WELCOME TO

Biochemistry | Chapter-7

Chapter-7

Vitamins

- Definition and classification with examples
- Sources, chemical nature, functions, coenzyme form, recommended dietary requirements, deficiency diseases of fat- and water-soluble vitamins

Vitamins.

Definition of vitamins—

- The word “Vitamin” comes from the Latin word “Vita” means “life”.
- Vitamins are organic component in food that is needed in very small amount for growth and for maintaining good health.
- Vitamins are chemicals found in very small amounts in many different foods.
- They required to the body through diet because they cannot be synthesized by the body.
- Water soluble vitamins cannot be stored in human’s tissues. Their excess is exerted with urine.
- Fat soluble vitamins can be stored in adipose tissue and the liver.

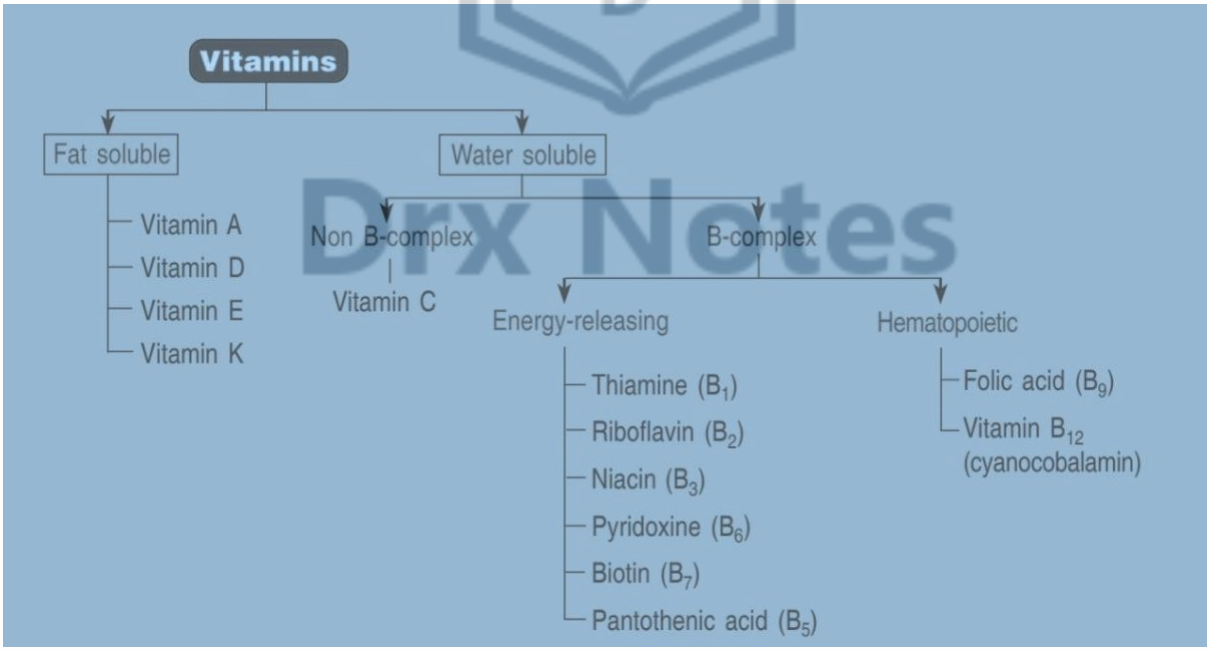
Common functions of vitamins—

- They build up the resistance of the body against disease.
- Prevent and cure various disease caused by deficiency.
- Help the Digestion and Utilization of Minerals salts and carbohydrates in the in the body.
- Stimulate and give strength to digestive & Nervous system.
- Help Maintenance of Proper Health & normal Growth.

Classification of Vitamins with examples—

On the basis of solubility vitamins are mainly 2 types.

