

VOLATILE OIL

Aromatic plant: It is a common term used to refer spices, condiments, perfumes and flavor yielding plants. These plants are used as spices or in perfumery because they all produce characteristic flavours and odour due to the presence of component known as essential oils or volatile oils.

Volatile oils are odorous principle in the various plant parts, because they evaporate when exposed to air at ordinary temperature. So they are called volatile or ethereal oils, or essential oils. This is called as essential because volatile oils represents the 'essences' or odouriferous constituents of the plants and also they represent the active constituents.

Volatile oils are colorless particularly when they are fresh but on standing they may oxidize and resinify, thus it is darkening. They should be stored in a cool place in lightly stoppered, preferable full amber glass containers.

Occurrence:

Depending upon the plant family, volatile oils it may occur in specialized secretory structures such as glandular hairs, modified parenchyma cells, oil-tubes which is called as vittae or in lysigenous or schizogenous cavity.

Volatile oils may act as repellent to insects, thus preventing the destruction of the flower and leaves and they may serve as insect attractant, thus help in cross fertilization of the flowers.

Chemical constituents of volatile oils may be divided into two broad classes which is based on their biosynthetic origin i.e.,

- a) Terpene derivatives which formed via the acetate mevalonic acid pathway and
- b) Aromatic compounds which is formed via the shikimic acid phenyl propanoid rout.

Physical characters:

- Volatile oil possess characteristic odor.
- Volatile has high refractive index
- They are optically active.
- Volatile oils are soluble in ether, alcohol, chloroform and acetone.

Volatile oils are lighter than water i.e. , their specific gravity is less than one except clove oil which is heavier than water.

Chemical characters:

- Volatile oils are the compounds of carbon and hydrogen and most of them contains oxygen.
- The constituents of essential oil which is based on carbon and hydrogen atoms are described as hydrocarbons or known as terpenes.
- The constituents containing oxygen are grouped as the alcohol, aldehydes, ketones, lactones, acids and esters.
- Chemically they are derived from terpenes and their oxygenated products/compounds. they are made up of isoprene unit and are usually mixture of terpenes / monoterpenes, sesquiterpenes or diterpenes and their derivatives. The oxygenated constituents are responsible for its odour and taste.

Medicinal and commercial uses:

- There are about 35 species and about 50 other aromatic plants in common use throughout the world. Spices like cardamom, cassia, cinnamom, cloves, ginger, nutmeg, pepper constitute about 90 % of the world trade.
- The volatile oils are not only used in perfumery and cosmetics but also are important ingredients for the manufacturer of soaps, toiletries, deodorizers, as masking agent in cleaning mixture, polishes and insecticides.
- For therapeutic purposes they administered as inhalation, orally as gargles and mouth washes and transdermally.
- Those oils with high phenol content i.e., clove and thyme, have antiseptic properties and are used as carminatives.
- Oils showing antispasmodic activity and used in popular medicines.
- The constituents of many volatile oils are interfered with respiration and electron transport in a variety of bacteria, hence they are used in food preservation and in cosmetic preparation.

GENERAL METHODS OF PREPARATION

Volatile or essential oils are volatile constituents which are found in ducts, cavities, or glandular hairs of the plant. The most common method which is used for production of volatile oil is by distillation. The distillation is a vaporization process in which the vapors evolved are recovered by condensation. There are mainly four type of distillation techniques for isolation of essential oils from plant material.

- a) Water distillation (Hydrodistillation)

- b) Water and steam distillation
- c) Direct steam distillation

Water distillation (Hydrodistillation): In water distillation the material is completely immersed in water and is boiled by applying heat either by direct heat or steam jacket. The plant material and boiling water is in direct contact in this method. It is called hydro-distillation. During hydro-distillation plant material must be kept in motion by boiling water.

Advantages:

- Hydro-distillation is used only in case where the plant material cannot be processed by water and steam distillation or by direct steam distillation.

Disadvantages:

- The complete isolation of oil is not possible.
- Certain esters are partly hydrolysed and sensitive substances like aldehyde tend to polymerise.

Water and steam distillation: in this method the plant material is lodge or kept on a perforated grid or screen which is inserted above the bottom of still. The still is filled with water upto sufficient level and the water is heated. The saturated low pressure steam rises through the plant material. The plant materials comes in contact with steam only and not with boiling water.

Advantages:

- The decomposition of the oil is less. It requires less fuel, less time and the yield of volatile oil is more.

Disadvantages:

- The large quantities of steam is required for complete vaporization of high boiling essential oils and hence more time may be required for distillation.

Direct steam distillation: In this method the material is supported on a grid and saturated steam is injected by open or perforated coils which is placed below the grid. The oil vapors and steams are passed through the condenser where they are converted in to liquid which are collected in the receiver from which oil and water are mechanically separated and water returns to the still.

