

# DEFINITION OF VITAMINS

Vitamins are organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism.

Vitamins cannot be synthesized in the body.

Vitamins are obtained from different foods, milk, sun light (vitamin D) also synthesized by several microorganisms like yeast and molds.

The abbreviation IU stands for the international units which is the measurement for some vitamins. It is the same idea as milligrams, though they are not equivalent.

# VITAMINS IN MILK

Vitamins	Class	Concentration (per litre)
Vitamin A	Fat soluble	1590 I.U.*
Vitamin D	Fat soluble	22.1 I.U.
Vitamin E	Fat soluble	1.0 mg
Vitamin K	Fat soluble	0.04 mg
Vitamin B <sub>1</sub>	Water Soluble	0.4 mg
Vitamin B <sub>12</sub>	Water Soluble	1.5 mg
Pantothenic acid	Water Soluble	3.0 mg
Biotin	Water Soluble	50 $\mu$ g
Niacin	Water Soluble	0.2-1.2 mg
Pyridoxine B <sub>6</sub>	Water Soluble	0.7 $\mu$ g
Folic acid	Water Soluble	1.0 $\mu$ g
B <sub>12</sub>	Water Soluble	7.0 $\mu$ g
Vitamin C	Water Soluble	20 mg
Inositol	Water Soluble	180 mg
Choline	Water Soluble	150 mg

# **CLASS OF VITAMINS IN MILK**

**Class A: Fat soluble vitamins A, D, E and K**

**Class B: Water soluble vitamins, the B-complex (thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, choline, inositol, folic acid, p-aminobenzoic acid, B12) and vitamin C (Ascorbic acid).**

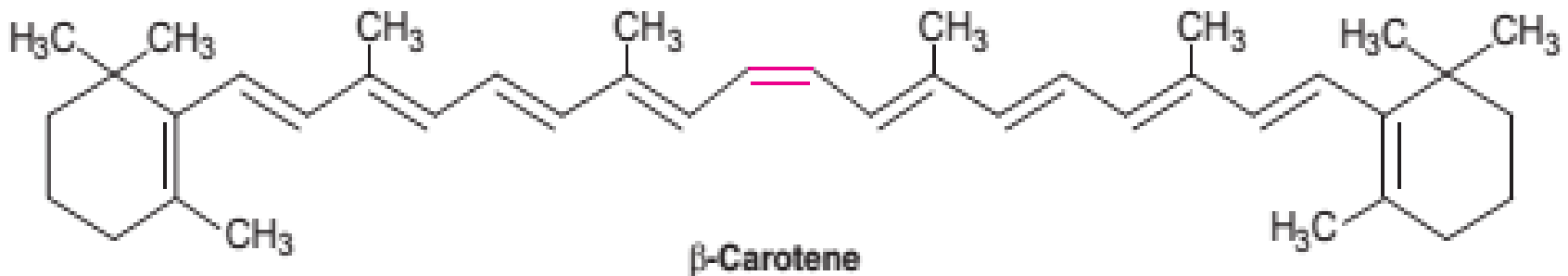
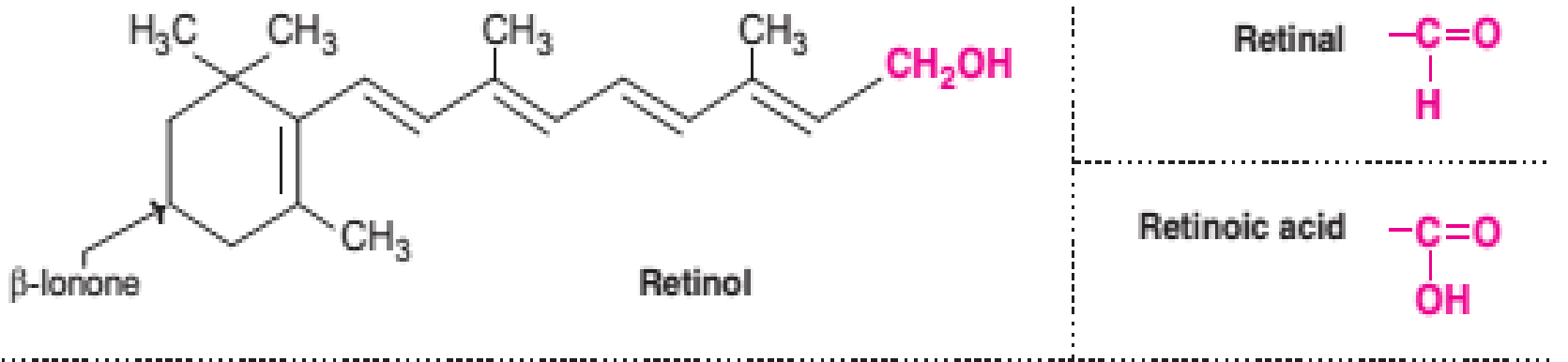
**All the above vitamins are present in milk, however, vitamin A and B2 group vitamins are present in appreciable amounts.**

