

VITAMINS TYPES AND FUNCTION{Part 1}

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- Funk et al (1912) coined the term vitamin from the words Vital + Amine, since the earlier identified ones had amino groups. Later work showed that most of them did not contain amino groups, so the last letter 'e' was dropped in modern term for vitamin.
- Vitamins regarded as 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.
- They are also called as "MIRACLE WORKERS".
- A nutritional deficiency caused due to decreased intake of vitamin is called as "PRIMARY DEFICIENCY".
- The deficiency which occurs due to inadequate absorption, increased requirement or increased excretion is called as "SECONDARY DEFICIENCY".

FAT SOLUBLE VITAMIN

- The four vitamins A, D, E and K
 - Their availability in the diet, absorption and transport are associated with fat.
1. They are soluble in fat, oils and fat solvents.
 2. They require bile for absorption.
 3. They are stored in liver and adipose tissue.
 4. They are not readily excreted in urine.
 5. Therefore, toxicity is possible.

Fat soluble vitamins are different from water soluble vitamins mainly because larger amounts can be stored in the body.

WATER SOLUBLE VITAMIN :

- Dissolve in water
- Generally readily excreted
- Subject to cooking losses
- Function as a coenzyme
- Participate in energy metabolism
- 50-90% of B vitamins are absorbed
- Marginal deficiency more common

VITAMIN A :

1. Active vitamin A- Preformed vitamin A can be obtained either directly from foods that are substantial in vitamin A (beef liver, fish liver oils, egg yolks and butter)
 - The active form of vitamin is retinol, an alcohol which can be converted to other forms (e.g. vitamin A esters) for storage in liver and tissues. much of the body's vitamin A is stored in the liver as retinyl palmitate
2. Provitamin A- provitamins, substances that are transformed into vitamins in the body
 - Beta-carotene is the most abundant and widespread provitamin A.

- Beta-carotene comes from a group of compounds called the "carotenoids (C40 polyisoprenoids).
- One need to eat approximately six times as much beta-carotene to get the same amount of vitamin A as in retinol.
- Carotenoids are not toxic even at high doses for long times.

The term retinoids is often used to include the natural and synthetic forms of vitamin A

1. Retinol (vit A alcohol)
2. Retinal (vit A aldehyde)
3. Retinoic acid (vitamin A acid)
4. β -carotene (provitamin A)

FUNCTIONS :

- Role in vision. Vitamin A (retinal) is an essential precursor for formation of the visual pigment, rhodopsin, in the retina of the eye. Retinal plays an important role in vision, especially night vision. Lowers cataract incidence.
- Role in growth. Helps regulate cell development, cell differentiation and cell division. Regulation of gene expression by retinoic acid, the acid form of vitamin A .Retinoic acid is formed within the target cell from retinol transported in the bloodstream. Retinoic acid, combined with protein receptor, acts as transcription regulator by binding to specific sequences of DNA in the nudeus. Affected cells include epithelium of numerous tissues, including skin and gut, and bone, ovary and testis. Retinoic acid is an especially important regulator of embryonic cell differentiation.
- Role in Bone and teeth fomation. Promotes the proper growth of bones and teeth. Bone cells (osteoblasts and osteoclasts) depend on vitamin A for their normal functioning.
- Is important in the formation and maintenance of healthy hair, skin and mucous membranes.
- Role in reproduction. Vitamin A holds an important place in sexual reproduction. Adequate levels of vitamin A are needed for normal sperm production. The female reproductive cycle requires sufficient amounts of vitamin A.
- Boosts the body's immune system helping to increase body resistance to infectious diseases.
- Function almost like steroid hormones
- Cholesterol synthesis requires vitamin A
- Carotenoids functions as antioxidant and reduce the risk of cancer.
- Prevent heart attack
- Retinoic acid is used in dermatology to cure acne and psoriasis.

RDA :

- For adults
 - 5,000 IU retinol for male
 - 4,000 IU retinol for female
- the requirement increases inGrowing children ,Pregnant women,Lactating mothers
6000 to 8000 IU

SOURCES :

- Liver, kidney, egg yolk, milk, cheese, butter, fish (cod or shark) liver oils

- Vegetables sources contain the provitamin A-carotene. :carrots, spinach, amaranthus, pumpkins, mango, papaya.

DEFICIENCY:

- Night blindness
- Xerophthalmia
- Keratomalacia
- Effect on growth
- Effect on reproduction
- Effect on skin and epithelial cells

TREATMENT AND PREVENTION:

- Retinol palmitate – 30mg orally for 2 successive days
- In vomiting and diarrhoea – 30 mg of vitamin A given intramuscularly
- Superadded bacterial infection treated with antibiotics
- Vitamin A supplements should be given to children during measles vaccination
- Pregnant women and children should be encouraged to eat green leafy vegetables

☞ VITAMIN D :

- It was isolated by Augustin G. Leitch in 1931
- It is absorbed in the small intestine, liver and other tissues store small amounts of vitamin D.

Vitamin D is a family of fat-soluble sterol compounds:

- Vitamin D1 (lanosterol)
- Vitamin D2 (ergocalciferol)
- Vitamin D3 (cholecalciferol)
- Vitamin D4 (dihydroergocalciferol)
- Vitamin D5 (7-dehydrocholesterol)

For humans, the two most important forms of vitamin D are:

- vitamin D2
- vitamin D3.

Vitamin D2 (ergocalciferol) is derived from plants and irradiated yeast and fungi.

Vitamin D3 is synthesized in the body when skin is exposed to sunlight

Vitamin D3 can be obtained from foods like milk, fortified cereals, tuna, salmon and fish oils.

