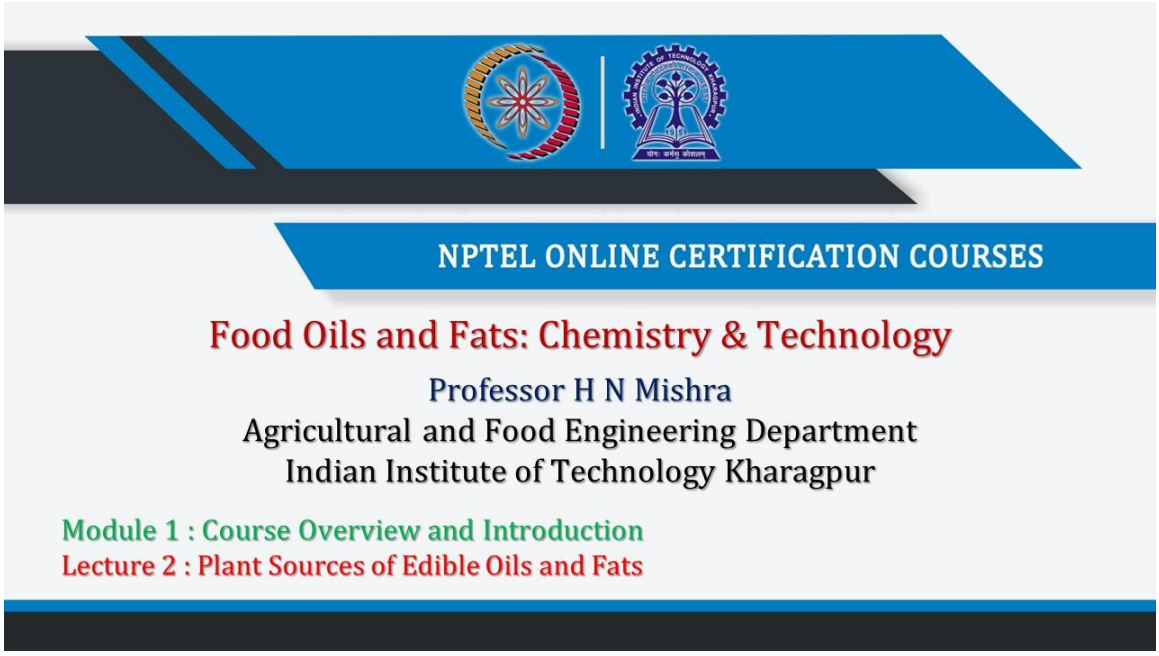
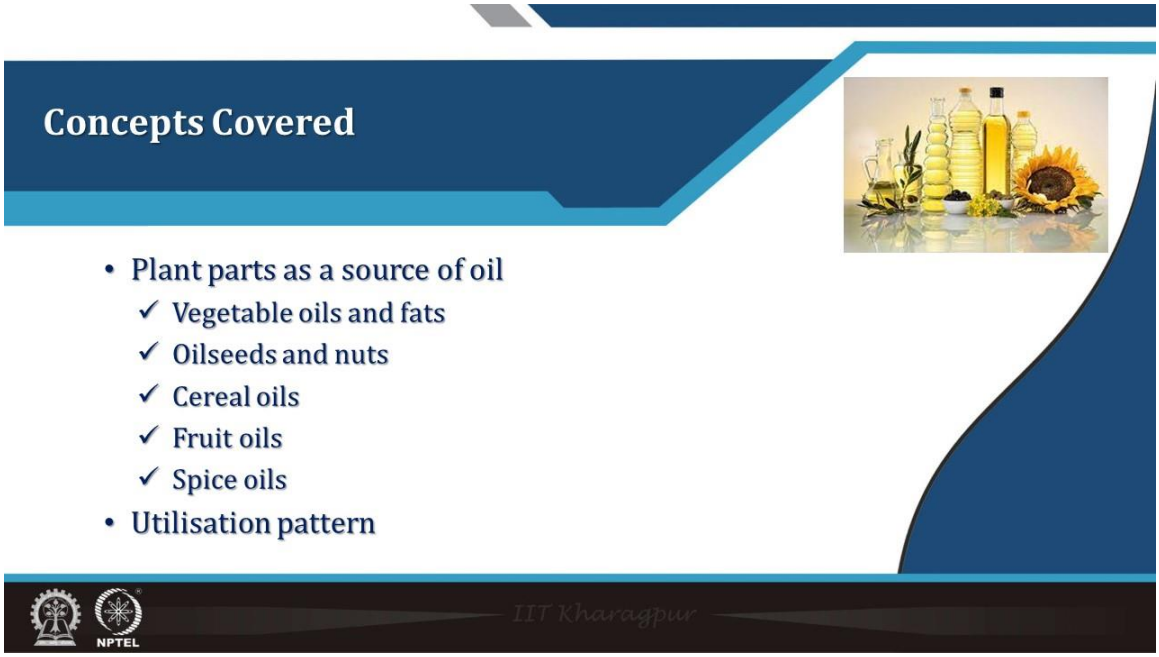
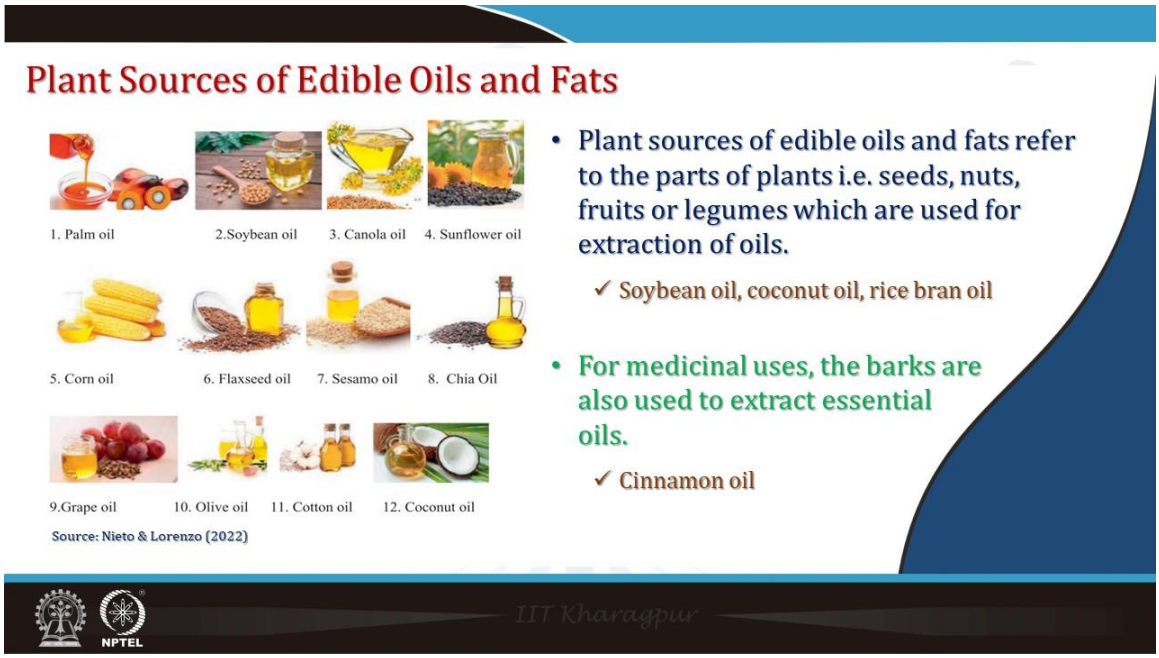
Food Oils and Fats: Chemistry & Technology
Professor H N Mishra
Agricultural and Food Engineering Department
Indian Institute of Technology Kharagpur
Week 1: Course Overview and Introduction
Lecture 2: Plant Sources of Edible Oils and Fats