# CLASSIFICATION OF FAT SOLUBLE VITAMINS

**Vitamin A (Retinol):** Vitamin A is comprised of retinol, retinal, and retinoic acid which are classified as retinoids. The structure of retinol is representative in having a six-membered  $\beta$ -ionone ring with a double bond that is conjugated with all trans double bonds of a polyunsaturated side chain derived from isoprene units and which bears a hydroxyl group (retinol), aldehyde group (retinal), a carboxyl group (retinoic acid), or a carboxylic acid derivative.

Retinol is present in animal tissues with long chain fatty acids. Plants synthesize carotenoids but not retinol, animals cannot synthesize carotenoids but can split them to retinol (vitamin A).

**$\beta$ -carotene (provitamin A):** This is found in plant foods. It is cleaved in the intestine to produce two moles of retinal.  $\beta$ -carotene and some of the pigments derived are  $\beta$ -apo-8' carotenal and  $\beta$ -apo-8'-carotenoic acid ethyl ester which is of practical importance. There are several forms of provitamin A belonging to the carotenoid pigments.



# CHARACTERISTICS OF VITAMIN A

Vitamin A is present in cow's milk as retinol, retinol ester and carotene. The content depends strongly on the amount of carotenoids in the feed. The ratio of retinol to carotene in milk varies with breed and species of animals.

Vitamin A is relatively stable to heat in the absence of oxygen, because of the highly unsaturated character of the molecule.

It is quite susceptible to oxidation, especially in the presence of sunlight or artificial light.

Vitamin A is unstable in the presence of mineral acids but stable in alkali.

**Vitamin A and the carotenoids have good stability during various food processing operations.**

**Pasteurization of milk does not result in vitamin A loss but exposure to light will result in loss. It is essential, therefore, that sterilized milk be packed in light impervious containers. Possible losses during storage of foods are more affected by duration of storage than by storage temperature.**

**Vitamin A is present as carotene in plant and must be converted to vitamin A for its function.**

# IMPORTANCE OF VITAMIN A IN DIET

- 
- **Helps in growth, health, initiate vision and reproduction**

- 
- **Keeps epithelial tissues healthy and thus aids in preventing infections**

- 
- **Maintains normal glandular functions such as maintenance of adrenal cortex and steroid hormones synthesis**

