VITAMIN

Vitamins are organic compounds required by the body in small amounts for metabolism, to protect health, and for proper growth in children. Vitamins also assist in the formation of hormones, blood cells, nervous-system chemicals, and genetic material. They generally act as catalysts, combining with proteins to create metabolically active enzymes that in turn produce hundreds of important chemical reactions throughout the body. Without vitamins, many of these reactions would slow down or cease.

CHEMICAL COMPOSITION:

Vitamins are organic compounds of different chemical nature. These are alcohols, aldehyde, organic acids, their derivatives or nucleotide derivatives.

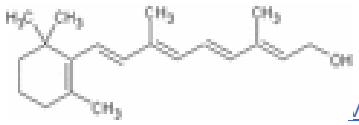
CLASSIFICATION OF VITAMINS:

Vitamins are classified according to their ability to be absorbed in fat or water.

1. **Fat Soluble Vitamins:** These are oily and hydrophobic compounds. These are stored in the liver and are not excreted out of the body. Bile salts and fats are required for their absorption. Vitamin A, D, E and K are fat soluble vitamins. Because these vitamins can be stored, their excessive intake may have toxic effect and can result in **Hypervitaminosis**.
2. **Water Soluble Vitamins:** Vitamin B complex and vitamin C are water soluble. They are compounds of carbon, hydrogen, oxygen and nitrogen. They are not stored in the body therefore they required daily in small amount.

FAT SOLUBLE VITAMIN

1. VITAMIN A:



/itamin A (Retinol)

Vitamin A is a pale yellow primary alcohol derived from carotene. It includes Retinol (alcoholic form), Retinal (Aldehyde form) and Retinoic acid (acidic form).

Source:

- In animal form, vitamin A is found in milk, butter, cheese, egg yolk, liver, and fish-liver oil.
- In plant source it obtained from vegetables as carrots, broccoli, squash, spinach, kale, and sweet potatoes.

Physiological Significance:

- All three forms of vitamin A are necessary for proper growth, reproduction, vision, differentiation and maintenance of epithelial cells.
- Vitamin A accelerates normal formation of bone and teeth.
- Retinoic acid is needed for glycoprotein synthesis.

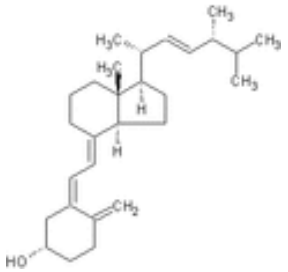
Deficiency of Vitamin A:

- An early deficiency symptom is night blindness (difficulty in adapting to darkness).
- Other symptoms are excessive skin dryness
- Lack of mucous membrane secretion, causing weakness to resist bacterial attack

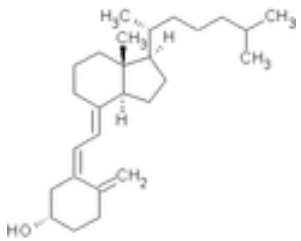
- Dryness of the eyes due to a malfunctioning of the tear glands.

Hypervitaminosis of Vitamin A: Excess vitamin A can interfere with growth, stop menstruation, damage red blood corpuscles, and cause skin rashes, headaches, nausea, and jaundice.

2. VITAMIN D (Calciferol or Antirachitic Vitamin):



Vitamin D2



Vitamin D3

Source:

- Vitamin D is obtained from egg yolk, cod liver oil and liver oil from other fishes.
- It is also manufactured in the body when sterols, which are commonly found in many foods, migrate to the skin and become irradiated.

Physiological Significance:

- This vitamin is necessary for normal bone formation and for retention of calcium and phosphorus in the body.
- It also protects the teeth and bones against the effects of low calcium intake by making more effective use of calcium and phosphorus.
- It decreases pH in the lower intestine.

