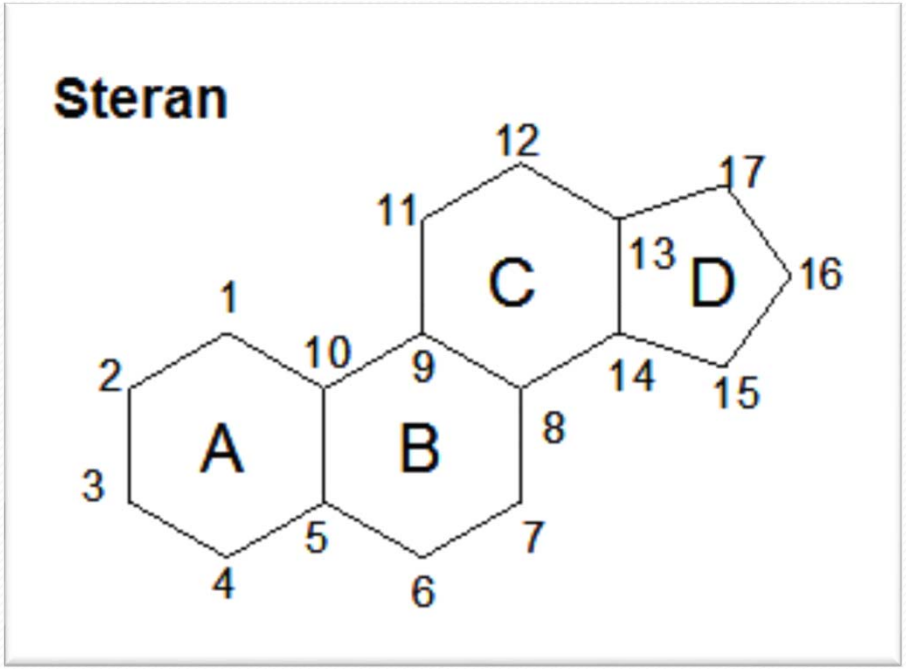
STEROIDS

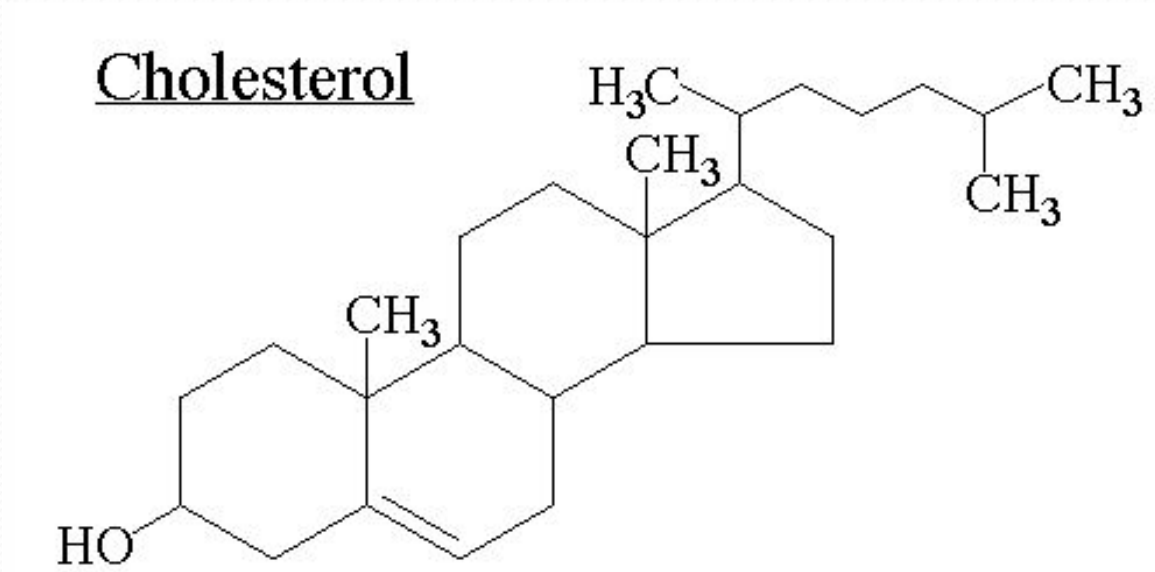
Steroids are the organic compounds containing the steroid nucleus – a tetracyclic system, consisting of three cyclohexane rings (A, B, C) and a cyclopentane ring (D), called steran (or by systematic nomenclature - ciclopentanperhidrofenantren). We refer to steroids *cholesterol, steroid hormones, bile acids, vitamin D.*



