

## OIL SEEDS PROCESSING

Under PMFME Scheme



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## CHAPTER 1

### 1.1 INTRODUCTION

The Oilseeds sector has been one of the most dynamic components of world agriculture in the past three decades growing at 4.1% per annum surpassing the growth of agriculture and live stock products. The performance of oilseeds on the domestic front during the last two decades has been commendable braving the vagaries of weather conditions, the global price aberrations and the ever increasing domestic demand.

The self-sufficiency in oilseeds attained through “Yellow Revolution” during early 1990’s, could not be sustained beyond a short period. Despite being the fifth largest oilseed crop producing country in the world, India is also one of the largest importers of vegetable oils today. There is a spurt in the vegetable oil consumption in recent years in respect of both edible as well as industrial usages.

### 1.2 VARIETIES OF OIL SEEDS

Nine oilseeds are the primary source of vegetable oils in the country, which are largely grown under rain fed conditions over an area of about 26 million ha. Among these, soybean (34%), groundnut (27%), rapeseed & mustard (27%) contributes to more than 88% of total oilseeds production and more than 80% of vegetable oil with a major share of mustard (35%), soybean (23%) and groundnut (25%).





### 1.3 SOYBEAN SEEDS

Soybean (*Glycine max*) is the world's most important seed legumes which contributes 25% to the global edible oil, about two third of the world protein concentrate for livestock feeding and is a valuable ingredient in formulated feeds for poultry and fish. The commercial cultivation of soybean crop in India commenced in late sixties. Starting from 0.32 lakh ha in 1970, soybean has reached to 101.1 lakh ha in 2011. Similarly, the production and productivity levels of 0.14 lakh tonnes and 438 kg/ha in 1970 have increased to 122.1 lakh tonnes and 1208 kg/ha in 2011 respectively. It is grown as annual crop in Kharif season and grains have about 40% protein. Parts of plants like leaves, stalks, petioles and stems are used as dryfodder for feeding the animals.

Soybean is predominantly grown as rainfed crop in Vertisols and associated soils with an average crop season rainfall of 900 mm. Soybean is a short day plant and is highly sensitive to day length. It has emerged as one of the most resilient rainfed Kharif season crops, as despite aberrant weather conditions in recent past, the crop has maintained a considerably good level of productivity. The area under soybean is mainly spread in latitudinal belt of about 15 to 25°N comprising the states of Madhya Pradesh, Maharashtra, Rajasthan, Chhattisgarh, Andhra Pradesh and Karnataka.



### 1.4 GROUNDNUT SEEDS

Groundnut (*Arachis hypogaea L.*) is an important oilseed and ancillary food crop of the world. A native of South America, groundnut is cultivated in tropical, sub-tropical, and warm temperate regions of the world. The commercial cultivation of groundnut, however, is confined to areas between 40°N and 40°S latitudes. Developing countries account for more than 80% of groundnut area in the world. The production is confined mainly to Asian and African countries. Asia accounts for about 50% of the global area and 60% of production. India accounts for about 25% of global area and contributes 19% to world groundnut production.

In India, groundnut is cultivated largely in kharif season (June to October) usually under rainfed conditions with low input use. In kharif, the pressure of insect pests and diseases including weeds is high and hence, the productivity is low. In rabi season (October to March), the crop is grown on residual moisture in Rice Fallow Lands or river beds under minimal irrigation situations and also in summer season (January-February to April-May) as an irrigated crop. The cultivation of groundnut in summer is practiced generally under high input conditions and the pressure of insect pests and diseases including weeds are relatively low and hence, the productivity is high. The spring groundnut, grown during March-April to July-August, after the harvest of potato/toria, also gives high productivity.





