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

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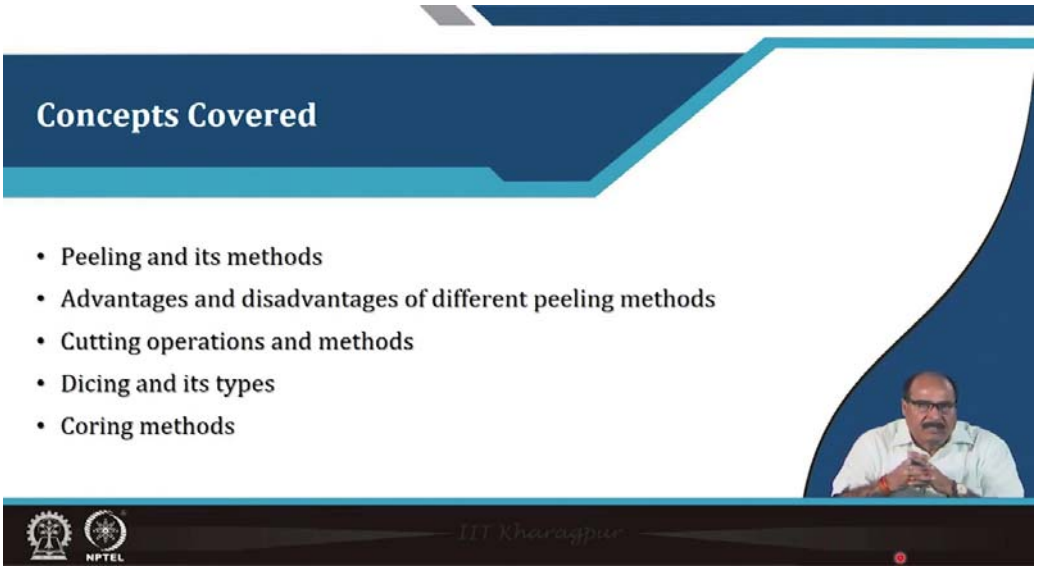
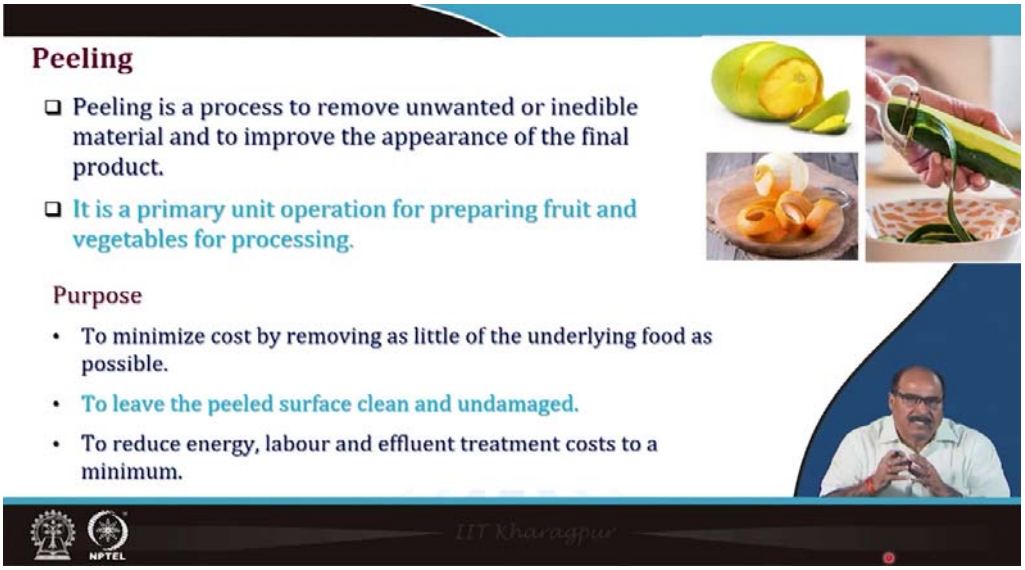
Lecture 18
Peeling, Coring, Slicing

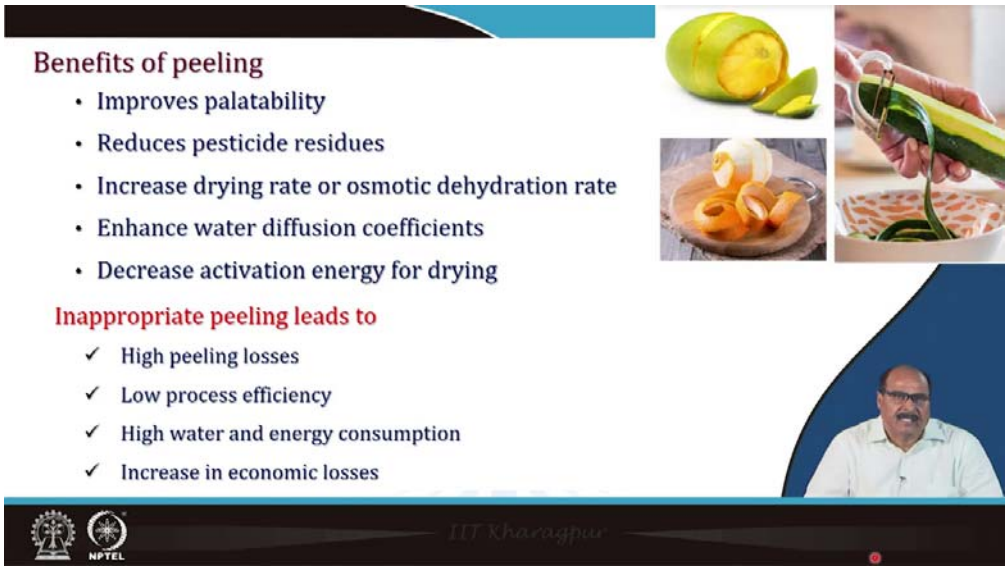


The topic which we will cover in this lecture include peeling and different methods of peeling, advantages and disadvantages of various peeling methods, cutting operations and methods of cutting, dicing and its type, and some methods for the coring of some fruits and vegetables.

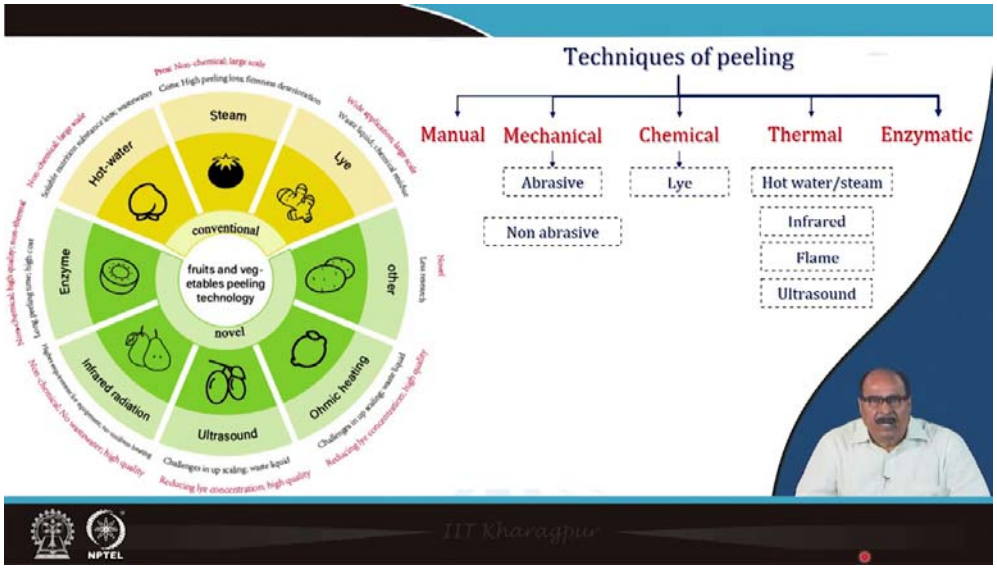


Peeling

Peeling is a process to remove unwanted or inedible material and to improve the appearance of the final product. It is a primary unit operation for preparing fruits and vegetable for processing. The purpose of the peeling is to minimize cost by removing as little of the underlying food as possible, to leave the peeled surface clean and undamaged, and to reduce energy, labour and effluent treatment costs to a minimum.

