Fat Soluble Vitamins

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VITAMINS

* Vitamins are accessory food factors which are organic in nature and must be supplied from outside to maintain health growth and the state of well-being of a person.
* Vitamins cannot be synthesized in the body; they must be supplied from outside e.g. through foods.

Classification of Vitamins (according to their solubility)

Vitamins can be classified according to their solubility

1. **Fat soluble vitamins**
   Vitamin A ,vitamin D ,vitamin E and Vitamin K

2. **Water soluble vitamins**
   Vitamin B complex and Vitamin C.

Vitamin A

* Vitamin A was discovered in 1909 by McCollum and Davis. Its chemical name is retinol.
* Carotenoids serve as precursor of Vitamin A and these are structurally related to beta carotene.
*

Characteristics of Vitamin A

* Mineral oil interfere with the absorption
* Stable to acid and alkali
* Destroyed by rancidity
* Stable to heat by usual cooking methods but slowly destroyed by exposure to air, heat, drying
* Stored in the liver
* Bile is necessary for absorption

Unit of measurement of Vitamin A

a) **Measured in International Units**

1 IU = 0.3 mcg retinol

1 IU = 0.6 mcg beta- carotene

1 IU = 1.2 mcg of other carotenoids

b) **Measured in terms of retinol equivalent**

1 RE = 1mcg retinol

1 RE = 6 mcg beta-carotene

1 RE = 12 mcg other carotenoids

Sources of Vitamin A

1. **Animal sources**
   Vitamin A is present in animal foods in the form of retinol which are highly bioavailable . Liver (sheep), Liver Oils of shark, halibut, cod and saw fish are the richest source of Vitamin A. Butter, ghee, eggs, whole milk powder, cheese, milk are good sources of vitamin A.

2. **Plant sources**
   Over 80% of daily supply of Vitamin A in the Indian diets is derived from its precursor beta carotene which are present in many plant foods. Green leafy vegetables like agathi, amaranth, colocasia leaves, coriander leaves, spinach, yellow orange fruits like ripe mango, jackfruit, papaya, orange, tomato and vegetable like carrots, pumpkin are good source of beta carotene. Blue green algae, spirulina is a rich source of beta carotene. it is used as nutrient dense food.

Functions of Vitamin A

1. **Function in Vision**

* Vitamin A occurs in the retina of the eye and is required in the process of vision to adjust to light of varying intensity (dark adaptation).
* It occurs in the light receptor cells in the retina in combination with protein. This substance is known as visual purple (rhodopsin). It is bleached in the presence of light, which enables a person to see.
* Some Vitamin A is used up in the process. If more vitamin A is not available, ability to adjust to changes in intensity of light is impaired.
* Night blindness occurs in severe Vitamin A deficiency; it indicates the inability of a person to see at night, when the amount of light is far too little to permit adequate vision.

Functions of Vitamin A

2. Health of Epithelial Tissues

* These tissues cover the outer surface of the body, line the major cavities and all the tubular systems in the body.
* These are specialised tissues, of which the outer covering is resistant; protective epidermis and the internal tissue is a secretory mucous membrane.
* Inadequate supplies of Vitamin A results in suppression of the normal secretions and produces a keratinized, dry, horny type of epithelium.
* The skin may become excessively dry and mucous membrane may fail to secrete normally and hence be prone to bacterial invasion.

Functions of Vitamin A

3. Immune Response

* Many of the epithelial tissues are important barriers to infection.
* Vitamin A deficiency impairs this function in a non-specific way.
* Vitamin A helps to maintain the lymphocyte pool.
* Vitamin A also function in T- cell-mediated responses.
* Some aspects of the immune response, such as immunoglobulin production are now known to be affected by retinoids.

Functions of Vitamin A

4. Haemopoiesis

Vitamin A deficiency in man and experimental animal is consistently associated with an iron deficiency type of anaemia. In these conditions, Vitamin A is required in addition to iron for a full response.

5. Growth

Retinoic acid is known to play its hormone- like function in control of growth and development of tissues in the musculo-skeletal system.