Advantages:

- Simple apparatus

- Economical
- It produces the best yield and purest oil.
- The large quantities of volatile oil is produced without much human labour.

Disadvantages:

- The high temperature of steam destroy the unstable perfumes components.
- Since high pressure steam causes considerable decomposition, distillation is started with steam of pressure followed by steam of high pressure towards the end of operation.

The fragrant parts of plant mainly the flowers are not suited for steam distillation. In order to prepare the odoriferous substances from such materials other methods are employed.

Volatile oil in such cases may be extracted either with volatile solvents or with fat or the material is allowed to be absorbed by fat. The methods can be divided into two types.

- a) Extraction with volatile solvents
- b) Extraction with non-volatile solvents i.e., fat
 - i) Without aid of heat (Enfleurage)
 - ii) With the aid of heat (Maceration)

Extraction with volatile solvents: Solvent ether, other solvents like petroleum ether, chloroform, carbon disulfide, wood alcohol and the low boiling fraction of benzene can be used for extraction. Extraction with volatile solvents is applied to rose, parma, orange blossoms, jasmine, jonquil, lily of valley etc.

Since some of the volatile oil are sensitive to heat and hence decompose during distillation. The plant material is directly treated with light petrol at 50 °C and the solvent is then removed by distillation under pressure.

Practically the process of extraction with volatile solvents consists of four steps.

- a) Selection and purification of the solvents
 - b) Evaporation of solvent and production of vegetable wax which is saturated with perfumes.
 - c) Recovery of the solvent
- The floral extracts which are obtained after the removal of the solvent are called as concretes oils or essences concretes.

- Plant wax is removed from the concrete oils by treatment with ethyl alcohol in shaking machine. Then the content is cooled to 0 °C for congealing wax and then it is filtered.
- The traces of alcohol are removed with the help of vacuum.

Extraction with Non-volatile solvent i.e., fat without aid of heat (Enfleurage):

- Extraction with nonvolatile solvent without aid of heat is known as enfleurage or absorption.
- It is applied to those flowers which continue to produce volatile oils even after they have been removed from the stem.
- The process is carried out in relatively primitive manner and it depends upon the capacity of the fatty oil to absorb and hold the volatile oil from the flowers.
- In enfleurage, the wooden frames at 5 m high and 50-80 square cm are made which is called as chassis.
- A glass plate is supported / kept in the middle of the frame.
- Then a layer of fat about 3 mm in thickness is spread on either sides of the glass plate.
- The flowers are spread over the layer of fat.
- Cross furrows are drawn through out the fat layer to enlarge the fatty surface which is exposed to the flowers.
- About 35 to 50 of such chassis are prepared and piled / placed over one another to the height of a man.
- The flowers which is enclosed in between two layers of fat release their aromatic components to fat.
- The length of exposure depends on the flowers such as for jasmine (24 hrs), jonquil (48 hrs), and for tuberose (72 hrs).
- After requisite time the flowers are removed by a rap on the frame or with the aid of the fingers.
- The process is termed as defleurer.
- The process can be repeated as often as desired until the fat has absorbed a sufficient amount of oil.
- The product obtained by enfleurage is known as 'pomad' or 'pomade francaise'.
- The fat contain 40 parts of beef fat and 60 parts of lard (abdomen of pig).
- Paraffin is also sometimes employed in enfleurage but it has much lower absorption capacity.
- The pomade is extracted with strong alcohol and last traces of fat are removed by freezing.

Extraction with nonvolatile solvents with the aid of heat: Extraction with nonvolatile solvents with the aid of heat is called as infusion or maceration.

- Here, purified animals and vegetable fats such as beef fat, lard, olive oil, or paraffin oil can be used.
- The flowers which is to be extracted are first immersed in the fat and then heated to about 50 to 70 °C for about 24 to 48 hours and depending upon the plant materials.
- The fat is then expressed from the flower by using hydraulic press or centrifuges.
- The fat which is partly aromatized can be treated with fresh materials until the fat acquires desired strength as to occur.
- These floral extracts are also known as pomades and are treated with alcohol for separation of volatile oil.
- This process is used for separation of oil from roes, oranges blossoms, lilies of the valley and violets.

Supercritical / carbon dioxide extraction:

Carbon dioxide which is a gas at ordinary condition can be liquefied below 31.3 °C, at pressure above 73 atmospheres and also can be maintained 73 atmospheres pressure and by keeping the temperature above 31.3 °C. both liquid and supercritical carbon dioxide are good solvent extraction of volatile oil.

Advantages:

- Carbon dioxide extracts all the desirable components due to its strong solvating power and low viscosity.
- Carbon dioxide penetrates and extracts components up to a molecular weight of 400 at 10 °C.
- It is having great significance for making the terpeneless oils.