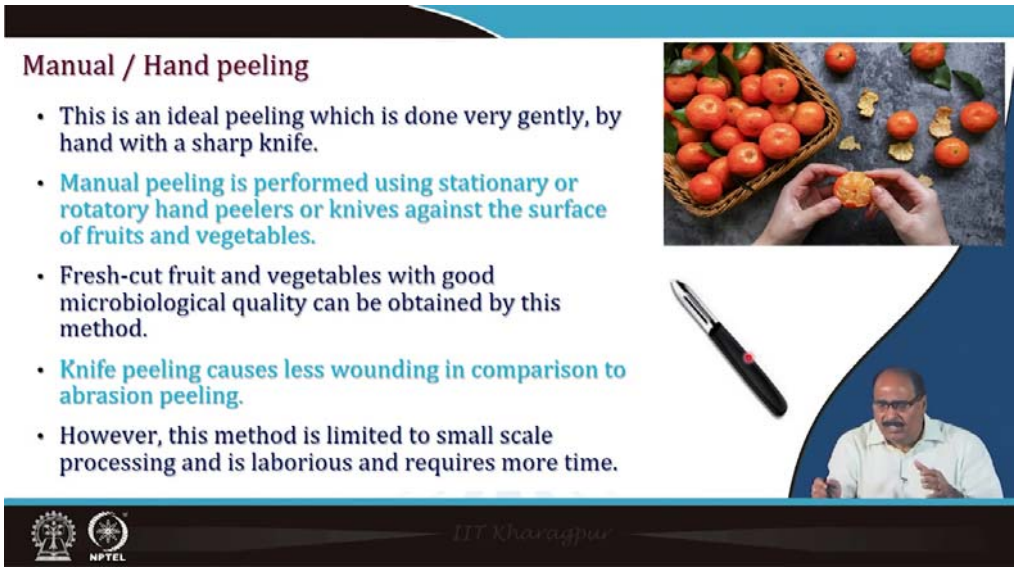


Benefits of the peeling include improved palatability of the produce, reduces pesticide residues, increases drying rate or osmotic dehydration rate, enhance water diffusion coefficients, decrease activation energy for drying up the pilled produced. However, inappropriate peeling may lead to high peeling losses, low process efficiency, high water and energy consumption, and increase in the economic losses. So, the operations should be carried out carefully.



The different methods of peeling include manual or mechanical methods like abrasive and non-abrasive methods, chemical methods including lye peeling, thermal processes like hot water or steam peeling, infrared flame peeling, ultrasound assisted peeling, and enzymatic peeling process.

So, these peeling technologies are grouped into two categories like conventional technologies, which include hot water peeling, steam peeling or lye peeling. The novel peeling methods include ohmic heating, ultrasound assisted infrared radiation, enzymatic peeling.

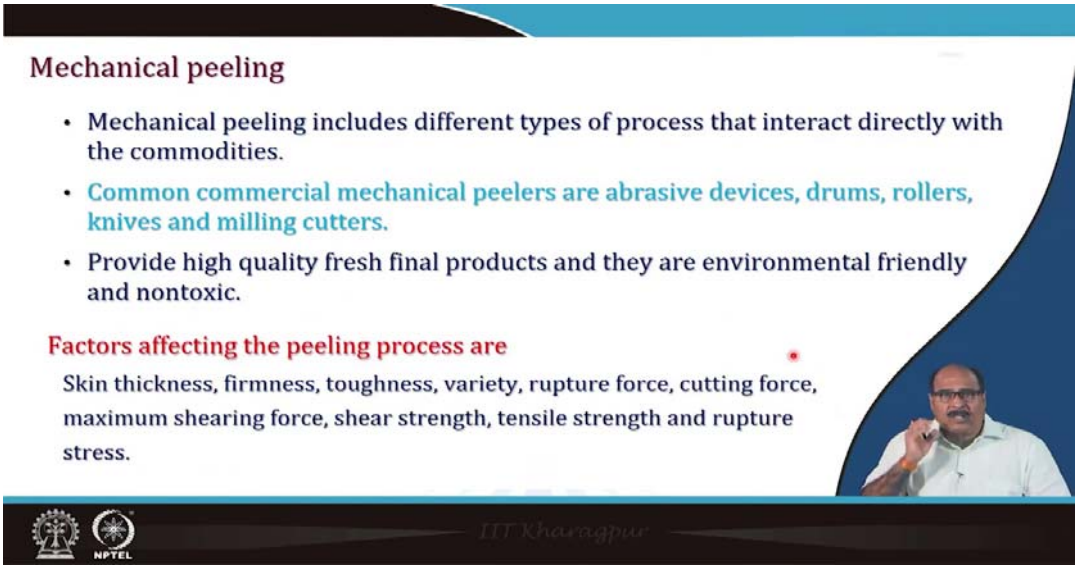


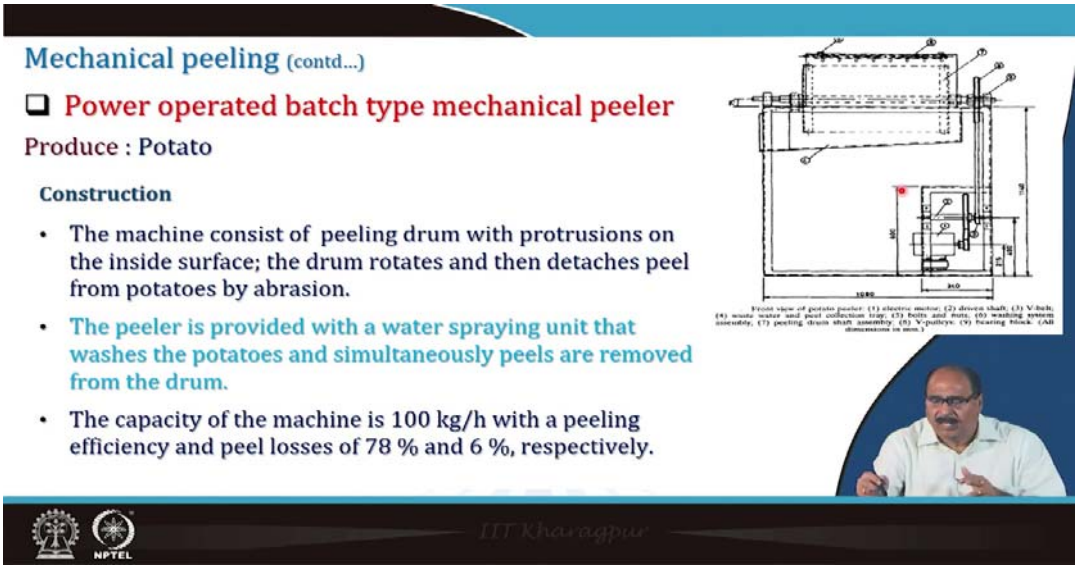
Manual/hand peeling

This is an ideal peeling which is done very gently, by hand with a sharp knife. Manual peeling is performed using stationary or rotatory hand peelers or knives against the surface of fruits and vegetables. Fresh-cut fruit and vegetables with good microbiological quality can be obtained by this method. Knife peeling causes less wounding in comparison to abrasion peeling. However, this method is limited to small scale processing and is laborious and requires more time.

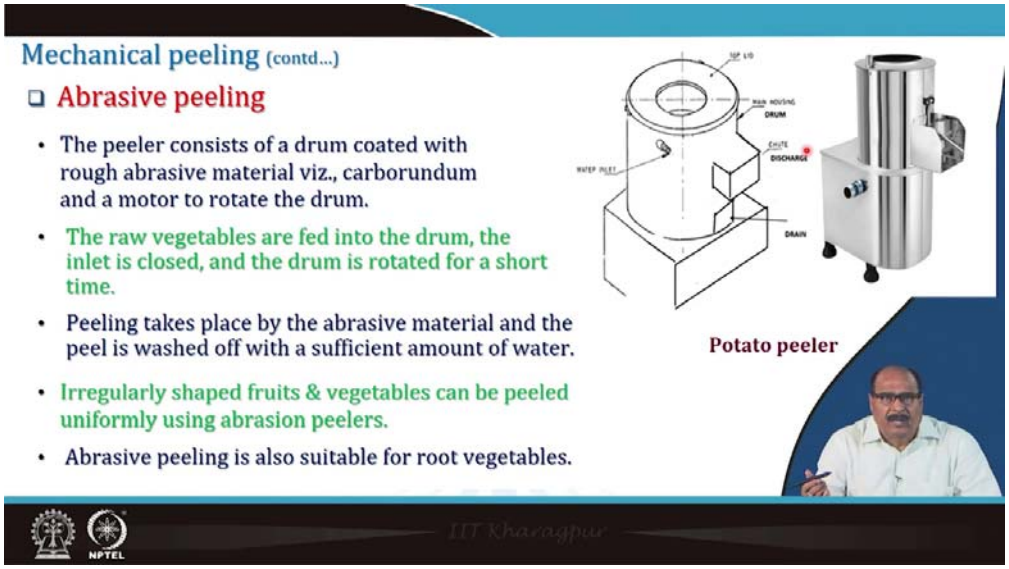
Mechanical peeling

Mechanical peeling includes different types of process that interact directly with the commodities. Common commercial mechanical peelers are abrasive devices, drums, rollers, knives and milling cutters. It provides high quality fresh final products and they are environmental friendly and nontoxic. The factors affecting the peeling processes are skin thickness, firmness, toughness, variety, rupture force, cutting force, maximum shearing force, shear strength, tensile strength, and rupture stress.

