

## **UNIT 7 SOURCES OF OILS AND FATS:**

Oils are chemical compounds of carbon, hydrogen and oxygen (but the ratio of hydrogen to oxygen is not 2:1) which remain liquid at ordinary temperature (10°C- 20°C). The solid state of oils is termed as fats. Oils obtained from various parts of plants fall under two main categories viz., a. essential or volatile oils and b. fatty or fixed oils. Essential oils are highly aromatic substances, mostly benzene or terpene derivatives or straight –chain hydrocarbon compounds of intermediate molecular length; they evaporate or volatilize in contact with air and are extracted by distillation or by solvents mainly. Fatty oils do not evaporate or volatilize and they cannot be extracted by simple diffusion method.

Fatty oils are composed of glycerine together with fatty acid, these are stored up in many plant parts like seeds, fruits and other organs. Fatty oils are produced by large number of both tropical and temperate plants. Fatty oils are stored up in seeds of the plants belonging to various families like Areaceae, Asteraceae, Brassicaceae, Euphorbiaceae, Fabaceae etc. Sometimes, they are stored in fruits, stems and other plant parts.

Fatty oils are of four types viz.,

1. Drying oils:

They form thin elastic film on exposure to air e.g., linseed oil, niger oil, soybean oil etc. They are very rich in unsaturated fatty acids, especially linoleic and linolenic acids, and have iodine number more than 130.

2. Semi-drying oils:

They form a soft film on exposure to air e.g., cotton seed oil, Sesame oil, mustard oils, corn oil, sunflower oil, cotton seed oil etc. These vegetable oils are intermediate between drying and non-drying oils. They absorb atmospheric oxygen slowly and produce a soft film even after a long exposure. They are fairly rich in linoleic and saturated acids but do not contain linolenic acid. Their iodine number varies from 100-130. They are mainly used for edible purposes, as illuminant and in making soaps and candles.

3. Non-drying oils:

These oils do not form a film but remain liquid at ordinary temperature e.g., groundnut oil, castor oil, olive oil etc. These oils do not absorb atmospheric oxygen and so un-capable to form elastic films even after long exposure.

They are fairly rich in saturated acids and oleic acids and either contains small amounts or no linoleic and linolenic acids. Their iodine number is less than 100.

Non-drying oils are used in the manufacture of soaps, as lubricants and as food.

4. Vegetable fats or tallows:

They remain solid or semi-solid at room temperature. They are fairly rich in saturated fatty acids and have a very low iodine number (8-50). They are edible and are also very useful in manufacture of soaps and candles. Some important vegetable fats are coconut oil, cocoa butter etc.

### **Extraction of vegetable oils:**

Vegetable oils are an important component for both food (for feeding, margarine and canned food industry, bakery, confectionery) and for non-food industry (production of detergents, paints, special varnishes, fatty acids, pharmaceuticals and cosmetics products, and painting). Vegetable oils and fats are found in nature in plant tissue, being concentrated in seeds, pulp, stone fruits, and in the tubers or sprouts.

Vegetable oils and fats are usually contained as insoluble droplets or deposits within the cells of plant tissue, more particularly in seeds. Before the extraction oil, the seed coat is usually removed with the help of specially designed decortication machines and then the seed kernel is reduced to paste. The fatty oils are usually extracted by the following methods:

#### **Cold Pressed or Cold Expeller Pressed:**

Cold pressed oils, also known as *cold expeller pressed oils*, have been mechanically pressed from the fatty portions of the botanical while ensuring that the maximum temperature (caused by friction) does not exceed 120 degrees.

#### **Expeller Pressed:**

Expeller pressed oils are mechanically pressed from the botanical material at high pressure to obtain maximum yield. Not all expeller pressed oils are cold pressed as high pressure extraction can cause temperatures to rise above 120 degrees. Only if temperature is monitored and kept under 120 degrees, can the oil be called cold pressed. Otherwise it is simply called expeller pressed. FromNatureWithLove.com always strives to supply cold pressed oils whenever possible, however, some oils cannot be cold pressed.