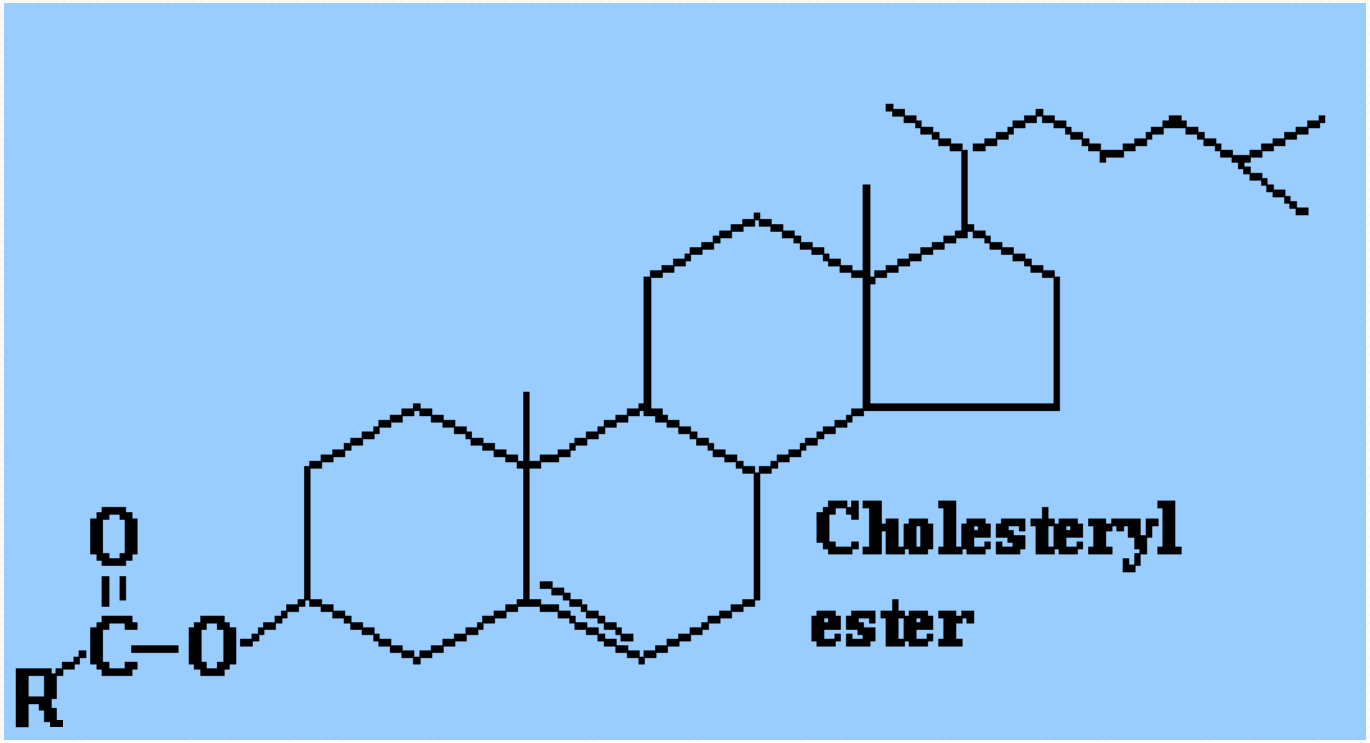
The most important steroid is

Cholesterol

It is a vital constituent of cell membranes and the precursor of steroid hormones and bile salts, yet its deposition in arteries has been associated with heart disease.



In animal tissues, especially in the liver, adrenals and plasma lipids cholesterol is esterified by a variety of fatty acids and most frequently by essential fatty acids, thus forming **cholesterol esters**:



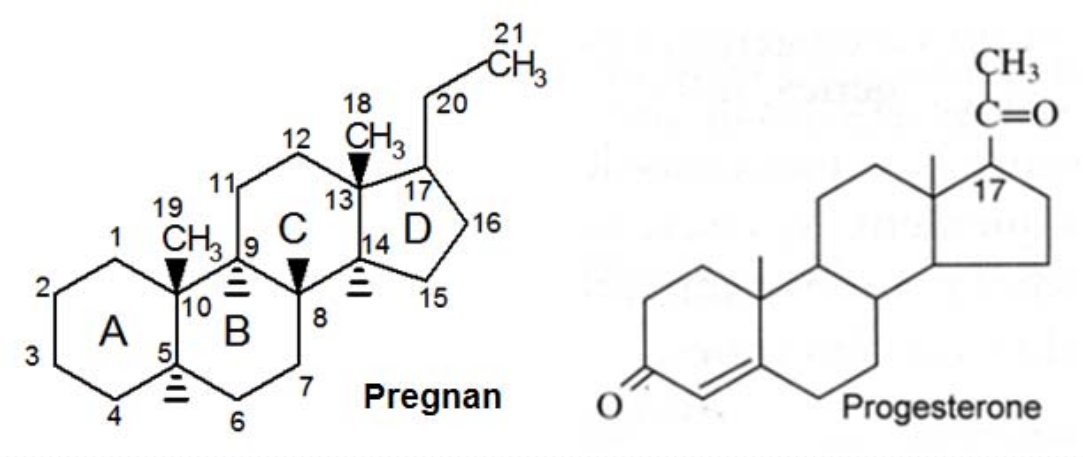
STEROID HORMONS

There are **four groups of steroid hormones: gestagens -** progesterone (corpus luteum hormone), **corticosteroids** (adrenal cortex hormones), **androgens** (male sex hormones), **estrogens** (female sex hormones**).**

At the basis of the chemical structure of the gestagens and corticosteroids, is **a saturated hydrocarbon - pregnane (10,13-dimethyl-17-ethylsteran) – with 21 carbon atoms.**

Pregnane is the parent of progesterone and several adrenocortical hormones.