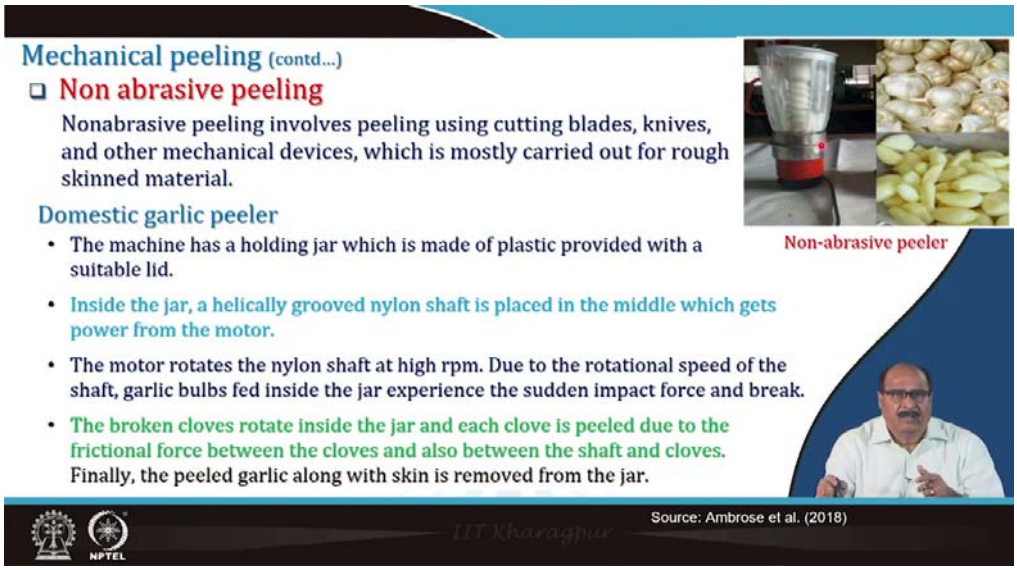




Power operated batch type mechanical peeler is particularly constructed for potato, it is used potato peeling. As shown in figure, the machine consists of peeling drum with protursions on the inside surface, the drum rotates and then detaches peel from potato by abrasion. The peeler is provided with a warm water spraying unit that washes the potato and simultaneously peels are removed from the drum. The capacity of the machine is 100 kg per hour with a peeling efficiency and peel losses of about 78 and 6%, respectively.

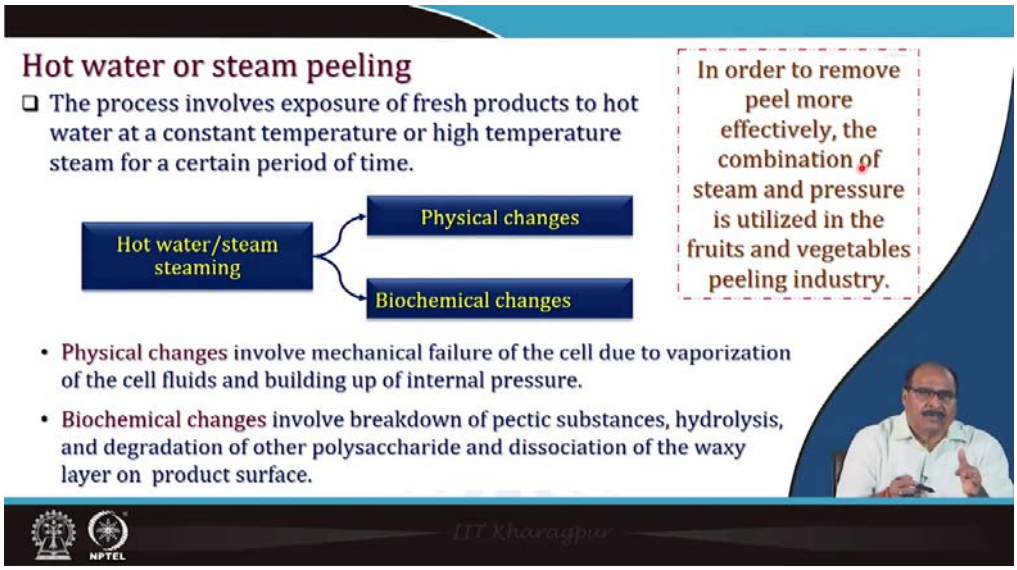


As shown in the figure, the abrasive peeler consists of a drum coated with rough abrasive material viz. carborundum and a motor to rotate the drum. The raw vegetables particularly potatoes are fed into the drum, the inlet is closed and the drum is then rotated for a short period of time. Peeling takes place by abrasive material and the peel is washed off with a sufficient amount of water. Irregularly shaped fruits and vegetables can be peeled uniformly using abrasion peelers. Abrasion peeling is also suitable for peeling of root vegetables.



Non-abrasive peeling is used for peeling of garlic, cloves. Non-abrasive peeling involves peeling using cutting blades knives and other mechanical devices, which is mostly carried out for rough skinned materials. Domestic garlic peeler has a holding jar which is made up plastic provided with a suitable lid. Inside the jar, a helically grooved nylon shaft is placed in the middle which gets power from the motor. The motor rotates the nylon shaft at a high rpm, due to the rotational

speed of the shaft, garlic bulbs fed inside the jar experience the certain impact force and break. The broken cloves rotate inside the jar and each clove is peeled due to the frictional force between the clove and also between the surface and the cloves. Finally, the peeled garlic along with the skin is removed from the shaft.

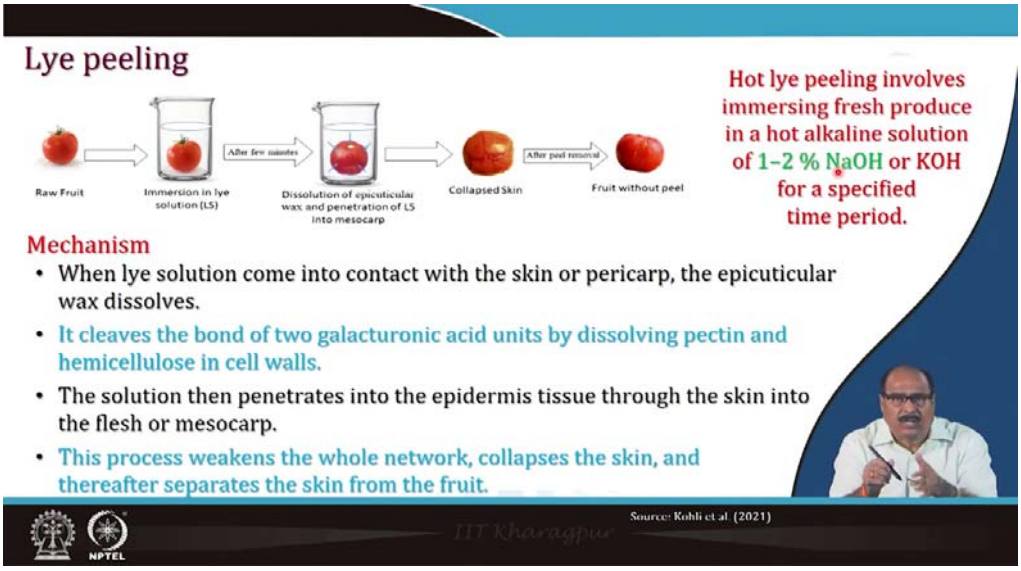


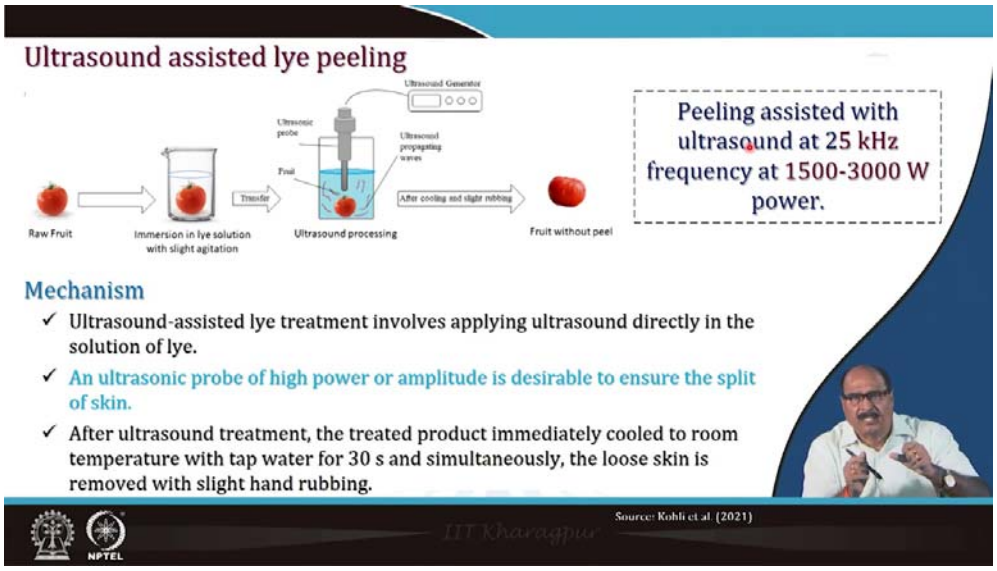
Hot water or steam peeling involves the exposure of fresh produce to hot water at a constant temperature or even high temperature steam for a certain period of time. So, this hot water or steam peeling is done in order to remove the peel more effectively, the combination of steam and pressure is utilized.

This hot water or steam peeling involves certain changes in the commodity like physical changes (mechanical failure of the cell due to vaporization of the cell fluids and building up of internal pressure), and biochemical changes (breakdown of pectic substances, hydrolysis and degradation of other polysaccharide and dissociates around the waxy layers on the product surface).

