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

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Lecture 43

Spice Pastes, Sauces and Gravies

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Hello, everybody. Namaskar. In today's lecture, we will discuss about Spice, Pastes, Sauces and Gravies.

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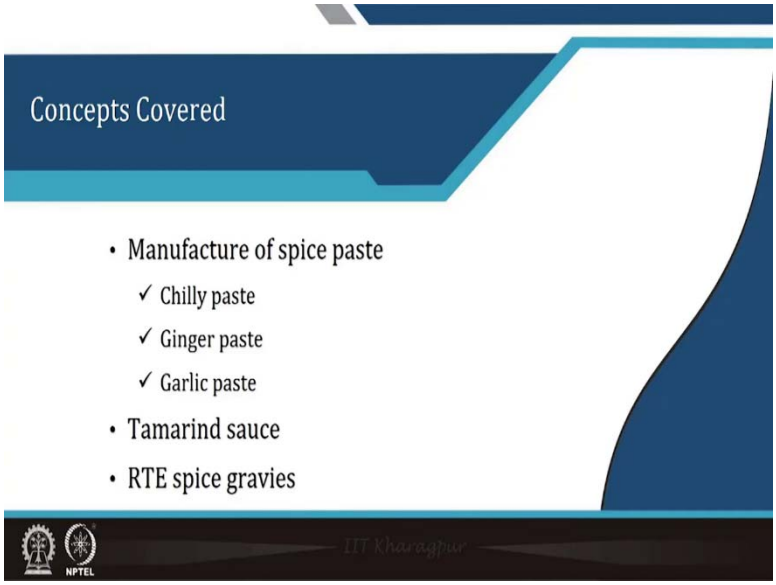

Here, the manufacturing technology of some common spice paste which are available in the market like chilly paste, ginger paste, garlic paste will discuss. Tamarind sauce and its manufacturing technology will be discuss and also about the ready-to-eat spice gravies.

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Spices not only enhance the sensory appeal of food products, but also they have several bioactive compounds and the processing of a spice product into paste helps in convenient addition to food products given the busier lifestyle of the consumers. So, it is basically in the prepared form so that the consumers they can easily add it into the food and get the desired taste and flavors.

Upon suitable treatment such as pasteurization, these pastes can be marketed as FFCG item. The cooking paste segment is gaining popularity among professionals, students, travelers, and chefs, in both urban as well as in rural areas.

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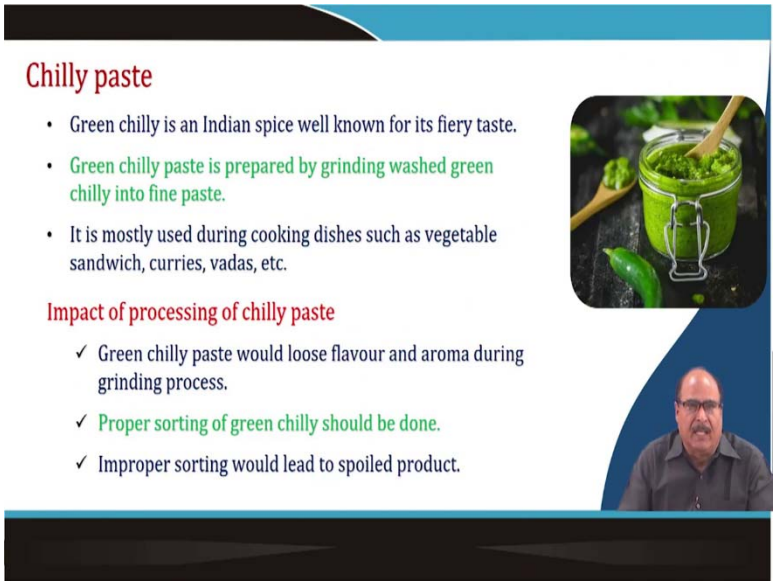

Chilly paste, let us discuss about it. Green chilly is an Indian spice which is well-known for its fiery taste. Green chilly paste is prepared by grinding the washed green chilly into fine paste. It is mostly used during cooking dishes such as vegetables, sandwiches, curries, vadas, etc. So, the impact of processing on the chilly paste if we discuss then green chilly paste would lose flavor and aroma during grinding process, if the process is not carried out properly. Also, the proper sorting of green chilly requires to be done and improper sorting would lead to spoiled product.

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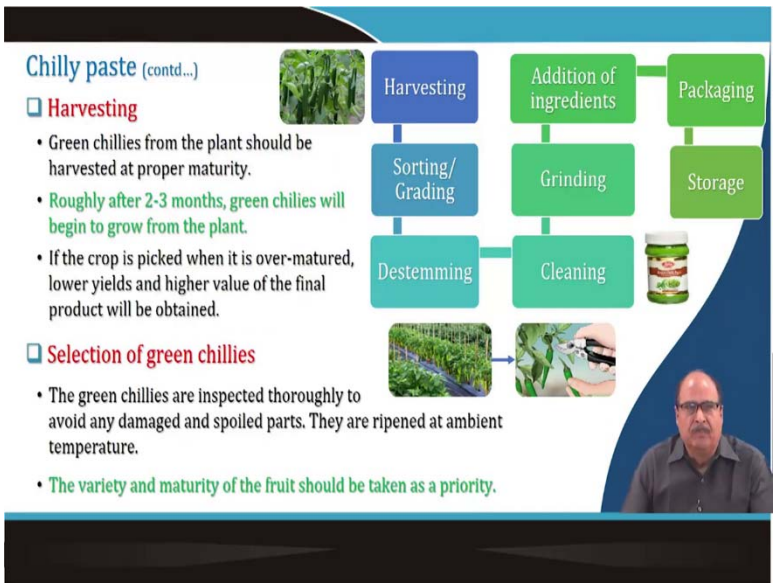

So, the different steps in the preparation of green chilly paste includes harvesting, sorting grading, destemming, then cleaning, grinding, addition of ingredients, finally packaging and

storage. So, these are the steps involved in the preparation of the green chilly paste. Then as far as the harvesting is concerned, the chillies should be harvested from the plant at the right stage of maturity. Roughly, it is considered that after 2 to 3 months, the green chilly plant would start giving fruit, and if the crop is picked when it is over-matured then it may result into lower yields, but the value of the final product may be a little better.

So, as far as the selection of green chillies is concerned obviously the green chillies are first inspected thoroughly to avoid any damage and spoiled parts. They are ripened at ambient temperature. The variety and maturity of the fruit is considered a priority that is specific varieties and specific maturity is required for getting desired quality products.

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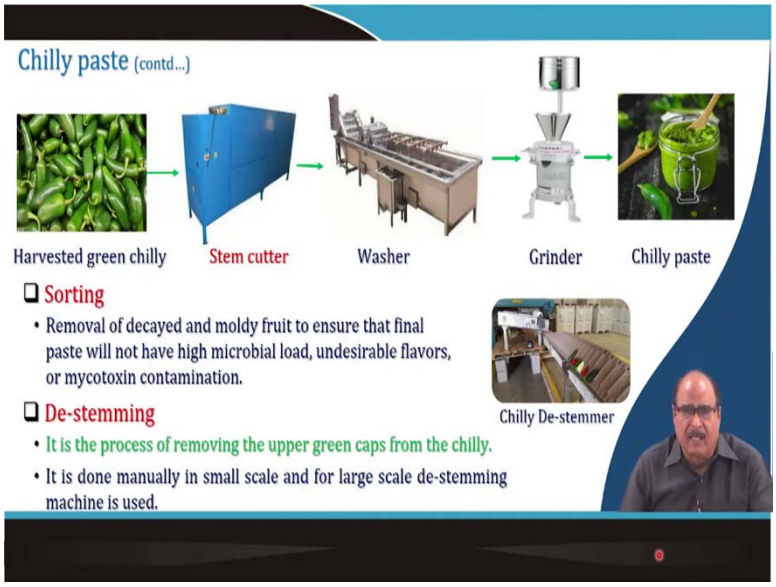

Removal of decayed and moldy fruit is done to ensure that the final paste will not have any microbial load, or undesirable flavors, or mycotoxin contamination. Also, to avoid this, the proper sorting and grading is done. And then, de-stemming is an important operation here. It is the process of removing the upper green cap from the chilly. It is done manually in a smaller scale plant as well as in larger scale industries. De-steaming machine is available which is used.