1. **Fat Soluble Vitamins:** Vitamins that dissolve in fat because fat is easily stored in our body, Fat soluble vitamins can be stored within out fat. This means they can accumulate and be saved for later use.
   - Vitamins A
   - Vitamins D
   - Vitamins E
   - Vitamins K
2. **Water Soluble Vitamins:** Water Soluble Vitamins that dissolve in water because our body is a watery environment. These vitamins can move through our body pretty easily & they can also be flushed out by the kidneys.
   - **A. B- complex.**
     - **Energy-releasing—** Thiamine (B_1), Riboflavin (B_2), Niacin (B_3), Pantothenic acid (B_5), Pyridoxine (B_6), Biotin (B_7).
     - **Hematopoietic—** Folic acid (B_9), Cyanocobalamin(B_{12})
   - **B. Non-B-complex. Example**— Vitamin C



Sources, chemical nature, functions, coenzyme form, recommended dietary requirements, deficiency diseases of fat-and water-soluble vitamins.

Vitamin A

- Vitamin A is also known as “Retinol” Dehydroretinol.
- It is a Colourless Vitamin insoluble in water & soluble in fat.
- Destroyed when exposure to sun light.

Sources.

- Carrot
- Chesses
- Yellow corn
- Papaya
- Fish Liver oil
- Mangoes

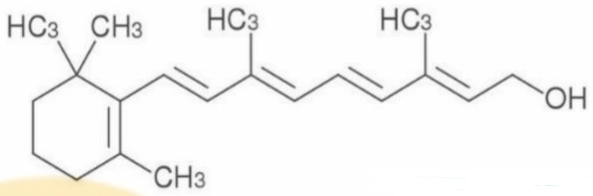


Fig: Retinol

Chemical nature.

Dietary requirements.

- For adult men— 900 micrograms (mcg).
- For adult women— 700 micrograms (mcg).
- For pregnant and lactating women have higher requirements.

Functions.

- Provide the defence against illness and infections.
- Helping for the vision
- Keeping skin and lining of some parts of the body healthy.

Coenzyme form.

- The active form of vitamin A is retinal, which converted from retinol by the action of retinol dehydrogenase enzyme and finally transported throughout the body.
- Retinoic acid (hormone like substance and is involved in the cell growth and differentiation).

Deficiency disease.

- Xerophthalmia – (Blindness in Childhood)
- Keratomalacia – (Whole Eye ball may shrink)

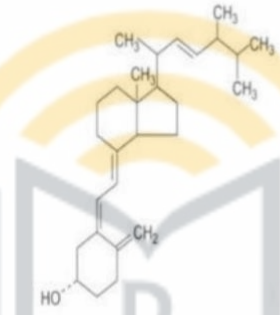
- Phrynoderma – (Skin lesion – Follicular Hyperkeratosis).

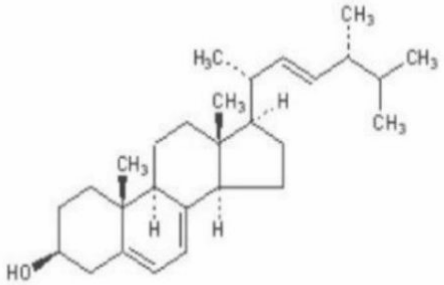
Vitamin D.

- Vitamin – D also known as “Calciferol” sunshine vitamin antirachitic factors.
- It is white crystalline substance
- Fairly heat resistance
- Soluble in fat & fat solvents.

Sources.

- Milk
- Sun light exposure
- Mushrooms
- Cod liver oil
- Egg Yolk
- Butter, etc.


Ergosterol structure


Ergocalciferol structure

Chemical nature

Dietary requirements.

- According to the institute of medicine (IOM), the daily intake for adults is 600-800 international units (IU).

Functions.

- Vitamin d helps to regulate the immune system and cell growth and differentiation.
- It is essential for the maintaining healthy bones and teeth.

Coenzyme form.

