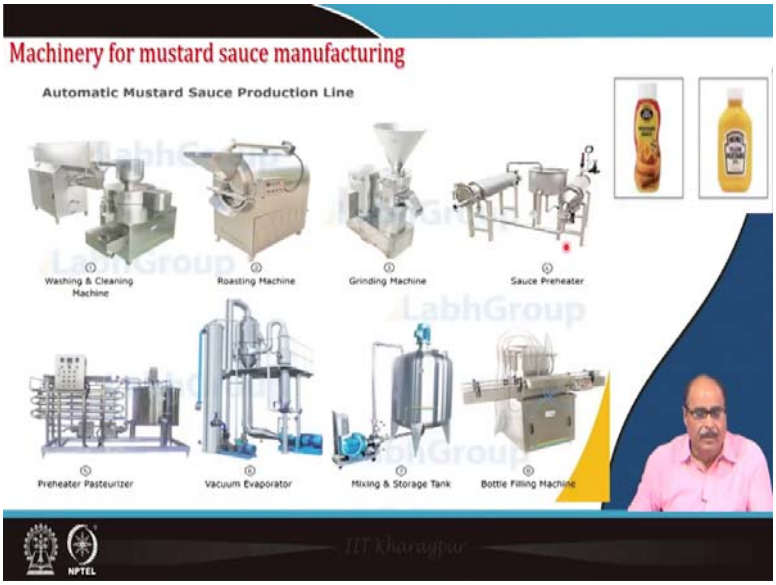

Machinery for mustard sauce manufacturing

The machinery required for mustard sauce preparation is a washing and cleaning machine, roasting machine, grinding, sauce preheater, bottle filling, mixing and storage tank, evaporator, preheater pasteurizer, vacuum evaporator, and bottle filling machine. All the necessary ingredients are roasted, pulverized and ground, mixed in sauce preheater and pasteurized and packaged.

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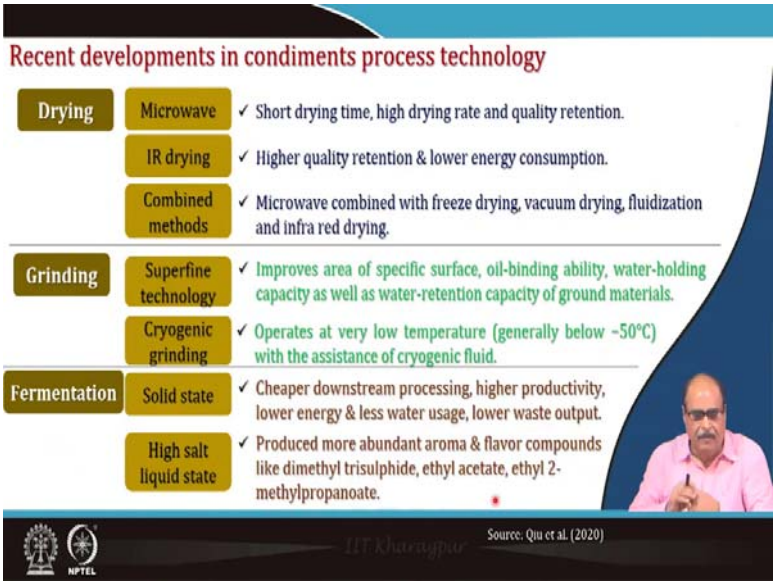

Recent developments in the condiments processing technology

Advanced method or novel methods of drying like microwave, infrared drying or combined method such as microwave combined with freeze drying, vacuum drying, fluidization drying, etc. gives a better product. For instance, mayonnaise or other such condiments are prepared that contain flavours and other bioactive substances which need to be retained. The technology of drying, grinding or fermentation should be such that these flavouring compounds are retained. In grinding, the superfine technology improves the area of a specific surface, oil binding ability, water holding capacity as well as water retention capacity of ground material. Cryogenic grinding operates at a very low temperature generally below 50 degrees Celsius with the assistance of cryogenic fluid, so that the flavouring potentials or characteristics are retained to the maximum. Fermentation may be either solid-state fermentation or high-salt liquid fermentation. The high salt liquid state fermentation produces more abundant aroma and flavour compounds like methyl trisulphide ethyl acetate, etc.