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Then washing, normally 10 to 100 PPM chlorine water is considered a good washing agent, it has some sanitizing effect also, it removes dirt and other compounds from the chilly. Then grinding is done with the other ingredients like salt, oil, acidity regulators like acetic acid, citric acid, etc.

Chilly is converted into a fine paste using a suitable grinding machinery like stone grinder. Then it should be packed in inert rigid and transferable containers and stored in cool, dry and hygienic place which is away from sunlight.

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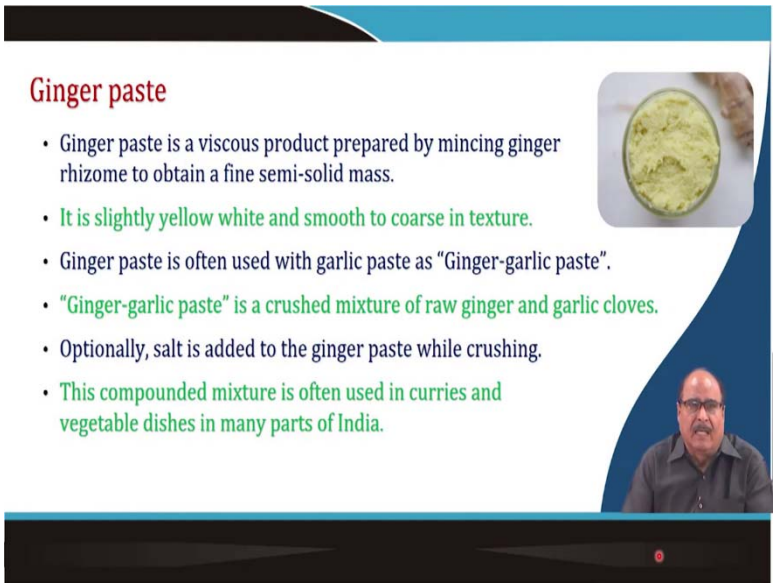

Ginger paste is a viscous product prepared by mincing ginger rhizome to obtain a fine semi-solid mass. Ginger paste is slightly yellow white and smooth to coarse in texture. Ginger paste is often used with the garlic paste like as “ginger-garlic paste”.

“Ginger-garlic paste” is a crushed mixture of raw ginger and garlic close together. And optionally, salt is added to the ginger paste while crushing. And this compound mixture is often used in curries, in vegetable dishes in many parts of India and it is frequently available in the market.

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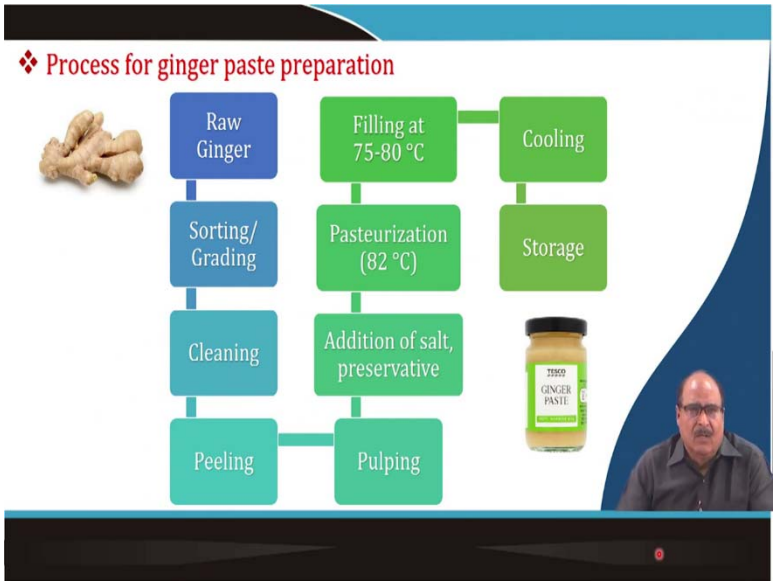

Process for the raw ginger paste preparation, here, ginger is harvested from the field, then sorting/grading, cleaning, peeling are the obvious treatment, after that it is subject to the pulping, addition of salt or preservatives, pasteurization to around 82°C and filling at 75 to 80°C and then cooling and storage. So, from ginger you get finally ginger paste.

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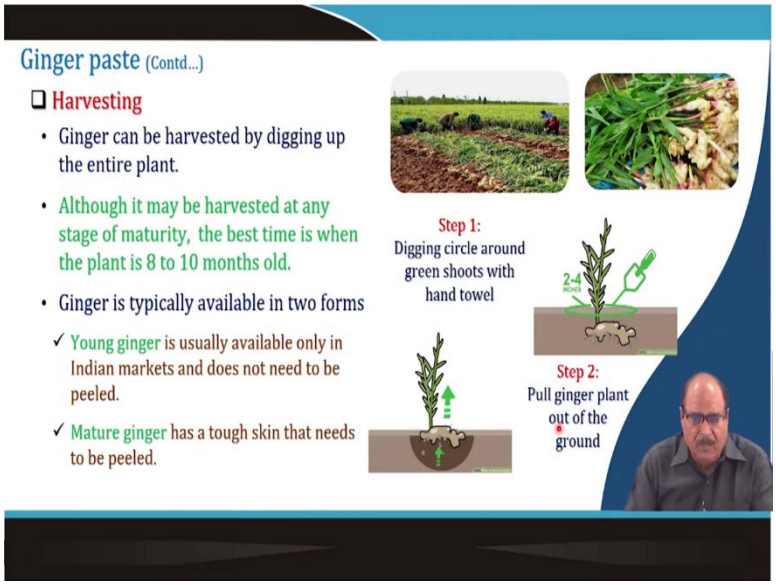

As far as the harvesting of the ginger is concerned, in the figure, because these are the tubers and found in underground. So, they are harvested by digging entire plant and although it may be harvested at any stage of maturity, but the best time is when the plant is 8 to 10 months old. The ginger is typically available in two forms, one is the young ginger which is usually available only in the Indian market and does not need any peeling. Whereas the mature ginger has a tough skin and it needs to be properly peeled.

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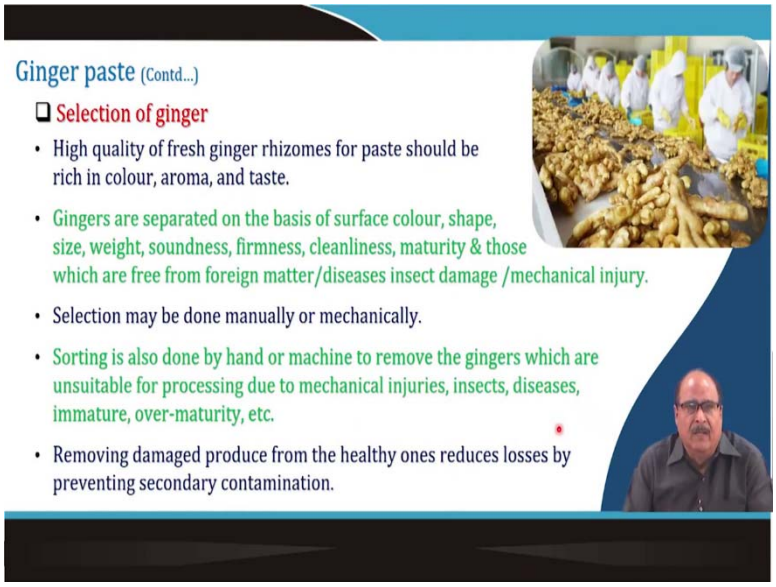

The high quality of fresh ginger rhizome for paste should be rich in the color, aroma and taste. Gingers are separated on the basis of surface colour, shape, size, weight, soundness, firmness, cleanliness, maturity and those attributes which make it free from foreign matter. If there is any

disease or insect damage or mechanical injury, then those should all be discarded. Selection may be done manually or mechanically.

