

Terpenes



- * What are Sesquiterpens and Diterpenes**
- *Their types.**
- *How we can synthesis it?**
- *Their biological activities**
- *Their natural occurrence**

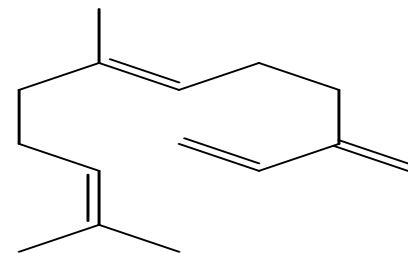
3-Sesqueterpens

15 carbons, three isoprene units

Types of Sesqueterpens

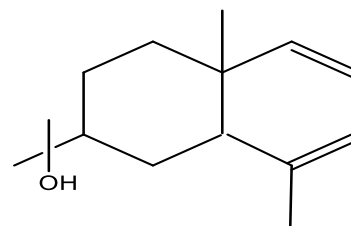
Perfumes
& insecticide

:Aliphatic



farnesene

:Monocyclic (ب) الحلقة الواحدة



Elemol

Increase the body immunity & prevent vomiting

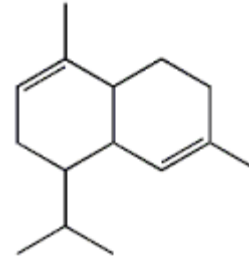
3-Sesquiterpens

:Bicyclic

Divided into two types

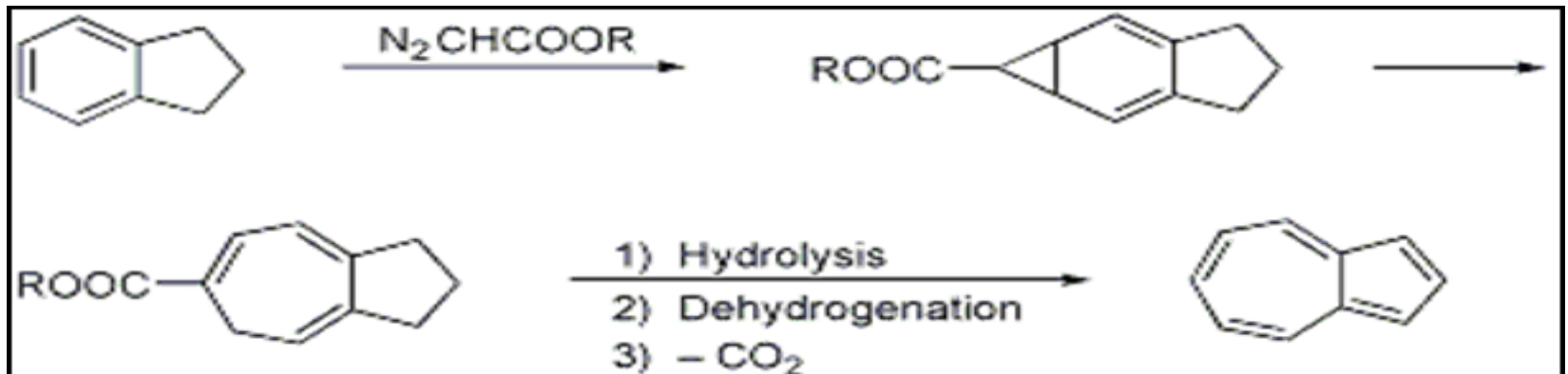
naphthalene (1)

used in skin cosmetics



alpha-cadinene

azulene (2)



Azulene

in asthma & joint pains

3-Sesqueterpens

:Tricycle (د) ثلاثية الحلقة

α -Santalene

α -Santalol

antiseptic & perfume

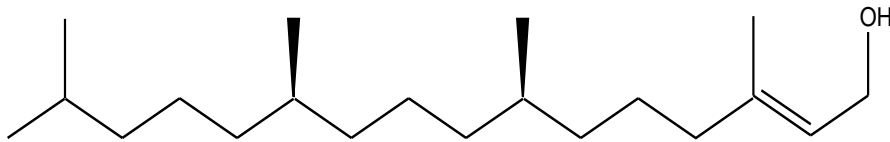
4-Diterpenes

Diterpene, a type of terpene, is an organic compound composed of four isoprene units and has the molecular formula $C_{20}H_{32}$

Five types

1-Aliphatic

Phytol فایتول



It is diterpene alcohol that is a precursor for vitamins E and K1. Which is important in blood clotting & as antioxidant

2-Monocyclic

Retinol , vit. A1

for the maintenance of the immune system and good vision

4-Diterpenes

3-Bicyclic

Clerodane

4-Tricyclic

Labdane

5-Tetracyclic

Kaurane



4-Diterpenes

Medicinal use

Taxol- an anti cancer drug From bark of Pacific Yew

Triterpenes

- Open chain.
- One cyclic.
- Pentacyclic
- Steroids

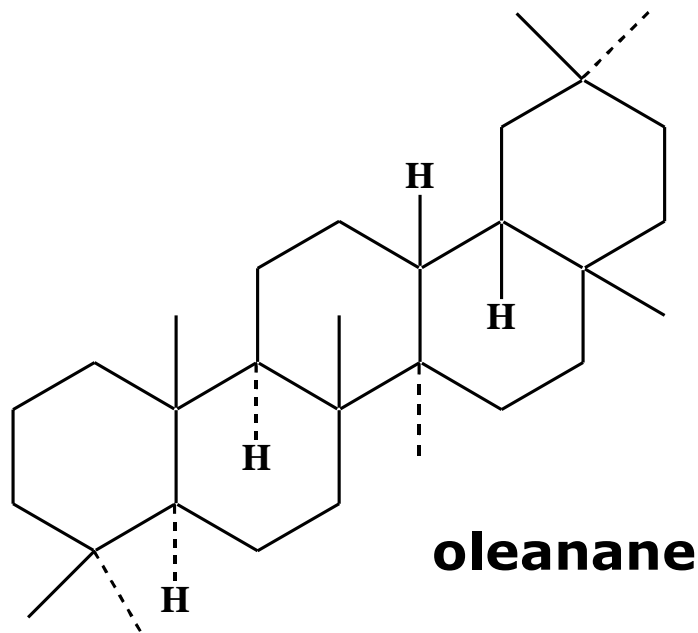


- * **What are Triterpenes, Tetraterpenes & Polyterpenes**
- * **Their types.**
- * **How we can synthesis it?**
- * **Their biological activities**
- * **Their natural occurrence**
- * **Identification**

Triterpenes

Triterpenes are terpenes consisting of **six isoprene** units and have the molecular formula $C_{30}H_{48}$. The pentacyclic triterpenes can be classified 3 classes

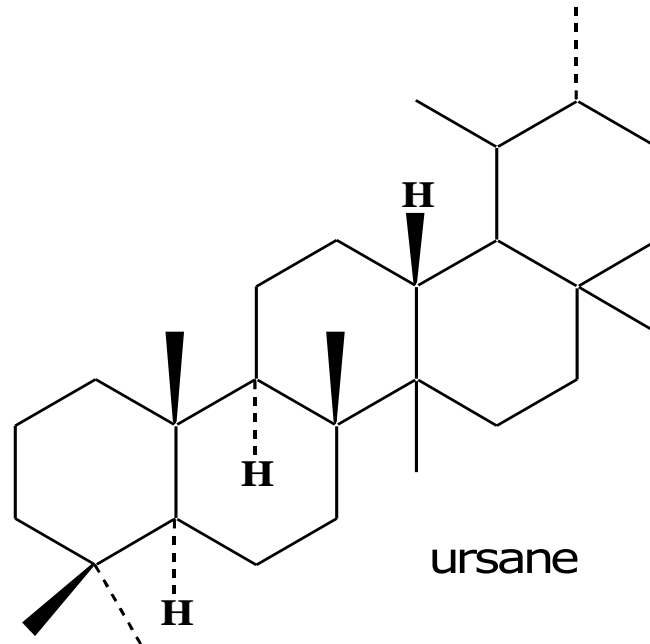
lupane, oleanane or ursane groups..



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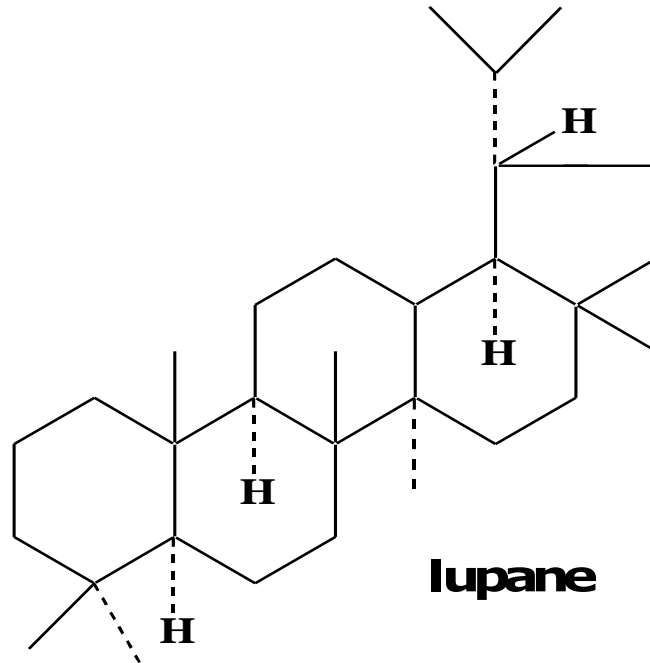
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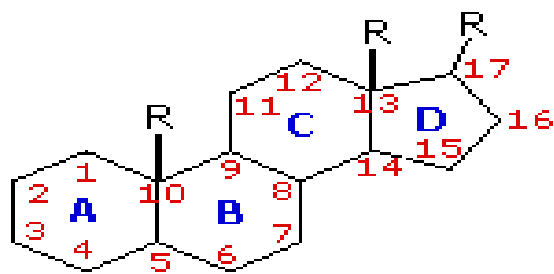