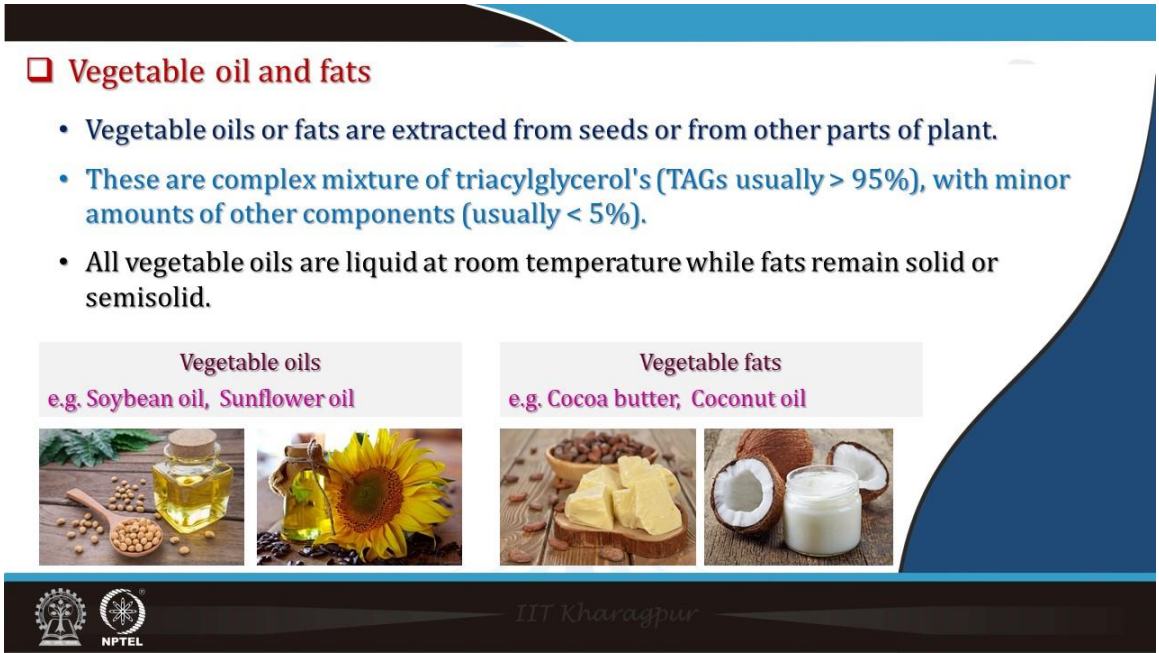


Hello friends, Namaste. Now, we are in the second lecture of the first module, we will discuss various sources particularly the plant sources of edible oils and fats. So, the

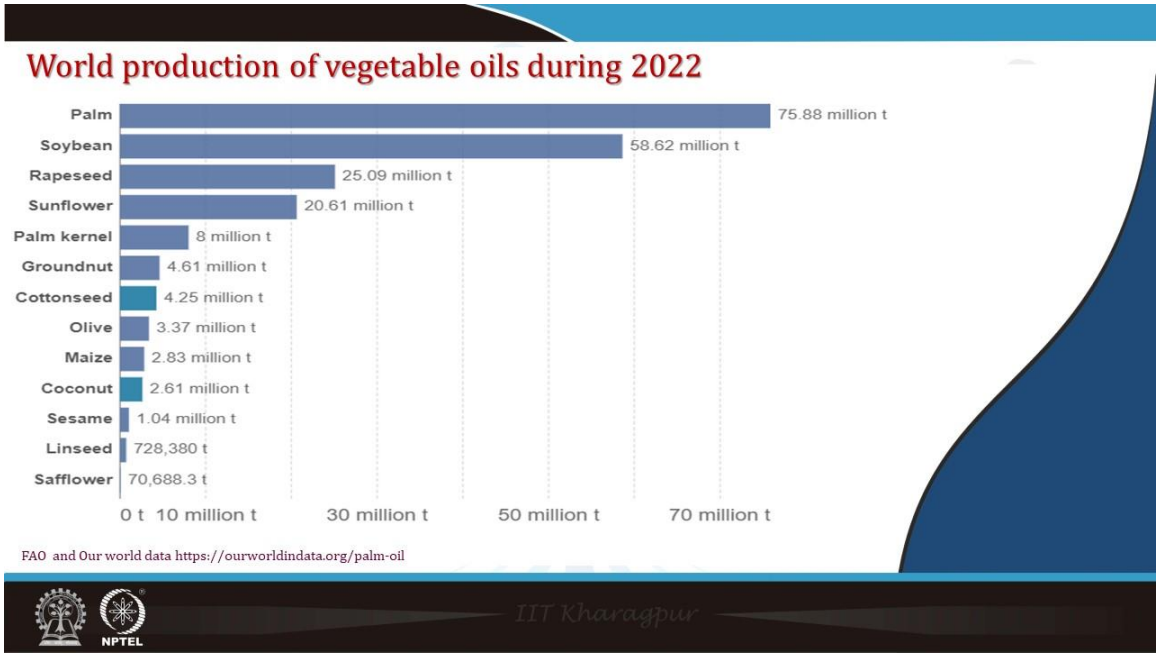
overall concept that we will discuss in this 25 to 30 minutes is the plant sources or plant parts as a source of oils and these include vegetable oils and fats, oil seeds and nuts, cereal oils, fruit oils, spice oils, and finally, we will discuss their utilization pattern that is what are the various oils, plant oils, how they are utilized in the country.