RDA :

- 400 IU
- In countries with good sunlight, 200 IU

DIETARY SOURCE :

- Fatty fish, fish liver oils, egg yolk.....Milk is not good source

Vitamin D can be provided to the body in three ways:-

1. Consumption of natural foods

2. By irradiating foods like yeast that contain precursors of vitamin D and fortification of foods
3. Exposure of skin to sunlight for synthesis of vit D

FUNCTIONS :

- Nerves and muscles must function properly; calcium is vital for nerve cell transmissions and muscle fiber contractions.
- Calcitriol functions in concert with parathyroid hormone (PTH) and calcitonin to regulate serum calcium and phosphorous levels by:
 1. Increasing dietary calcium absorption from the small intestine.
 2. Decreasing the urinary calcium excretion (increasing renal reabsorption).
 3. Stimulating resorption of calcium from bone
 - Instrumental in the growth, hardening and repair of bones.
 - Too much vitamin D, however, can increase calcium losses from bone
- There is evidence that vitamin D (specifically, vitamin D3) is involved in regulation of the body's immune system.
- Vitamin D is essential for normal insulin secretion by the pancreas and therefore control of blood sugar levels.

DEFICIENCY SYMPTOMS :

- Occurs in.....
Strict vegetarians ,Chronic alcoholics ,Individuals with liver and kidney disease or fat malabsorption syndromes. ,in some people who cover the entire body for religious customs.
- Leads to demineralization of bone
- Rickets in children and osteomalacia in adults
- Renal rickets
- Osteoporosis

HYPERVITAMINOSIS D:

- Demineralization of bone
- Increase calcium absorption from the intestine leading to elevated calcium in plasma.
- Prolonged hypercalcemia is associated with deposition of calcium in many soft tissues such as kidney and arteries.
- Loss of appetite
- Nausea
- Increased thirst
- Loss of weight

TREATMENT :

- Increased dietary intake of calcium, phosphates and vitamin D
- Exposure to ultraviolet in sunshine
 - Dietary supplementation

☞ VITAMIN E :

A family of eight different molecules. Four of the eight vitamin E molecules are called tocopherols (alpha, beta, gamma and delta) [also known as "Natural Tocopherols"] while the remaining four are called tocotrienols (alpha, beta, gamma and delta). D-alpha-tocopherol is the most biologically active in humans.

- it is essential for normal reproduction in many animals and known as anti-sterility vitamin.
- It is described as a.....'vitamin in search of a disease'

This is due to the lack of any specific vitamin E deficiency disease in humans.

Its absorbed along with fat in the small intestine, stored in adipose tissue, liver and muscle.

FUNCTIONS :

- Act as antioxidants
- Essential for the membrane structure and integrity of the cell.
- It preserves and maintain germinal epithelium of gonads for proper reproductive function.
- Protects liver from being damaged
- Protects against heart disease : d-alpha-tocopherol has been shown to inhibit the "dumping" of blood platelets (thus helping to avoid blood clots) and enhancing vasodilation (the opening of blood vessels).
d-alpha-tocopherol protects the fat component in low-density lipoproteins (LDLs) from oxidation and has shown moderate cholesterol-lowering capabilities

RDA :

- Daily consumption
10 mg for male , 8 mg for female

It is supplemented diet advised for pregnant and lactating women.

DEITARY SOURCES

Vegetables oils ,wheat germ oil, cotton seed oil, peanut oil, corn oil and sunflower oil

Also present in :Milk, meat, butter & eggs

DEFECIENCY :

- It serves as an antioxidant to free-radical reaction and to protect cells from lipid peroxidation.
- Cell membrane which are high in polyunsaturated lipids are the major site of damage .
- Systemic vit D appears to accelerate gingival wound healing in rat.
- Deficiency: rare in adults usually due to impaired fat absorption or transport; seen usually in children (anemia, edema in infants)
- Muscular dystrophy
- Hemolytic anemia
- Dietary hepatic necrosis

TOXICITY

It is least toxic

No toxic effect has been reported even after ingestion of 300 mg/day for 23 years

VITAMIN K :

- Found in different forms:-
- Vitamin K1(phyloquinone)-found in green leafy vegetables, dairy products and soyabean
- Vitamin K2(menaquinone)- intestinal bacteria synthesize in terminal ileum and colon
- Vitamin K3 (menadione) – it is a synthetic form.
- The "K" in vitamin K comes from the German word "koagulation," which refers to blood clotting (coagulation).

FUNCTION:

As cofactor necessary for production of :

- blood clotting factors .Vitamin K is needed for the body to make four of the blood's coagulation factors, including prothrombin (also known as factor II), proconvertin (factor VII), Christmas factor (factor IX) and the Stuart-Power factor (factor X)
- and proteins for bone formation : Bone osteoblasts contain three vitamin K dependent proteins osteocalcin, matrix Gla protein and protein S which help in bone matrix formation

RDA:

- No RDA, it can be adequate synthesized in the gut.
- It is recommended that half of the body requirement is provided in the diet, while the other half is met from bacterial synthesis.
- For an adult 70-140 µg/day

DIETARY SOURCES :

- Cabbage, cauliflower, tomatoes, spinach
- Also present in egg yolk, meat, liver, cheese and dairy products.

DEFICIENCY :

- May occur due to
- its faulty absorption (lack of bile salts)
- loss of vitamin into feces
- administration of antibiotics
- Inadequate synthesis of clotting factors which can lead to an increase in:-
 - Prothrombin time
 - Haemorrhage

HYPERVITAMINOSIS K :

- hemolytic anemia
- Jaundice
- Particularly in infants

ANTAGONISTS OF VIT K : Heparin , Salicylates & dicumarol

TREATMENT

- 10mg of Phytomenadione intramuscularly
- 10mg of Menadiol sodium phosphate orally daily.