There are mechanical sorters available. Sorting is also done by hand or machine to remove the gingers which are unsuitable for processing due to mechanical injuries, insect, disease, immaturity or over maturity and so on. So, removing damaged produce from the healthy ones reduces losses by preventing secondary contamination.

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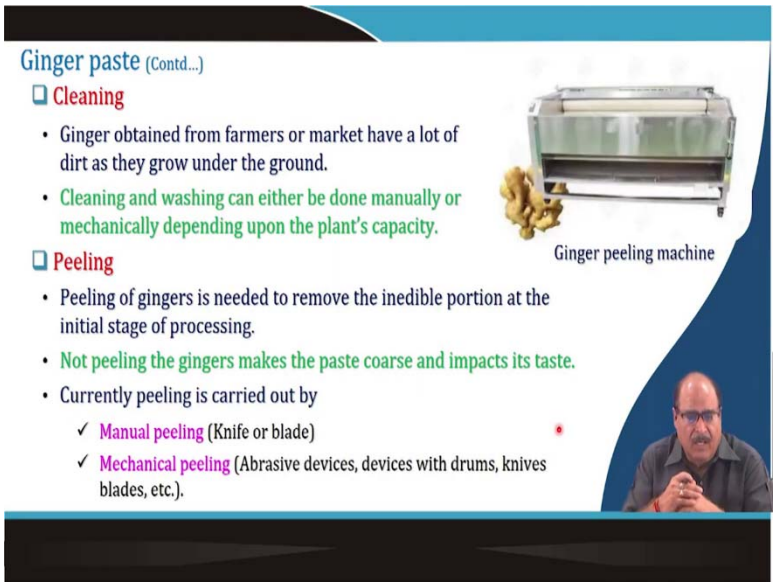

Cleaning is an important operation that is in any fruit, vegetable, spices, the cleaning and washing should be proper because gingers they are dig from the soil, so they are likely to be contaminated with the soil particles, muds, etc and also bacterial contamination may be more. So, they should be properly washed and cleaned and even sanitized using chlorine water and such other agents.

Then cleaning is followed by peeling. A peel is required to be removed, the inedible portion at the initial stage of processing. If the peeling is not done then it makes the ginger paste coarse and it impacts its taste.

So, currently peeling is carried out by either manually in the industry using knife or blade or even mechanical peelers also like abrasive devices, devices with drums, knives, blades, etc are available. So, depending upon the industry requirement and size of the plant they normally go either mechanical peeling or manual peeling.

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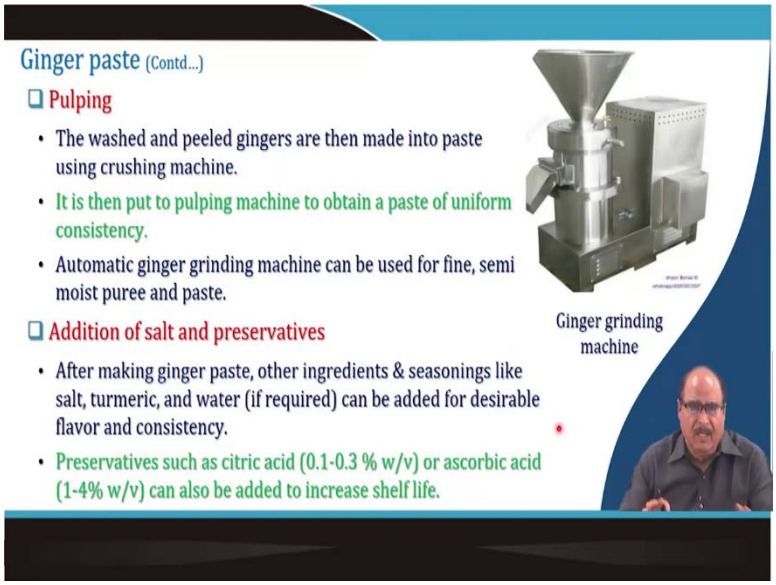

Then next operation is the pulping by ginger grinding machine which can be seen here in the figure. The washed and peeled ginger are made into paste using a crushing machine and it is then put into pulping machine to obtain the paste of uniform consistency. And automatic ginger grinding machines can be used to produce fine, semi moist puree and paste.

Then after the pulp is made, in this, certain preservatives and salts are added. The ingredients such as seasonings like salt, turmeric, and water if required can be added to the desirable quantities for giving desired flavor and consistency. Preservatives like citric acid to the tune of 0.1 to 0.3 percent weight by volume or ascorbic acid 1 to 4 percent weight by volume can be added to increase the self-life of the paste.

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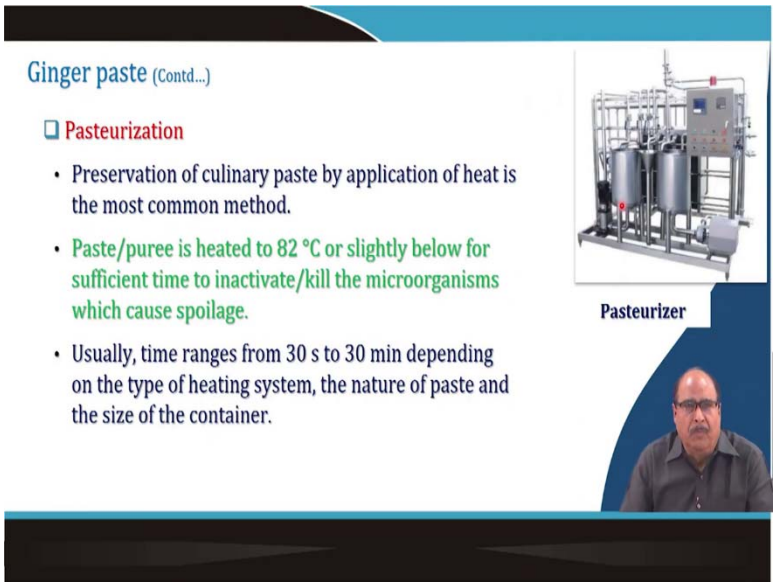

Then, another important operation is the pasteurization. The puree or paste is heated to around 82°C or slightly below for sufficient time to inactivate or kill the microorganism which might cause spoilage. Usually, the time ranges from 30 seconds to 30 minutes depending on the type of the heating system, the nature of paste, and the size of container.

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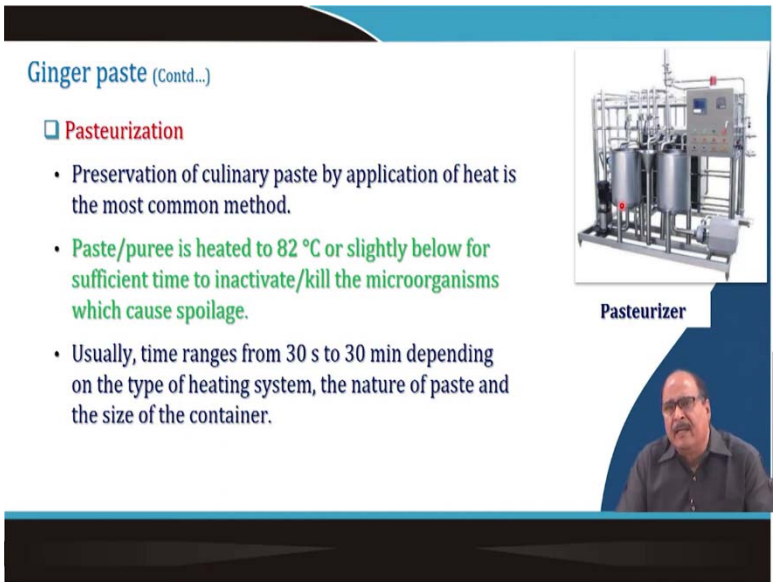

After pasteurization, the pasteurized paste is filled into the container using FFS machines. In the filling machines, the temperature normally is not lower than 75 to 80°C, that is, it should be filled while it is hot. And then it is immediately sealed to retain the freshness of the product. Their paste containers come in various sizes and shapes including bottles, cans, pouch packs and so on.