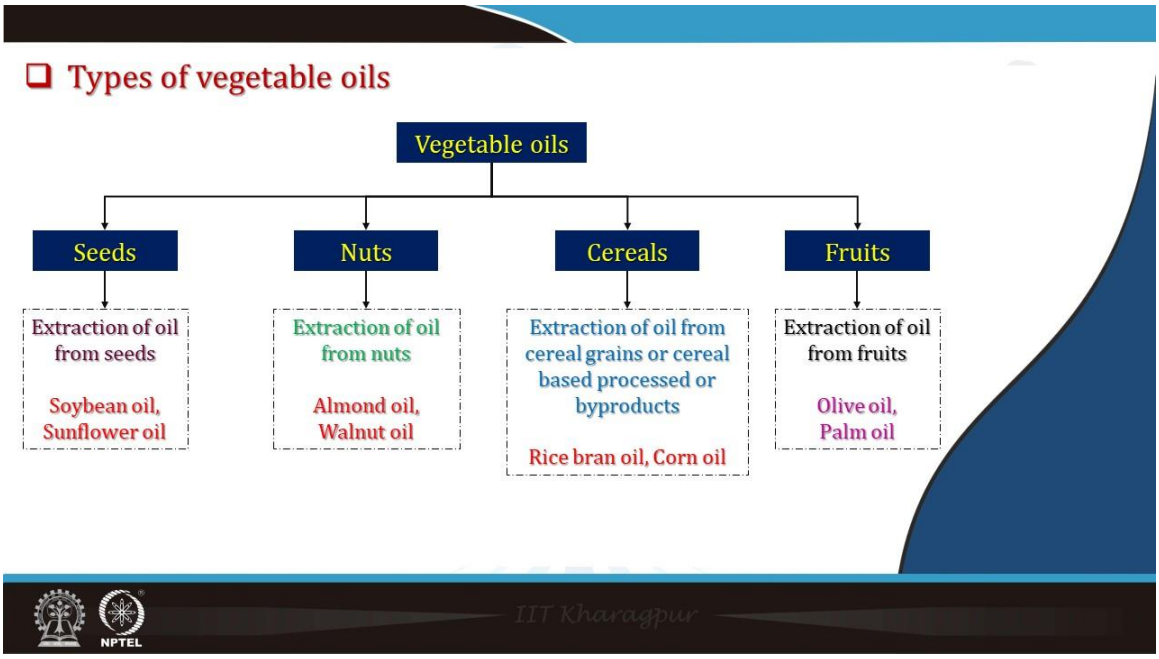
In the figure, the plant sources of edible oils and fats refer to the parts of plants that as seeds, nuts, fruits, or legumes that are used for extraction of oils like soybean oil, coconut oil, and rice bran oil. In soybean oil, we use seed, soybean seed for extraction of oil whereas, in the coconut which is whole fruit is used of the coconut plant, flesh of the coconut is used for extraction of oil. In rice bran oil it is the outer layer, the bran layer which is a byproduct of the rice milling industry is used for the extraction of oil. For medicinal usage, the barks of the medicinal plants etcetera are also used to extract essential oils like cinnamon oil. Cinnamon oil is extracted from the bark of the cinnamon tree and contains a lot of good quality healthy oils.



