

VITAMIN E

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VITAMIN E

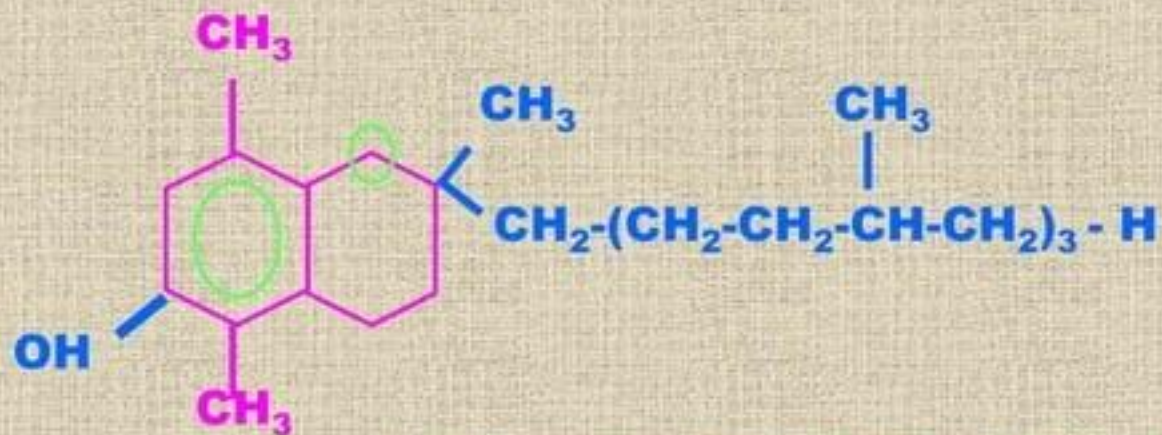
- *Chemical nature:*
- Vitamin E is chemically known as tocopherol (Greek: tocos=childbirth, piro=to bear and ol=alcohol)
- An alcohol was capable to prevent reproductive failure in animals
- Hence it is known as anti-sterility vitamin
- **Chemistry:**
- Vitamin E is the name given to group of tocopherols and tocotrienols

- About 8 tocopherols have been identified
- Alpha- tocopherol is most active
- The tocopherols are derivatives of 6-hydroxy chromane (tocol) ring with isoprenoid side chain
- The antioxidant property is due to the chromane ring
- There are four main forms of tocopherols
- They are

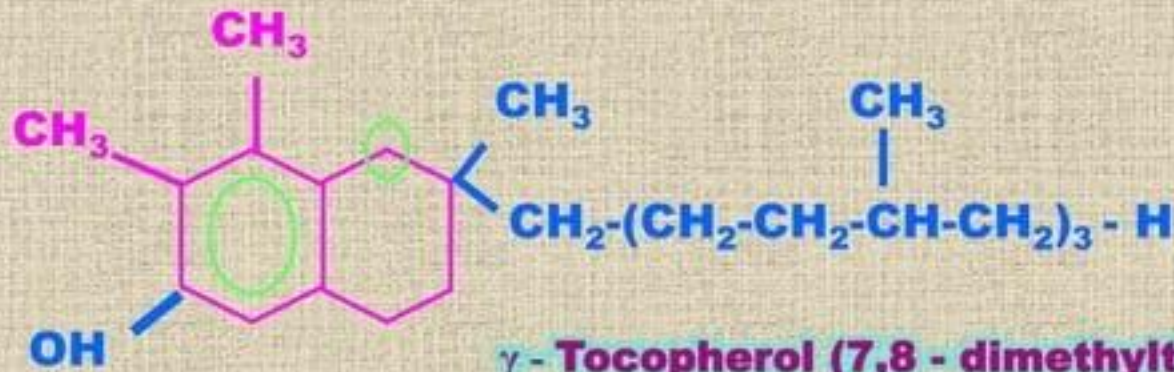
- α -tocopherol : 5,7,8 trimethyl tocol
- β -tocopherol : 5,8 dimethyl tocol
- γ -tocopherol : 7,8 dimethyl tocol
- δ -tocopherol : 8 methyl tocopherol
- **α -tocopherol is most active and predominant form of vitamin E**
- Tocotrienols : There are four related vitamin E compounds called α, β, γ and δ tocotrienols



