

**Food Oils and Fats: Chemistry and Technology**

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**Module 12: Packaging, Storage, & QA/QC**

**Lecture 60: Regulatory Requirements & Course Summary**



**NPTEL ONLINE CERTIFICATION COURSES**

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**Lecture 60 : Regulatory Requirements & Course summary**



Hello everyone. Namaskar. Now, we are in the last lecture of this course that is the lecture 60.

## Concepts Covered

- International and regional regulations
  - ✓ Codex Alimentarius and FSSAI
- FSSAI regulations for quality and safety of fats and oils
- Food safety and quality standards for fats and oils
- Regulations for packaging
- Course summary
- Acknowledgements



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In the next half an hour or so, we will discuss about regulatory requirements of some important fats and oils. And also we will take up the summary of the course. We will summarize that whole thing what was discussed in this course. Then concept covered are like international and regional regulations like Codex Alimentarius and FSSAI. FSSAI regulations for quality and safety of fats and oils, food safety and quality standards for important or major fats and oils, regulations for packaging and also I told you the course summary and finally, the acknowledgments.

## Regulations related to fats & oils

- Knowledge of government regulations relevant to the chemical analysis of foods is extremely important to persons working in the food industry.
- **Federal laws and regulations reinforce the efforts of the food industry to provide wholesome foods, to inform consumers about the nutritional composition of foods, and to eliminate economic frauds.**
- In some cases, they dictate what ingredients a food must contain, what must be tested, and the procedures used to analyze foods for safety factors and quality attributes.
- **Information about food standards and safety practices established by international organizations is essential for successful food business operation.**



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You know that knowledge of government regulations relevant to the chemical analysis of food is extremely important to persons working in the food industry. The laws and regulations reinforce the effort of the food industry to provide wholesome food, to inform consumers about the nutritional composition of food and to eliminate economic frauds. In some cases, they dictate what ingredients a food must contain, what must be tested and the procedures used to analyze food for safety factors and quality attributes. Information about food standards and safety practices established by international organizations is essential for successful food business operation.

### ❑ International standards and policies

- With the need to compete in the worldwide market, employees of food companies must be aware that allowed food ingredients, names of food ingredients, required and allowed label information, and standards for foods and food ingredients differ between countries.

**For example, colorings and preservatives allowed in foods differ widely between countries, and nutritional labelling is not universally required.**

- To develop foods for, and market foods in, a global economy, one must seek such information from international organizations and from organizations in specific regions and countries.

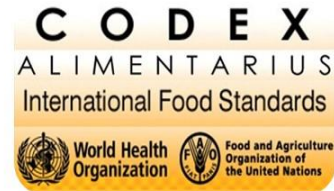


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So, the various international standards and practices with regard to the regulations and control in the food particularly with reference to fats and oils. Here with the need to compete in the worldwide market, employees of food companies must be aware that allowed food ingredients, names of food ingredients required and allowed label information and standards for food and food ingredients differ from countries to countries. For example, colorings and preservatives allowed in food differ widely between countries and nutritional labeling is not universally required. To develop food for and market food in a global economy, one must seek such information from international organizations and from organizations in specific regions and countries.

## ❑ Codex Alimentarius

- The Codex Alimentarius Commission (Codex Alimentarius (Latin for “code concerned with nourishment”) was established in 1962 by two United Nations organizations, the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), to develop international standards and safety practices for foods and agricultural products.
- The standards, published in the Codex Alimentarius, are intended to protect consumers' health, ensure fair business practices in food trade, and facilitate international trade of foods.



So, one major governmental body that is the Codex Alimentarius that is the international body Codex Alimentarius Commission, Latin for code concerned with nourishment, the word Codex Alimentarius, the code concerned with nourishment. So, this Codex Alimentarius Commission was established in 1962 by two United Nations organizations that is the Food and Agriculture Organization commonly known as FAO and the World Health Organization's WHO. And objective was to develop international standards and safety practices for food and agricultural products. The standards published in the Codex Alimentarius are intended to protect consumers health, ensure fair business practices in food trade and facilitate international trade of foods.

### Content of Codex Alimentarius

Volume	Subject
1A	General requirements
1B	General requirements (food hygiene)
2A	Pesticide residues in foods (general text)
2B	Pesticide residues in foods (maximum residue limits)
3	Residues in veterinary drugs in foods
4	Foods for special dietary uses
5A	Processed and quick-frozen fruits and vegetables
5B	Fresh fruits and vegetables
6	Fruit juices
7	Cereals, pulses (legumes) and derived products, and vegetable proteins
8	Fats and oils and related products
9	Fish and fishery products
10	Meat and meat products, soups and broths
11	Sugars, cocoa products and chocolate, and misc. products
12	Milk and milk products
13	Methods of analysis and sampling

### The Codex Alimentarius is published in 13 volumes

- One on general requirements (includes labeling, food additives, contaminants, irradiated foods, import/export inspection, and food hygiene).
- Nine on standards and codes of practice compiled on a commodity basis.
- Two on residues of pesticides and veterinary drugs in foods.
- One on methods of analysis and sampling.
- Volume 8 is on “Fat and oils and related products”.