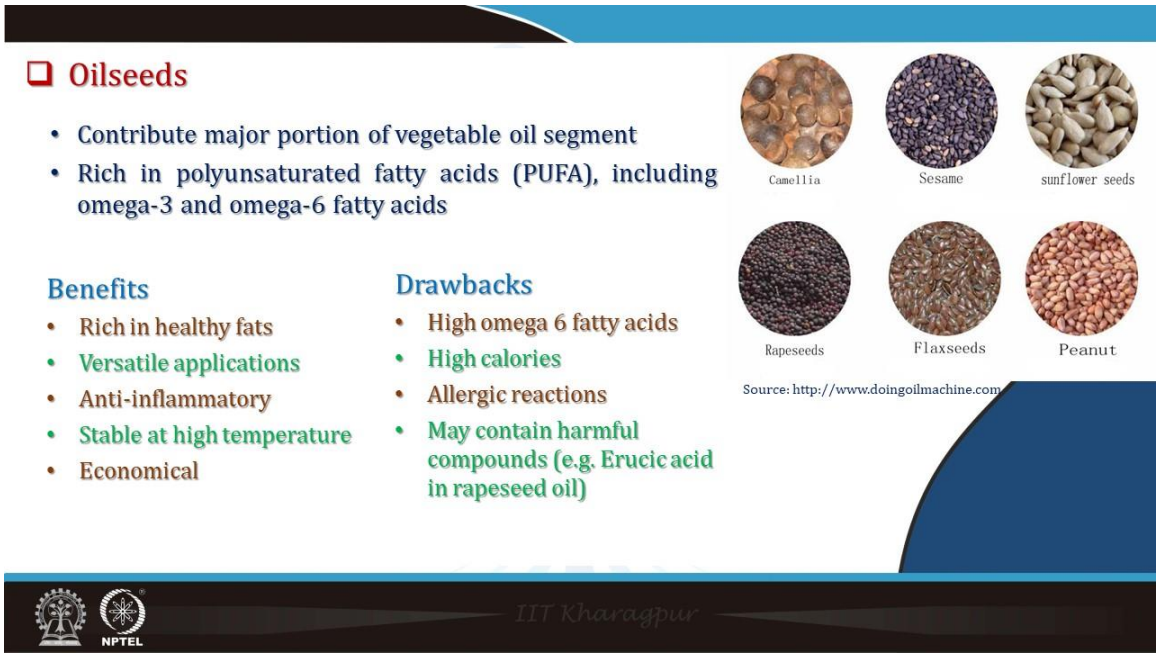
Then the vegetables, oils, and fats are extracted from seeds or other parts of the plant. These vegetable oils and fats are a complex mixture of triacylglycerols more than 95 percent they include triglycerides or triacylglycerol and they also contain some minor amounts of other components which is generally less than 5 percent. Most vegetable oils and fats are a complex mixture of triacylglycerols and minor components. All vegetable oils are liquid at room temperature while the fats remain solid or semi-solid depending upon the type and quantity of the fatty acids present in them.



This figure shows the world production of vegetable oil during 2022 where you can see that 75.88 million tons of palm tops the list. Soyabean with 58.62 million tons in the second which is followed by rapeseed, sunflower, palm kernel, groundnut, cottonseed, olive, maize, and finally, safflower oil which contains around 70,688.3 tons. So, these are the statistics of the world's production of vegetable oil during 2022.



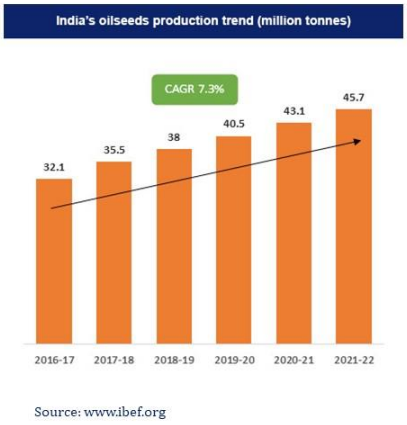
So, if you look at the what are different types of vegetable oils or what are different types of vegetable materials that are used to get the oil. So, number one as I told you earlier the seeds are the ones like soybean seeds, and sunflower seeds that are used to extract the oil. Another category of the plant is the nuts that is like elements, walnut etcetera They are used to extract the oil so, nuts. Then various cereals are used for extraction of oil particularly the bran layer or germs etcetera like corn germ oil, wheat germ oil, and rice bran oil these are extracted from the cereals. And finally, another very important category of the plant is fruits which are used to extract the oils Olive fruit or palm fruit is used for extraction recovery of oils.



First, let us discuss the oil seeds. It is a well-known fact that oil seeds contribute a major portion of the vegetable oil segment. They are rich in polyunsaturated fatty acids including omega 3 and omega 6 fatty acids. So, these oil seeds are oil extracted from the oil seeds have both benefits as well as drawbacks. The benefits include that they are rich in healthy fats, they are versatile applications, they are anti-inflammatory, they are stable at high temperatures as well and they are economical sources of the oil. The drawback includes there is some oil seeds have a high content of or excessively high content of omega fatty acids which may not be good to consume. Also, they have high calories, some oil seeds may have certain allergic reactions, they may contain harmful components like uric acid as in the case of rapeseed oil, and so on. So, both the oil seeds have positive as well as negative points.

If you look at the oil seed production statistics in the country as a whole and at a global level, India is the fourth largest producer of oil seed in the world. It has 20.8 percent of the total area under cultivation globally accounting for 10 percent of the global production.

Oilseeds production statistics

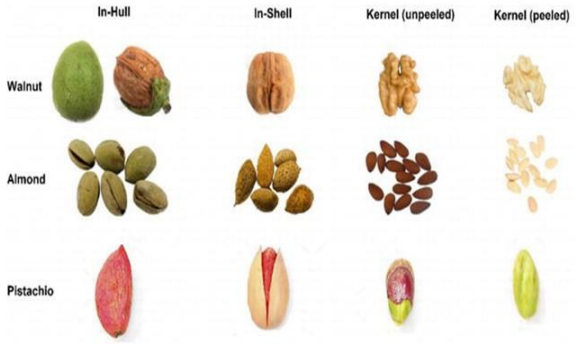


Source: www.ibef.org

- India is the 4th largest oilseeds producer in the world.
- It has 20.8% of the total area under cultivation globally, accounting for 10% of global production.
- The country produces groundnut, soybean, sunflower, sesamum, niger seed, mustard and safflower oilseeds.
- In 2020-21, the production of the country was 365.65 lakh tonnes which was a 10% increase from that of the previous year.
- Rajasthan (20%), Gujarat (20%), Madhya Pradesh (19%) and Maharashtra (16%) are the top producers of oilseeds.

The country produces groundnut, soybean, sunflower, sesame, niger seed, mustard and safflower seeds. In 2021, the production of oil seeds in the country was 365.65 lakh tons which was a 10 percent increase from that of the previous years. In India Rajasthan with 20 percent share which is followed by Gujarat with 20 percent share, Madhya Pradesh with 19 percent and Maharashtra with 16 percent share. So, the oil seed production in the country is expected to grow at a CAGR of 7.3 percent and it is growing if you look at the data from 2016-17 to 2020-21 to 22 which is given in this figure that it is growing at a CAGR of 7.3 percent.

