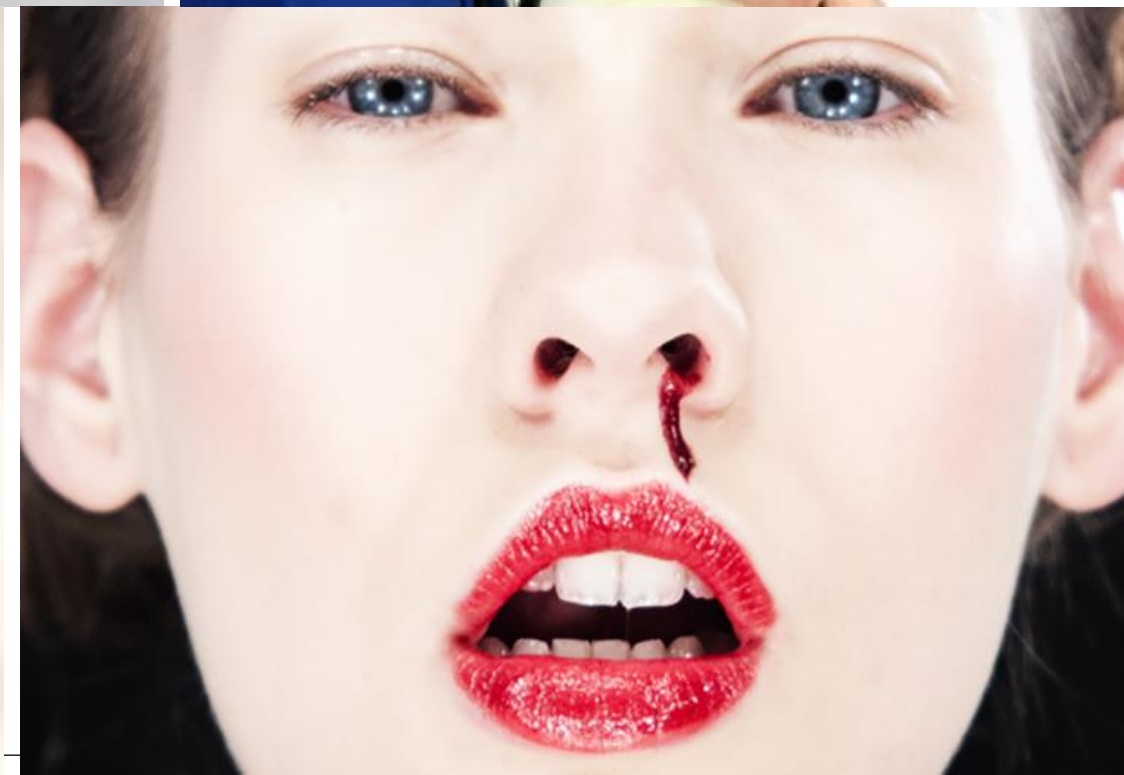



CABBAGE
CUCUMBER
KALE
BRUSSELS SPROUTS
SPINACH

GROUP OF FOODS RICH IN VITAMIN K

VITAMIN K

Group of lipophilic, hydrophobic vitamin that are needed for the post transitional modification of certain proteins, mostly required for blood coagulation.

Objectives

- History of vitamin K
- Types of vitamin K
- Sources of vitamin K
- Biochemical roles of vitamin K
- Deficiency manifestation of vitamin K
- Toxicity of vitamin K

History

- Henrik Dam isolated vitamin K from alfa-alfa leaves (K_1).
- Edward Doisy isolated factor with similar properties from fish meal (K_2).

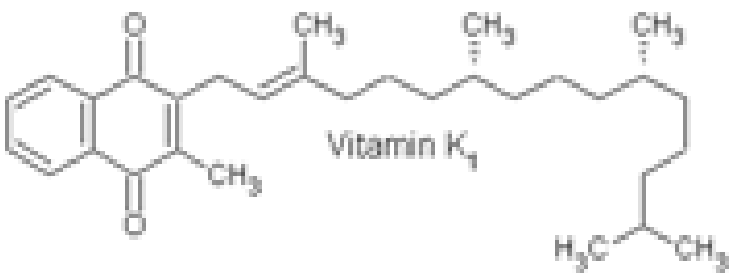
Henrick Carl Peter Dam

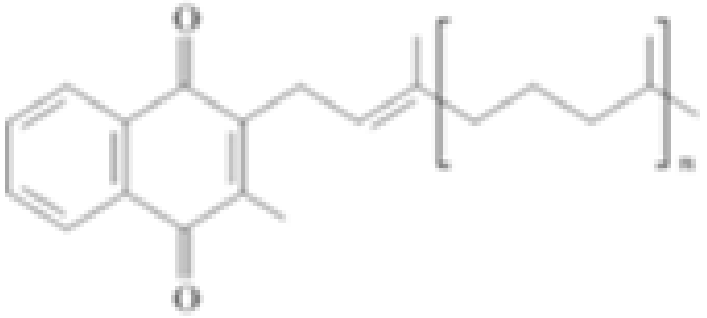
Edward Adelbert Doisy

Fat soluble vitamins

Vitamin K

- **K_1, phylloquinone**
  - Chloroplasts in plants
- **K_2, menaquinone**
  - Bacterial synthesis
- **K_3, menadione**
  - Synthetic, water soluble form
  - Complexed to improve stability





Vitamin K2

SOURCES AND DAILY REQUIRMENT

- K1 chiefly present in

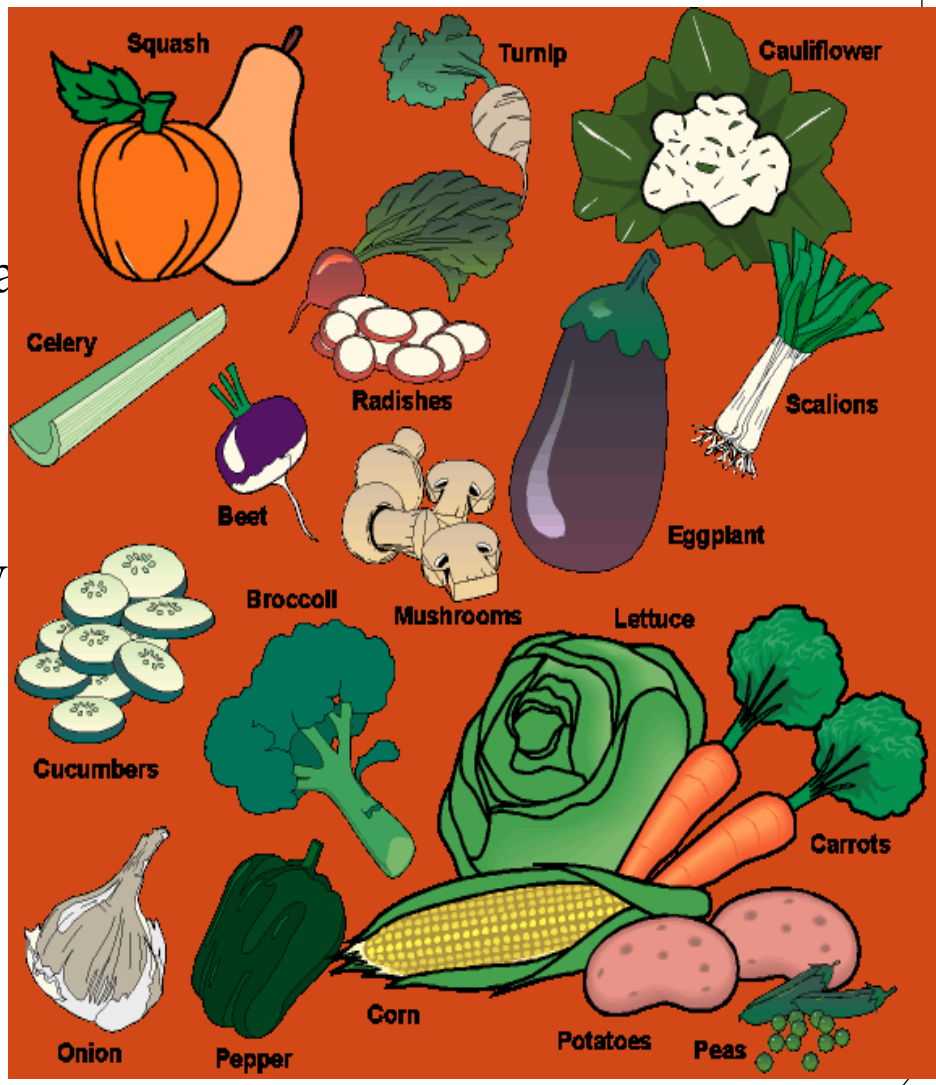
green vegetables such as alfalfa, spinach, cauliflower, cabbage, Soya bean, tomatoes.

