15. BIOMOLECULES

iii) VITAMINS

I. Vitamins

- The word vitamin (vital - essential, amines - amino compounds) was proposed by Funk (1912).
- He defined it as an **accessory food factor which is essential for growth and healthy maintenance** of **the body.**
- They do not provide energy or body building materials.
- But they are essential for energy transfer and regulation of metabolism.
- Some vitamins form parts of many enzymes. Deficiency of vitamins leads to deficiency disorders. There are two types of vitamins, namely, **fat soluble vitamins and water soluble vitamins.**

FAT SOLUBLE VITAMINS :

- A, D, E and K are the fat soluble vitamins. They need bile juice for absorption. They are transported to all parts by lymph.

1. Vitamin-A:

- An alcohol ($C_{20}H_{29}OH$) contain ionone **ring** and **hydrocarbon** chain.
- Its chemical name is **retinol.** It is commonly called **anti xerophthalimic vitamin.**
- The main sources of vitamin-A are fish liver oils, milk, butter, egg yolk etc. In plants vitamin-A is in the form of β-carotene (provitamin-A).
- In the liver and intestine, β-carotene becomes Vitamin-A. It is rich in carrots, green leafy vegetables etc.
- Vitamin-A plays an important role in growth and activity of epithelial tissues and a vital role in vision.
- It is essential for resynthesis of rhodopsin (visual purple) in retina.
- Deficiency of Vitamin-A leads to **nyctalopia** (night blindness), **xerophthalmia** (dryness of cornea, swollen eye lids) and **keratomalacia** (dry and scaly skin).

2. Vitamin-D :

- Sterol consisting of 4 rings and a side chain. 3 rings are 6-charbon rings and one ring is cyclopentane.
- The chemical name of vitamin-D is **calciferol.** It is commonly called **antiricketic vitamin** or **sunshine vitamin.**
- The main sources of this vitamin are fish liver oils, milk, butter, egg etc. Mammalian skin can synthesise vitamin-D in presence of sun light *(i.e..* U.V. rays).
- Vitamin-D is important for calcium metabolism and it increases the absorption of calcium and phosphorus from the intestine and is thus necessary for formation of healthy bones and teeth.
- Deficiency of Vitamin D in children leads to **rickets** (bones fails to calcify properly leading to bow legs, knok-knees, ribs become deformed leading to pigeon breast) and in adults to **osteomalacia** (bones become soft and fragile).

- Over doses of Vitamin D (hyper vitaminasis of vitamin D) causes nausea, head ache, kidney damage, calcification of soft tissues etc.

3. Vitamin E :

- Chromone ring with3 methyl groups. It is an unsaturated alcohol.
- The chemical name of vitamin E is **tocopherol.** Its common name is **anti-sterelity vitamin.** The sources of E-Vitamin are wheat germs oil, nuts, wheat and maize etc.
- This vitamin acts as an anti oxidant. It maintains health and integrity of muscles by controlling the oxidation of polyunstaturated fatty acids.
- Vitamin-E plays an important role in functioning of gonads.
- Deficiency of vitamin-E leads to sterelity in males, abortion in females, besides **muscular dystrophy.**

4. Vitamin K :

- Naphthaquinine derivative.
- The chemical name of vitamin K is **naphtho quinone.**
- It is commonly known as **antihaemorrhagic vitamin.**
- It is found in green leafy vegetables, tomato, cheese, eggs, liver etc. Intestinal microbes also synthesise vitamin K.
- It is necessary for the formation of prothrombin, which is required for clotting of blood.
- Deficiency of K-vitamin leads to delay in blood clotting process leading to loss of more blood even from minor wounds.

WATER SOLUBLE VITAMINS :

- **B** and **C** vitamins are water soluble vitamins. They are directly absorbed by the intestine and are carried to all parts by blood.

Vitamin-B complex :

- Several vitamins have been grouped as B-complex because of their similarities in distribution in common natural sources.
- Most of the vitamins of B-complex acts as co-enzymes.
- Main sources of B-complex group of vitamins are liver, milk, eggs, kidneys, fish, cereals, pulses, nuts, peas, beans, green leafy vegetables etc.

Vitamin B_1 (Thiamin) :

- Contains pyridine and thiazole molecules (dimethyl amino pyridine).
- Cereals, outer brain layers, yeast, milk, green vegetables.
- ATP + Bi $\rightarrow$ AMP + Bipyrophosphate Activates carboxylases.
- Beri Beri (oedema in leges).

Vitamin B_2 (Riboflavin) :

- Flavin derivative
- Yeast, vegetables milk, egg white, liver and kidney.

- Two enzymes FMN and FAD are formed, coenzymes for several dehydrogenases.
- Dark red tongue, dermatitis, cheilosis, (fissuring at corners of mouth & lips).

Vitamin B_3 (Pentothenic acid) :

- Pentothenic acid it is a Dipeptide ($C_9H_{17}O_5N$)
- Present in all food stuffs
- Compound of coenzyme A. Essential for basic reactions in metabolism.
- Deficiency case Burning feet.

Vitamin B_5 (Nicotinic acid or Niacin):

- Nicotinic acid or Niacin.
- Pyridine derivative (Nicotinamide)
- Meat, yeast, milk, green leafy vegetables contains B_5.
- Essential for growth, promoters formation of fats from carbohydrates. Important component of coenzyme (DPN and NADP).
- Pellegra (rough skin) dermatitis, diarrhoea.

Vitamin B_6 (Pyridoxine):

- Pyridine derivative, pyridoxal phosphate.
- Cereals, grams yeast, egg yolk, meat.
- Synthesis of fats from carbohydrates. Transportation of amino acids across cell membrane.
- Dermatitis, convulsion.

Vitamin B_7 (Biotin) or Vitamin H:

- Heterocyclic S-monocarboxylic acid. It is called co-enzyme R ($C_{10}H_{16}O_3N_2S$).
- Yeast, liver, kidney, milk.
- Coenzyme for carboxylases. Essential for synthesis of lipids.
- Dermatitis. Blood chlesterol increases. Loss of hair, paralysis.

Vitamin B_9 (Folic acid) :

- It consists of glutamic acid, para amino benzoic acid and pterin.
- Spinach leaf, intestinal bacteria.
- Coenzyme, synthesis of RNA. Formation of red cells.
- Anaemia, inflammation of tongue, gastro intestinal disorders.

Vitamin B_{12} (Cynocobal amine):

- Resembles heme. Co^{3+} is centrally situtated in corrin ring (C_{63} H_{88} O_{14} N_{14} PCo)
- Liver of ox, ping fish etc.
- Formation of RBC, synthesis of nucleic acids. Synthesis of lipids from carbohydrates.
- Pernicious anaemia hyperglycemia.
- Present in all food stuffs

Vitamin C (Ascorbic acid):

- Acid. Resemble glucose.

- Green leafy vegetables, citrous fruits.
- Maintenance of redox potentials of cells, coleagen synthesis. Scurvy delay in wound healing