Triterpenes

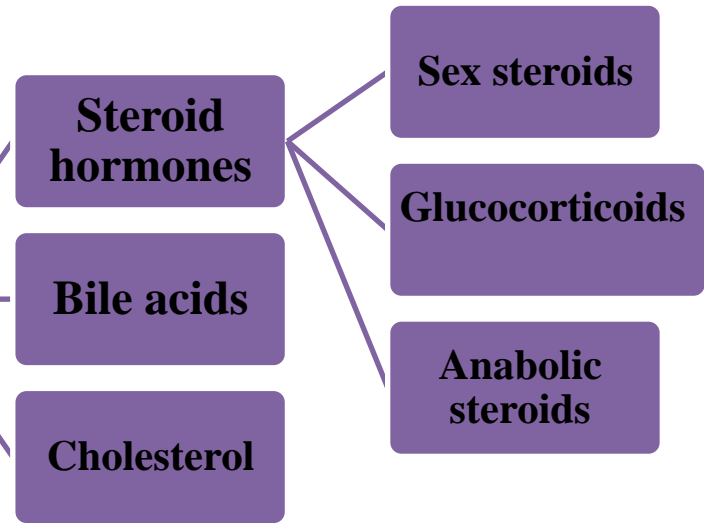
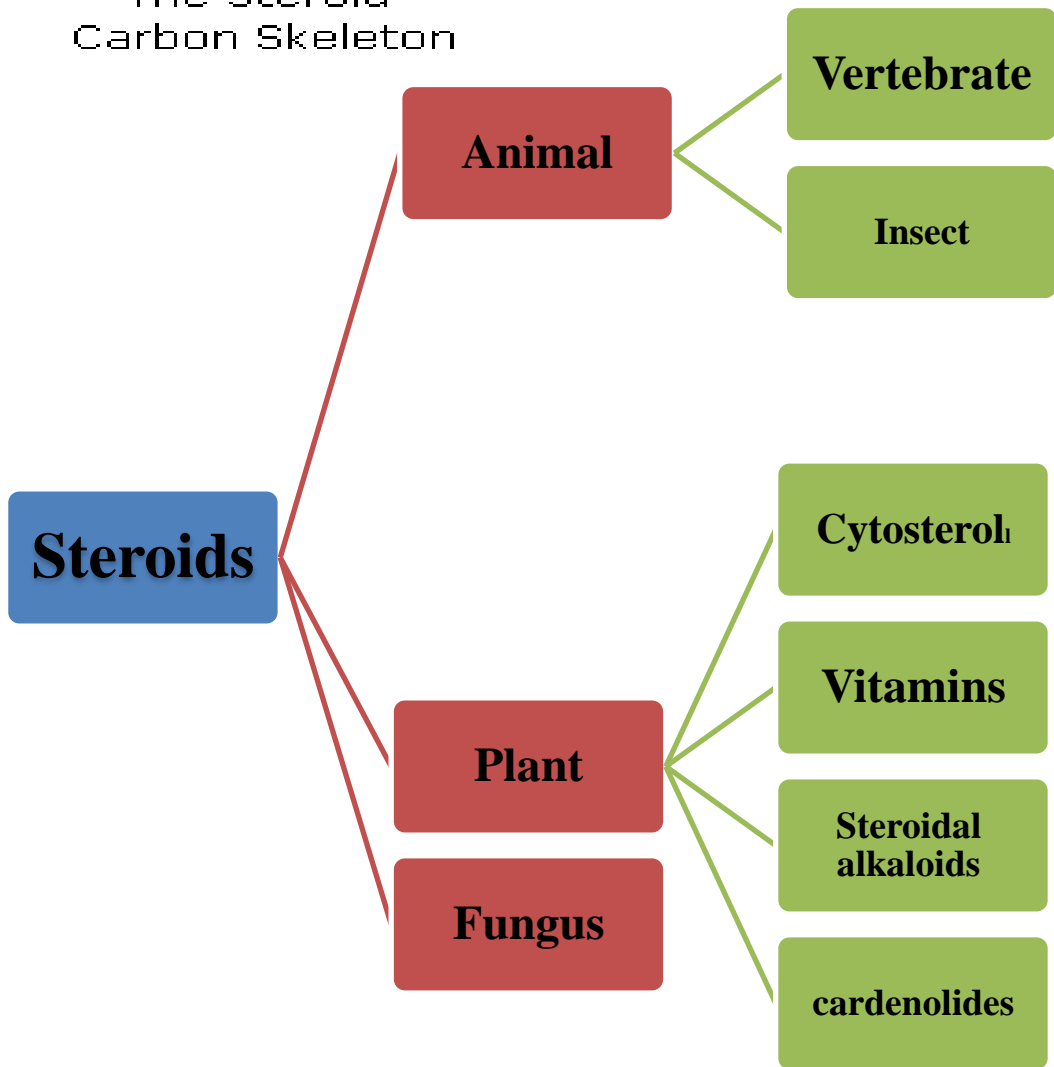
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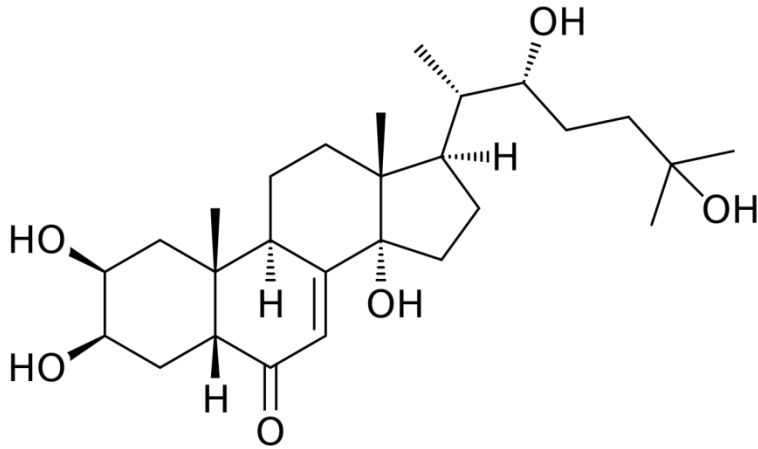
The Steroid Carbon Skeleton



Steroids, are derivatives of the triterpene squalene.

Animal steroids

1- Insect steroids



Ecdysteroids

- Produced by endocrine gland (prothoracic).
- Sex steroid, control several important aspects of reproduction.

2-Steroids Vertebrate

1- Steroid hormones

I. Six hormones:

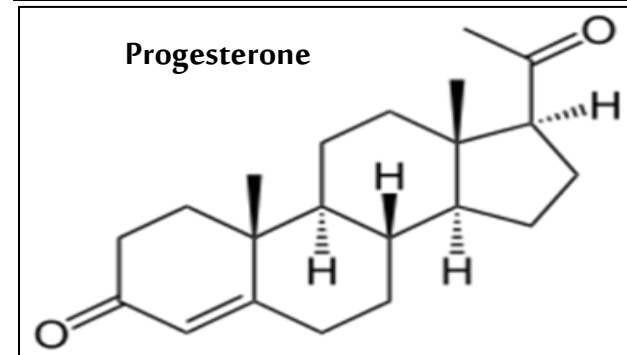
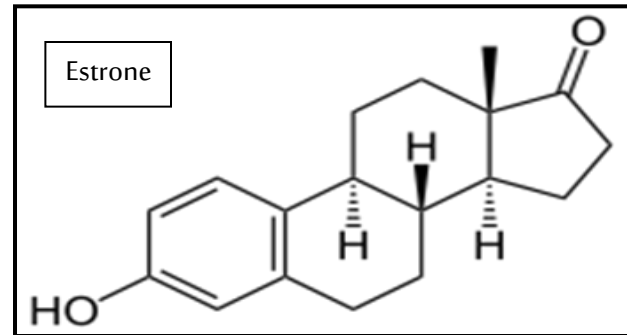
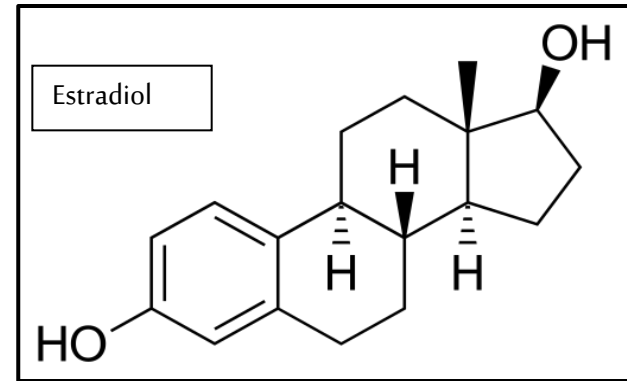
1-Eestrogens

are a group of compounds named for their importance in both menstrual and estrous reproductive cycles.