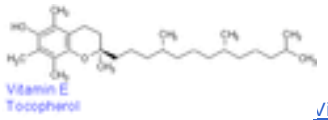
Deficiency:

- Vitamin D deficiency produces **rickets** in children and **Osteomalacia** in adult.
- Rickets is characterized by abnormities of the rib cage and skull and by bowlegs, due to failure of the body to absorb calcium and phosphorus.
- Osteomalacia is characterized by softness of pelvic girdle, ribs and femoral bones.

Hypervitaminosis of Vitamin D:

- Because vitamin D is fat-soluble and stored in the body, excessive consumption can cause vitamin poisoning, kidney damage, lethargy, and loss of appetite.

3. VITAMIN E (Tocopherol or Fertility Vitamin):



Vitamin E or Tocopherol

Source:

- It is found in vegetable oils, wheat germ, liver, and leafy green vegetables.
- They are also present in little amount in meat, milk and eggs.

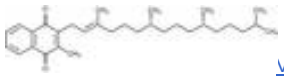
Physiological Significance:

- Vitamin E acts as antioxidants. They play some role in forming red blood cells and muscle and other tissues and in preventing the oxidation of vitamin A and fats.
- It is also associated with cell maturation and differentiation.

Deficiency:

- Deficiency of vitamin E causes sterility in both male and females.
- It causes muscular dystrophy.
- In children it causes haemolysis, creatinuria.

4. VITAMIN K (Phylloquinone or Antihemorragic Vitamin or Coagulation Vitamin):
Vitamin K is a complex unsaturated hydrocarbon found in two forms Vitamin K_1 (Phylloquinone) and Vitamin K_2 (Menaquinone).



Vitamin K1 - Phylloquinone

Source:

- The richest sources of vitamin K are alfalfa, fish livers, leafy green vegetables, egg yolks, soybean oil, and liver.
- It is also produced by bacteria in human intestine therefore no dietary supplement is needed.

Physiological Significance:

- This vitamin is necessary mainly for the coagulation of blood.
- It aids in forming prothrombin, an enzyme needed to produce fibrin for blood clotting.
- Acts as an inducer for the synthesis of RNA.
- It is also required for the absorption of fat.

Deficiency:

- Digestive disturbances may lead to defective absorption of vitamin K and hence to mild disorders in blood clotting.

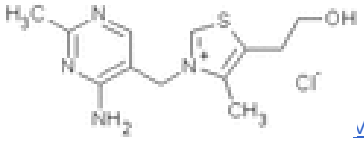
Hypervitaminosis of Vitamin K:

- Administration of large doses of vitamin K produces haemolytic anemia and jaundice in infants because of breakdown of RBCs.

WATER SOLUBLE VITAMIN

Known also as vitamin B complex, these are fragile, water-soluble substances, several of which are particularly important to carbohydrate metabolism. They include **Vitamin B_1 (Thiamine), Vitamin B_2 (Riboflavin), Vitamin B_3 (Niacin or Nicotinic Acid), Vitamin B_6 (Pyridoxine), Vitamin B_{12} (Cobalamin) etc.**

5. VITAMIN B_1 (Thiamine):



Vitamin B1 (Thiamine Chloride)

Thiamine, or vitamin B_1, a colorless, crystalline substance. It is readily soluble in water and slightly in ethyl alcohol.

Source:

- Vitamin B_1 is abundantly found in germinating seeds, un-milled cereals, beans, orange juice, tomato, egg, meat, fish, organ meats (liver, heart, and kidney), leafy green vegetables, nuts, and legumes.

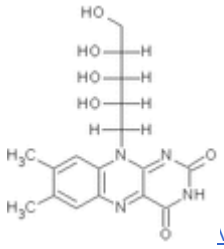
Physiological Significance:

- Acts as a catalyst in carbohydrate metabolism, enabling pyruvic acid to be absorbed and carbohydrates to release their energy.
- Thiamine also plays a role in the synthesis of nerve-regulating substances.

Deficiency:

- Deficiency in thiamine causes beriberi, which is characterized by muscular weakness, swelling of the heart, and leg cramps.