## 1.5 MUSTARD SEEDS

The mustard seed ranks fourth among the major oilseeds of the world. India is an important rapeseed mustard growing country in the world, occupying largest area and has second position in production after China. The cultivation of the plant for oilseed production is almost entirely confined to the temperate and warm temperate zone of Asia and Europe. Rapeseed thrives best in rich soil in a cool and moist climate. Mustard seed in its various species of white, brown, and black is a close relative of rapeseed. The rapeseed-mustard group includes brown sarson, raya, and toria crops. Indian mustard (*Brassica juncea* L.) is predominantly cultivated in Rajasthan, UP, Haryana, Madhya Pradesh, and Gujarat. It is also grown under some nontraditional areas of South India including Karnataka, Tamil Nadu, and Andhra Pradesh. The crop can be raised well under both irrigated and rainfed conditions. Being more responsive to fertilizers, it gives a better return under irrigated conditions. Brown sarson (*B. Rapa* ssp. *sarson*) has 2 ecotypes lotni and toria. Yellow sarson (*B. Rapa* var. *trilocular*) is cultivated in Assam, Bihar, Orissa, and West Bengal as a rabi crop. In Punjab, Haryana, UP, Himachal Pradesh, and Madhya Pradesh, it is grown mainly as a catch crop.



### 1.6 SUNFLOWER SEEDS

The cultivated sunflower (*Helianthus annuus L.*) is native of southern United States and Mexico, during later part of 20th century, the crop was introduced to India. Seed contains the oil varying from 35-43%. The unsaturated fatty acids such as oleic and linoleic, comprise about 90% of the total. High oleic sunflower seeds are used for confectionary purposes and oil has good keeping quality. Sunflower hulls are used in animal feeds as a source of roughage, as a fuel to generate steam or electricity and in production of furfural and ethyl alcohol.

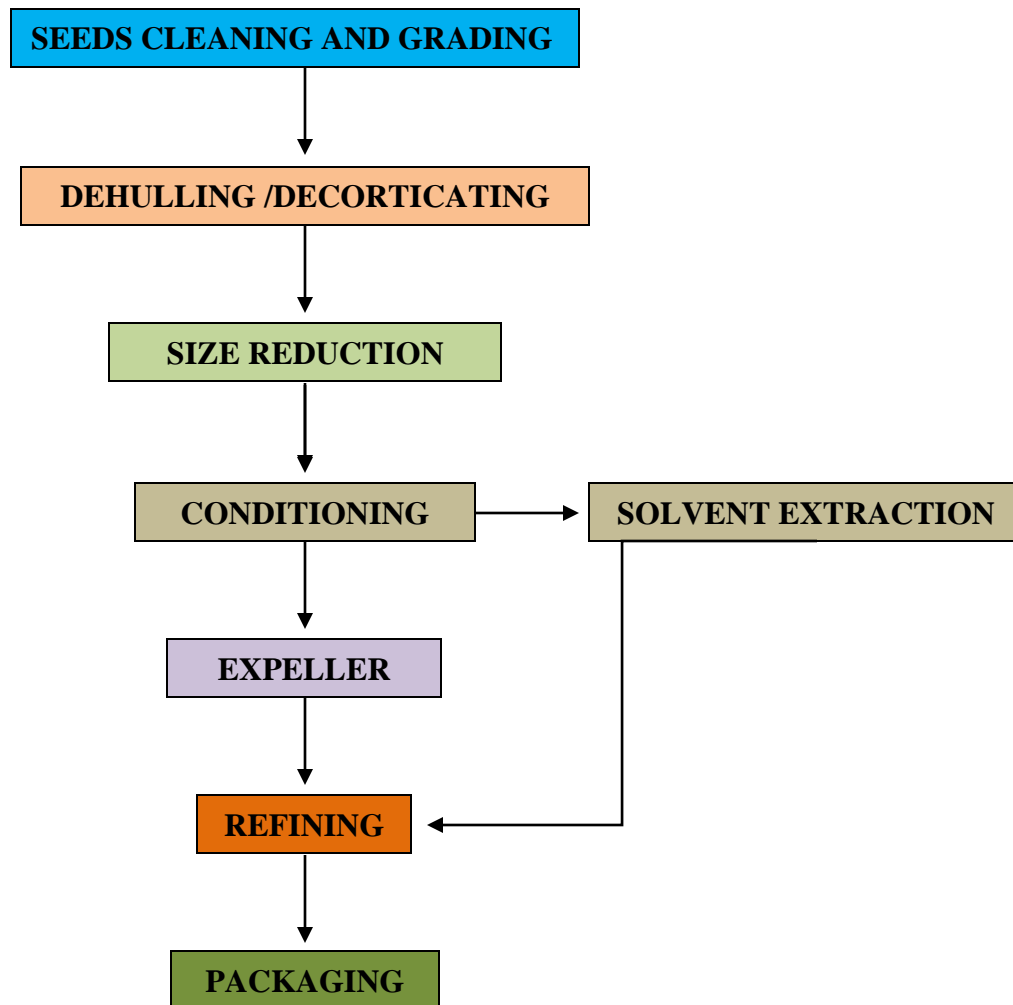
Karnataka, Andhra Pradesh and Maharashtra are the major sunflower growing states contributing about 91% and 82% of the country's area and production respectively. Sunflower contribution to Indian oilseed production is about 3.85% and major growing areas in the world are Russia, Ukraine, Argentina, China, France, USA, Spain and India.