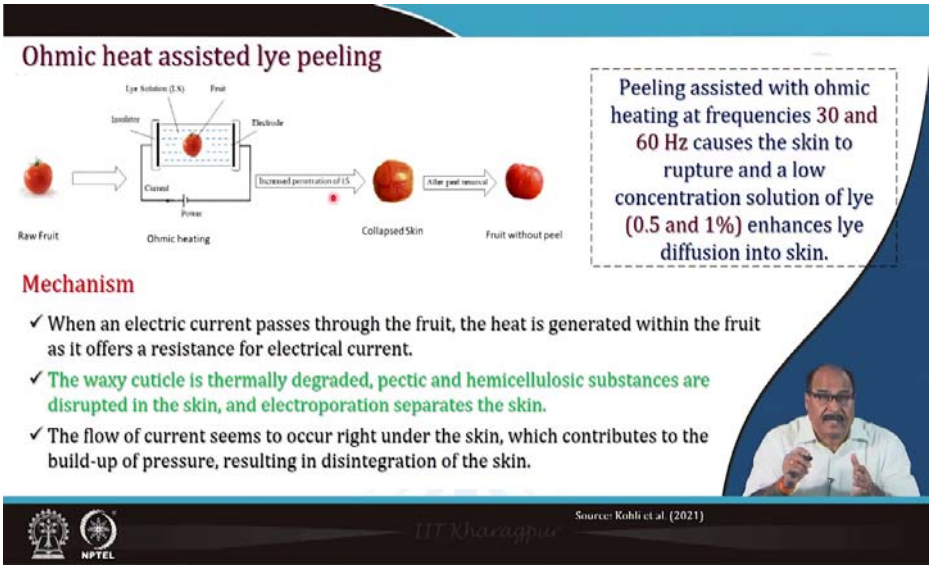
Lye peeling is a very common method, used for peeling the commodities like tomato. It involves immersing fresh produce in a hot alkaline solution of 1-2% sodium hydroxide or potassium hydroxide for a specified time period. Among these sodium hydroxide is most commonly used.

When lye solution comes into contact with the skin or pericarp of the commodity, the epicuticular wax dissolves. It leaves the bond of two galacturonic acid units by dissolving pectin and hemicellulose in the cell walls. The solution then penetrates into the epidermis tissue through the skin into the flesh or mesocarp. This process weakens the whole network, collapses the skin and thereafter separates the skin from the fruit. So, the skins get loosen and then finally has been emerged in lye solution and then hot lye solution for one or two minutes, followed by the collapse skin is finally either by simples rubbing or by using dry air or dry water spreads or jet spray, it can be removed easily.

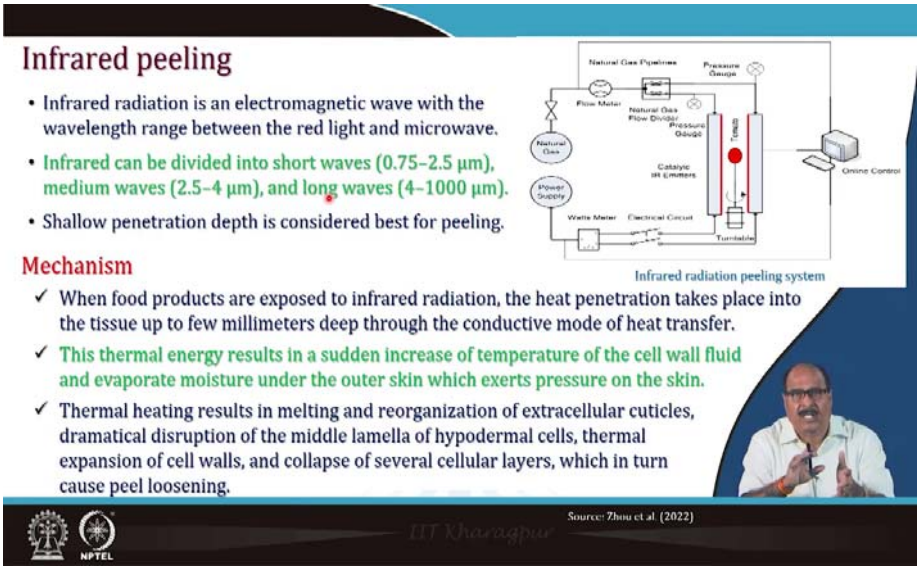




The ultrasound assisted lye peeling involves applying ultrasound directly in the solution of lye. An ultrasonic probe of high power or amplitude is desirable to ensure the split of skin. After ultrasound treatment, the treated product immediately cooled to room temperature with tap water for 30 s and simultaneously, the loose skin is removed with slight hand rubbing. The peeling assisted with ultrasound operates at 25 kHz frequency at 1500-3000 W power.

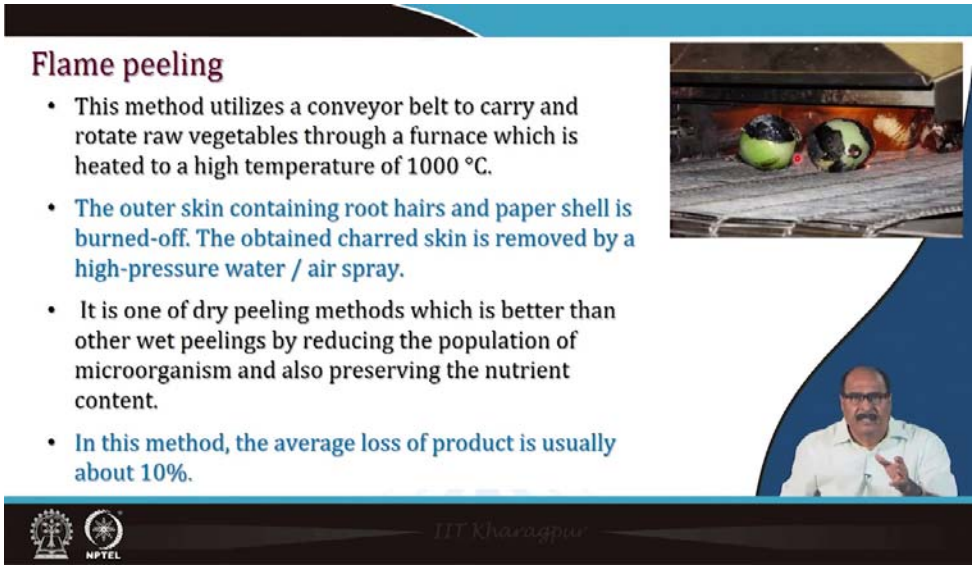


Similarly, this ohmic heat assisted lye peeling it is another this peeling assisted with Ohmic heating at frequencies 30 and 60 Hz causes the skin to rupture and a low concentration solution lye (0.5 and 1%) enhances that lye diffusion into the skin. When the electric current passes through the fruit, the heat is generated within the fruit as it offers a resistance for the electric current. So, the waxy cuticle is thermally degraded, pectic and hemicellulose substances are disrupted in the skin and the electroporation separates the skin. So, the flow of the current seems to occur right under the skin, which contributes to the build-up of pressure, resulting in the disintegration of the skin and then the remain disintegrated skin is separated from the fruit either by simples rubbing or air jet spray.



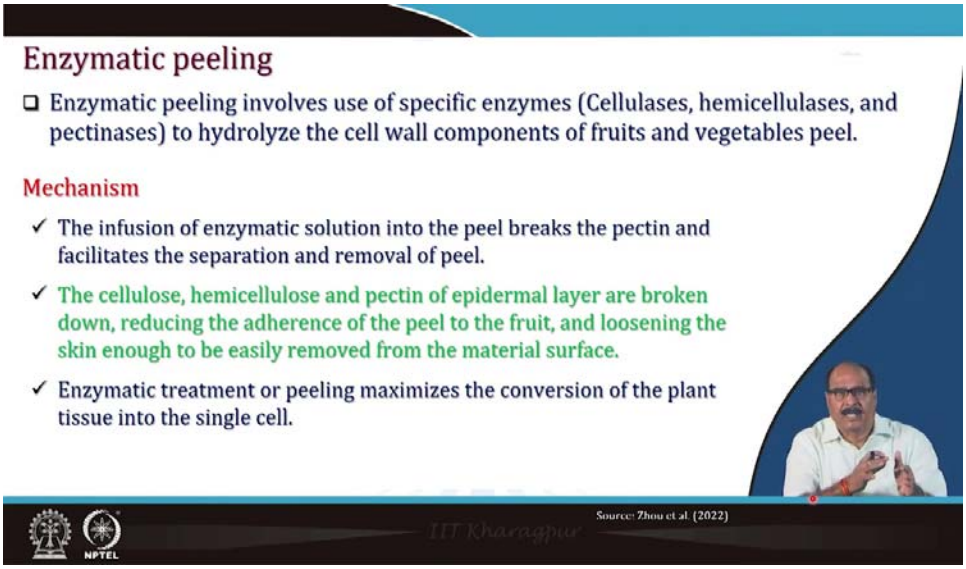
Another novel method of peeling is infrared peeling. Infrared radiation is an electromagnetic wave with the wavelength range between the red light and microwave. Infrared can be divided