eg. **Estrone & Estradiol**

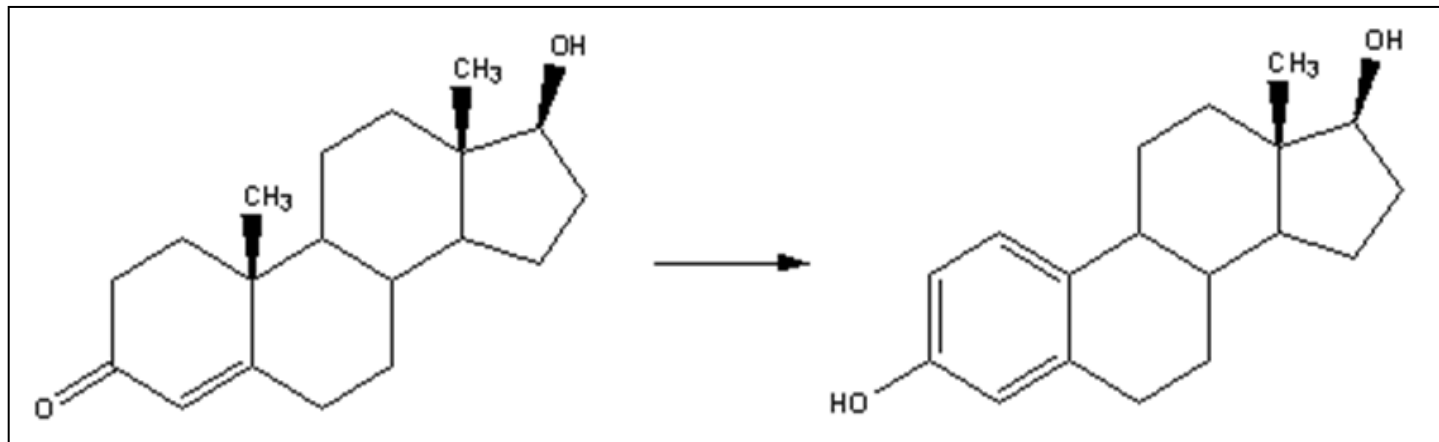
2-progestogens

involved in the **female menstrual cycle**, pregnancy (supports gestation) and embryogenesis of humans and other species



Synthesis of Estrone

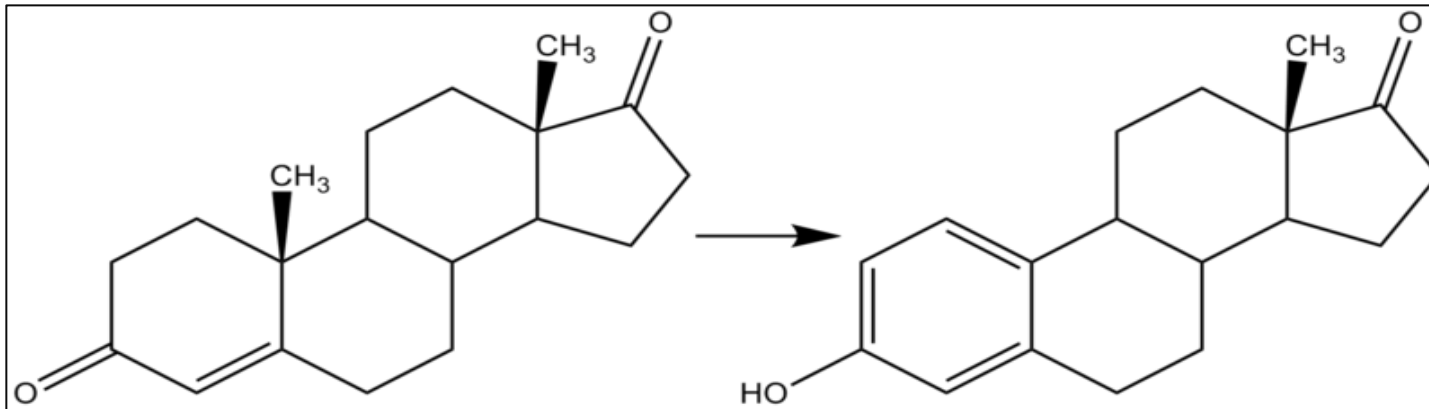
Estrone is synthesized via aromatase from androstenedione, a derivative of progesterone. The conversion consists of the demethylation of C-19 and the aromaticity of the 'A' ring. This reaction is similar to the conversion of testosterone to estradiol



Conversion of testosterone to estradiol

Synthesis of Estrone

Estrone is synthesized via aromatase from androstenedione, a derivative of progesterone. The conversion consists of the demethylation of C-19 and the aromaticity of the 'A' ring. This reaction is similar to the conversion of testosterone to estradiol

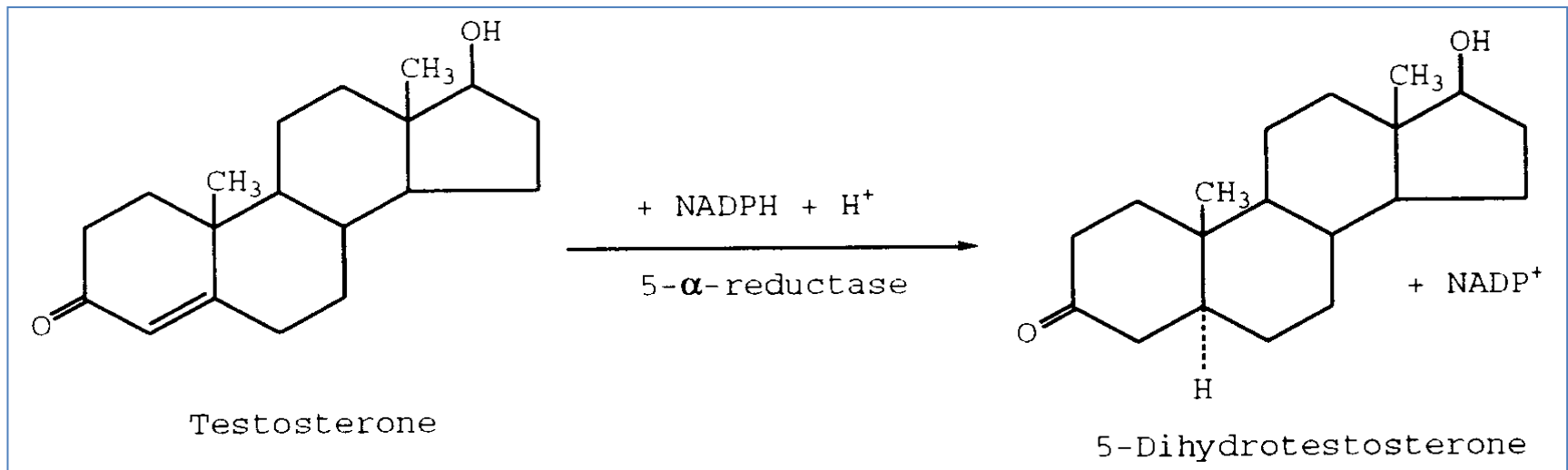
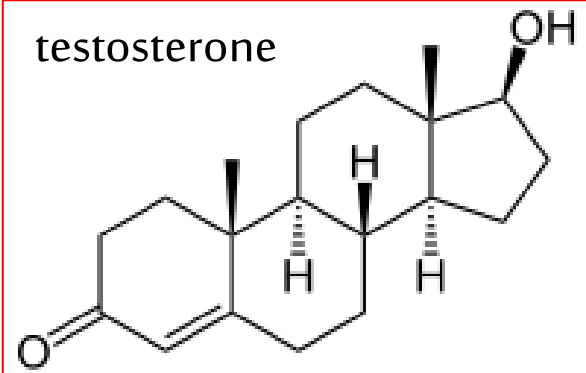


Conversion of Androstendione to Estrone

3-Androgens

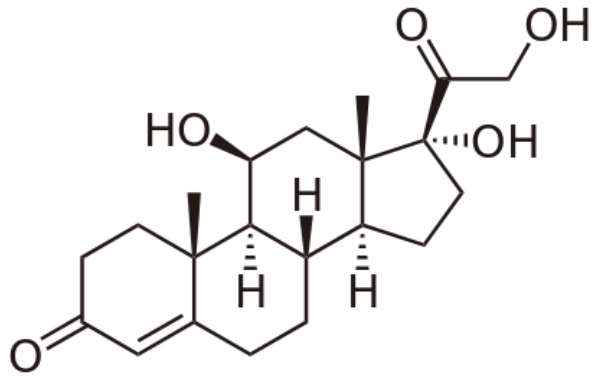
is the generic term for any natural or synthetic compound that stimulates or controls the development and maintenance of male characteristics in vertebrates

Eg. testosterone plays a key role in the development of male reproductive tissues