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Then, after packing, since it was packed hot, it needs to be cooled immediately, these are cooled fast to prevent the flavor loss through stack burning, which occurs when the paste stays at high temperature after cooking is complete. So, containers of ginger may be cooled in cold water or by immersion in cold water or by spraying the cold air. After cooling, the proper storage must be done.

For primary packaging of the ginger paste, gas jars, stand-up pouches, PET bottles, or polypropylene cups, etc. are available and all these may be put in the secondary packaging like cartoon palletized unit or tertiary packaging for transport, where paper boards, cartons, or reusable plastic crates, etc. are used.

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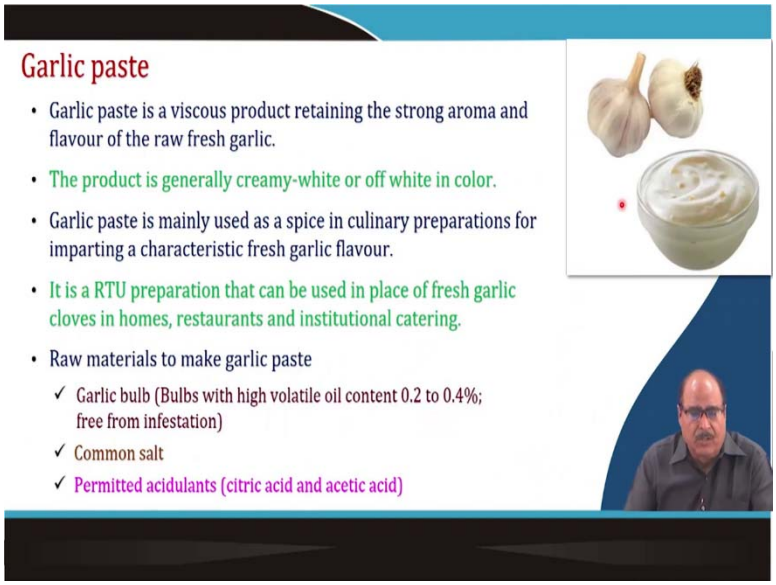

The another important product is the garlic paste. Garlic paste is a viscous product, retaining the strong aroma and flavor of the raw fresh garlic, as can be seen here in the picture. The product is generally creamy-white, or off white in color. Garlic paste is mainly used as a spice in culinary preparations for imparting a characteristic fresh garlic flavor.

It is a ready-to-use preparation and that can be used in place of fresh garlic cloves in home, restaurant and in institutional catering. The raw material to make the garlic paste are the garlic bulbs that is the bulbs with a high volatile oil content may be 0.2 to 0.4 percent and it should be free from infection. Then the common salt and the permitted acidulant like citric acid and acetic acid are used in its preparation.

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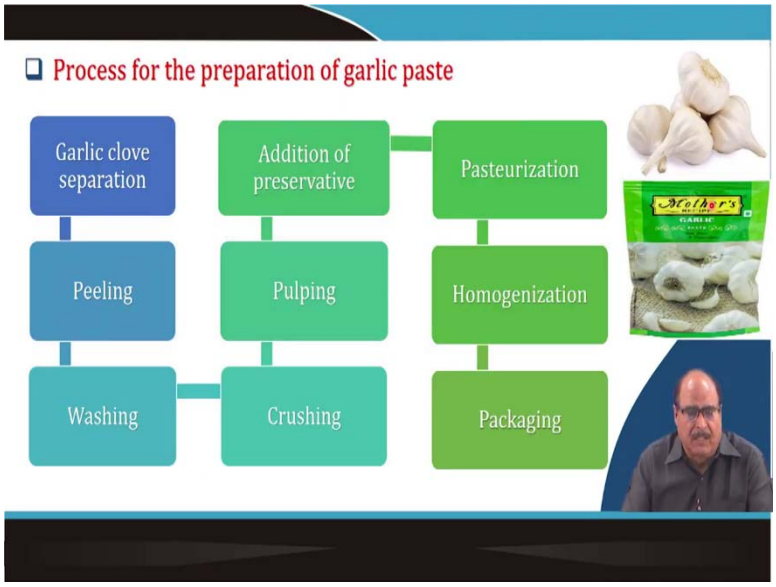

The process flowchart for preparation of garlic paste include garlic clove suppression, peeling, washing, crushing, pulping, addition of preservatives, pasteurization, homogenization, and finally, packing.

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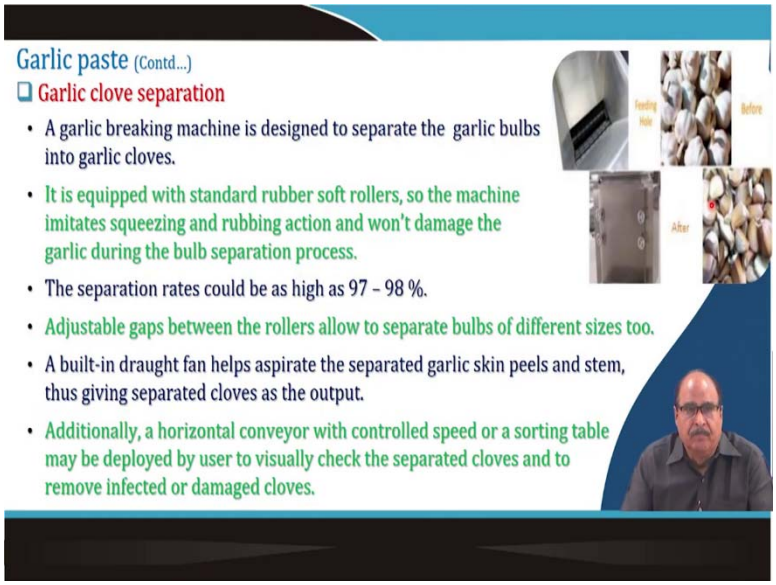

So, for separating the garlic cloves, a garlic breaking machine is designed. And here the garlic bulbs are used and are separated into garlic cloves. The machine is equipped with standard rubber soft rollers, so it imitates squeezing and rubbing action and will not damage the garlic during the bulb separation or clove separation process.

The separation rate could be as high as 97 to 98 percent in different machines and the adjustable gaps between the roller allow to separate bulbs of different sizes also. A built-in drought fan helps aspirate the separated garlic skin peels with stem, thus giving separated cloves as the output. Additionally, a horizontal conveyor with controlled speed or a sorting table may be deployed by the user to visually check the separated cloves and to remove infected or damaged cloves.

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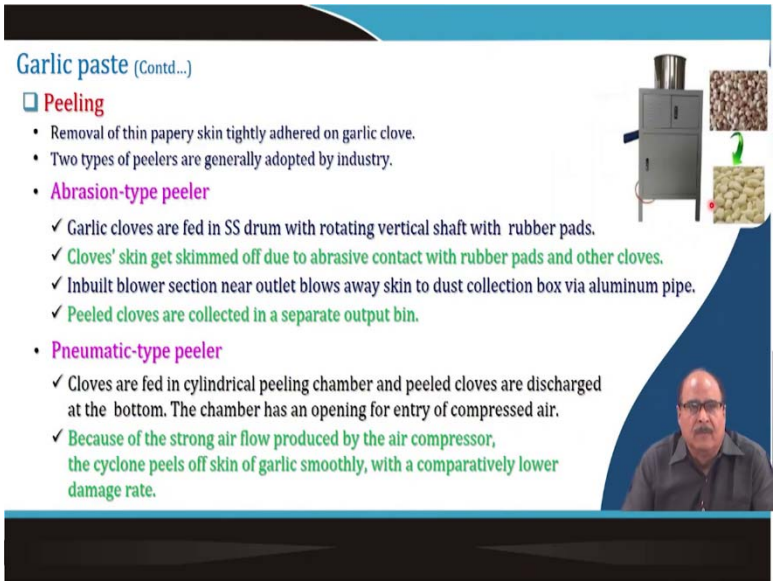

Then these cloves are peeled that is the peeling include consists of removing the thin papery skin which is tightly adhered to the clove. And two types of peelers are generally adapted by the industry, it is abrasion-type peeler, or pneumatic-type peelers. In the abrasion-type peelers, garlic cloves are fed in a stainless-steel drum with rotating vertical shaft with rubber pads.

