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

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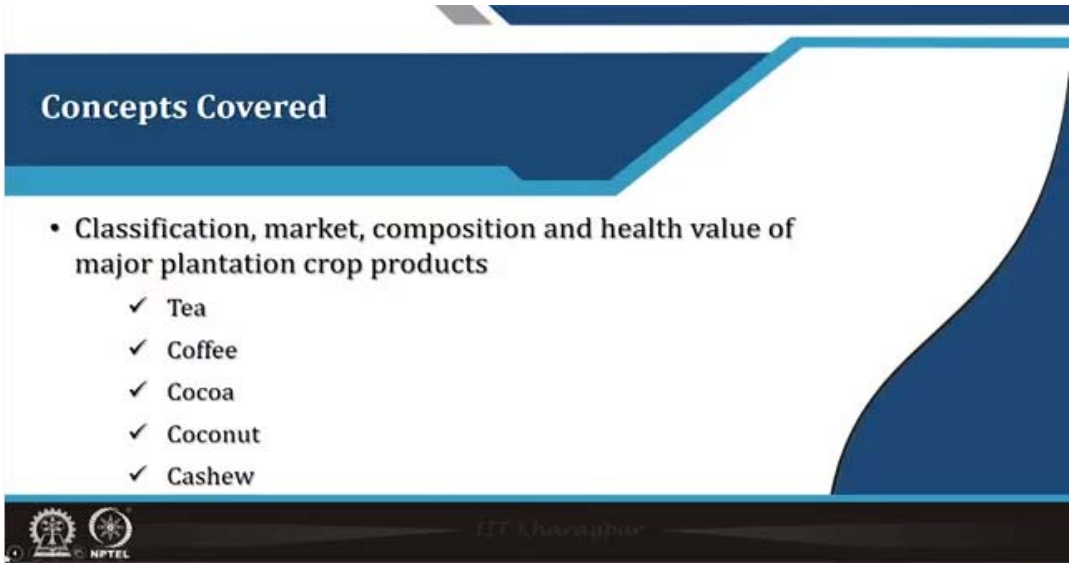
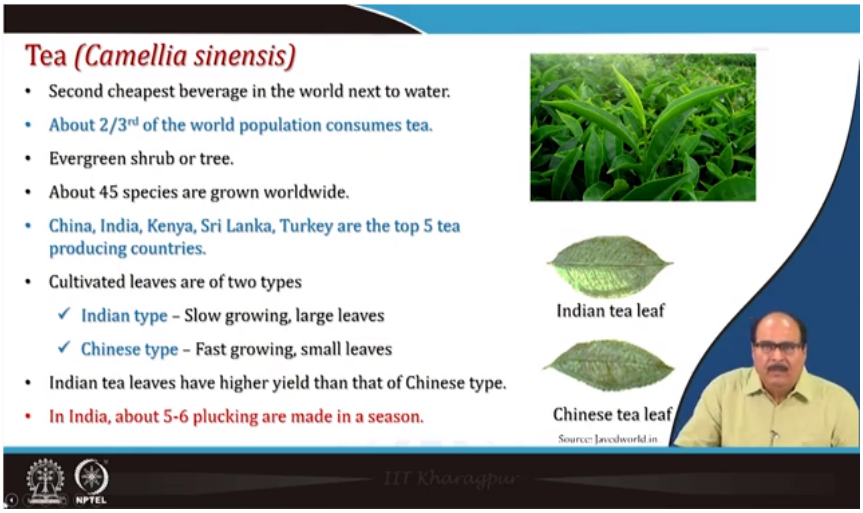
Lecture 5
Plantation Crops

In this lecture, composition, nutritional and health value of plantation crops are discussed.



The concept that is covered in this lecture, is the classification, market, composition and health value of major plantation crop products like tea, coffee, cocoa, coconut, cashew etc.



Tea (*Camellia sinesis*)

Tea (*Camellia Sinensis*) is the second cheapest beverage in the world next to water. About two thirds of the world population consumes tea. It can be seen from the figure, that the tea trees are evergreen shrub or trees. There are about 45 species of tea, that are grown in the world, in which *Camellia Sinensis* is the best one. China, India, Kenya, Sri Lanka, Turkey are the top five tea producing countries of the world.

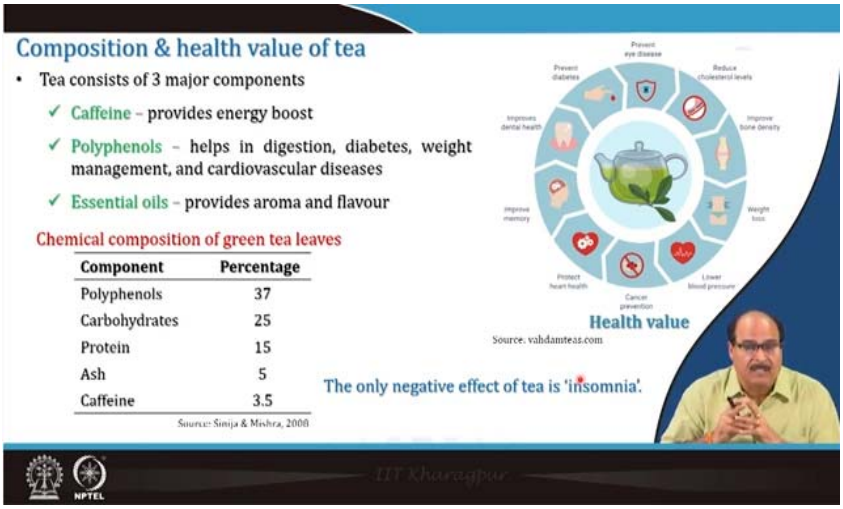
Cultivator tea leaves are of two types. a) Indian type- These are slow growing and large leaves containing tea plants. b) Chinese type- It can be seen in the figure that the Chinese type is a fast growing and small leaves containing tea plant. Indian type has the higher yield than the Chinese type. In India, these bushes are pruned regularly, in order to encourage more and more leaf production. In India, about 5-6 tea plugging are made in a season. The top terminal bud and top terminal two or three leaves are plugged and after that, they are processed.

Production & Classification of Tea

The global tea market revenue in 2020 was 186.6 billion $, where India ranked third with about 15.8 billion $. India is the second largest producer of tea, with a production of 1.2 billion kg tea in 2021 and the consumption of tea was about 1.1 billion kg.

Total tea export of India is about 826.47 million $, in financial year 2020 and 755.86 $, in financial year 2021. India makes different types of tea and there are different tea products depending on the manner, in which they are processed. For e.g., fermented i.e., black tea or semi-fermented oolong tea, unfermented green tea.

Major tea brands in India includes Red Label, Wagh Bakri, Lipton, Taj Mahal, TATA tea etc. The data shows in this figure, the increasing the trend in the million-dollar values i.e., the export of revenue generated by the tea export.