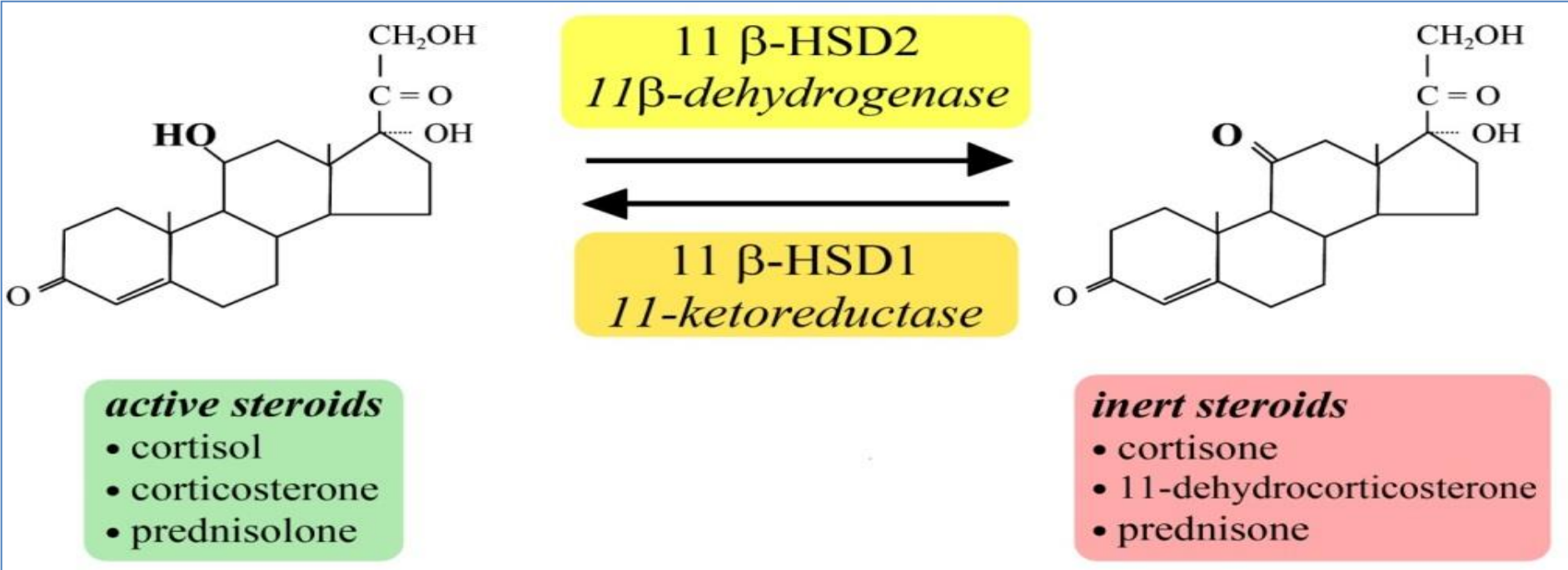


II-Glucocorticoids

Glucocorticoids regulation of the metabolism of glucose, its synthesis in the adrenal cortex. The name glucocorticoid (pertaining to **glucose** + **cortex**)



Cortisol



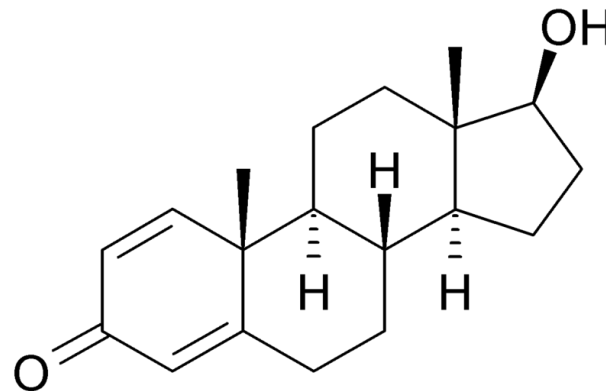
- active steroids**
- cortisol
 - corticosterone
 - prednisolone

- inert steroids**
- cortisone
 - 11-dehydrocorticosterone
 - prednisone

III -Anabolic steroids

Anabolic steroids, technically known as **anabolic-androgenic steroids (AAS)**

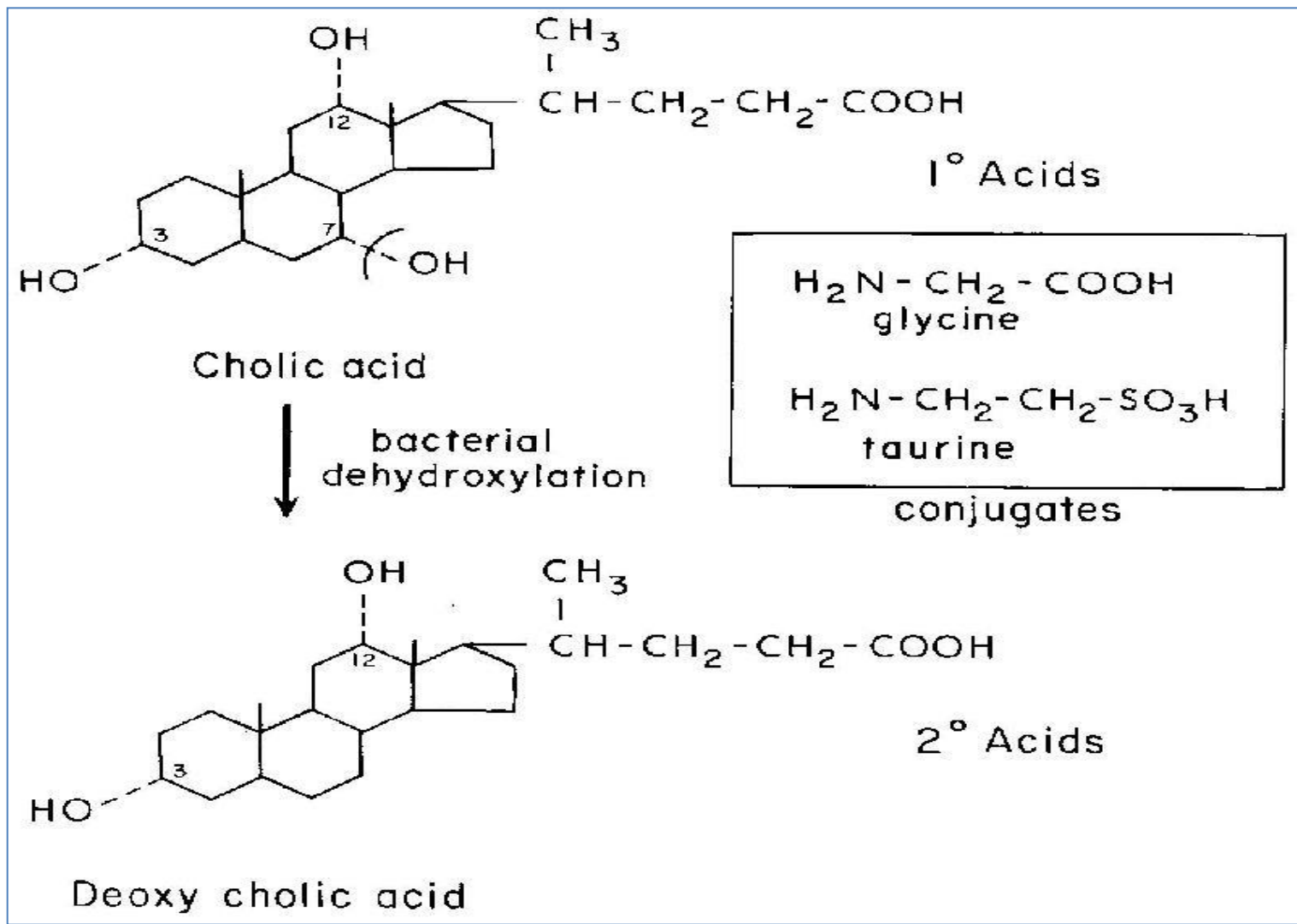
are drugs that have similar effects to testosterone in the body. They increase protein within cells, especially in skeletal muscles



Boldenone

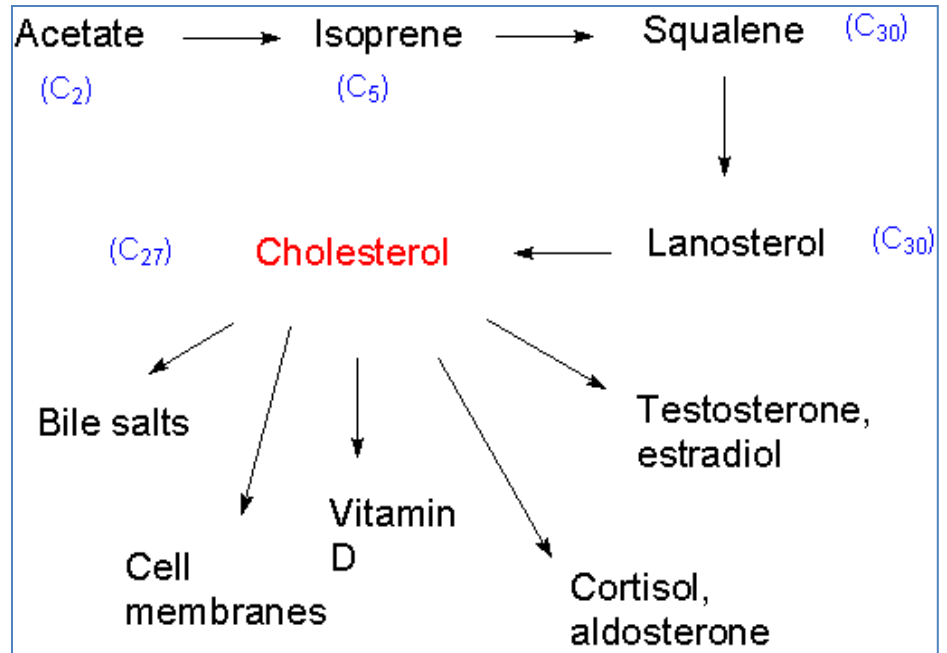
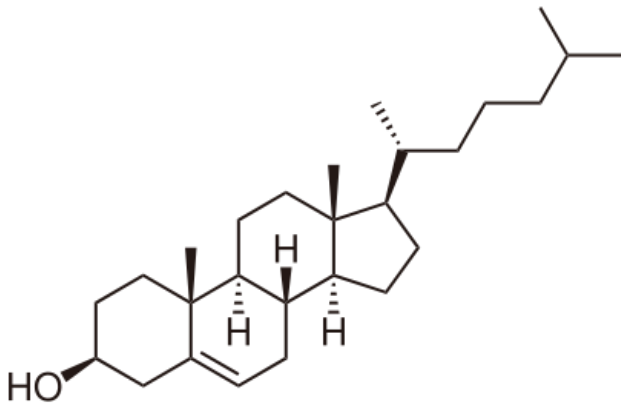
2- Bile acids

