

Volatile Oils

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Outline

- Definition and classification
- Chemical composition
- Uses
- Extraction methods
- Examples of drug containing volatile oils

Learning objectives

- After completing this unit you will be able to:
 - ✓ Define and classify volatile oils
 - ✓ Summarize biosynthesis and constituents of volatile oils
 - ✓ Discuss volatile oils extraction methods
 - ✓ Describe crude drug containing volatile oils

Definition

- **Volatile oils are:**
 - ✓ odorous volatile principles of plant and animal source, evaporate when exposed to air at ordinary temperature
 - ✓ the concentrated extracts of volatile, non-water-soluble aroma compounds from plants.
 - ✓ are also called **essential oil** or **ethereal oil**
 - ✓ In most instances volatile oil **preexists** in the plant contained in special secretory tissues, oil ducts, oil cells, or oil glands .

Cont...

- ❑ In few cases they **didn't preexist**, but formed by the decomposition of a glycoside.
- ❖ For example, whole black mustard seeds are odourless,
 - crushing the seeds and adding water to it gives a strong odour
 - due to formation of **allyl isothiocyanate** by decomposition of Sinigrin by an enzyme myrosin.

Properties

- Soluble in alcohol and other organic solvents
- Practically insoluble in water
- Lighter than water (**clove oil** is heavier)
- Possess characteristic odour
- Have high refractive index
- Most of them are optically active
- Can dissolve fixed oils, fats, resins, camphor, and free alkaloids.
- Are highly sensitive to heat, moisture, and oxygen.

Cont...

- Colourless liquids, but when exposed to air and direct sunlight these become darker due to oxidation.
- Differ from fixed oil in various ways:
 - ✓ can be distilled from their natural source
 - ✓ are not glyceryl esters of fatty acids
 - ✓ don't leave permanent grease spot on paper
 - ✓ not saponified with alkalis.

Essential oils	Fixed oils
Secondary metabolites	Primary metabolite
Mixture of terpenes, sesquiterpenes, & their oxygenated derivatives	Mixture of fatty acids
Can evaporate at room temperature	Can't evaporate at room temperature
Obtained from leaves, roots, in petals, & bark.	Obtained from seed of plant & animal
Possess high refractive index	Possess low refractive index
These are optically active.	These are optically inactive.
No permanent stain left after evaporation	Permanent stain left after evaporation
They are unable to undergo saponification	Can be easily saponified.
do not rancid, rather they oxidize & lose their therapeutic benefit	Can go rancid (stale) over time
Colorless	Some possess colors (yellowish)
Have characteristic odor	May or may not possess odor
Low boiling point	High boiling point

Properties ...

- **Constituents**

- Hydrocarbons: exclusively made from terpenes(mono-, sesqui-, & diterpenes)
- Oxygenated compounds (esters, alcohols, aldehydes, ketones, phenoles, and oxides)