- Calcitriol is an active form of vitamin D and acts as a coenzyme.

Deficiency disease.

- Child – Rickets – Disease of Growing Bones

- Adult – Osteomalacia – Similar as rickets (Bones become softer).
- Osteoporosis and others auto immune disorders.

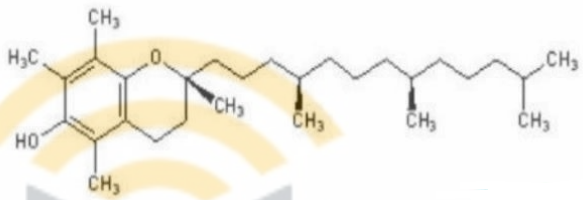
Vitamin E.

- It is also known as “Tocopherol” anti-sterility factor.
- Vitamin E is light yellow oil.
- Slowly oxidized and destroyed by UV- Rays.

Sources.

- Corn
- Egg
- Milk
- Soybean
- Meat
- Rice, etc.

Tocopherol structure



Chemical nature.

Dietary requirements— According to the national institutes of health (NIH), the recommended daily intake for adult men and women is 15 milligrams per day.

Functions.

- It helps to maintain the health of the cells in the retina and necessary for the proper function of the visual cycle.
- Plays an important role in the immunity functions.
- It acts as an antioxidant and prevent the body against any damage.
- Helps in cell growth and differentiation.

Coenzyme— Tocopherols and Tocotrienols.

Deficiency disease.

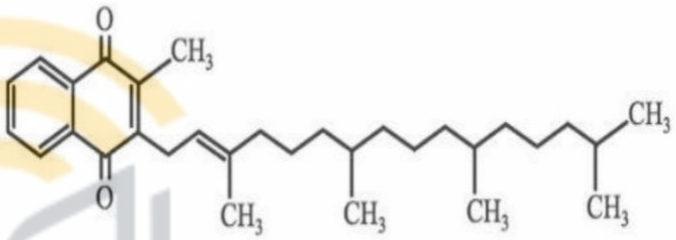
- Very low birth weight infants
- Neurological Problem
- Impairment of Immune Response
- Neuromuscular Problem etc.

Vitamin K

- It is also known as “Phylloquinone” Antihemorrhagic factors.
- It is Yellow viscid oil.
- Sensitive to light.

Sources.

- Spinach
- Coriander leaf
- Cabbage
- Broccoli
- Guava & Other Fruits.



Phylloquinone structure

Chemical nature.

Dietary requirements— The recommended intake for the adult men and women is 120 micrograms per day.

Functions.

- Vitamin K2 is important for blood clotting and maintaining healthy bones, it is produced by bacteria in the gut and is also found in fermented foods such as cheese and natto.

Coenzyme form

- Phylloquinone – Vitamin-K1
- Menaquinone – Vitamin-K2
- Menadione – Vitamin-K3

Deficiency diseases.

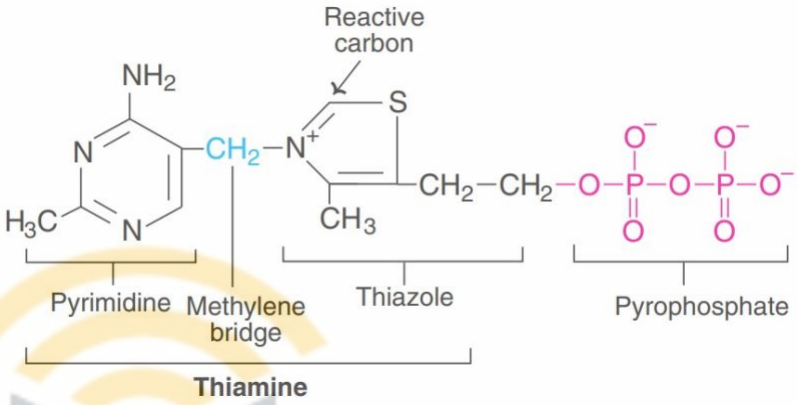
- Cause loss of Blood – Clotting Power
- In Infants haemorrhage should form.