COOH in side chain Secreted by gallbladder Help absorption of fats



3-Cholesterol

Cholesterol helps the body produce hormones, bile acid, and vitamin D



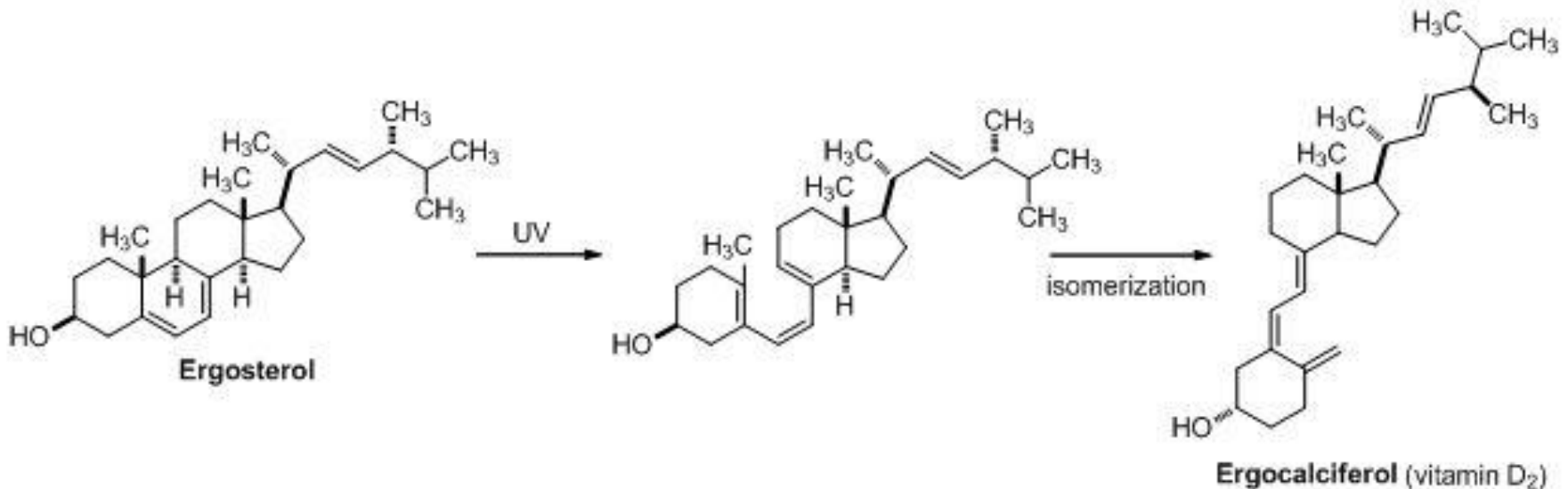
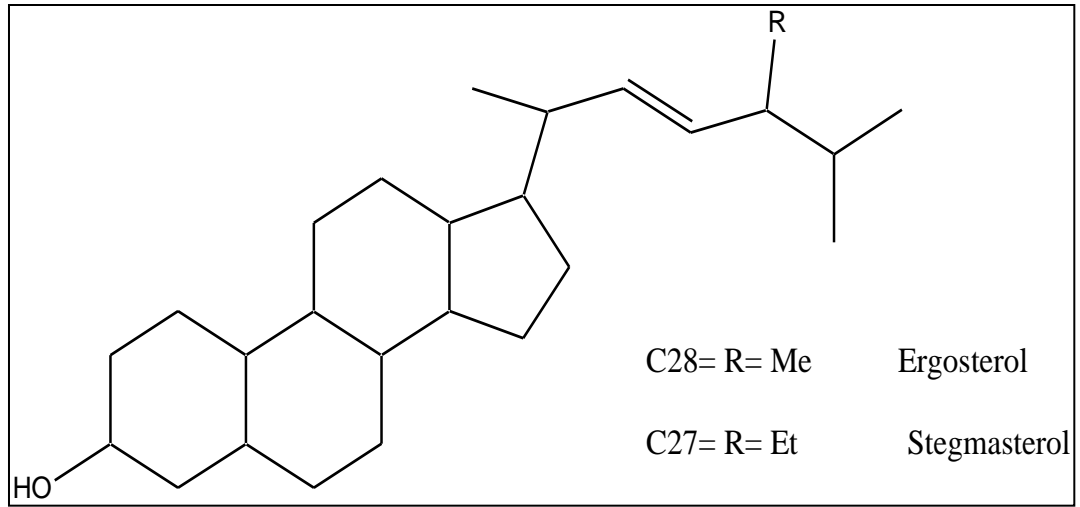
Plant steroids phytosterols

1-Cytosterol

include β -sitosterol, campesterol, ergosterol

Eg. Ergosterol is a biological precursor (a provitamin) to vitamin

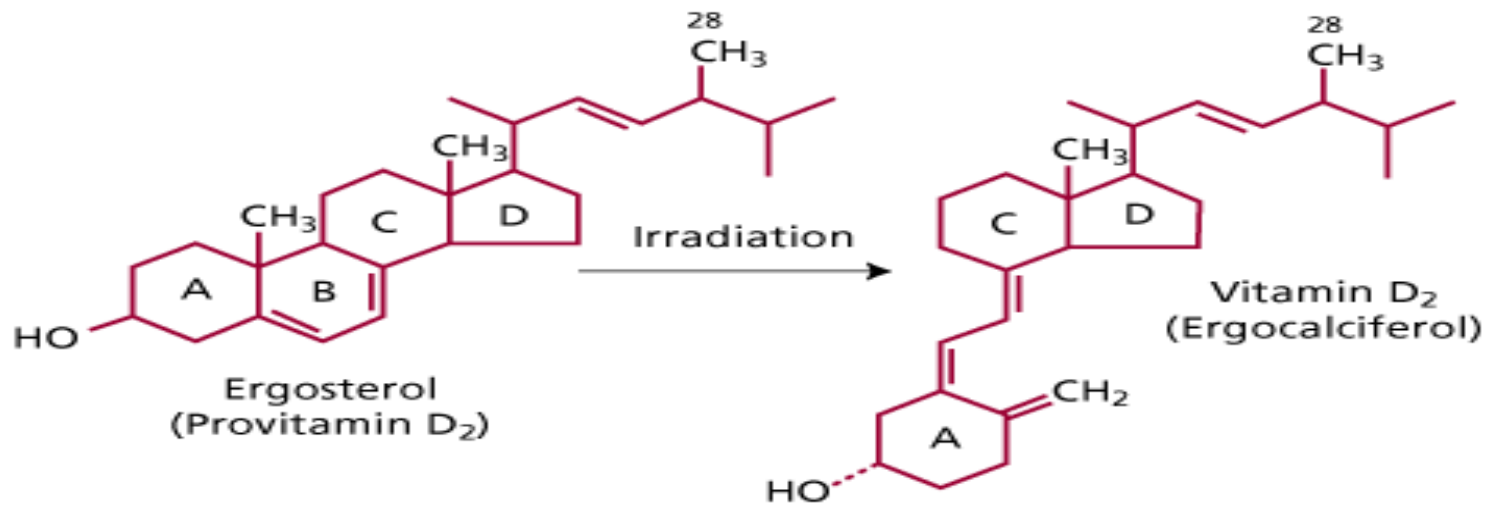
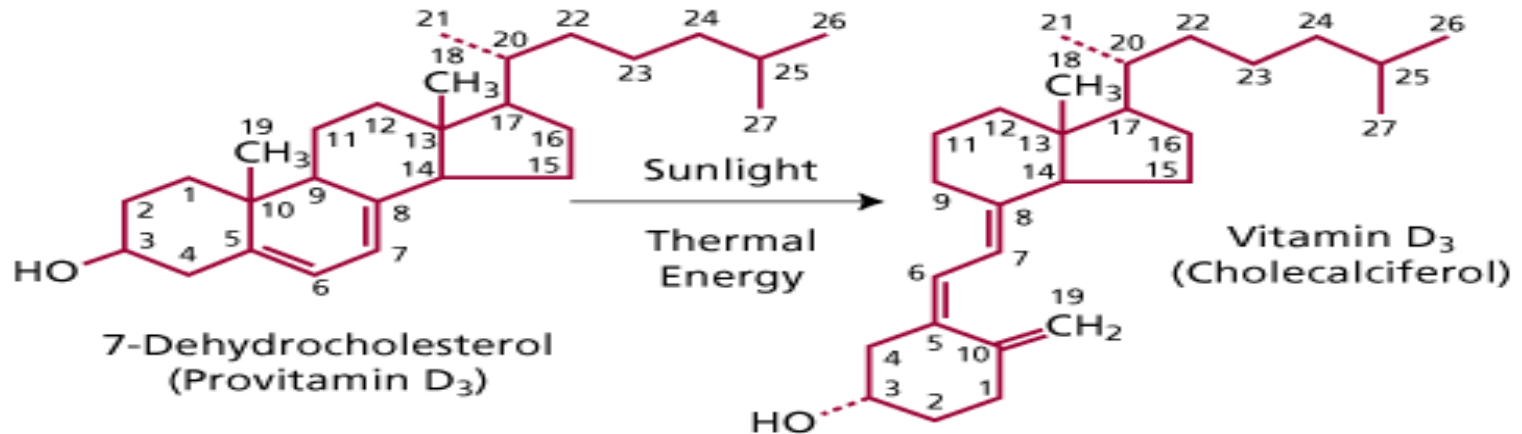
D_2
A sterol found in yeast and fungal cell membranes