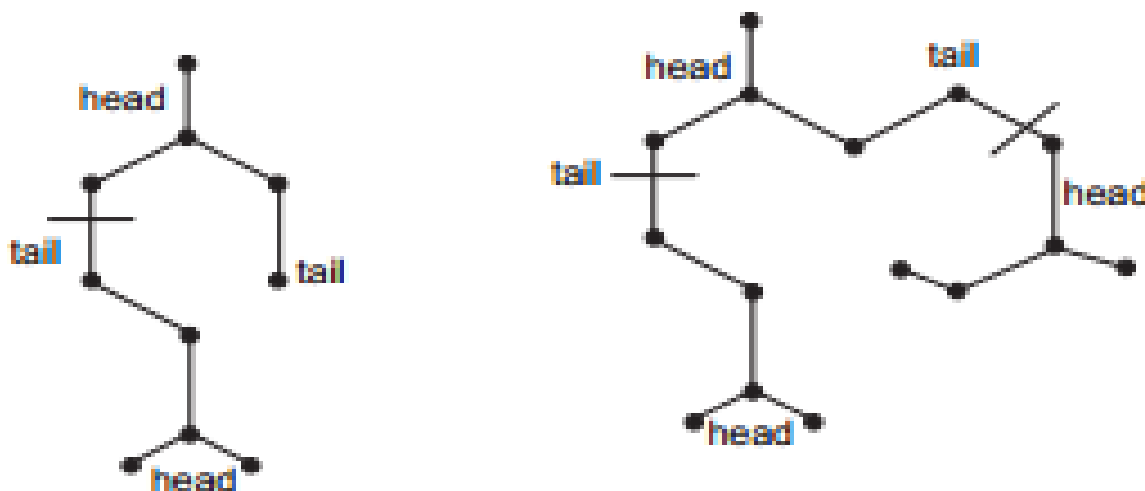
Classification

- Volatile oils are classified on the basis of functional groups present

Groups	Drugs
Hydrocarbons	Turpentine oil
Alcohols	Peppermint oil, Pudina, Sandalwood oil, etc.
Aldehydes	Cymbopogon sp., Lemongrass oil, Cinnamon, Cassia, and Saffron
Ketones	Camphor, Caraway and Dill, Jatamansi, Fennel, etc.
Phenols	Clove, Ajowan, Tulsi, etc.
Phenolic ethers	Nutmeg, Calamus, etc.
Oxides	Eucalyptus, Cardamom, and Chenopodium oil
Esters	Valerian, Rosemary oil, Garlic, Gaultheria oil, etc.

Terpenoids

- Terpenoids are plant origin hydrocarbons of the general formula $(C_5H_8)_n$ as well as their oxygenated, hydrogenated, and dehydrogenated derivatives.
- **Terpenoids are responsible for the fragrance** of plants and flowers.
- Isoprene rule states that the terpenoid molecules are constructed from two or more isoprene units joined in a 'head to tail' fashion.



Terpenoids....

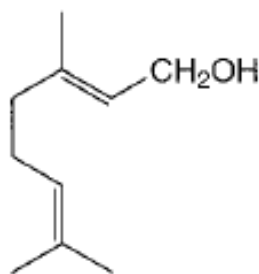
- However; carotenoids are joined tail to tail and carbon atom is not a multiple of five.

Classification of Terpenoids

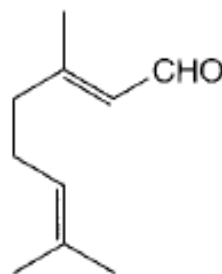
S. No	No of carbon atoms	Value of n	Class
1	10	2	Monoterpenes ($C_{10}H_{16}$)
2	15	3	Sesquiterpenoids ($C_{15}H_{24}$)
3	20	4	Triterpenoids ($C_{20}H_{32}$)
4	25	5	Sesterpenoids ($C_{25}H_{40}$)
5	30	6	Triterpenoids ($C_{30}H_{48}$)
6	40	8	Tetraterpenoids ($C_{40}H_{64}$)
7	>40	>8	Polyterpenoids ($(C_5H_8)_n$)

Chemical Composition

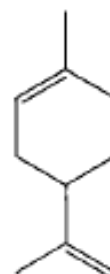
- Many of them are terpenoid in origin
- A smaller number such as those of cinnamon and clove contain principally aromatic
- A few compounds (e.g. thymol, carvacrol), although aromatic in structure, are terpenoid in origin
- Very few are glycosides (bitter almond oil and mustard oil)



Geraniol



Citral



Limonene

Storage of volatile oils

- ❖ Volatile oils are liable to oxidation on storage in presence of air, moisture, and light.
- ❖ Oxidation is followed by the change in colour, odour, and increase in viscosity.
- ❖ Hence, they must be stored
 - in well-closed and well filled containers away from light in cool places

Pharmaceutical applications

- In pharmaceutical, foods, beverages, and cosmetic industries
 - ✓ flavouring agent, perfuming agent
- **For therapeutic purposes**
 - ✓ Carminative (e.g. Umbelliferous fruits)
 - ✓ Anthelminthic (e.g. Chenopodium oil)
 - ✓ Diuretics (e.g. Juniper)
 - ✓ Antiseptic (e.g. Eucalyptus)
 - ✓ Counter irritant (e.g. Oil of winter green)
 - ✓ Local anesthetic (e.g. Clove)
 - ✓ Sedative (e.g. Jatamansi)
 - ✓ Local irritant (e.g. Turpentine)
 - ✓ Insect repellent (e.g. Citronella)
 - ✓ Source of vitamin A (e.g. Lemongrass)

Extraction methods

Distillation

- Due to the influence of hot water and steam, the essential oil is freed from the oil glands in the plant tissue
- The vapour mixture of water and oil is condensed
 - From the condenser, distillate flows into a separator, where oil separates automatically from the distillate water.