CHAPTER 2

2.1 PROCESSING OF OIL SEEDS



### **2.1.1 CLEANING**

The first preparation step is cleaning to remove foreign materials from the oil seeds. This includes the separation of plant tissues, pebbles, dust, etc. to protect the processing equipment and enable the production of high quality soy products. Some weed seeds have been shown to reduce the oxidative stability of the extracted oil if they are not removed.

### **2.1.2 DRYING**

To remove the hull effectively a moisture content of 10% is needed, which requires a drying process prior to dehulling. Heated air is distributed through the oil seeds to achieve some loss of water, followed by cooler air, which removes the residual moisture laden air.

### **2.1.3 DEHULLING**

De-hulling operation is performed for the removal of seed coat which also helps in reducing the anti-nutritional factors.

### **2.1.4 CONDITIONING**

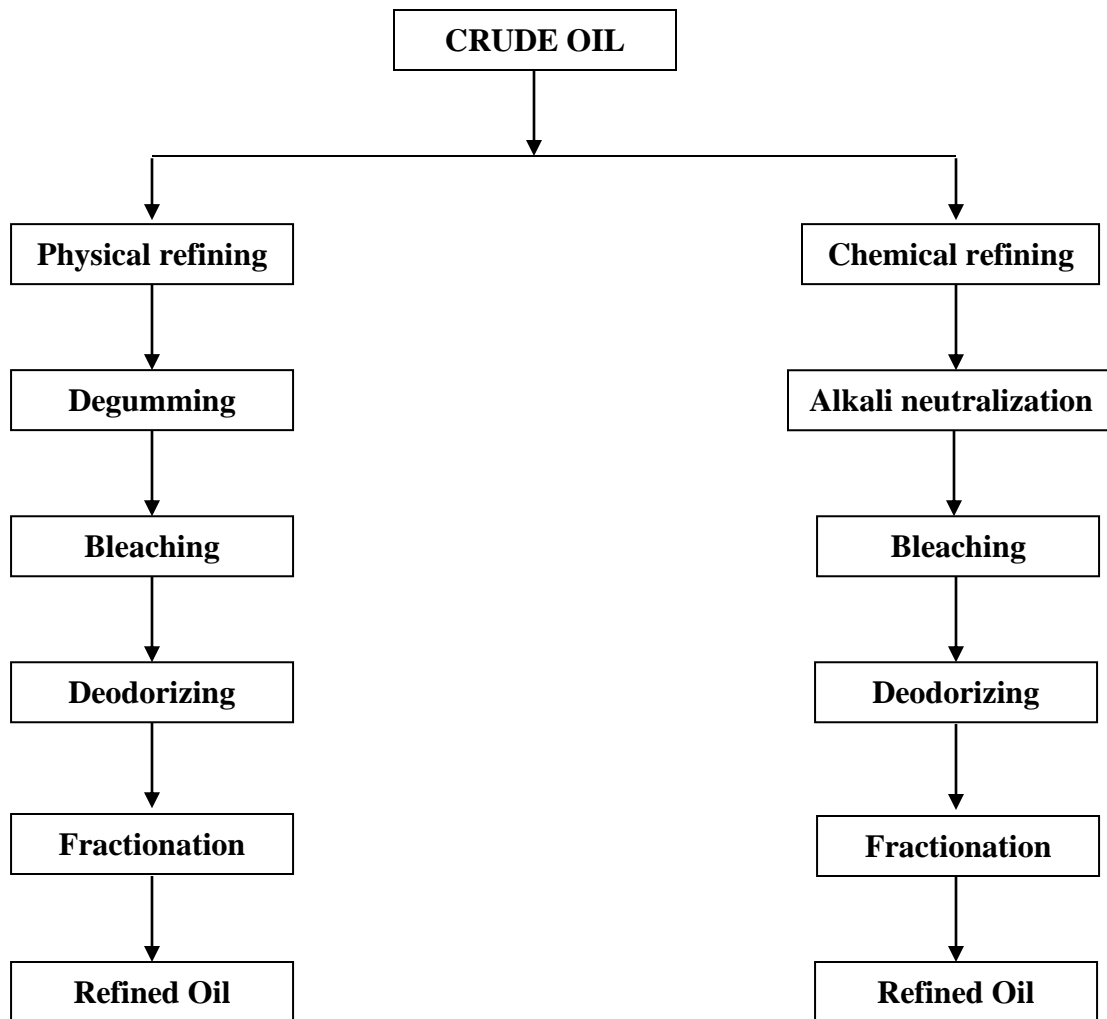
Conditioning is done with the help of heat and moisture to obtain the optimum plasticity necessary for flake production, prior to oil extraction.