Progesterone is a steroid hormone secreted by the corpus luteum of the ovary, or by placenta. He has the ability to transform the endometrium, favoring implantation of the fertilized egg in the uterine mucosa during pregnancy.

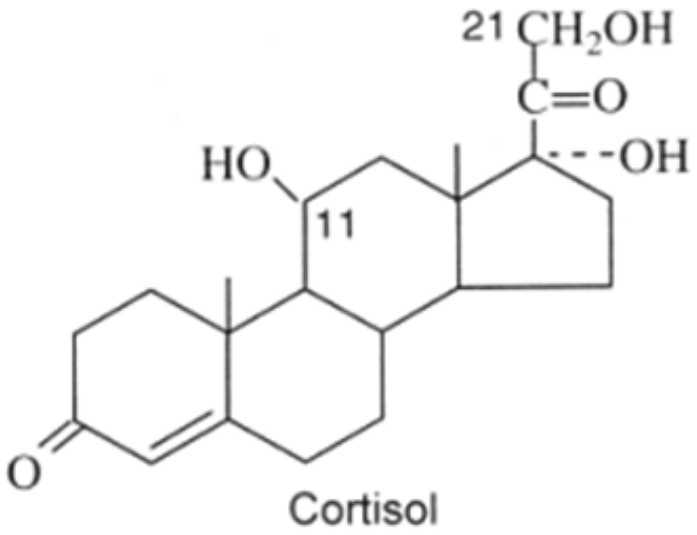


Corticosteroids

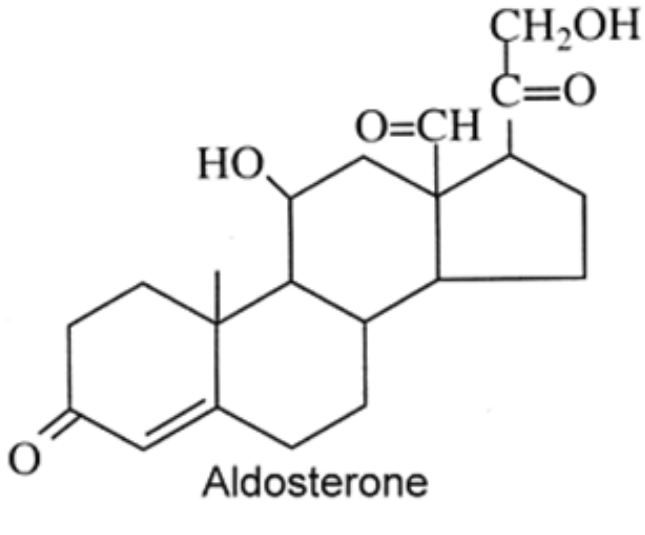
Corticosteroids (adrenal cortex hormones) regulates thr carbohydrate metabolism (glucorticoids) and hydro-saline metabolism (mineralocorticoids).

The most important representative of glucocorticoids is **cortisol** (11β-,17α-, 21-trihydroxy-pregnen-4-dione-3,20). It acts as an antagonist of insulin, increasing blood glucose, activating the gluconeogenesis in the liver (the synthesis of glucose).

The most important mineralocorticoid is **aldosterone**, produced in the *zona glomerulosa* of the adrenal cortex. It works especially at the level of distal and collectors tubules of the nephron, stimulating the reabsorption of sodium and water and excretion of potassium, resulting in increased blood volume and blood pressure.