Oilnuts



Walnut, almond and pistachio at different stages of drying (In-hull, In-shell, Unpeeled kernel, and Peeled kernel)

Source: Chen & Pan (2022)

- Tree nuts are a type of nut that grows on trees.
- They are characterized by a hard outer shell and an edible kernel or meat inside.
- Common examples of tree nuts include
  - ✓ Almonds, Walnuts, Hazelnuts, Cashews, Pistachios, Macadamia nuts, and Brazil nuts.

The other category is the oil nuts, that is the tree nuts are a type of nuts that grows on trees. They are characterized by a hard outer shell and an edible kernel or meat inside, ok. So, these nuts are used that is inside the kernels they are a valuable source of oil. So, common examples of tree nuts include almonds, walnuts, hazelnuts, cashew nuts, pistachios, macadamia nuts, and Brazil nuts. You can see here the pictures of walnuts, almonds, and pistachios given where the in-shell, in-hull, and finally, kernel that is the kernel both un-peeled and peeled kernel. So, the peeled kernel they are the source of valuable oil in many cases.

Almond oil extracted from sweet or bitter almonds is an excellent source of unsaturated fatty acids and phytosterols. It contains more vitamin E as compared to the other oil nuts and features excellent moisturizing properties. In the global market, the share of almond oil is dollar 1456.3 million in 2020. The projected market size by 2031 is dollar 5584.4 million. It is expected to grow at a CAGR of 13 percent from 2022 to 2031.

Walnut oil that is walnut oil is an edible specialty oil and has multiple domestic and industrial uses. It is extracted using the processes like cold pressing and expeller pressing. The demand for walnuts is rising globally as they are a resource of proteins and essential fatty acids. The global market share of walnut oil include a dollar 1.28 billion in 2021. The projected market size is 2.08 billion by 2029 and it is expected to grow at a CAGR of 6.25 percent from 2022 to 2029.

Cereal oils

- Cereal oils are that extracted from various grains such as corn, rice, wheat, and oats.
- Cereal oils are a good source of healthy fats, vitamins, and minerals.
  - ✓ Wheat germ oil is high in vitamin E; Corn oil is rich in omega-6 fatty acids.
- Adding cereal oils to diet can help meet daily nutritional requirement
- Cereal oils have a high smoke point, which means they can be used for high-temperature cooking methods like frying and baking.
- They can also be used in salad dressings, marinades, and other recipes that require oil.
- Cereal oils have a relatively long shelf life due to high antioxidant content.
- They can be stored for longer periods of time without going rancid or spoiling.


https://www.amazon.in/

The other important category includes cereal oils. They are extracted from various grains such as corn, rice, wheat, and oats. Cereal oils are a good source of healthy fats, vitamins, and minerals wheat germ oil is high in vitamin E, corn oil is rich in omega-6 fatty acids. So, adding cereal oils to your diet can help meet daily nutritional requirements. Cereal oils have a high smoke point, which means they can be used for high-temperature cooking methods like frying and baking. They can also be used in salad dressings, marinades, and other recipes that require oil. Cereal oils have a relatively long shelf life due to their high antioxidant content. They can be stored for longer periods without going rancid or spoiling.

Wheat germ oil

✓ This oil is extracted from the germ of wheat kernels and is often used in cosmetics and supplements due to its high vitamin E content.

Oat germ oil

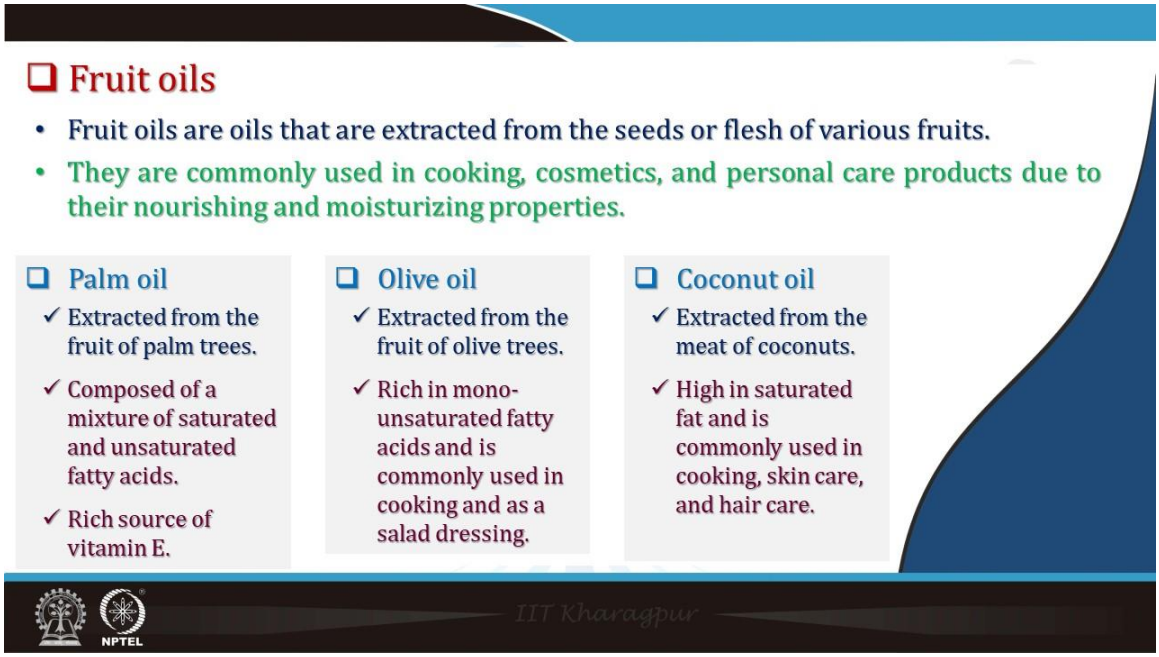
✓ This oil is extracted from the germ of oats and is used in cooking and cosmetics.

✓ It has a high concentration of antioxidants and is believed to have anti-inflammatory properties.