#### **Solvent Extracted:**

Sometimes it is necessary to use a solvent in order to extract the oil from certain seeds, nuts or kernels in order to make the extraction cost effective. Once the oil has been obtained, the solvent is then removed from the oil, but a trace percentage of the solvent may still be present in the final oil. Coconut, Palm, Grapeseed and Rice Bran are typically solvent extracted.

#### **CO2 Extracted:**

CO2 extracted oils are extracted using fluid carbon dioxide as the solvent. Carbon dioxide is converted to liquid using high pressure making it a safe and effective solvent that allows all the desirable active constituents of a plant to be collected without the risk of heat degradation. Once the extraction is complete, the pressure is released allowing the carbon dioxide to return to its natural gaseous state, leaving behind only the extracted essence of the plant. CO2 extracted oils are the closest representation of the natural plant ever achieved. CO2 total extracts include the

volatile components as well as the heavier, waxy components that give plants their color, and are therefore thick and waxy in consistency.

**Infusion/Macerate:**

An infused or macerated oil is a vegetable oil that has been "infused" with the fat soluble properties of other botanicals. Plant material is bruised and soaked in a base oil for a set duration of time. The base oil is sometimes gently heated to encourage infusion. The material is then filtered. Additional material may be infused in the same oil a number of times. The final oil is then well filtered to remove any traces of plant particles. The benefit to using an infused vegetable oil is that the infused oil will contain the therapeutic properties of both the vegetable oil and the botanicals that were infused into the oil.

**RBD:**

RBD is the abbreviation for "Refined, Bleached and Deodorized." Within the description / extraction method for each of our vegetable oils, we note those oils that are refined, bleached or deodorized.

**Refined:**

Some oils undergo a refinement process in order to remove impurities, improve the color or texture, or stabilize the shelf life of the oil. The oil is reacted with a weak base solution to saponify the free fatty acids into soap. The oil is then centrifuged and washed with water until the pure oil remains. The oil may also be degummed to remove the sticky phospholipids, color pigments and odor lending portions.

**Bleached:**

Some lipids are bleached in order to improve the color and clarity of the oil. Bleaching is generally done by passing the oil through fuller's earth or clay and then filtering the oil.

**Deodorized:**

Some lipids undergo a deodorization process in order to remove compounds that lend an unappealing or overpowering aroma to the oil. This is generally done by blowing high temperature steam through the oil to vaporize the aromatic components. This process is made more effective by heating the oil to high temperatures and performing this process under a vacuum to help remove all of the volatile odorous substances. Due to the high temperatures used, deodorization is clearly the most damaging process of refinement.

**Winterized:**

Oils that are winterized are cooled and filtered to remove the solid crystallized fractions. This process results in a lighter and clearer oil.

## **GROUND NUT/PEANUT:**

BOTANICAL NAME: *Arachis hypogea*

Family: Fabaceae or Leguminosae

Local name: Badam, Mungphali

Parts used: Seed (Fruit pod)

Ground nut or Peanut oil is obtained from the seeds of the plant *Arachis hypogea* belonging to the sub-family Papilionatae of the family Leguminosae. The plant is a native of Brazil from where it was introduced into Asia and Africa in the early part of the 16<sup>th</sup> century. India occupies first position in Groundnut cultivation. It is extensively cultivated in various states of India like Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka.

*Arachis hypogea* is a prostrate much branched annual herb. Leaves are pinnate compound, stipulate. Roots are of both tap and adventitious types. Flowers in dense axillary spikes, sessile and shortly pediceled- generally two types of flowers e.g., sterile and fertile types are developed. Former is with yellow- coloured papilionaceous corolla and latter is without corolla. Stamens 10. Carpel one, Ovary sessile, 2-3 ovuled, style long and filiform. Fruit a thick, oblong, reticulate lomentum, burying itself to ripen underground. Seeds 1-3, irregularly ovoid, cotyledons thick, fleshy.