The Codex Alimentarius is published in 13 volumes. All these 13 volumes are listed here that is among this one volume is on general requirements which includes labeling, food additives, contaminants, irradiated foods, import-export inspection and food hygiene etc. There are nine standards and codes of practice combined on commodity basis. For example, volume 8 is especially compiled on fats and oils and related products. There are two volumes on residues of pesticides and veterinary drugs in foods and one volume is on methods of analysis and sampling. So, it contains there 13 volumes.

- **Codex has efforts to**
  - ✓ **validate and harmonize methods of food safety analysis among countries and regions,**
  - ✓ **maintain the smooth flow of international commerce, and**
  - ✓ **ensure appropriate decisions on food exports and imports.**
- **The setting of international standards on food quality by Codex has been a high priority in world trade to minimize “nontariff” trade barriers.**
- **International trade of food and raw agricultural products has increased due to reduced economic trade restrictions and tariffs imposed.**



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So, the Codex has efforts to validate and harmonize methods of food safety and analysis among countries and regions. It maintains the smooth flow of international commerce and ensures appropriate decisions on food exports and imports. The setting of the international standards on food quality by Codex has been a high priority in the world trade to minimize non-tariff trade practices or trade barriers. International trade of food and raw agricultural products has increased due to reduced economic trade restrictions and tariff imposed. So, that is the Codex Alimentarius is one standard.

## ❑ Other standards



- Other international, regional, and country-specific organizations publish standards relevant to food composition and analysis.
- **The Food Safety and Standards Authority of India (FSSAI) publishes standards important in India.**
- The Saudi Arabian Standards Organization (SASO) publishes standards documents (e.g., labeling, testing methods) important in the Middle East (except Israel).
- **The European Commission (EC) sets standards for foods and food additives for countries in the European Economic Community (EEC).**
- In the USA, the Food Ingredients Expert Committee, which operates as part of the US Pharmacopeia, sets standards for the identification and purity of food additives and chemicals, published as the Food Chemicals Codex (FCC).



Then there are also other standards or regulations like the other international, regional and country specific organization publish standards relevant to food composition and analysis. That is in India, it is the Food Safety and Standards Authority of India popularly known as FSSAI. It publishes standards of various products, food products including fats and oil and related products. The Saudi Arabian Standards Organization like popularly known as SASO, it publishes standard documents for example, labeling, testing method etc and this is important in the Middle East or except Isarel. The European Commission (EC) sets a standard for food and food additives for countries like European Economic Communities. In USA, Food Ingredient Export Community which operates as part of the US Pharmacopeia sets a standard for the identification and purity of food additives and chemicals which is published as Food Chemical Codex (FCC).

For example, a company may specify in the purchase of a specific food ingredient that it be “FCC grade.”

- Countries other than the USA adopt FCC standards (e.g., Australia, Canada).
- At an international level, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) sets standards for purity of food additives.
- The Codex Alimentarius Commission is encouraged to utilize the standards established by JECFA.
- Standards established by FCC and JECFA are used by many countries as they develop their own standards.



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That is for example, a company may specify in the purchase of a specific food ingredient that is to be FCC grade. Countries other than the USA and adopt FCC standards like in Australia, Canada etc they also use FCC standard. At an international level, the Joint FAO and WHO Expert Committee on Food Additive popularly known as JECFA, it sets standards for purity of food additives. The Codex Elementary Commission is encouraged to utilize the standard established by JAGFA. The standards established by FCC and JECFA are used by many countries as they develop their own standards.

### ❑ Food Safety and Standard authority of India (FSSAI)

- FSSAI is a regulatory body responsible for supervising the safety standard of food business across the nation.
- To run food and food related business in India, FSSAI certificate or FSSAI license is mandatory.
- In today's world, as people prefer certified food consumption, FSSAI license can provide the food business with legal benefits and expansion scope.
- Not to forget it builds goodwill and trust, ensures food being wholesome, create consumer awareness.



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Let us talk about little bit food safety and standards authority of India. This FSSAI is a regulatory body responsible for supervising the safety standards for food business across the nation. To run food and food related business in India, FSSAI certificate or FSSAI license is mandatory. In today's world, as people prefer certified food consumption, FSSAI license can provide the food business with legal benefits and expansion scope. Not to forget it builds goodwill and trust ensures food being wholesome create consumer awareness.