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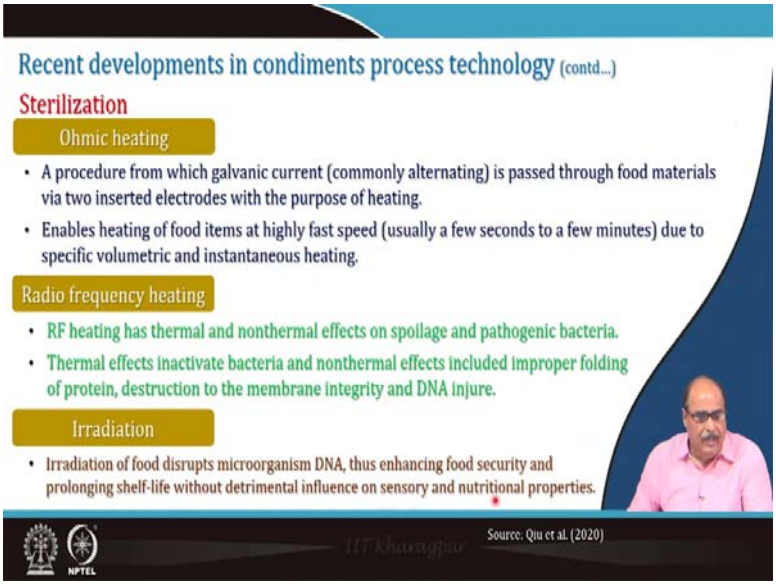

Sterilization

It is an important operation for sterilizing condiments. Recent developments or innovative technologies like ohmic heating, radiofrequency heating and irradiation are encouraged more and more. Depending upon the type or combination or formulation which is used in the spice manufacture, the process parameters are properly selected and optimized to have better retention of flavouring potential.

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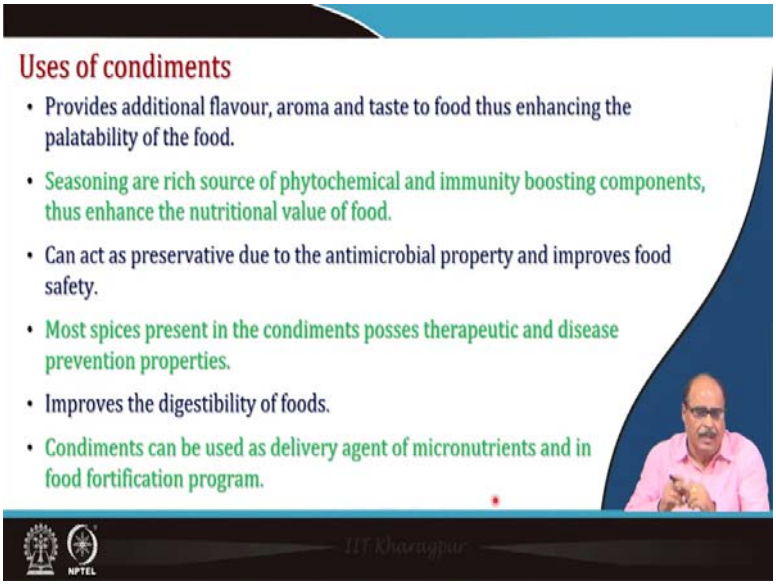

Uses of condiments

Condiments provide additional flavour, aroma and taste to food that enhances the palatability of the food. Seasonings are rich sources of phytochemicals and immunity-boosting components that enhance the nutritional value of the food. Condiments can act as a preservative due to their antimicrobial properties and improve food safety.

Most spices present in the condiments possess certain therapeutic and disease-prevention properties. They can be considered health-boosting or health-promoting components. It also improves the digestibility of the foods. Condiments can be used as a delivery agent of micronutrients and also in food fortification programs.

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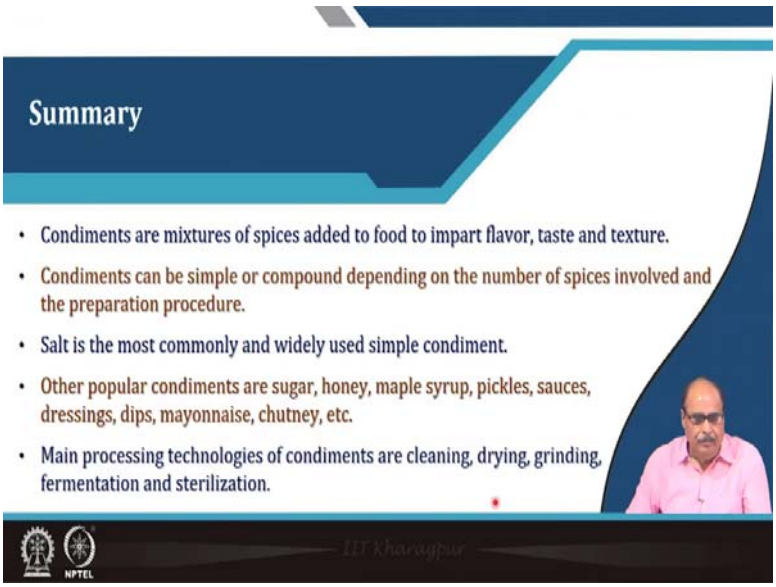