### USES:

1. The groundnut or peanut is grown mainly for its oil. The ground nut oil is obtained from the seeds either by expression or by solvent extraction process. It is a non- drying vegetable oil used mainly for cooking. Edibles fried in peanut oil have pleasant flavour and keep well for long time.
2. Besides cooking, the oil is also used for several other purposes. It is used in making soap, shaving creams, cold creams etc.
3. The oil is used in the manufacture of vegetable ghee and vanaspati.
4. Peanut butter is prepared from peanut. It is prepared by grinding roasted and blanched kernels to which 1-4% salt is added.
5. Peanut oil is also used as a lubricant as well as an illuminant.
6. Oil is also used in leather dressings, furniture cream, candies, glycerine etc.
7. Groundnut milk is prepared from the kernels after shelling fresh pods and soaking them in water for one to two hours. Seed coat is removed and seeds are ground to fine pulp.

Water is added to the pulp and whole thing is stored for 10 minutes and strained through a fine cloth. The residue is again treated with water, pulverized and filtered to get as much milk as possible.

8. Groundnut curd is prepared by adding small quantity of milk curd to boiled groundnut milk and keeping it overnight for fermentation.
9. The groundnut oil emulsified with insecticides has been used successfully for the control of many insect pests of plants.
10. Oil cake obtained as residue after expression of oil from groundnut seeds is called poonac, which is good for cattle feed and can be applied as manure for paddy, sugarcane, vegetables, banana etc.
11. Groundnut shell is used in the manufacture of activated carbon, acetic acid, alcohol, acetone etc.
12. Fine powder of peanut shell is used for polishing tin plates, for cleaning carbon from aircraft engines etc.
13. Green plant after harvesting pods are used as cattle feed.

### **Diseases and insect pests:**

Common diseases are:

1. Tikka disease caused by *Mycosphaerella personata*. It can be controlled by spraying the crop with 1% Bordeaux mixture or dusting with sulphur.
2. Rosette and mosaic diseases due to virus. Control measure is not yet known.
3. Collar rot caused by *Pellicularia rolfsii*. It can be controlled by disinfecting soil with chloropicrin and growing resistant varieties.
4. Irregular leaf spot caused by *Mycosphaerella arachidicola*. It can be controlled by crop rotation, growing resistant varieties and by spraying with 1% Bordeaux mixture.

Common insect pest are:

1. Aphids and Red hairy caterpillar (*Amsacta albistriga*). They can be controlled by dusting with 10% BHC or Endrin.
2. Stem borer (*Sphenoptera perroteti*) is another important insect pest, it can be controlled by removing and destroying infested plants.

## COCONUT:

Botanical name: *Cocos nucifera*

Family: Arecaceae

Local names: Narikol, Narial

Parts used: Fruit (Fibrous drupe)

Coconut Oil is obtained from the dried meat or the coconut plant *Cocos nucifera* of the family Palmae (Arecaceae).

The coconut is cultivated extensively in the saline islands of tropical seas, especially in the humid coastal belts of tropical countries like Bangladesh, India, Sri Lanka, Polynesia and the West Indies. In India, coconut is mainly cultivated in Kerela, Karnataka, Tamil Nadu and West Bengal.

*Cocos nucifera* is a large, tall and erect palm attaining a height upto 24 metre. Stem is marked with annular leaf scars. Leaves are large, pinnatisect, arranged in the form of a crown. Flowers monoecious in large branched spadix. Perianth segments leathery, valvate. Stamens 6, pistillode small or absent. Carpels 3, ovary ultimately becomes 1-celled due to abortion of 2 carpels. Fruit a large fibrous drupe. Endosperm oily and watery.

## USES:

1. As food products:
  - i. The kernel of ripe coconut is eaten raw. It is used in many culinary items.
  - ii. Dried kernel is used in confectionery and food industries.
  - iii. Refined coconut oil is edible and extensively used as cooking medium. In South India, coconut kernel is used in most of the food preparations.
  - iv. Coconut milk is very nutritious and is a sweet tasting refreshing drink.
  - v. Coconut oil is used in preparing artificial fat known as margarine. It is used as milk thickener and as an ingredient of artificial milk for infants.
  - vi. Toddy or palm wine is a beverage in tropical countries which is extracted from spadix inflorescence and consumed either in natural state or after fermentation.
  - vii. Tree roots have narcotic property and are sometimes chewed.
  - viii. Sugar haggery and vinegar are prepared from sap.