### FSSAI regulation for food oils & fats

Food category name	Food sub-category name	Product name	FSSR number
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Soybean oil [02.1.2]	2.2.1(14)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Partially hydrogenated and winterized soybean oil [02.1.2]	2.2.3(1)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Partially hydrogenated soybean oil [02.1.2]	2.2.3(2)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Refined Soybean Oil [02.1.2]	2.2.1(16)(vii)



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So, now in this table I have given that is FSSAI regulations that are in force particularly with related to food, oils and fats. So, this food, oils and fats the category is two, 0-2 category that is fats and oils and fat emulsions. In this there is a subcategory 0, 2.1 that is fat, oils and essentially free from water. So, in this 2.1 the product name may be soybean oil 2.1.2 and its FSSAI number is 2.2. So, in this subcategory the product name is partially hydrogenated vintherize soybean oil that is 0, 2.1.2 and its FSSAI number is 2.2.3 then bracket 1. Partially hydrogenated soybean oil that is 2.1.2 and its FSSAI number is 2.2.3 within bracket 2. Refined soybean oil its FSSAI number is 2.2 and 1, 16.6.



Food category name	Food sub category name	Product name	FSSR number
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Groundnut oil (Moongh phali ka tel) [02.1.2]	2.2.1(3)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Refined groundnut oil [02.1.2]	2.2.1(16)(iii)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Rapeseed oil (Torlia oil) or mustard oil (Sarson ka tel) [02.1.2]	2.2.1(6)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Rapeseed or mustard oil-low erucic acid [02.1.2]	2.2.1(7)



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Then this ground nut oil like Bhuong Phalika Tel it is FSSAI number is 2.2.1, 3 within bracket 3. Refined ground nut oil is 2.2.1 within bracket 16, 3. Raphseed oil that is Torlia Tel or mustard oil Sarsoka Tel its 2. 2.16 and Raphseed oil or mustard oil with low erucic acid is 2.2.1 bracket 7. Then refined mustard or Raphseed oil its 2. 2.1, 16.9.

Food category name	Food sub category name	Product name	FSSR number
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Refined Mustard/Rapeseed Oil [02.1.2]	2.2.1(16)(ix)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Sun flower seed oil [02.1.2]	2.2.1(22)
02 -Fats and oils, and fat emulsions	02.1 -Fats and oils essentially free from water	Refined Sunflower Oil [02.1.2]	2.2.1(16)(vii)



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Then sunflower seed oil it is 2.2.1, 22. Refined sunflower oil 2. 1, 16, 7. So, these are the FSSAI number and this is this number one can go to the FSSAI website or you search on the Google or even printed volumes, gadgets etc are available. Here the different specifications

for these all the oils specific specific quality criteria and all those things are very beautifully narrated and which must be followed by the industry.

### ❑ FSSAI regulation for oil

- Refined vegetable oil means any vegetable oil which is obtained by expression or solvent extraction of vegetable oil bearing materials, deacidified with alkali and/or physical refining and/or by miscella refining using permitted foodgrade solvents followed by bleaching with absorbent earth and/or carbon and deodourised with steam. No other chemical agent shall be used.
- **The name of the vegetable oil from which the refined oil has been manufactured shall be clearly specified on the label of the container.**
- In addition to the mentioned standards to which refined vegetable oils shall conform to the standards prescribed in these regulations for the specified edible oils shall also apply except for acid value which shall be not more than 0.5.
- **Moisture shall not exceed 0.10 percent by weight.**



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So, FSSAI regulations for oil that is refined vegetable oil means any vegetable oil which is obtained by expression or solvent extraction of vegetable oil bearing material, deacidified with alkali and or physical refining and or by micellar refining using permitted food grade solvents followed by bleaching with absorbent earth and or carbon and deodorized with steam no other chemical agent shall be used. So, this is the clear cut definition or regulation that is provided in the FSSAI for oil. The name of the vegetable oil from which the refined oil has been manufactured shall clearly be specified on the label of the container. This is the requirement of FSSAI for oils and fats. In addition to the mentioned standards to which refined vegetable oil shall confirm to the standards prescribed in the regulations that we saw earlier for the specified vegetable oil shall also apply except for acid value which shall be not more than 0.5 percent. Moisture shall not exceed 0.1 percent by weight in any case in the oil that is the strict regulation of FSSAI.

### FSSAI regulation for oil (Contd...)

- Test for argemone oil shall be negative
- Further, if the oil is obtained by the method of solvent extraction and the oil imported into India whether obtained by solvent extraction or otherwise, it shall be supplied for human consumption only after refining and shall conform to the standards laid down under regulation 2.2.1.16.
- The oil so refined shall not contain hexane more than 5 ppm.



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Also the test for argument oil shall be negative. Further if the oil is obtained by the method of solvent extraction and the oil imported into India whether obtained by solvent extraction or otherwise it shall be supplied for human consumption only after refining and shall confirm to the standard let down under regulation 2.2.1.16 And the oil so refined shall not contain hexane more than 5 ppm.

