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PHARMACOGNOSY AND PHYTOCHEMISTRY - II

UNIT 2

TOPIC :

- **Volatile oils :** Mentha, Clove, Cinnamon, Fennel, Coriander,



Volatile Oils (Essential Oils)

- Volatile oils, also known as essential oils, are odoriferous (fragrant), volatile, and aromatic liquids obtained from various parts of plants such as leaves, flowers, fruits, bark, or roots.
- They evaporate readily on exposure to air at room temperature and possess the characteristic aroma of the plant from which they are obtained.

General Characteristics

- Volatile in nature – evaporate when exposed to air.
- Insoluble in water but soluble in alcohol, ether, and organic solvents.
- Lighter than water, though a few are heavier (e.g., oil of clove).
- Possess a strong characteristic odor and taste.
- Do not leave a greasy stain on paper (unlike fixed oils).

Classification

A. Based on Chemical Nature

1. Hydrocarbon oils – Limonene (Orange oil), Pinene (Turpentine oil)
2. Alcoholic oils – Menthol (Peppermint oil), Geraniol (Rose oil)
3. Aldehydic oils – Cinnamaldehyde (Cinnamon oil), Citral (Lemon oil)
4. Ketonc oils – Menthone (Peppermint oil), Camphor (Camphor oil)
5. Phenolic oils – Thymol (Thyme oil), Eugenol (Clove oil)
6. Ester oils – Methyl salicylate (Wintergreen oil)

B. Based on Plant Part Used

- Leaf oils → Eucalyptus, Mentha
- Flower oils → Rose, Jasmine
- Fruit oils → Lemon, Orange
- Bark oils → Cinnamon
- Root oils → Ginger, Vetiver

Uses and Applications

- Medicinal uses:
 - Carminative, antiseptic, expectorant, analgesic, antispasmodic.
- Pharmaceutical uses:
 - Used as flavoring and perfuming agents in formulations.
- Cosmetic uses:

- Used in perfumes, soaps, lotions, and creams.

Mentha

- Common Name: Mint, Peppermint
- Biological Source: *Mentha piperita* and *Mentha arvensis*, *Mentha spicata*
- Family: Lamiaceae (Labiatae)
- Part Used: Leaves and flowering tops
- Geographical Source:



- Widely cultivated in India, Japan, USA, UK, and Europe.
- In India, mainly grown in Uttar Pradesh, Punjab, and Haryana.

Mentha is an aromatic, perennial herb with square stems, opposite leaves, and purple or pink flowers. The plant has a strong, pleasant, cooling odour due to volatile oils.

Composition

Constituent	Percentage / Function
Volatile oil (Mentha oil)	1–3%
→ Menthol	30–55% (main active constituent)
→ Menthone	10–30%
→ Menthofuran, Cineole, Limonene	Trace amounts
Tannins, Flavonoids, and Bitter principles	Minor constituents

Chemistry & Chemical Classes

- Chemical Class: Volatile oils (Monoterpenes)
- Main Active Compound: Menthol ($C_{10}H_{20}O$)
- Other Compounds: Menthone, Isomenthone, Menthofuran, Cineole
- Chemical Nature:
 - Menthol: A cyclic alcohol
 - Menthone: A ketone derivative
 - Both belong to the terpenoid (isoprenoid) group

Compound	Chemical Class	Effect
Menthol	Alcohol	Cooling, mild anesthetic
Menthone	Ketone	Fragrant, flavouring agent

Cineole	Ether	Expectorant
Limonene	Hydrocarbon	Fragrance component

Biosources

- Botanical Source: *Mentha piperita*, *Mentha arvensis*, *Mentha spicata*
- Family: Lamiaceae
- Part Used: Leaves and flowering tops
- Cultivation:
 - Grown in cool, moist climates.
 - Prefers light, well-drained soils.
 - Harvested just before flowering when the oil content is maximum.
- Extraction:
 - Steam distillation of fresh or partially dried leaves → gives Mentha oil.
 - Oil is then cooled to crystallize menthol.

Therapeutic Uses

Mentha and its oil are used in medicine, cosmetics, and food industry.

Therapeutic Use	Description
1. Carminative	Relieves gas and stomach discomfort.
2. Antispasmodic	Relaxes smooth muscles of GIT.
3. Antiseptic and Analgesic	Menthol gives a cooling and pain-relieving effect on skin and mucous membranes.
4. Expectorant	Helps in cough and cold preparations.
5. Flavoring Agent	Used to improve the taste of medicines and toothpastes.
6. Local Anaesthetic	Cooling effect in topical creams and throat lozenges.