2. Feed for livestock:

The residual cake obtained after oil extraction is used as cattle and poultry feed. When fed to cow, buffalo, goat and sheep, it helps to increase the output and quantity of milk.

3. Medicinal importance of coconut water:

Coconut water of tender coconut is recommended during body dehydration due to diarrhea and vomiting. It increases blood circulation in kidneys and causes profuse diuresis. It is used as culture medium for microbes.

4. Commercial products:

Coconut oil is used in the manufacture of the best soaps, cosmetics, shaving creams, shampoos and toilet preparations. It is also used in the preparation of hair oil and also in the manufacture of candles. Coconut water is also used in making Vinegar.

5. Other uses:

Dried leaves of coconut palm are used for making thatches and sheds. Mats, screens and baskets are made by the leaflets. Coconut fibre called Coir is obtained from fibrous mesocarp.

### **Diseases and Insect Pests:**

Common diseases are:

1. True bud-rot caused by *Phytophthora palmivora*. It can be controlled by destroying the plant to prevent the spread of the disease.
2. Shoot-rot caused by *Gloeosporium sp.* It can be controlled by spraying the crown with 1% Bordeaux mixture.
3. Leaf-rot caused by *Gliocladium roseum*. The control measure is not yet known.

Common insect pests are:

1. Coconut black beetle or Rhinoceros beetle (*Oryctes rhinoceros*) can be controlled by burning of all decaying refuse.
2. Coconut caterpillar (*Nephantis serinopa*) can be controlled by cutting and burning infested leaves.

## **LINSEED (FLAX)**

Botanical name: *Linum usitatissimum*

Family: Linaceae

Local names: Tishi, Tichi, Alsi

Parts used: Seed

It is obtained from the flax plant *Linum usitatissimum* of the family Linaceae. In India, flax plant is grown mainly for the oil contained in the seed while in western countries it is grown mainly for the fibre obtained from the stem and used in the manufacture of linen.

In India, it is grown mainly in temperate regions of UP, Madhya Pradesh, Maharashtra, Bihar and West Bengal. It is mainly cultivated for the oil contained in the seed rather than the fibre obtained from the stem.

It is an annual herb, reaching upto a height of 1.2m. Leaves are alternate, simple, linear or lanceolate, exstipulate, entire. Inflorescence cymose or solitary. Flowers are blue or white, regular, hermaphrodite. Sepals 5, imbricate. Petals 5, contorted, fugacious. Stamens 5, disk gland opposite to the petals. Carpels 5, united. Ovary 5-chambered, each chamber 2-locellate. Styles 5, usually free, stigmas clavate or capitate. Ovules 10 in each locellus. Fruit a 5-celled capsule. Seeds compressed.

### **USES:**

1. Linseed oil is colorless to yellowish oil obtained from the dried, ripened seeds of the flax plant.
2. It is also used in the preparation of lubricants, greases and polishes.
3. Linseed is a drying oil and is used in the manufacture of paints, varnishes, linoleum, soft soap, printer's ink.
4. Raw linseed is used in pharmaceutical industries as an emollient, demulcent, expectorant and diuretic.
5. The oil of linseed is also used in the application of burns when mixed with lime.
6. Boiled linseed is used in the manufacture of water proofing materials.
7. Oil cake is used as protein supplement to live stock.
8. It is also used as manure.



9. It is also used in cosmetic industries.

## **SOYBEAN:**

Botanical name: *Glycine max*

Family: Fabaceae

Local names: Soybean, Garomah, Bhatwan

Parts used: Pod (fruit)

It is an erect, bushy herbaceous annual plant attaining a height of 1.5 metres. The flowers are papilionaceous with a tubular calyx of five unequal sepal lobes. The pods contain 1-3 seeds. Soybean hulls may be yellow, green, brown or black, either all in one colour or a pattern of two colours. Cotyledons are yellow, green and the helium may be black, brown, buff or light yellow. Soybean is an annual plant, surviving only one growing season and can reach heights of 0.2–1.5 m (0.7–1.4 ft). Soybean may also be referred to as soyabean or soya and originates from Northeast China.

