University of Fallujah
College of Medicine

Vitamin E

Lecture : 2

Stage : 2nd Stage

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Department: Chemistry and Biochemistry

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Learning Objectives

-Understand What is vit.E

-Understand the structures and action mechanism of vit. E.

-Identify the clinical roles of vit. E

Vitamin E

Function

- antioxidant
- protects cell walls
- formation of red blood cells
- prevent cancer and heart disease
- immune system health

Vitamin

E

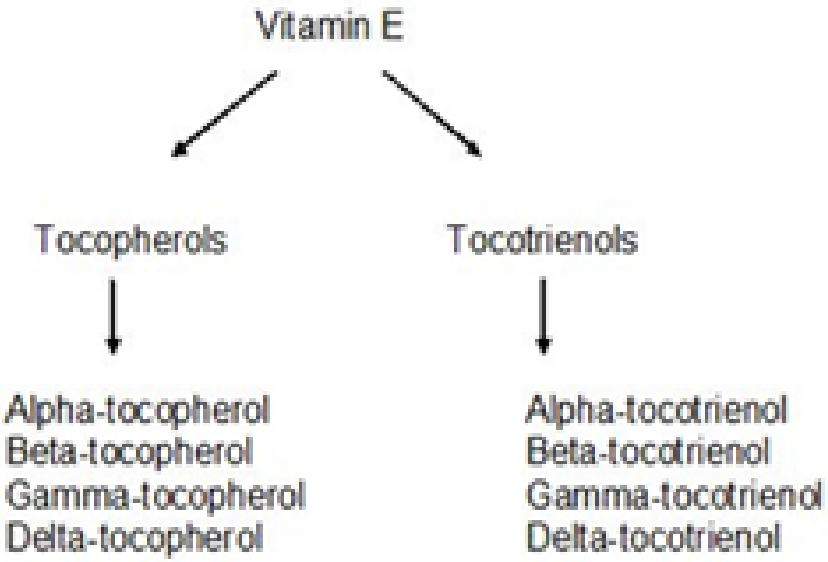
Tocopherol

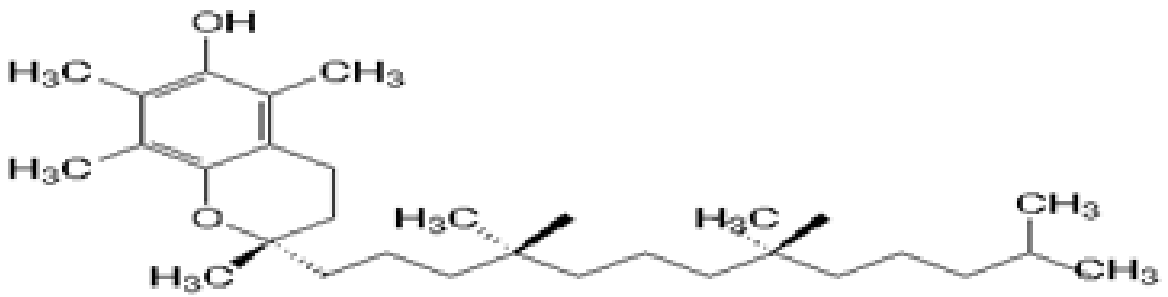
Sources

- egg yolks
- nuts and seeds
- soybean
- whole-grain products

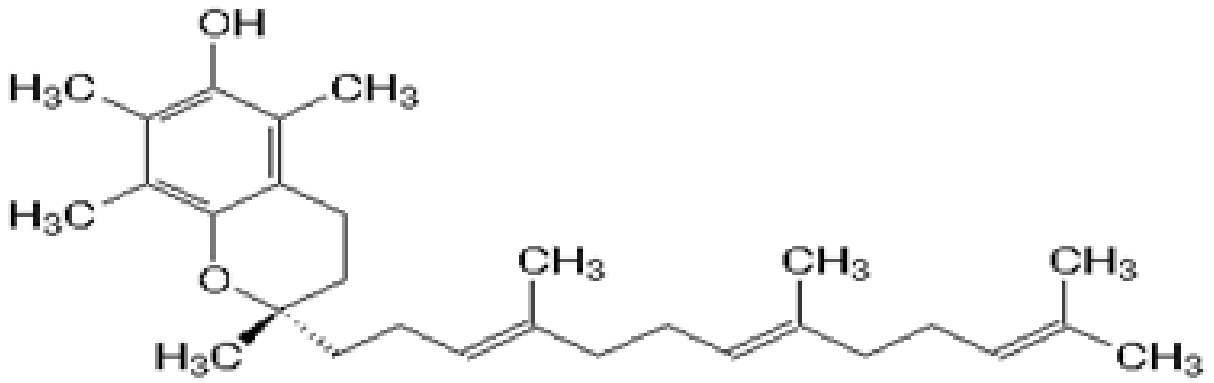
Vitamin E

Vitamin E refers to a group of eight fat-soluble compounds that include both tocopherol and tocotrienol. The vitamin is synthesized by plants, and has eight different isoforms (Vitamers) divided into two classes of four Vitamers each.





Vitamin E (α-tocopherol)



Tocotrienol Structure

Vitamin E is a the principle membrane-associated antioxidant molecule in mammals. It plays a **major role in preventing oxidative damage to membrane lipids by scavenging free radicals.**

Vitamin E is **not a single molecule**, but a family of 8 related molecules called **tocopherols and tocotrienols.**

Each of the different tocopherols exists in eight stereoisomers.

Dietary vitamin E is predominantly alpha and gamma-tocopherol. The structure of alpha-tocopherol is the long hydrocarbon chain similar to the tail of a fatty acid.