Deficiency symptoms of Vitamin A

* Rough, scaly skin, dry mucous membrane, causing a general low resistance to microbe invasion
* Poor tooth formation
* Xerosis of conjunctiva of eye, Bitot's spots on the conjunctiva of eye
* Corneal Xerosis of eye, perforation, Keratomalacia and loss of sight

Vitamin D

* Pure Vitamin D was isolated in 1930 and was called calciferol.
* Vitamin D is also known as 'sunshine vitamin' because the body is able to convert a precursor 7-dehydrocholesterol, a steroid present in the skin, to vitamin D in the presence of sunlight.
* Vitamin D is now considered a pro hormone than a vitamin. It can be synthesized in the body in adequate amounts by simple exposure to sunlight even for 5 minutes per day.

Forms of Vitamin D

* Vitamin D2 (calciferol)
* Vitamin D3 (activated 7 dehydrocholesterol , cholecalciferol)

Characteristics of Vitamin D

* Stable to heat and oxidation
* Destroyed by rancidity
* Skin synthesis by activity of ultraviolet light on cholesterol
* Stored in the liver
* Enhance absorption of calcium and phosphorus

Food sources of Vitamin D

* Foods are not a good source of Vitamin D.
* It is found in small quantities in liver, egg yolk, milk, milk fat, butter and ghee obtained from animal fed on pastures exposed to sunlight.
* The richest source known is fish liver oils such as halibut, cod, shark and saw fish. Fish liver oil do not form part of the diet and have to be taken as a supplement.
* Vanaspati maybe fortified with 180 International Units of Vitamin D per hundred gram.
* Irradiation of the skin with sunlight is the main source of Vitamin D. The midday sun is rich in ultraviolet light and helps in synthesizing Vitamin D.

Functions of vitamin D

* Absorption of calcium and phosphorus : Calcitriol, a hormone is an activated form of vitamin D. It acts with two other hormones (the parathyroid hormone and the thyroid hormone calcitonin) and stimulates the absorption of calcium and phosphorus in the small intestine. Without the presence of vitamin D formation of strong and rigid bones is not possible.

* Bone mineralization : The bone tissue formation from calcium and phosphorus and other materials is regulated by Calcitriol. It regulates the rate of deposit and resorption of these minerals in bone. This balancing process helps to build and maintain bone tissue. Vitamin D hormone can be used to treat rickets in children and osteoporosis in older women.

Deficiency symptoms of vitamin D

* Soft bones
* Bowed legs
* Poor teeth
* Lowered amount of calcium and phosphorus in the blood
* Poor posture
* Enlargement of junctions between the ribs and breast-bone forming a series of knobby protuberances called rachitic rosary
* Projection of breast-bone (pigeon breast)
* Narrow pelvis, spinal curvature, knock knees, scull deformation
* Osteomalacia in in adults, weakening of bones, increased porosity, decrease density in bones resulting in various deformities, pain in the bones of the legs and lower back, general physical weakness, difficulty in walking and susceptibility to bone fractures.

Vitamin E

* Vitamin E was named tocopherol from a Greek word meaning childbirth or to bring forth.

Functions of Vitamin E

* Exact biochemical mechanism of its function in human body is still unknown.
* In general Vitamin E plays an important role in maintaining stability and integrity of cell membrane.
* Vitamin E converts the free radicals into less reactive and non-toxic form.
* Vitamin E works as protector against oxidation.

Sources of Vitamin E

* Vitamin E is found particularly in vegetable fats oils, dairy products, meat eggs, cereals, nuts, wheat germ oil, leafy green vegetables, and yellow vegetables.
* Vitamin E is widely distributed in foods therefore we can get sufficient amount of Vitamin E in our daily diet.
* The suggested requirement of Vitamin E is 0.8 mg per gram of essential fatty acids.

Deficiency symptoms of vitamin E

* In severe deficiency: increased haemolysis of RBC, creatinuria, deposition of brownish pigment in smooth muscles, development of muscular dystrophy.