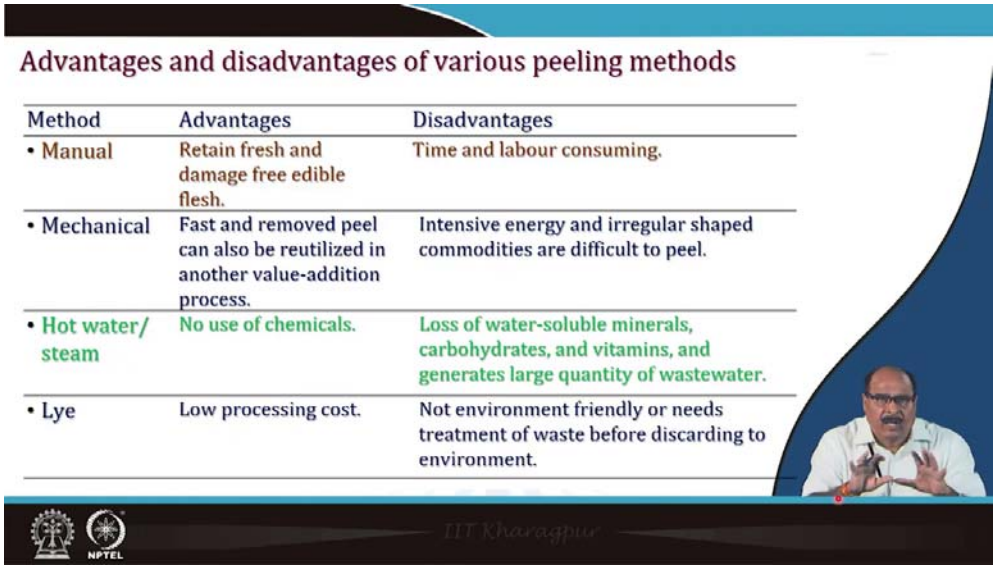
into short waves (0.75–2.5 μm), medium waves (2.5–4 μm), and long waves (4–1000 μm). Shallow penetration depth is considered best for peeling. When food products are exposed to infrared radiation, the heat penetration takes place into the tissue up to few millimeters deep through the conductive mode of heat transfer. This thermal energy results in a sudden increase of temperature of the cell wall fluid and evaporate moisture under the outer skin which exerts pressure on the skin. Thermal heating results in melting and reorganization of extracellular cuticles, dramatical disruption of the middle lamella of hypodermal cells, thermal expansion of cell walls, and collapse of several cellular layers, which in turn cause peel loosening.



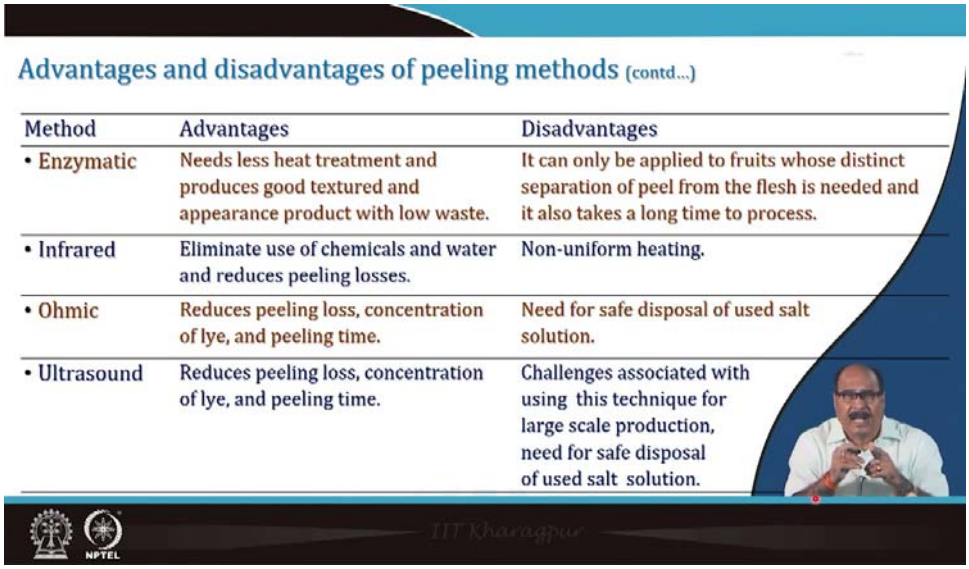
Flame peeling utilizes a conveyor belt to carry and rotate raw vegetables through a furnace which is heated to high temperature as high as 1000 °C. It is passed through this furnace for a few seconds to few minutes depending upon the type of the fruits or vegetables. The outer skin containing root hairs and paper shell is burned-off. The obtained charred skin is removed by a high-pressure water / air spray. It is one of dry peeling methods which is better than other wet peelings by reducing the population of microorganism and also preserving the nutrient content. In this method, the average loss of product is usually about 10%.

Enzymatic peeling involves use of specific enzymes (Cellulases, hemicellulases, and pectinases) to hydrolyze the cell wall components of fruits and vegetables peel. The infusion of enzymatic solution into the peel breaks the pectin and facilitates the separation and removal of peel. The cellulose, hemicellulose and pectin of epidermal layer are broken down, reducing the adherence of the peel to the fruit, and loosening the skin enough to be easily removed from the material surface. Enzymatic treatment or peeling maximizes the conversion of the plant tissue into the single cell.

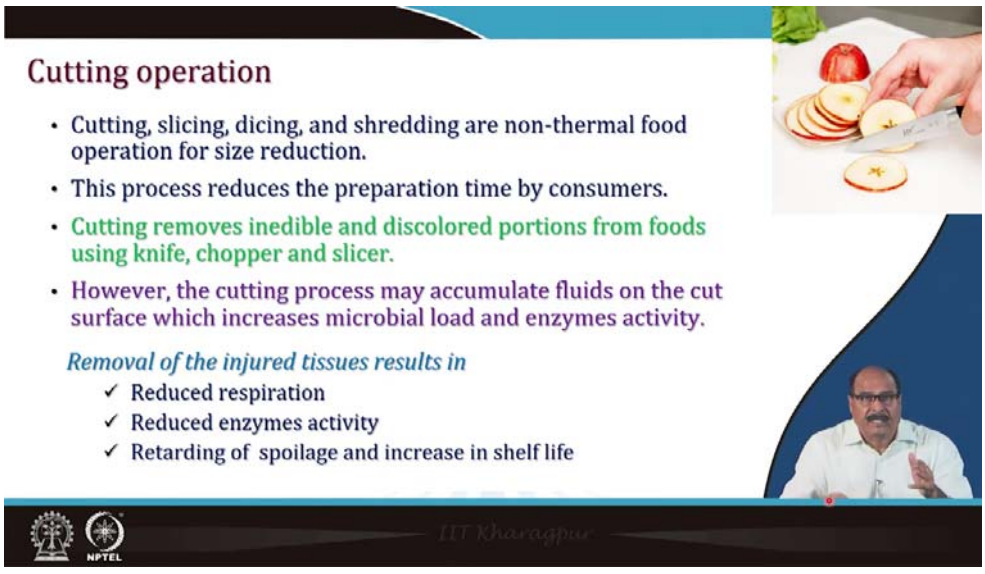




Manual peeling retains fresh and there is a less damage of free edible flesh. However, it is time and labour consuming. Mechanical peelings are fast and the removed peel removed can be reutilized in another value addition process, however, it is energy intensive operations and irregular shaped commodities are difficult to peel. In hot water or steam peeling, there is no use of chemical. However there are losses of water-soluble minerals, carbohydrate, vitamins and they generate large quantity of wastewater. Although lye peeling requires a low processing cost, but it is not environment friendly or needs the treatment of waste water before discarding it to the environment.

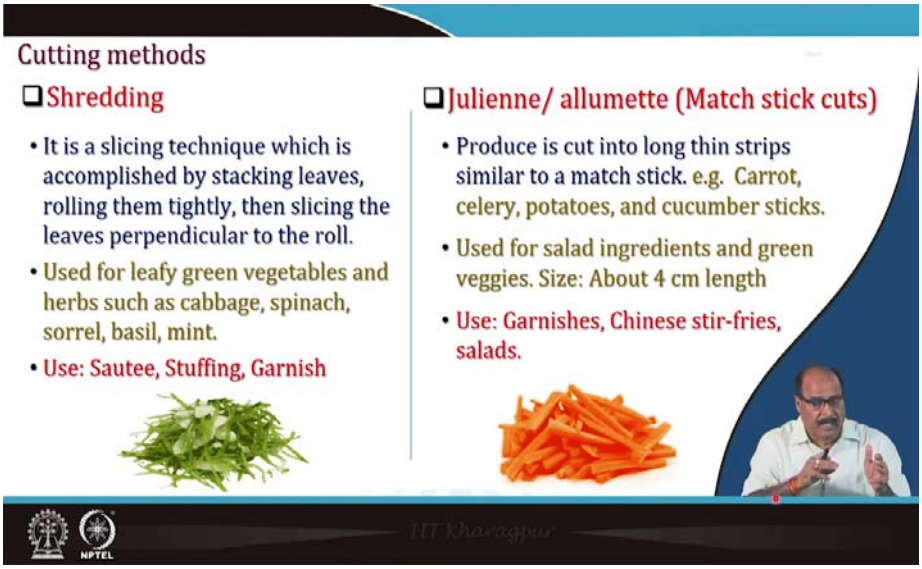


Enzymatic method needs less heat treatment and produces good textured and appearance product with low waste, but it can only be applied to fruits whose distinct separates of peel from the flesh is needed and it also takes a long time to process. Infrared, ohmic and ultrasound methods are considered novel peeling methods and eliminate use of chemicals and water to reduce the peeling losses, it reduces peeling loss, concentration of lye is also not required, and peeling time is less. There may be non-uniform heating in infrared peeling, there is a need of safe disposal of used salt solution in ohmic peeling. The challenges associated with ultrasound technique are larger scale production and need for safe disposal of the use salt solution.