Pharmacological Actions

- Produces cooling sensation (activates cold receptors).
- Mild antiseptic and analgesic.
- Improves digestion and relieves nausea.

Commercial Applications

- Pharmaceutical Uses:
 - Used in toothpastes, mouthwashes, cough syrups, lozenges, and balms.
 - Menthol crystals used in ointments and nasal inhalers.

- Food Industry:
 - Used as flavouring in candies, chewing gums, and beverages.

Clove

- Common Name: Clove
- Biological Source: Dried flower buds of *Syzygium aromaticum*
- Family: Myrtaceae
- Part Used: Dried flower buds
- Geographical Source:
 - Native to Indonesia (Moluccas Islands)
 - Cultivated in India (Kerala, Tamil Nadu, Karnataka), Zanzibar, Sri Lanka, and Madagascar



→ Clove is a small, evergreen tree about 10–12 meters tall. The buds are collected just before they open, then dried until they turn dark brown. They have a strong, spicy aroma and pungent taste due to the presence of volatile oil (clove oil).

Composition

Constituent	Percentage / Role
Volatile Oil (Clove oil)	15–20%
→ Eugenol	70–90% (main active compound)
→ Eugenyl acetate	10–15%
→ β -Caryophyllene	Minor
Tannins	10–15% (astringent)
Resins, Mucilage, and Fixed oil	Trace amounts

Chemistry & Chemical Classes

- Chemical Class: Volatile oils (Phenylpropanoids)
- Main Chemical Constituents:
 - Eugenol ($C_{10}H_{12}O_2$): A phenolic compound responsible for clove's antiseptic and analgesic properties.
 - Eugenyl acetate: Ester form of eugenol.

Compound	Chemical Nature	Action
Eugenol	Phenolic compound	Analgesic, antiseptic, local anesthetic

Eugenyl acetate	Ester	Fragrance, flavour
β -Caryophyllene	Sesquiterpene	Aromatic, anti-inflammatory

Biosources

- Botanical Source: Dried flower buds of *Syzygium aromaticum*
- Family: Myrtaceae
- Cultivation:
 - Grown in tropical climates with rich, loamy soil and heavy rainfall.
 - Clove trees start producing buds after 7–8 years.
- Collection:
 - Buds are collected when they change color from green to pink, but before they open.
 - Then sun-dried or smoke-dried until brown.
- Extraction:
 - Steam distillation of buds gives clove oil.

Therapeutic Uses

Clove and clove oil have important medicinal and pharmaceutical applications.

Therapeutic Use	Explanation
1. Analgesic and Local Anesthetic	Eugenol provides pain relief, especially in toothache.
2. Antiseptic / Antimicrobial	Effective against bacteria and fungi.
3. Carminative and Stimulant	Used to relieve flatulence and improve digestion.
4. Antispasmodic	Relaxes smooth muscles of the gastrointestinal tract.
5. Dental Applications	Used in tooth powders, mouthwashes, and dental fillings (Zinc eugenolate cement).
6. Antioxidant	Protects against oxidative stress in herbal preparations.

Pharmacological Actions

- Antiseptic

- Analgesic
- Carminative
- Anti-inflammatory

Mechanism of Action

- Eugenol acts on sensory nerve endings to block pain sensation — giving a local anesthetic effect.
- It also denatures bacterial proteins, causing antiseptic action.
- In the GIT, it stimulates enzyme secretion and reduces gas formation.

Commercial Applications

Application Area	Examples / Details
Pharmaceuticals	Used in dental creams, toothache drops, mouthwashes, antiseptic creams
Dental Uses	Eugenol forms Zinc eugenolate cement for temporary fillings
Flavoring Agent	Used in toothpaste, syrups, and mouth fresheners
Food Industry	Spice and flavouring in bakery, sauces, and beverages
Perfumery and Cosmetics	Used in soaps, perfumes, and cosmetics due to its pleasant aroma
Insect Repellent	Clove oil repels mosquitoes and insects

Cinnamon

- Common Name: Cinnamon
 - Biological Source: Dried inner bark of *Cinnamomum zeylanicum* (also called *Cinnamomum verum*)
 - Family: Lauraceae
 - Part Used: Dried inner bark
 - Geographical Source:
 - Native to Sri Lanka (Ceylon) and South India
 - Also cultivated in China, Indonesia, Vietnam, and Madagascar
- Cinnamon is the dried inner bark of a small evergreen tree. The bark is thin, smooth, and has a pleasant, sweet aroma and warm, spicy taste. It is rolled into quills (sticks) when dried.