Vitamin (B_1).

- Thiamine is water soluble. it has a specific in the carbohydrate metabolism (also called anti-Beri-Beri or antineurotic).

Sources.

- Cereals.
- Pulses.
- Seeds oil.
- Nuts.
- Yeast, animal liver, kidney, heart etc.



Chemical nature.

Dietary requirements.

- Dietary supply for adults 1-1.5 mg/day.
- For children 0.7-1.2 mg/day.
- Pregnancy and lactation 2 mg/day.

Functions.

- It helps in the metabolism of the carbohydrates into the energy.
- It also plays a role in muscle contraction and conduction of nerve signals.

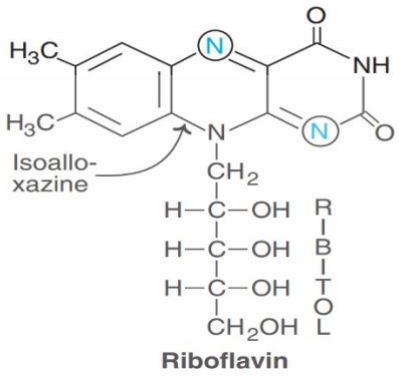
Coenzyme form— Thiamine pyrophosphate

Deficiency disease.

- Beri-Beri is most common.
- Loss of appetite
- Peripheral neuropathy.

Vitamin (B_2)

Sources.



- Milk and milk products.
- Meat.
- Eggs.
- Liver,kidney.

Chemical nature.

Dietary requirements—Daily requirement for adults 1.2-1.7 mg.

Functions.

- Riboflavin through its coenzyme takes part in a variety of cellular oxidation-reduction reactions.
- It helps in the blood cell production and body growth.

Coenzyme form.

- Flavin mononucleotide (FMN).
- Flavin adenine dinucleotide (FAD).

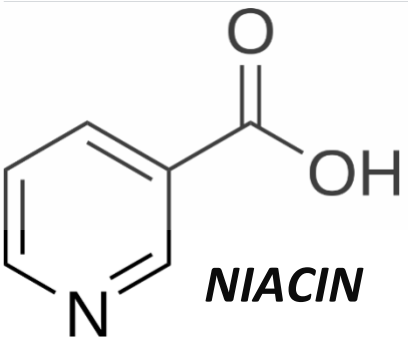
Deficiency disease.

- Cheilosis.
- Glossitis.
- Dermatitis.

Vitamin (B_3)

- Niacin or nicotinic acid is also known as pellagra preventive factor.

Sources.



- Liver.
- Yeast.
- Whole grains, cereals.
- Pulses like beans, peanuts.

Chemical nature.

Dietary requirements— Daily requirements for adults is 15-20 mg.

Functions.

- Therapeutically it shows the many biochemical effects on body than vitamin.
- There is tendency for the increased levels of glucose and uric acid in the circulation.

Coenzyme form.

- Nicotinamide adenine dinucleotide (NAD+).
- Nicotinamide adenine dinucleotide phosphate (NADP+).

Deficiency disease.

- Pellagra.
- Dermatitis.

Vitamin (B_5)

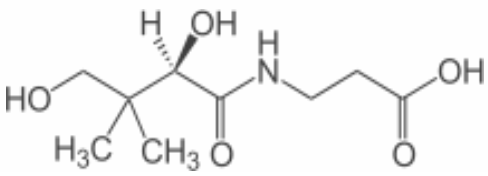
- It is also known as chick anti-dermatitis factor is widely distributed in nature.

Sources.

- Eggs.
- Liver.
- Meat.
- Yeast.
- Milk.

Chemical nature.

Dietary requirements— Daily intake for adult is 5-10 mg.



Pantothenic acid

Functions.