Wheat germ oil and oat germ oil, are two important cereal oils. Wheat germ oil is extracted from the germ of wheat kernel that is often used in cosmetics and supplements due to its high vitamin E content. Oat germ oil is extracted from the germ of oats and is used in cooking and cosmetics. It is high in concentration of antioxidants and is believed to have anti-inflammatory properties.

Corn oil is extracted from the germ of corn kernels and is widely used in cooking, baking, and salad dressing. Rice bran oil is extracted from the rice bran and is commonly used in Asian cuisine. It has a high smoke point and has a mild flavor. The rice bran oil if you look here at the high nutritional content of rice bran oil is the one that boosts its adaptation in the food industry.

The global rice bran oil market is projected to grow from dollar 6.67 billion in 2021 to dollar 12.27 billion by 2028 and is expected to grow at a CAGR of 9.09 percent in the forecast period of 2021 to 2028. If you look at that Asia Pacific that is in 2019 the rice bran oil market was to the tune of dollar 4.31 billion and in 2020 it increased to the tune of 4.68 billion.



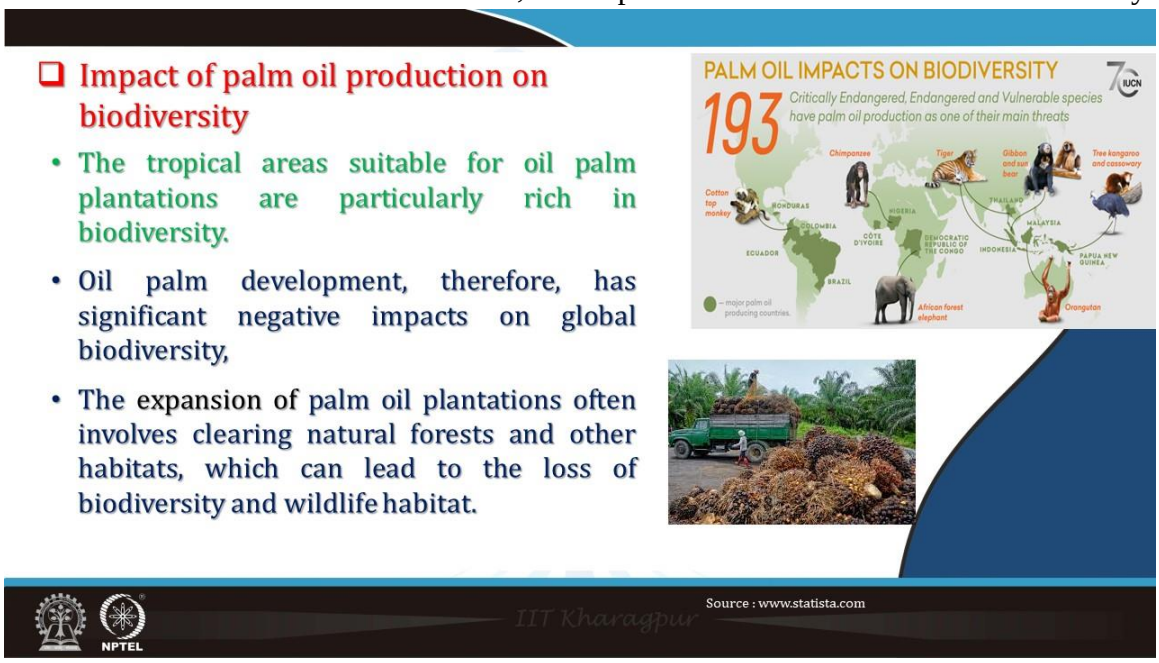
Fruit oils are the oils that are extracted from the seeds or flesh of various fruits. They are commonly used in cooking, cosmetics, and in personal care that is in personal care products due to their nourishing and moisturizing properties. Palm oil, olive oil, and coconut oil are important fruit oils. Palm oil is extracted from the fruit of palm trees. It is composed of a mixture of saturated and unsaturated fatty acids. It is a rich source of vitamin E. Olive oil is extracted from the fruit of olive trees. It is rich in monounsaturated fatty acids and is commonly used in cooking and as a salad dressing oil. Coconut oil is extracted from the meat of coconut. It is high in saturated fat and is commonly used in cooking, skincare, and hair care.

The palm oil production if you look at the statistics, you can see that global palm oil production has significantly increased in the last 10 years. Indonesia and Malaysia are the leading producers and exporters of palm oil worldwide. The figure you can see below that Indonesia, its production share is 58 percent in the globe. It is the data of 2019 that it has a production of 42.5 million metric tons and has a share of 58 percent in the global market. The second is Malaysia with a production of 19 million metric tons having a 26 percent share. These are followed by other countries like Thailand, Colombia, Nigeria, Papua New Guinea etcetera.