### **2.1.5 EXTRACTION**

Extraction of oil from the mash is done with the help of screw, hydraulic, or centrifugal presses, this method is known as dry method. Since centrifugal presses are not so much efficient thus screw and hydraulic presses are more used by modern mill. The factors which determine the extraction are temperature, pressure applied, duration of pressure and the ratio of fiber and kernel. Extraction of oil can also be done through wet method, where hot water as a liquid is used to extract oil from ruptured cell of seeds. Treatment with hot water also helps in protein coagulation and hydrolyze gums, resins and starch thus preventing the oil from foaming during frying. After removal moisture, oil is extracted.

**2.2 PROCESS OF OIL REFINING**

Although crude oil is directly used, but it has been refined for used as more sophisticated edible oil. Refining of crude oil involves either physical refining or chemical refining. The process of physical refining involves steps like degumming, bleaching, deodorizing and fractionation while chemical withering process involves alkali neutralization, bleaching, deodorizing and fractionation.





### **2.2.1 ALKALI NEUTRALIZATION :**

To reduce free fatty acids and polar lipids in crude oil, it is treated with solution called sodium hydroxide or sodium carbonate and the process is called as alkali neutralization or alkali refining.

### **2.2.2 DEGUMMING :**

Alkali neutralization is not alone sufficient for removal of all the impurities thus the process of degumming is performed in both i.e. physical refining and chemical refining. Degumming is mainly done to target impurities like phospholipids and other polar lipids (gums). Removal of gums are done with the help of centrifugation.

### **2.2.3 BLEACHING :**

Like degumming, bleaching also an important steps of physical refining and chemical refining. The process of bleaching is performed for the removal of pigment by using charcoal or clay.

### **2.2.4 DEODORIZING :**

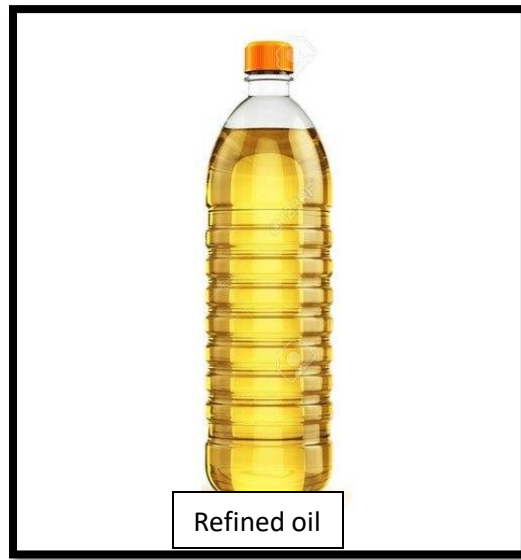
Deodorizing is done by steam distillation and used for removing those products which are volatile in nature. The process of deodorizing is carried out at 230°C for 2 hours followed by cooling of oil and passing it through filter.

