

UNIT-II

ALKALOIDS

- Alkaloids are the nitrogenous compound of the plant origin containing a heterocyclic ring, basic in nature and contain one and more nitrogen atom in their heterocyclic ring.
- They have definite physiological & pharmacological action on man or other animals.
- Alkaloids are secondary metabolites which are synthesized from **shikmic acid** pathway.

Types of Alkaloids

1. True alkaloids :- They are derived from amino acid containing 'N' atom in heterocyclic.
2. Proto alkaloids :- They are also derived from amino acid but they do not contain 'N' atom inside the heterocyclic ring.
3. Pseudo alkaloids :- They are not derived from amino acid but they contain 'N' atom inside the ring.

▶ **DRUGS** :-

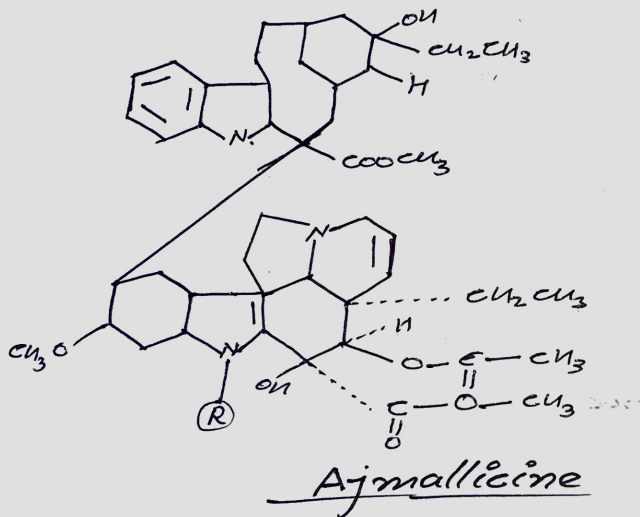
1. Vinca
2. Rauwolfia
3. Belladonna
4. Opium

1. Vinca

* Synonyms: Vinca rose, Catharanthus, Madagascar periwinkle, Burmasi, Saclabahas.

* Biological source: It is obtained from dried whole plant of Catharanthus roseus family - Apocynaceae.

* Chemical constituents:



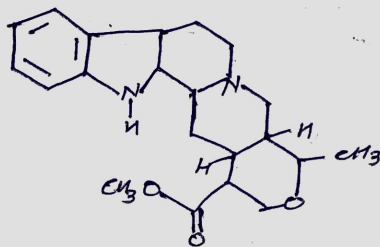
Vinblastine = R → CH₃

Vincristine = R → CHO

Vinca contains mainly indole alkaloids such as Vincristine and Vinblastine.

The other alkaloids present in Vinca are Ajmalicine, Serpentine and Tetrahydroalstonine.

1



* Chemical class:- Vinca belong to **indole** group of alkaloids.

* Commercial Applications:-

→ It is used as antidiabetic agents.

→ **Vinblastin** is an antitumour alkaloid used in the treatment of **Hodgkin's disease**. (It is a type of lymphoma in which cancers originate from a specific type of WBC's) and **non-Hodgkin's lymphomas**.

→ **Vincristine** is a cytotoxic compound and used to **treat leukaemia** in children.

→ Antineoplastic agents.

→ used in treatment of cancer.

* Therapeutic uses:-

→ It is used as antidiabetic agent.

→ It also used as anti-neoplastic agent, anticancer, antihypertensive.

2. Rauwolfia

* Synonyms:- Rauwolfia root, Serpentina root, Sarpagandha, Chandrika, Chhotachand, Indian snake root.

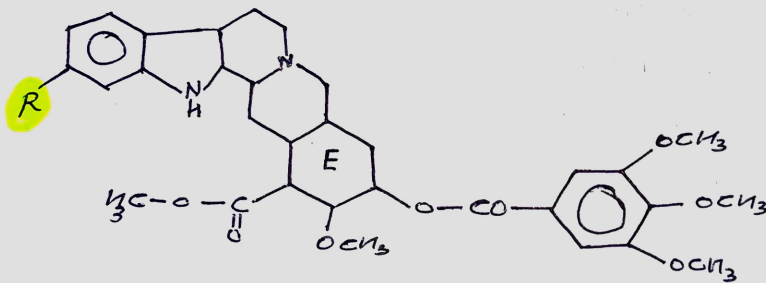
* Biological source:- Rauwolfia consists of dried roots of plant known as **Rauwolfia serpentina**.

* Family:- Apocynaceae.

* Chemical class:- It belong to indole group of alkaloids.

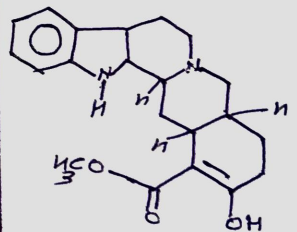
* Chemical constituents:-

- Rauwolfia contains about 0.7-2.9% total alkaloids bases from which more than 30 alkaloids have been isolated.
- The prominent alkaloids isolated from the drug are reserpine.
- The other alkaloidal components are ajmalinine, ajmaline, ajmalicine (8-yohimbine), serpentine, serpentinine, tetrahydroreserpine, saubasine, reserpinine, isoajmaline and harmbinine.

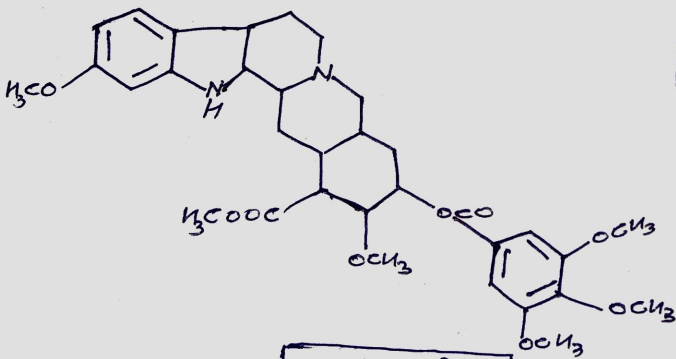


Reserpine (R = -CH₃)

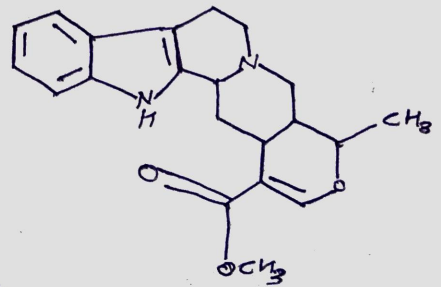
Deserpidine (R = -H)



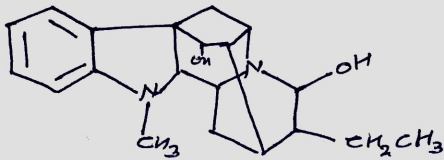
Yohimbine



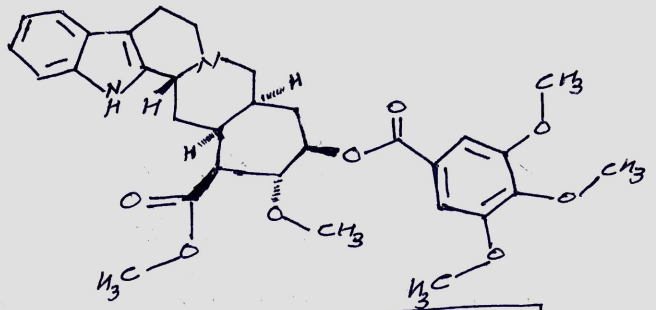
Reserpine



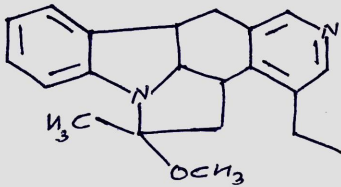
Ajmalicine



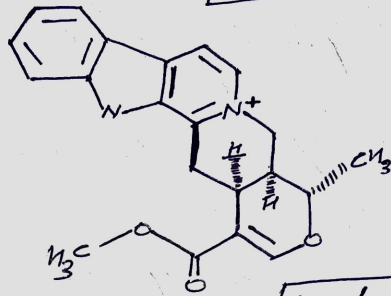
Ajmaline



Deserpine



LanKamessine



Alstonine

* Therapeutic Uses

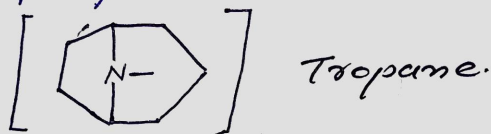
- Rauwolfia is used as **hypotensive** and **transquilliser** effect.
(stress ↓ relieves without producing sleep)
- It is also used to treat dysentery, painful infection of intestinal canal, uterine contraction.
- It is also used as stomacluc, cures fever.
- It also used in anxiety condition.

* Commercial Application

- Rauwolfia mainly applied as **antihypertensive agent** and **transquilliser**.
- Serpentine used in combination with reserpine & supplements → **hypertensive action**.
- Ajmaline is used in **angina pectoris** and **cardiac arrhythmia**.
- Ajmalicine is used to increase blood flow to the brain.

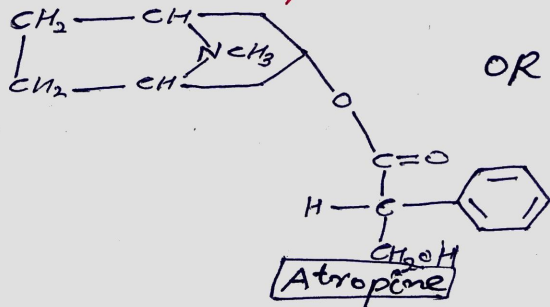
3. Belladonna

- * Synonyms:- Belladonna Leaf, Belladonna Folium, Belladonna Herb, Deadly Night shade.
- * Biological source:- Belladonna herb consists of dried leaf and aerial part of plant name Atropa belladonna Linn. or Atropa acuminata.
- * Family:- Solanaceae.
- * Chemical class:- It belongs to tropane group of alkaloids.