Composition & health value of tea

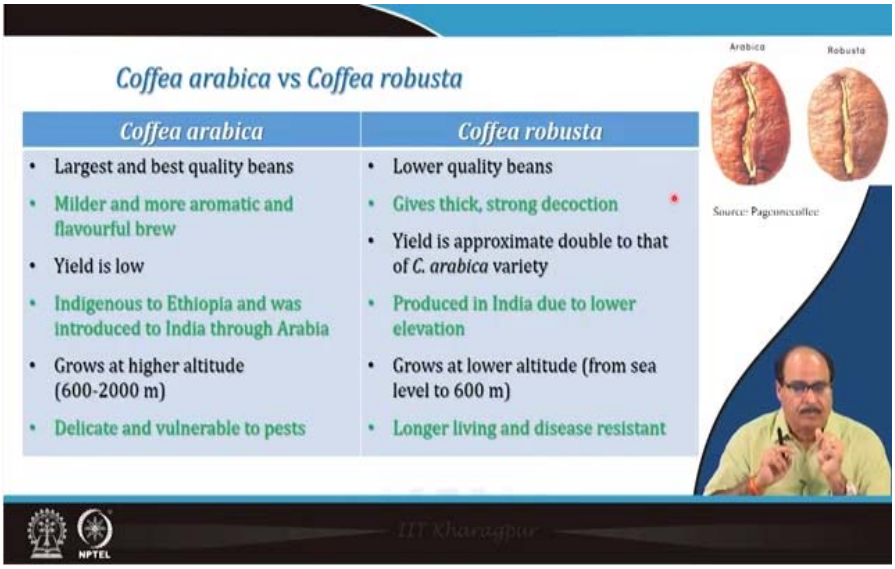
Tea consists 3 major components. a) water soluble b) water insoluble compounds. The major components present in the tea leaf include caffeine, which provides i) energy or the stimulating action, ii) polyphenols, which help in digestion, managing diabetes, weight and cardiovascular diseases etc., iii) essential oils, which provides aroma and flavor.

Chemical composition of green tea leaves

It has polyphenols about 35-37%, carbohydrate 25%, protein 15%, ash 5% and caffeine 3.5%. The health value of the tea can be seen in the figure. Tea, both green tea as well as black tea are remedies for various diseases like diabetes, eye disease. They reduce cholesterol levels, improve bone density, weight loss, lowering blood pressure, prevent cancer, protect heart health, improve memory, improve dental health etc. The negative effect of the tea include insomnia.

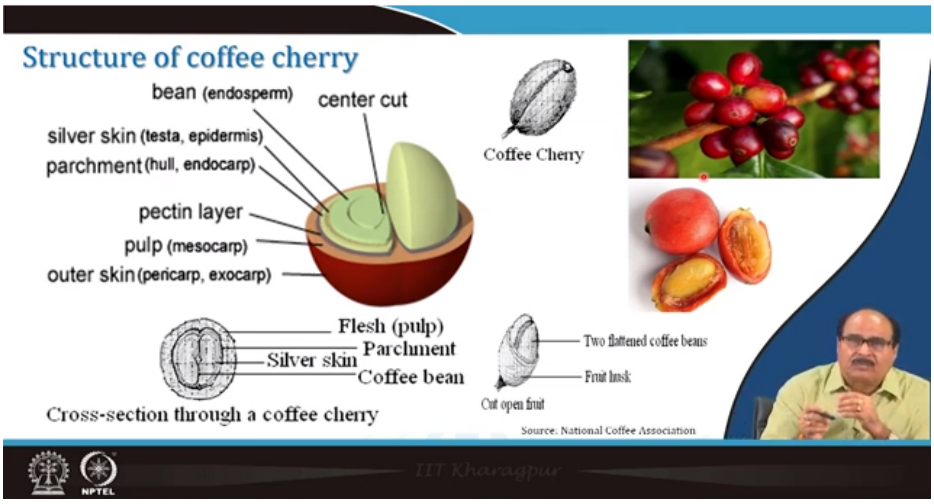
Coffee (*Coffea*)

Coffee is the third most popular beverage in the world next to water and tea. Coffee is an evergreen shrub or small tree. It is indigenous to Central Africa and Asia. Three major varieties of coffee include *Coffea Arabica*, *Coffea robusta* (*C. canephora*) and *Coffea liberica*. So, this *Coffea arabica* and *Coffea robusta*, almost supply the world's largest part of the consumption of the coffee.



Coffea arabica vs Coffea robusta

If a comparison between *Coffea arabica* and *Coffea robusta* has been performed, then it can be found that *Coffea arabica* is the largest and best quality beans, whereas *Coffea robusta* gives inferior or lower quality beans. *Coffea arabica* has the milder and more aromatic and flavorful brew, whereas *Coffea robusta* gives thick and strong decoction. *Coffea robusta* is liked most in India. *Coffea arabica*'s yield is low but *Coffea robusta*'s yield is approximately doubled to that of *Coffea arabica* variety. *Coffea arabica* is indigenous to Ethiopia and was introduced to India through arabia, whereas, *Coffea robusta* is produced in India due to lower elevation. *Coffea arabica* grows at higher altitude (600 to 2000 m). *Coffea robusta* can be grown at a comparatively lower attitude (600 m from sea level). *Coffea arabica* is delicate and vulnerable to pest. *Coffea robusta* is a longer living and disease resistant variety.



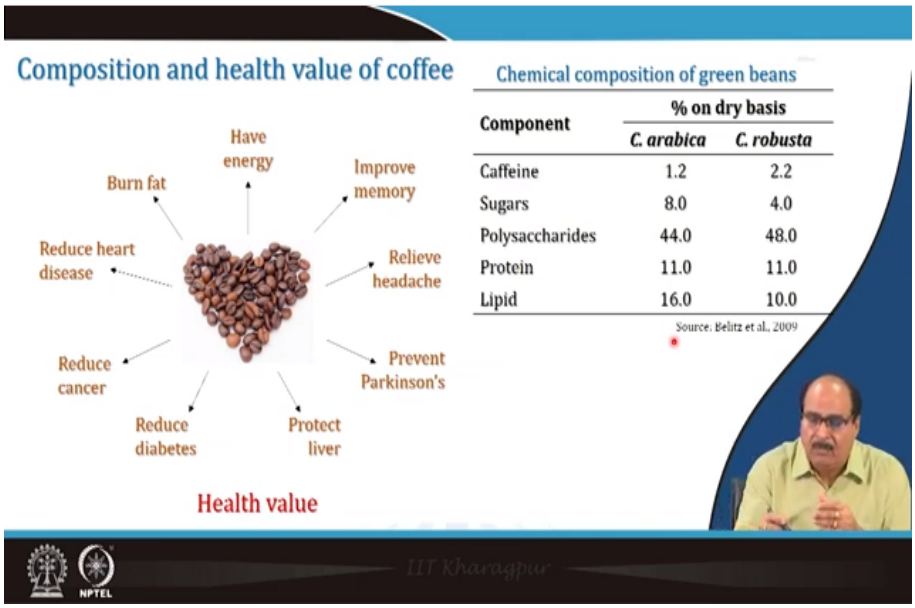
Structure of coffee cherry

It can be seen in the figure, that the coffee cherry, if it is very ripe, it is deep red or orange in color, depending on the plant species. It can also be seen from the figure that, the cross section of coffee cherry shows that, it has two flattened beans inside. These beans are valuable source of the coffee beverage that has been consumed. The outer part of the coffee cherry is the husk or peel and it has two flattened beans inside.