- K2 present in

fish, meat, egg yolk, liver and dairy products.

- Daily requirement.

70-140 µgm/day.



Absorption

- Stable to heat, destroyed by sunlight ,acids and alkalies.
- Absorption – in intestine with chylomicron.

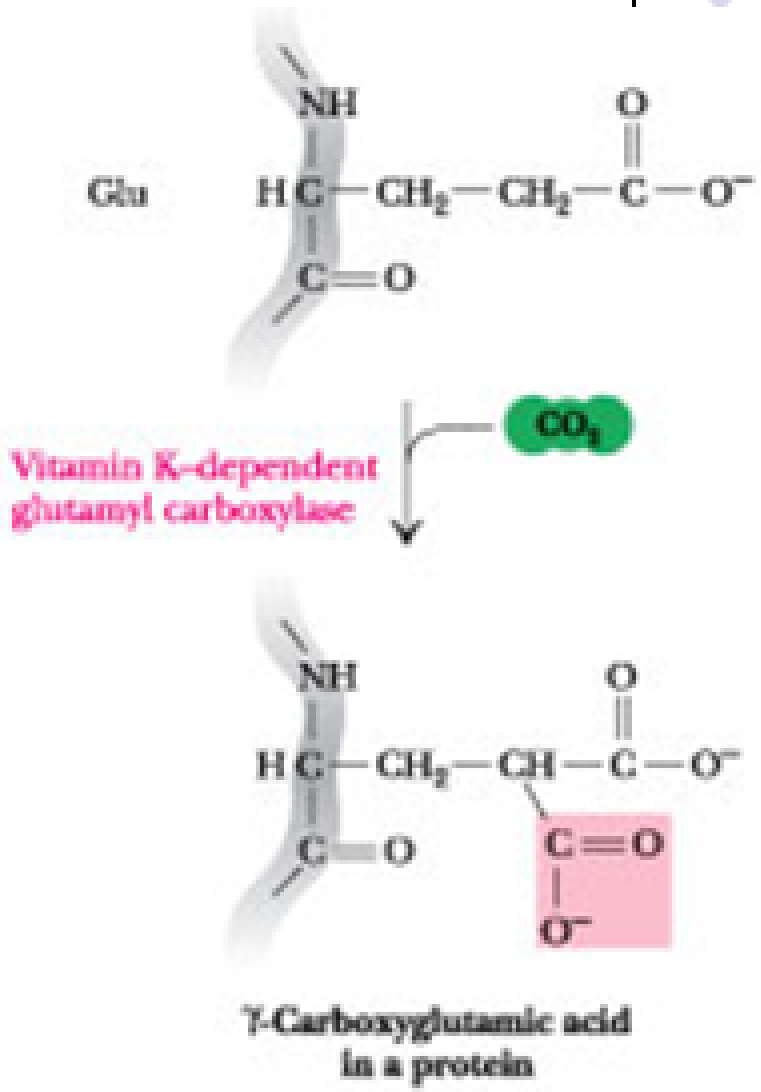
  Bile salts + pancreatic juice

- Transport -β- lipoprotein
- Storage - liver (for short period), lungs , bone marrow , kidney , lymph nodes , adrenal glands can store vit K in high amount.
- Can be synthesized by intestinal bacteria.

Physiological Effects of Vitamin K

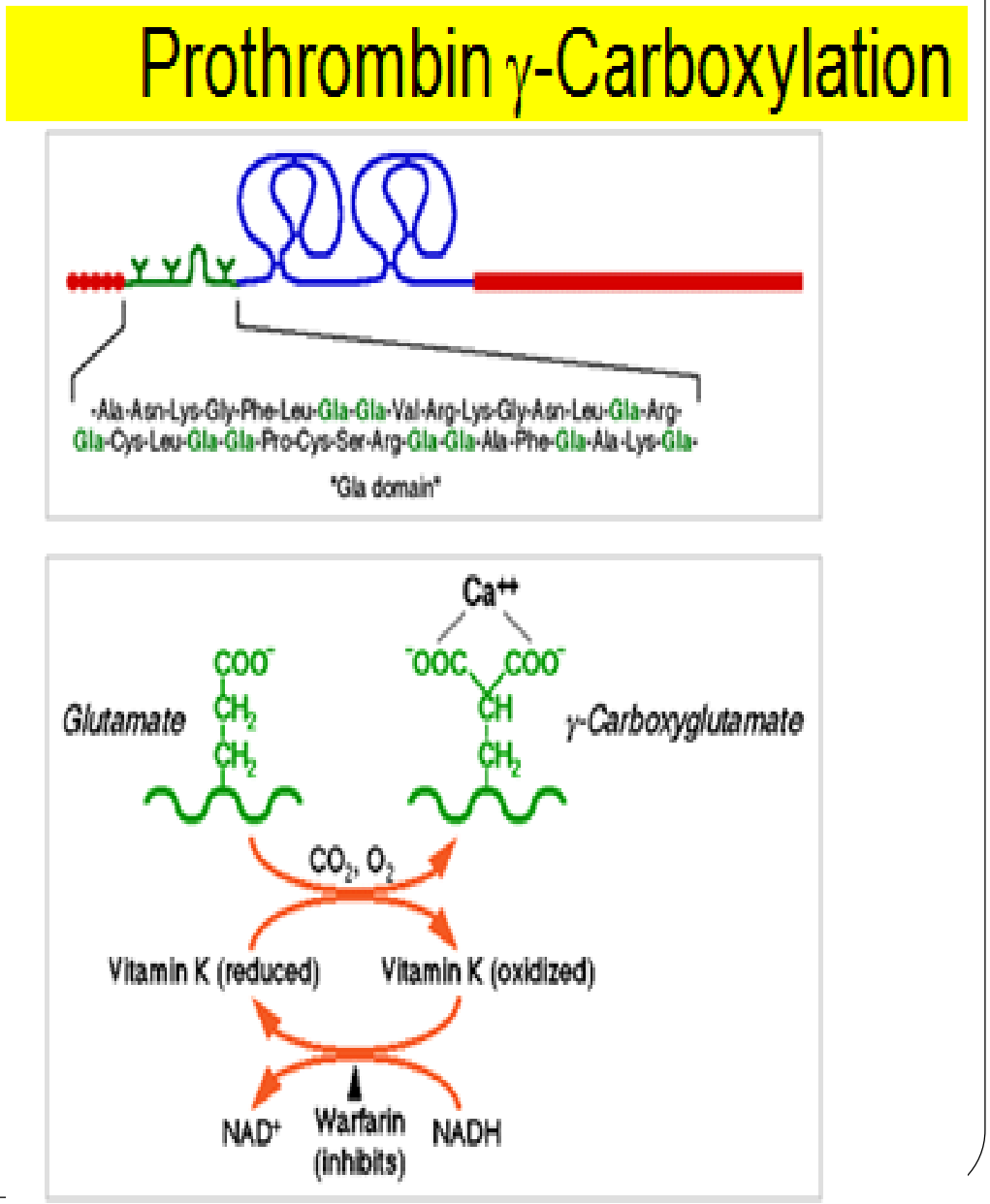
- Vitamin K serves as an essential cofactor for a carboxylase that catalyzes carboxylation of glutamic acid residues on vitamin K-dependent proteins. These proteins are involved in:

  1) Coagulation
  2) Bone Mineralization
  3) Cell growth

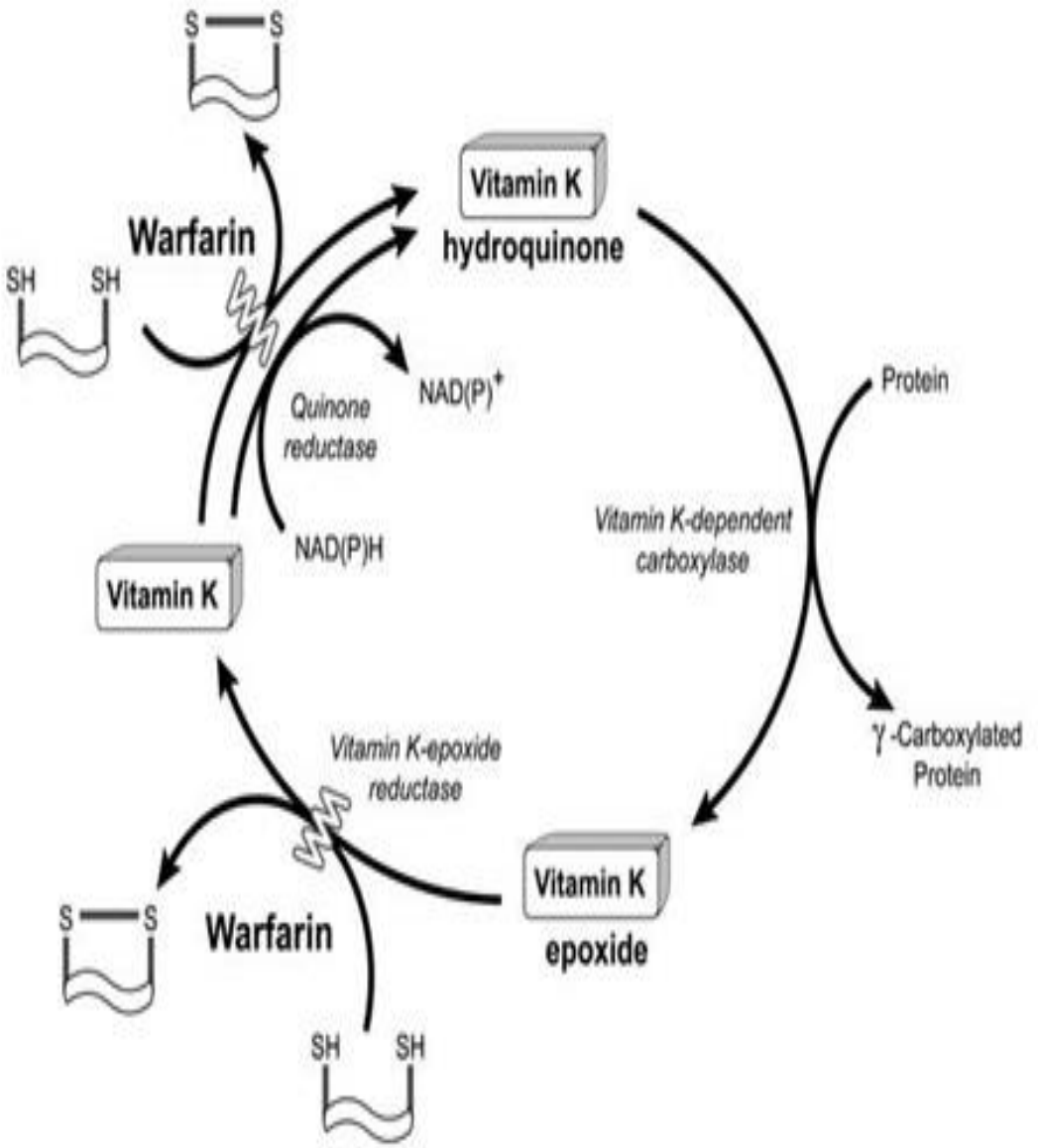


Vitamin K dependent coagulation

- Certain clotting factors/protein requires calcium to bind for activation.
- Calcium can only bind after gamma carboxylation of specific glutamic acid residues in these proteins.

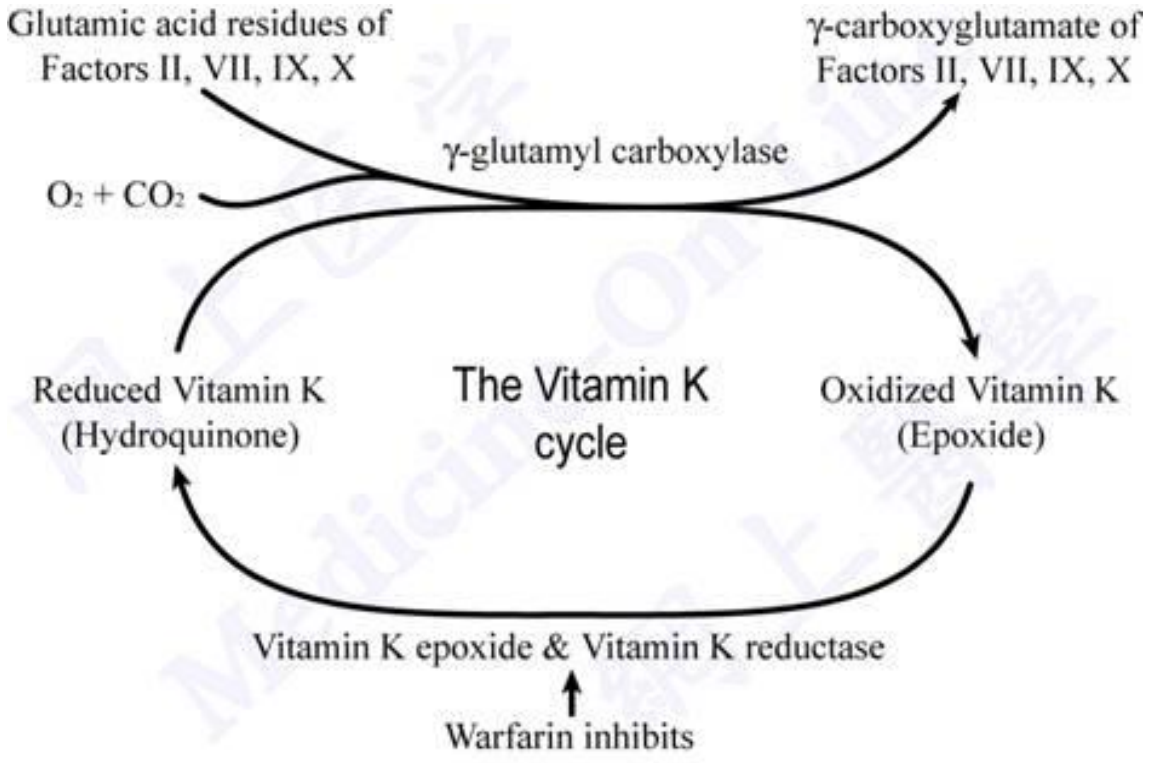


- The reduced form of vitamin K acts as a cofacto for this carboxylation reaction.
- The reaction also requires O_2 and CO_2.
- Reaction is inhibited by warfarin, synthetic analogue of dicumarol