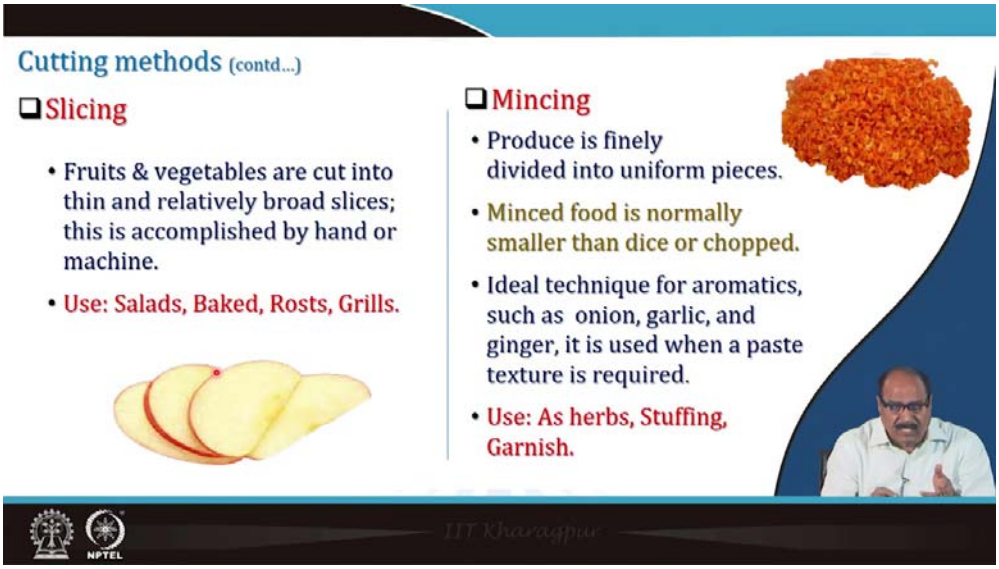


Cutting, slicing, dicing, and shredding are non-thermal food operation for size reduction. This process reduces the preparation time by consumers. Cutting removes inedible and discolored portions from foods using knife, chopper and slicer. However, the cutting process may

accumulate fluids on the cut surface which increases microbial load and enzymes activity. Removal of the injured tissues in the cutting results in reduced respiration, reduced enzymatic activity or it may also result in retarding the spoilage and increase in the shelf life.

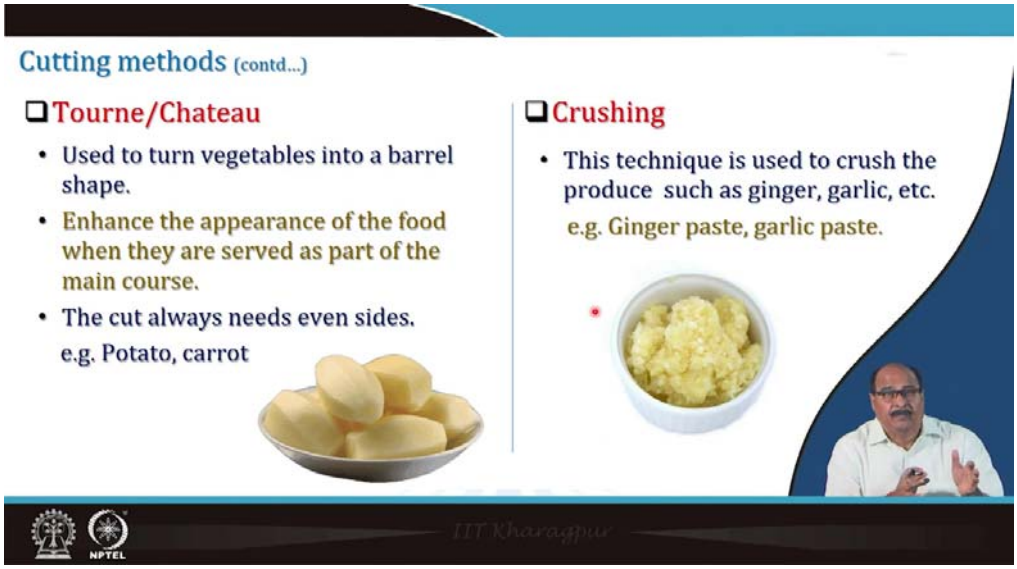


Shredding is a slicing technique which is accomplished by stacking leaves, rolling them tightly, then slicing the leaves perpendicular to the roll, and used for leafy green vegetables and herbs such as cabbage, spinach, sorrel, basil, mint. Julienne/allumette (Match stick cuts) involves cutting of the produce into long thin strips similar to a match stick. e.g. Carrot, celery, potatoes, and cucumber sticks with a size of about 4 cm length, and are used for salad ingredients and green veggies.

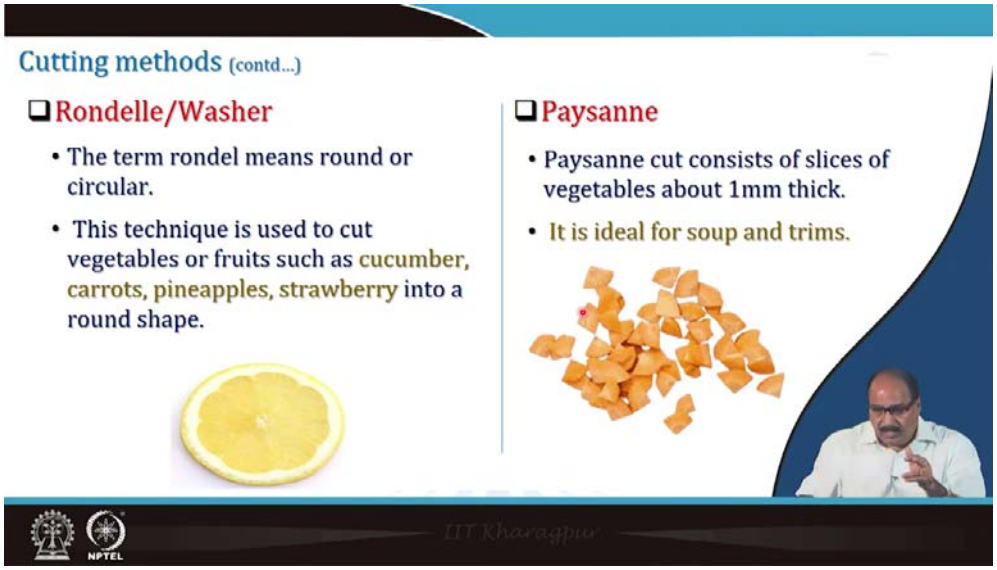


Fruits & vegetables are cut into thin and relatively broad slices; this is accomplished by hand or machine. The slices are used for salad, baked goods for baking, roasts grills etc. In mincing,

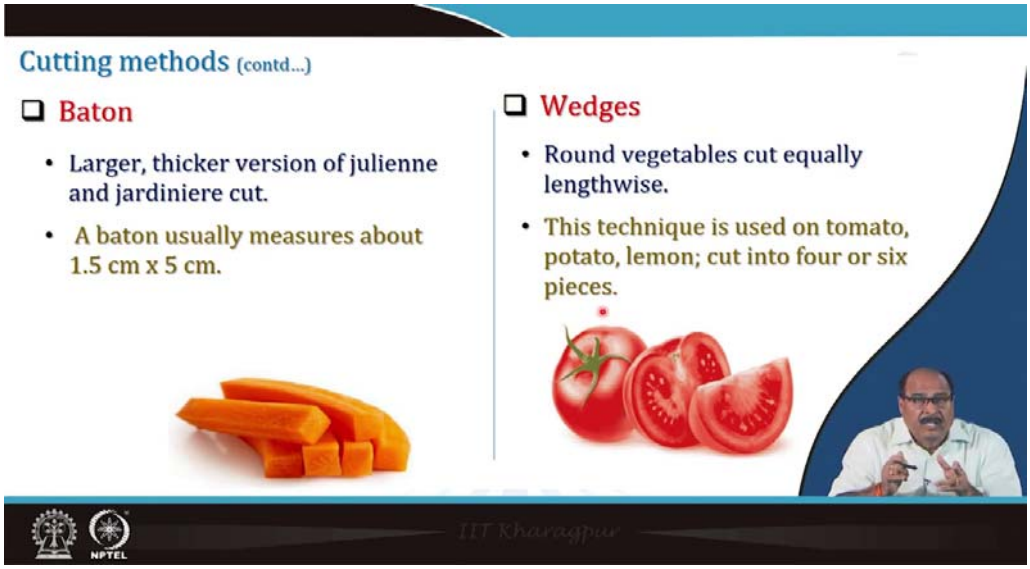
produce is finely divided into uniform pieces. Minced food is normally smaller than dice or chopped. It is an ideal technique for aromatics, such as onion, garlic, and ginger, it is used when a paste texture is required.