The internal structure of the coffee bean is covered by a silvery skin i.e., testa epidermis, parchment, which is hull endocarp. Then there is a pectin layer, finally exists the pulp mesocarp and outer skin pericarp or exocarp. During coffee processing, except the seed, the remaining things like pulp, skin, parchment etc. all are removed.

Market statistics of coffee

As per the market statistics, Karnataka, Kerala and Tamil Nadu are the major producers of coffee in India. India is the fifth largest producer and sixth largest exporter of the coffee in the world. India accounts for 3.14% of the global coffee production, coffee production during 2020-2021 is 3, 42,000 million tons. Total coffee export is stood at 719.5 million $. Only 30% of the coffee is consumed domestically. The three major brands of coffee in India are Nescafe, BRU or TATA coffee.



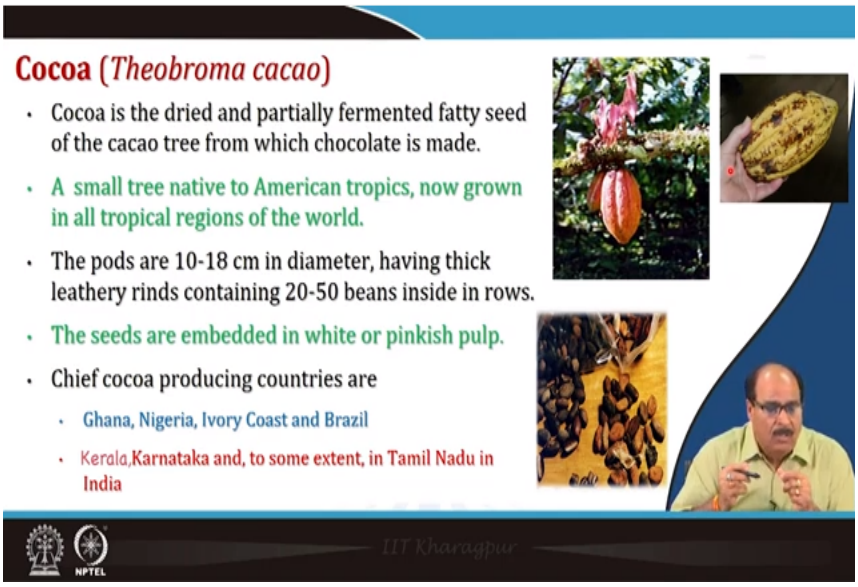
Composition and health value of the coffee

Chemical composition of green beans

The chemical composition of green beans (i.e., *C. arabica* and *C. robusta*) is represented in the table, in % on dry basis. They have polysaccharide around 44 to 48 %, protein about 11 % in both, lipid 16 to 10 %. *Coffea arabica* has 1.2 % caffeine and *Coffea robusta* has a higher caffeine i.e., 2.2%. It is due to the higher caffeine content, *Coffea robusta* gives a strong decoction and a good stimulating action.

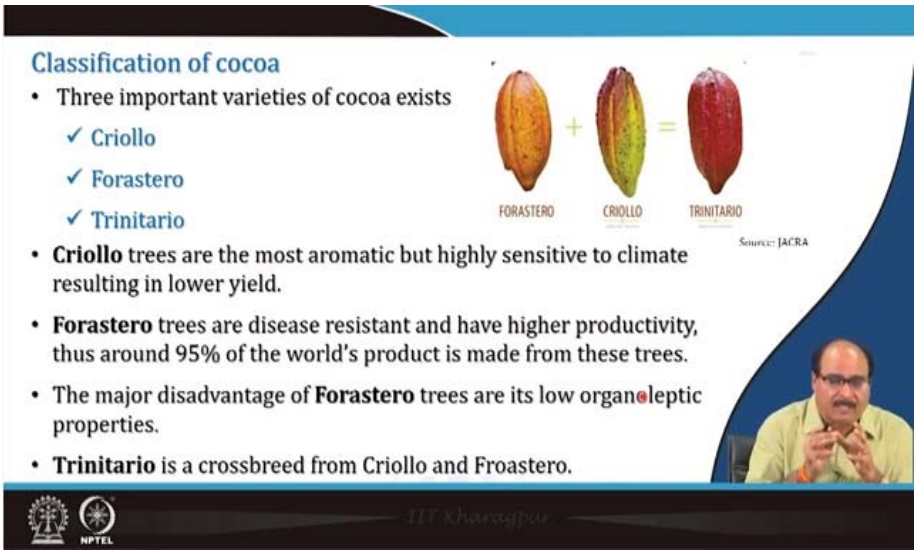
Health value of coffee

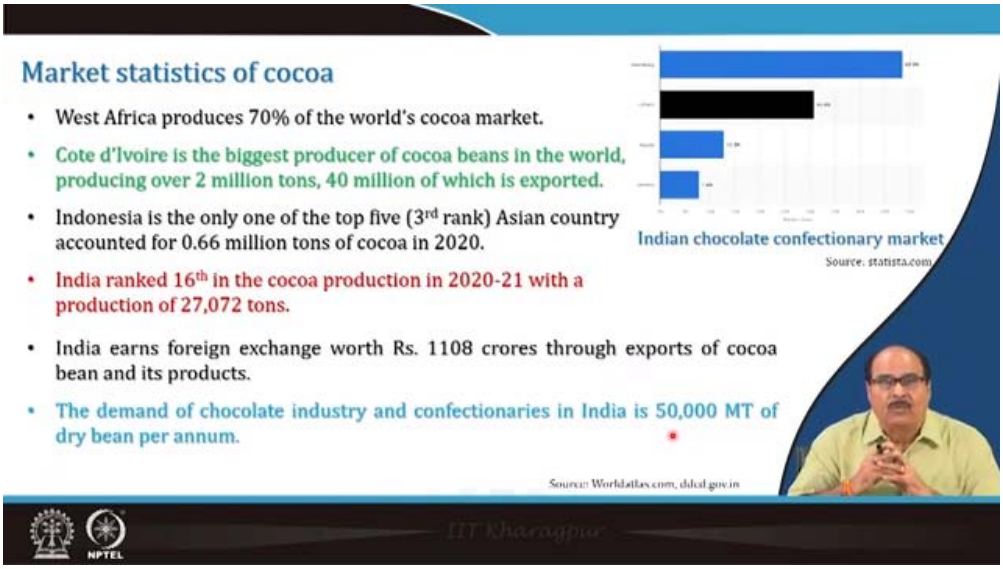
Coffee has a good energy value, it improves memory, relieves headache, prevents Parkinson's disease, protects liver, reduces diabetes, reduces cancer, reduces heart diseases, burns fat and it is a storehouse for various medicines or agents, like health promoting bioactive agents.