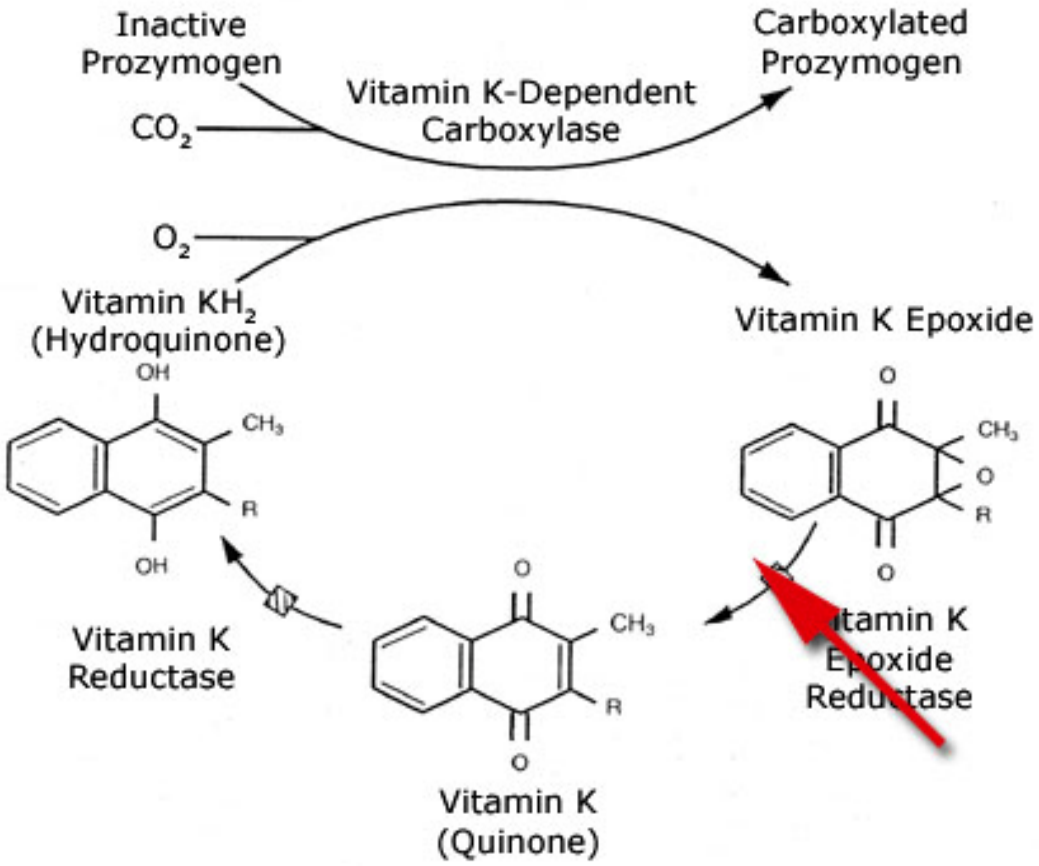


Vitamin K dependent proteins

- Factor II (prothrombin)
- Factor VII (proconvertin)
- Factor IX (thromboplastin component)
- Factor X (Stuart factor)

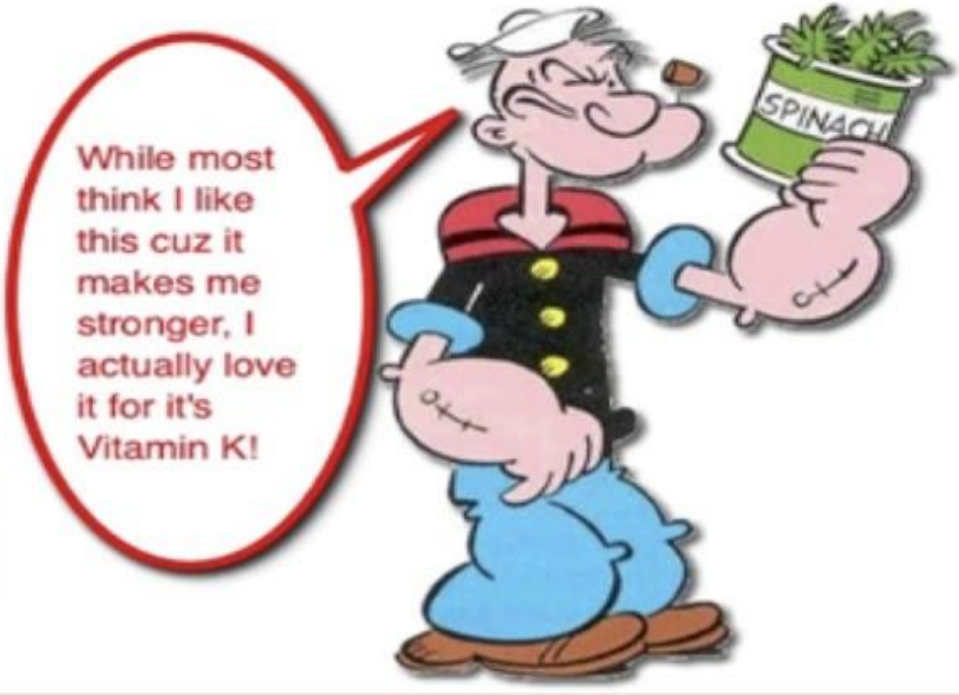


- Vitamin K dependent γ-carboxylation is also necessary for functional activity of C-reactive protein, osteocalcin and structural proteins of kidney , lung and spleen.
- Osteocalcin binds tightly to hydroxy apatite crystals of bones, this binding is dependent on degree of carboxylation.

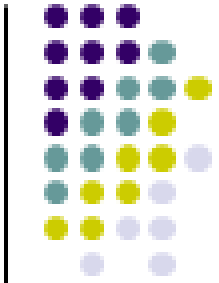


Functions of vitamin K

- ✓ It has another physiologic functions include electron transport chain, and photosynthesis.
- ✓ It has role in Immune Functioning and produces energy.
- ✓ It acts as Antioxidant.



Vitamin K Deficiency

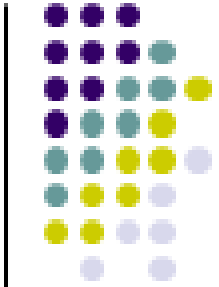


Results in impaired blood clotting and, potentially, bleeding.

Vitamin K deficiency can result from:

- a lack of vitamin k in the diet
- disorders that reduce fat absorption
- Taking certain drugs, including anticonvulsants and some antibiotics
- Use of coumarin anticoagulants
- Salicylates
- Large doses of vitamin E
- Hepatic insufficiency

Symptoms of Vitamin K Deficiency



- Bruising from bleeding into the skin
- Nosebleeds
- Bleeding gums
- Bleeding in stomach
- Blood in urine
- Blood in stool
- Tarry black stool
- Extremely heavy menstrual bleeding
- In infants, may result in intracranial hemorrhage

Vitamin K Deficiency in Infants

Newborns are prone to vitamin K deficiency because…

1. Vitamin K and lipids are not easily transported across the placental barrier
2. Prothrombin synthesis in the liver is an immature process in newborns, especially when premature.
3. The neonatal gut is sterile, lacking the bacteria that is necessary in menaquinone synthesis.
4. Breast milk is not a good source of vitamin K

Results in a hemorrhagic disease called vitamin K deficiency bleeding (VKDB)

This disease is associated with breastfeeding, maladsorption of lipids, or liver

disorders.