### **2.2.5 FRACTIONATION :**

Allowing the oil to stand for a time at low temperatures so that glycerides, which naturally occur in the oil, with higher melting points solidify and can then be removed from the oil by filtering. Over time glycerides can degrade releasing fatty acids into the oil increasing the acidity levels and reducing the quality.

**2.2.6 ADVANTAGES AND DISADVANTAGES OF DIFFERENT REFINING METHOD**

<b>REFINING</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Chemical	Functional process. Large amount Free fatty acids reduces.	Expensive. Time consuming. Produce polluting effluent.
Physical	Less energy requirement. Less expensive. Produce less effluent.	Loss of vitamins. Loss of deep red color. Oxidative damage is more.



## CHAPTER 3

### 3.0 EQUIPMENTS FOR OIL SEEDS PROCESSING

#### 3.1 THRESHER

The seeds are detached with the help of thresher or stripper. There are two types of thresher one is rotating drum and other is fixed drum which are used for stripping seeds.



#### 3.2 OIL EXTRACTOR :

Extraction of oil is done either by wet method or dry method. Dry method includes use of screw pressure for extraction oil.





### 3.3 FILTER PRESS:

A filter press is a batch operation, fixed volume machine that separates liquids and solids using pressure filtration. The extracted oil has some impurities. These oils are sent into the filter press for further filtration.



### 3.4 CLARIFICATION MACHINE:

Clarification of oil is done to remove non oily solids dirt by passing oil through hot water at 95°C. Oil and dirt separated from each other where dirt settled down at the lower part while clear oil presents at upper part.



## CHAPTER 4

### 4.0 PACKAGING:

Packaging is an important part of food manufacturing process. It protect the food products from physical ,chemical, biological damages. Without packaging, food handling would be a messy, inefficient and costly exercise and modern consumer marketing would be virtually impossible. Thus food packaging lies at the very heart of the modern food industry.

Packaging Institute International defined packaging as the enclosure of products, items or packages in a wrapped pouch, bag, box, cup, tray, can, tube, bottle or other container form to perform one or more of the following functions: containment, protection, preservation, communication, utility and performance. If the device or container performed one or more of these functions, it was considered a package.

### 4.1 NEED OF PACKAGING :

Packaging performs a series functions:

**4.1.1 CONTAINMENT :** The containment function of packaging makes a huge contribution to protecting the environment from the myriad of products that are moved from one place to another on numerous occasions each day in any modern society. Faulty packaging (or under-packaging) could result in major pollution of the environment.

**4.1.2 PROTECTION :** the primary function of the package: to protect its contents from outside environmental influences such as water, water vapor, gases, odors, microorganisms, dust, shocks, vibrations and compressive forces.

**4.1.3 CONVENIENCE :** Products designed to increase convenience include ready to cook or ready to eat foods which can be reheated in a very short time, preferably without removing the primary package. Thus, packaging helps in convenience of consumer. Convenient packages promote sales.

**4.1.4 COMMUNICATION :** Packaging contains a lot of information such name of its manufacturer, product name, terms and uses, date of manufacturing, best before. nutritional information thus helping the consumer to be more informed.

## **4.2 TYPES OF PACKAGING :**

### **4.2.1 PRIMARY PACKAGING :**

- Primary package are those package which directly came into contact with food products. It provides first or initial layer of protection to the food products.
- Examples of primary packaging includes Metal cans, tea bag, paperboard cartons, glass bottles and plastic pouches.

### **4.2.2 SECONDARY PACKAGE :**

- Secondary package are those package which surrounds or contains the primary package.
- It further used to group primary packages together.
- Act as carriers and many a times also used for the display of primary package.
- Ex. Corrugated case, Boxes.

### **4.2.3 TERTIARY PACKAGE :**

- It contains number of secondary package together.
- Mainly used for bulk handling of food products.
- Example : stretch-wrapped pallet.