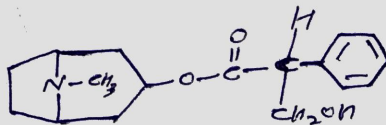


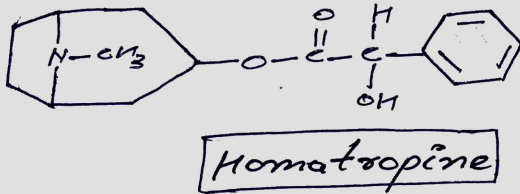
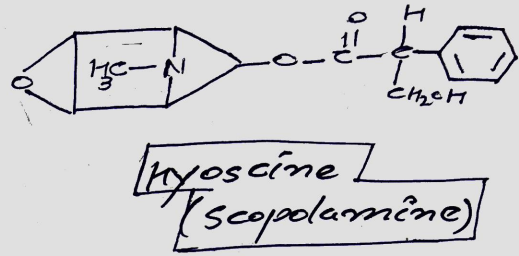
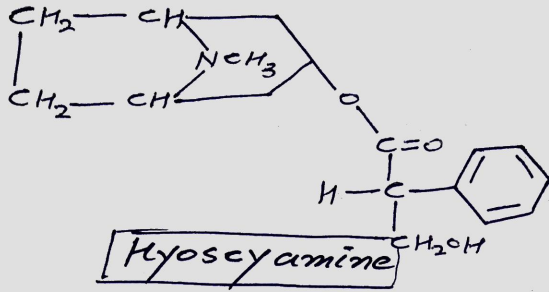
* Chemical composition:-

- The total alkaloidal content of drug is 0.4 to 1% & varies in different part of plant roots (0.6), stems (0.05), leaves (0.4), Unripe and Ripe berries (0.19-0.21) and seeds (0.33%).
- The main alkaloids are 1-hyoscyamine and racemic form atropine.
- Drug also contains belladonnine, scopoletin, hyoscyne, pyridine & N-methyl pyrrolidine.



OR





* Therapeutic uses

- It is used as **anticholinergic, antispasmodic**.
- It also used to **reduce secretion of sweat**.
- It also used as pain reliever, muscle relaxant & anti-inflammatory.
- It also used in treatment of Whooping cough and Hay fever.
- Atropine is suitable for the GI problem like abnormal intestinal motility.
- Atropine is also used as an **antidote to opium and chloroform poisoning**.
- Ophthalmologist use atropine to **dilate their patient's pupils for eye examination and surgery**.

* Commercial Applications

- Various preparation of belladonna are used as **lotion, plasters**.
- To relieve pain from **sciatica, Gout, cardiac palpitations**.
- Many other preparation available such as alcohol extract, tincture, belladonna ointment, juice etc.

4. Opium

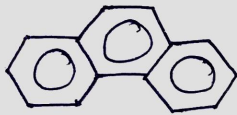
* Synonyms: Raw opium; Crude opium; Gum opium; Aphium.

* Biological source :-

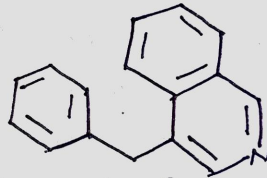
Opium is the air dried milk latex obtained by incision from the unripe capsules of the plant Papaver Somniferum Linn.

* Family :- Papaveraceae

* Chemical class :- opium belongs to phenanthrene group of alkaloids or contain benzyl isoquinoline ring system.



Phenanthrene
[morphine & codeine
contain
phenanthrene]

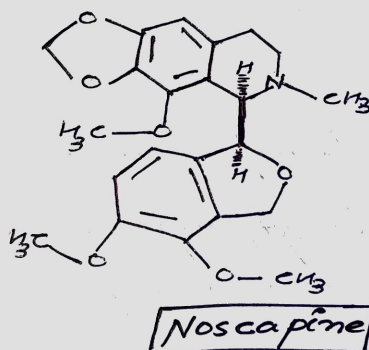
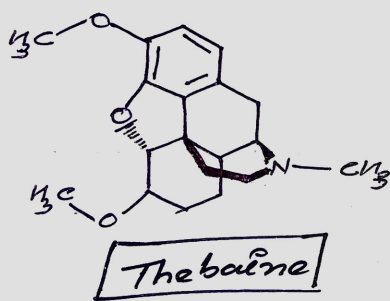
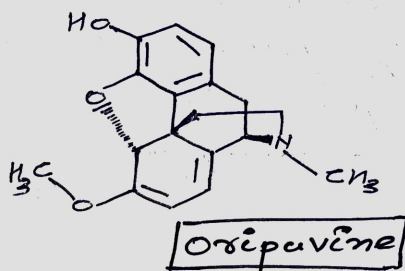
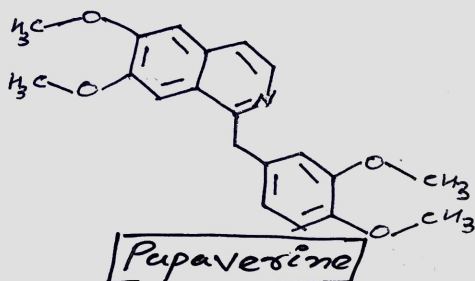
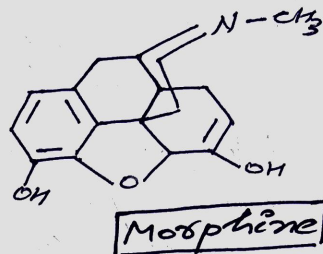
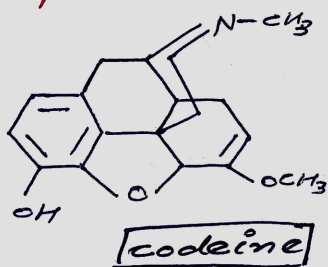


Benzyl isoquinoline Ring
[Narcotine, papaverine
& Narceine]

* Chemical constituents :-

- Opium contains about 35 alkaloids among which morphine (10-16%) is the most important base.
- The other alkaloids isolated from the drug are codeine (0.8-2.5%), Narcotine, thebaine (0.5-2%), noscipine (4-8%), narceine and papaverine (0.5-2.5%). Morphine contains a phenanthrene nucleus.
- The less important alkaloid of opium are narceine, lanthopine etc.

- Apart from the alkaloid opium also contains **musilage, sugars, wax and salts of potassium, magnesium and calcium.**



* Therapeutic Uses :-

- Opium is mainly used as **sedative, hypnotic and analgesic activity.**
- Apart from that it is also used as **constipation** treatment.
- Codeine relieves local irritation in the bronchial tracts and as an anti-tussive used in various cough medicine.
- Papaverine has relaxant effect on smooth muscles of the intestinal and bronchial tract & the blood vessels.

* Commercial Applications

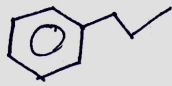
- Opium is used for isolation of codeine, commercially which is safe and mild in action with compare to morphine.
- Morphine is used to manufacture of opomorphine, codeine, ethyl-morphine and diacetylmorphine.
- There are many commercial variety of opium are available in various form such as powder form, concentration, camphorated tincture etc.

PHENYLPROPANOIDS and FLAVONOIDS

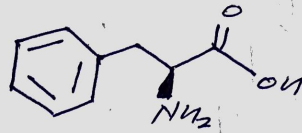
▶ Phenylpropanoids

- Phenylpropanoids are naturally occurring phenolic compound which contain **3-carbon** side chain attached to aromatic ring.
- They are synthesized by plant from **amino acid, phenylalanine & tyrosine** with the help of enzyme **phenylalanine Ammonia Lyase (PAL)**.
- They are present in many plant species and are used as UV light protection defend against herbivorous.
- They regulate a wide range of physiological process such as pigmentation of flower & fruits.
- They also play an important role such as anti-inflammatory, analgesic, bacteria & anti-fungal activity.

- The structure of simple phenylpropanoids is $C_6H_5-CH_2-CH_2-$.

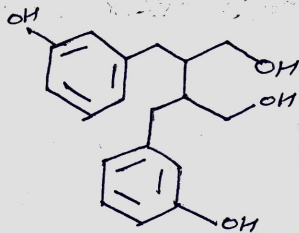


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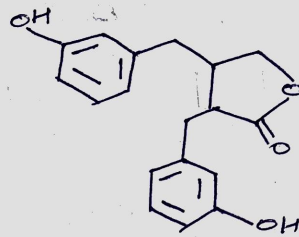


Lignans

- The term "lignan" was first introduced by Harwood (1948) to describe a group of **dimeric phenylpropanoids** where two phenylpropanoid molecules are attached by its central carbon (C8).
- Lignans are a subgroup of non-flavonoid polyphenols.
- They are widely distributed in the plant kingdom, act as antioxidants and defence molecules against pathogenic fungi and bacteria.
- * Biological Source:-
 - They are obtained from a wide variety of plant based foods, including seeds, whole grains, fruit & vegetables.
 - Podophylotoxin is natural occurring asyltetra lignin obtained from **Podophyllum hexandrum**.
- * family:- Berberidaceae
- * Chemical class:- They are belongs to **polyphenols**
ex:- Example of lignans are **enterolignan**, **enterodiols**, and **enterolactone**.



Enterodiol



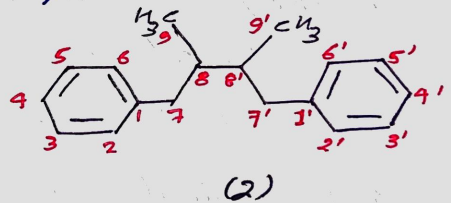
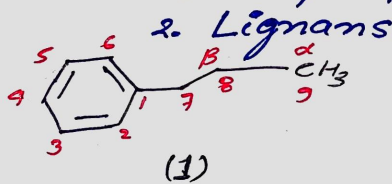
Enterolactone

* They are derived from phenyl alanine via dimerisation of substituted aromatic alcohols.

* They are subgroup of non-flavonoid poly phenolic.

* Chemical structure of lignans:

Lignans containing following structure like 1. phenyl propanoids &



* Chemical constituents:-

• Podophyllum & Etoposide

* Therapeutic Uses:-

• Lignans act as antiviral, anticancers, anti-inflammatory, antimicrobial, antioxidants, hepato protective.

• It also act as analgesic & aphrodisiac activity, immunosuppressive, osteoporosis prevention.

• It is also prescribed for relief of Asthma & malaria.

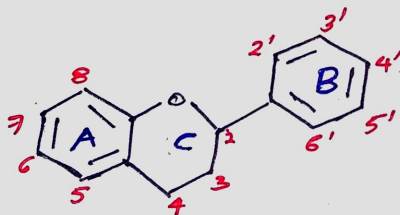
* Commercial Applications:- In market Lignans are available in concentrated product of flax seeds.

► Flavonoids

Flavonoids word derived from Latin words

Flavins means → yellow colour.