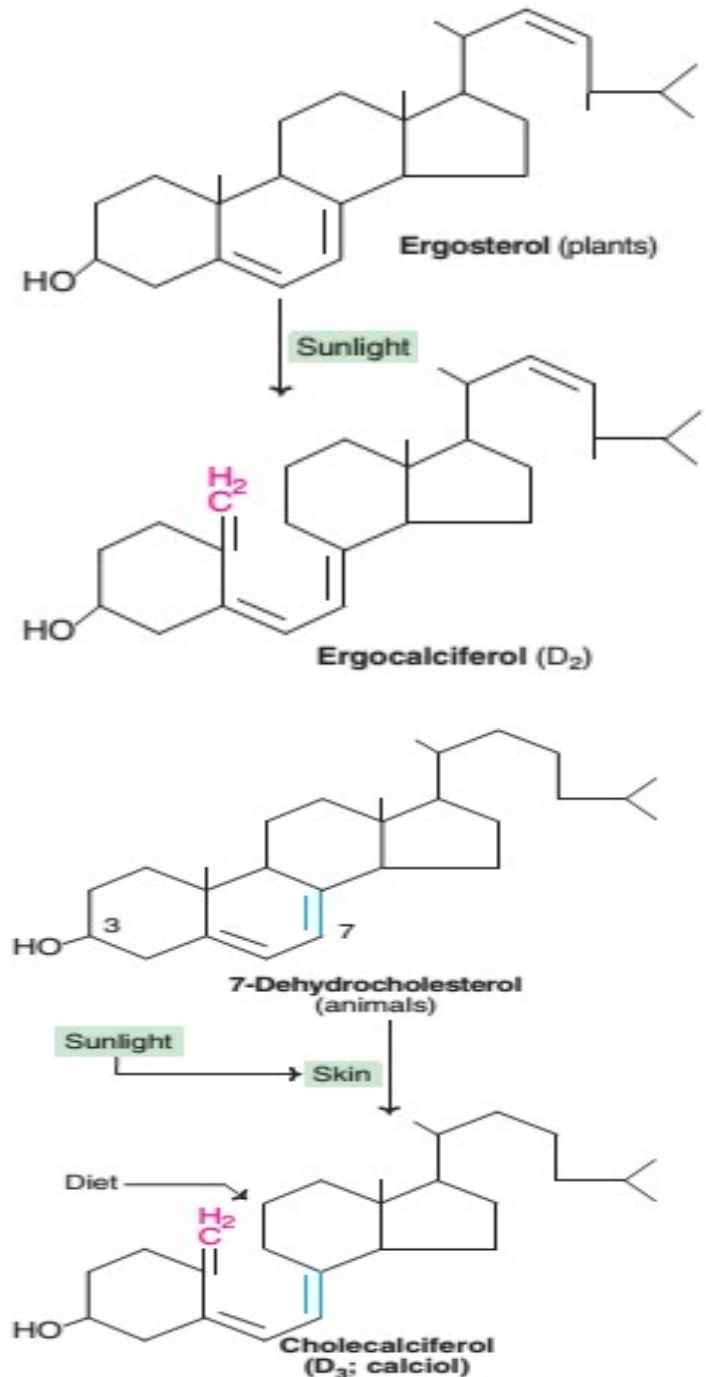


# VITAMIN D:

Vitamin D is a fat soluble vitamin functioning like hormone.

Ergocalciferol (D<sub>2</sub>) occurs in plant material and is formed by UV irradiation from ergosterol. Cholecalciferol (D<sub>3</sub>) is formed by UV irradiation of 7-dehydrocholesterol in animals particularly in the skin.

Both forms of this vitamin occur in milk, D<sub>2</sub> coming from the feed and D<sub>3</sub> from their radiated skin of the cow.



## **CHARACTERISTICS OF VITAMIN D:**

**Active form of vitamin D is identified as 1,25 - dihydroxycholecalciferol which triggers the synthesis of calcium binding proteins for the calcification of bones. Thus, this vitamin prevents disease called rickets in children and osteomalacia in pregnant women and osteoporosis in old.**

**1 IU is 0.25ng of cholecalciferol. Average value of this vitamin in bovine milk is 13.0 and 31.2, I.U. for winter and summer milk respectively.**

**Vitamin D in milk can be increased by exposure of cow to sunlight, feeding higher levels of irradiated plant material, irradiating milk and fortification in milk with vitamin D.**

# IMPORTANCE OF VITAMIN D IN DIET

- Aid in calcium and phosphorus retention so as to make strong bones

- Maintains and activates alkaline phosphatase in bones and serum calcium and phosphorus level

- Increases citrate blood levels

Vitamin D is sometimes called the sunshine vitamin because the ultraviolet radiation of the sun can convert an active precursor of the skin(7-dehydrocholesterol, the intermediate formed during cholesterol biosynthesis) to vitamin D.