### ❖ FSSAI regulation for mustard oil

#### Specifications

1	Butyro-refractometer reading at 40 °C <b>or</b> Refractive index at 40 °C	58.0 to 60.5 1.4646 to 1.4662
2	Saponification value	168 to 177
3	Iodine value	96-112 Polybromide shall be Negative
4	Unsaponifiable matter	Not more than 1.2 % by weight
5	Acid value	Not more than 6.0
6	Bellier test turbidity temperature (Acetic acid method)	23.0 °C to 27.5 °C
7	Test for argemone oil	Negative
8	Test for hydrocyanic Acid	Negative

- Rape seed oil (toria oil), mustard oil (sarson ka tel) means the oil expressed from clean and sound mustard seeds, belonging to the *compestris*, *juncea* or *napus* varieties of Brassica.
- It shall be clear free from rancidity, suspended or foreign matter, separated water, added colouring or flavouring substances or mineral oil.



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So, these are some of the major regulations and the list is long one. I recommend that is one can go and have detailed study of these recommendations. So, just for example, you see the FSSAI regulation for mustard oil that is published here that is the rapeseed oil, torii oil or

mustard *sarson ka tel* means that is the oil expressed from clean and sound mustard seeds belonging to the *compestris, juncea or napus* varieties of Brassica. It shall be clear free from rancidity suspended or foreign matter separated water added coloring or flavoring substances or mineral oil. The oil should be clear for this. The next is the specification. It is butyro refractometer reading at 40°C should be 58 to 60 or refractive index at 40°C should be in the range of 1.4646 to 1.4662. Its saponification value should range in between 168 to 177. Its iodine value may be in the range of 96 to 112 that is polybromide shall be negative and saponifiable matter not more than 1.2 percent by weight. Acid value should not be more than 6. This is a barrier test turbidity temperature that is a stick acid method at 23°C to 27.5°C. Test for argemone oil should be negative, test for hydrocyanic acid should be negative. So, this is the FSSAI recommend recommended specification for mustard oil.

### ❖ FSSAI regulation for safflower oil

#### Specifications

1	Butyro-refractometer reading at 40 °C <b>or</b> Refractive index at 40 °C	62.4 to 64.7 1.4674-1.4689	<ul style="list-style-type: none"> <li>• Safflower seed oil (<i>berry ka tel</i>) means the oil expressed from the seeds of <i>Carthamus tinctorius</i>.</li> <li>• It shall be clear, free from rancidity, suspended or other foreign matter, separated water, added coloring or flavouring substances, or mineral oil.</li> </ul>
2	Saponification value	186-196	
3	Iodine value	135-148	
4	Unsaponifiable matter	Not more than 1.0 %	
5	Acid value	Not more than 6.0	
6	Bellier test turbidity temperature (Acetic acid method)	Not more than 16 °C	



Similarly, FSSAI regulation for safflower seed oil that is *berry ka tel* means the oil expressed from the seeds of *Carthamus tinctorius*. It shall be clear free from rancidity suspended or other foreign matters separated water, added coloring or flavoring substances or mineral oil. Its specification include that is butyrometer or butyro refractometer reading at 40°C should range between 62.4 to 64.7. Its refractive index at 40°C should range lie between 1.46742 to 1.4689. Its saponification value may be in between 186 to 196, iodine value should range between 135 to 148. Its saponification matter should not be more than 1 percent, acid value not more than 6 percent and beller test arbitrary temperature that is not more than 16 °C. So, this is the regulation for say flower oil.

## ❖ FSSAI Regulation for Soybean oil

### Specifications

1	Butyro-refractometer reading at 40 °C <b>or</b>	58.5 to 68.0	• Soybean oil means the oil expressed from clean and sound soybeans (Soja max) from which the major portion of the gums naturally present have been removed by hydration and mechanical or physical separation.
	Refractive index at 40 °C	1.4649-1.4710	
2	Saponification value	189 to 195	• It shall be clear, free from rancidity, suspended or other foreign matter, separated water added coloring or flavouring substances or mineral oil.
3	Iodine value	120 to 141	
4	Unsaponifiable matter	Not more than 1.5 %	
5	Acid value	Not more than 2.50	
6	Phosphorus	Not more than 0.02	



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Similarly, the regulation for soybean oil FSSAI regulation. Soybean oil means the oil expressed from clear and sound soybeans that is sojوماتes from which the major portion of the gums naturally present have been removed by hydration and mechanical or physical separation. Its at clear, free from rancidity, suspended or other foreign matter, separated water, added coloring and or flavoring substances or mineral oils. The specification its butyro refractometer reading at 40 °C should lie between 58. 5 to 68. Its refractive index at 40 °C should be in between 1.4649 to 1.4710. Its saponification value should be in between 189 to 195, iodine value 120 to 141. It should have un saponifiable manner not more than 1.5 percent, acid value not more than 2.5 and phosphorus not more than 0.02. So, these are the some of the recommendations. Similarly, from all most of the oil such a specification recommendations are available in FSSAI notifications and FSSAI they have given the number. So, one who is interested they can they must consider it, they must go through it and maintain it the industry must the business operators for the oil they must see that their product meets the recommended standard by FSSAI because FSSAI it is a mandatory standard.