Extraction...

- Three type of distillation
 - ✓ Water distillation (hydrodistillation)
 - ✓ Water and steam distillation
 - ✓ Steam distillation

Extraction...

- **Water (hydro) distillation**
 - the material is completely immersed in water, which is boiled by applying direct heat.
 - there is direct contact between boiling water and plant material.



Rubber tube

Condenser

Clamp

Iron stand

Clevenger-apparatus

Round-bottom flask

Heating mantle

Hydro-distillation set-up

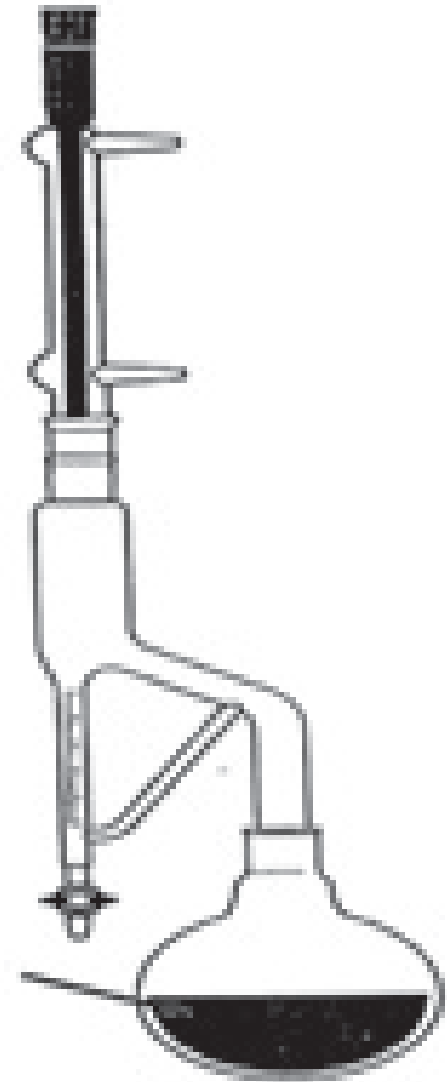
Extraction...

- **Advantages**

- inexpensive,
- easy to construct
- suitable for field operation

- **Disadvantages**

- complete extraction is not possible
- Hydrolysis
- polymerization



Extraction...