Composition

Constituent	Percentage / Function
Volatile Oil (Cinnamon oil)	0.5 – 2.0%
→ Cinnamaldehyde	60 – 75% (main active compound)
→ Eugenol	5 – 10%
Tannins	8 – 10% (astringent)
Mucilage & Sugars	Minor constituents
Calcium Oxalate Crystals	Structural component

Chemistry & Chemical Classes

- Chemical Class: Volatile oil (Aromatic aldehyde)
- Major Constituents:
 - Cinnamaldehyde (C_9H_8O): Gives cinnamon its odor and taste; acts as an antimicrobial and carminative.
 - Eugenol ($C_{10}H_{12}O_2$): Phenolic compound with antiseptic and flavouring properties.

Compound	Chemical Nature	Pharmacological Action
Cinnamaldehyde	Aromatic aldehyde	Carminative, stimulant, antiseptic
Eugenol	Phenol	Analgesic, flavouring agent

Biosources

- Botanical Source: *Cinnamomum zeylanicum* (True Cinnamon)
- Family: Lauraceae
- Part Used: Inner bark
- Cultivation:
 - Prefers tropical climate with rich, well-drained soil.
 - Grown in Sri Lanka, South India (Kerala, Tamil Nadu), and Indonesia.
- Collection:
 - Bark is peeled from young shoots after removing the outer corky layer.
 - The inner bark rolls naturally into quills upon drying.
- Extraction:
 - Steam distillation of bark and leaves → Cinnamon oil (essential oil).

Therapeutic Uses

Cinnamon has been used since ancient times as a spice, flavoring, and medicine.

Therapeutic Use	Explanation
1. Carminative & Stomachic	Relieves flatulence, nausea, and improves digestion.
2. Antiseptic & Antimicrobial	Used in mouthwashes, tooth powders, and topical antiseptics.
3. Astringent	Useful in mild diarrhea and sore throat.
4. Flavoring Agent	Added to syrups, teas, and oral medicines.
5. Antioxidant	Helps in reducing oxidative stress.
6. Hypoglycemic	Shown to lower blood sugar levels (in small doses).

Pharmacological Actions:

- Carminative (relieves gas)
- Stimulant
- Antiseptic
- Antioxidant
- Antidiabetic (mild)

Mechanism of Action

- Cinnamaldehyde stimulates the secretion of digestive enzymes → improves digestion.
- It also destroys microorganisms by disrupting bacterial cell walls.
- Has anti-inflammatory and antioxidant effects by inhibiting free radicals.

Commercial Applications

Application	Examples / Uses
Pharmaceuticals	Used in mouthwashes, cough syrups, and carminative mixtures
Food Industry	Flavoring agent in spices, bakery, confectionery, and beverages
Perfumery & Cosmetics	Used for its sweet aroma in soaps and perfumes
Dental Products	Included in toothpaste, powders, and mouth fresheners
Traditional Medicine	Used in Ayurveda and Unani for cold, cough, and digestive issues

Fennel



- Common Name: Fennel
- Botanical Name: *Foeniculum vulgare* Mill.
- Family: Apiaceae (Umbelliferae)
- Part Used: Dried ripe fruits (sometimes called seeds) and volatile oil
- Description:
 - Fennel is a biennial or perennial aromatic herb.
 - It grows up to 2 meters tall and has feathery leaves and yellow flowers arranged in umbels.
 - The fruits are small, oblong, and greenish-brown with a pleasant aromatic odor and sweet taste.
- Significance: Used as a flavoring agent, carminative, and digestive in traditional medicine and food.

Composition

- Major Active Constituents:
 - Volatile oil (1–4%) — the main component responsible for aroma and medicinal properties.
- Main Constituents of Volatile Oil:
 - Anethole – gives characteristic sweet aroma and flavor.
 - Fenchone – contributes to the bitter taste and aroma.
 - Estragole (methyl chavicol) – minor component, aromatic.
- Other Constituents:
 - Fixed oils, proteins, sugars, vitamins, and minerals.