2- Vitamins

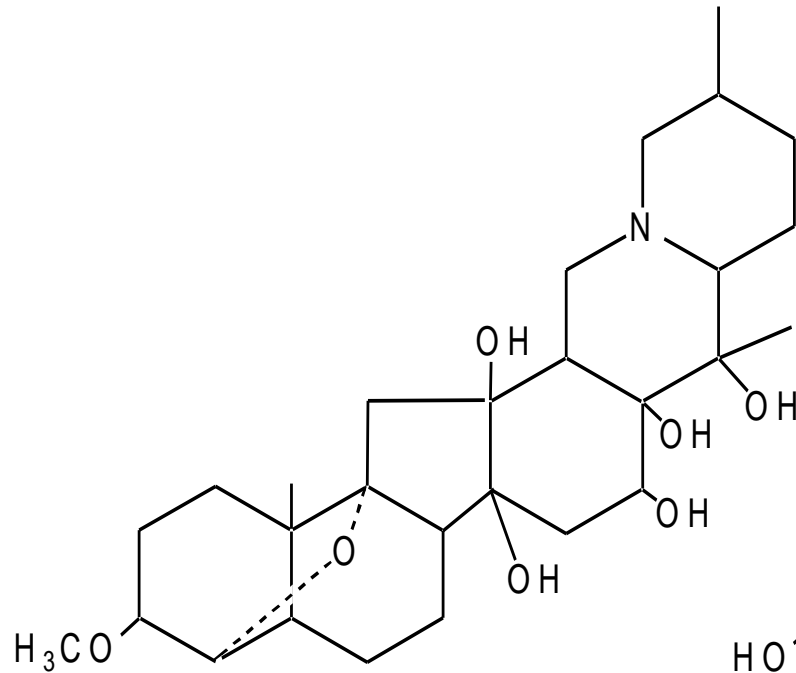
Vitamin D2 is important for bone growth

Ergosterol is converted to Vitamin D2 by a photochemical-ring opening reaction

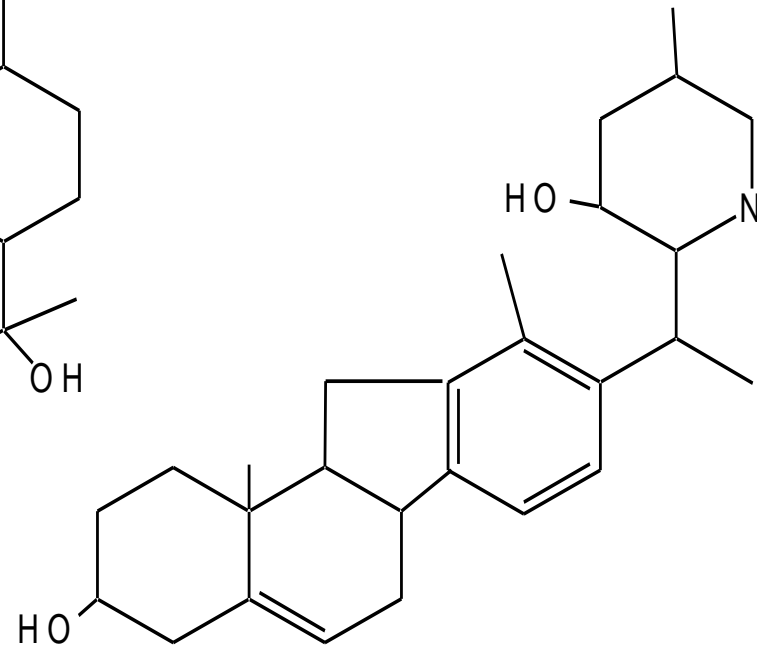


३- Steroidal alkaloids

1- Veratrum alkaloids

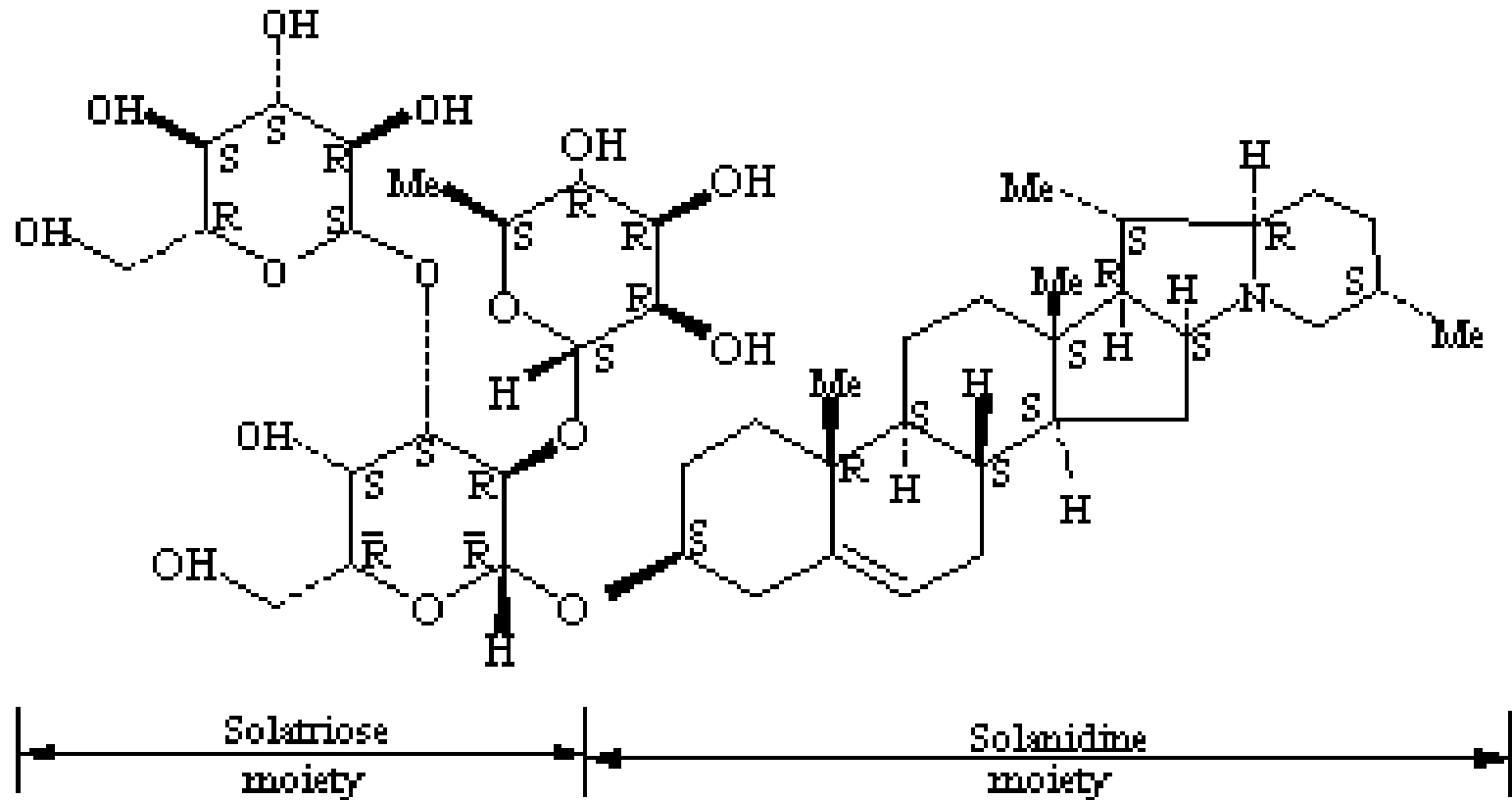


Veratridine



Veratramine

2- Solanum alkaloids

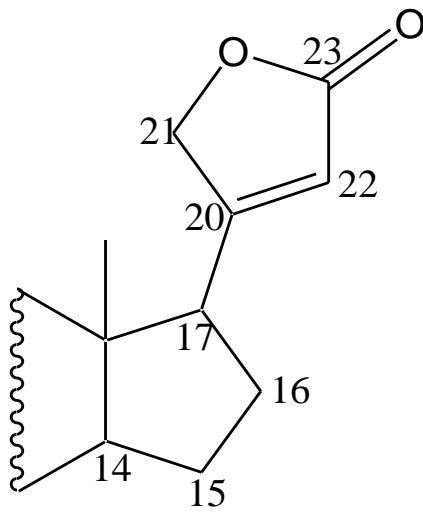
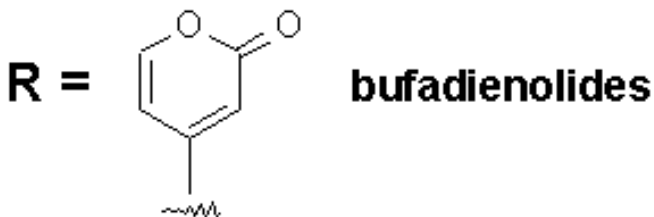
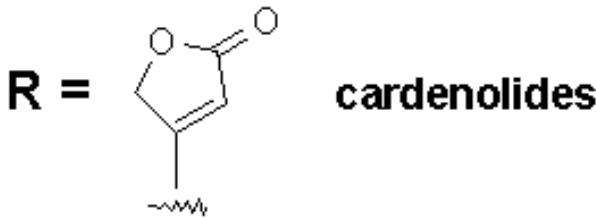


4- Cardenolides & bufadienolides

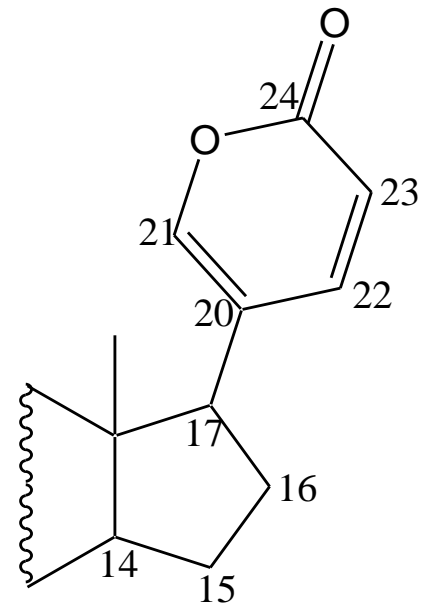
22-24 carbon atoms, carbon 3 linked with sugar