### **USES:**

1. Seeds are consumed as green vegetables, in salads as infant food, cracker bread, cakes, biscuits, ice-cream, chocolate bars, casein cheese.
2. Soybean oil is a highly refined oil rich in omega-6 fats, and some studies suggest that its consumption may be associated with several negative health effects.
3. Seeds are source of edible and semi-drying oil used in cooking. Soybean oil has a relatively high smoke point, which makes it a good option for high-heat cooking.
4. The oil from soybean is also used in the manufacture of glycerine, varnishes, paints, water proofing, soaps, shampoo, candles, insecticides, printing ink, etc.
5. Artificial nutritious milk is prepared from the seeds called soybean milk.
6. Soya oil cake is used as fodder.
7. Soybean oil is rich in vitamin K, which may help maintain bone strength and reduce the risk of fractures. One animal study also found that the oil may help prevent bone loss.

8. Soybean oil is rich in vitamin E, a nutrient that can help promote skin health. Applying it topically may protect against inflammation and help the skin retain moisture.

### **Diseases and Insect Pests:**

Common diseases are:

1. Bacterial blight caused by *Pseudomonas syringae*. It can be cured by planting seed pre-treated with antibiotic prior to planting to kill bacteria. spray plants with an appropriate protective copper based fungicide before appearance of symptoms.
2. Bacterial pustule caused by *Xanthomonas campestris*. It can be cured by planting the seed only in well drained soil and y treating the seed with antibiotic prior to planting.
3. Leaf rust caused by *Phakopsora pachyrhizi*. In order to treat the disease, it is advised not to plant soybeans in fields where common bean, sunflowers or other susceptible crops have been grown the previous season; space plants in narrow rows; avoid excessive irrigation after plants are no longer flowering; plant soybean varieties that are less susceptible to the disease.

Common insect pests are:

1. Armyworms (Beet armyworm, Western striped armyworm) *Spodoptera exigua*, *Spodoptera praefica*:

Organic methods of controlling armyworms include biological control by natural enemies which parasitize the larvae and the application of *Bacillus thuringiensis*; there are chemicals available for commercial control but many that are available for the home garden do not provide adequate control of the larvae.

2. Mexican bean beetle (*Epilachna varivestis*):

Plow crop residue into soil after harvest; plant soybean varieties that are less susceptible to the disease; rotate crops to a non-susceptible crop for at least one year; apply an appropriate foliar fungicide to protect plants from bloom to pod fill.

## **MUSTARD:**

Botanical name: *Brassica campestris*, *B. nigra*, *B. juncea*, *B. hirta*

Family: Cruciferae (Brassicaceae)

Local names: Sorioh, Sarson.

Parts used: Seeds

Mustard oil is obtained from several varieties of oil seeds known as rape seed and mustard belonging to the genus *Brassica* under the family Cruciferae (Brassicaceae). These seeds fall under following groups viz., Brown sarson obtained from *Brassica campestris*, *Brassica juncea*, *Brassica nigra*, *Brassica alba*. Mustard plant is an annual or biennial herb. Leaves large, lyrate. Inflorescence raceme. Flowers are yellow or white, sepals erect or spreading, petals distinctly clawed. Stamens 6, tetradynamous. Carpels 2. Fruit siliqua, elongate, terete or angular. Seeds globose.

### **USES:**

1. Mustard is mainly used as edible oil for cooking and also for making pickles.
2. Mustard oil is used in several ayurvedic medicines, particularly as liniment for massage in paralytic diseases of nervous system and joint pains.
3. Seeds are used as condiment in preparation of vegetables, curries, sausages and salad dressings, etc.
4. Mustard oil alongwith rock salt is used as remedy for the diseases of gums.
5. The oil is also used as an illuminant and for making soaps.
6. It is also used as a lubricant.
7. Oil cake is proteinaceous and used as cattle feed.
8. Plants are used as green fodder for cattle.