Clove's skin get skimmed off due to abrasive contact with rubber pads and other cloves of the garlic. This inbuilt blower section near outlet blows away the skin to dust collection box via aluminum pipe and peeled cloves are collected in a separate output bin. In the pneumatic-type peeler, cloves are fed in a cylindrical peeling chamber and peeled cloves are discharged at the bottom.

The chamber has an opening for entry of the compressed air. Because of the strong air flow produced by the air compressor, the cyclones peels off skin of the garlic smoothly, with a comparatively lower damage rate. So, the peeling is done properly, but damage to the cloves is minimal.

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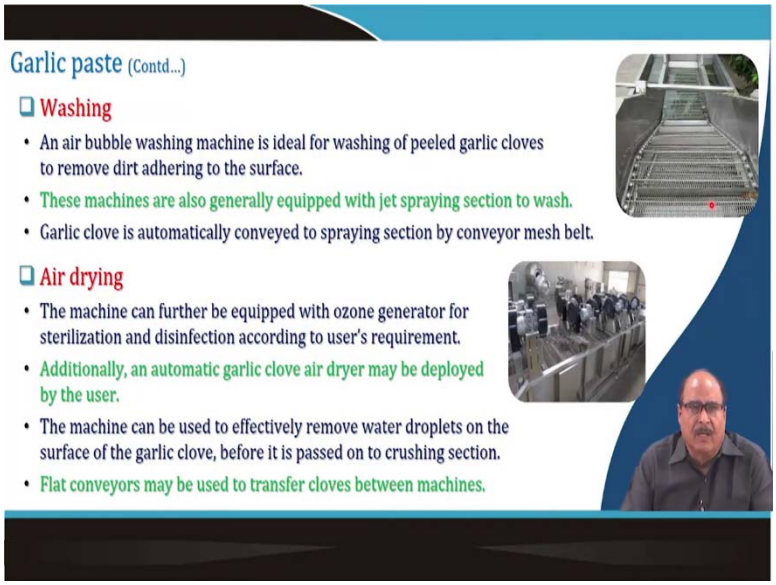

Then the peeled cloves are washed using air bubble washing machine. These air bubble washing machines are generally equipped with jet spraying section to wash. The garlic cloves are automatically conveyed to spraying section by the conveyor belt where it is properly washed and then it is dried. The machine drying unit can be further equipped with ozone generator for sterilization and disinfection according to the user's requirement.

Additionally, an automatic garlic clove air dryer may be deployed by the user. So, the machine can be used effectively to remove water droplets on the surface of the garlic cloves, before it is passed to the crushing section, because if the surface moisture is not removed, then it may increase the moisture content of the paste and which may encourage a microbial growth. The flat conveyors may be used to transfer the cloves between the machine.

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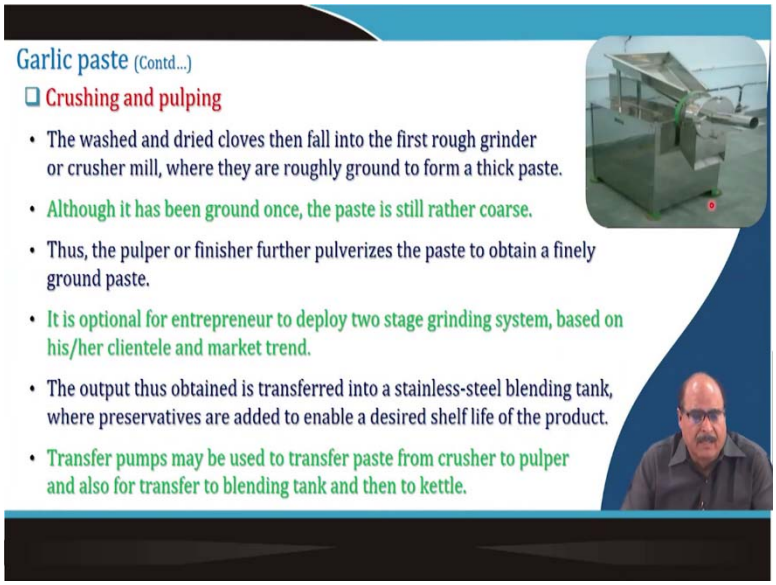

Then the crushing and pulping of the washed and peeled cloves, that is the washed and dried cloves fall into the first rough grinder or crusher mill, where they are roughly ground to form a thick paste. Although, it has been ground once, but the paste is still rather coarse. Thus, the pulper or finisher further pulverizes the paste to obtain a finely ground paste.

It is optional for the entrepreneurs to deploy a two-stage grinding system based on his or her clientele and the market trend or market demand. The output thus obtain is transport into a stainless-steel blending tank where preservatives are added to enable a desired shelf-life of the product and transfer pump may be used to transport the paste from crusher to pulper and also for transferring it to the blending tank and then to the kettle.

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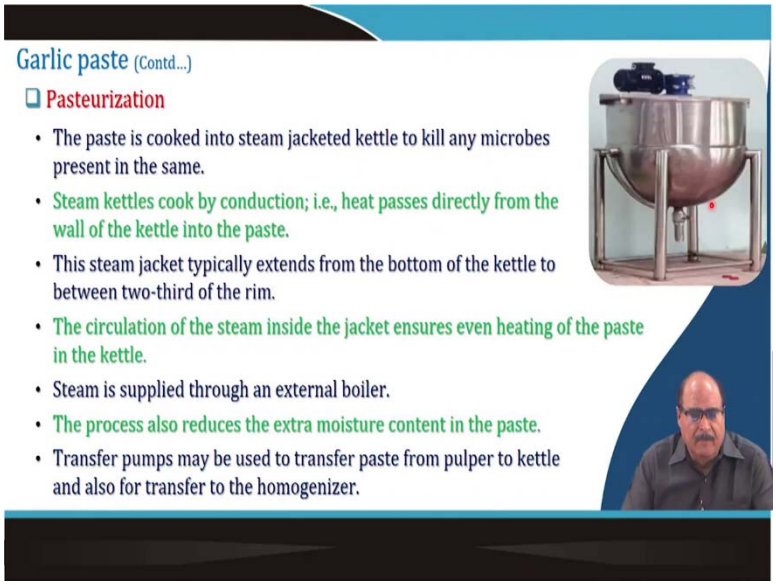

Then, the paste is pasteurized. It is cooked into steam jacketed kettle to kill any microbes present in them. In the picture of the kettle, here, steam kettles cooked by conduction that is heat passes directly from the wall of the kettle into the paste. The steam jacket typically extends from the bottom of the kettle to between two-third of the rim.

The circulation of the steam inside the jacket ensures even heating up of the paste in the kettle. Steam is supplied through an external boiler. The process also reduces the extra moisture content in the paste. It removes the extra moisture content. Transfer pumps may be used to transfer paste from the pulper to kettle and also to transfer it to the homogenizer.