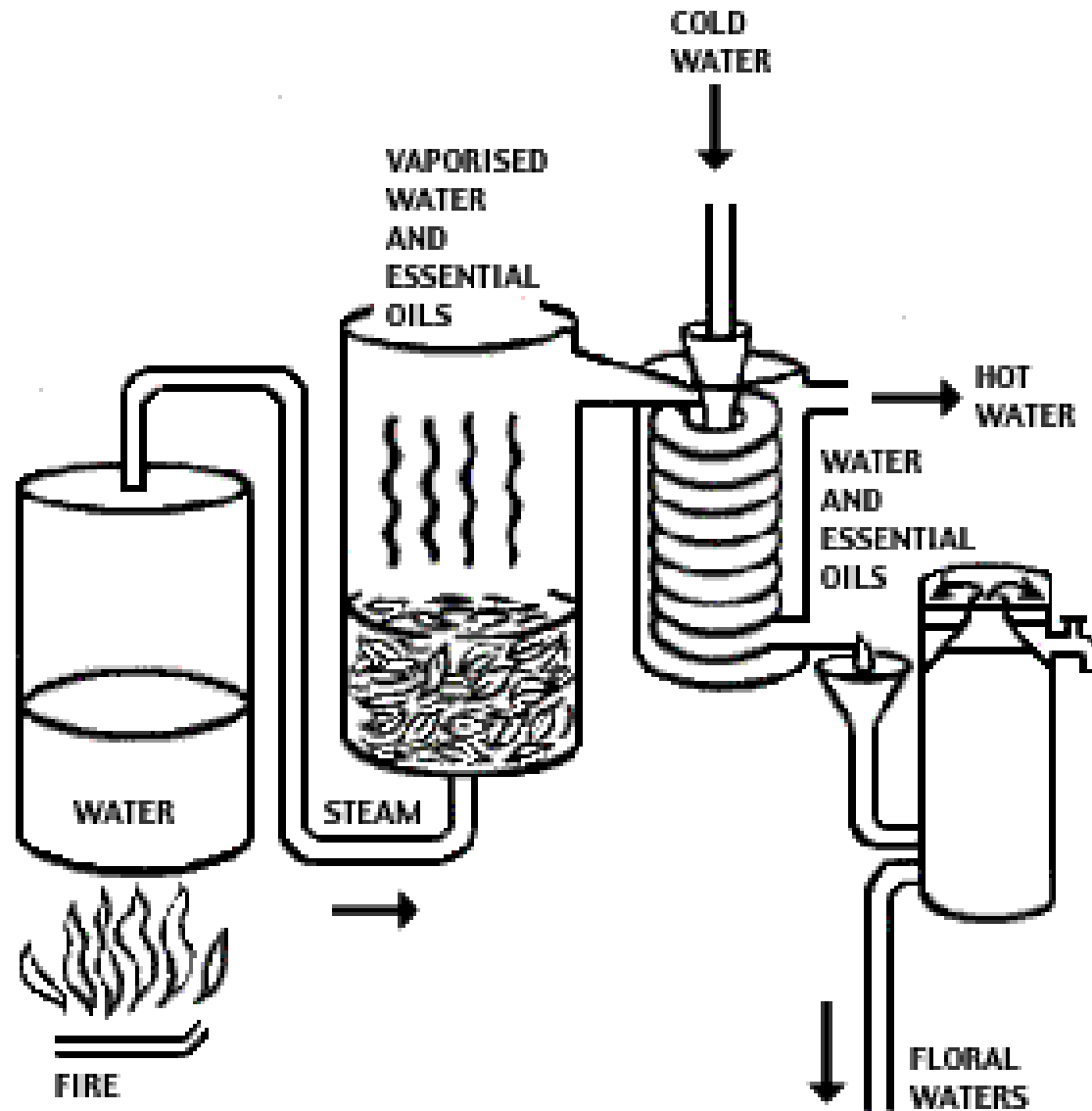
- Water and steam distillation
 - The equipment used is generally similar to that used in water distillation,
 - ✓ but the plant material is supported above the boiling water on a perforated grid.

Extraction...

- **Steam distillation**

- ✓ plant material with steam generated outside the still in a satellite.
- ✓ the plant material is supported on a perforated grid above the steam inlet
- ✓ It is the most widely accepted process for the production of essential oils on large scale.

Extraction...



Extraction...

❑ Advantages

- Amount of steam can be readily controlled
- No thermal decomposition of oil constituents.
- Most widely accepted process for large-scale oil production, superior to the other two processes.

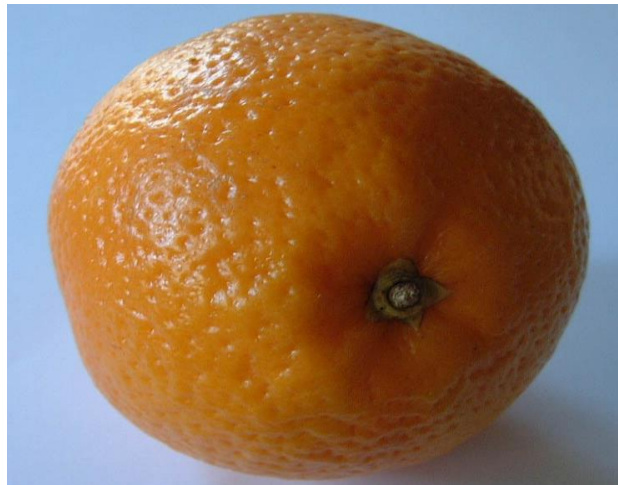
❑ Disadvantage

- Much higher capital expenditure needed

Extraction...

Expression method

- refers to any physical process in which the essential oil glands in the peel are crushed or broken to release the oil
- Used for extraction of thermolabile VO's such as lemon peel oil.
 - ✓ yields a product of superior quality (natural odour)



Extraction...

Enfleurage method

- Also called cold fat extraction
- glass plates are covered with a thin layer of fixed oil or fat up on which the fresh flowers are spread.



Extraction...