- Flavonoids are polyphenolic compound and available in maximum plant species.
- These are widely distributed group of plant substance which gives colour to the plant and are responsible for plant **pigmentation of fruit, leaf & flowers**.
- They have main role as antioxidant, activity, anti-inflammatory, & immune system benefits.
- They have the general structure of **15 carbon skeleton**, which consists of two benzene rings & a heterocyclic ring.
- chemically represented as **C₆-C₃-C₆**.
- **DRUGS:-** Tea & Ruta



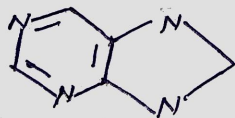
2-phenyl Benzopyrane

- Flavonoids consists of aromatic ring (A) condensed to heterocyclic ring (C) attached to 2nd aromatic ring (B).

- Flavonoids are divided into 2-subclasses—
 - i) Anthocyanins
 - ii) Anthoxanthins
 - **Anthocyanins** are responsible for various colours such as purple, blue & red.
 - **Anthoxanthins** are white or yellowish or colourless compounds.
- * Physical properties:- Flavonoids are crystalline solid with sharp melting point generally soluble in water & alcohol. Insoluble in organic solvents.

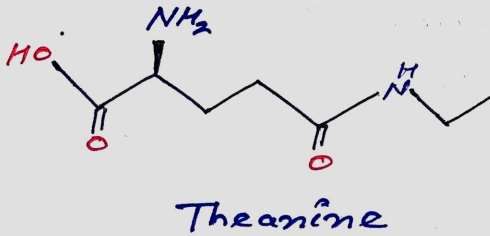
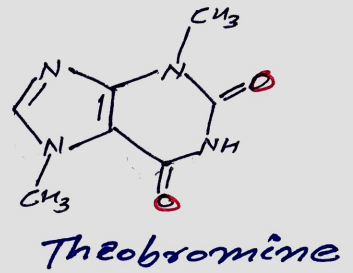
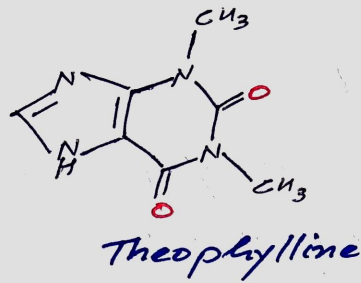
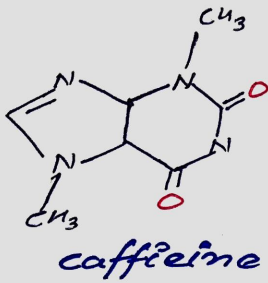
Tea

- * Synonyms:- Camellia thea, Folia thea
- * Biological source:- It is obtained from prepared leaves & leaf buds of **thea sinensis**.
- * family:- Theaceae (tea) & Rubiaceae (coffee).
- * Chemical class:- It is the purine alkaloids



Purine ring

- * Chemical constituents:-
 - The leaves of tea mainly contains **caffeine**.
 - It also contains **theobromine** & **theophylline** in minor quantities.
 - The colour of tea leaf is due to **Gallotannic acid**.
 - The agreeable odour is due to presence of a yellow volatile oils.



* Therapeutic Uses:-

- It acts as antioxidant & CNS stimulant, & diuretic effects (due to caffeine).
- Also used as anticancer, antidiabetic, & diuretic effect.
- It also prevent the skin disorders, respiratory & respiratory diseases.

* Commercial Applications:-

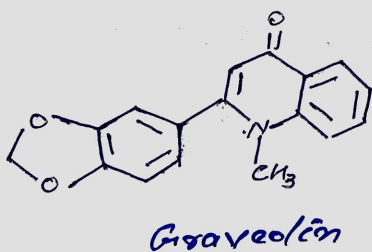
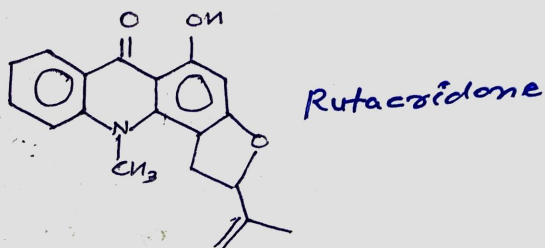
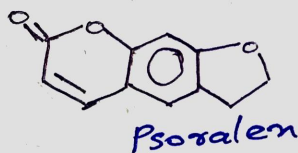
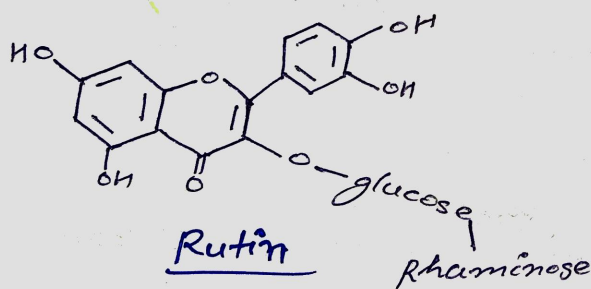
- Green tea is used in functional beverages for their antioxidant properties.
- Leaves are used in preparation of mouth wash due to its antiseptic properties.
- It also reduces acne on face.
- Boiled leaves mixed with lemon juice is used as hair conditioner.
- Tea leaf waste is used for isolation of caffeine in industrial scale.

Ruta

- * Synonyms:- Herby grass, Rue, Ruta graveolens, garden rue.
- * Biological source:- It consists of entire plant known as Ruta graveolens.
- * family:- Rutaceae
- * chemical class:- It belongs to flavonoids glycosides.

* chemical constituents:-

- Ruta contains various types of chemicals like alkaloids, glycosides, volatile oils.
- Main constituents:- Rutin (about 2%), Orsaveline, Rutaridin, Bergapten, Naphthohydrochin.
- others:- Rutamine, Dictamine, Rutacridone, steric acid, palmitic acid, ferulic acid etc...



* Therapeutic Uses:-

- * Ruta has Anti-tussive and spasmolytic action.
- * It is also used as anti-epileptic and immuno-suppressive agent.
- * Used to improve digestion strength.
- * It is also used as anti-oxidant & anti-cancer.

* Commercial Application:-

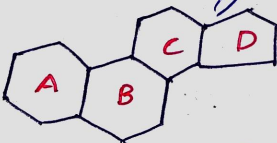
- The leaf infusion is used for proper regulation of menstrual flow.
- The plant decoction & infusion are used for washing of fungal infection and ringworm infection.

STERIODS , CARDIAC GLYCOSIDES & TRITERPENOIDS

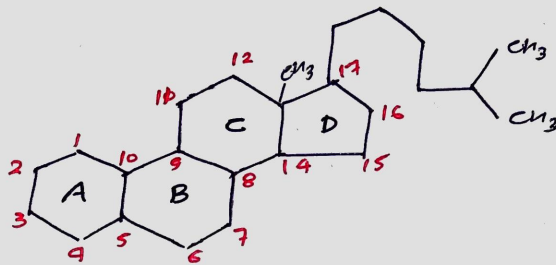
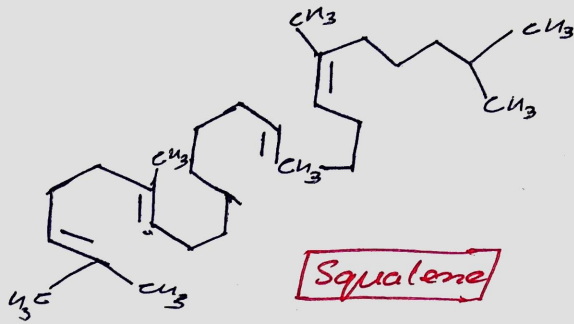
▶ Steroids

- * Steroids are biologically active organic compound characterised by molecular structure of 17-carbon atom arranged in 4 fused ring.

3- six membered and 1-cyclopentane ring.



- * They are derived from the cyclisation of triterpenoids. "Squalene" via acetate mevalonate pathway.



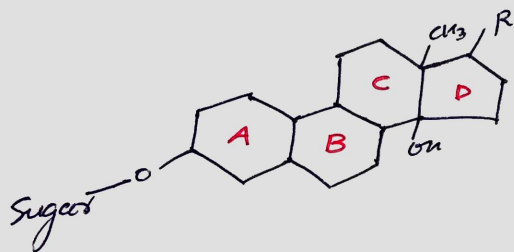
Steroid Ring system

- * Prassinosteroids are small group of plant steroids responsible for plant growth hormone activity
- * Different chemical groups at different positions on steroidal moiety leads to the formation of many different types of steroidal compounds. Such as **sex hormone (Progesterone & testosterone)**.
- * Anti-inflammatory steroids like corticosteroids, cardiac steroids like digoxin, digitoxin.
Animal steroids like cholesterol, glycosides.

► Cardiac Glycosides

- * Cardiac Glycosides are class of organic compound which increase the force of contraction of heart and increase heart rate or cardiac output by inhibiting **Sodium-potassium ATPase pump**.
- * Glycosides contain one or more sugar (glycone) unit linked with non-sugar (aglycone)

Sugar + Non-sugar \rightarrow Cardiac Glycosides

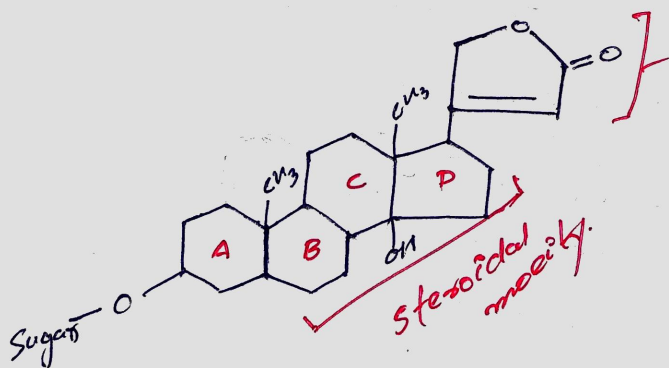


General Structure of Cardiac Glycosides

- * Cardiac Glycosides can be divided into two categories -

1. Cardenolides (C_{23})
2. Bufadienolids (C_{24})

1. Cardenolides: In cardenolides there are 5-membered unsaturated **lactone ring** attached with steroidal moiety at C_{17} position.