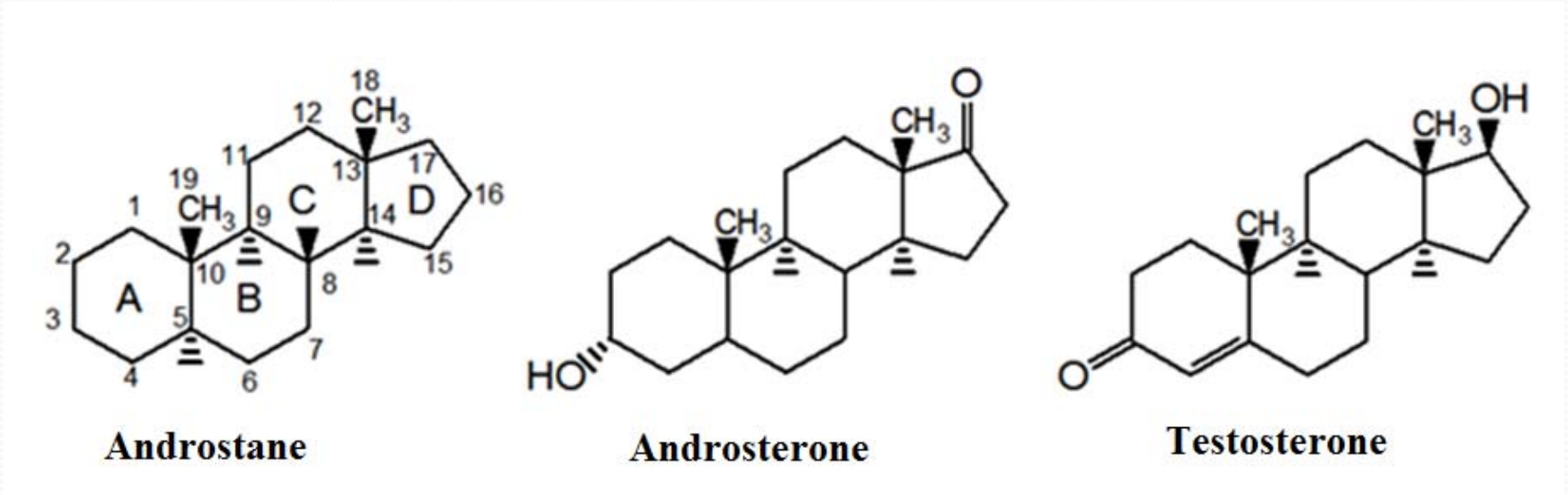
Cortisol



Aldosterone

Androgens (male sex hormones)

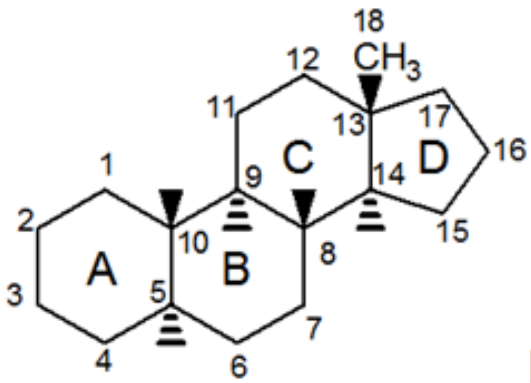
At the basis of the chemical structure of the androgens is the hydrocarbon **androstane** (10,13-dimethyl-steran) – with 19 carbon atoms. The main male sex hormones are **androsterone** and **testosterone**.



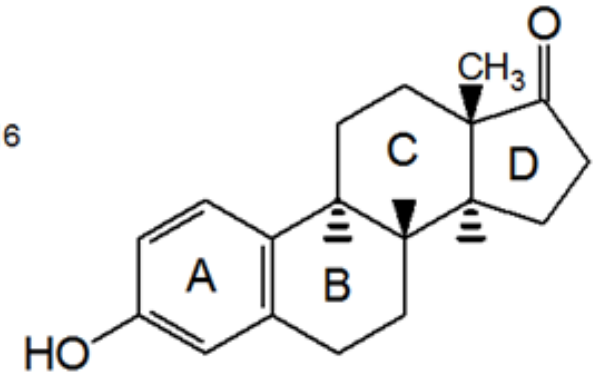
Androgens stimulate the development and functions of male genital glands and the development of male secondary sexual signs. They are synthesized in the testes, adrenal, and in very small quantities in ovary.

Estrogens (feminine sex hormones)

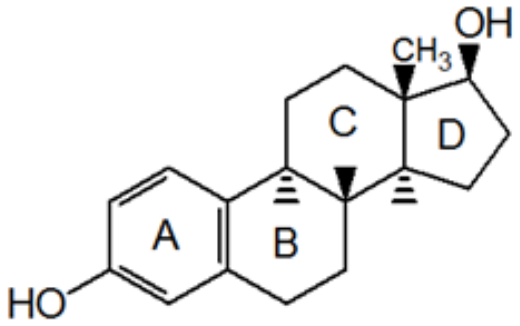
At the basis of the chemical structure of the estrogens is the hydrocarbon **estrane** – with 18 carbon atoms. The most important estrogen hormones are **estrone** and **estradiol**. In estrogens the A ring is aromatic.



Estrane



Estrone



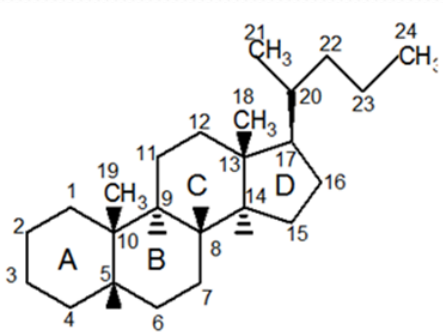
Estradiol

Estrogens are produced in the female sexual glands, but also in small quantities in the adrenal gland and testicles. Estrogens stimulate the development and female genital glands, development of female secondary sexual signs, and together with gestagens regulate ovulation, fertilization, pregnancy.