- **α-Tocopherol**
- α-Tocopherol is an important **lipid-soluble antioxidant**.
- It performs its functions as antioxidant by the **glutathione peroxidase pathway** and it protects cell membranes from oxidation by reacting with lipid radicals produced in the lipid peroxidation chain reaction.
- This would remove the free radical intermediates and prevent the oxidation reaction from continuing.

- **Tocotrienol**

Tocotrienol are members of the vitamin E family.

The slight difference between tocotrienol and tocopherol lie in the **unsaturated side chain** having three double bonds in its farnesyl isoprenoid tail.

- **Comparison of Tocotrienol and Tocopherol**
- **Tocotrienol** are forms of natural vitamin E that **can protect against brain cell damage, prevent cancer and reduce cholesterol.**
- These biological characteristics, however, **are not present in tocopherol due to their chemical structure**.
- The **unsaturated side-chain** in tocotrienol causes them to penetrate tissues with saturated fatty layers more efficiently making them ideal for **anti-aging oral** supplements and **the skin care** range.
- **Tocotrienol are better able than tocopherol** at combating oxidative stress of skin that had been exposed to UV rays of the sunlight.

- **Sources**

The natural form of the vitamin is **synthesized only by plants and is found predominantly in plant oils.**

Function

Vitamin E has the following functions:

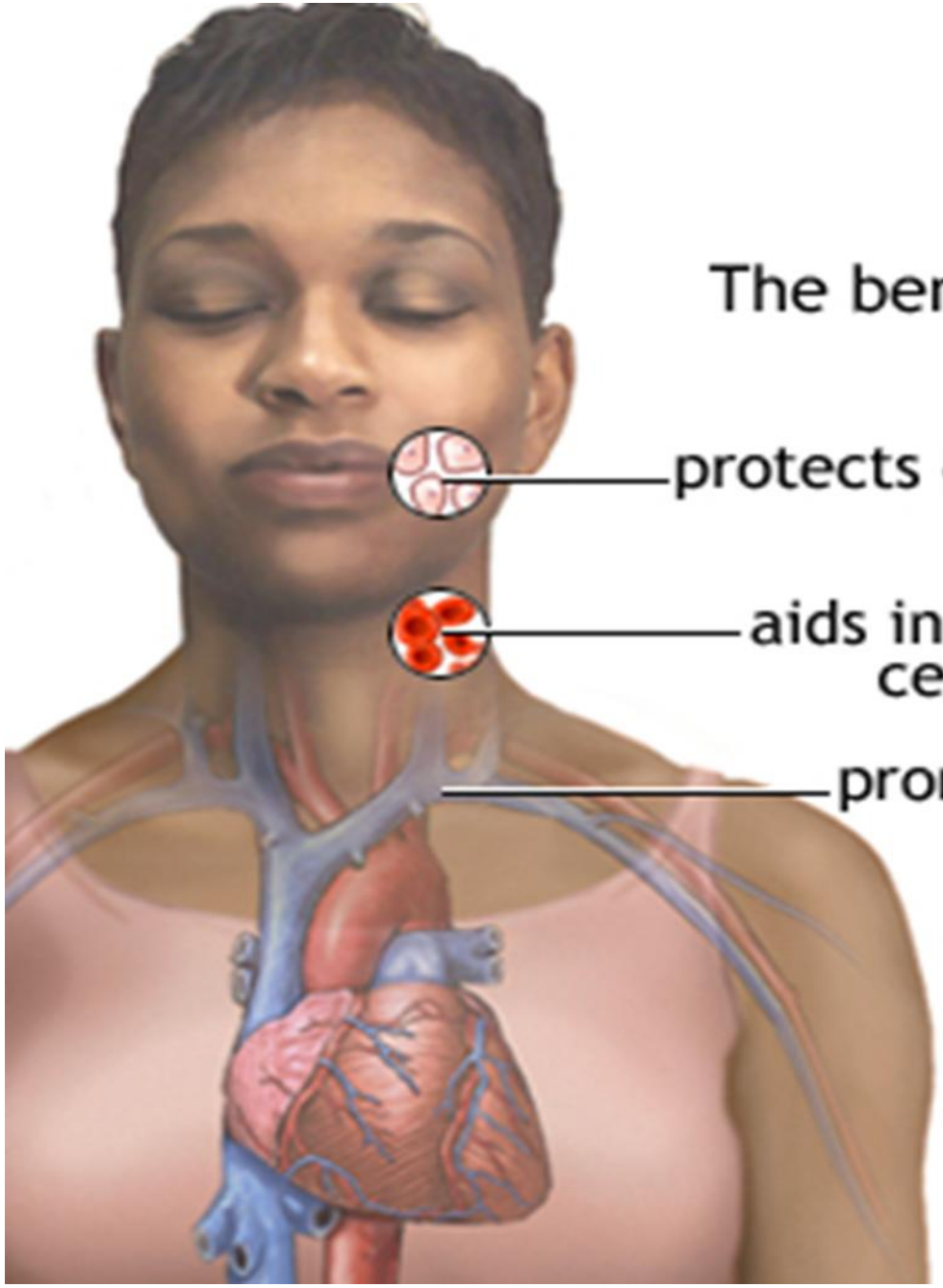
1- It is an antioxidant. This means it protects body tissue from damage caused by substances called free radical,which can harm cells, tissues, and organs. (They are believed to play a role in certain conditions related to aging).

2- It helps keep the immune system strong against viruses and bacteria.

3- It helps form red blood cells and widen blood vessels to keep blood from clotting inside them.

4- It helps the body use vitamin K.

5- Cells also use vitamin E to interact with each other. It helps them carry out many important functions.



The benefits of vitamin E:

protects cell membranes and tissues from damage by oxidation

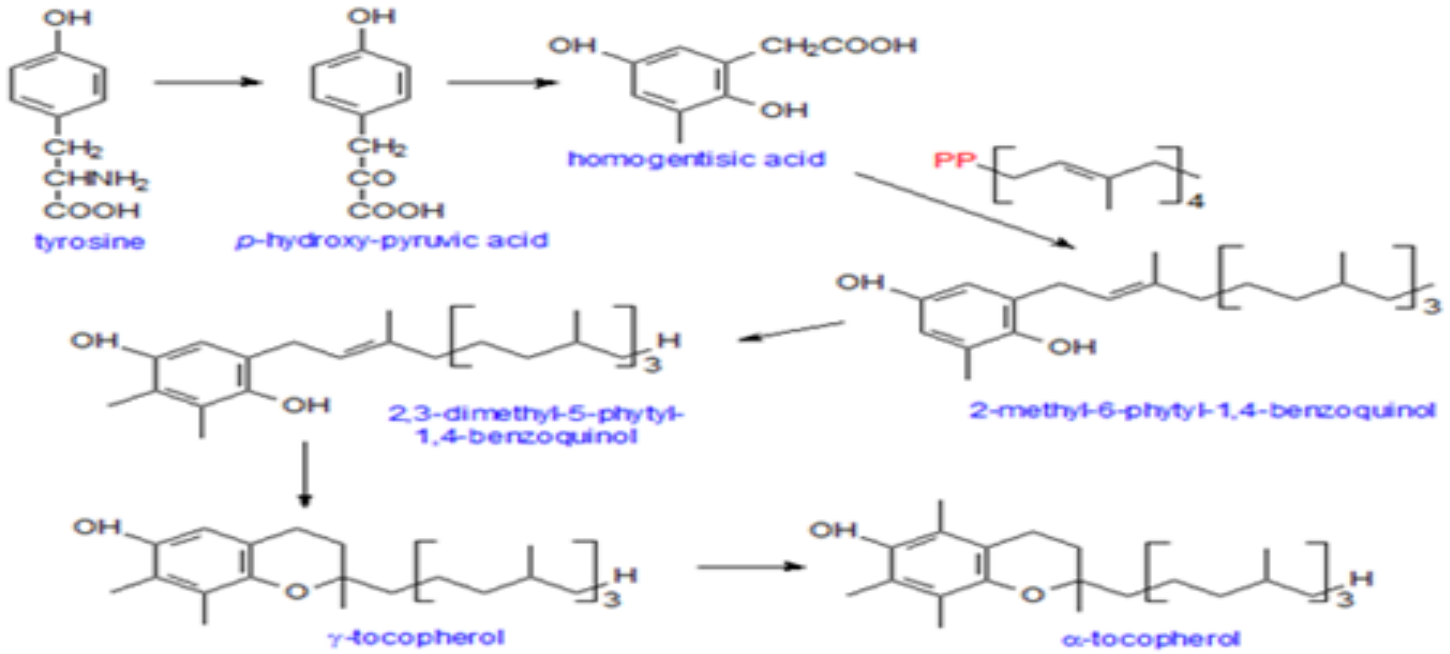
aids in the formation of red blood cells and the use of vitamin K

promotes function of a healthy circulatory system

RDA: 30 iu (international units)

Fat-soluble

The plant chloroplast is the site of biosynthesis, and the aromatic amino acid **tyrosine** can be considered the basic precursor.