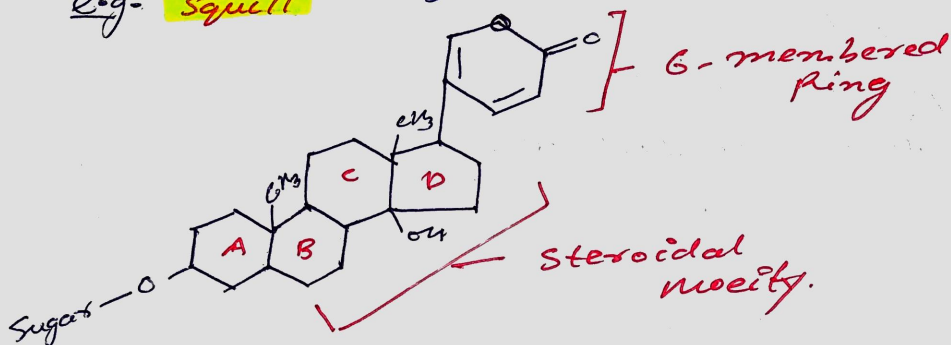
Lactone ring.

ex: Strophanthus
Digitalis and
Hellebora

2. Bifadienoloids

In Bifadienoloids there are 6-membered lactone ring attached α, β positions.

e.g. **Squill**



▶ Triterpenoids

Terpenoids:- Terpenoids are hydrocarbon of plant origin of the general formula $(C_5H_8)_n$. As well as their oxygenated, hydrogenated & dehydrogenated derivatives.

Triterpenoids:- Tri-terpenes are composed of 3 terpene unit or consist of 6-isoprene units, with molecular formula $(C_{30}H_{48})$

* It is biosynthesized by cyclisation of **Squalene** by mevalonate acid pathway.

Chemical Classification

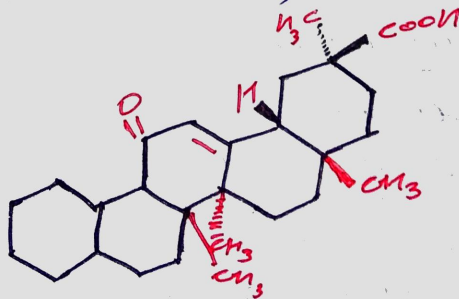
- classified into 3-group-
- i) Acyclic tri-terpenes (e.g. Squalene)
 - ii) Tricyclic triterpenes (e.g. Lanosterol)
 - iii) pentacyclic triterpenes (e.g. Alpha amylene, β -amylene, Luped)

Liquorice

- * Synonyms:- Liquorice roots, Glycyrrhiza Mulethi, Sweet wood.
- * Biological Source:- It consists of dried, unpeeled roots and stolons of the plant known as Glycyrrhiza Glabra.
- * family:- Leguminosae
- * Chemical Class:- It belongs to tri-terpenoids Saponins

* Chemical Constituent:-

- The main constituent of Liquorice is Glycyrrhizic (acid).
- Glycyrrhizic acid is a glycoside and on hydrolysis yields Glycyrrhizic acid.
- Other constituents of Liquorice are Glucose (upto 4%), Sucrose (2.5 - 6.5%), asparagin (2 - 4%) and Fat.



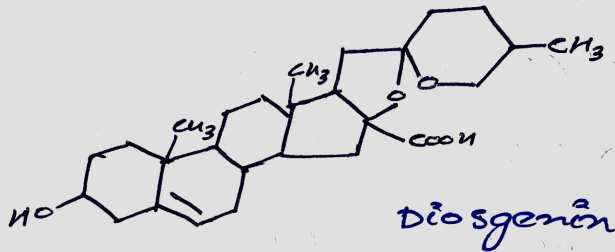
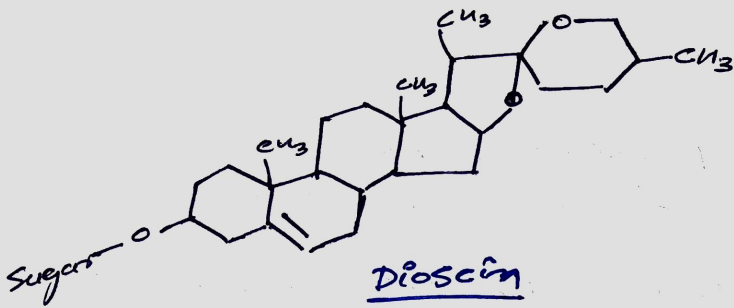
* Therapeutic uses:-

- Liquorice is used as an expectorant and demulcent.
- It is used in cough mixture & as a flavouring agent.
- Used in peptic ulcers and healing

- It is also used as anti-inflammatory and eczema.
- * Commercial Application :-
 - It is used as an energy tonic, particularly for spleen and stomach.
 - The important ingredient (glycoside) (Alaba) in medicinal oils for epilepsy, paralysis, rheumatism, haemorrhagic disease.

Dioscorea

- * Synonyms:- Rheum root, Yam
- * Biological Source:- It is obtained from dried tubers of dioscorea deltoidea, D. composita.
- * Family:- Dioscoreaceae
- * Chemical class:- It belongs to steroidal saponins
- * Chemical constituents:-
 - The main active constituents of Dioscorea is diogenin (4-6%) and small quantity of hecogenin.
 - It also contains smilagenin, epismilagenin and beta isomer yamogenin
 - It also contain an enzyme Sapogenase & starch.
 - Diogenin is the hydrolytic product of saponin diosinin.



* Therapeutic Use

- Diggenin being steroidal in nature, is used as precursor for synthesis of several corticosteroids, sex hormones & oral contraceptives.
- Dioscorea is used in treatment of rheumatic Arthritis.

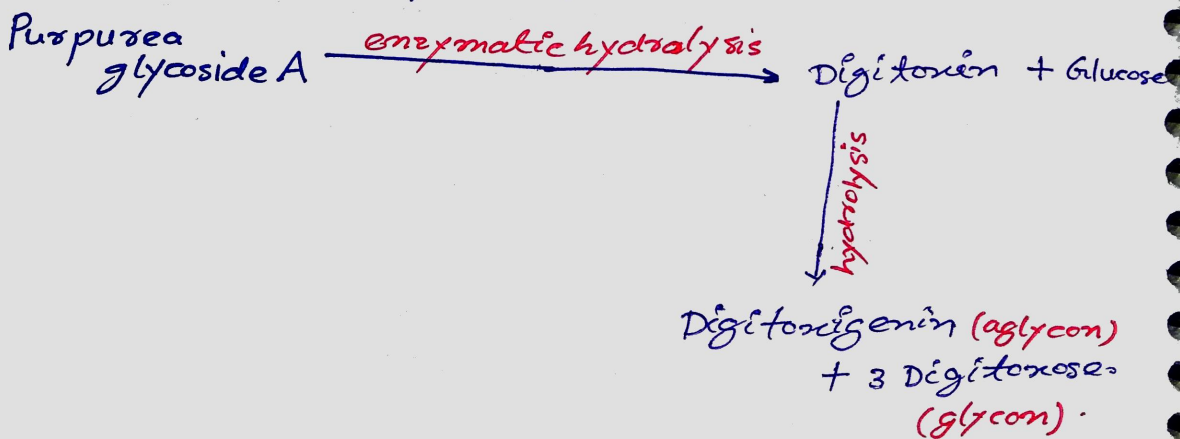
* Commercial Application :-

- Dioscorea is used as precursor for synthesis of several drugs like corticosteroids, sex hormone & oral contraceptives.

Digitalis

- * Synonyms: Foxglove leaves, finger flowers, lady's glove, Folia Digitalis.
- * Biological source: Digitalis consists of dried leaves of *Digitalis Purpurea*.
- * family: Scrophulariaceae.
- * chemical class: It belongs to cardiac glycosides.
- * chemical constituents:

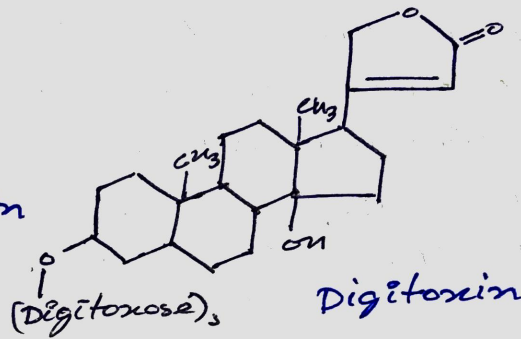
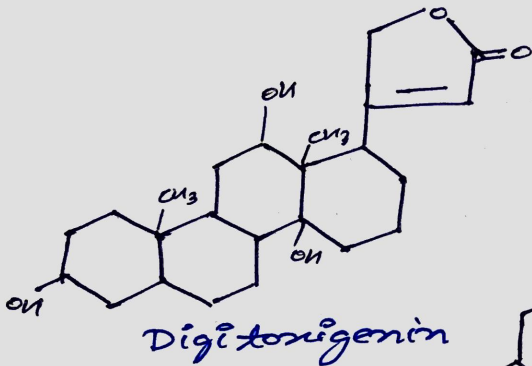
- Digitalis contains mixture of both primary & secondary cardiac glycosides (cardenoloids)
- Purpurea glycosides A and B.
- Purpurea glycoside A on hydrolysis gives digitoxin & glucose, where as purpurea glycoside B on hydrolysis give Gitoxin & glucose.
- Digitoxin upon further hydrolysis gives digitoxigenin and 3-moles of digitoxose.



Purpure Glycoside B $\xrightarrow[\text{hydrolysis}]{\text{Enzymatic}}$ Gitoxin + Glucose

hydrolysis

Gitoxigenin + 3-Digitoxose.



* Therapeutic uses :-

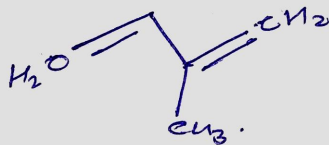
- Digitalis is used in treatment of congestive heart failure (CHF)
- Another major use of digitalis is slowing ventricular range in arterial fibrillation & Atrial flutter.
- Supraventricular Tachycardia

* Commercial Applications :-

- Digitalis is only drug which is used in Allopathic medicine.
- Direct **IV inject** form is applied in CHF.
- Digoxin is available as oral & injection form.

VOLATILE OILS

- The odourous, volatile principles of plants and animals origin are known as **essential oil** or **etherial oils** or **volatile oils**.
- Plants containing essential oils are called **aromatic plants**.
- They produce characteristic **flavours & odours** due to presence of compounds that are volatile oil.
- These are "**essential**" due to feel that it represents essence or active principle of plants.
- Chemically they are derived from **terpenes** and their **originated compounds**.
- They are made up of **isoprene units**.
(C_5H_8).
and are usually **Mono - sesqui diterpenes**.



- ▶ **DRUGS**:- 1. Mentha | 2. clove | 3. Cinnamon
4. Fennel | 5. Coriander.

* Physical Properties

- Mono & sesqui terpenoids are always volatile in nature and produces characteristic flavour & odour.
- Most of them are **colourless liquids** when they are fresh.
- But on long storage they may oxidised and changes colour.