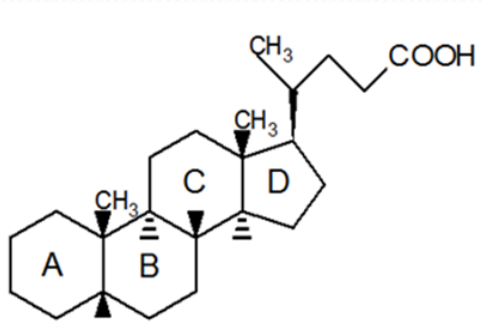
Bile acids

At the basis of the chemical structure of bile acids is the hydrocarbon **cholan** with **24 carbon atoms**, which is oxidised to **5β-cholanic acid**. Bile acids are obtained by its hydroxylation in positions 3, 7 and 12.

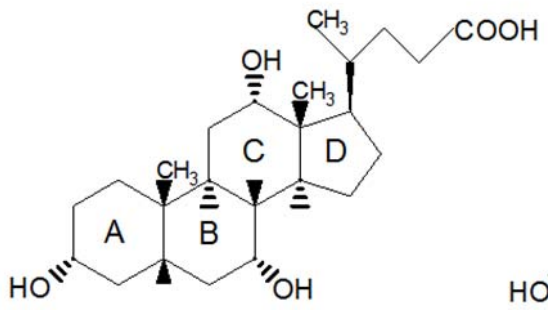
In the human body bile acids are synthesized from cholesterol. Bile acids contribute to the emulsification of food fats, activate the enzyme lipase, which catalyzes the hydrolysis of fats. Human bile contains several bile acids including **cholic acid** and its amides with glycine (**glycocholic acid**) or taurine (**taurocholic acid**).



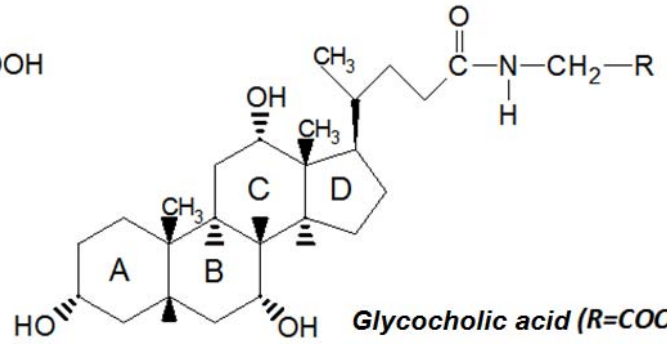
Cholan



5β-cholanic acid



Cholic acid



Glycocholic acid (R=COONa, K^+)

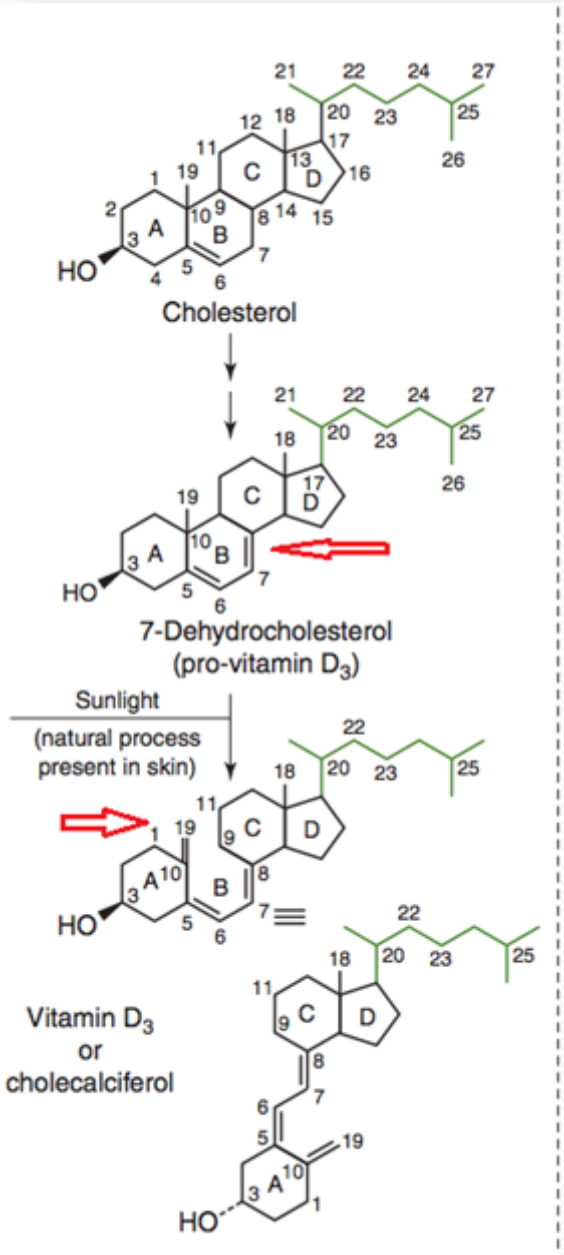
Taurocholic acid (R=CH_2SO_3Na, K^+)