Cardenolides (five lactone ring, unsaturated at carbon 17)

Bufadienolide (six lactone ring, unsaturated at carbon 17)



Lactone ring of Cardenolide

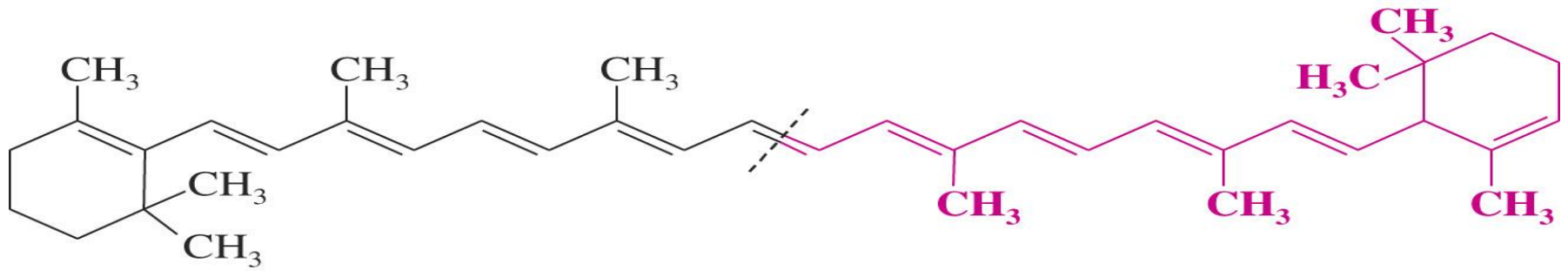


Lactone ring of Bufadienolide

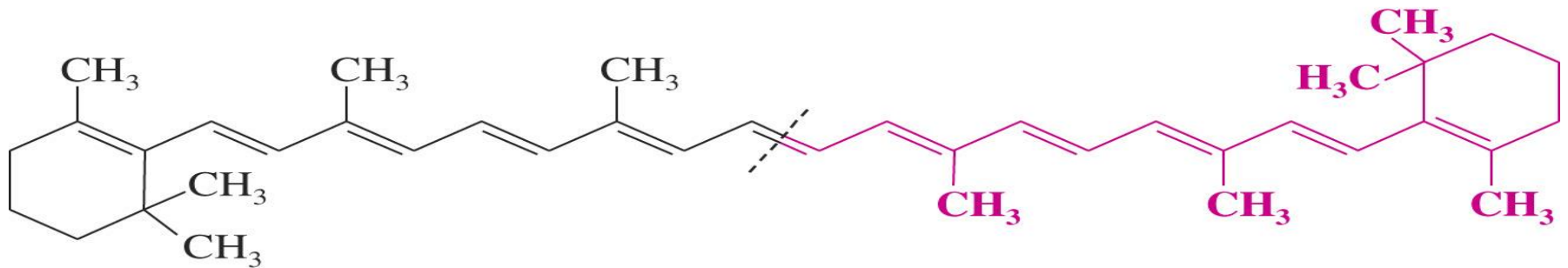
Tetraterpines

The carotenes are biosynthetic precursors to Vitamin A.

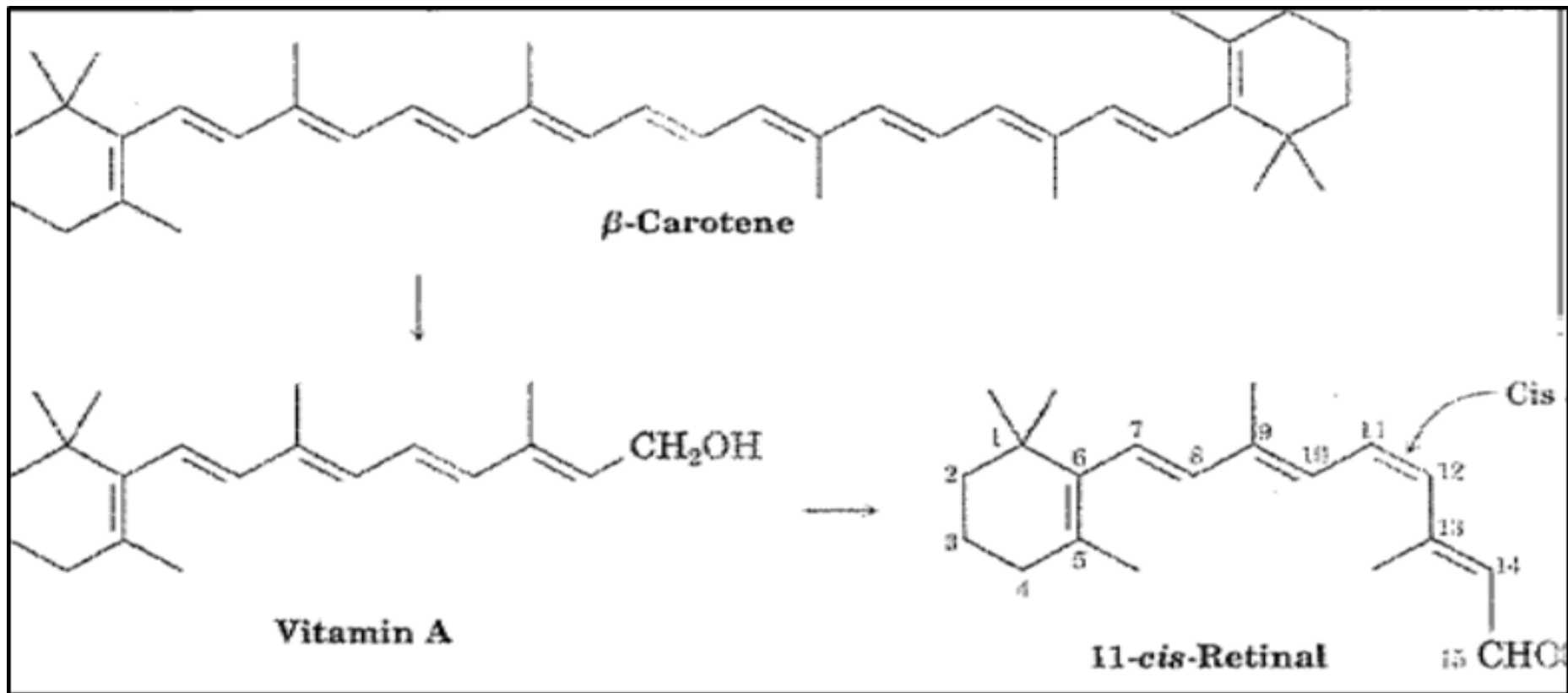
Carotenes are converted to vitamin A by enzymes in the liver