### **Diseases and insect pests:**

Common diseases are:

1. *Alternaria* blight caused by *Alternaria brassicae*: It can be controlled by growing resistant varieties and also by treating seeds with hot water and by spraying seed plots with 1% Bordeaux mixture at the seedling stage. Practice of crop rotation is recommended.

2. White rust caused by *Albugo candida*: It can be controlled by removing and burning affected parts.

Common insect pests are:

1. Mustard aphid (*Lipaphis erysimi*)- control measures are clean cultivation and spray the crop with 0.05% nicotine or fish-oil rosin soap.
2. Mustard saw-fly (*Athalia proxima*)- can be controlled by removing larvae and dusting the crop with 3% BHC or spraying with DDT.

## ESSENTIAL OILS:

Essential oils, which are obtained through mechanical pressing or distillation, are concentrated plant extracts that retain the natural smell and flavor of their source. Essential oil bearing plants are: Eucalyptus, Camphor, Jasmine, Camomile etc, Citronella, Agar wood, Patchouli

Chemically essential oils are combination of several organic substances, such as benzene derivatives, terpenes and various other hydrocarbons and straight-chain compounds. They have smaller molecules ordinarily less than 20 carbon atoms and possess a characteristic fragrance. Each essential oil has a unique composition of chemicals, and this variation affects the smell, absorption, and effects on the body. The chemical composition of an essential oil may vary within the same plant species, or from plant to plant.

Synthetic oils are not considered true essential oils.

The essential oils bearing plant may belong to the family apaceae, asteraceae, lamiaceae, lauraceae, Poaceae etc. Essential oils are extensively used in perfumery, pharmaceutical and flavour industries.

Some of the essential oil bearing plants found in India are as follows:

### I. CAMPHOR:

Botanical name: *Cinnamomum camphora*

Family: Lauraceae

Local names: Kophoor, Kopur

### USES:

1. Camphor oil has a variety of uses. It has anti-inflammatory and is often an ingredient in vapor rubs, liniments, and balms.
2. Many people use it to relieve irritation, itching, and pain.
3. As an ingredient in different products, it can also help ease inflammatory conditions and chest congestion.
4. In addition, camphor oil is popular in cooking, predominantly in India.

## II. CITRONELLA:

Botanical name: *Cymbopogon winterianus*

Family: Poaceae

Local names: Gandhbiringa, Gandheghas

Uses:

1. **Ceylon** and **Java** are the two main varieties of Citronella from which the essential oil is derived via steam distillation of their fresh leaves.
2. Used in aromatherapy applications. Citronella Essential Oil slows or prevents the growth or spread of harmful airborne bacteria, repels flying insects, uplifts negative moods, and relaxes the body and mind. It is reputed to reduce muscles spasms, ease headaches, and boost energy.
3. Used cosmetically or topically in general, Citronella Essential Oil can deodorize and refresh foul body odors, eliminate head and body lice, slow the look of aging, enhance skin health, and improve skin's absorption of moisture.
4. Citronella Oil conditions the hair, protects it from sun damage, boosts volume, and removes tangles.
5. Used medicinally, Citronella Essential Oil eliminates and prevents the growth of fungus on wounds, boosts the healing of wounds, relieves spasms and gas, stimulates and improves circulation, facilitates the healing of eczema and dermatitis, reduces swelling, tenderness, and pain, promotes the body's expulsion of toxins, strengthens immunity, reduces symptoms of the flu, colds, and fever, promotes weight loss, and boosts metabolism and digestion.

## III. AGARWOOD:

Botanical name: *Aquilaria agallocha*

Family: Thymelaceae

Local names: Sasi, Agoru chandan, Agar, Oud

Uses:

1. Diffusing agarwood allows its warm, grounding fragrance to relax both mind and body.
2. The ancient fragrance of Oud has been enjoyed in religious ceremonies for centuries to enhance centeredness and focus. Inhale this blend to improve meditation.
3. The oil Strengthens concentration.