### ❑ BIS standards/regulations

- Oil is a commodity consumed by every person.
- **It may become health hazardous unless protected properly.**
- Therefore, different standards like PFA, AGmark, and BIS are formulated which give specifications on the quality parameters of oil at the time of sale, the shelf life of the oil in different plastic packaging materials, and specifications on safety and performance of packaging materials.
- **The shelf life required for oil in PET/PVC bottles is 60 and 180 days under normal and accelerated storage conditions, respectively.**
- The vinyl chloride (VC) monomer content in PVC should be  $< 1$  ppm and VC migration into oil  $< 10$  ppb.



BIS Bureau of Indian Standards they also have their standards or regulations for various products for oils and fats also etc. That is you know that oil is a commodity consumed by every person it may be both that is another. So, different standard like PFA, AGMARK, BIS are formulated which give a specifications on the quality parameters of oil at the time of sale. The shelf life of the oil in different plastic packaging materials and specifications on safety and performance of packaging material. However, these BIS standards are not mandatory these are voluntary, but the BIS is level mark it improve the credibility of the company and the quality it speaks about the shelf life required for oil like a BIS regulation in plate or PVC bottle is 60 and 180 days under normal and accelerated storage conditions. So, the also the vinyl chloride (VC) monomer content of PVC should be less than 1 ppm and VC migration into oil should be less than 10 ppb.

❖ BIS specifications for plastic packaging materials for packing edible oils/fats

IS No-Year	Specification
12724-1989	Flexible packaging materials for packaging of refined edible oil.
12883-1989	Polyvinyl chloride (PVC) bottle for edible oils.
12887-1989	Polyethylene terephthalate bottles for packaging of edible oils. 11352-1985 specification for flexible packs for packaging Vanaspati.
10840-1994	Blow molded HDPE container for packaging of Vanaspati.



So, BIS specifications for plastic packaging materials for packaging edible oils and fats like IS number and year is that 12724 of 1989 it is a specification for flexible packaging material for packaging of refined edible oil. 12883 of 1989 is the polyvinyl chloride bottle for edible oils 12887 of 1989 provides specific specification for polyethylene terephthalate bottles for packaging of edible oil. 11352 of 1985 specification is for flexible packs for packaging Vanaspati. 10840 of 1994 it provides blow mold SDPE containers for packaging of Vanaspati. So, similarly like FSSAI, mandatory similarly there are for different oils and fats and their related product as they relate their packaging and labeling there are BIS standard MRV standards and this can be, but they are mandatory, but it is recommended that as the company should follow this and see that these product their product meet the requirement of the regulations.

### To summarize on regulations

- Regulatory requirements for fats, oils and fat-based products ensures good quality and safe products in the global and regional markets.
- The international standards help in maintaining the quality and safety standards for food and agricultural produce.
- Food business operators must abide by these regulations for successful operation and safeguarding the rights of the consumers.
- Information about such requirements must be obtained through the different organizations and their publications for smooth functioning of the food business.



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So, to summarize on the regulations we will say that yes regulatory requirements are fat, oils and fat based products ensures good quality and safe products in the global and regional markets. The international standards help in maintaining the quality and safety standards for food and agricultural produce. Food business operators must abide by these regulations for successful operation and safeguarding the rights of the consumers. In fact, interstitial and agricultural or agencies or information about such requirements must be obtained through the different organizations and their publications very smooth functioning of the food business. Like for example, if you are in the international trade. So, FCC regulations or codex we will tell you as commissions, that those regulations one must follow different even the various countries also they have their own regulations. So, one must see the regulations in force in that particular country where you are intending to export your product. So, all these things should be followed to have a fair trade business.



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These are the references that are used in this lecture for the regulation part.

## Course Summary

summary

- This course covers the fat and oil industry market potential, production statistics, and utilization patterns while throwing light on the issues and challenges faced by this industry. It also explains its nutritional importance, physicochemical properties, and important chemical reactions.
- **Mechanical expelling, solvent extraction, refining processes, oil modification methods, valorization techniques, packaging, QA/QC and regulatory requirements of fats and oils of plant and animal origin are discussed.**



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Now, let us talk about the I will that summarize this being the last lecture of the course. Let us have a overview that is what we studied major points in the last 12 week that is in the 60 classes. You know this course cover the fat and oil industry market potential, production statistics and utilization patterns while throwing light on the issues and challenges faced by this industry. It also explained its nutritional importance, physico chemical properties and important chemical reactions that the oil sulphates undergo under various conditions. Mechanical spelling, solvent extraction, refining processes, oil modification methods,

valorization techniques, packaging, quality analysis, quality control and regulatory requirements of fats and oils of plant and animal origins were also discussed in this course.