Vitamin K - Toxicity

- Not common except with over-supplementation
  - Phylloquinone and menaquinone are relatively nontoxic
    - Jaundice; brain damage
  - Menadione toxic to skin and respiratory tract in high doses

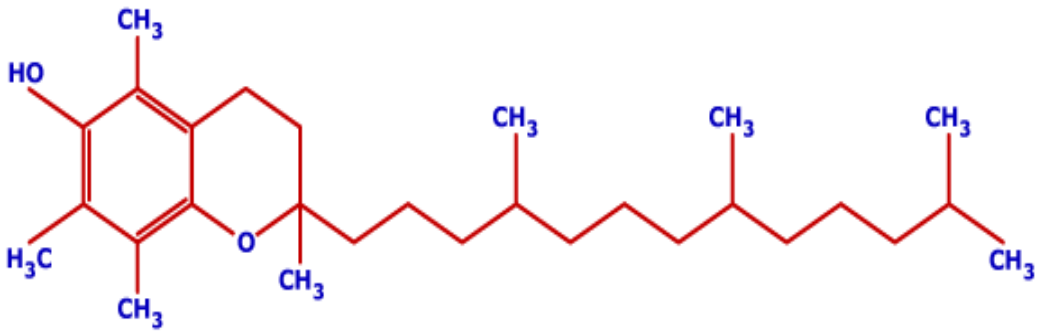

E

Objectives

- Structure of vitamin E
- Types of vitamin E
- Sources of vitamin E
- Introduction of free radicals & antioxidants.
- Biochemical functions deficiency manifestations of vitamin E
- Clinical uses of vitamin E

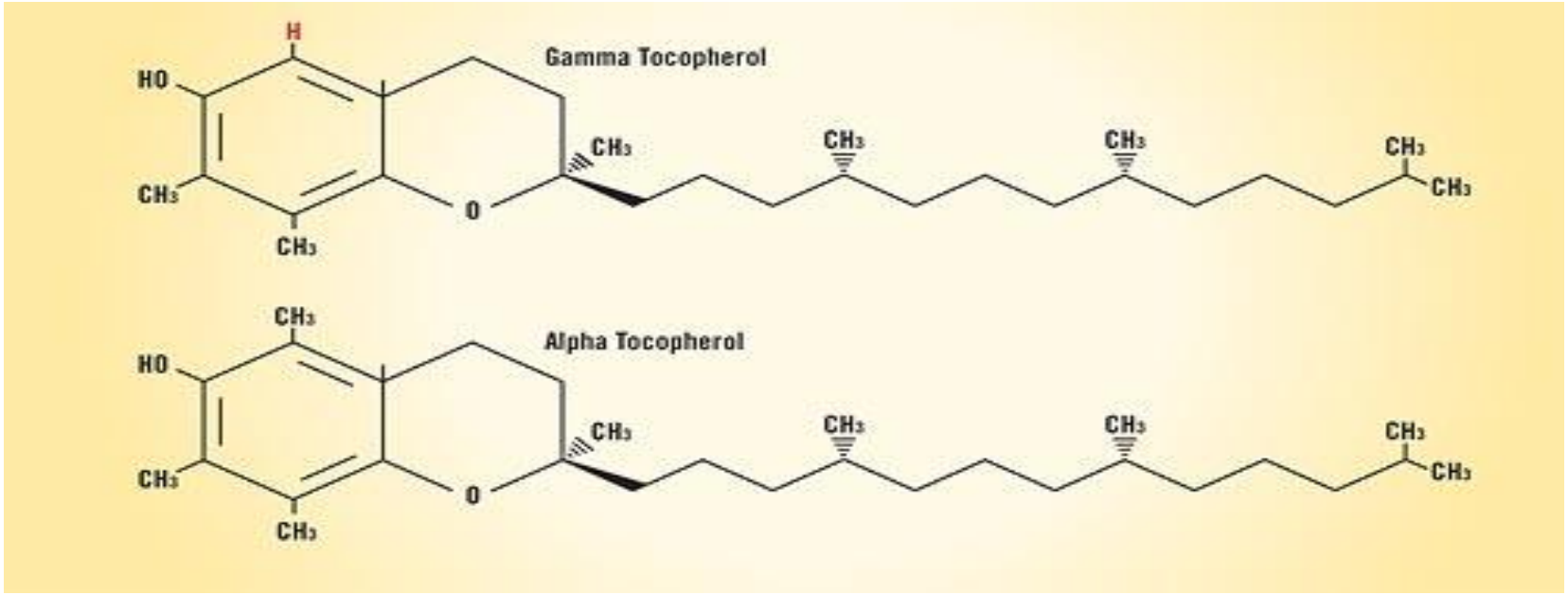
Tocopherol

- Greek word tokos-for offspring ,pheros- to bear;
- Tocopherols are derivative of 6- hydroxy chromane(tocol) ring with isoprenoid side chain.
- Antioxidant property is due to phenolic-OH group at 6^{th} carbon.
- Yellow liquid stable to heat and acid, unstable in alkali, UV ,O2.
- Most are destroyed by freezing and deep frying.



Tocopherol

- 8 naturally occurring tocopherols.
- Differ from each other in the number and position of methyl groups.
- α tocopherols 5, 7, 8 trimethyl tocol.
- β tocopherol 5, 8 dimethyl tocol.
- γ tocopherol 7, 8 dimethyl tocol.
- δ tocopherol 8 methyl tocol

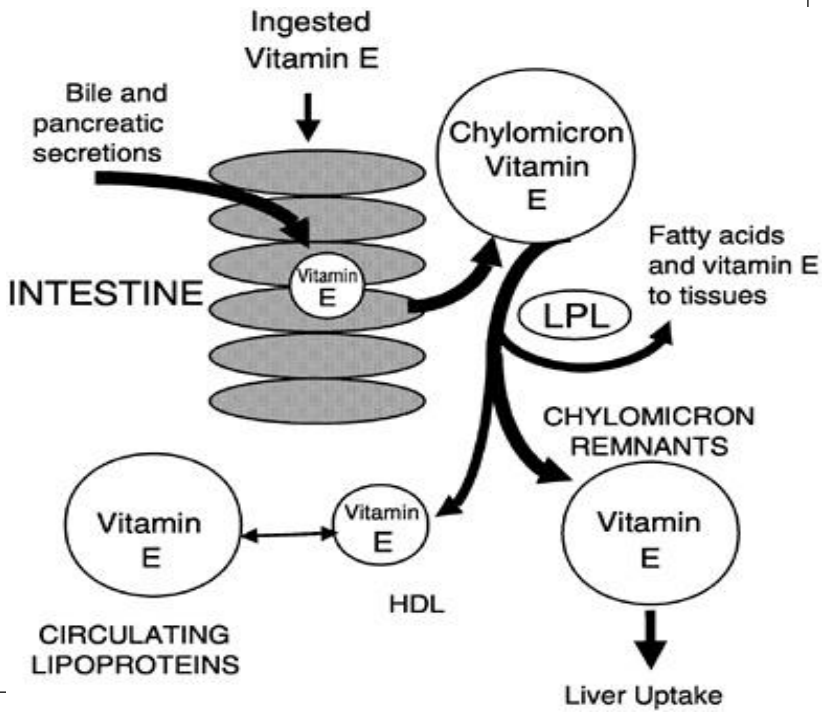


SOURCES AND DAILY REQUIRMENTS

- Cotton seed oil, corn oil, sunflower oil, wheat germ oil and margarine are the richest sources.
- Small amount found in dry Soya beans, cabbage, yeast, lettuce, apple seeds, peanuts.
- DAILY REQUIRMENTS
- 10mg for men.
- 8mg for women.
- For children 10-15 IU /day.
- Adults 20- 25 IU /day.