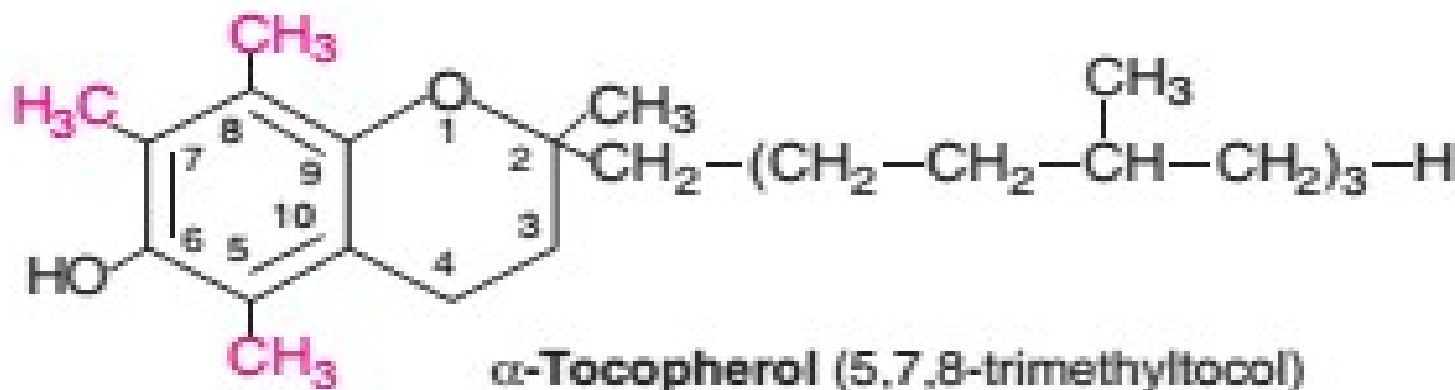
## VITAMIN E (TOCOPHEROL):

Vitamin E consists of a group of tocopherols, the active one in milk is  $\alpha$ -tocopherol.

This serves as an membrane antioxidant protecting polyunsaturated fatty acids from peroxidation.

The vitamin E content is rather low that depends to some extent on feed. Summer milk has higher concentration than winter milk.

It is stable to heat but may be partly destroyed by intensive illumination in the presence of  $O_2$ .



# IMPORTANCE OF VITAMIN E IN DIET

- **Plays role in human nutrition and is associated with nutrition of muscles**

- **Maintains integrity of vascular system and central nervous system**

- **This detoxifying agent maintains kidney, tubules, lungs, genital structure, liver and red blood cell membranes**

- **Optimal absorption of amino acids from the intestine**

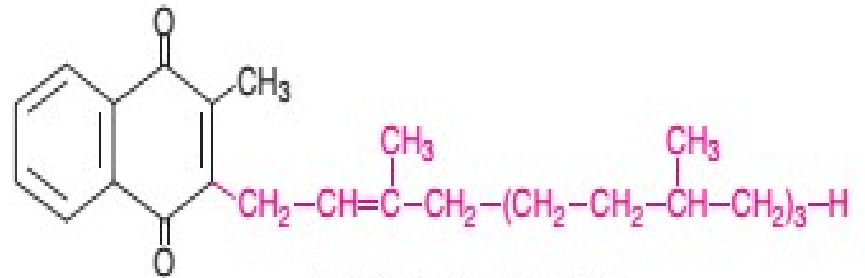
# VITAMIN K:

Vitamin K is present only in traces in milk.

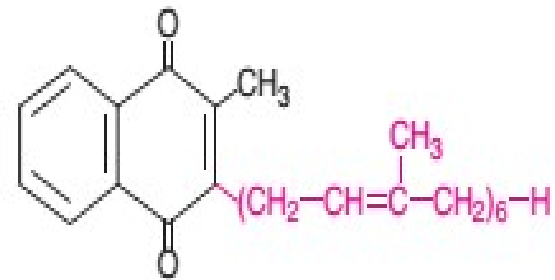
It is required for the production of blood clotting factors, essential for coagulation.

Different forms:

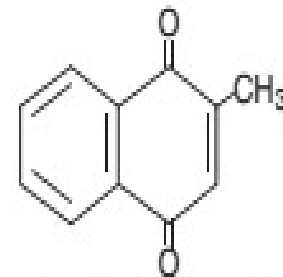
- Vitamin K1 (phylloquinone) is present in plants.
- Vitamin K2 (menaquinone) is produced by the intestinal bacteria and also found in animals.
- Vitamin K3 (menadione) is a synthetic form.



Vitamin K<sub>1</sub> (phylloquinone)



Vitamin K<sub>2</sub> (menaquinone)



Vitamin K<sub>3</sub> (menadione)