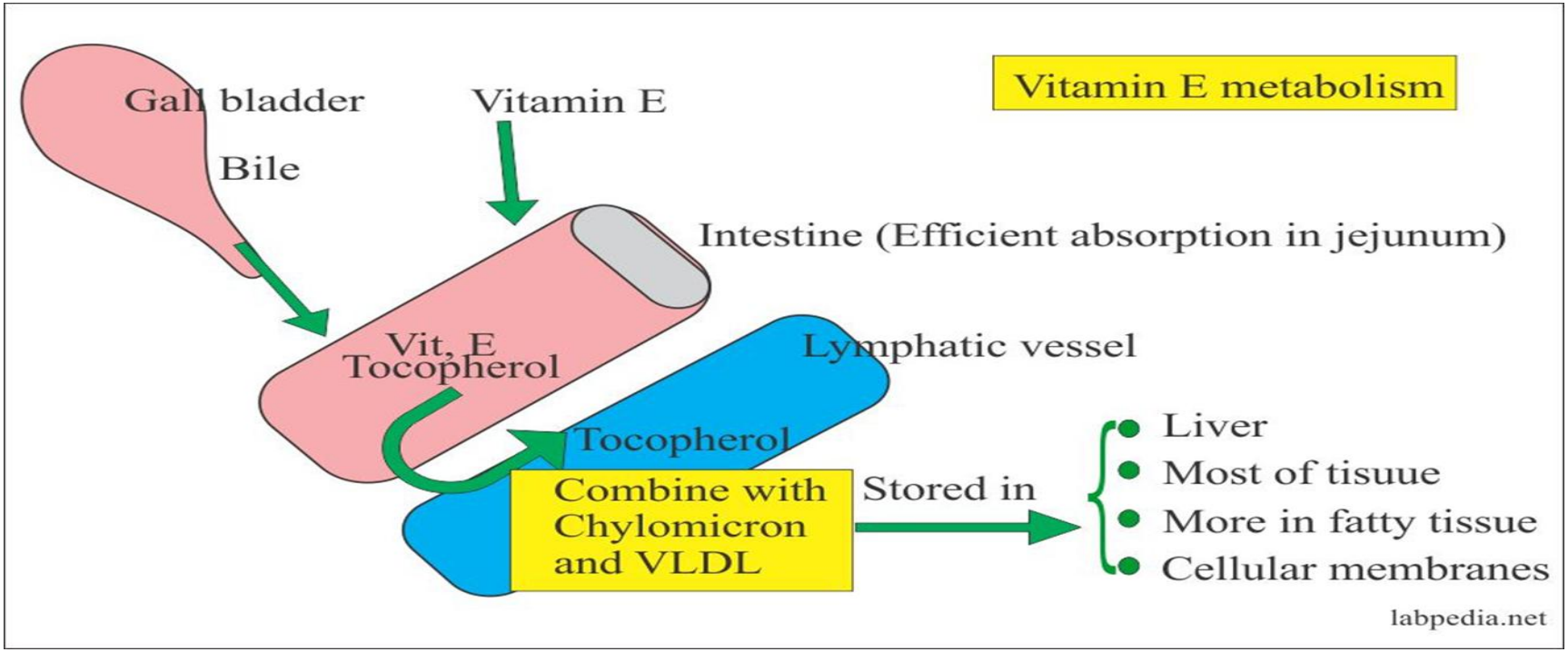
Absorption and Transport •

- Absorption of vitamin E is highly dependent upon the same processes that are utilized during fatty acid digestion and metabolism. **Bile acids are considered essential for vitamin E absorption and micelle formation.**
- Once formed, the micelle is then able to cross the unstirred water layer and release its contents into the enterocytes. After passing through the enterocytes the vitamin E is packaged into a chylomicron and readied for circulation.

Once in the circulation, vitamin E is liberated from chylomicrons and much is taken up by the liver, where it is repackaged into **very low density lipoproteins** and secreted again into blood.

Vitamin E is transported in blood **bound to a variety of lipoproteins,** from which it is taken up by tissues throughout the body.

Vitamin E is stored within the fat droplets of adipose tissue cells



- **Storage**
- Vitamin E is a lipid soluble vitamin and therefore over 90% of total body vitamin E is found in the **adipose tissue.**
- **Excretion**
- Vitamin E is **excreted mainly via bile, urine, feces, and the skin.**
- The vitamin is **oxidized** and forms **hydroquinone** and then is **conjugated** to form **glucuronate.**
- Once formed the glucuronate can be excreted into bile or further degraded in the kidneys and excreted in the urine. Because of the poor intestinal absorption of vitamin E, **fecal excretion is the main route of vitamin E elimination.**

Mechanism of action of antioxidants, vitamin E

Free radicals, such as **superoxide, hydroxyl ions and nitric oxide** all contain an unpaired electron.

These radicals can have a negative effect on cells causing oxidative damage that leads to cell death. Antioxidants, such as vitamin E due to its lipid solubility is particularly important in protecting cell membranes, prevent cell damage by binding to the free radical and neutralizing its unpaired electron.

The resulting **tocopherol radical is then reduced back to tocopherol by glutathione, vitamin C or other molecules.** Thus **the free hydroxyl group on the aromatic ring** is responsible for the antioxidant properties.

Deficiency

It happens almost exclusively in people with an inherited or acquired condition that impairs their ability to absorb the vitamin (for instance, cystic fibrosis, short bowel syndrome or bile duct obstruction) and in those who **cannot absorb dietary fat** or have rare disorders of fat metabolism. Vitamin E deficiency causes **neurological problems** due to poor nerve conduction.

Deficiency can also cause anemia due to oxidative damage to red blood cells, retinopathy and impairment of the immune response