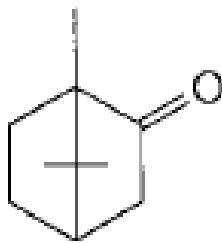
Modern Methods

- Very expensive, so
 - used in certain case
 - ✓ costly essential oils in a natural state without any alteration of their
 - ✓ thermo sensitive components or
 - ✓ the extraction of essential oils for micro-analysis
- examples
 - ✓ Solid phase micro-extraction (SPME)
 - ✓ Supercritical fluid extraction (SFE)
 - ✓ Microwave distillation

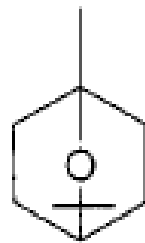
Examples of VO Containing Drugs

Camphor oil

- Obtained from the wood of *Cinnamomum camphor* (Lauraceae),
 - ✓ A tree widely grown in Taiwan, Japan and south China:
- **Constituent**
 - ✓ camphor, cineol, pinene, and diterpenes



Camphor



Cineole

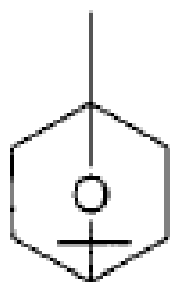
Camphor...

Uses:

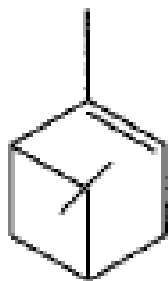
- Externally as a rubefacient
- Internally as a mild antiseptic and carminative
- It finds many non-pharmaceutical uses.

Eucalyptus oil

- distilled from the fresh leaves of various species of *Eucalyptus* (Myrtaceae)
- **Constituent**
 - ✓ cineole (Eucalyptol) (major)
 - ✓ pinene,
 - ✓ camphene



Cineole



α -Pinene



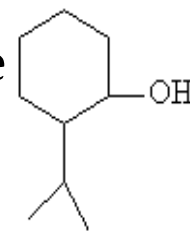
Eucalyptus oil...

Use

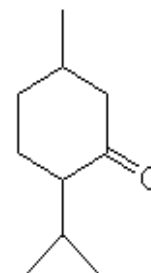
- For Alleviating The Symptoms Of Nasopharyngeal Infections,
- For Treating Coughs And As A Decongestant.
- Solution Of Eucalyptus Oil Is Used As Nasal Drops.

Peppermint oil

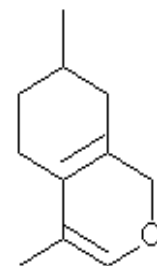
- Volatile oil obtained by steam distillation from the fresh flower tops of *menthe piperita* (lamiaceae) and other species of *mentha*
- **Constituent**
 - contains chiefly menthol
 - Other important constituents
 - ✓ menthone, menthofuran, Jasmone



Menthol



Menthone



Menthofuran

Peppermint oil...

Uses

- Carminative, stimulant, counter irritant and flavoring agent.
- It has mild anti- septic properties.
- It is also used in to the paste, and tooth powders, shaving creams, tobacco

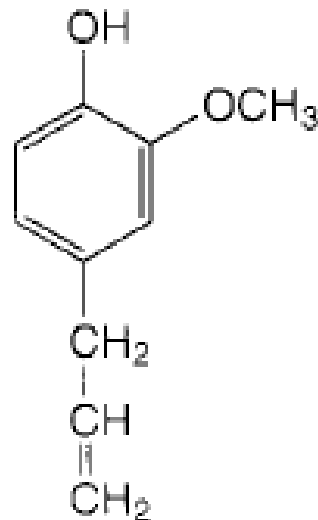
Clove oil 'kirunfud'

- From dried flowering buds of *Eugenia caryophyllus* (Myrtaceae).

✓ It contains not less than 15% V/W of clove oil

- **Constituent**

- eugenol (70-90%),
- eugenol acetate,
- carophyllens



Eugenol



Clove oil...

Uses:

- dental analgesic, stimulant, aromatic, flavoring agent and anti- septic
- The sesquiterpenes of clove have been cited as potential anti- carcinogenic compounds.