- The Indian fats and oils market growth is expanding at a CAGR of 6.82 % over the forecast period 2021 to 2027. Dependence on imports, low oilseeds productivity, inadequate infrastructure, etc. are the key challenges faced by the industry.
- Oils and fat are important energy sources and are essential for but not limited to vitamin absorption, brain function, and heart and skin health. The energy value of fat is 9.3 kcal/g and on average, 40% of the daily energy requirement of humans is supplied by dietary triacylglycerols.
- Important plant sources of vegetable oils are seeds, nuts, cereals, and fruits, and sources of animal fats are milk fat, rendered fat and marine oils. Oilseed, tree nut, fruit, and spice oils are some of the most widely used and traded edible oils and fats, while butter and ghee are the important animal fats in India.
- Glycerides are esters of glycerol and fatty acids and can be classified as mono-, di-, and triglycerides. They form major components of fats and oils, while glycerolipids and non-glycerolipids are minor.



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You know we discussed in the earlier class that Indian fats and oil market growth is expanding at a CAGR of 6.82 percent over the forecast period of about 2021 to 2027. So, its dependence on imports, low oil said productivity, inadequate infrastructure etc are the key challenges faced by the industry. Oil and fats are important energy sources and that is they give 40 percent of the daily energy requirement of human is specified by dietary triacylglycerols. Important plant sources of vegetable oils are seed, nuts, cereals, fruits and sources of animal fats include milk fat, rendered fat and marine oils etc. Fats are the esters of glycerol and fatty acids and can be classified either mono-, di-, triacylglycerol. The major component of fats and oils with glycerolipids or non-glycerolipids are the minor components.

- Fatty acids are carboxylic acids with hydrocarbon chains ranging from 4 to 36 carbons. Lipids' physiochemical and nutritional properties depend on the type of fatty acids.
- **The bulk properties of the oil are density, viscosity, melting point, specific heat capacity, thermal conductivity, etc. Key chemical properties of lipids are hydrolysis, oxidation, saponification, polymerization, esterification, inter-esterification, halogenation, methylation, etc.**
- Fat undergoes a crystallization process through super-cooling, nucleation, and crystal growth, and exhibits polymorphism, which is the ability of a material to exist in a number of crystalline structures with different molecular packing.
- **Rancidity is the natural process of decomposition of lipids leading to undesirable flavor; its types are oxidative, hydrolytic, and ketonic and the flavor change before the onset of rancidity is called as reversion.**
- Antioxidants are substances that inhibit or delay the oxidation of a substrate. TAC and OSI are used to measure the antioxidant capacity and relative resistance of fat and oil samples to oxidation.



Then the fatty acids are carboxylic acids with hydrocarbon chains ranging from 4 to 36 carbons. Lipids, physio, chemical and nutritional properties depend on the type of the fatty acid that they contain. The bulk properties of the oil are density, viscosity, melting point, specific heat capacity, thermal conductivity etc. Key chemical properties of lipids are hydrolysis, oxidation, saponification, polymerization, esterification, inter-esterification, halogenation, methylation etc. Then fats undergo a crystallization process through super cooling, nucleation and crystal growth and exhibits polymers which is the ability of a material to exist in number of crystalline structures with different molecular packing. Rancidity is the natural process of decomposition of lipids leading to undesirable flavor. Its type of oxidation, its types are oxidative, hydrolytic, ketonic etc and they result into the flavor changes. Antioxidants are the substances that are added to inhibit the oxidation, autooxidation and TSC and OSI are used to measure the antioxidant capacity and relative resistance of fats and oil samples to oxidation.

- The primary processing of oilseeds is cleaning, de-hulling, crushing, cooking, and flaking. Thermal pretreatments are reported to increase oil yield, oxidative oil stability, bioactive compounds recovery, and formation of new functional compounds. Microwave, ultrasound, pulsed electric field and enzyme pre-treatment of oilseeds are novel pretreatment methods.
- **Mechanical expression of oil involves the application of pressure (using hydraulic or screw presses) to force oil out of the oil-bearing material. It can be cold pressing or hot pressing or in combination. Hydraulic and screw presses are used for mechanical expression. The continuous mechanical expression process is currently the most commonly encountered in the processing of oleaginous seeds.**
- Solvent extraction is an alternative approach and involves dissolving the oil-containing material in a solvent, separating the oil from the rest of the plant material and evaporating the solvent. Distillation, evaporation, membrane filtration, and absorption are the oil recovery methods from miscella, and the desolventizing, toasting, drying, and cooling (DTDC) process is used for removing the solvent from the de-oiled oilseed.