- Essential oil are **immiscible with water**.
- Density is generally lower than water & they are soluble in common organic solvents such as alcohol

Uses:-

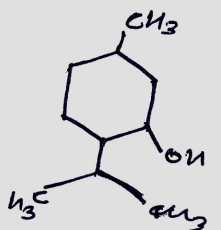
- Volatile oils are used as **flavouring & perfuming** agent in pharmaceutical formulations, foods, beverages and cosmetics.
- They are also used as medicinal agents such as **carminatives, antihelmatics, diuretics, antiseptic, local anaesthetic, sedative & local irritant.**

Mentha

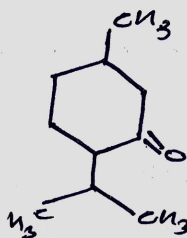
- * Synonyms:- Mint, Peppermint oil, Mentha oil, Pudina.
- * Biological source:- The oil is obtained by steam distillation of fresh flowering tops of the plant name Mentha piperita.
- * family:- Labiatae or Lamiales
- * chemical class:- It belongs to cyclic mono-terpenes.
- * chemical constituents:-
Peppermint oil contains chiefly

as well as in form of esters in the

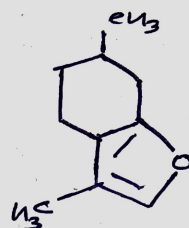
- American peppermint oil contains 80% menthol
- Japanese oil contains 70-90%
- Other important constituents of peppermint oil are Menthone, Menthofuran, Jasmine, cineole, piperine, Camphene etc...



menthol



menthone



menthofuran

Uses:

- Peppermint or mentha oil is used as **carminative, stimulant and flavouring agent**
- It has mild anti-septic property.
- It is used in toothpaste, tooth powder, shaving cream, powder & different pharmaceutical
- They are also consumed in preparation of chewing gum, Jellies, perfumes.

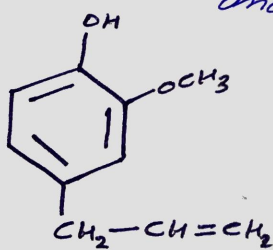
Commercial Application:

- It is flavour of choice in several products like **cosmetic, food products and drugs**
- **tobacco, cigarettes, beverages** prefer menthol as flavour.

Clove

- * Synonyms: Caryophyllum, clove flowers, clove bud
Laung (Hindi).
- * Biological source:
Clove consists of dried flower bud of Eugenia caryophyllus.
- * family: Myrtaceae
- * Chemical class: It is phenyl propanoids.
- * Chemical constituents.

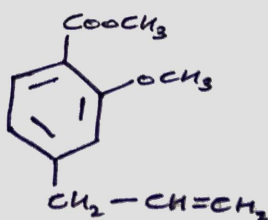
- Clove contains about 15-20% of clove oil
tannins 10-13%, resins, chroomone
and Eugene.
- The volatile oil of the drugs contains
Eugenol about (70-90%),
Eugenol acetate, caryophyllenes
and esters.



Eugenol

Therapeutic uses:

- used as dental analgesic
• carminative, stimulant
• flavouring agent, aromatic
& antiseptic.
- Also used in preparation
cigarettes.
- The oil is used in perfumery
& in manufacture of vanillin.



Eugenol acetate

Commercial Applications:

- Generally it is marketed
as many form like oil,
powder form, toothpaste,
& also used in preparation of
costly cigarettes

Cinnamon

* Synonyms: Cinnamon bark, Kalmi Dalchini,
> ceylon cinnamon.

* Biological source: It consists of a dried inner bark of shoots of plant name cinnamomum zeylanicum.

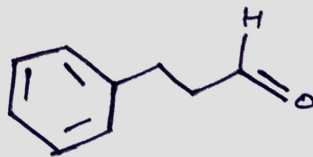
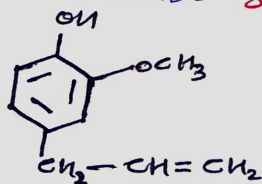
* family: Lauraceae.

* Chemical class:-

Cinnamon oil is aldehyde group of volatile oils

* Chemical constituents:-

- Cinnamon oil contains cinnamaldehyde (60-70%) and Eugenol (5-10%).
- Cuminaldehyde, Benzaldehyde and caryophyllene.
- Cinnamon barks also contains tannins, volatile oil, mucilage, calcium oxalate and starch.



* Therapeutic uses:

- Bark is used as carminative > stomachic and mild astringent
- It is also used as flavouring agent, stimulant, aromatic and antiseptic
- And also used as spices, and condiments.
- Also used in preparation of candy, dentifrices, perfumes.

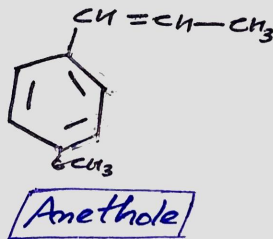
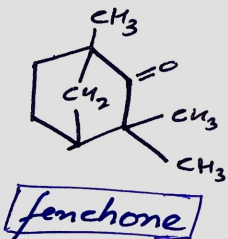
cinnamaldehyde

Commercial Applications:-

- Cinnamon capsule is used for sugar metabolism - and,
- Bark oil is used as a flavouring agent also in perfumery industries.

Fennel

- * Synonyms :- Fennel fruits, Saunf,
- * Biological source :-
 - Fennel consists of **dried riped** fruits of the plant known as *Foeniculum Vulgare*.
- * family :- Umbelliferae.
- * Chemical class :- It is based on **monoterpenes** and **ketone group** of volatile oils.
- * Chemical constituents :-
 - Fennel consists of **3-7%** of **volatile oils**.
 - **27%** protein and fixed oils.
 - The chief active constituent of volatile oil is **ketone, fenchone (20%)** and **anethole (50%)**.
 - The other constituents are **phellandrene, limonene**.



- Therapeutic uses :-
 - Used as carminative
 - aromatic & stimulant
 - expectorant and flavouring agent.
- Commercial Applic
 - Fennel oil is useful in pharmaceutical industry as a cough medicine
 - antiseptic, laxative
 - and as an additive in various types of bakery, confectionery and cosmetics.

Coriander

* Synonyms :- coriander fruit , Dhaniya

* Biological Source :-

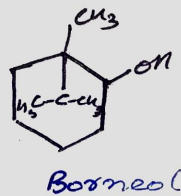
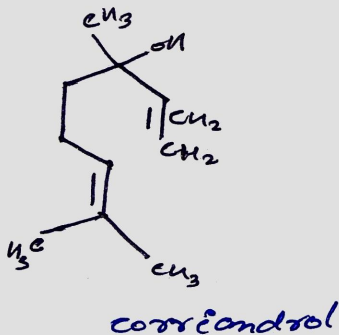
It consists of dried ripe fruit of plant known as corianderum sativum

* family :- Umbelliferae

* Chemical class :- coriander fruit belongs to oxygenated acyclic monoterpenes.

* Chemical constituents :-

- coriander yields from 0.3-1% Volatile oils, fixed oils (13%), protein 20%
- Volatile oil of the drug contains 13% of coriandrol and coriandryl acetate
- and small quantity of borneol, Geraniol and pinene.



Therapeutic

* Therapeutic Uses

- used as an aromatic, carminative, stimulant and flavouring agent.
- Also used as spasmolytic and anti-inflammatory, antiseptic, anti-hypertensive.

* Commercial Application

- Coriander oil is used in aromatic elixir preparation, aromatherapy & flavouring agent.

TANNINS

- Tannins are secondary metabolites, present in solution form in **cell sap** and **distinct vacuoles**.
- Tannins are mostly used for their specific **astringent property**.
- Tannins are also used for **wound healing capacity** and they form a **protective coating** around the injuries and prevent external irritation.
- They are used in medicines for **allied purpose** or in treatment of **diarrhoea**.
- Commercially they find extensive application in **leather industries**.
- Chemically they contain the mixture of complex organic substance, in which **polyphenols** are present.
- Normally they have high mol. wt. compound.
- Tannins form colloidal solution with water and are non-crystalline substances.

- In solution they show acidic reaction due to phenols.

Classifications

1. Hydrolysable Tannins
2. condensed tannins
3. Pseudo tannins

1. Hydrolysable tannins:-

- These are hydrolysed by acid or enzymes into gallic acid, ellagic acid.
- Hydrolysable tannins with ferric chloride becomes blue color.

example - Amla, Arjuna, Rhubarb, clove & che

2. condensed Tannins:-

- They are also called as non-hydrolysable tannins ^{ex,} cinnamon bark, black catechu, pale catechu & pterocarpus.
- They are much resistant to hydrolysis and such type of tannins basically contains flavinoids derivatives.
- Non-hydrolysable tannin with ferric chloride solution becomes brownish-green colour.

3. Pseudo tannins:-

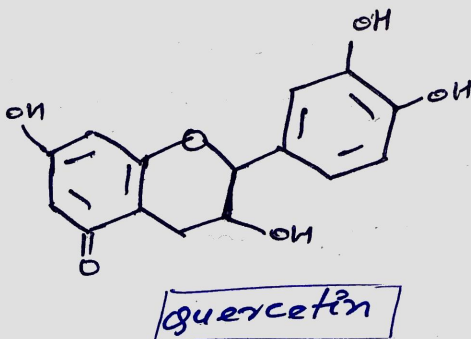
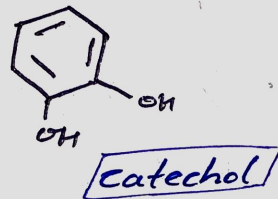
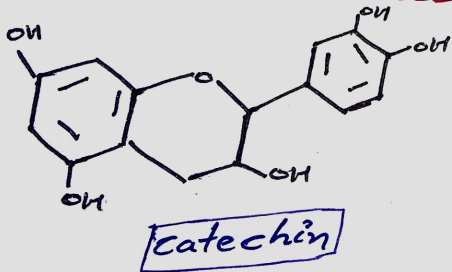
- They are chemically phenolic compound with low molecular weight and they did not show gold beater's test.

example - coffee, Nuxvomika, Ipecac root,

Catechu

- * Synonyms: Cutch, Kattha
- * Biological source:
It consists of dried aqueous extract of **Heartwood** of plant Acacia Catechu.
- * family: Leguminosae
- * Chemical class: It belongs to tannins, chemically polyphenolic compound.
- * Chemical constituent:

- It contains 10-20% **acacatechin**,
- It contains tannins like **catechins**, **catechu tannic acid**.
- Also contains flavinoids like **quercetin** and other constituents like **catech red** and **gum**.



* Therapeutic Uses

- Used as an astringent and for cooling and digestive purpose.
- Used for relaxed condition of throat, mouth, gum, cough and diarrhoea.
- Tutch is used for dyeing, tanning & as a preservative to fishing nets. and sails.