- ***α*-Tocopherol (5,7,8-trimethyltocol)**

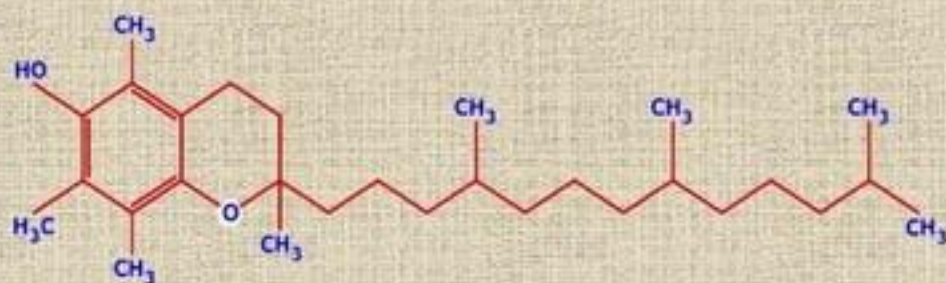


β-Tocopherol (5,8 - dimethyltocol)

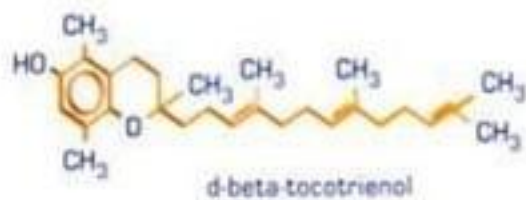
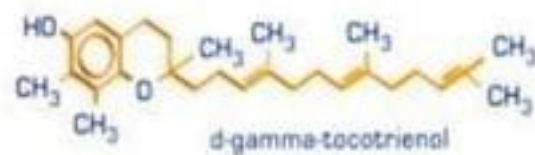
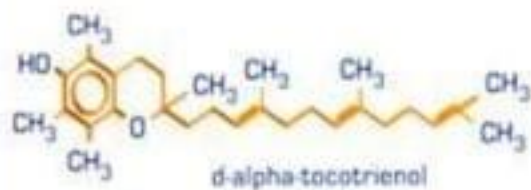
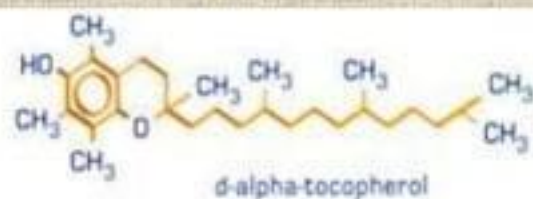


γ-Tocopherol (7,8 - dimethyltocol)

Figure 10.11



Tocopherol



ABSORPTION

- Vitamin E is absorbed along with fat in the **upper small intestine**
- Mechanism: Vitamin E combines with Bile salts (micelles) to form mixed micelle and taken up by the mucosal cell
- In the mucosal cell, it is incorporated into **chylomicrons**

Transport

- **Dietary vitamin E** is incorporated to chylomicrons
- In the circulation, chylomicrons transport vitamin E to the peripheral tissue or to the liver
- **Hepatic vitamin E** is incorporated to **VLDL**
- In the circulation, VLDL is converted LDL
- Vitamin E is transported with **LDL** to reach the peripheral tissues including adipose tissue
- *Storage:* Mainly stored in **liver and adipose tissue**
- Present in **biological membranes**, because of its affinity to phospholipids

Biochemical functions

- Most of the functions of the vitamin E are related to its **antioxidant property**
- It prevents the non-enzymatic oxidations of various cell components by molecular oxygen and free radicals such as superoxide and hydrogen peroxide (H_2O_2)
- **Selenium** helps in these functions
- Vitamin E is lipophilic in character and is found in association with lipoproteins, fat deposits and cellular membranes