### **4.2.4 QUATERNARY PACKAGE :**

- Quaternary package is mainly used for handling the tertiary packages.
- It generally includes a metal container which can be transferred to or from ships, trains.



### 4.3 PACKAGING OF OIL:

Packaging of oil is mainly done to protect the oil from outside environment especially after the completion of process so that oil can retain color, flavor, freshness for a longer period of time.

Packaging of oil is also done to increase their shelf life :

#### 4.3.1 Hydrolytic rancidity :

As the temperature increases, water holding capacity of oil increase. Hydrolytic rancidity occurs due to presence of moisture, mainly due to hydrolysis of oil to glycerol and free fatty acids results in to off odor. Thus proper packaging prevents the hydrolytic rancidity.

#### 4.3.2 Oxidative Rancidity :

Oxidative rancidity in oil caused due to oxidation of unsaturated fatty acids chain. Aldehydes and ketones are the final products of oxidation responsible for the rancid odor of oils. Due to presence of natural antioxidant and pigments, unrefined oil are less prone to oxidation than refined oil.



#### 4.3.3 Microbial growth due to increase in water activity:

Microbial growth in oil occurs when moisture content is more than 65%.

**4.3.4 Packaging protect oil from degradation of color and vitamins** by protecting it from direct exposure of UV light. Thus oil are protected by using opaque and pigmented packaging materials

### **4.4 PACKAGING MATERIAL FOR OIL:**

#### **4.4.1 PET :**

PET can be made into film by blowing or casting. It can be blow moulded, injection moulded, foamed, extrusion coated on paperboard and extruded as sheet for thermoforming. Melting point of PET is higher than PP which is around 260°C and due to the manufacturing conditions does not shrink below 180°C. Thus PET is ideal for high-temperature applications. PET is also flexible to low temperature (-100°C). It also act as good barrier of oxygen and water vapour.



#### **4.4.2 FLEXIBLE POUCHES:**

The high packaging cost of rigid/semi-rigid packs and lack of assurance on quality and quantity in buying loose oil has led to the introduction of flexible pouches as retail packs. Flexible packaging materials have the following advantages:

- Optimum balance between cost and benefits.
- Lower storage and handling costs.

- Amenable to high-speed FFS machines.



#### 4.4.3 LDPE :

Low-density polyethylene is heat sealable, inert, odour free and shrinks when heated. It act as a barrier to moisture and has high gas permeability, sensitivity to oils and poor odour resistance. It is less expensive, therefore widely used. One of the great attributes of LDPE is its ability to be fusion welded to itself to give good, tough, liquid-tight seals.



### 5.4.4 GLASS :

Now a day glass container has been also used for packaging. It has following advantages:

- act as strong barrier to moisture and gases.
- Prevent unwanted odors and microbial growth.
- do not react with food products.
- suitable for heat processing when hermetically sealed
- glass are re-useable and recyclable
- they are transparent to display the contents
- they are rigid, to allow stacking without container damage.

The disadvantages of glass include:

- glass have high weight which increases the transportation cost.
- very much fragile and low resistance to thermal shock as compare to other materials.

potentially serious hazards from glass splinters or fragments .



## CHAPTER 5

### 5.0 STANDARDS AND REGULATIONS

#### 5.1 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.

#### 5.2 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 (PET) 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.



**5.3 FSSAI REGULATIONS 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 food grade solvents followed by bleaching with absorbent earth and/or carbon and deodorized 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 under-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.
- Test for argemone oil shall be 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. It shall conform to the following standards:-

Butyro-refractometer reading at 40°C	58.0 to 60.5
OR	
Refractive index at 40°C	1.4646 to 1.4662
Saponification value	168 to 177
Iodine value	96-112: Polybromide test shall be Negative
Unsaponifiable matter	Not more than 1.2 per cent by weight
Acid value	Not more than 6.0
Bellier test (Turbidity temperature - Acetic acid Method)	23.0°C to 27.5°C
Test for Argemone oil	Negative
Test for Hydrocyanic Acid	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 5.00 ppm.
- Safflower seed oil (berry ka tel) means the oil expressed from the seeds of *Carthamus tinctorius*. It shall be clear, free from rancidity, suspended or other foreign matter, separated water, added colouring or flavouring substances, or mineral oil. It shall conform to the following standards:-

Butyro-refractometer reading at 40°C		62.4 to 64.7
	Or	
Refractive Index at 40°C		1.4674-1.4689
Saponification value		186-196
Iodine value		135-148
Unsaponifiable matter		Not more than 1.0 per cent
Acid value		Not more than 6.0
Bellier test Turbidity temperature Acetic acid method		Not more than 16°C

- 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 5.00 ppm.