Cocoa (*Theobroma cacao*)

Cocoa is the dried and partially fermented fatty seed of the cacao tree (*Theobroma cacao*) from which the chocolate is made. The cocoa tree is a long tree. In the branches, directly on the main trunk and directly on the branches, the flowers appear. This flower is finally converted into fruit, i.e., the cocoa fruit. This cocoa tree is a small tree to American tropics, now grown in all tropical regions of the world. The pods are 10 to 18 cm in diameter, having thick leathery rinds containing 20-50 beans inside in rows. The beans are arranged inside in the rows. The seeds are embedded in white or pinkish pulp. The beans or the seeds are inside the cocoa pod, which are the valuable source of chocolate and cocoa butter. Chief cocoa producing countries in the world are Ghana, Nigeria, Ivory Coast and Brazil. Kerala, Karnataka and to some extent Tamil Nadu produce cocoa in India.



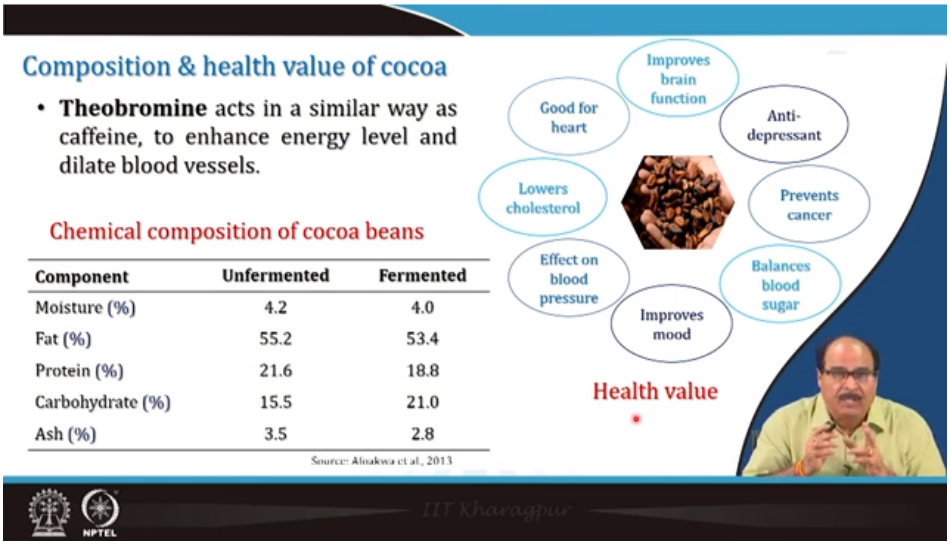


Classification of cocoa

Cocoa is a classified in three important varieties. That are Criollo, Forastero and Trinitario. Criollo trees are the most aromatic but highly sensitive to climate, resulting in lower yield. Forastero trees are disease resistance and have higher productivity, thus around 90% of the world's product is made from these trees. The major disadvantage of Forastero trees are its lower organoleptic properties. Trinitario is the crossbreed from Criollo and Forastero.

Market statistics of cocoa

West Africa produces 70% of the world cocoa market. Cote d'lvoire is the biggest producer of cocoa beans in the world, producing over 2 million tons, 40 million of which is exported. Indonesia is the only one of the top five Asian country accounted for 0.66 million tons of cocoa in 2020. India ranked 16th in the cocoa production in 2021 with a production of about 27,072 tons. India earns foreign exchange worth Rs. 1108 crore through export of cocoa beans and its products. The demand of chocolate industry and confectionaries in India is 50,000 MT (metric tons) of dry beans per annum.



Composition & health value of cocoa

Health value of cocoa

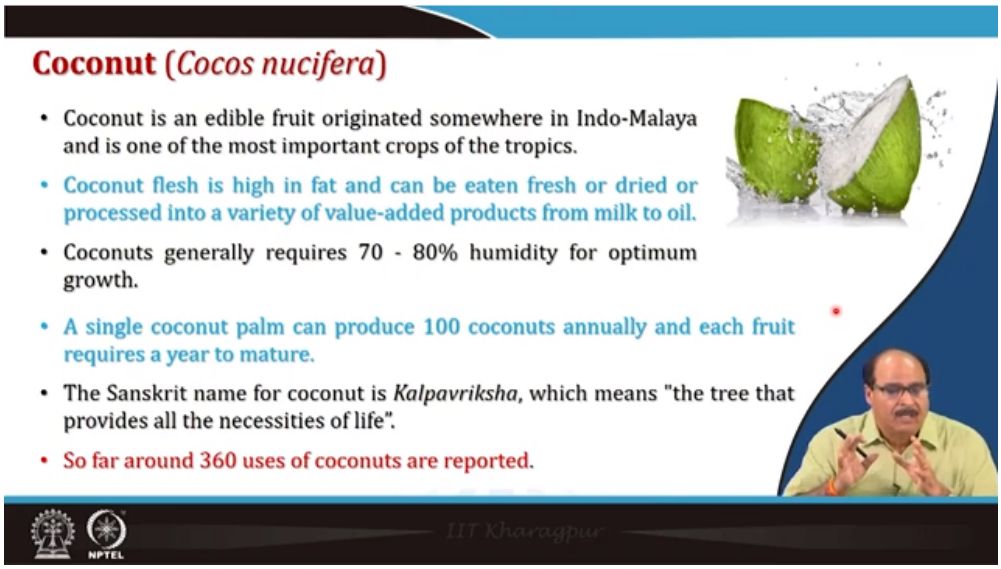
Cocoa is a good source of Theobromine, which acts in similar way as caffeine, to enhance energy level and to delete blood vessels.

Chemical composition of cocoa beans

The moisture (%), fat (%), protein (%), carbohydrate (%), ash (%) of the both unfermented and fermented cocoa beans are provided in the table. Both the unfermented and fermented cocoa beans contain about 55 % of fat, which is a very good and valuable quality to make cocoa butter. It is due to its eating characteristics, melting characteristics and since it melts at room temperature, melts in the mouth, cocoa is used in various confectionary products or even savory products like ice cream, desserts etc.