* Commercial Applications:-

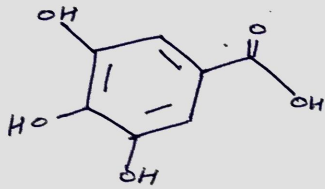
- Catechu is used in preparation of herbal tooth powder. like Vicco Bajradanti.
- Accacia catechu + Conniphora mukul + Hemamelis is used as gargle for pharyngitis and gingivitis.

* Pale Catechu

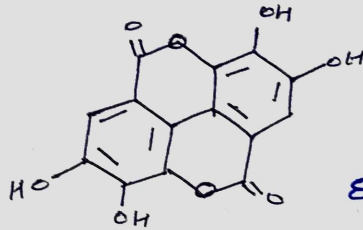
- Synonyms: Cambier, Cambis
- Biological source:
It is dried aqueous extract of leaves and young shoots of Uncaria Cambier.
- family: Rubiaceae.
- chemical class:-
It belongs to catechol tannins.

* Chemical constituents:-

The drug contains condensed tannins in form of catechins (7-33%), catechu tannic acid (20-50%) and catechu red, the drug also contains pueric acid, gallic acid, ellagic acid, catenol, and gambirine & gambirdine.



Gallic acid



Ellagic acid.

* Uses (Therapeutic):-

- Used as astringent,
- In the treatment of diarrhoea, relaxed condition of throat, mouth and gums.

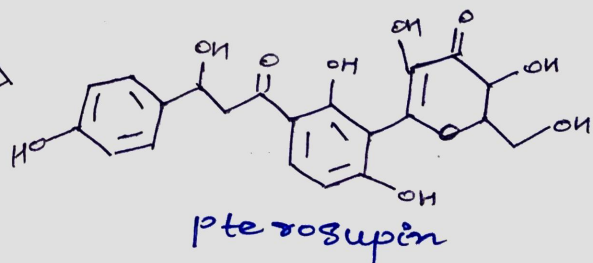
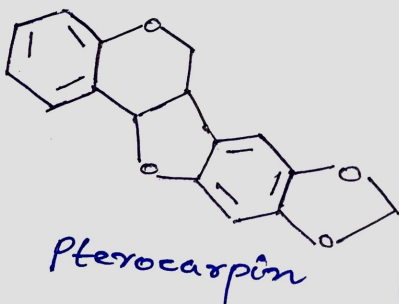
* Commercial Application

- Used as astringent in form of Loenge
- It is also used in dyeing & tanning industries and also protecting fishing nets.

Pterocarpus

- * Synonyms: Indian Kino tree, Malabar Kino
> Rakta chandan
- * Biological sources-
It consists of dried juice of the plant Pterocarpus Marsupium.
- * family :- Leguminosae
- * chemical class :-
It belongs to condensed tannins.
- * chemical constituent :-

- Kino contains about 70-80% kino tannic acid, kino red, catechol, resin & gallic acid.
- It also contains marsupin & pterosupin, pterocarpin & pomopteroarpin.



- * Therapeutic Uses :-
 - Used as powerful Astringent and also in treatment of diarrhoea and dysentery, Haemorrhage, toothache and in diabetes.
- * Commercial Applications
 - used in manufacture of ayurvedic dental preparations.
 - used as skin & hair conditioners.

RESINS

- Resins are solid, semi-solid, or liquid substance of complex chemical nature containing large number of carbon atoms.
- These are mixture of **essential oils**, **oxygenated terpenes** & **carboxylic acids** found as exudations from the trunk.
- Most of the resins are heavier than water.
- They are **insoluble in water** but soluble in **alcohols, volatile oils, fixed oils, chloroal hydrate** & **non-polar organic solvents** like **Benzene or ether**.
- They are usually formed in **Schizogenus** or **Schizolysigenus** cavity or duct as end product of metabolism.

Classification of Resins

* Depending upon combination with other constituents-

1. Oleoresins :- Resins & oils in homogenous mixture are called as oleoresins.
eg; **capsicum, capaiba, ginger**
2. Oleo-Gum-Resin :- Resins are homogeneous mixture of volatile oil, Gum & resins.
eg; **Myrrh, guggul**.

3. Glyco-Resins :- These are made up of resins and sugars and are present in *Jalap* & *Epomoea*.

4. Balsam Resins :- If the resins contains benzoic acid and or cinnamic acid it is called as Balsam.

ex- Balsam of Tolu, *Storax*, Balsam of Peru.

* Depending upon the type of constituents

Resins are of three types-

1. Acid resins

- eg. • *Colophony* (contain abietic acid)
- *Copaiba* (Copaibic & oxy-copaibic acid)
- *Myrrh* (

2. Ester Resins

- eg. *Benzoin* (contain coniferoyl benzoate)
- Storax* (cinnamyl cinnamate)

3. Resin Alcohol

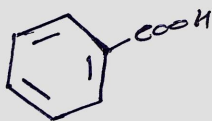
These are the complex alcohol of high molecular weight they are found in free state.

- eg. *Peru Balsam* (Peru-resinotannol)

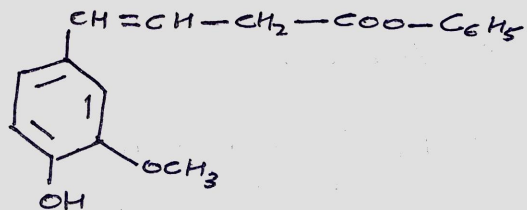
Benzoin

- * Synonyms:- Sumatra Benzoin, Loban
- * Biological source:-
It is Balsamic obtained from incision on stem of the plant name **Styrax Benzoin**.
- * Family:- **Styracaceae**.
- * Chemical class:- It is Balsamic Resin.
- * Chemical constituents:-

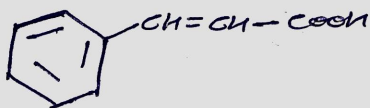
- It contains free **Balsamic acid** (Benzoic & cinnamic acid), Summaratesinic acid & siaratesinic acid.
- The major constituent is an ester **coniferyl benzoate** (about 76%)
- It also contains sterol, vanillin, phenyl propyl cinnamate and cinnamic acid.



Benzoic acid



coniferyl benzoate



cinnamic acid

* Therapeutic Uses:-

- Benzoin is a irritating expectorant, carminative & diuretic.
- Also used externally as anti-septic and protective.
- It is used in the form of compound tincture.
- Used as an inhalation, specifically in treatment of upper respiratory tract infection.

* Commercial Application:-

- Industrially, it is used to fix the odour of essence, soaps, perfumes and several other cosmetics.
- And mask the taste of pharmaceutical preparation.

Guggul

* Synonyms:- Gum-guggul, commiphora

* Biological Source:-

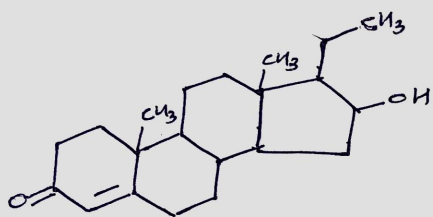
Guggul is the oleo-gum resin obtained by making deep incision at the basal part of the stem bark of Commiphora Wightii

* family:- Burseraceae

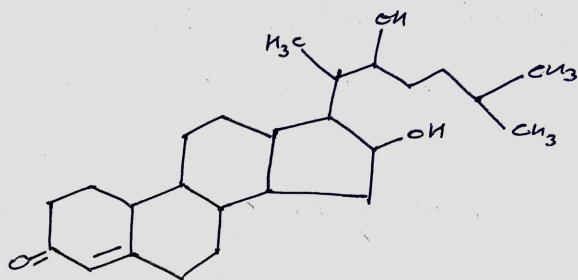
* Chemical class:- It belongs to oleo-gum resins.

* Chemical Constituents

- It contains **steroids, diterpenoids** and **aliphatic esters**.
- Guggul also contains **Z-guggulosterone, E-guggulosterone** and three new sterols (I, II, III guggulosterols).
- It also contains **60% of gums, 30% resins** and **0.5-1.5% Volatile oil**.



Guggulosterone-Z



Guggulosterol-I

* Therapeutic Uses

- Guggul is used as **anti-inflammatory, anti-rheumatic, hypolipidemic** and **hypochlolesterimic agent**.

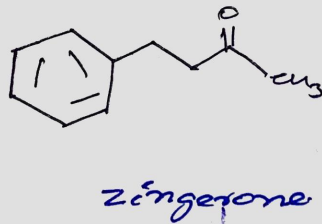
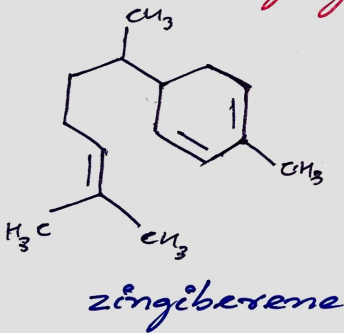
* Commercial Application

- Paste of guggul is locally applied in **rheumatoid Arthritis, skin disease, piles**
- It reduce foul smell and swelling of bone.
- Its vapours are useful as **deodorant, and disinfectant** in the house.

Ginger

- * Synonyms: zingiber, zingiberis, sonth
- * Biological source: Ginger consists of rhizome of *zingiber officinale*
- * family: zingiberaceae.
- * Chemical class: It belongs to oleo-resins.
- * Chemical constituents:

- It contains about 1-4% volatile oil, starch (40-60%), fat (10%), fiber (5%)
- *zingiberene* is the principle constituent of ginger oil.
- The pungent principle of ginger is *gingerone*.



- * Therapeutic uses:
 - Used as stomachic, aromatic, carminative & stimulant
 - and flavouring agents
 - zinger oil is used in mouthwash, beverages and liquors.

* Commercial Application:

- 0.5g - 1.5g of powdered ginger is effective in nausea & vomiting during pregnancy.

Asafoetida

* Synonyms:- Gum asafoetida, devils
, hing

* Biological source:-

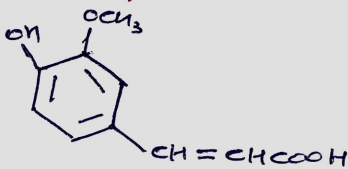
Asafoetida is the oleo-gum-resin obtained by incision from the rhizome & roots of plant name Ferula Foetida

* family:- Umbelliferae.

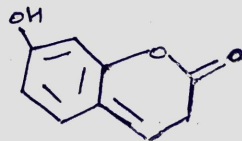
* Chemical class, it belongs to oleo-gum-resin.