VITAMIN D –

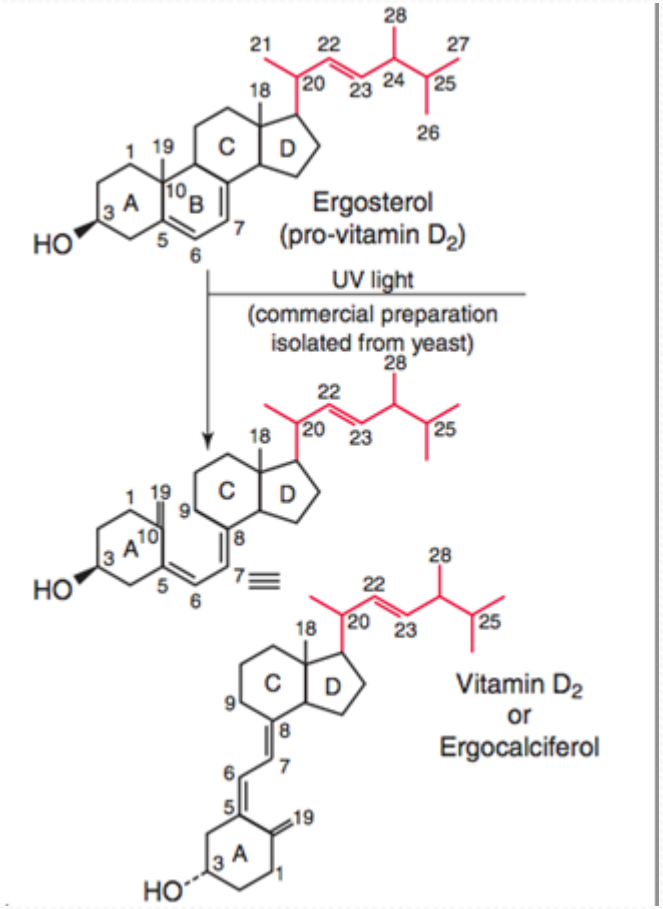
- Refers to a group of fat-soluble vitamins responsible for increasing intestinal absorption of calcium, iron, magnesium, phosphate and zinc. Vitamin D has a significant role in calcium homeostasis and metabolism. Insufficiency of vitamin D leads to **rickets** in children.

- In humans, the most important compounds are **vitamin D_3** (also known as **cholecalciferol**) and **vitamin D_2** (**ergocalciferol**). The major natural source of the vitamin is the synthesis of vitamin D (specifically cholecalciferol) in the skin dependent on sun exposure (specifically UVB radiation). Cholecalciferol and ergocalciferol can be ingested from the diet.

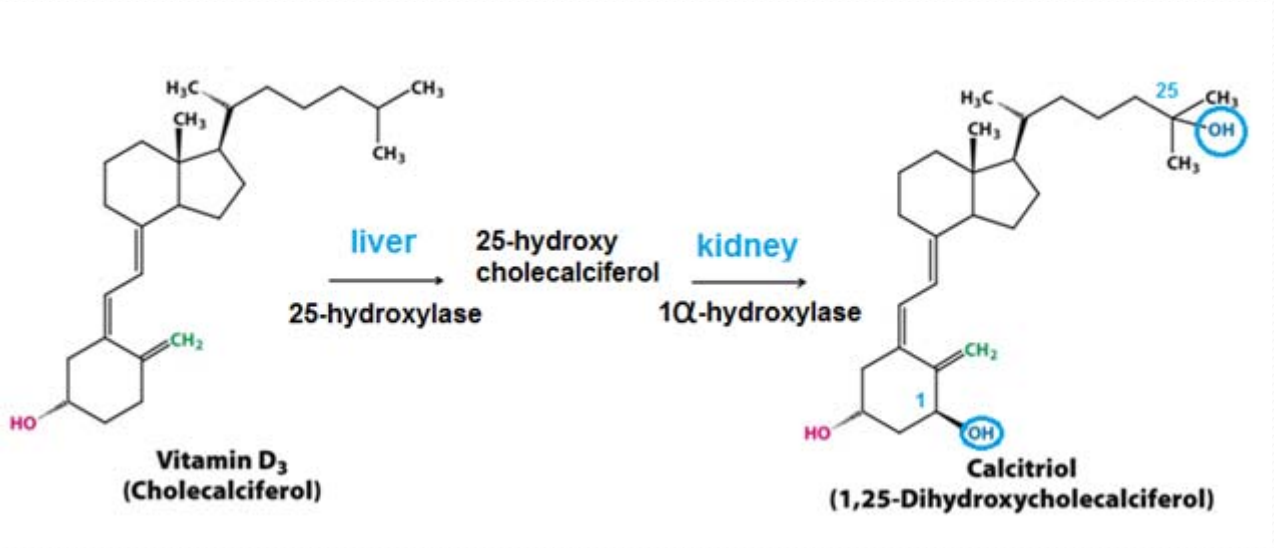
Sinteza vitaminei D_3 (colecalciferolului):



Formation of vitamin D2 (ergocalciferol)



Vitamin D from the diet or dermal synthesis from sunlight is biologically inactive; activation requires enzymatic conversion (**hydroxylation**) in the liver and kidney. In the liver, cholecalciferol (vitamin D_3) is converted to calcidiol, which is also known as 25-hydroxycholecalciferol ($25(OH)D_3$). Part of the calcidiol is converted by the kidneys to **calcitriol (1,25-dihydroxycholecalciferol)**, the biologically active form of vitamin D.