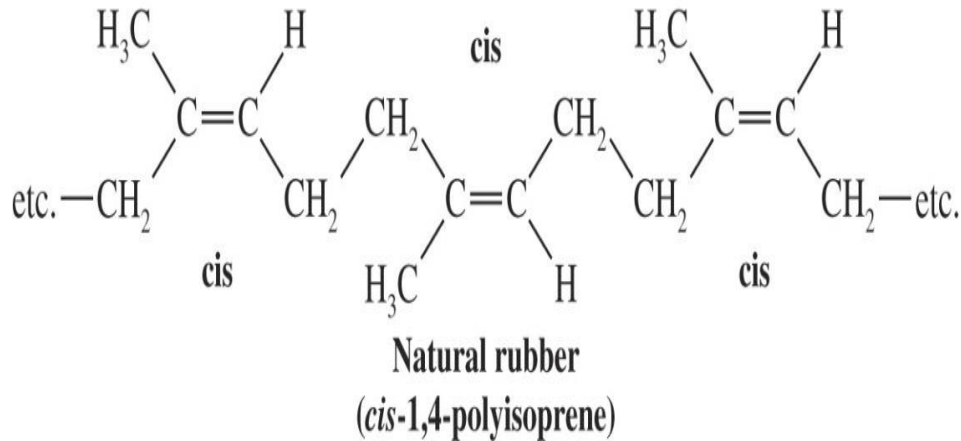
α -Carotene



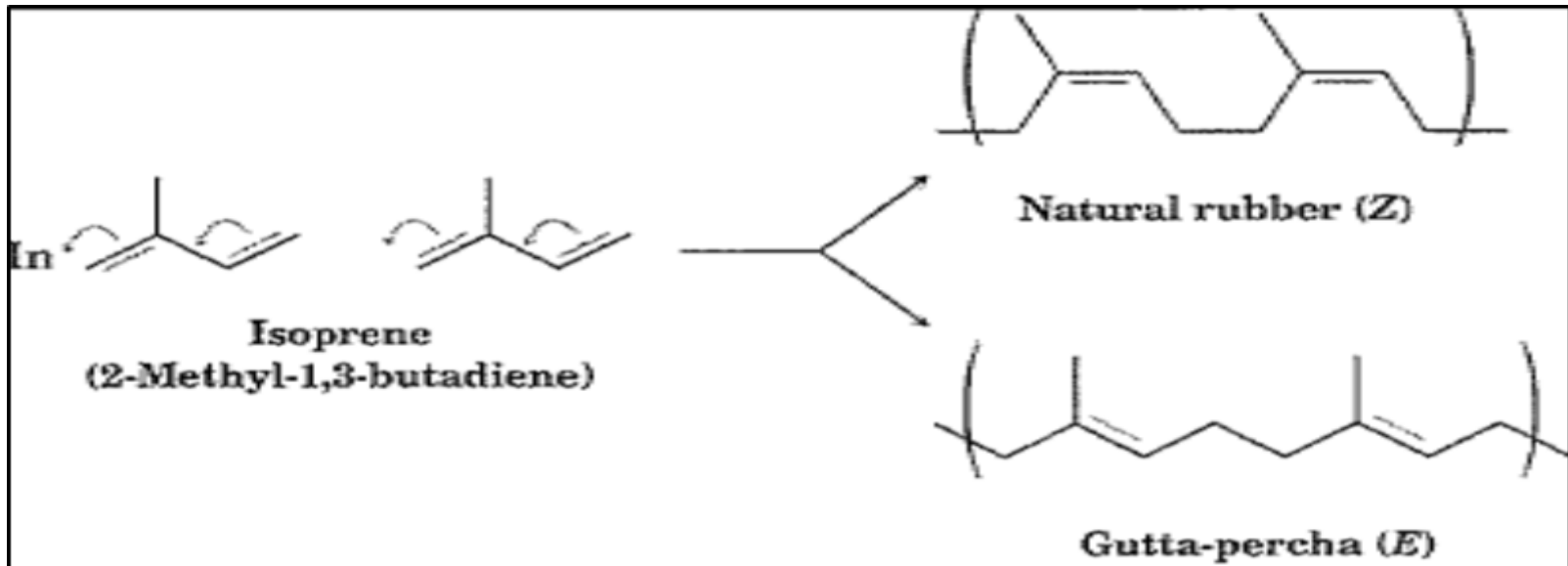
β -Carotene



Polyterpines



Natural rubber can be viewed as a 1,4-addition polymer of isoprene. Isoprene units in natural rubber are linked head-to-tail and all of the double bonds are cis



Structure Elucidation

1-Color reactions

a) Libermann-Burchard test:

chloroform filtrate + few drops of acetic anhydride, boil and cool, >>>>>>>>>>>> con. Sulfuric acid (the sides of the test tube), shows a **brown ring** (the junction of two layers) and (upper layer turns green) which shows (Steroids) and formation of **deep red** color (triterpenoids)

b) Salkowski's test:

chloroform filtrate few drops of cone. Sulfuric acid, shake well and allow standing for some time, red color appears at the lower layer indicates the presence of Steroids and formation of yellow colored lower layer indicates the presence of Triterpenoids.

2-Physical Mehtods

Molecular formula , Specific rotation & Refractive index

3-Spectral Methods

UV, IR, MS& NMR

2- Physical Methods

1. Molecular formula

Empirical formula can be found out by **elemental analysis**. While molecular weight can be determined by vapour density, elevation of boiling point and depression of freezing point.

2. Specific rotation

Specific rotation of a compound is measured to ascertain the **optical activity** exhibited by it. It helps to distinguish between optical isomers.

3. Refractive index

It is measured to calculate **the value of molecular refraction**, which is useful to find out the nature of the carbon skeleton especially in the case of sesquiterpenoids.

3-Spectral Methods

1-UV

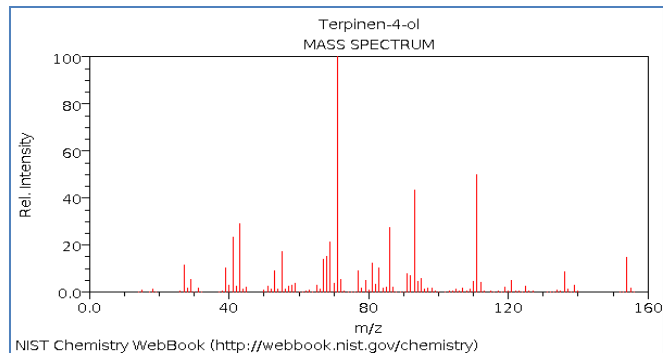
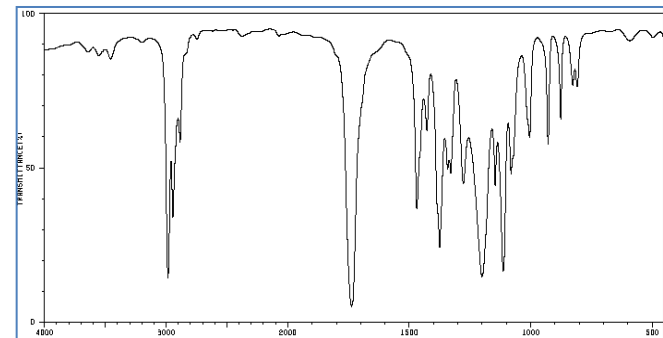
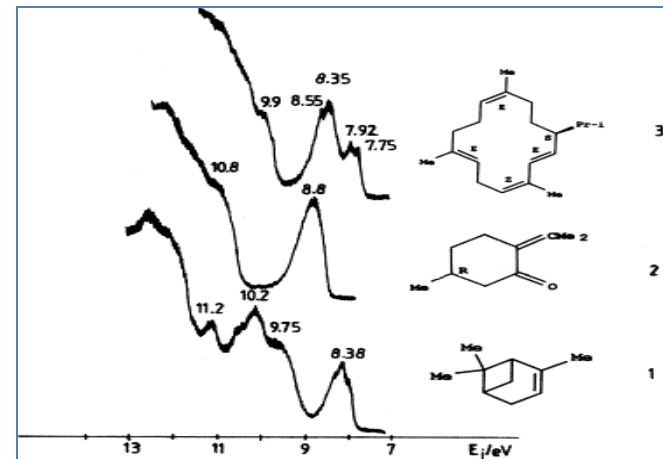
Functional groups, present in terpenoids, which absorb in the UV range between 200-350nm are termed as chromophores. However UV data becomes valuable only when the terpenoid molecule contains conjugated double bonds and/or α,β -unsaturated carbonyl group.

2-IR

This method is routinely used for the identification as well as the structure elucidation of new terpenoids.

3-MS

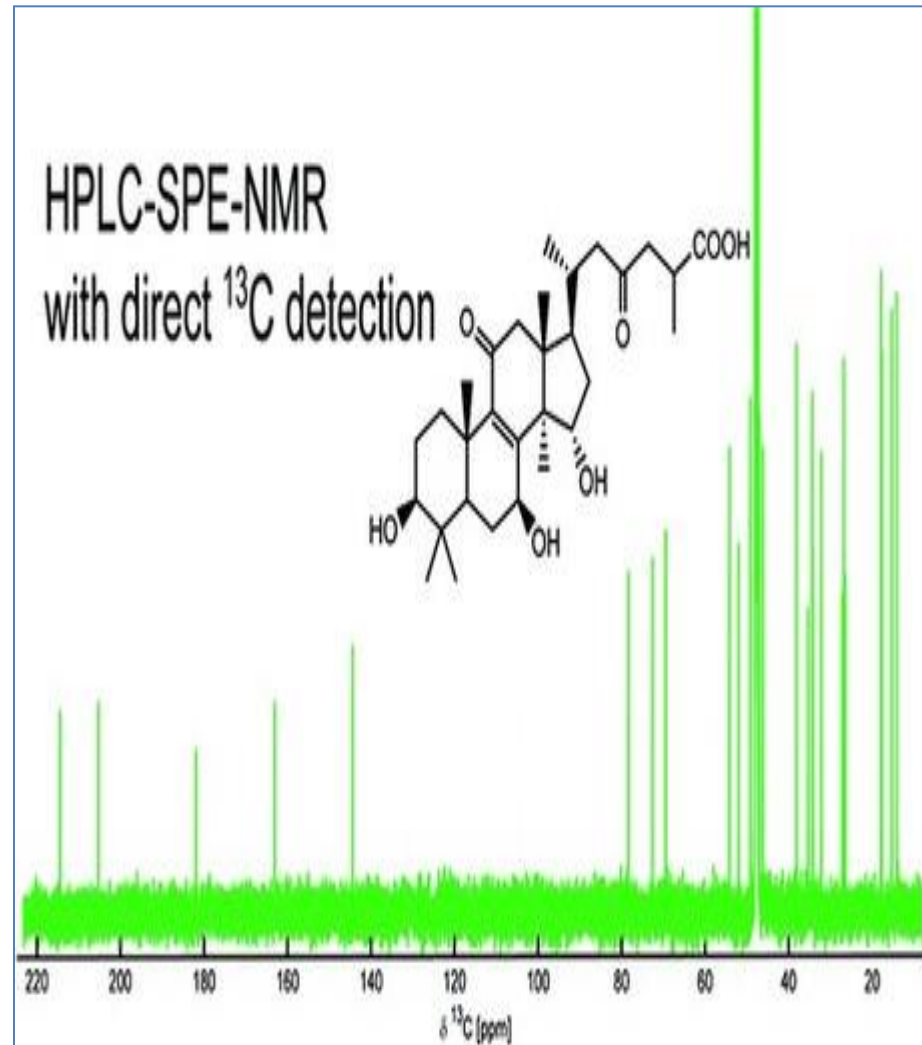
MS affords the exact molecular ion peak along with diagnostic fragmentation patterns of the terpenoid molecule. It is an important tool for the structure determination

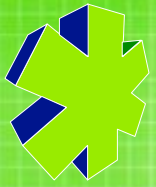


4. NMR

- NMR spectroscopy comprising of both **HMR** and **CMR** is in fact one of the

The combination of 1D selective and 2D NMR techniques such as **COSY**,





Thank you!