Absorption and transport

- Absorbed in small intestine with help of bile.
- Transported to liver associated with lipoproteins.
- Stored in muscles and adipose tissues.
- No significant excretion.
- Destroyed in GIT and tissues.

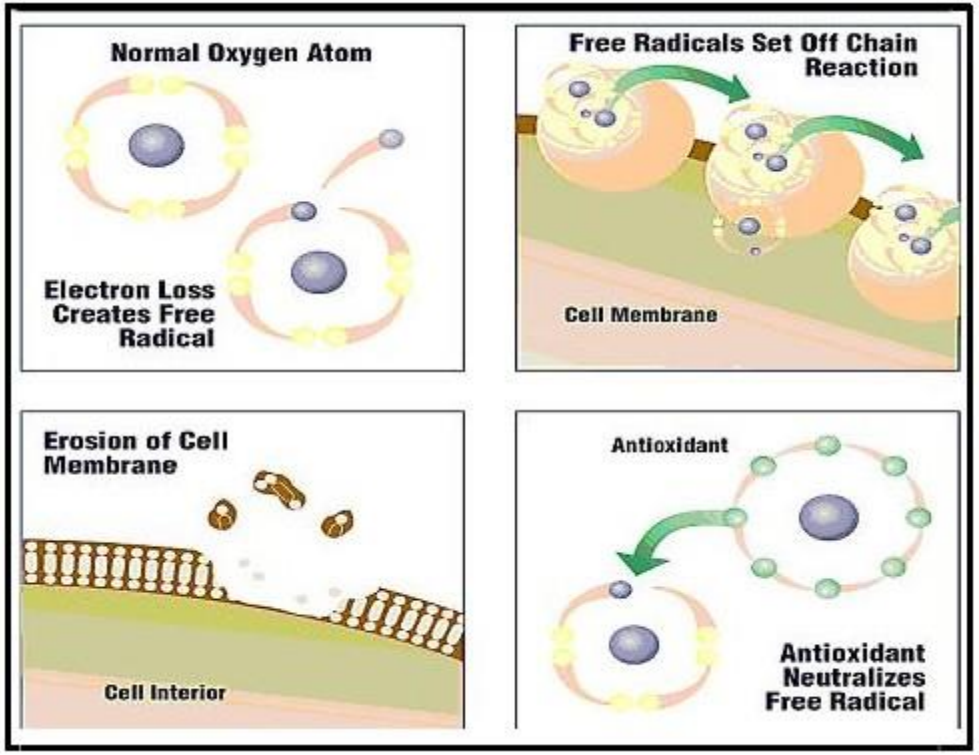


What are Free radicals ?

Any particle containing one or more unpaired electrons.

Particles with an unpaired electron spinning around the nucleus. (can be atom, ions, molecule).

Properties of free radicals



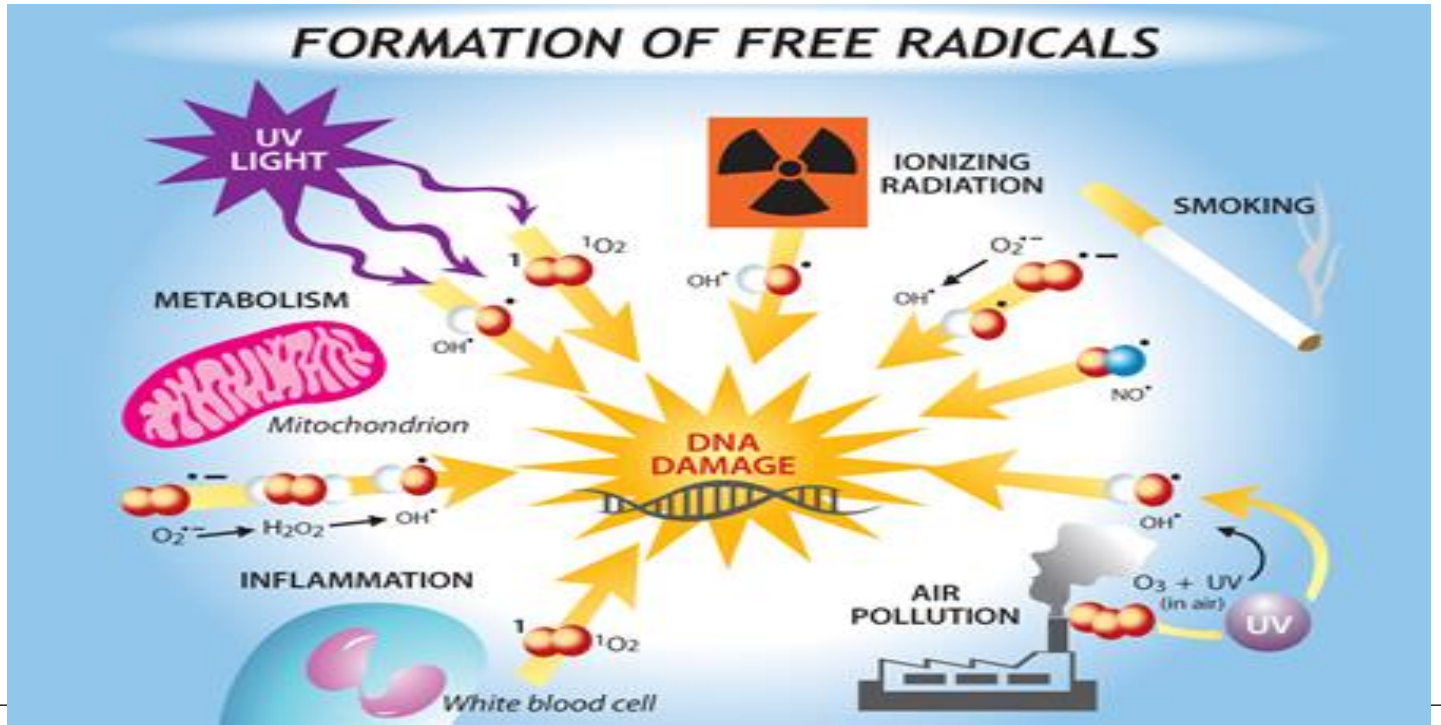
1. Highly reactive
2. Very short half-life
3. Generate new radicals by chain reaction
4. Cause damage to biomolecules, cells and tissues

Most free radicals in biological systems are derivatives of oxygen (Reactive Oxygen Species, ROS), but there are also derivatives of nitrogen (Reactive Nitrogen Species, RNS), Reactive Metabolites or Intermediates.

Generation of Free Radical

1. Cellular metabolism

About 1-4% of oxygen taken up in the body is converted to free radicals. They are constantly produced during the normal oxidation of foodstuffs.