- The functions of pantothenic acid are exerted through coenzyme A. it plays a unique role in integrating various metabolic pathways. More than 70 enzymes that depends on coenzyme A are known.

Coenzyme form— Coenzyme A

Deficiency disease.

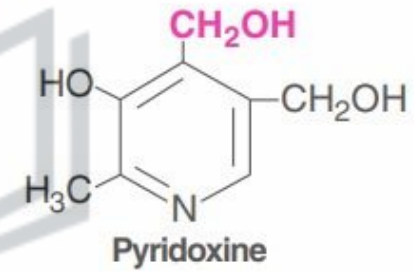
- Burning feet syndrome (pain and numbness in the toes, sleeplessness, fatigue etc).

Vitamin (B_6).

- Vitamin B_6 is used to collectively represent the three compounds namely pyridoxine, pyridoxal, and pyridoxamine.

Sources.

- Egg yolk.
- Milk.
- Meat.
- Cabbage.
- Roots and tubers.



Pyridoxine

Chemical nature.

Dietary requirements—Daily requirements about- 2-2.2 mg/day. During pregnancy/lactation 2.5 mg/day.

Functions.

- It helps in the amino acid metabolism and helps in the secretion of serotonin, histamine etc.
- It helps in the antibody's synthesis.

Coenzyme form— Pyridoxal phosphate (PLP).

Deficiency disease.

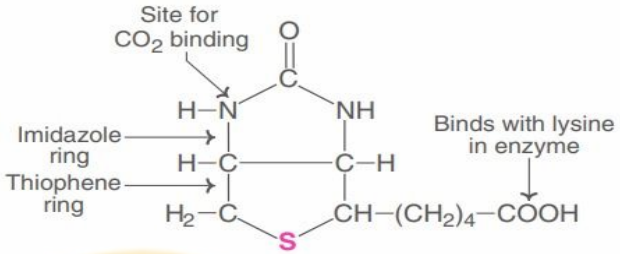
- Neurological disorder like- depression, mental confusion.
- Decrease secretion of amines like histamine.
- Decreased in haemoglobin level.

Vitamin (B_7)

- Biotin or vitamin H is a sulphur containing B complex vitamin.

Sources.

- Liver.
- Kidney.
- Egg yolk.
- Milk.
- Tomatoes.
- Grains.



Biotin with binding sites.

Chemical nature.

Dietary requirements— Daily requirement for adult is 100-300 mg.

Functions.

- Biologically it helps in the synthesis of fatty acids, gluconeogenesis, citric acid etc.
- Biotin used as the treatment for hair loss and to promote healthy hair, skin and nails.

Coenzyme form— Biocytin is coenzyme form.

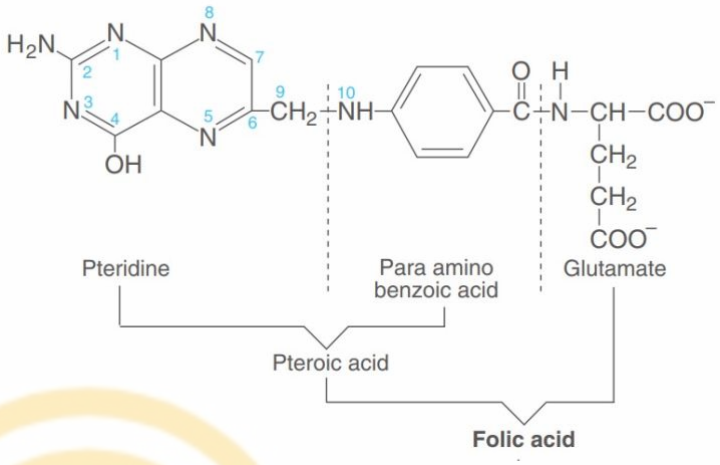
Deficiency disease.

- The symptoms of biotin deficiency include anaemia, loss of appetite, nausea, dermatitis.
- May also cause depression, hallucinations etc.