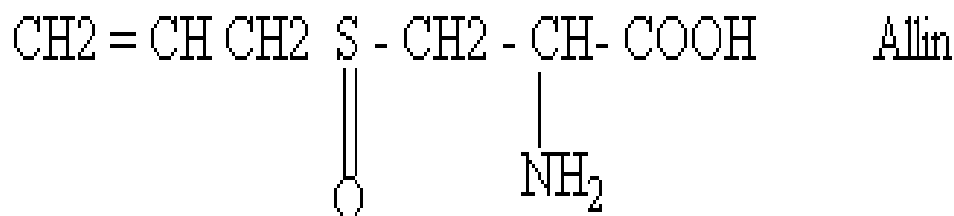
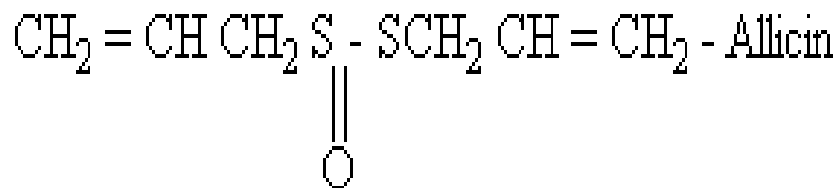
Garlic oil

- Obtained from the bulb of *Allium sativum* (Liliaceae).

- **Constituents**

- ✓ **Allicin**

- the most important of the biologically active components in the crushed bulb.
- produced when the precursor **alliin** is cleaved by the action of the enzyme **alliinase** upon crushing the tissue.



Garlic ...

Uses:

- ✓ as antimicrobial activity,
- ✓ effects on lipid metabolism,
- ✓ antithrombotic agent through inhibition of platelet aggregation.

Lavender oil

- It is the volatile oil obtained by steam distillation of fresh flowering tops of *Lavandula officinalis* (Lamiaceae).
- **Constituent**
 - ✓ 30-40% Esters calculated as linalyl acetate
 - ✓ linalool, pinene, geraniol, and cineol to some extent.



Lavender oil ...

Uses

- Hypnotic in aromatherapy
- For treatment of flatulent dyspepsia and topically for rheumatic pain.

Corainder oil “dimblal”

- From the dried, ripe fruits of *Coraindram satvum* (Umbelliferae).
- **Constituent**
 - 65-70% of (+)-linalool
 - flavonoids, coumarins, isocoumarins and phenolic acids.



Coriander oil...

Use

- Pharmaceutically coriander and its oils are used as a flavoring agent and carminative.
- The oil is used along with purgatives to prevent intestinal gripping

Cardamom

- From dried ripe seeds of *Elettaria cardemomum* (Zingiberaceae).
- **Constituent**
 - ✓ oil contains a high proportion of **terpinyl acetate** and **cineole**



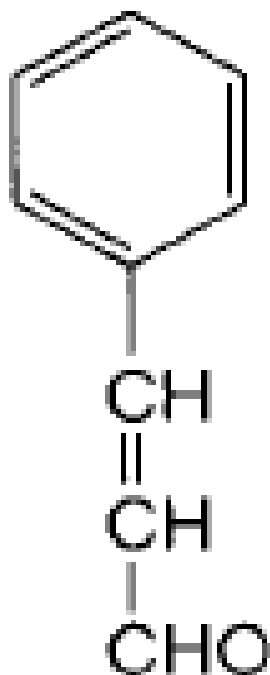
Cardamom...

Use

- Cardamom is aromatic, stimulant, carminative, diuretics
- used as flavoring agent

Cinnamon oil “Kerefa”

- From the dried bark of the shoots of *Cinnamomun zeylanicum* (Lauracea).
- **Constituent**
 - ✓ contains about 60-75% w/w of cinnamic aldehyde



Cinnamon oil ...

Use

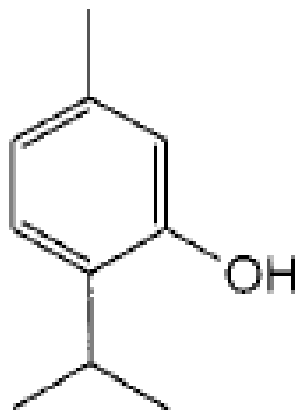
- as a flavouring agent and mild astringent
- The oil has carminative properties
- A powerful germicide

Thyme oil “Tosign”

- Thyme oil is produced from the fresh aerial part by steam distillation from *Thymus vulgaris* and other species of *Thyme* (Lamiaceae).

- **Constituent**

- ✓ Thymol is the principal (30-35%)
- ✓ Others such as carvacrol 1-4%, cymene 15-28%, terpinene 5-10%



Thymol



Thyme oil ...

Use

- used as antiseptic, antitussive and expectorant.
- spasmolytic effect is also reported
 - ✓ which may be due to the flavonoids of the leaves