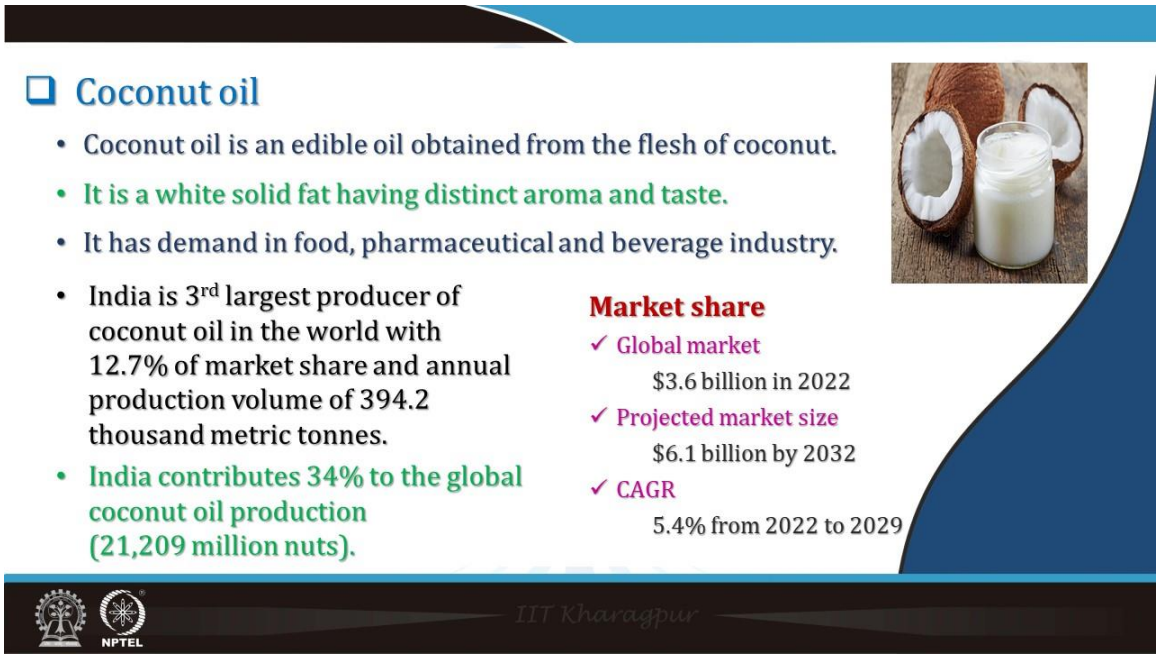
The palm oil yield if you look that oil palm produces about 35 percent of all vegetable oil on less than 10 percent of the land allocated to oil crops. Currently, about half the people in the world rely on palm oil as part of their diets and it is the dominant oil used in food in Africa and Asia.

And if you look here, obviously, because palm oil is the major oil, there is a reason to say that if you want to use that for producing one ton of palm oil only 0.26 hectares of land is required whereas, for producing one-ton soybean oil 2 hectares land is needed. For producing one-ton sunflower oil 1.43 hectares as well as for producing one-ton rapeseed oil 1.25 hectares of land is needed. The productivity per hectare of palm oil is higher and

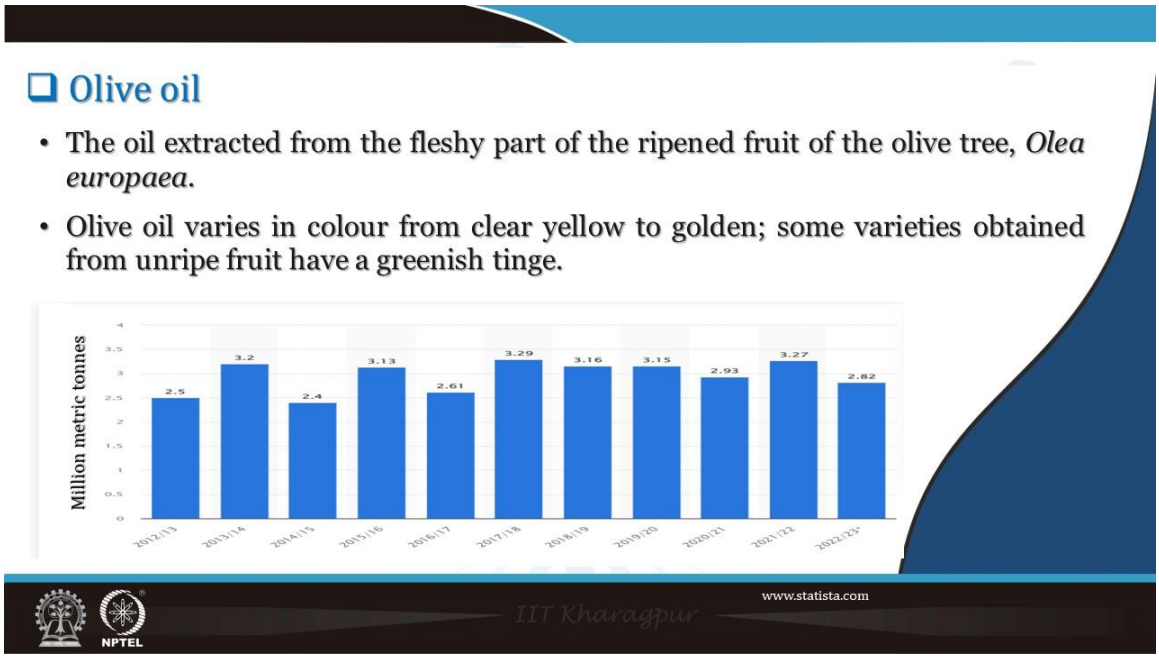
also it is an economic source of oil. So, but impact of it has some effect on biodiversity.



The tropical area suitable for oil palm plantations is particularly rich in biodiversity. Oil palm development, therefore, has a significant negative impact on global biodiversity. The expansion of palm oil plantations often involves clearing natural forests and other habitats, which can lead to the loss of biodiversity and wildlife habitat. So, this is an important point that must be considered or looked into by the stakeholders or those who are involved in the cultivation of oil palm.



Coconut oil is an edible oil obtained from the flesh of coconut. It is a white solid fat with having distinct aroma and taste. It has demand in the food, pharmaceutical, and beverage industries. India is the third largest producer of coconut oil in the world with 12.7 percent of market share and an annual production volume of 394.2 thousand metric tons. India contributes 34 percent to the global coconut oil production with its production figure of 21,209 million nuts. The global market share of coconut oil is to the tune of dollar 3.6 billion in 2022. The projected market share by 2032 is 6.1 billion dollars. It is continue expected to grow at a CAGR of 5.4 percent from 2022 to 2029.



If you look at the data of the olive oil that is produced in the figure it is then from the year 2012-13 to 22-23 and with little increase, almost it has remained stagnant you can say around 2.5 to 3.3 or 3.29 million metric tons over the years. So, the oil extracted from the fleshy part of the ripened fruit of olive oil or olive tree that is olea europia. Olive oil varies in color from clear yellow to golden and some varieties obtained from unripe fruit have a greenish tint. So, olive oil is a very good oil particularly because it has a good amount of fatty acids, omega fatty acids, and other health-promoting components.