Vitamin (B_9)

Sources.

- Green leafy vegetables.
- Whole grains.
- Cereals.
- Liver
- Kidney.
- Eggs.



Chemical nature.

Dietary requirements.

- Daily requirements in adults are 200 µg.
- During pregnancy 400 µg.
- During lactation 300 µg.

Functions.

- It helps in the production of DNA and RNA, the genetic materials.
- It is important when cells and tissues are growing rapidly, such as in infancy, adolescence, and pregnancy.
- Helps in the iron metabolism and maintain the iron level in body

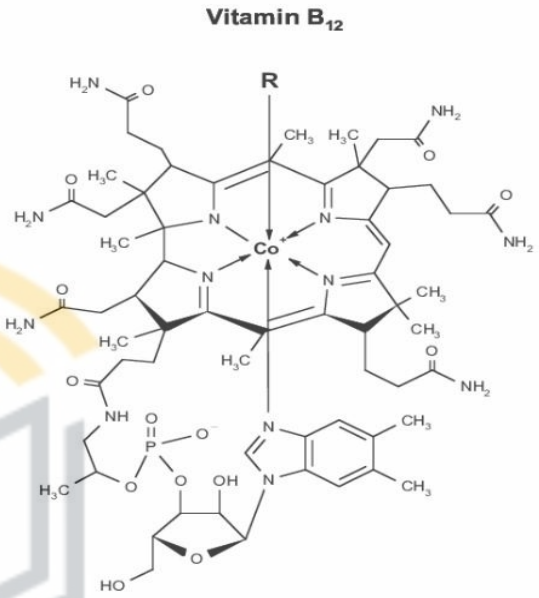
Coenzyme form— Tetrahydrofolate (THF or FH_4).

Deficiency disease.

- Macrocytic anaemia.
- Neural defects in the foetus.

Vitamin (B_{12}).

Cobalamin is also known as anti- pernicious anaemia vitamin. It is the unique vitamin, synthesized by only microorganisms and not by animals and plants.



Sources.

- Liver, kidney
- Milk.
- Fish.
- Curd.
- Chicken etc.

Chemical nature.

Dietary requirements.

- Daily requirement for adult is 3µg.
- For children 0.5-1.5 µg/day.
- During pregnancy/lactation 4µg

Functions.

- It is the necessary substance for the red cells production and the DNA.
- It is also for functioning and development of brain and nerve cells.

Coenzyme form—

- Methylcobalamin (MeCbl).
- Adenosylcobalamin(AdoCbl).

Deficiency disease.

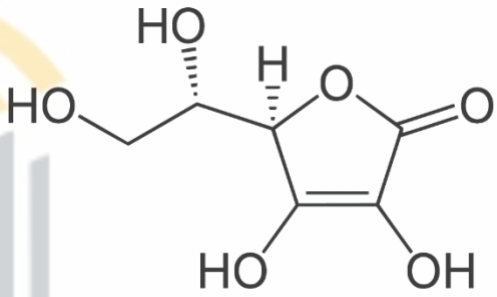
- Pernicious anaemia.
- Neuronal degeneration.

Vitamin C

- Vitamin C is a water-soluble versatile vitamin. The acidic property of vitamin C is due to the enolic hydroxyl groups.

Sources.

- Citrus fruits.
- Goose berry.
- Guava.
- Green vegetables.
- Tomatoes.
- Adrenal gland and gonads.



Ascorbic acid

Chemical nature

Dietary requirements— Daily requirements for the adult is 60-70 mg.

Functions.

- Maintaining the healthy conditions of skin, blood vessels, bone and cartilage.
- Helps in the wound or infections healing.
- Helps in growth of hairs.

Coenzyme form— Ascorbic acid.

Deficiency disease

- Scurvy.
- Sore gums, loose teeth, anaemia.
- Decreased immunocompetence, delayed wound healing.