Tourne or chateau is used to turn vegetables into a barrel shape, it enhance the appearance of the commodity when they are served as part of the main course. The cut always needs even sides. The crushing technique is used to crush the produce such as ginger, garlic etc. into fine paste like ginger paste, garlic paste.

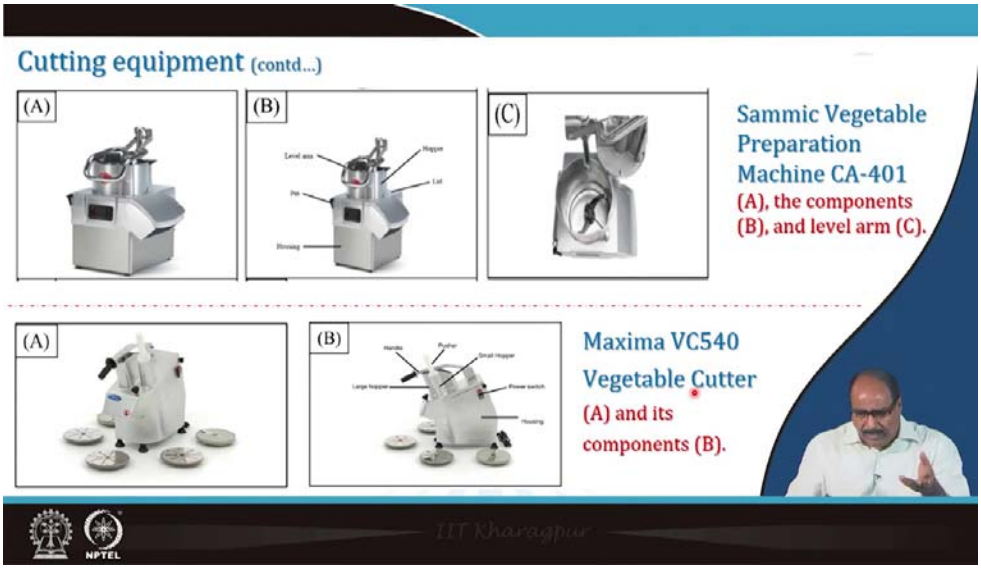


The term Rondelle means round or circular, this technique is used to cut vegetables or fruits such as cucumber, carrots, pineapples, strawberry into a round shape. Paysanne cut consists of slices or vegetables of about one millimetre thick, it is ideal for soup and trims.

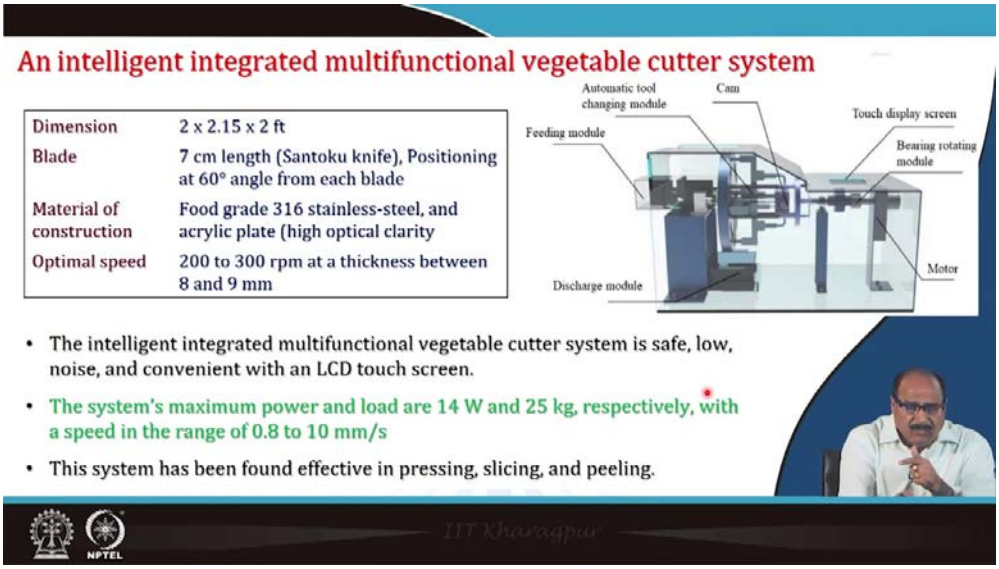


The baton it a larger, thicker version of julienne and jardiniere cut, a baton usually measures about 1.5 to 5 centimetre. Wedges are the round vegetables cut equally lengthwise, this technique is used on tomato, potato, lemon which are cut into 4 or 6 pieces.

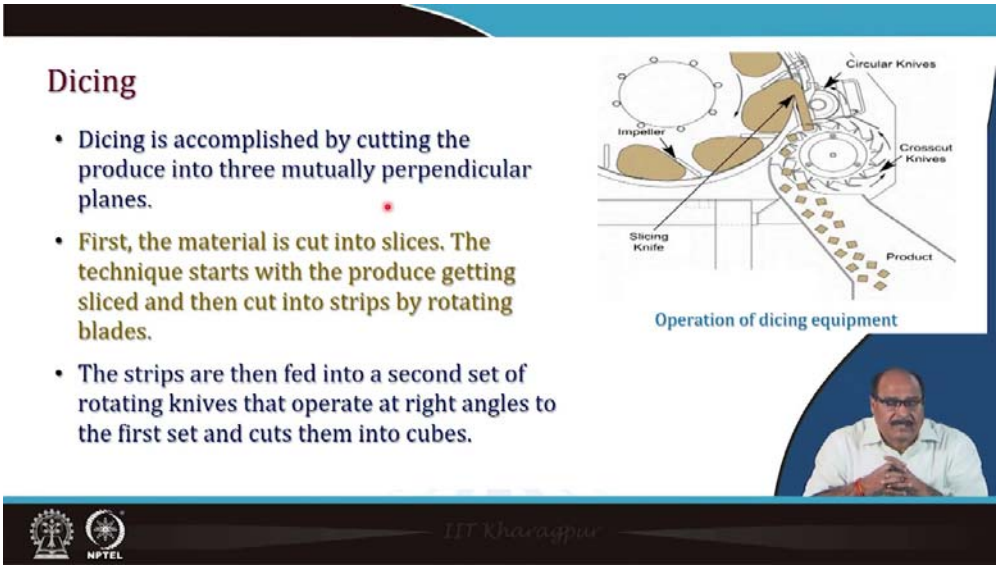
The slide shows some new cutting equipment and these equipments are very common and are available in the market.



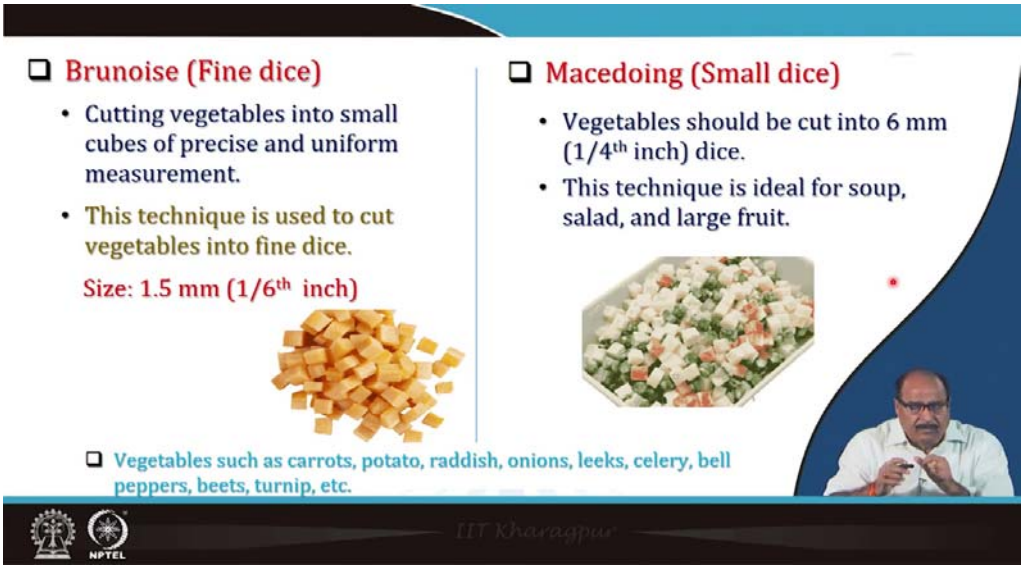
These are the figures of Sammic vegetable preparation machine or Maxima VC540 for vegetable cutters with their components.