* Chemical constituent:-

- Asafoetida contains resin (42-65%)
, gum (20-25%) & Volatile oil (4-20%)
- The resin of the drugs consists chiefly ferulic acid & Umbelliferone.



Ferulic acid



Umbelliferone

* Therapeutic uses

- Used as terbine stimulant, carminative, flavouring agent, antiseptic, sauces & pickles.
- And in Veterinary medicines.

* Commercial Applications

- Powdered resin **300 - 1000mg** Three times daily.
- Tincture of **2 - 4 ml** or **20 drops** as a single dose.

Myrrh

* Synonyms: Gum Myrrh, Myrrha, Bol

* Biological source: Myrrh is an oleogum resin obtained from Commiphora molmol.

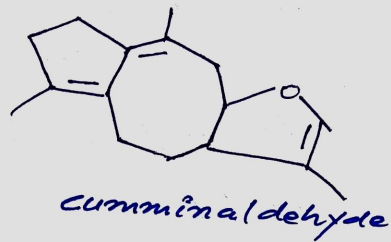
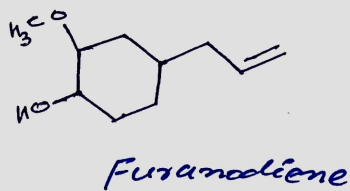
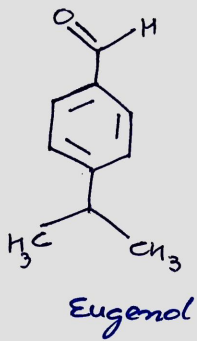
* family: Burseraceae

* Chemical class: It belongs to oleogum resin.

* Chemical constituents

Myrrh contains about 10% volatile oil, 60% gum, 25-40% of resin.

- The volatile oil contains sesquiterpenes like Eugenol, elemol, cuminaldehyde.
- The resin of myrrh consists of α, β, γ Commiphoric acid.



* Therapeutic Uses :-

- It is used as stimulant & an antiseptic
- It is also used as astringent to the mucous membrane.
- Its tincture is used in mouthwashes & gargles.

* Commercial Application :-

- In Ayurveda, it is sold as **yograj guggulu** (**Baidyanath**) for anti-inflammatory & anti-hyperlipidemic activity.
- Myosh tincture **1-2 ml** twice a day.

Colophony

* Synonyms :- Colophonium, Gum resin, Amber-resin.

* Biological source :-

Colophony is the residue left after the distillation of the oil of **terpentine** from the crude oleoresin obtained from various species of pines like **Pines Palustris**, **Pines longifolia**, **Pines radiata**

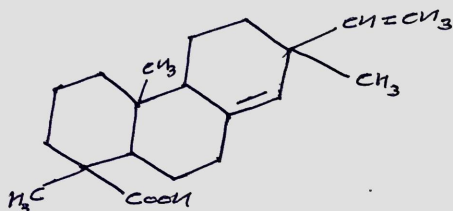
* family :- Pinaceae

* Chemical class :-

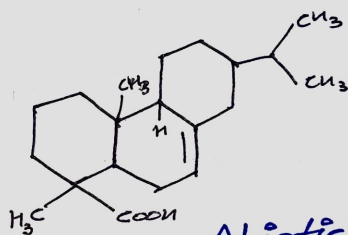
It belong to acid-resin.

* Chemical constituent:-

- Colophony contain resin acid about 90% and Ester of fatty acid, other acid in colophony are Sapinic acid and pimeric acid.
- The resin consist of the various type of acid like diterpenic which is known as abietic acid.



Pimeric acid



Abietic acid

* Therapeutic Uses :-

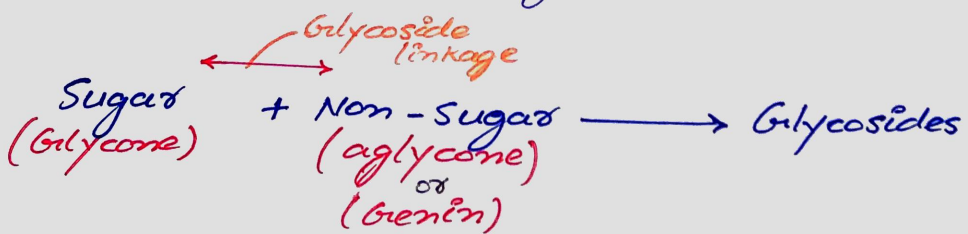
- It is used as stimulant and diuretic
- Also used in preparation of ointments & soap.
- It is also used as protective coating like polymers.

* Commercial Applications:-

- Industrially it is used in preparation of varnishes, soaps, printing inks.

GLYCOSIDES

- Glycosides are **organic compound** obtained from **plant** and **animal** sources which on enzymatic or acid hydrolysis yield one or more sugar moieties known as **glycone** and **aglycone (genin)**.
- Aglycone part responsible for chemical & therapeutic property.
- Glycone part responsible for facilitated absorption of glycosides and helps in transportation of glycone portion at the site of action.
- Linkage between aglycone & glycone is called as **glycoside linkage**, and on the basis of this linkage α & β stereoisomers is assign.

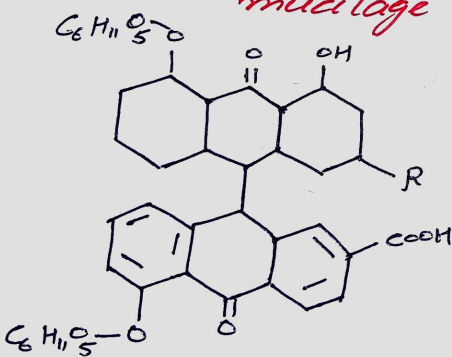


Example — **Alonin (Aloe)**, **Digitoxin**,
Digitalis, **Glycyrrhizine (liquorice)**.

Senna

- * Synonyms:- Senna leaf, Senai-Ki-pattis
cassia senna.
- * Biological Source:- It consist of dried leaf lets of cassia angustifolia
or Cassia Senna.
- * family:- Leguminosae
- * Chemical class:-
It is belong to anthraquinone Glycoside.
- * Chemical constituent:-

- Senna contain mainly two anthraquinone glycoside called as **Sennaside A & B**.
- Sennaside A & B which account for purgative properties.
- They also contains **Kaempferol oleo-emodin** also contain **phytosterol** and **salicylic acid**, **mucilage**, **Resin** and **calcium oxalate**.



R	Glycosides	Rotation
COOH	Sennoside A	Trans
COOH	Sennoside B	Meso
CH ₂ OH	Sennoside C	Trans
CH ₂ OH	Sennoside D	Meso

* Therapeutic uses:-

- Used as purgative.
- It is also used for irritable bowel syndrome, hemorrhoids & weight loss.
- It is also used in loss of appetite, indigestion, jaundice and anaemia.
- In cosmetic field, Senna improves skin quality by moisturizing and softening the skin.

* Commercial Application:-

- In market Senna is available in tablet, powder, capsule & extract forms.
- For constipation in children 8.5 mg daily increase just enough to cause one bowel movement.
- For constipation in elderly people 17mg daily has been use.

Aloes

* Synonyms: Aloe, Kumari, Musabbar

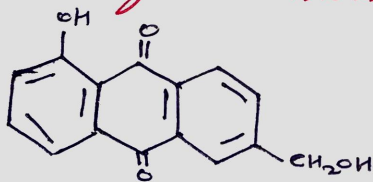
* Biological sources: Aloe is dried juice of the leaves of Aloe Barbadosis.

* family: Liliaceae

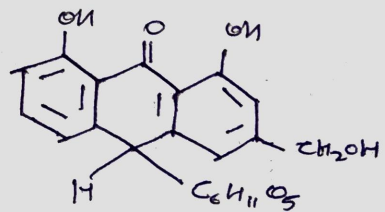
* Chemical class: It belongs to Anthraquinone Glycosides.

* Chemical constituents:

- The active composition of Aloe is Aloin.
- Chief constituent is Barbaloïn.
- Aloe also contains isobarbaloïn, β -barbaloïn, aloe-emodin & Resins.
- It also contains choline, saponins, glucosamine



Aloe-emodin



Barbaloïn

* Therapeutic uses:

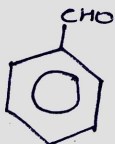
- used as a purgative.
- used for treatment of burns and sores.
- Also used in treatment of pain & itching.
- It also stimulates the growth of hairs.

* Commercial Application:

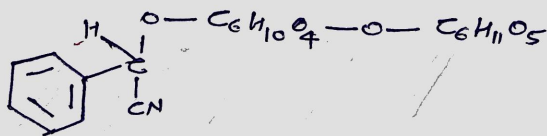
- Aloe vera gel is found in many commercial skin care products shampoo & conditioners.
- It may administered in the form of **sachets, pills or tablets.**

Bitter Almond

- * Synonyms: Amygdala amara
- * Biological source: It is obtained from dried riped seed of the plant **Prunus Amygdalus.**
- * family: Rosaceae
- * chemical class: It belongs to cyanogenic glycosides.
- * chemical constituents:
 - It contains about **40-50% of fixed oil, 20% of proteins, 1-3% amygdalin.**
 - It also contains **0.5% of volatile oils.**
 - Bitter almond oil contains **80% of Benzaldehyde & 2-6% hydrocyanic acid.**



Benzaldehyde



Amygdalin

* Therapeutic Uses.

- Used as sedative, the oil is used in demulcent skin lotion.
- It is also used in preparation of amygdalin, in perfumery & in form of liquors.
- It is also used for the treatment of heartburn, & laxative.

* Commercial Application:-

- It is employed in preparation of amygdalin & bitter almond water.

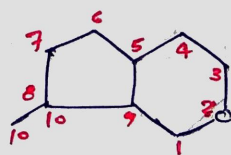
IRIDOIDS, OTHER TERPENOIDS & NAPHTHAQUINONES

IRIDOIDS

- Iridoids are the type of monoterpenoids in the general form of **cyclopentanopyron** found in wide variety of plants and some animals.
- They are biosynthetically derived from **8-oxogeranyl**



8-oxogeranyl



Iridane

- Iridoids are typically found in plants as glycosides most often bound to **Glucose** as **iridoids glycosides**.
- Structurally they are bicyclic **cis-fused cyclopentanopyrans**.
- Cleavage of a bond in the cyclopentane rings gives rise to subclass known as **secoiridoids**, **oleuropein** and **amarogentin**.
- They are found in **Rubiaceae**, **Lamiaceae**, **Scrophulariaceae**, **Acanthaceae** family.
- Alkaloids produced by plants acts primarily as a defence against herbivorous or against infection by microorganisms.