We also discussed the primary processing of oil seeds like cleaning, dehulling, crushing, cooking, flaking. Thermal properties or thermal pretreatments reported to yield increased oil yield, oxidative oil stability, bioactive compounds recovery and the formation of new functional compounds. Microwave ultrasound, pulse-electro filled-aid enzyme pretreatment of oil seeds are the novel pretreatment method that we discussed in the various lectures. We also discussed the mechanical expression of oil which involves the application of pressure that is using either hydraulic or a screw press to force the oil out of the oil bearing materials. The continuous mechanical expression process is currently the most commonly encountered process in the processing of oligosaccharides that oil seeds. The solvent extraction is an alternative approach to involve dissolving the oil containing material in a solvent separating the oil from the rest of the plant material and evaporating the solvent. Distillation, evaporation, membrane filtration and absorption are the recovery methods from miscella and the desolventizing, toasting, drying and cooling process is used for removing the solvent from the de-oiled seeds and all these aspects we discussed in the different classes.

- Crude oil obtained from oil seed comprises of gums, waxes, free fatty acids, and glycerides. The refining process reduces or removes certain undesirable impurities from the crude oil. Steps involved in refining are filtration, degumming, neutralization, bleaching and deodorization. Membrane technology and ultrasound refining are considered to be promising methods owing to their higher quality and stability.
- **Oils and fats are modified to alter their properties, improve stability, and achieve economic benefits. Hydrogenation, inter-esterification, and winterization are methods of modification.**
- Hydrogenation is a chemical process that adds hydrogen to double bonds that leads to saturation, cis-/trans-isomerization, and shifts of double-bond locations. Interesterification exchanges fatty acid positions from one glyceride to another. Winterization is a thermo-mechanical separation process where component triglycerides of fats and oils are crystallized from a melt.
- **Fractionation is the separation of fats & oils into fractions with different MP. Plasticization is making lipids have plastic properties. Interesterification, high oleic oils, blending, and fractionation are the methods to carry out trans-free oil modification.**



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We also discussed that crude oil obtained from the oil seed contains various gums, waxes, fatty acids, etc and these are removed during the refining process in the different process like filtration, degumming, de-filtration, bleaching, deodorization, etc. And the membrane technology and ultrasound refining are considered to be the promising methods owing to their quality and stability. The products treated by these methods are of higher quality and they are also stable. Then we discussed the various modification techniques that is what to improving the functionality and other desirable properties of the fates and oils like hydrogenation, inter-esterification, winterization, etc. We have discussed the fractionation is the process of fates and oil which fractions into different products with different melting properties. Plasticization is making lipids that is a baking lipids have plastic properties, inter-esterification, high oleic oil blending and fractionation are the methods to carry out transfer modifications. Hydrogenation is a chemical process that adds hydrogen to double bond that leads to saturation, cis-trans isomerization and shifts of double bond locations, etc. So, all these things details we discussed in various classes.

- Animal fat is obtained from the tissues of mammals and/or poultry in the commercial processes of rendering or extracting. Rendering is a thermal processing operation and it's of three types-dry, wet, and low-temperature wet rendering. Lard, tallow, and fish oil are obtained by rendering.
- Tubular bowl & disc bowl are two types of centrifuges used to separate cream from milk. The cream is churned to change the emulsion type to obtain butter, which is again heated to produce ghee.
- Cooking oil is a plant or animal-based fat used in frying, baking, or other types of cooking. Factors to decide the right oil for cooking are fatty acid composition, smoke point, omega ratio, and antioxidant potential. During frying, water released results in oil hydrolysis, oxidation, decomposition, polymerization, and volatile and non-volatile compounds are released.
- Commonly used cooking oils are: seed oils (groundnut, mustard, sesame, etc.), Fruit & nut oils (palm, coconut, and olive oil), and rice bran oils. Some of the specialty oils used are tree-nut oils (almond, cashew, etc), tropical exotic oils (mango kernel butter, kokum butter), and essential oils (citrus oil, chili oil, etc.). Oil powder and liposomes are novel products developed by freeze drying, coacervation, fluidized bed coating, spray drying. Their processing technologies are explained in detail in the lectures.



We also discussed that is a various animal fat from their sources from where they are obtained like lard, tallow and fish oils they were obtained by rendering. Then tubular bowl and disc bowls are two types of centrifuge which are used to separate the cream from milk and then this cream is used to make butter or ghee. Cooking oil we discussed their cooking oil for their characteristics, properties, how they can be maintained in various operations like factors like which decide the right oil for cooking or fatty acid composition, smoke point, omega ratio, etc. Then commonly used cooking oils which we discussed were seed oils like groundnut oil, mustard oil, sesame oils, fruit and nut oils like palm oil, coconut oil, olive oil, rice ground oil, even some of the specialty oils that are tree nut oil like almond oil, cashew oil, tropical exotic oil like mango kernel butter, kokum butter, essential oil like citrus oil, this chili oil etc and oil powder and liposomes these are the novel products developed by freeze drying, coacervation, fluidized bed drying, spray drying. So, their processing technologies for all these commonly used cooking oil and exotic oils etc they were explained in detail in the various lectures.

