

4.4. VOLATILE OILS

4.4.1. Introduction

Volatile oils are obtained from various plant parts. They are basically the mixture of hydrocarbon terpenes, sesquiterpenes, and polyterpenes and their oxygenated derivatives.

Volatile oils carry the plant's active constituents and hence are also called **essential oils**. Mostly the volatile oils are already present in special secretory tissues in the plant, e.g., the oil ducts in umbelliferous fruits, the oil cells or oil glands present in sub-epidermal tissue in lemon and orange, mesophyll in eucalyptus leaves, trichomes in some plants, etc.

When volatile oils are not already present in the plant, they are formed by glycoside decomposition. For example, whole black mustard seeds are although odourless, but when crushed and added water a strong odour is produced.

Volatile or **ethereal oils** are defined as, "odorous volatile principles of plant and animal origin which evaporate when exposed to air at ordinary temperature".

4.4.2. Occurrence and Distribution

Aromatic plants contain essential oils. These plants occur in over 60 families, including **Lauraceae, Myrtaceae, Umbelliferae, Labiatae, and Compositae**. The oil present in them ranges from a very small amount to as much as 1-2%.

Various specialised secretory structures present within the plants and generate volatile constituents are given in the **table 4.6**:

Table 4.6: Specialised Secretory Structures in Plants and their Biological Sources and Families

Specialised Secretory Structures	Biological Sources	Families
Glandular hairs	<i>Lavandula angustifolia</i> (lavender oil)	Lamiaceae
Oil tubes (or vittae)	<i>Foeniculum vulgare</i> (fennel) <i>Pimpinella anisum</i> (aniseed)	Apiaceae
Modified parenchymal cells	<i>Piper nigrum</i> (black pepper)	Piperaceae
Schizogenous/lysigenous passages	<i>Pinus palustris</i> (pine oil) and <i>Citrus limon</i> (lemon oil)	Rutaceae

Volatile oils can be formed by two methods, i.e., by hydrolysis of some glycosides, and directly by the protoplasm. Different volatile oil containing plant parts, their biological sources are given in **table 4.7**.

Table 4.7: Plant Organs, their Biological Sources and Families

Plant Organs	Biological Sources	Families
Petals (rose oil)	<i>Rosa gallica</i> , <i>R. alba</i> , <i>R. damascena</i> , and <i>R. centifolia</i>	Rosaceae
Flowering tops (lavender oil)	<i>Lavandula angustifolia</i>	Lamiaceae
Leaves (citronella oil)	<i>Cymbopogon winterianus</i> and <i>C. nardus</i> .	Poaceae
Bark (cinnamon oil)	<i>Cinnamomum camphora</i>	Lauraceae
Fruit (caraway oil)	<i>Carum carvi</i>	Apiaceae
Wood (pine oil)	<i>Pinus palustris</i>	Pinaceae
Buds (clove oil and chamomile oil)	<i>Syzygium aromaticum</i> and <i>Matricaria chamomilla</i>	Compositae
Rhizomes (ginger oil and calamus oil)	<i>Zingiber officinale</i> and <i>Acorus calamus</i> .	Zingiberaceae Araceae
Seeds (grains of paradise and cardamon)	<i>Aframomum melegueta</i> and <i>Elletaria cardamomum</i>	Zingiberaceae

4.4.3. Isolation

The amount of volatile oils present in plants reaches its maximum at some particular time, e.g., jasmine has the greatest concentration of volatile oil at sunset, thus the plant parts containing volatile oils should be collected at this particular time. The following **four methods** are available for the isolation of volatile oils:

- 1) **Extraction by Steam Distillation:** In this commonly used method, the plant parts are macerated followed by steam distillation when the volatile oil goes into distillate from which it is extracted using a pure organic volatile solvent (light petroleum). This method should be used carefully, as some volatile oils decompose during distillation leading to ester hydrolysis into none or less fragrant compounds.
- 2) **Extraction by Scarification:** This method is used for obtaining lemon oil, orange oil, and bergamot oil. These oils are present in large oil glands found beneath the surface in the peel of the fruit. Scarification can be carried out by the following **two methods**:
 - i) **Sponge Process:** In this process, longitudinal or transverse cuts are made on the fruits to remove its contents. The peel is immersed in water for a short duration to make it soft for expression. The one performing the extraction process takes a sponge in one hand and presses the softened peel against the sponge with the other hand. This causes the oil glands to burst open and release the volatile oils. This oil is absorbed by the sponge and transferred to a collecting vessel. The turbid liquid containing oil and water is left undisturbed for some time, so that the oil and water separates out and the oil can be collected. This entire process is carried out in a cool, dark room to protect the oil from the harmful effects of heat and light.
 - ii) **Ecuelle Process:** In this process, the oil is collected by rupturing the fruit rinds using a device having numerous pointed projections with a rotary movement.
- 3) **Extraction by Non-Volatile Solvents:** This process utilises a non-volatile solvent (e.g., a fine quality of either lard or olive oil). The lard or olive oil saturated with the floral oil is sometimes used as a flavouring base for preparing pomades, brilliantine, etc. The lard or olive oil is sometimes converted to a triple extract by agitating with two or three successive portions of alcohol to dissolve the odorous substances. The mixed alcoholic solutions obtained constitute the commercial triple extract.

Extraction using non-volatile solvents can be carried out by the following **three methods**:

- i) **Enfleurage:** In this method, a fatty layer is prepared using lard. The flower petals are spread over the fatty layer and allowed to imbibe. After imbibition, the fatty layer is replaced with fresh petals. After the fatty layer gets saturated, the odorous principles are removed by treating with alcohol and a triple extract is prepared. When oil is used as a solvent, the flowers are placed on an oil-soaked cloth supported by a metal grid enclosed in a frame. Fresh flowers are added as per the requirement, and the oil is expressed from the cloths. The obtained oil can be used as a perfumed oil or extracted with alcohol to convert into a triple extract.
 - ii) **Maceration:** This method is also used for extracting volatile matters of flowers. In this method, the lard or oil is heated on a water bath, followed by addition of flowers and continuous stirring of the mixture. The exhausted flowers are removed, pressed, and the expressed liquid is returned to the hot fat. To this fresh flowers are added and the process is continued till defined weights of flowers and solvent have been used. A triple extract can be prepared by extracting the perfumed lard or oil with alcohol.
 - iii) **Spraying:** In this method, a warm air current is sprayed through a column of flowers. This oil-laden air is sprayed with oil or melted fat. The layer absorbs and dissolves most of the perfume. Then the oil or fat is collected and extracted with alcohol as above.
- 4) **Extraction by Volatile Solvents:** The thermolabile volatile oils decompose during distillation. Thus, the plant material is directly treated with light petrol at 50°C temperature and distilled under reduced pressure to remove the solvent.

4.4.4. Identification Test

Natural drugs with volatile oils are chemically tested as follows:

- 1) A thin section of drug is treated with an alcoholic solution of Sudan III. A red colour appears that confirms the presence of volatile oils.
- 2) A thin section of drug is treated with a tincture of alkane. A red colour appears that confirms the presence of volatile oils.

4.4.5. Therapeutic Effects

As volatile oil molecules enter the body, they correlate with physiological functions through the following three modes of action:

- 1) **Biochemical (Pharmacological):** They chemically interact in the bloodstream with hormones and enzymes (like farnesene).
- 2) **Physiological:** They interact by participating in specific physiological function; **for example**, the volatile oil present in fennel contains oestrogen-like compounds which prevent female problems (like lactation and menstruation).
- 3) **Psychological:** On inhaling the volatile oil molecules, the olfactory area of the brain (limbic system) gets triggered and releases chemical and neurotransmitter messengers. These cause mental and emotional behavioural changes. Lavender and lemon oils are associated with sedative and relaxant properties.

4.4.6. Pharmaceutical Applications

Volatile oils are employed as flavouring agent, perfuming agent in pharmaceutical products, foods, beverages, and in cosmetics. They serve as medicinal agents for therapeutic effects like:

- 1) Carminative (e.g., umbelliferous fruits),

- 2) Anthelmintic (e.g., chenopodium oil),
- 3) Diuretics (e.g., juniper),
- 4) Antiseptic (e.g., eucalyptus),
- 5) Counter irritant (e.g., oil of winter green),
- 6) Local anaesthetic (e.g., clove),
- 7) Sedative (e.g., jatamansi),
- 8) Local irritant (e.g., turpentine),
- 9) Insect repellent (e.g., citronella), and
- 10) Source of vitamin A (e.g., lemongrass).

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