- Soyabean oil means the oil expressed from clean and sound soyabeans (*Soja max*) from which the major portion of the gums naturally present have been removed by hydration and mechanical or physical separation. It shall be clear, free from rancidity, suspended or other foreign matter, separated water added colouring or flavouring substances or mineral oil. It shall conform to the following standards:-

Butyro-refractometer reading at 40°C	58.5 to 68.0
Refractive Index at 40°C	1.4649-1.4710
Saponification value	189 to 195
Iodine value	120 to 141
Unsaponifiable matter	Not more than 1.5 per cent
Acid value	Not more than 2.50
Phosphorus	Not more than 0.02

- 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 5.00 ppm.

#### **5.4 SANITARY AND HYGIENIC REQUIREMENTS FOR FOOD MANUFACTURER/PROCESSOR/HANDLER**

The place where food is manufactured, processed or handled shall comply with the following requirements:

1. The premises shall be located in a sanitary place and free from filthy surroundings and shall maintain overall hygienic environment. All new units shall set up away from environmentally polluted areas.
2. The premises to conduct food business for manufacturing should have adequate space for manufacturing and storage to maintain overall hygienic environment.
3. The premises shall be clean, adequately lighted and ventilated and sufficient free space for movement.
4. Floors, Ceilings and walls must be maintained in a sound condition. They should be smooth and easy to clean with no flaking paint or plaster.
5. The floor and skirted walls shall be washed as per requirement with an effective disinfectant the premises shall be kept free from all insects. No spraying shall be done during the conduct of business, but instead fly swats/ flaps should be used to kill spray flies getting into the premises. Windows, doors and other openings shall be fitted with net or screen, as appropriate to make the premise insect free The water used in the manufacturing shall be potable and if required chemical and bacteriological examination of the water shall be done at regular intervals at any recognized laboratory.
6. Continuous supply of potable water shall be ensured in the premises. In case of intermittent water supply, adequate storage arrangement for water used in food or washing shall be made.
7. Equipment and machinery when employed shall be of such design which will permit easy cleaning. Arrangements for cleaning of containers, tables, working parts of machinery, etc. shall be provided.

8. No vessel, container or other equipment, the use of which is likely to cause metallic contamination injurious to health shall be employed in the preparation, packing or storage of food. (Copper or brass vessels shall have proper lining).
9. All Equipments shall be kept clean, washed, dried and stacked at the close of business to ensure freedom from growth of mould/ fungi and infestation.
10. All Equipments shall be placed well away from the walls to allow proper inspection.
11. There should be efficient drainage system and there shall be adequate provisions for disposal of refuse.
12. The workers working in processing and preparation shall use clean aprons, hand gloves, and head wears.
13. Persons suffering from infectious diseases shall not be permitted to work. Any cuts or wounds shall remain covered at all time and the person should not be allowed to come in direct contact with food.
14. All food handlers shall keep their finger nails trimmed, clean and wash their hands with soap, or detergent and water before commencing work and every time after using toilet. Scratching of body parts, hair shall be avoided during food handling processes.
15. All food handlers should avoid wearing, false nails or other items or loose jewellery that might fall into food and also avoid touching their face or hair.
16. Eating, chewing, smoking, spitting and nose blowing shall be prohibited within the premises especially while handling food.
17. All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.
18. The vehicles used to transport foods must be maintained in good repair and kept clean.
19. Foods while in transport in packaged form or in containers shall maintain the required temperature.
20. Insecticides / disinfectants shall be kept and stored separately and away from food manufacturing / storing/ handling areas.