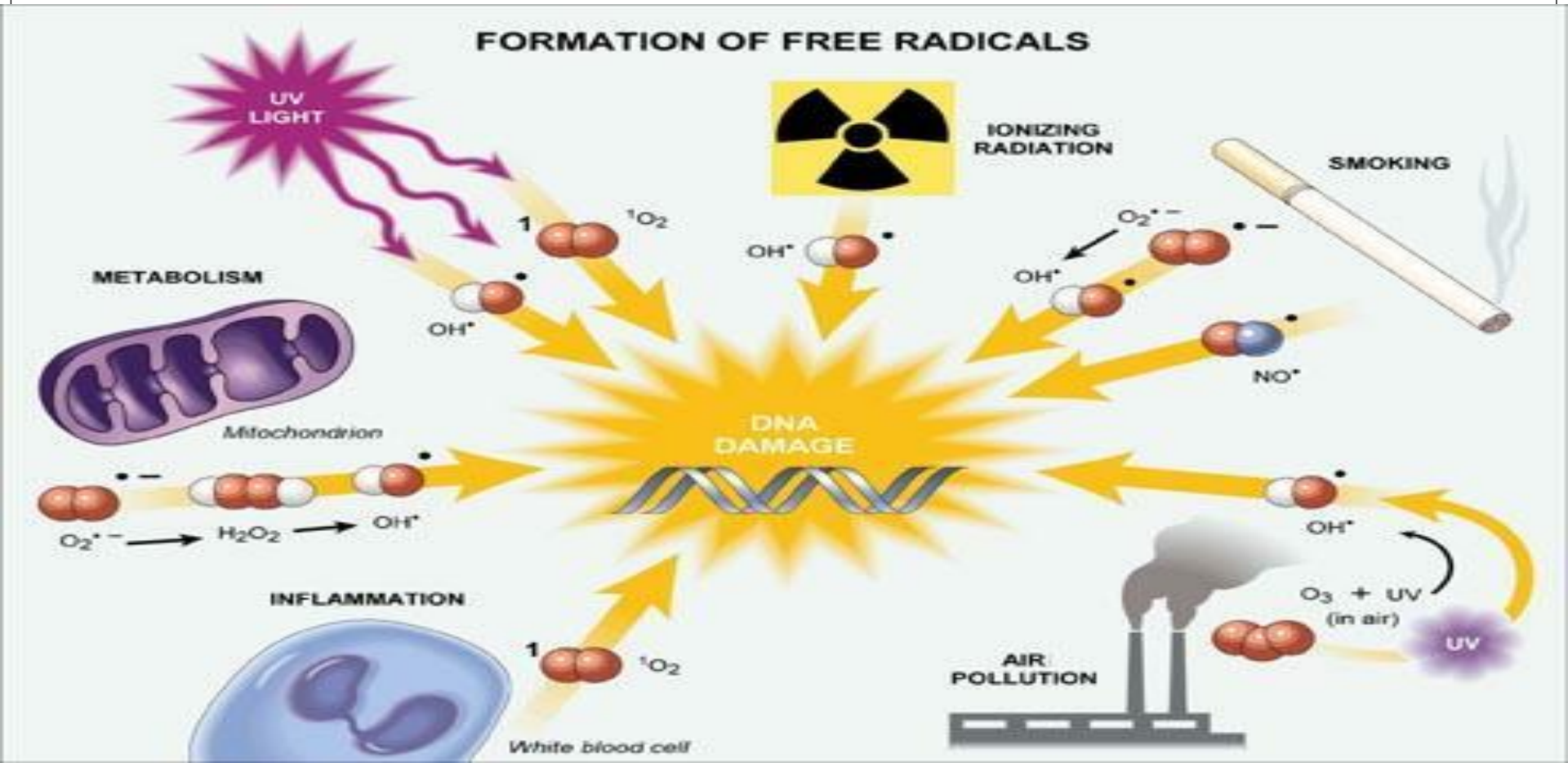
Generation of Free Radical

2. Environmental effects:

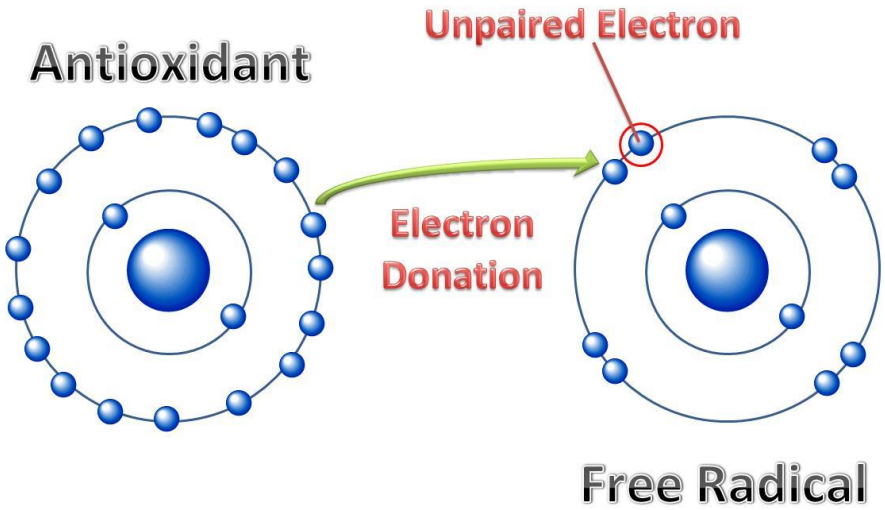
a) due to drug metabolism.

b) due to damages caused by UV or X-rays

c) cigarette or alcohol.



Antioxidants



- Prevents the transfer of electron from O_2 to organic molecules
- Stabilizes free radicals
- Terminates free radical reactions

Functions of vitamin E

- Most important function is as antioxidant .
- The biochemical function are directly or indirectly related to this property.

- Prevents non enzymatic oxidation of various cell components by molecular oxygen and free radicals(PUFA).

- Maintains the integrity of cell membrane by preventing per oxidative effect of free radicals on lipid of cell membrane.

Antioxidant action in polyunsaturated fatty acids

In polyunsaturated fatty acids per oxidation of lipids occur in three stages.

- 1)INITIATION

Removal of hydrogen atom (H) from poly unsaturated FA by hydroxyl radical.