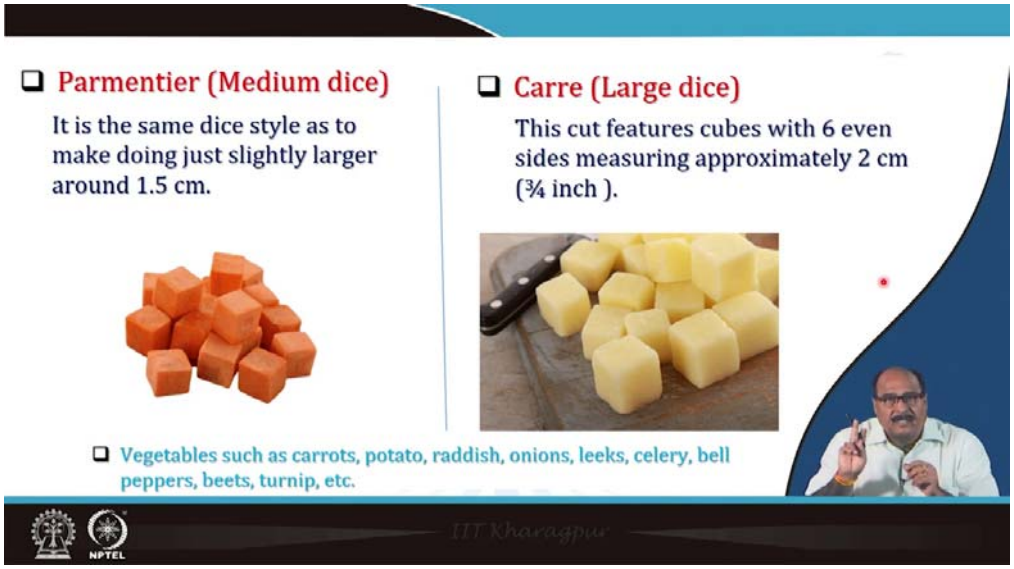
The intelligent integrated multifunctional vegetable cutter system is safe, low, noise, and convenient with an LCD touch screen. The system's maximum power and load are 14 W and 25 kg, respectively, with a speed in the range of 0.8 to 10 mm/s. This system has been found effective in pressing, slicing, and peeling.



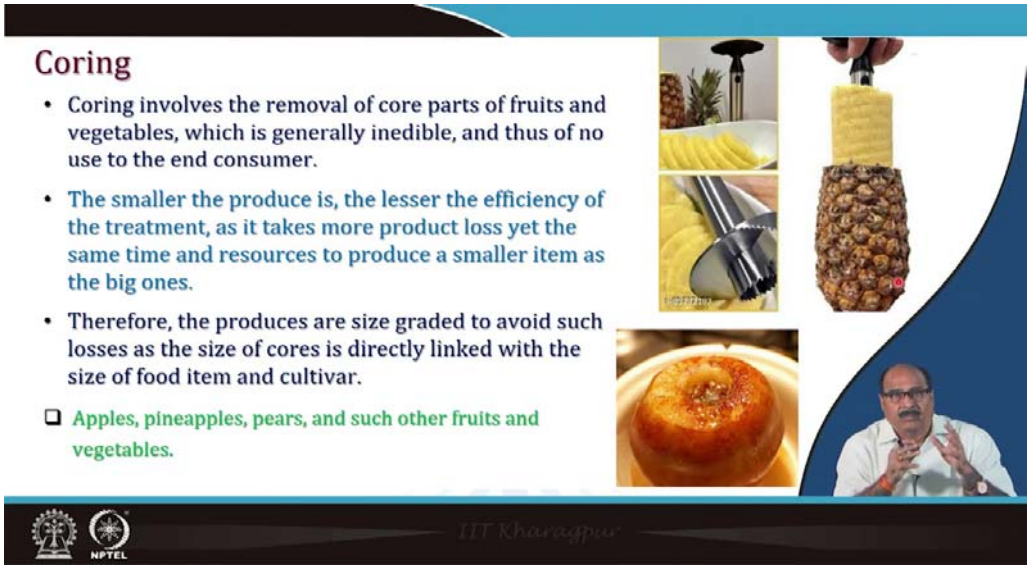
Dicing is accomplished by cutting the produce into three mutually perpendicular planes. First, the material is cut into slices. The technique starts with the produce getting sliced and then cut into strips by rotating blades. The strips are then fed into a second set of rotating knives that operate at right angles to the first set and cuts them into cubes.



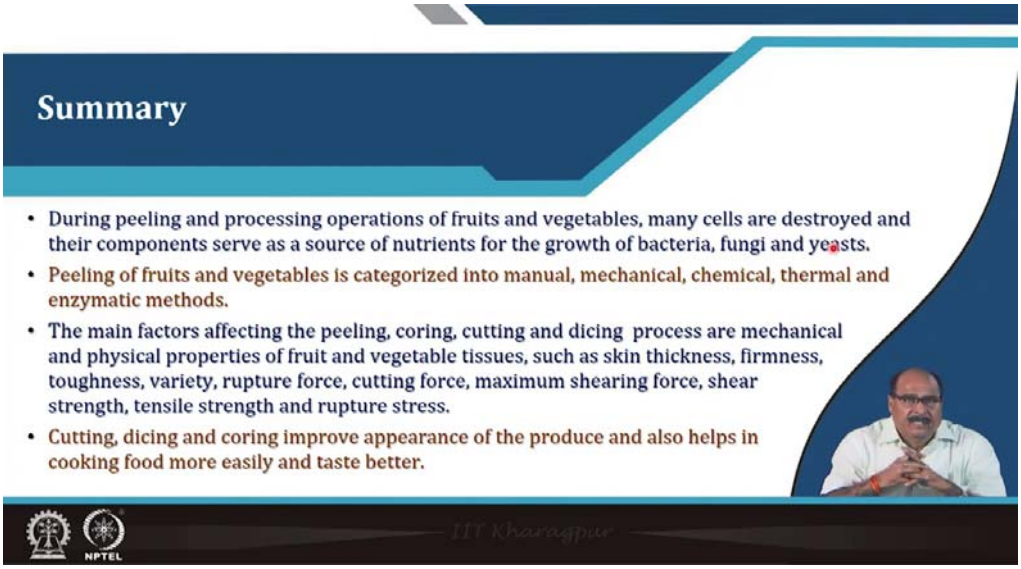
Brunoise is cutting vegetables into small cubes of pieces and uniform measurement. In macedoing, mall dice vegetables should be cut into 6 mm dice, this technically is ideal for soup, salad and large vegetables like carrot, potato, radish, onions etc.



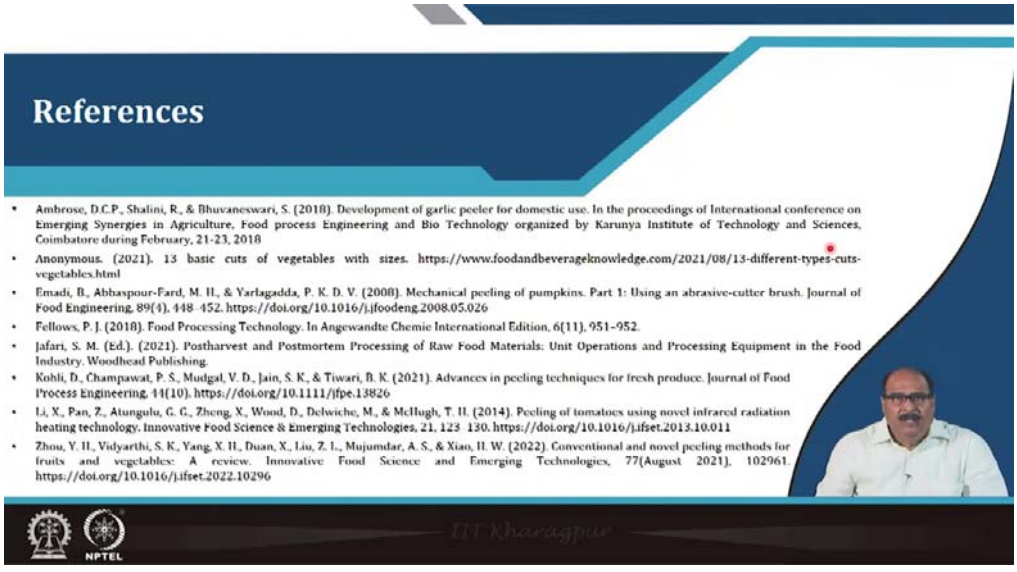
Parmentier (Medium dice) is the same dice style as to make doing just slightly larger around 1.5 cm. Carre (Large dice) features cubes with 6 even sides measuring approximately 2 cm (¾ inch).



Coring involves the removal of core parts of fruits and vegetables, which is generally inedible, and thus of no use to the end consumer. The smaller the produce is, the lesser the efficiency of the treatment, as it takes more product loss yet the same time and resources to produce a smaller item as the big ones. Therefore, the produces are size graded to avoid such losses as the size of cores is directly linked with the size of food item and cultivar. So, the commodity like apples pineapple, peers are such other fruits and vegetables are cored using these techniques.



In summary, during peeling and processing operations of fruits and vegetables, many cells are destroyed and their components serve as a source of nutrients for the growth of bacteria, fungi and yeasts. Peeling of fruits and vegetables is categorized into manual, mechanical, chemical, thermal and enzymatic methods. The main factors affecting the peeling, coring, cutting and dicing process are mechanical, and physical properties of fruit and vegetable tissues, such as skin thickness, firmness, toughness, variety, rupture force, cutting force, maximum shearing force, shear strength, tensile strength and rupture stress. Cutting, dicing and coring improve appearance of the produce and also helps in cooking food more easily and taste better.



These are the references for further study. Thank you.