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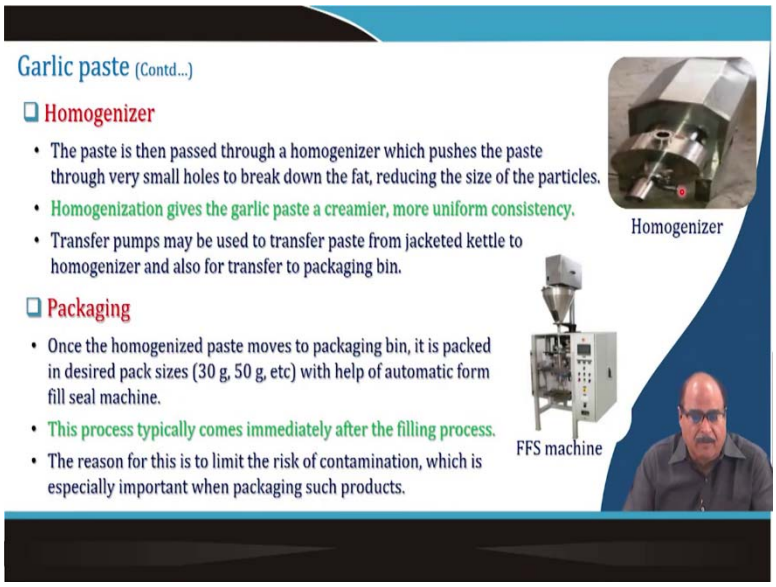

The homogenizer pushes the paste through very small hole. In the homogenizer there are very fine holes and the paste is pushed through that and here it under pressure it breaks down the fat and therefore reduces the particle size of the fat. And it gives a uniformly homogeneous mass. So, homogenization gives a garlic paste a creamier and more uniform consistency.

And here, transfer pumps may be used to transfer the paste from jacketed kettle to the homogenizer and also to transfer to the packaging bin. In the packaging bin, the homogenized paste is packed in desired pack sizes may be of 30-gram, 50-gram, 100-gram, etc. with the help of automatic form fill and seal machine which is called popularly FFS machines.

This process typically comes immediately after the filling process. And the reason for this is to limit the risk of contamination, which is especially important when packaging such products.

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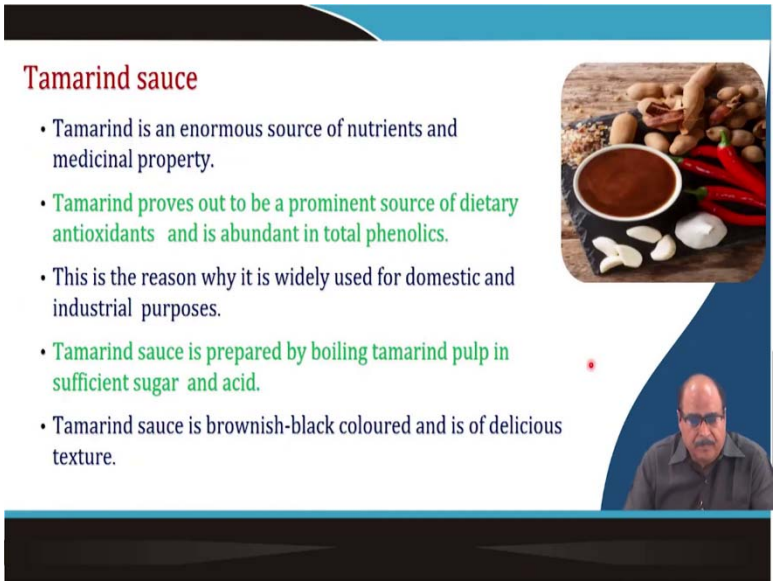

Then we will discuss about tamarind sauce. Tamarind is an enormous source of nutrients and it has medicinal property. Tamarind proves out to be a prominent source of dietary antioxidant and is abundant in total polyphenols and this is the reason why it is widely used for domestic and industrial purposes. Tamarind sauce is prepared by boiling tamarind pulp in sufficient sugar and acid. Tamarind sauce is the brownish black color and is of delicious texture.

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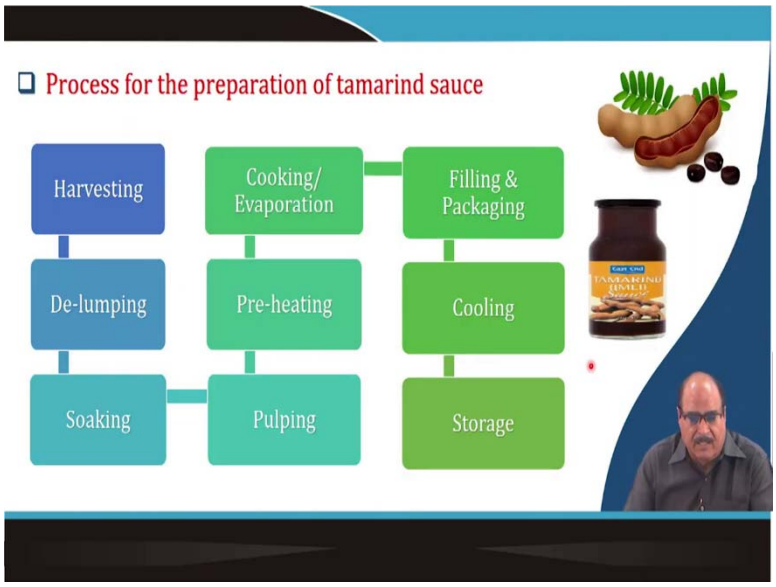

The process flow for the preparation of the tamarind sauce include harvesting of the tamarind, de-lumping, soaking, pulping, pre-heating, cooking and evaporation, then filling and packaging, cooling, and storage.

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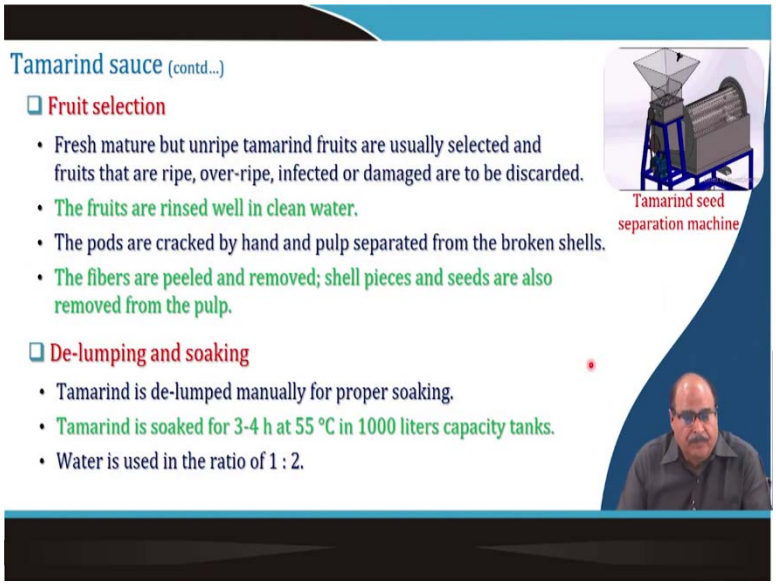

The fruit selection is important that fresh mature but unripe tamarind fruits are usually used for making the sauce. Fruits that are ripe, over-ripe, infected or damaged, they are discarded. The fruits are rinsed well in clean water. The pods are cracked by hand and the pulps are separated from the broken shells. The fibers are peeled off and removed; shell pieces and seeds are also removed from the pulp. Then the tamarind is de-lumped manually for proper soaking. Tamarind is soaked for about 3 to 4 hours at 55°C in 1000-liter capacity tanks. Here water is used in the ratio of 1:2.

