

Vitamins

BCH 350 (Lec 12)

Vitamin D is different from all other nutrients in that the body can synthesize it with the help of sunlight. Therefore, vitamin D is not an essential nutrient. Given enough sun, people need no vitamin D from food.

Vitamin D Sources:

- Cholecalciferol is produced in the skin by U.V. radiation of 7-dehydrocholesterol (vitamin D precursor, that is synthesized by the liver).
- Performed vitamin D from fish-liver oils, flesh of oily fish, egg yolk and liver (milk is a poor source of vitamin D).

Absorption and activation:

- It is absorbed in the intestine.
- Activation of vitamin D, starts in the liver cells, where it is hydroxylated on the 25th position by 25-hydroxylase → 25-hydroxycholecalciferol.
- 25-hydroxy D₃ is further hydroxylated in kidney by 1- α hydroxylase → 1,25 dihydroxy D₃ (calcitriol) which is the metabolically active form of the vitamin (500-1000 fold greater in biological activity than its precursor).
- Parathyroid hormone is essential for the hydroxylation step in the kidney.
- 24,25 dihydroxy D₃ is another active form. However, it is less active than 1,25 dihydroxy D₃. The level of the two active forms are reciprocally related, but they are nearly equal in normal calcium level.
- Diseases affect liver or kidney may impair the transformation of precursor vitamin D active form therefore, produce symptoms of vitamin D deficiency.



Vitamin D role in Bone:

- Vitamin D acts as a regulator of the metabolism of calcium and phosphorous by promoting the transport of calcium and probably secondary phosphorous into the blood stream from intestinal lumen, bones and renal tubules (target organs).
- Vitamin D's role in bone growth is to make (Ca^{2+} and PO_4^{2-}) available in the blood that bathes the bone. Vitamin D acts in 3 ways to maintain blood concentration of Ca^{2+} and phosphorous.
 1. Stimulate their absorption from the GIT.
 2. It mobilizes Ca^{2+} and PO_4^{2-} from bones to blood.
 3. Stimulate their retention by the kidney.

Vitamin D deficiency:

Vitamin D deficiency symptoms are those of Ca^{2+} deficiency.

Rickets:

The vitamin D deficiency disease in children soft pliable bones with various deformities.

Osteomalacia:

- A bone disease characterized by softening of bones. Symptoms include bending of the spine and bowing of the legs. The disease occurs most often in adult women, bones become more susceptible to fracture.

Osteo = bone mal = bad (soft)
- Inadequate vitamin D is recognized as a risk factor in osteoporosis.

Vitamin D Toxicity:

Essential D:

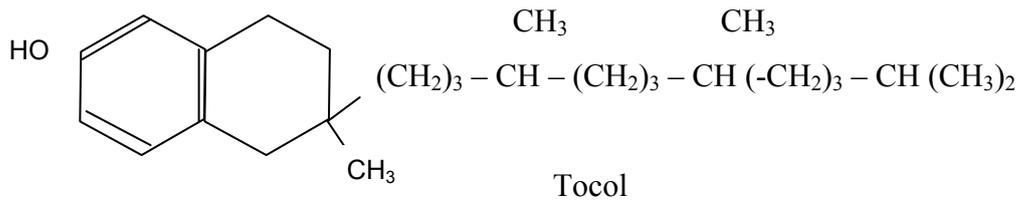
1. enhances Ca^{2+} absorption, produce high blood Ca^{2+} .
2. enhances bone resorption (return of bone Ca^{2+} into blood).
3. excess Ca^{2+} then tends to precipitate in the soft tissues, forming stones including kidney stones.

Vitamin D from Sun:

1. Prolonged exposure to sunlight degrades the vitamin D precursor in the skin, preventing its conversion to the active vitamin.
2. Prolonged exposure to sunlight cause skin cancer.