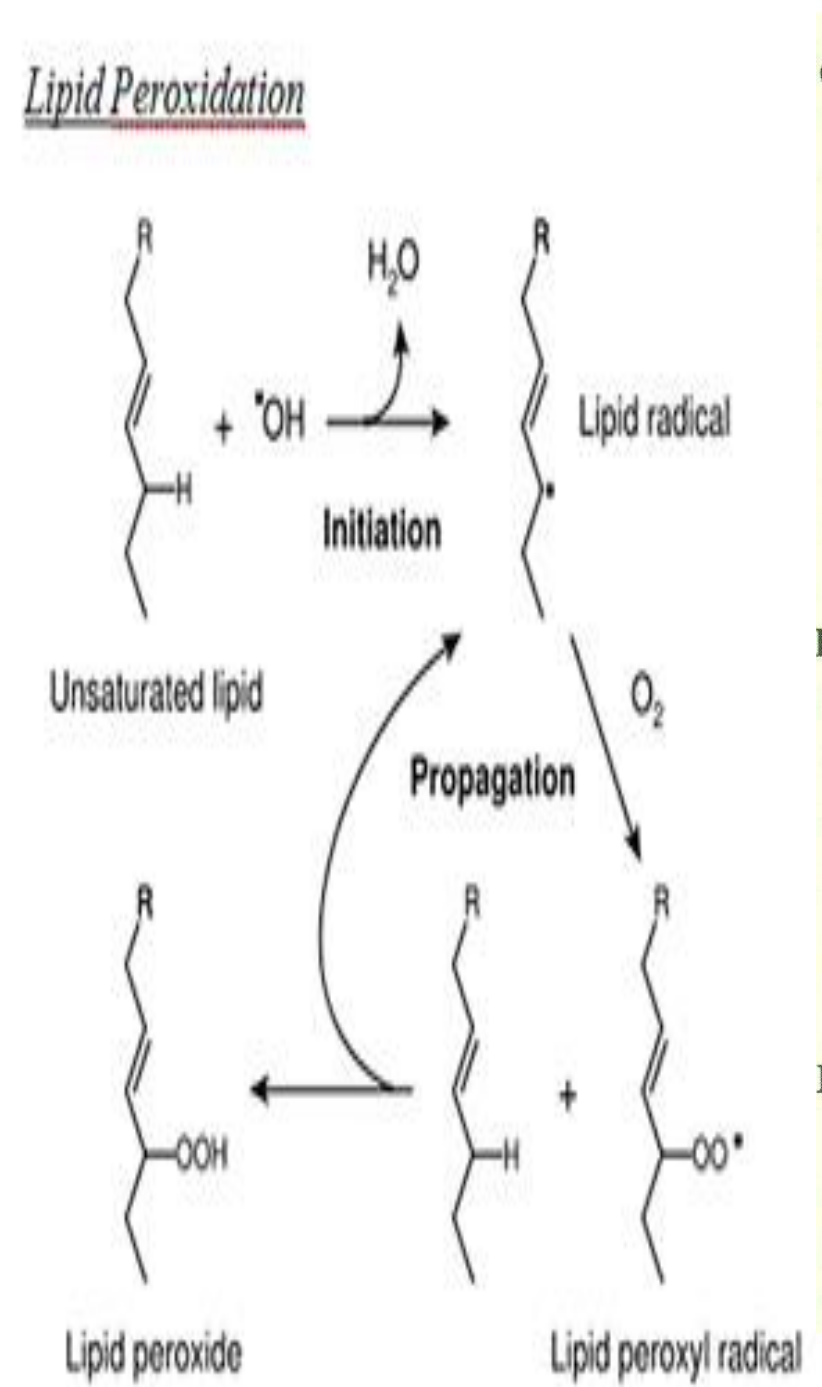
$$LH + OH^{-} \longrightarrow L^{-} + H_2O$$

- 2)PROPAGATION

Under aerobic conditions the free radicals take oxygen to form per oxy radical(LOO),

This in turn can remove H atom from another PUFA(LH) to form lipid hydro peroxide(LOOH).

$$L^{-} + O_2 \longrightarrow LOO^{-}$$



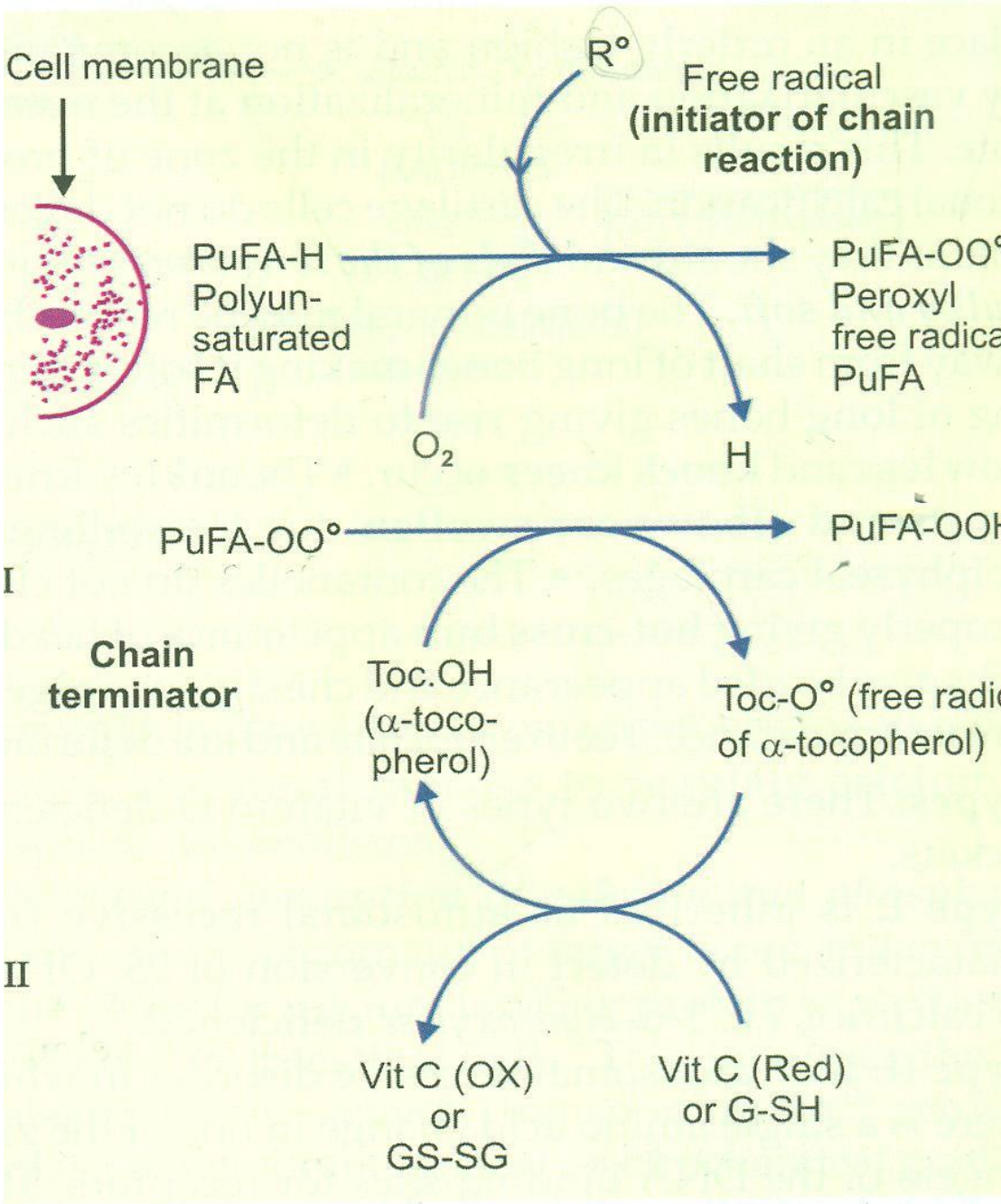


FIG. 12.5: ROLE OF VIT E AS ANTIOXIDANT

- The hydroperoxides are capable of further stimulating lipid peroxidation.

- 3) TERMINATION
- Lipid per oxidation proceed as chain reaction until available PUFA gets oxidized.

- Vitamin E inhibit the propagation phase of lipid per oxidation.

- Preserve and maintains the germinal epithelium of Gonads, so help in reproduction.
- Increase heme synthesis by increasing activity of δ-aminolevolenic acid synthase and ALA dehydratase.
- Require for cellular respiration(involved in the synthesis of co enzyme Q).
- Prevents the oxidation of vitamin A.
- Prevents cancer, cataract.

- Require for storage of creatine in muscle.
- Protects liver from harmful effects of substances like carbon tetrachloride.
- Synthesis of nucleic acid.
- Enhance immune response.
- Used in heart disease(prevents oxidation of LDL).
- Prevents aging process and Alzheimer's disease.

Deficiency

- Hemolytic anemia

  Erythrocyte hemolysis(due to peroxides).

Neuro muscular disorder

loss of muscle co ordination

Nocturnal muscle cramps

Intermittent claudication

Implication of viral diseases.

Related to oxidative stress.

Infertility in experimental animals

Inability to produce healthy ovum, loss of motility of spermatozoa.

CLINICAL USES

- Nocturnal muscle cramps.
- Intermittent claudication.
- Fibrocystic breast disease.
- Atherosclerosis.


THANK
YOU!