- Oilseed cake is the major by-product which rich source of protein and used to develop novel food products, animal feed, fertilizers, etc. The byproducts produced in oil refineries are lecithin, free fatty acid distillates, acid oil, etc. can be used to manufacture pharmaceutical and cosmetic products. Biomass is another byproduct mostly used as fuel and fertilizer. Waste cooking oil could be used for biodiesel production through transesterification.
- Oil blending is practiced to achieve the ideal omega ratio, cooking profile, and stability of oils. Fortification of edible oils and fats with vitamins A and D is a good strategy to address micronutrient malnutrition.
- Edible oil packaging methods like sparging, inert gas blanketing, and use of novel packaging materials like edible films, bio-based polymer packaging materials, and handling and storage of oils were discussed.
- Quality tests like anisidine value, thiobarbituric acid value, gas chromatographic methods, free fatty acid/acid value, detection of adulterants, FFA content and oxidation products measurement were detailed.
- International and national (FSSAI) regulations for the manufacture, packaging and distribution of the oil were presented.



Also we discussed that oil seed cake that is a major byproduct which is a rich source of protein and is used to develop novel food products, animal feed, fertilizers etc. Then the byproducts used in oil refinery are lecithin, free-fatty acid, distillate acid, oil etc and they can be used to manufacture pharmaceutical and cosmetic products. So, these are obtained from the oil milling by products. Biomass is another byproduct mostly used as a fuel and fertilizer. Waste cooking oil could be used for biodiesel production through transesterification. Then we also discussed that is very important aspect and the oil blending that is oil blending or oil fortification that is oil blending is practiced to achieve an ideal omega ratio cooking profile as well as stability of the oil. Fortification of oils with vitamin A and D is a good strategy to address micronutrient malnutrition. Essential oil packaging method like sparging, inert gas, blanketing and use of novel packaging materials and edible films, bio based polymers, packaging materials, handling and storage of oil seeds all these aspects were discussed in detail. We also discussed the quality test, quality analysis test like anisidine value, thiobarbituric acid, gas chromatography method, free fatty acid value, adulteration of pre fatty acid content, oxidation products that is their measurement these were detailed. Then international and national regulations for the manufacture, packaging and distributions of oil were presented in the different lectures.

- Special focus was provided to novel techniques such as ultrasonication, microwave treatment, PEF, high-pressure processing, enzyme treatment, etc., and their use in oilseeds pretreatment, extraction, refining, modification, frying technologies, and by-product utilization. To eliminate the issues and challenges of traditional methods were highlighted.
- **Opportunities that are available in oil powder, liposome, specialty oil manufacturing, oil blending, and fortification were shown.**
- The growing population, increasing consumer awareness, demand from food processing industries, and technological advancement show the start-up and entrepreneurship potential of the oils and fats industry in India.



So, special focus in this course was given to novel techniques such as ultrasonication, microwave treatment, pulse electric field treatment, high pressure processing, enzymatic treatment etc and their use in oil seed pretreatment, extraction, refining, modification, frying technology and byproduct utilization. So, we discussed both why that is the traditional methods and whatever the drawbacks in the traditional method, how they can be eliminated like to eliminate the issues and challenges faced by the traditional methods these were highlighted and how by the application of these novel techniques how these challenges can be overcome. Then opportunities that are available in oil powder, liposome, a specialty oil manufacturing, oil blending and oil fortifications were discussed in detail and it was shown and this provides the future of this oil milling industry. The growing population, increasing consumer awareness, demand from the food processing industries and technological advancement. So, the start up and entrepreneurship potentials of the oils and fat industry in India,



### □ Opportunities for entrepreneurship and start-up in food oil and fat sector

- ✓ Online marketplace
- ✓ Innovative packaging solutions and marketing
- ✓ Organic and cold-pressed oils
- ✓ Edible oil refining
- ✓ Oilseed processing technology
- ✓ Mobile oil extraction units
- ✓ Waste management and byproduct utilization
- ✓ Edible oil fortification
- ✓ Speciality oils



There is a great demand, great scope of starting up there is a entrepreneurship or the enterprise and start up agency etc to have a finally, convert into a various commercial ventures. So, the different opportunities for entrepreneurship are areas where the start up in food, oil and fat sector could be opened they include that is online marketplace, innovative packaging solutions and marketing for oils and speciality oil products, organic and cold press oil, their packaging, their branding, then edible oil refining that is there is a need that is even a small scale home scale refining equipment etc can be developed and using the novel technologies, oil seed processing technology, mobile oil extraction unit, waste management and byproduct utilization, edible oil fortification and speciality oil. So, these are some of the sectors areas which can where innovative ideas can be used to have a start up or entrepreneurship venture.

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*Wishing participants of the  
course all the best for their  
future endeavors...*



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So, finally, I wish the participants of the course all the best for their future endeavors. Finally, I thank you all very much. Thank you. Enjoy.