4. Promotes inner peace and balance.
5. Supports healthy digestion.
6. Enhances meditation.
7. Powerful natural aphrodisiac.
8. Soothes ongoing stress.
9. Inspires strength and clarity.
10. Supports greater personal awareness

## **EXTRACTION METHOD OF ESSENTIAL OILS:**

Essential Oils are not made, but instead, they are extracted from plant materials. Extractions are used to obtain a plant's active botanical constituents that function as its "life force." They are essentially the liquefied version of a plant, and they effectively allow its beneficial compounds to reach the bloodstream faster than they would by simply consuming the plant.

A herbal extract is produced when a botanical material is introduced to a solvent in which some of the plant material components dissolve. Ultimately, the solvent becomes infused with the botanical materials that it has pulled from the source plant, and this is what is referred to as the "extract." The solution that remains at the end of the process can be liquid, or the liquid can be removed to turn the remnants of the botanical into a solid. The solvents can act as preservatives or as agents that help plant cells to break down and release their contents.

### ***STEAM DISTILLATION***

Steam Distillation is the most popular method used to extract and isolate essential oils from plants for use in natural products. This happens when the steam vaporizes the plant material's volatile compounds, which eventually go through a condensation and collection process.

#### **I. STEAM DISTILLATION PROCESS**

1. A large container called a *Still*, which is usually made of stainless steel, containing the plant material has steam added to it.
2. Through an inlet, steam is injected through the plant material containing the desired oils, releasing the plant's aromatic molecules and turning them into vapor.
3. The vaporized plant compounds travel to the condensation flask or the *Condenser*. Here, two separate pipes make it possible for hot water to exit and for cold water to enter the Condenser. This makes the vapor cool back into liquid form.
4. The aromatic liquid by-product drops from the Condenser and collects inside a receptacle underneath it, which is called a *Separator*. Because water and oil do not mix, the essential oil floats on top of the water. From here, it is siphoned off. (*Some essential oils are heavier than water, such as clove essential oil, so they are found at the bottom of the Separator.*)

#### **II. SOLVENT EXTRACTION**

This method employs food grade solvents like hexane and ethanol to isolate essential oils from plant material. It is best suited for plant materials that yield low amounts of essential oil, that are largely resinous, or that are delicate aromatics unable to withstand the pressure and distress of steam distillation. This method also produces a finer fragrance than any type of distillation method.



Through this process, the non-volatile plant material such as waxes and pigments, are also extracted and sometimes removed through other processes.

Once the plant material has been treated with the solvent, it produces a waxy aromatic compound called a "concrete." When this concrete substance is mixed with alcohol, the oil particles are released. The aforementioned chemicals used in the process then remain in the oil and the oil is used in perfumes by the perfume industry or for aromatherapy purposes.

### III. CO2 EXTRACTION

Essential oils derived from the supercritical CO2 extraction of herbs are similar to the oils produced through distillation in that they can be used in aromatherapy and natural perfumery.

Oils derived from steam distillation vary in their qualities depending on the temperatures, pressures, and length of time applied for the process. The CO2 extraction process might thus produce higher quality oils that have not been altered by the application of high heat, unlike the steam distillation process. In CO2 extraction, none of the constituents of the oil are damaged by heat.

Thus, the difference between traditional distillation and supercritical extraction is that instead of heated water or steam, CO2 is used as a solvent in the latter method. The supercritical extraction process operates at temperatures between 95 to 100 degrees F whereas steam distillation operates at temperatures between 140 to 212 degrees F.

In steam distillation, the molecular composition of both the plant matter and the essential oil are changed due to the temperature applied. On the other hand, a CO2 extract is closer in chemical composition to the original plant from which it is derived, as it contains a wider range of the plant's constituents.

For example, CO2 Extraction of German Chamomile flowers yields a green extract, because the absence of heat means it was not altered from its natural state or "denatured." The resulting extract is thus more similar in composition to the original flower than the distilled essential oils is.

CO2 extracts are usually thicker than their essential oil counterparts and often give off more of the aroma of the natural herb, spice, or plant than a distilled essential oil. CO2 extracts have been said to contain more plant constituents than the amount extracted from the same plant using steam distillation.