Then very important component although the quantity may be less compared to the other oils, from a health point of view the spice oils and food processing point of view the spice oil become very important. So, spice oils refer to the essential oils that are extracted from spices like cinnamon, clove, nutmeg, black pepper, and ginger. These oils are obtained through various methods of distillation or extraction from spice plant's leaves, flowers, stems, roots, or seeds. Spice oils are highly concentrated and possess the characteristic fragrance and flavor of the respective spices. They are commonly used in the food and beverage industry as well as in perfumery, aromatherapy, and medicinal applications.

Spice oils

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Clove oil

Extracted from the dried flower buds of the clove tree, used in dental care products, perfumes, and as a flavoring agent in cooking.

Cinnamon oil

Obtained from the bark of cinnamon trees, used in cosmetics, aromatherapy, and as a flavoring agent in food and beverages.

Nutmeg oil

Extracted from the seeds of the nutmeg tree, used in perfumes, soaps, and as a flavoring agent in cooking.

Black pepper oil

Obtained from the dried fruit of the black pepper plant, used in massage oils, aromatherapy, and as a flavoring agent in food and beverages.

www.statista.com

That is Clove oil is one very important oil that has eugenol and it is used for making medicine for toothache etcetera. So, this clove oil that is used. So, similarly the other oils they have a lot of medicinal properties. Clove oil extracted from the dried flower buds of the clove tree is used in dental care products and perfumes as well as a flavoring agent in cooking. Cinnamon oil that is obtained from the bark of the cinnamon tree is used in cosmetics, aromatherapy, and as a flavoring agent in food and beverages. Nutmeg oil which is extracted from the seeds of the nutmeg tree is used in perfumes, soaps, and as a flavouring agent in cooking. Black pepper oil which is obtained from the

dried fruits of the black pepper plant is used in massage oil, aromatherapy, and as a flavoring agent in food and beverages.

- **Ginger oil**

  Extracted from the root of the ginger plant, used in aromatherapy, cosmetics, and as a flavoring agent in food and beverages.

- **Cardamom oil**

  Obtained from the seeds of the cardamom plant, used in perfumes, soaps, and as a flavoring agent in cooking and beverages.

- **Fennel oil**

  Extracted from the seeds of the fennel plant, used in aromatherapy, cosmetics, and as a flavoring agent in food and beverages.

Ginger oil that is extracted from the root of the ginger plant is used in aromatherapy, cosmetics, and as a flavoring agent in food and beverages. Cardamom oil is obtained from the seeds of the cardamom plant and it is used in the preparation of perfumes, and soaps and as a flavoring agent in cooking and beverages. Fennel oil which is extracted from the seeds of the fennel plants is used in aromatherapy, cosmetics, and as a flavouring agent in food and beverages.

Uses of plant oils

Oil type	Use	Example
Oilseed oils	Cooking, frying and baking, as well as in the production of margarine, shortening, and salad dressings.	Soybean oil, Sunflower oil, Mustard oil
Cereal oils	Production of margarine and shortening, as well as in industrial applications such as biofuel production	Corn oil, Rice bran oil
Fruit oils	food preparation, salad dressings as well as in cosmetics, soaps, and skincare products.	Olive oil
Treenut oils	Salad dressings and baking, as well as in cosmetics, soaps, and skincare products.	Almond oil
Spice oils	food and beverage production, as well as in perfumery, aromatherapy, and medicinal applications.	Clove oil

The uses of various plant oils if you see that is the oil seeds, The oils obtained from oil seeds like soybean oil, sunflower oil, mustard oil etcetera are used for cooking, frying, and baking as well as in the production of margarine, shortening, and salad dressings. Cereal oils like those obtained from corn oil, rice bran oil etcetera are used in the production of margarine and shortening as well as in industrial applications such as biofuel production, etcetera. Fruit oils which are obtained from olive oil or other fruits are used extensively in food preparation. Olive oil is extensively used in making various foods or as a salad dressing as well as in cosmetics, soaps, and skin care products. Tree nut oils like those obtained from almonds etc. are used in salad dressing and baking as well as in cosmetics, soaps, and skin care products. Spice oil for example, clove oil has very good food and beverage application it is used in the production of foods and beverages as well as in perfumery, aromatherapy, and medicinal applications.

So, finally, I would like to summarize this lecture that edible oils and fats are essential components of a healthy and balanced diet, they are rich sources of energy and provide essential fatty acids, vitamins, and minerals. The market potential for edible oils and fats is significant due to the increasing demand for healthy and sustainable food products. Seed oils, tree nut oils, fruit oils, and spice oils are some of the most widely used and traded edible oils and fats globally. Cereal oils are an excellent source of omega-3 and omega-6 fatty acids which are essential for making that are maintaining optimal health. Coconut oil showed its versatility in applications from domestic usage to pharmaceutical in the beverage industry. All these various plant sources of oils are used extensively in Indian products. One major thing is that most of these plant oils are rich sources of polyunsaturated fatty acids, except barring a few that are solid at room temperature most

of them like rice bran oil, sesame oil, sunflower oil, cotton seed oil etcetera. They are a good source of that is not only omega 6 and omega 1 but also they have a good amount of antioxidants. As I also told earlier the trend is that we should consume more polyunsaturated fatty acids and also for the proper health of the consumers there should be a proper that is the MUFA, monounsaturated fatty acids, and polyunsaturated fatty acids. Their ratio as well as the ratio of omega 3 and omega 6 fatty acids should be in a proper proportion and these oil should have a good quality of or a good amount of antioxidants. Most plant oils have all these, they have a proper amount of MUFA and PUFA, they have a good amount of mono omega 6 and omega 3 fatty acids as well and they have naturally natural antioxidants present in them.

So, we should consume more and more plant oils and we should use plant oils for better health benefits. These are some of the references that are used in this lecture, ok. Thank you very much for your patience here.