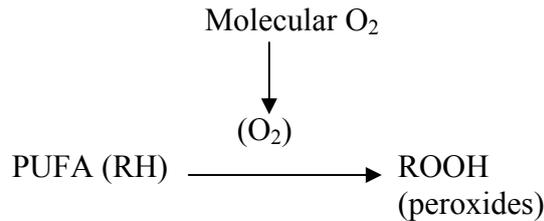
Vitamin E (Tocopherols)

- Vitamin E is a fat-soluble antioxidant. It protects other substances from oxidation by being oxidized itself.



- Therefore naturally occurring tocopherols.
- α -tocopherol (5,7,8 trimethyl tocol) is the most active and abundant one.

Vitamin E as an antioxidant:



- Vitamin E is specially effective in preventing the oxidation of polyunsaturated fatty acids (PUFA), but it protects all other lipids e.g. vitamin A from oxidation by molecular oxygen and free radicals (N.B.: if O₂ attach PUFA → FA peroxides).
- Vitamin E exerts an especially important antioxidant effect in the lungs, where the cells are exposed to high concentration of O₂.
- Vitamin E also protects the lung from air pollutants that are strong oxidants.
- Vitamin E also prevents heart disease by protecting LDL from oxidation which encourages development of atherosclerosis (oxidized LDL).
- Vitamin E may play role in keeping stability of erythrocytes.

Vitamin E Deficiency:

- When blood concentration of vitamin E falls below a critical level, the RBCs tend to break, open, spill their contents (hemolysis) due to increased fragility of the red blood cell membrane because of peroxidation of their membrane PUFAs. This is known as erythrocyte hemolysis which is seen in premature infants born before the transfer of vitamin E from the mother to the fetus that takes place in the last weeks of pregnancy.
- Vitamin E deficiency is associated with diseases that cause malabsorption of fat. These include diseases of the liver, gallbladder and pancreas.

Vitamin E Toxicity:

- Vitamin E toxicity effects are not serious as vitamin A or vitamin D toxicity.

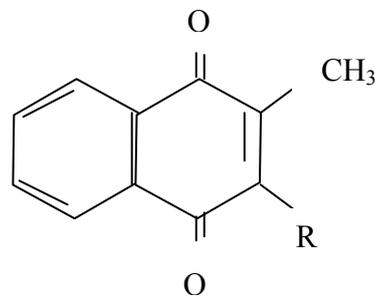
- High doses of vitamin E interfere with blood-clotting action of vitamin K is enhancing the action of anti-coagulant medication leading to hemorrhage (blood fails to clot).

Vitamin E sources:

- Cotton seed oil, corn oil, peanut oil and wheat germ oil are good sources.
- Green lettuce leaves also have high content.
- Other good sources: eggs, muscle meat, liver, fish.

Vitamin K:

- Has a role in blood clotting. The vitamin participates in the synthesis of several bone proteins.
- Vitamin K may play a role in reducing the risk of hip fracture.



Vit K (vit K₁, k₂, k₃)

Blood Clotting:

- At least 13 different proteins and the mineral Ca₂₊ are involved in making blood clotting.
- Vitamin K is essential for the activation of one of these proteins, among of them prothrombin, the precursor of thrombin.
- When any of the blood-clotting factor is lacking → hemorrhagic diseases.

Intestinal synthesis:

Like vitamin D, vitamin K can be obtained from a non food source, bacteria in the intestinal tract (intestinal flora) synthesize vitamin K that the body can absorb, but people cannot depend on this source alone.

Deficiency:

- Manifested by remarkable tendency to bleed profusely from minor wounds and easy bursing.
- Diagnosed by prolonged blood coagulation time.
- Is rare, but may occur in 2 cases.
 1. ↑ fat malabsorption conditions.

2. Medication interfere with vitamin K's synthesized its action in the body
e.g. antibiotics kill the bacteria that produce vitamin K.

- Vitamin K deficiency can be fatal.

Toxicity:

- Vitamin K toxicity symptoms include RBC hemolysis, jaundice and brain damage.

N.B:

- High intake of vitamin K can reduce the effectiveness of anti coagulant medication used to prevent the blood from clotting.

- People take these medication should each vitamin K-rich foods.

In food: Green vegetables e.g. spinach, also fruits, peas, vegetable oils, tomatoes, egg yolk, liver, etc.