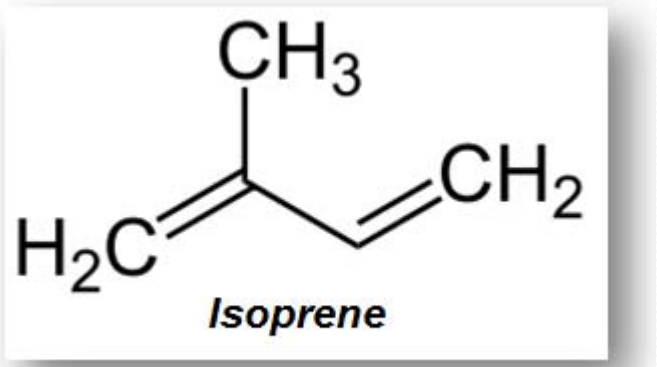


Calcitriol acts as a hormone, regulating the intestinal absorption of calcium and concentration of calcium and phosphate in the bloodstream, promoting the healthy growth and remodeling of bone. Calcitriol also affects neuromuscular and immune function.

As vitamin D is synthesized in adequate amounts by most mammals exposed to sunlight, it is not strictly a vitamin, and may be considered a hormone .

Terpenes. Fat-soluble vitamins A, E, K

Terpenes, known as the isoprenoids, is a group of structurally heterogeneous chemical compounds, which are widespread in nature. Their structure is based on the structure of the **isoprene**:

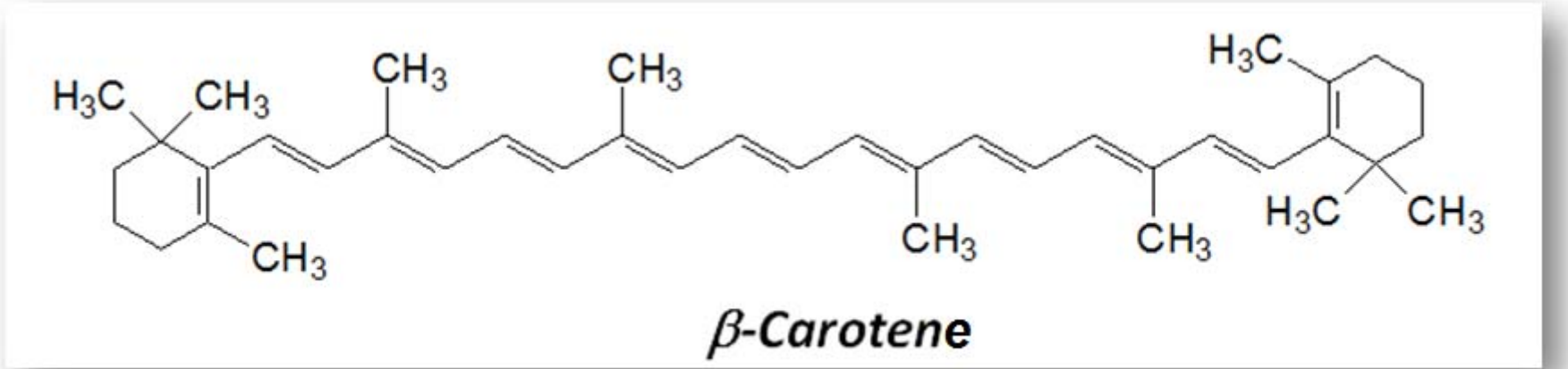


Isoprene

Terpene fragments can be found in the composition of fat-soluble vitamins**: A, E, K.**

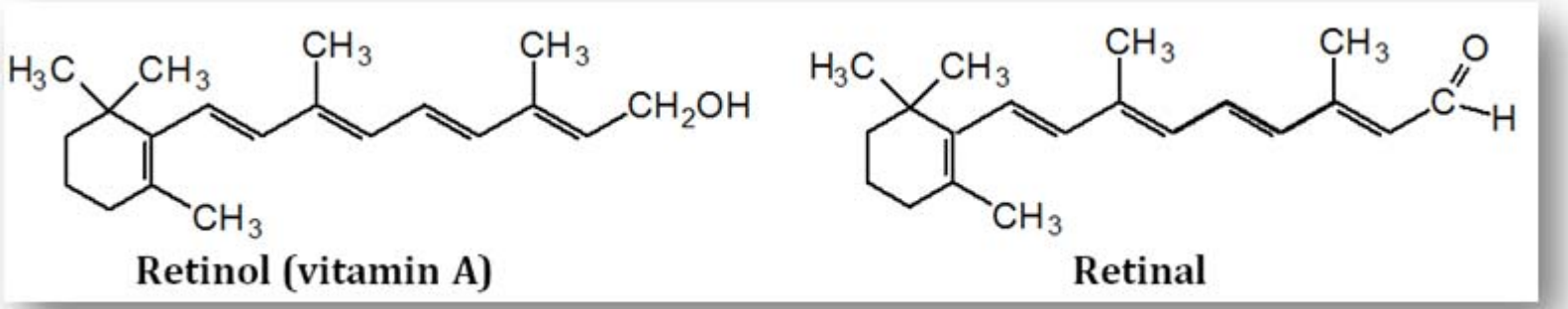
Carotenoids

- is a group of **terpenes**, widespread in plants as vegetal pigments (in carrot, tomato, maize, etc.). Their molecules contain a large number of conjugated double bonds and, therefore, they are colored substances. For natural carotenoids trans configuration of double bonds is characteristic . For example, β**-carotene**:



β-Carotene

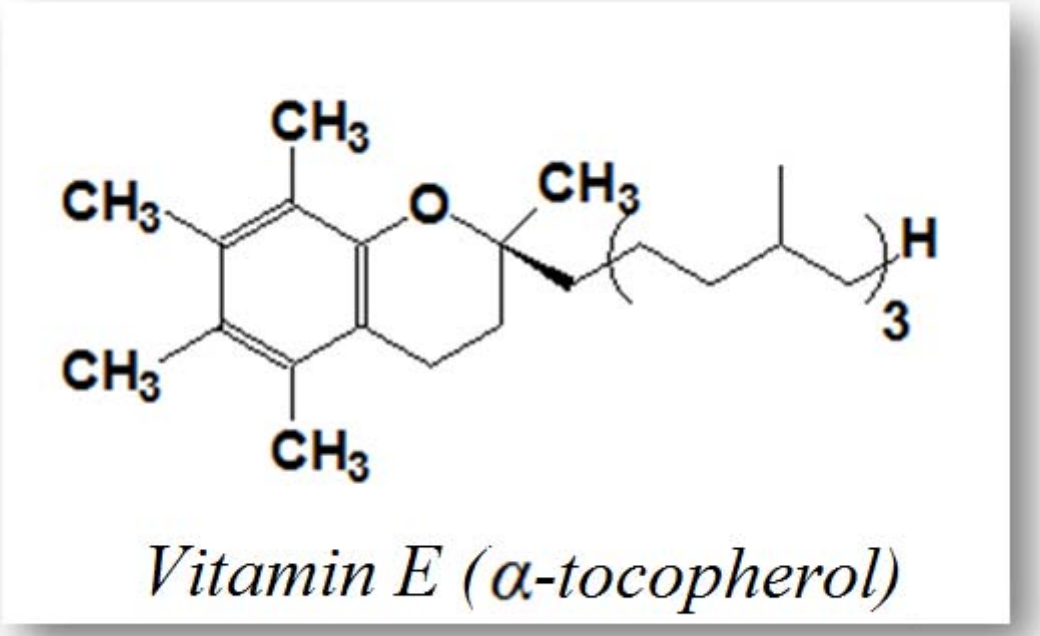
In the body the molecule of β-**carotene** under the action of the enzyme **carotinase**, splits into two molecules of **vitamin A**, which is further oxidized to trans-retinal:



In the retina under the action of the enzyme *trans-retinal isomerase* the trans-retinal turns into cis-retinal, and then binds to a protein ***opsin*** forming a photosensitive pigment ***rhodopsin***, which participates in the visual process. Vitamin A is contained in fish oil, egg yolk, etc. The insufficiency of vitamin A in the body disturbs the normal growth, the mechanism of vision, and decreases body's resistance to infections.

Vitamin E (α-tocopherol)

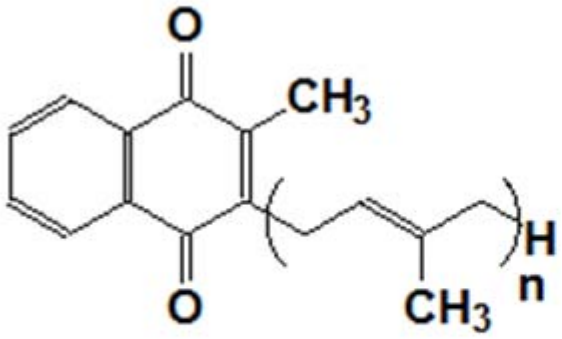
- is a hydroquinone derivative with isoprene fragments. It is found naturally in vegetable oils. Vitamin E in the human body plays an important role, functioning as an antioxidant. Its main biological function is to enhance fertility.



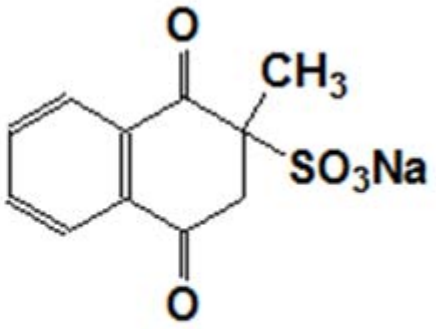
Vitamin E (α-tocopherol)

Vitamin K

- represents a derivative of 1,4-naphthoquinone with the isoprene chains. Possesses an antihemoragic action and is necessary to ensure a normal blood clotting. In medicine is used its synthetic analogue – vicasol.



Vitamin K_2 (n = 6, 8)



Vicasol