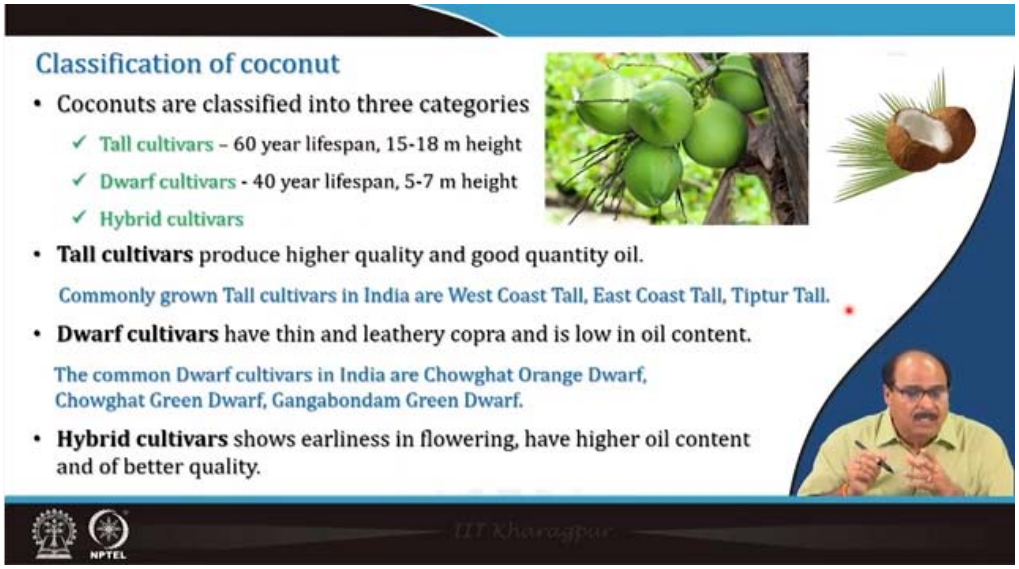
Health value of cocoa

Cocoa improves mood, balances blood sugar, and prevents cancer. It is used as antidepressant, improves brain function. It is good for heart, lowers cholesterol and it has a good effect on lowering down the blood pressure or maintaining the proper blood pressure.



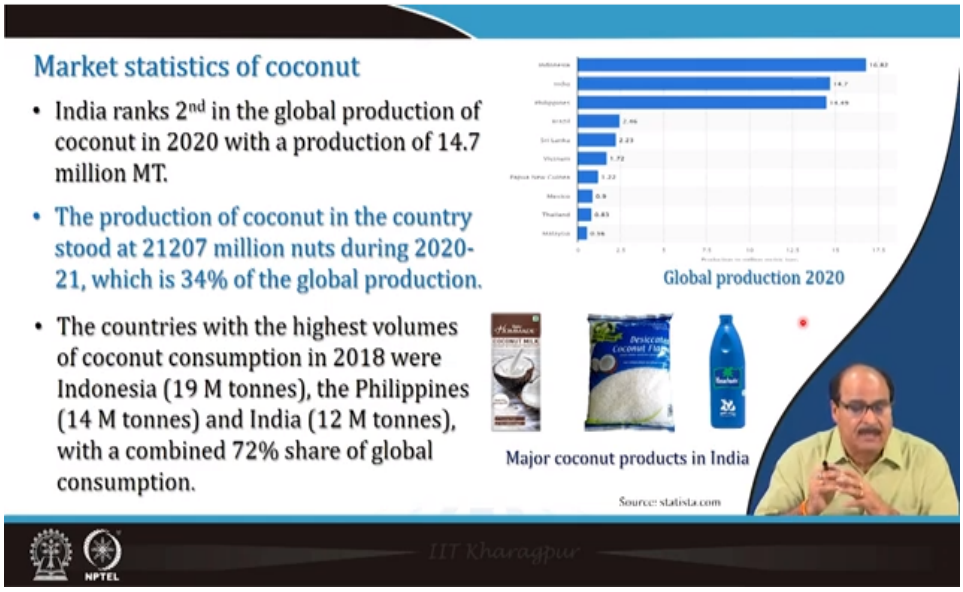
Coconut (*Cocos nucifera*)

Coconut is an edible fruit, originated somewhere in Indo-Malaya and is one of the most important crops of the tropics. Coconut flesh is high in fat and can be eaten fresh or dried or processed into a variety of value-added products from milk to oil. Coconuts generally require 70 to 80% humidity for optimum growth. A single coconut palm can produce 100 coconuts annually and each fruit required a year to mature. The Sanskrit name of coconut is *Kalpavriksha*, which means “the tree that provides all the necessities of life”. So, far around 360 uses of coconut are reported in the literature.



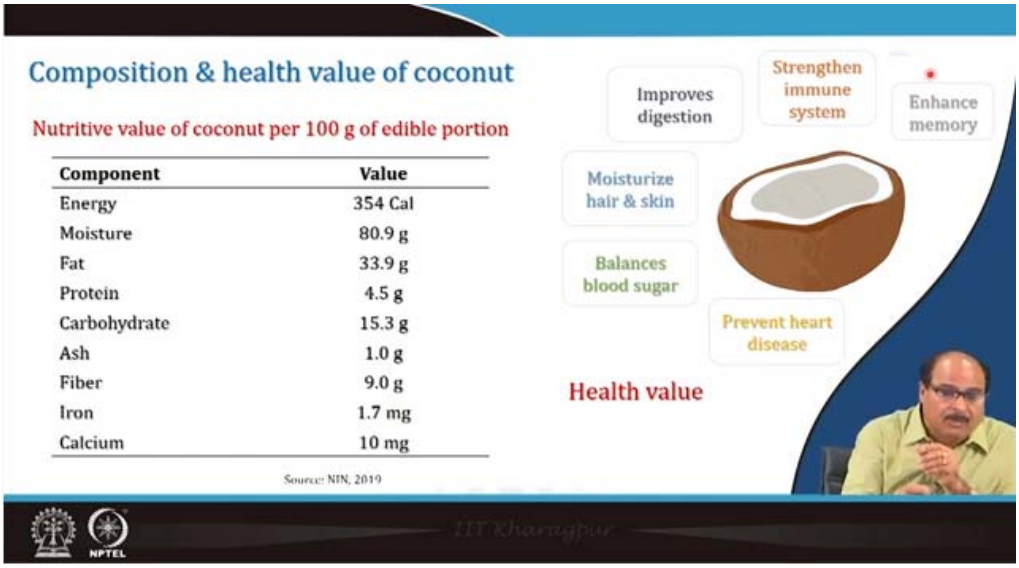
Classification of coconut

The coconut is classified into three major categories like tall cultivars, dwarf cultivars and hybrid cultivars. Tall cultivars have about 60 years lifespan. They are around 15 to 18 m in height. Dwarf cultivars have 40 years life span and they are about 5 to 7 m in height. Tall cultivars produce higher quality and good quality oil. Commonly grown tall cultivars in India are West Coast Tall, East Coast Tall, and Triptur Tall. Dwarf cultivars have thin and leathery copra and is low in oil content. The common dwarf cultivars in India are Chowghat Orange Dwarf, Chowghat Green Dwarfs, and Gangabondam Green Dwarf. Hybrid cultivars shows earliness in flowering, have higher oil content, which gives a better quality.