### THE CO2 EXTRACTION PROCESS

- Pressurized carbon dioxide becomes liquid while remaining in a gaseous state, which means it is now "supercritical." In this state, it is pumped into a chamber filled with plant matter.

- Because of the liquid properties of the gas, the CO<sub>2</sub> functions as a solvent on the natural plant matter, pulling the oils and other substances such as pigment and resin from the plant matter. The essential oil content then dissolves into the liquid CO<sub>2</sub>.
- The CO<sub>2</sub> is brought back to natural pressure and evaporates back into its gaseous state, while what is left is the resulting oil.

CO<sub>2</sub> is colorless, odorless, and can be easily and completely removed by releasing the pressure in the extraction chamber. It is what we exhale and is needed by plants in order for them to thrive, which illustrates its harmlessness when employed in the extraction process. This absence of potentially harmful solvents in CO<sub>2</sub> extraction means neither the human body nor the environment is polluted.

#### IV. MACERATION PROCESS

1. Plant material is finely *cut, crushed, or ground* into moderately coarse powder.
2. Plant material is placed in a closed *vessel*.
3. Solvent (*Menstruum*) is added.
4. The mixture is allowed to stand for 1 week and is *shaken* occasionally.
5. The liquid is *strained*.
6. Solid residue (*Marc*) is pressed to recover any remaining liquid.
7. Strained and expressed liquids are *mixed*.
8. Liquids are *clarified* through filtration or subsidence.

When the maceration process is complete, the base oil will likely have changed color. The final maceration should be filtered of its plant material and poured into an airtight container to be stored in a cool, dry place for up to 12 months. A macerated oil will go cloudy or will smell bad when rancid. 5-10% of a macerated oil can be used as an 'active botanical' in a cosmetic formula. Used in a larger quantity, it can also replace a plain base oil.

#### V. ENFLEURAGE

Enfleurage is not commonly used today, but it is one of the oldest methods of essential oil extraction that implements the use of fat. By the end of this process, either vegetable fat or animal fat becomes infused with the flower's fragrance compounds. The fats that are used are odorless and solid at room temperature. The enfleurage process can be done either "hot" or "cold." In both instances, the fat that is saturated with fragrance is called "enfleurage pomade."

#### COLD ENFLEURAGE

1. Highly purified and odorless vegetable or animal fat, usually lard or tallow, is spread out over glass plates in a frame called a *chassis* and is allowed to set.
2. Fresh flower petals or fresh whole flowers are then placed on top of the layer of fat and pressed in. They are allowed to set for 1-3 days or for a couple of weeks depending on the flowers that are used. During this time, their scent seeps into the fat.

3. The depleted petals are replaced and the process is repeated until the fat reaches the desired saturation.
4. The final product is the enfleurage pomade: the fat and the fragrant oil. This is washed with alcohol to separate the botanical extract from the remaining fat, which is used to make soap. When the alcohol evaporates from this mixture, the “absolute” is what is left over.

## HOT ENFLEURAGE

1. The only difference in this process is that the fats are heated.

## VI. COLD-PRESS EXTRACTION

This method is also called Expression or Scarification and is used for citrus peels in particular.

1. The whole fruit is placed in a device that mechanically pierces it to rupture the essential oil sacs, which are located on the underside of the rind. The essential oil and pigments run down into the device’s collection area.
2. The whole fruit is pressed to squeeze out the juice and the oil.
3. The oil and juice that are produced still contain solids from the fruits, such as the peel, and must be centrifuged to filter the solids from the liquids.
4. The oil separates from the juice layer and is siphoned off into another receptacle.

## VII. WATER DISTILLATION

Delicate flowers such as roses and orange blossoms would clump together when introduced to steam in the distillation process, so the most effective method of extraction in this situation is to submerge fragile plant material in pure boiling water instead. The water protects the extracted oil from overheating. The condensed liquids cool down and separate from each other. The remaining water, which can sometimes be fragrant, is referred to by several names including *hydrolate*, *hydrosol*, *herbal water*, *essential water*, *floral water*, or *herbal distillate*.