6. VITAMIN B_2 (Riboflavin):



Vitamin B2 (Riboflavin)

Source:

- The best sources of riboflavin are liver, milk, meat, dark green vegetables, whole grain and enriched cereals, pasta, bread, and mushrooms.

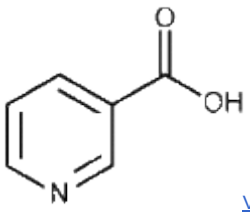
Physiological Significance:

- It is essential for carbohydrate metabolism. Enzyme containing riboflavin is called **Flavoproteins**.
- It acts as coenzyme for enzyme catalyzing oxidation-reduction reaction.

Deficiency:

- Its deficiency causes **Glossitis** (inflammation of tongue).
- Lack of thiamine causes skin lesions, especially around the nose and lips, and sensitivity to light.

7. VITAMIN B_3 (Niacin or Nicotinic Acid):



Vitamin B3 (Niacinamide)

Source:

- The best sources of niacin are liver, poultry, meat, canned tuna and salmon, whole grain and enriched cereals, dried beans and peas, and nuts.
- The body also makes niacin from the amino acid tryptophan.

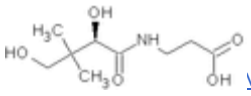
Physiological Significance:

- Nicotinic acid is essential for the normal functioning of skin, intestinal tract and the nervous system.
- Vitamin B_3 works as a coenzyme in the release of energy from nutrients.

Deficiency:

- A deficiency of niacin causes **pellagra**, the first symptom of which is a sunburnlike eruption that breaks out where the skin is exposed to sunlight.
- Later symptoms are a red and swollen tongue, diarrhea, mental confusion, irritability, and, when the central nervous system is affected, depression and mental disturbances.

8. PANTOTHENIC ACID or VITAMIN B5:



Vitamin B5 (Pantothenic Acid)

Source:

- Its main sources are liver, milk, meat, eggs, wheat germ, wheat bran, potatoes, sweet potatoes, tomatoes, cabbage, cauliflower and broccoli. Fruit and other vegetables also have pantothenic acid.

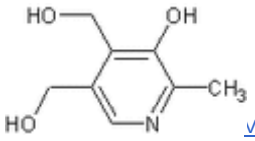
Physiological Significance:

- Pantothenic acid is essential for growth of infants and children,
- It plays a major role in the metabolism of proteins, carbohydrates, and fats.

Deficiency:

- Its deficiency causes nausea, vomiting, gastrointestinal disorders, improper growth and fatty liver.

9. VITAMIN B_6 (Pyridoxine):



vitamin B6 (Pyridoxal) Chemical Structure

Source:

- The best sources of pyridoxine are whole (but not enriched) grains, cereals, bread, liver, avocadoes, spinach, green beans, and bananas.
- It is also found in milk, eggs, fish, chicken, beaf, pork and liver.

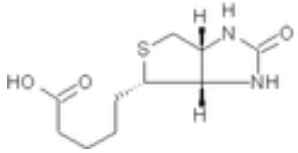
Physiological Significance:

- Pyridoxine, or vitamin B_6, is necessary for the absorption and metabolism of amino acids.
- It also plays roles in the use of fats in the body and in the formation of red blood cells.

Deficiency:

- Pyridoxine deficiency is characterized by skin disorders, cracks at the mouth corners, smooth tongue, convulsions, dizziness, nausea, anemia, and kidney stones.

10. VITAMIN b_7 (Biotin):



Vitamin B7 (Biotin)

Biotin is also known as "anti-egg white injury factor" or as H-factor.

Source:

- Biotin occurs in combined state as biocytin. It is found in yeast, liver, kidney, milk and molasses.

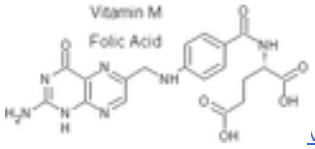
Physiological Significance:

- Biotin serves as prosthetic group for many enzymes which catalyze fixation of CO_2 into organic molecules.
- It helps in synthesis of fatty acids.