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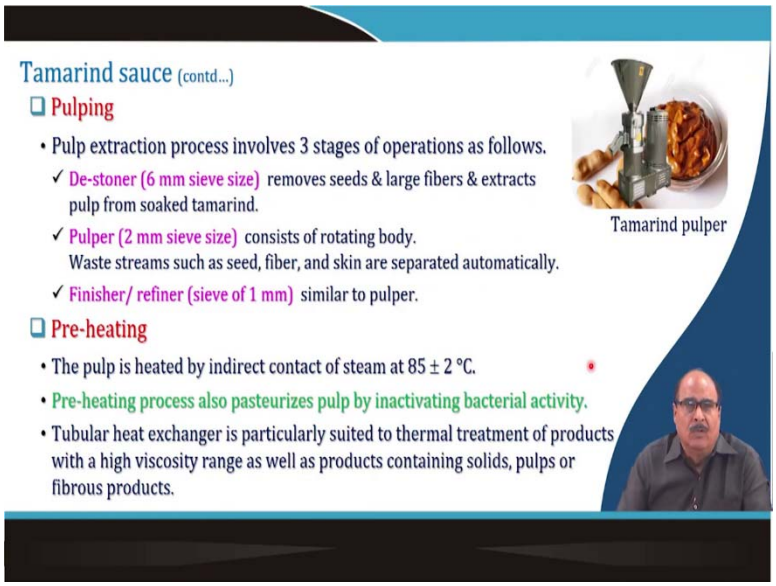

Then pulping, the pulp extraction process involves three stages of operation, where a de-stoner is used with 6 mm sieve size, it removes the seeds and large fiber extracts pulp from the soaked tamarind. Then pulper which is having 2 mm sieve size, it consists of rotating body. Waste

streams such as seed, fiber, skins are separated automatically here in this pulper. And then finally there is a finisher or refiner, where the sieve of 1 mm is used and it is similar to pulper but gives a very fine particle size material.

Then preheating, the pulp is heated by indirect contact of steam at around 85 ± 2 °C. Pre-heating process also pasteurize the pulp by inactivating bacteria. Tubular heat exchangers are particularly suited to thermal treatment of the product with the high viscosity ranges as well as the products containing solids, pulps or fibrous part.

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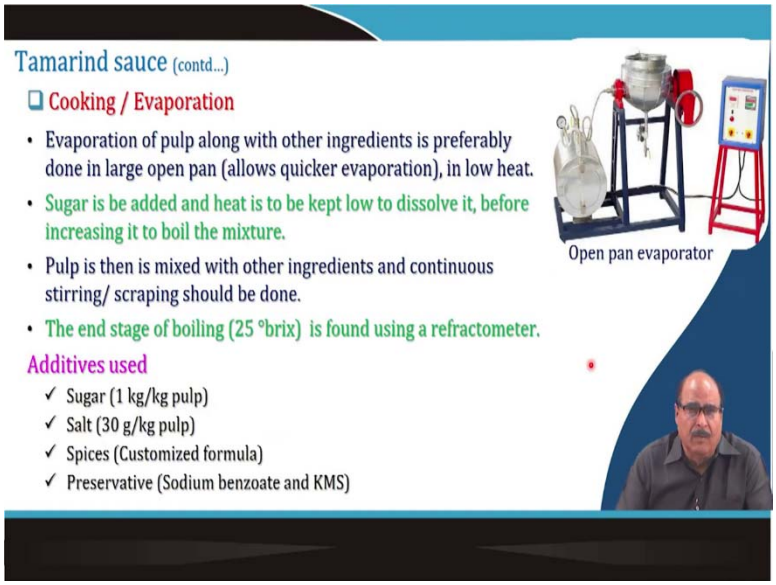

The tubular heat exchangers are used for cooking or evaporation. The evaporation of the pulp along with other ingredient is preferably done in large open pan which allow quicker evaporation and the heat is comparatively, low heat is used, sugar is added and the heat is to be kept low to dissolve it before increasing it to boil the mixture. Pulp is then mixed with other ingredients and continuous stirring/scraping is done.

The end stage of boiling is measured by a refractometer that is at the end of the boiling, the brix will be around 25°. The additives generally used here are sugar maybe 1 kg per kg of the pulp. Salt maybe 30 gram per kg pulp. Spices as per the requirement i.e. customized formula. And the preservative, generally sodium benzoate or potassium metabisulfites are used.

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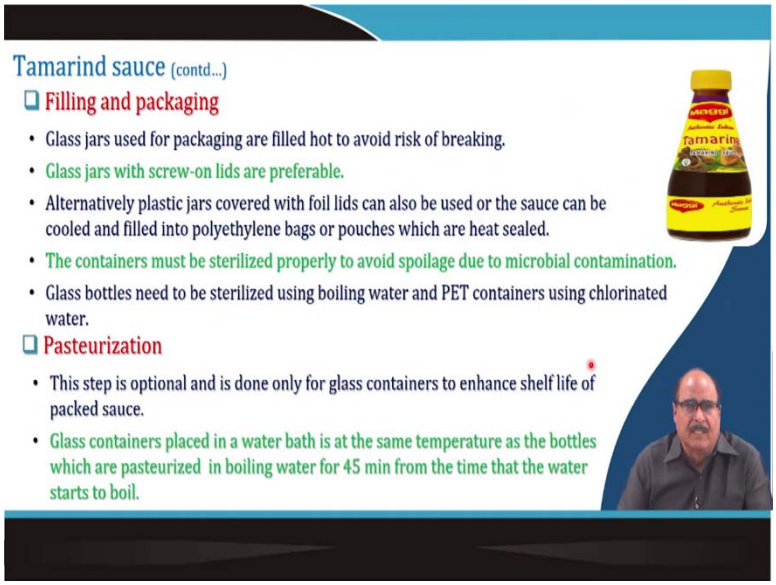

Then, glass jars are used for packing. They are filled hot to avoid any risk of breaking. Glass jars with the screw-on lids are preferable. Alternatively, plastic jars covered with foil lids can also be used for sauce packing and it cooled and filled into polyethylene bags or pouches which are later heat sealed. The container must be sterilized properly to avoid spoilage due to microbial contamination.

And glass bottles need to be sterilized using boiling water and PET containers using chlorinated water. Then after the filling they are pasteurized that is this step is optional, and is generally for glass containers to enhance the shelf life of the packed sauce. Glass containers are placed in water bath at the temperature as the bottles which are pasteurized in the boiling water for about 45 minutes or so from the time that the water starts to boil.

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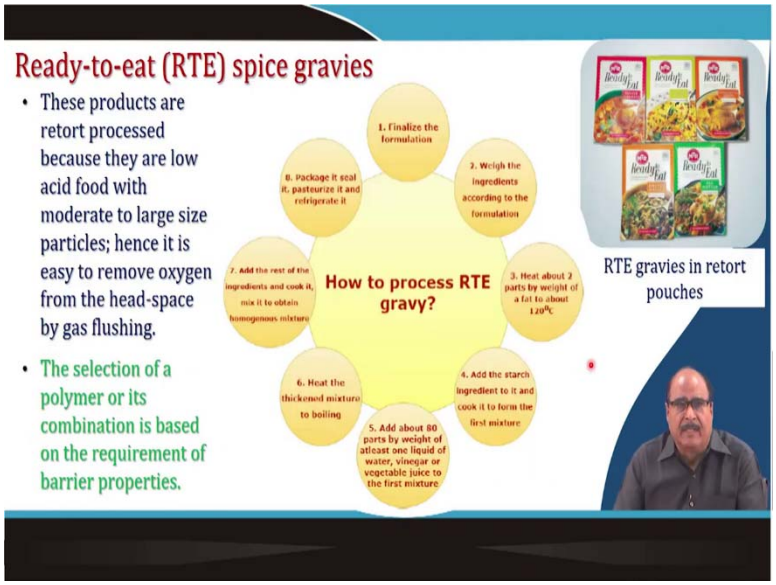

Then we will see the ready-to-eat spice gravies. These products are retort processed because they are low acid food with moderate to large sized particles, hence it is easy to remove oxygen from the heat space by gas flushing. The selection of a polymer or its combination is based on requirement of the barrier properties.

So, for preparation of the ready-to-eat gravies, the first step is the finalize the formulation with the ingredient according to the formulation then heat about two parts by weight of the fat to about 120°C and then add the starch ingredient to it and cook it in the form of a first mixture.

About 80 parts by weight of this is added to 1 part of the water, vinegar or vegetable juice to the first mixture is followed by heating the thickened mixture to boiling and then the rest of the ingredients are added and it is cooked, that is the mixture is cooked and mixed to obtain a purely homogeneous mixture.

Finally, it is packaged and sealed. And after packaging and sealing, it pasteurized and refrigerated. So, these are the process for the preparation of spice gravy.