Market statistics of coconut

India ranks second in the global production of coconut in the year 2020 with a production of 14.7 million MT. The production of coconut in the country stood at 21,207 million nuts during 2020-21, which is 34% of the global production. The countries with the highest volume of coconut consumption in 2018 were Indonesia (19 M tons). Philippines has consumed 14 million tons, India consumes 12 million tons of coconut, with a combined 72% share of the global consumption. According to the global production of coconut in 2020 (can be seen in the figure), Indonesia is a major grosser.



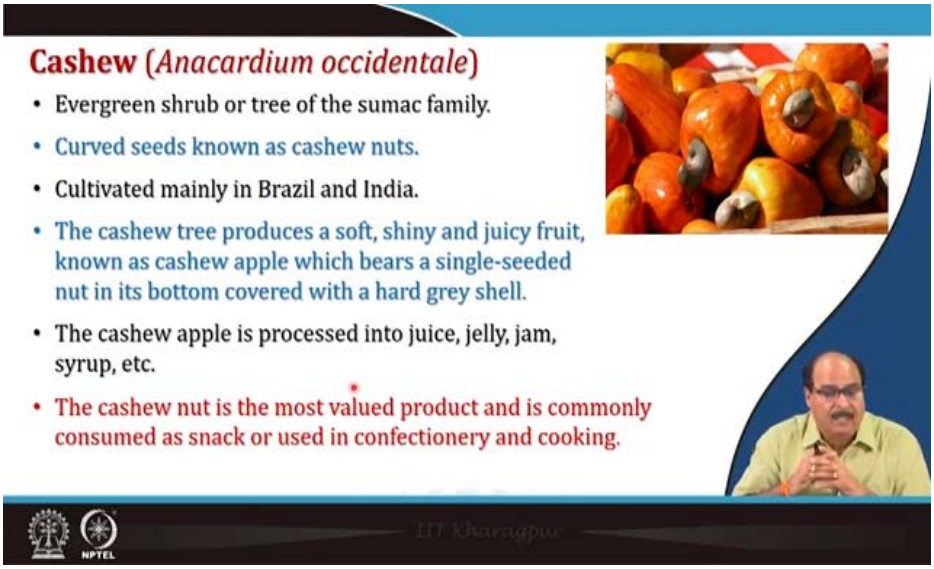
Composition & health value of coconut

Composition of coconut

The table represents the nutritive value of coconut per 100 g of the edible portion. It contains energy around 354 calories, per 100 g. It has around 80-81 % moisture, 30 % fat, it has about 4.5% protein, carbohydrate around 15-16%. It has a good quantity of fiber i.e., 9%. Coconut is highly fibrous material. Its iron and calcium content are also good.

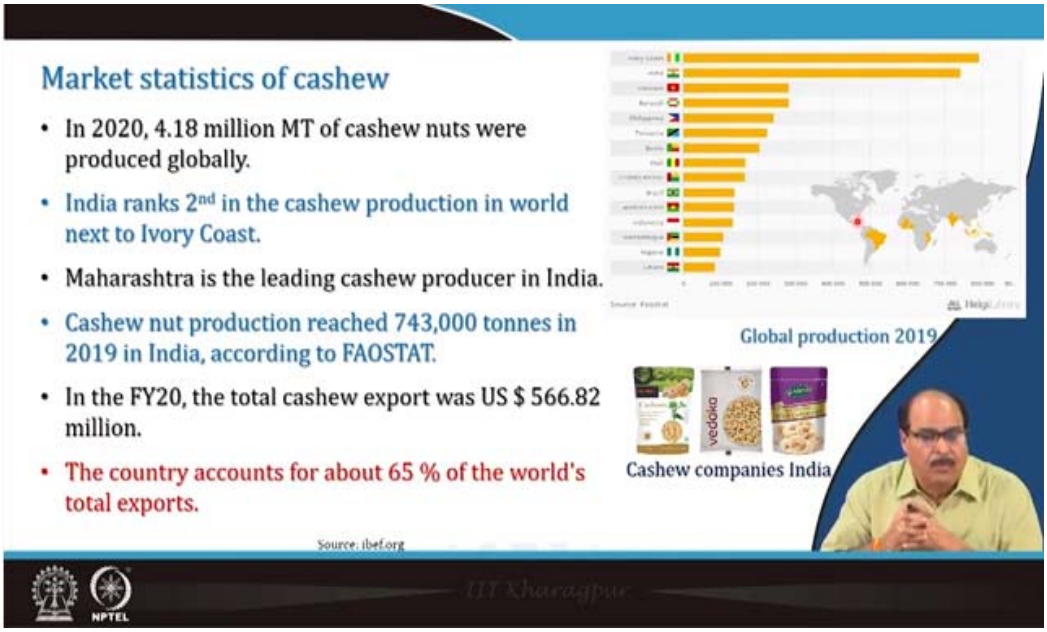
Health value of coconut

Coconut prevents heart disease. It enhances memory, strengthen immune system, improves digestion. It improves the moisture and hair and keeps our skin moist. It maintains a good health of the hair and it balances blood sugar. So, coconut also has a good health value.



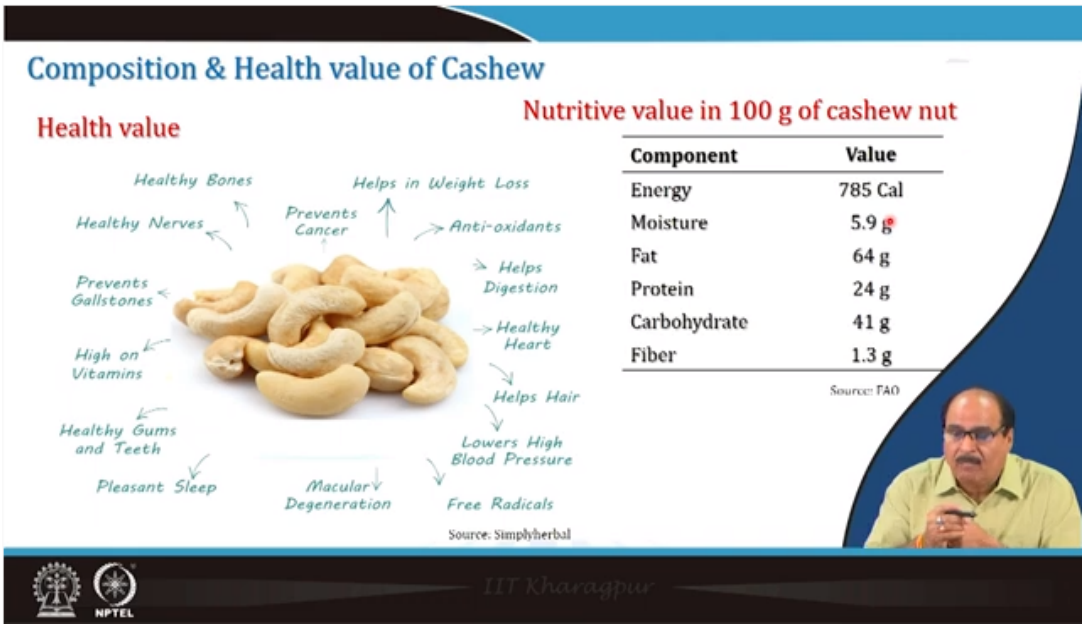
Cashew (*Anacardium occidentale*)