- It protects the **PUFA** from peroxidation reactions
1. Vitamin E is essential for **membrane structure and integrity of the cell**, hence it is **membrane antioxidant**
 2. It prevents the peroxidation of PUFA
 3. It protects the **RBC from hemolysis** by oxidizing agents (H_2O_2)
 4. It is associated with **reproductive function** and **prevents sterility**

5. Vitamin E preserves and maintains **germinal epithelium of gonads for proper reproductive function**
6. It increases the synthesis of heme by enhancing the activity of enzyme – δ **aminolevulinic acid (ALA) synthase and ALA dehydratase**
7. It is required for **cellular respiration** –through **ETC (Stabilize coenzyme Q)**
8. Vitamin E prevents the **oxidation of Vitamin A and carotenes**

9. It is required for proper storage of creatine in skeletal muscle
10. It is required for absorption of amino acids from intestine
11. It is involved in synthesis of nucleic acids
12. It protects the liver from toxic compounds such as carbontetrachloride
13. It works in association with vitamin A,C and beta-carotene, to delay the onset of cataract

14. Vitamin E is recommended for the prevention of chronic diseases such as **cancer and heart disease**

- *Vitamin E prevents oxidation of LDL*
- *Oxidized LDL promotes heart diseases*
- **Selenium:** It is a component of **glutathione peroxidase** and function as antioxidant
- It reduces the requirement of vitamin E in diet
- It is required for normal pancreatic function and enhancing the absorption of vitamin E

Daily Requirement

- Males -10 mg/day
- Females - 8 mg/day
- Pregnancy - 10 mg/day
- Lactation - 12 mg/day
- 15 mg of vitamin E is equivalent to 33 IU
- Pharmacological dose is 200-400 IU/day
- Sources:
- Rich sources are **vegetable oils**
- Includes germ oil, sunflower oil, corn oil and margarine

+ DEFICIENCY

- In humans, deficiency of vitamin E is seen in
- **Premature infants:**
- Transfer of vitamin E from maternal blood occurs during last few weeks of pregnancy
- Premature infants will have vitamin E deficiency
- **Impaired absorption:** Seen in conditions such as
- abetalipoproteinemia (fat malabsorption)
- **Obstructive jaundice**
- Intestinal diseases such as celiac spure

- **Genetic vitamin E deficiency:** It is caused by lack of a protein that normally transports α -tocopherol from hepatocytes to VLDL
- **Clinical features:**
- **Hemolytic anemia or macrocytic anemia** seen in premature infants
- In adults, increased susceptibility of erythrocytes for hemolysis under oxidative stress
- Muscle weakness and **proteinuria** is seen

Muscular dystrophy

- Vitamin E deficiency leads to increased **oxidation of PUFA**, with consumption of oxygen and production of **peroxides**
- Peroxides increase the intracellular **hydrolase** activity
- The hydrolases catalyze **breakdowns in muscle** and produce muscular dystrophy
- The muscle **creatine is low** and **creatinuria occurs**

Hepatic necrosis

- Vitamin E and selenium prevents **hepatic necrosis**
- *Spinocerebellar ataxia and impaired vision:*
- Chronic deficiency in children is associated with ataxia, weakness, loss of touch and position senses, impaired vision and retinopathy
- Increased **lipid peroxidation in nervous tissue causes neurological lesions**

- Oxidation of PUFA in rods leads to oxidative damage in retina
- Deficiency in animals:
- Muscular dystrophy and reproductive failure
- Vitamin E is least toxic

+ Therapeutic uses of vitamin E

Disease	Mechanism of action
Nocturnal muscle cramp (NMC)	<ul style="list-style-type: none">• Prevent oxidation of certain radicals & better utilization of O₂, improving muscle metabolism
Intermittent claudication (IC)	<ul style="list-style-type: none">• Decrease circulating lactate & increase pyruvate level• Improvement in blood supply ,opening of new vessels
Fibrocystic breast disease (FBD)	<ul style="list-style-type: none">• Probably acts by correcting the deranged progesterone/estrogen ratio in women of FBD
Atherosclerosis	<ul style="list-style-type: none">• Inhibition the formation of lipid peroxides & restores PG-I₂ synthesis• Inhibits platelet aggregation• Increases HDL –cholesterol