Vitamin K

* Vitamin K is widespread in nature.
* It is essential in diet due to its involvement in synthesis of prothrombin and other blood clotting factors.
* It is soluble in fat soluble solvents.
* Vitamin K compounds are sensitive to alkali, light and ionizing radiation.
* Most of the human requirement of Vitamin K is met by the synthesis by symbiotic bacteria in the lower intestinal tract of the human body.

Functions of Vitamin K

* Prothrombin and other blood clotting factors are formed in the liver with the help of Vitamin K.
* These factors are necessary for blood clotting.
* For those newborn infants, especially those born premature, a single dose of 1 mg of Vitamin K immediately after birth is often a routine measure to prevent haemorrhagic disease.

Sources of Vitamin K

* It is widely distributed in nature.
* Green leafy vegetables, tomatoes, cauliflower, egg yolk, soya bean oil and liver are good sources.
* We also utilize Vitamin K synthesized by enteric bacteria.

Deficiency of Vitamin K

* Its deficiency interferes with the formation of prothrombin and thus reduces the clotting tendency of blood.
* Blood clotting time is prolonged.
* This condition is called hypoprothrombinemia.
* Internal or external haemorrhages may ensue either spontaneously or following injury or surgery.

MCQs for exercise

* 1.This Vitamin is related with eyesight
* a) Vitamin B
  b) Vitamin C
  c) Vitamin A
  d) Vitamin D

* 2. Vitamin A was first described by
  a) Funk
  b) Hawkins
  c) McCollum and Davis
  d) Tekaki

MCQs for exercise

* 3. A condition in which a person cannot see in dim light in Vitamin A deficiency is
  a) beri beri
  b) Bitot's spots
  c) Scurvy
  d) Night blindness

* 4. Corneal xerosis is associated with deficiency of
  a) Vitamin A
  b) Vitamin B
  c) Vitamin D
  d) vitamin K

MCQs for exercise

* 5. This can be obtained from green leafy vegetables
  a) Retinol
  b) Carotene
  c) Protein
  d) none of the above

* 6. This Vitamin is soluble in fat
  a) Vitamin C
  b) Vitamin A
  c) Vitamin B
  d) none of the above
  d) Vitamin E

MCQs for exercise

* 7. This vitamin is also known as anti- rickets substance
  a) Vitamin A
  b) Vitamin D
  c) Vitamin E
  d) Vitamin K

* 8. This Vitamin regulates absorption of calcium and phosphorus in small intestine
  a) Vitamin B
  b) Vitamin C
  c) Vitamin A
  d) Vitamin D

MCQs for exercise

* 9. This is also known as sunshine vitamin
  a) Vitamin A
  b) Vitamin B
  c) Vitamin C
  d) Vitamin D

* 10. Osteomalacia and Rickets are associated with the deficiency of following vitamin
  a) Vitamin A
  b) Vitamin B
  c) Vitamin C
  d) Vitamin D

MCQs for exercise

* 11. Pigeon chest, Bowed legs, Knock knees are symptoms of deficiency of
  a) Vitamin A
  b) Vitamin B
  c) Vitamin C
  d) Vitamin D

* 12. For strong bones and teeth our body needs
  a) Vitamin A
  b) Vitamin B
  c) Vitamin C
  d) Vitamin D

MCQs for exercise

* 13. tocopherol is the chemical name of following vitamin
  a) Vitamin A
  b) Vitamin E
  c) Vitamin C
  d) Vitamin D

* 14. This vitamin is associated with coagulation of blood
  a) Vitamin K
  b) Vitamin E
  c) Vitamin C
  d) Vitamin D

MCQs for exercise

* 15. This Vitamin helps in the synthesis of prothrombin
  a) Vitamin E
  b) Vitamin K
  c) Vitamin C
  d) Vitamin D

Answer Key 1) c, 2)c, 3) d, 4) a, 5) b, 6) b, 7) b, 8) d, 9) d, 10) d, 11) d, 12)d, 13) d,14) a, 15) b