It is an evergreen shrub or tree of the sumac family. It can be seen from the picture, that the curved seeds are known as the cashew nuts. It is cultivated mainly in Brazil and in India. The cashew tree produces a soft, shiny and juicy fruit known as cashew apple, which bears a single-seeded nut in its bottom covered with a hard grey shell. The picture shows the cashew apple, actually plugged from the plant. After that, it is processed and then particularly dried and inside shell there is the seed, which is a valuable material that is obtained. The cashew apple is processed into juice, jelly, jam, syrup etc. The cashew nut is the most valued product and is commonly consumed as snack or used in confectionary items or in cooking various products.



Market statistics of cashew

In 2020, 4.18 million tons of cashew nuts were produced globally. India ranked second in the cashew production in the world, next to Ivory Coast. Maharashtra is the leading estate in the country, in cashew production. Cashew nut production reached around 7,43,000 tons in 2019 in India, according to the FAOSTAT. In the financial year 2020, the total cashew export was 566.82 million $. The country accounts for about 65 % of the world's total exports of the cashew. The cashew companies in India are Vedoka, Nutraj, Happilo etc.



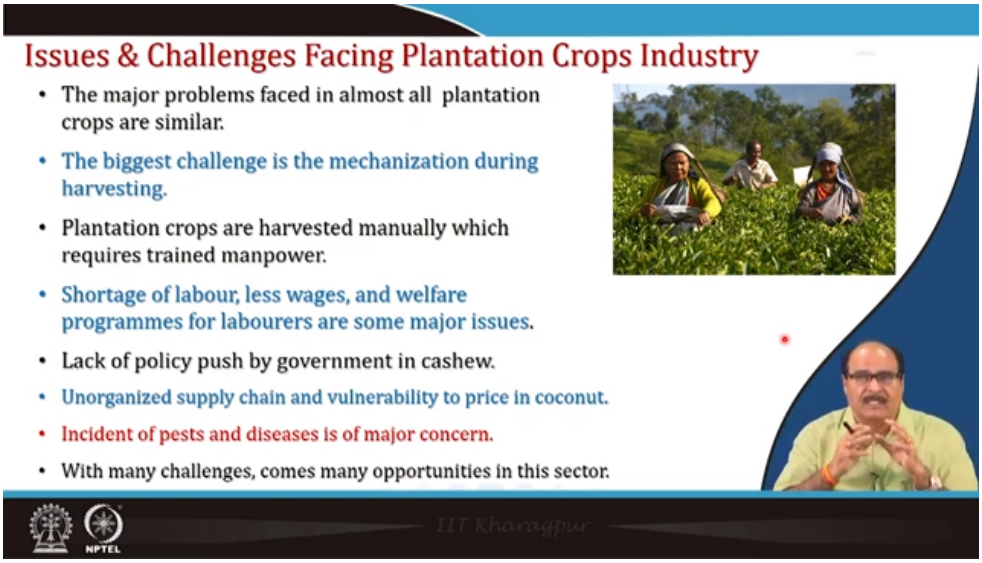
Composition & Health value of Cashew

Nutritive value in 100g of cashew nut

100 gram of the cashew nut contain about 785 calories of energy. It has about 5 to 6 % moisture, 64 % fat, 24 % protein, about 41 % carbohydrate, 1.3 % fiber.

Health value of cashew

Cashew helps in maintaining healthy bones, healthy nerves. It prevents gallstones. It is high in vitamins. it maintains healthy gums and teeth. It gives a pleasant sleep. It lowers blood pressure, maintains blood pressure. It gives free radical. It helps in improvement in the hair and gives shining hair. It maintains healthy heart, helps in digestion. It acts as antioxidants, helps in weight loss etc.



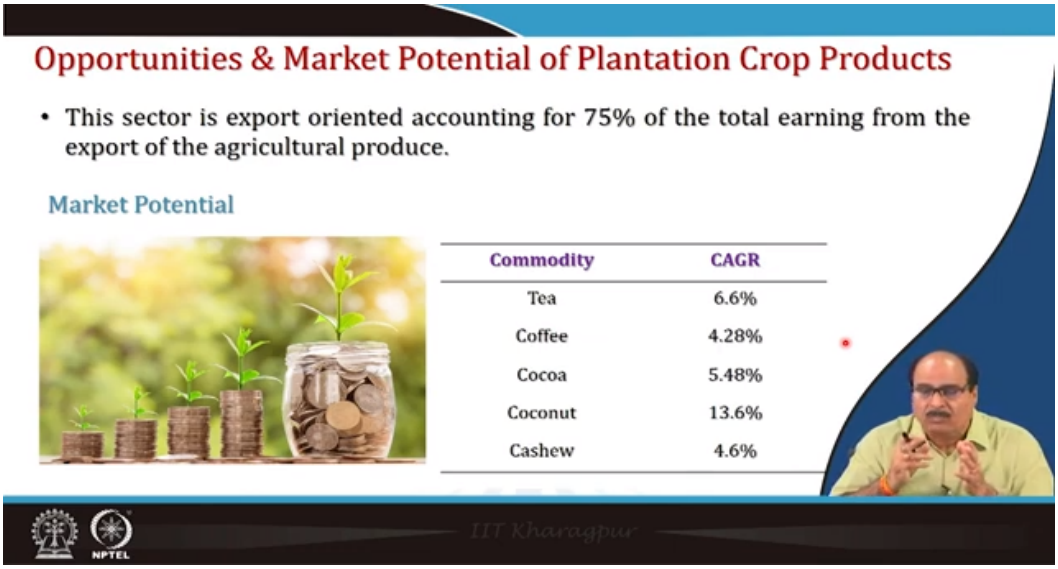
Issues & Challenges Facing Plantation Crops Industry

The major problems faced in almost all plantation crops sectors are the similar. The biggest challenge is the mechanization during harvesting process. Plantation of crops are harvested manually, which requires manpower. There is a need and working of some robots etc. For e.g., Cocoa is a very high tree and specific setups are needed to pluck the cocoa from the biggest tree.