Deficiency:

- Its deficiency caused the destruction of intestinal bacteria.
- It leads to nausea and muscular pain.

11. VITAMIN B_9 or M or Bc (Folic Acid):



Vitamin M or Folic Acid

Source:

- Folic acid is found in yeast, liver and kidney.
- Fish meat and green leafy vegetables, milk and fruits also provide folic acid.

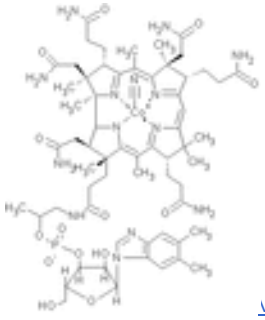
Physiological Significance:

- Folic acid acts as a coenzyme and help in synthesis of purines and thymine during DNA synthesis.
- It helps in formation and maturation of red blood cells.

Deficiency:

- Folic acid deficiency gives rise to **megaloblastic anemia**.
- The patient suffers from retarded growth, weakness, infertility, inadequate lactation in females and gastrointestinal disorders.

12. VITAMIN B_{12} (Cynocobalamin):



Vitamin B12

Vitamin B_{12} or **Cobalamin**, or **Anti-Pernicious Anaemic Factor (APA)**, one of the most recently isolated vitamins.

Source:

- Cobalamin is obtained only from animal sources—liver, kidneys, meat, fish, eggs, and milk. Vegetarians are advised to take vitamin B_{12} supplements.

Physiological Significance:

- It is necessary in minute amounts for the formation of nucleoproteins, proteins, and red blood cells.
- It is necessary for the functioning of the nervous system.
- It stimulates the appetite of the subject.

Deficiency:

- Due to its deficiency **Pernicious Anemia** results which is characterized by symptoms of ineffective production of red blood cells, faulty myelin (nerve sheath) synthesis, and loss of epithelium (membrane lining) of the intestinal tract.

13. LIPOIC ACID:

- Lipoic acid is a sulphur containing fatty acid. It is widely distributed in natural foods. Lipoic acid functions as a coenzyme in oxidative decarboxylation of pyruvic acid and α-ketoglutaric acid. Its deficiency disorders have not been recorded.

14. INOSITOL

Source:

- Yeast, meat, milk, nuts, fruits, vegetables and grains contains Inositol.

Physiological Significance:

- It increases peristalsis of small intestine, increase the rate of contraction of heart muscles.

Deficiency:

- Deficiency symptoms include retarded growth, failure of lactation, loss of hair over the body (alopecia) etc.

15. CHOLINE:

Source:

- Choline is found in liver, egg yolk, meat, cereals, rice, milk, fruits and vegetables.

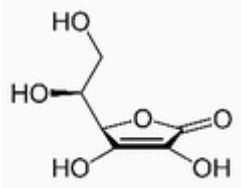
Physiological Significance:

- Acetyl choline is a chemical mediator of parasympathetic activities and other activities of nervous system.
- It prevents accumulation of fat in the liver.

Deficiency:

- Its deficiency causes fatty liver, slipped tendon diseases etc.

15. VITAMIN C (Ascorbic Acid or Antiscorbutic Vitamin):



Vitamin C - Ascorbic Acid

Source:

- Sources of vitamin C include citrus fruits, fresh strawberries, cantaloupe, pineapple, and guava.
- Good vegetable sources are Broccoli, Brussels sprouts, Tomatoes, Spinach, Kale, Green Peppers, Cabbage, and Turnips.

Physiological Significance:

- Vitamin C is important in the formation and maintenance of collagen, the protein that supports many body structures and plays a major role in the formation of bones and teeth.
- It also enhances the absorption of iron from foods of vegetable origin.
- The connective tissue fibrils and collagen are synthesized with the help of vitamin C.
- It play important role in wound repair.
- It protects body against stress.

Deficiency:

- This well-known Scurvy is the classic manifestation of severe ascorbic acid deficiency. Its symptoms are loss of the cementing action of collagen and include hemorrhages which lead to loosening of teeth and cellular changes in the long bones of children.