Chemistry & Chemical Classes

- Chemical Class: Volatile (essential) oils – mainly phenylpropanoids and monoterpenes.
- Important Chemical Compounds:
 - Anethole ($C_{10}H_{12}O$) – aromatic compound, used in perfumery and medicine.
 - Fenchone ($C_{10}H_{16}O$) – bicyclic monoterpene ketone.
 - Estragole ($C_{10}H_{12}O$) – similar to anethole but slightly more pungent.
- Properties:

- Volatile oils are colorless to pale yellow liquids with a sweet, aromatic smell.
- Soluble in alcohol and organic solvents.

Biosources

- Biological Source: Dried ripe fruits of *Foeniculum vulgare*.
- Cultivation:
 - Widely cultivated in India, Egypt, China, and Mediterranean countries.
 - Prefers sunny climate and well-drained soil.
- Collection: Fruits are collected when ripe, dried, and sometimes distilled for oil extraction.

Therapeutic Uses

- Digestive Aid: Stimulates appetite, relieves bloating and gas (carminative).
- Antispasmodic: Relaxes smooth muscles of intestines and uterus.
- Expectorant: Helps in cough and cold by loosening mucus.
- Galactagogue: Enhances milk secretion in nursing mothers.
- Antimicrobial: Mild antibacterial and antifungal effects.
- Aromatic and Flavoring Agent: Improves taste and odor of medicines.

Commercial Applications

- Pharmaceutical Use:
 - Used in carminative mixtures, gripe water, and digestive tonics.
 - Fennel oil used in cough syrups and lozenges.
- Food Industry:
 - Used as a flavoring agent in bakery items, confectionery, liqueurs, and pickles.
 - Commonly chewed after meals as a mouth freshener.
- Cosmetic Use:
 - Used in perfumes and soaps due to its sweet fragrance.
- Other Uses:
 - Fennel essential oil used in aromatherapy.

Coriander



- Common Name: Coriander, Dhania
- Botanical Name: *Coriandrum sativum* L.
- Family: Apiaceae (Umbelliferae)
- Part Used: Dried ripe fruits (commonly called seeds) and volatile oil
- Description:
 - Coriander is an annual aromatic herb growing up to 1 meter in height.
 - It has delicate, divided leaves and small white flowers in compound umbels.
 - The fruits are small, round, yellowish-brown, and aromatic.
- Significance:
 - Used as a culinary spice, flavoring agent, and traditional medicine for digestive problems.

Composition

- Major Active Constituents:
 - Volatile oil (0.1–1%) – main active component.
- Main Constituents of Volatile Oil:
 - Linalool ($C_{10}H_{18}O$) – gives the pleasant aroma and flavor.
 - Geraniol – contributes to fragrance.
 - Camphor and borneol – minor constituents.
- Other Constituents:
 - Fixed oil (up to 20%), proteins, carbohydrates, and minerals.

Chemistry & Chemical Classes

- Chemical Class: Volatile (essential) oils – mainly monoterpenes and alcohols.
- Important Chemical Compounds:
 - Linalool ($C_{10}H_{18}O$) – main constituent, aromatic alcohol.
 - Geraniol, α -pinene, limonene, camphor – minor monoterpenes.
- Properties:
 - The volatile oil is colorless to pale yellow with a sweet, spicy odor.
 - Soluble in alcohol and organic solvents; sparingly soluble in water.

Biosources

- Biological Source: Dried ripe fruits of *Coriandrum sativum* L.
- Cultivation:
 - Grown widely in India, Russia, Morocco, and Mediterranean regions.
 - Requires cool climate and well-drained loamy soil.
- Collection:
 - Fruits are harvested when fully ripe, dried, and sometimes distilled to obtain coriander oil.

Therapeutic Uses

- Carminative: Relieves gas, bloating, and indigestion.
- Stomachic: Improves appetite and digestion.
- Antispasmodic: Reduces intestinal spasms.
- Antimicrobial: Mild antibacterial and antifungal activity.
- Anti-inflammatory and Antioxidant: Due to linalool content.
- Flavoring Agent: Used to mask unpleasant taste in medicines.

Commercial Applications

- Pharmaceutical Uses:
 - Used in digestive tonics, carminative mixtures, gripe water, and cough syrups.
 - Volatile oil used in aromatic preparations and liniments.
- Food Industry:
 - Common spice in curries, pickles, and sauces.
 - Coriander oil and seed powder used as flavoring agents.
- Cosmetic Uses:
 - Oil used in perfumes, soaps, and lotions due to its pleasant fragrance.
- Other Uses:
 - Seeds used as condiment and mouth freshener.