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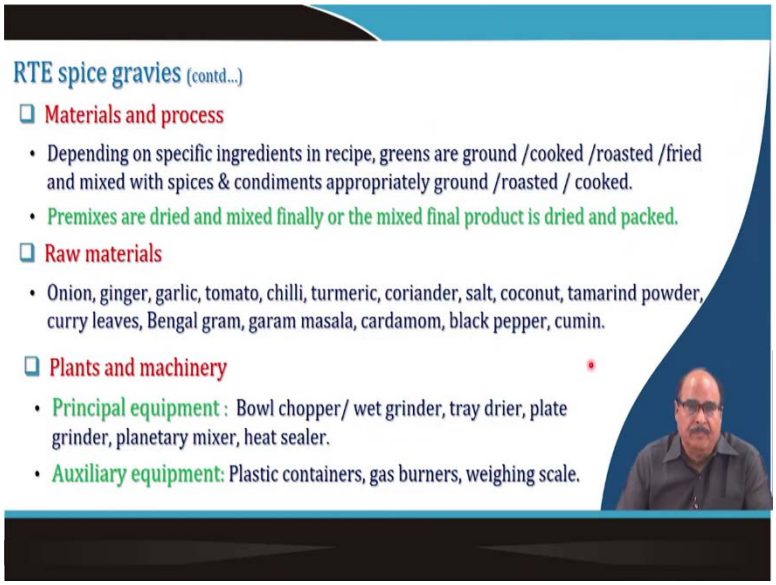

So, the materials and process that is depending upon the specific ingredient in recipe, greens are ground, cooked, roasted, fried and mixed with spice and condiments appropriately ground, roasted, cooked. Premixes are dried and mixed finally or the mixed final product is dried and packed, so as the case may be, these materials are prepared.

Normally, the raw material which is used for a spice gravy include onions, ginger, garlic, tomato, chilly, turmeric, coriander, salt, coconut, tamarind powder, curry leaves, Bengal gram, garam masala, cardamom, black pepper, cumin as per the formulation, as per the requirement.

Then the plant and machinery used for making gravies are principal equipment such as ball chopper, wet grinder, tray dryer, plate grinder, planetary mixer, heat sealer, etc. and auxiliary equipment maybe plastic containers, gas burners, weighing scales and so on.

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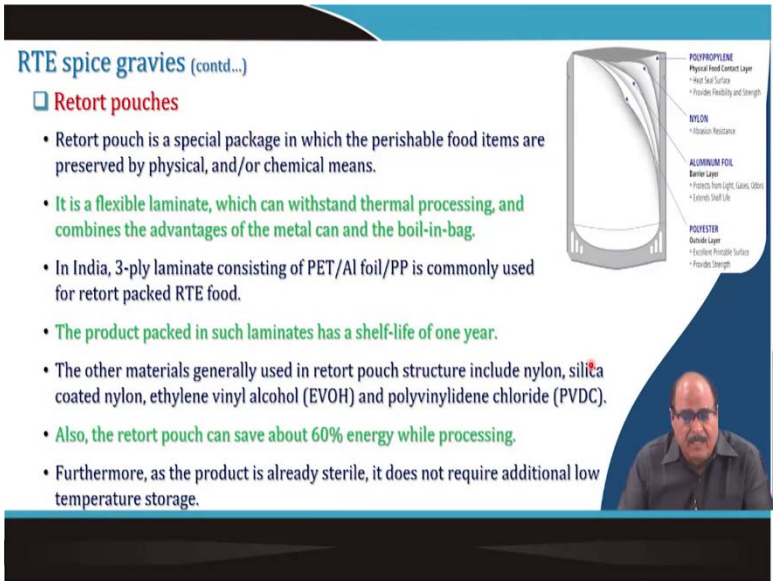

And then important thing is that these are the retort pouch. The retort pouch is a special package in which the perishable food items are preserved by physical and or chemical means. It is a flexible laminate, which can withstand thermal processing and combines the advantage of the metal can and the boil-in-bag. In India, 3-ply laminate consisting of PET, aluminum foil and polypropylene is commonly used for retort packed RTE foods.

The product packed in such laminates has a shelf-life of about one year or more. The other material generally used in the retort pouch structure include nylon, silica coated nylon, ethylene vinyl alcohol or polyvinylidene chloride. Also, the retort pouch can save about 60 percent energy while processing.

Furthermore, as the product is already sterile, it does not require additional low temperature storage because this retort pouches are sterilized until they are not opened, they can kept under normal conditions.

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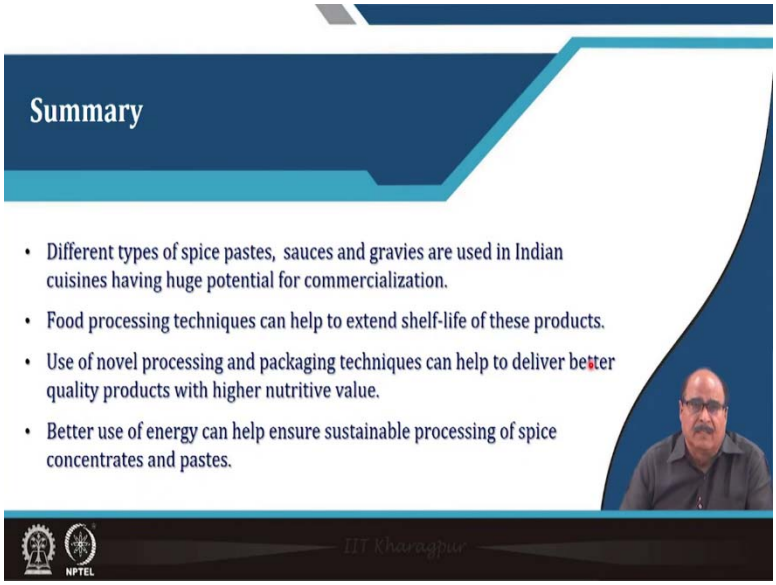

So, finally, I will summarize that as spice pastes are important and use in ready-to-use, ready-to-eat foods. Spices are available plenty in the market. However, there are certain precautions which need to be taken that particularly the grinding process operation, pre-treatments, packaging, etc. should be done under proper conditions otherwise there may be a danger of removing the separation of the syrup and water separation or bacterial contamination, etc.

So, proper sterilization, proper packaging is required even in the ready-to-eat garlic paste. They are also packed in the small tubes, small sachets, etc. So, novel technologies for processing and packaging of these paste gravies and sauces are very important, so that their functionalities, their characteristic, flavor and aroma is retained. Care should be taken to ensure that during processing these flavorings are not lost.

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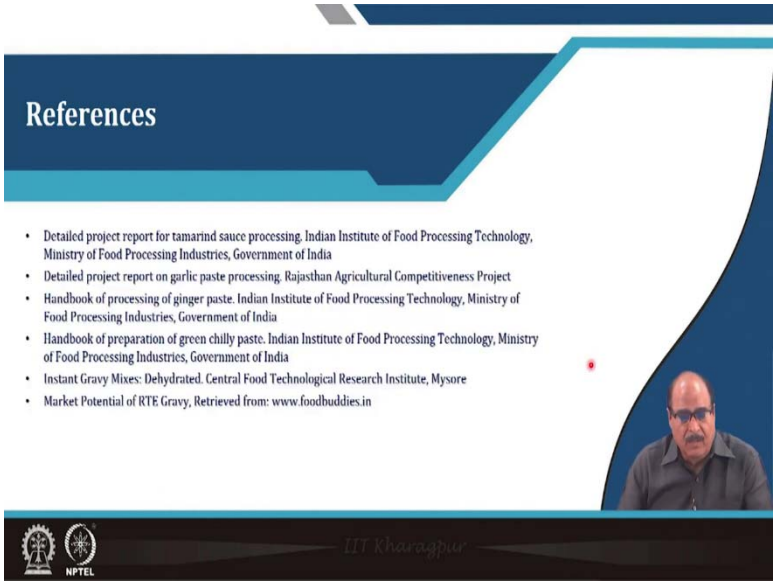

These are the references used inside this lecture. Thank you very much for your patience hearing. Thank you.