Summary

So, finally, I will summarize this lecture by saying that the various mixtures of spices and their extract are prepared in a specific manner to impart characteristic flavours, tastes and textures and these products are generally known as condiments. They may be simple condiments or compound condiments. Salt is the most common and widely used simple condiment. The other condiments may include sugar, honey, maple syrup, etc. The main processing technology for making condiments includes cleaning, drying, grinding, fermentation and sterilization. These processes and process parameters for grinding, and technology for sterilization need to be standardized. The emerging technologies as far as possible either hurdle technology concepts or the processes such as high-temperature short time (HTST) or ultra-high temperature (UHT) should be used. The non-thermal process can

be used for these operations so that the flavouring, taste, flavour, texture, etc. of the product is preserved to the desired category at the same time product has a good mouthfeel and a good shelf life. So, accordingly, the products should be properly packaged as well. Packaging material and packaging technology are important. These products are packed using an FFS machine i.e. fill and seal machines either in PET bottles and glass jars or even in pouches, etc.

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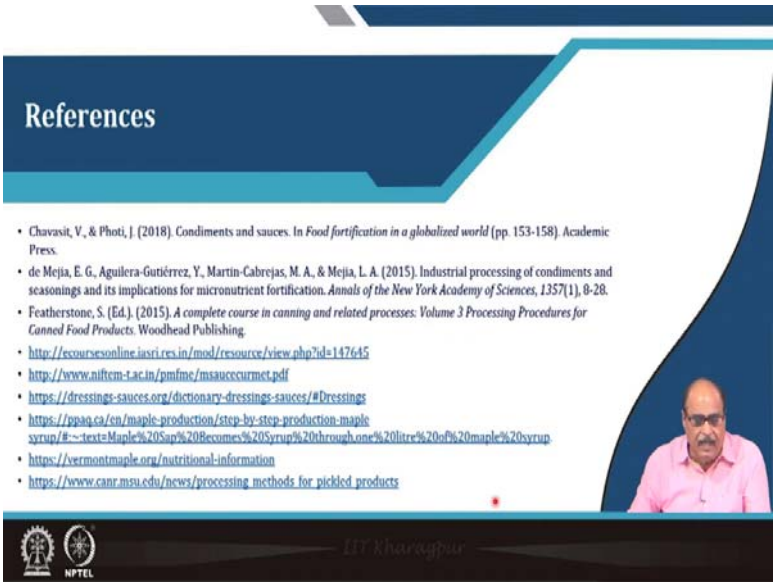

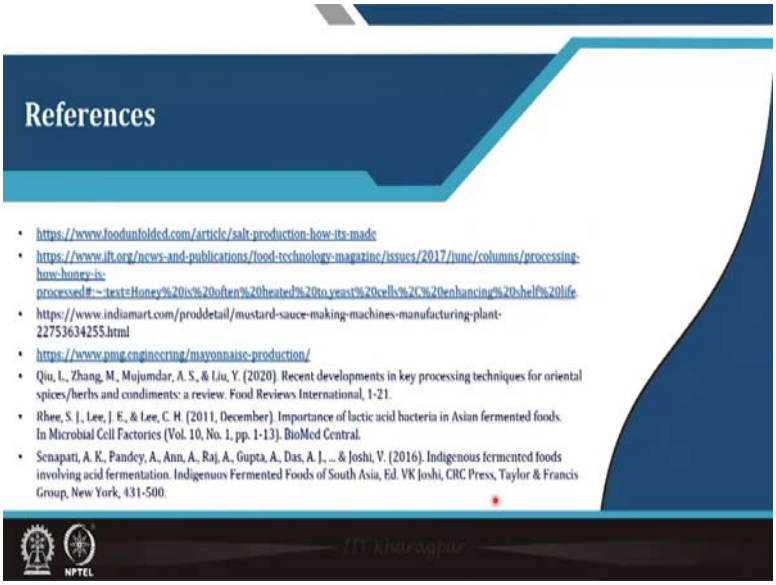

These are the references that are used in this lecture. Finally, thank you very much for your patience in hearing. Thank you.