Coffee cherry are small shrub. There are some coffees, that are in the same bunch, some coffee will ripe, some will remain green. So, it becomes a challenge to pick up the ripe coffee from the bunches. Mechanical methods are generally used to collect the ripe coffee from the tree. These methods are operated manually. So, these are laborious methods. So, if some systems are developed, which can mechanize and pick up and choose the right ripe and mature products from the trees, that will be really beneficial for the plantation industry, Shortage of labour, less wages, and welfare programmes for labourers are some major issues.

Lack of policy push by the government in cashew, unorganized supply chain and vulnerability in the pricing in the coconut etc., these are the other major issues in the industry.

Incident of pest and diseases is another major concern. For e.g., although, tea leaves contain the good amount of polyphenols, but they are susceptible to diseases. Many times, there is pest control. If the pesticides are sprayed, then their residue will remain in the leaves and that may create problem, when the leaves are dried. So, there should be proper measure of these insecticides, that how they are used onto the major crops and the diseases in the major crops are to be controlled. There should not be any extra pesticide residue on the leaves. With many challenges, many opportunities come in this sector.

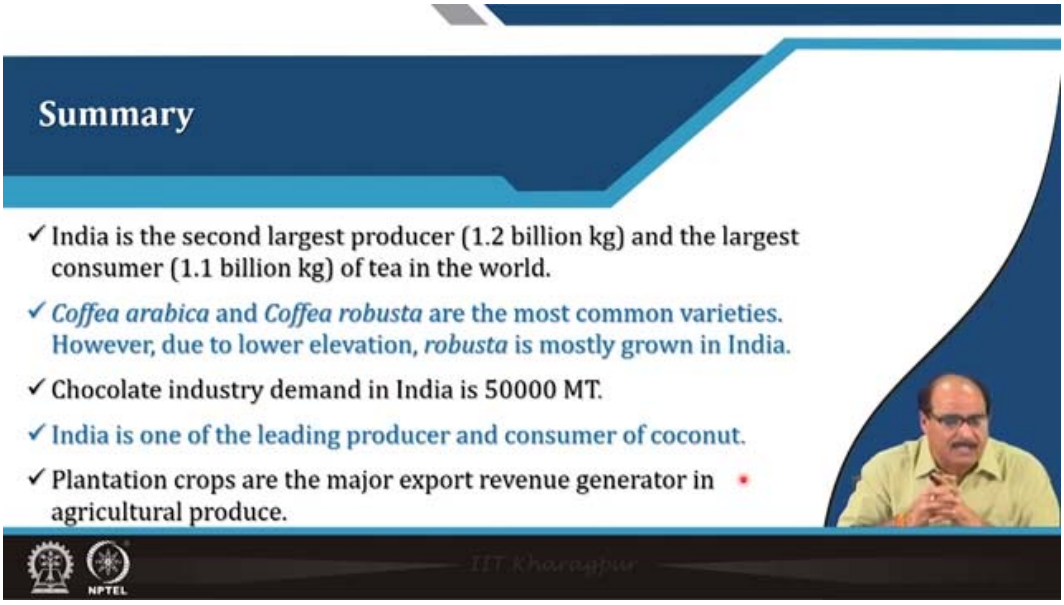


Opportunities & Market Potential of Plantation Crop Products

This sector is export oriented, accounting for 75% of the total earning from the export of agricultural produce. The commodity of tea is expected to grow at a CAGR of 6.6 %, coffee at 4.28 % CAGR, cocoa at a 5.48 % CAGR, coconut highest 13.6 % and cashew 4.6 % CAGR.

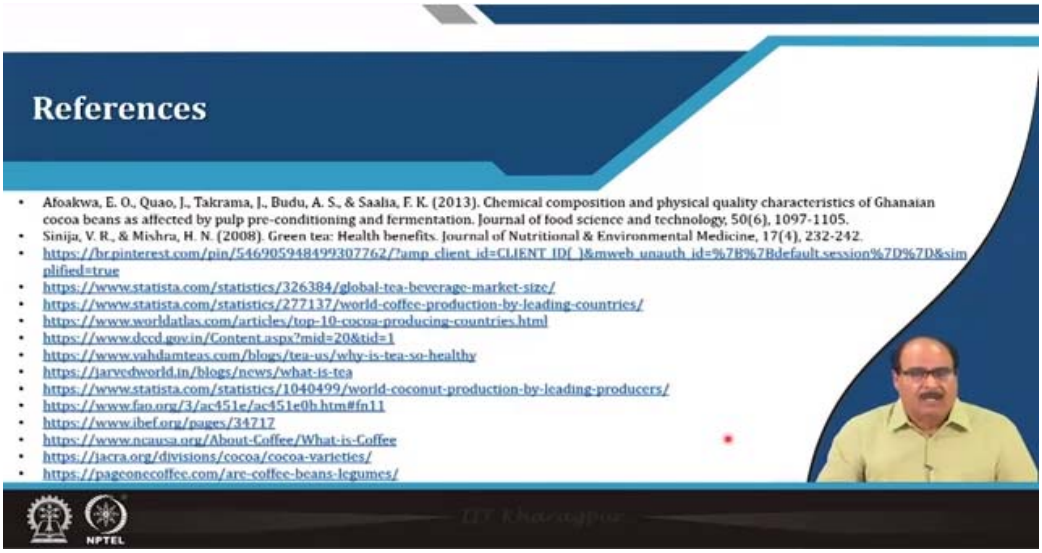
Coconut or other plantation crop are considered as cash crops and there is a big potential, big market and generation. But there are certain issues which are needed to be solved, like issues related to their processing, issues related to their handling etc. For e.g., coconut has a very hard covering, and the usable portion is inside. Recently, some machines are developed, which are used to remove the hard cover of coconut. But otherwise, they have to be cut manually, and the outer coverage also have to be removed manually, so that it again boosts the industry.

There are also issues, in the processing of crops, which are to be solved. For e.g., the cashew apple contains cashew oil, which is a very pungent oil. It is even very harsh in taste and it is very strong. This oil is removed by drying. It requires a special skill.



Summary

India is the second largest producer with 1.2 billion kg and the largest consumer with 1.1 billion kg of the tea in the world. *Coffea arabica* and *Coffea robusta* are the most common varieties. However, due to lower elevation, *Coffea robusta* is mostly grown in India and its decoction, also has found favor in the Indian market. Chocolate industry demand in India is 50,000 MT. India also produces good and significant amount of cocoa, which is further processed into beverage and chocolate and butter. India is one of the leading producer and exporter, consumer of coconut. Plantation crops are the major export revenue generator in agricultural produce.



The references used in this lecture are mentioned above.