Classification

1. Iridoids Glycosides :-

Glucose unit attached with iridoids.

example - **Harpagoside**

2. Simple Iridoids

It is not attached with glucose

example - **Volarate**

3. Secoisoidoids:- cleavage of the 7 to 8 bond of cyclopentane ring of isoidoids.

example - **Grandiopicrosside**

4. Bisoidoids:- it is formed by dimerisation of isoidoids & secoisoidoids.

example - **sylbestrosside**

OTHER TERPENOIDS

- These are large group of **organic compound derivatives** of terpenes or modified terpenes.
- They are unsaturated molecules composed of linked isoprene unit, generally having the formula $(C_5H_8)_n$.
- They are colourless and soluble in organic solvent.
- They are generally optically active and volatile in nature.

classification

A. Based on value of "n" terpenoid are classified as follows:-

Values of "n"	Number of C-atom	class	Mol. formula	Examples
1.	5	hemiter/isoprene	(C_5H_8)	Isoprene
2.	10	Monoterpenes	$(C_{10}H_{16})$	Menthol
3.	15	Sequi terpenes	$(C_{15}H_{24})$	zenziberene
4.	20	Diterpenes	$(C_{20}H_{32})$	Abioticin, Vit. A.
5.	25	ses terpenes	$(C_{25}H_{40})$	Variocolol
6.	30	triterpenes	$(C_{30}H_{48})$	Squalenes, Cholesterol

B) Based on number of ring present in terpenoids-

1. Acyclic Terpenoids:-

containing open structure.

example- *Citral, citromellol.*

2. Bicyclic terpenoids:-

containing two ring in a structure

example- *Pinane*

3. Mono-cyclic terpenoids:-

containing one ring.

example- *Menthol, α -terpineol*

4. Tercyclic terpenoids:-

containing three ring in a structure.

example- *sterols.*

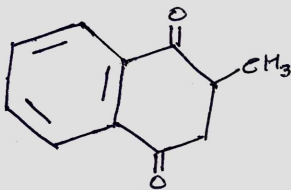
NAPHTHAQUINONES

- Naphthaquinones are widely occurring natural *Syn phenolic compounds.*
- Naphthaquinones are structurally *Naphthalene* like 2 common isomers of parent Naphthaquinone are 1,2-Naphthaquinone & 1,4-Naphthaquinones.
- Few examples of naturally occurring Naphthaquinone are *alkalmin, Juglone, Nigrosposin-B, Phylloquinone, Vitamin-K* etc...

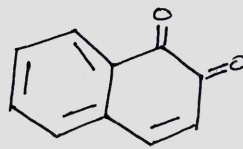
- Naphthaquinone - are yellow or orange colour pigment, mainly found in angiosperm

Family - Such as Droseraceae
> Ebenaceae.

- They are bacterial & fungal product obtained from 2° metabolites of higher plants.
- These compound are widely used as colourants for cosmetics, fabrics, food & for medicinal purpose, including anti-inflammatory & anti-microbial



1,4 - Naphthaquinone



1,2 - Naphthaquinone

▶ DRUGS :-

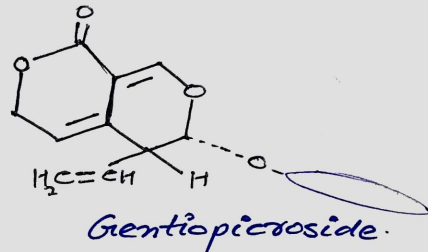
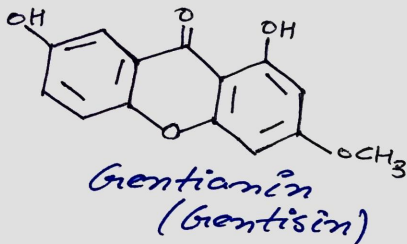
1. Gentian
2. Artemisia
3. Taxus
4. Carotenoids

Gentian

- * Synonyms :- Gentian Root, Gentiana Root, Radix Gentiane.
- * Biological source :- Gentian is the dried partially fermented + Rhizome & root of yellow Gentian, Gentiana Lutea.
- * family :- Gentianaceae
- * chemical class :- It belongs to all isoidols Groups.

* Chemical constituents:-

- Drug contain bitter glycosides mainly gentiopicrin which also known as Gentiopicroside.
- During formation & drying it's breakdown to Gentigenun & glucose.
- Drug also contains Amarogentin, Gentiocide & mixture of Gentiopicsin & Gentsin called gentinin.



* Therapeutic Uses :-

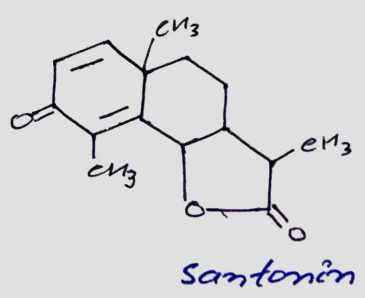
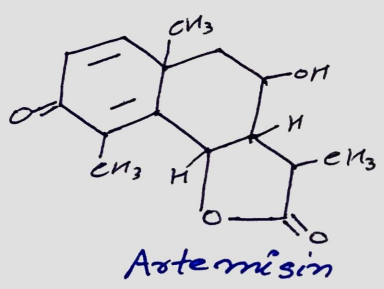
Used as a bitter tonic in stimulant gastric secretion & hence improving the appetite.

* Commercial Application :-

- Average daily dose is 2-4 gm of drug.
- KCN tea infusion also used to improvement the appetite.

Artemisia

- * Synonyms:- Worm seeds, Santonica
- * Biological source :-
It is obtained from dried aerial parts of *Artemisia annua*.
- * Family:- Asteraceae
- * Chemical class:- It belongs to sesquiterpenoids.
- * Chemical constituent:- It contains volatile oil & true crystalline substance.
(i) Santonin & (ii) artemisinin, Santanins
- The volatile oil contains cineole, pinane of resin.



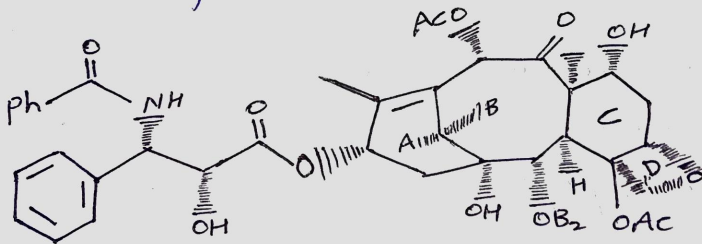
- * Therapeutic uses :-
Used as antimalarial, Antibacterial, immunomodulator.
- * Commercial Application :-
- It is used in manufacture of wine, insect repelling action.
• Used in flavouring of spirit & wines.

Taxus

- * Synonyms:- yew, Himalyan yew
- * Biological Source:- It consist of dried leaves, bark & roots of various species of *Taxus*.
Taxus paccota (mainly leaves), *Taxus preeifolia* (stembark), *Taxus comatensis* (leaves & roots).
- * Chemical class:- belong to Diterpenoids.

* Chemical constituent:-

- Main constituents is Taxol (Paclitaxel), cephalomannine.
- Others are caryophyllene oxide, farnesol.



Taxol

* Therapeutic Uses:-

- Used as anticancer, analgesic, anti-inflammatory, antidiarratic, anticonvulsant.
- Taxol is used in the treatment of breast, ovarian & lung cancer.

* Commercial Application:-

- It is used in injection form.
- is available in different form called paclitaxel albumin establish nano particle formulation.

Carotenoids

* Synonyms:- carotenoids

* Biological source:-

They are plant pigments such as bright red, yellow & orange colour which are available in fruits, vegetables. Even they are available in algae & Bacteria.

* Chemical class:- Belongs to Tetraterpenoids
18 isoprene units

* Chemical constituents:- These are more than 600 types of carotenoids.

• Among them the most important are α -carotene, β -carotene, β -cryptoxanthin, lutein, zeaxanthin & Lycopene

There are two different chemical classes -

- 1) carotenes
- 2) xanthophylls

1) carotenes:- carotenes are hydrocarbons and do not contain oxygen.

2) xanthophylls:- They contain oxygen.

carotenoids are classified as-

- a) Provitamin A
- b) Non provitamin A

a) Provitamin A:- Provitamin A is turn into Vitamin A (retinol) in the intestine or liver.

- Vitamin A helps to maintain eye health and provides immunity.

example - α -carotene, β -carotene, β -cryptoxanthin.

- Mango, papaya, carrots, sweet potato and pumpkin are good sources of β -carotene. Whereas α -carotene obtain from tomatoes, pumpkin, carrots.

b) Non provitamin A:-

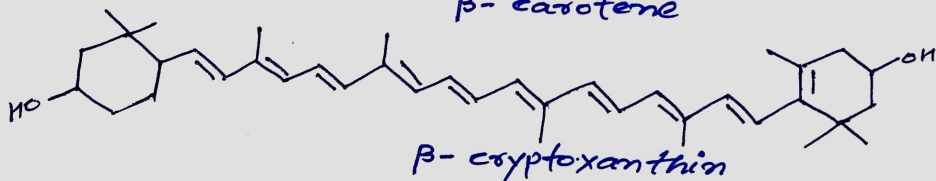
These are lutein, zeaxanthin and lycopene, because they cannot be converted into retinol.



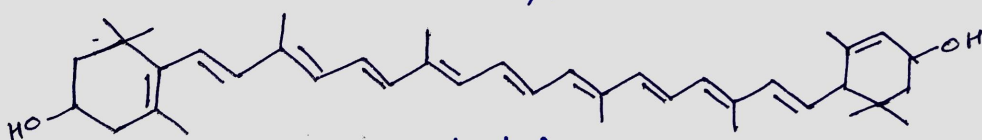
α -carotene



β -carotene



β -cryptoxanthin



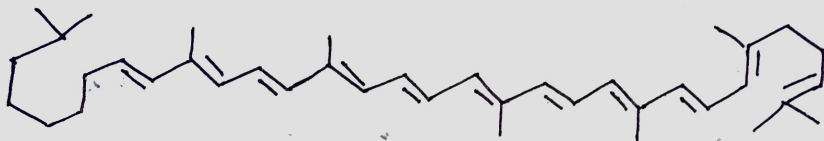
Lutein

* Lycopene:- Lycopene is a naturally occurring plant nutrient that gives fruits and vegetable a red colour.

It is found in tomato, red orange, watermelon, and guava.

function- Lycopene is used as a heart protection, against sunburn, certain type of cancer, reduce high BP.

- It protects against oxidative damage to lipids, proteins and DNA.



Lycopene