VITAMINS

BY FATIMA HAIDER

KGMC

VITAMIN	ACTIVE FORM	SOURCES	FUNCTIONS
Vitamin B_1 (Thiamine)	Thyamine pyrophosphate (TPP)	Cereals, meat, nuts, green vegetables, eggs	-carbohydrate metabolism -normal functioning of nervous system
Vitamin B_2 (Riboflavin)	Flavin mononucleotide (FMN) and Flavin adenine dinucleotide (FAD)	Yeast, germinating seeds, green leafy vegetables, milk, eggs, liver, meat	Work with other B vitamins to promote healthy growth and tissue repair, and helps release energy from carbohydrates -electron transfer
Vitamin B_3 (Niacin)	NAD^+ and $NADP^+$	Yeast, legumes, liver, meat	-work with other B vitamins to help release energy from carbohydrates - plays a role in DNA repair -electron transfer
Vitamin B_5 (Pentothenic Acid)	Coenzyme A and Acyl carrier protein (ACP)	Wheat germs, cereals, yeast, liver, eggs	-synthesis of cholesterol -energy production -fatty acid synthesis -acyl carrier
Vitamin B_6 (Pyridoxine)	Pyridoxal phosphate (PLP)	Yeast, unrefined cereals, pulses, vegetables, meat, fish, egg yolk	-maintain healthy brain function -formation of RBCs -breakdown of proteins -synthesis of antibodies
Vitamin B_7 (Biotin)	Biocytin (enzyme bound biotin)	Liver, kidney, egg yolk, vegetables	-coenzyme of carboxylase reactions
Vitamin B_9 (Folic Acid)	Tetrahydrofolic acid	Green leafy vegetables, liver, yeast	-transfer one-carbon units -synthesis of methionine, serine, purine nucleotides, and thymidine monophosphate - work with B_{12} and Vitamin C to help the body digest and utilize proteins
Vitamin B_{12} (Cobalamin)	Methylcobalamin, Deoxyadenosyl-cobalamin	Only animal origin, meat, egg, liver, fish	-coenzyme for reactions: Hemocysteine → methionine Methylmalonyl CoA → succinyl CoA - formation of RBCs - maintenance of CNS
Vitamin C (Ascorbic Acid)	Ascorbic acid	Citrus fruits, amla, leafy vegetables, tomatoes	-collagen biosynthesis - bone and dentin formation - wound healing - acts as antioxidant

			- prevents atherosclerosis and coronary heart disease by preventing oxidation of LDL - converts folic acid to its active form - absorption of iron from intestine
Vitamin A (Retinol)	Retinoids i.e. Retinol, Retinal, Retinoic acid	-Fish liver oil - animal liver - milk and dairy products -dark green leaves e.g. spinach - yellow and red fruits and vegetables e.g. carrots, tomatoes, peaches	- vision - cell differentiation and growth - mucus secretion - maintenance of epithelial cells - β-carotenes have antioxidant function -maintenance of reproduction
Vitamin D (Cholecalciferol)	1,25dihydroxy Cholecalciferol (calcitriol)	Cod liver oil, sunlight induced synthesis of vitamin D_3 in skin, egg yolk	-regulation of calcium and phosphorus metabolism -calcification of bone
Vitamin E (Tocopherol)	α-tocopherol	Soya and corn oils, germ oil, fish oil, eggs, alfalfa	- natural antioxidant -protects cell membrane and tissues from damage by oxidation -required for normal reproduction and prevents sterility
Vitamin K	Phylloquinone (Vitamin K_1), Menaquinones (Vitamin K_2)	Green leafy vegetables, tomatoes, cheese, meat, egg yolk	-important role in blood coagulation - required for activation of clotting factors prothrombin II, factor VII, IX and X - γ-carboxylation of glutamate residues in clotting

VITAMIN	DAILY REQUIRE-MENTS	DEFICIENCY	TOXICITY
Vitamin B1 (Thiamine)	1.0 – 1.5 mg	Beriberi (four types) 1.Dry beriberi (peripheral neuritis) 2.Wet beriberi (cardiac manifestation) 3.Cerebral beriberi (Wernickle Korsakoff syndrome) 4.Infantile beriberi	No established toxic level (Toxicity with water-soluble vitamins are not common as any excess amount will leave through the urine)
Vitamin B2 (Riboflavin)	1.3 – 1.7 mg	Cheilosis (fissures at angle of mouth), Glossitis (inflammation of mouth), dermatitis, vascularization of cornea	None
Vitamin B3 (Niacin)	15 – 20 mg	Pellagra characterized by 4 D's Dermatitis, Diarrhea, Dementia, Death	-Vasodilation and flushing - Liver damage
Vitamin B5 (Pentothenic Acid)	5 – 10 mg	Burning feet syndrome	None
Vitamin B6 (Pyridoxine)	1.6 – 2 mg	Neurological disorders (depression, nervousness, irritability), Epileptic convulsions, dermatitis, hypochromic microcytic anemia	Pyridoxine seems to be safe at levels 100 to 150 mg/day. Women, self medicating for PMS taking 500 to 5000 mg/day have shown peripheral neuropathy within 1 to 3 years
Vitamin B7 (Biotin)	150 – 300 µg	Deficiency is uncommon as biotin is synthesized by intestinal microorganisms in large quantities Experimentally induced symptoms are nausea, anorexia, glossitis, dermatitis, alopecia (loss of hair), depression, muscle pain	None
Vitamin B9 (Folic Acid)	200 µg	Megaloblastic or macrocytic anemia, neural tube defects, promotes birth defect spina bifida	None
Vitamin B12 (Cobalamin)	3 µg	Pernicious anemia (intrinsic factor deficiency), megaloblastic anemia (functional folate deficiency), neuropathy (dementia), Methylmalonic aciduria	None
Vitamin C (Ascorbic Acid)	60 – 70 mg	Scurvy (bleeding tendency, muscle weakness, swollen bleeding gums, loosening of teeth, osteoporosis, poor wound healing)	Severe diarrhea and deficiency of oxalate stones in kidneys

Vitamin A	800 – 1000 retinol equivalents	Night blindness, xerophthalmia, formation of Bitot's spots, dry, rough and scaly skin, retardation of growth in children, infertility	Nausea, vomiting, alopecia (loss of hair), scaly and rough skin, bone and joint pain, teratogenic effect on fetus
Vitamin D (Cholecalciferol)	200 – 400 IU	Rickets (in children), Osteomalacia (in adults)	Nausea, vomiting, anorexia, increased thirst, loss of weight, hypercalcemia, formation of kidney stones
Vitamin E (Tocopherol)	8 – 10 mg	Hemolytic anemia, Retrolental fibroplasia in premature infants	None
Vitamin K	70 – 140 µg	Hemorrhagic disorder, Increased clotting time	-hemolytic anemia and kernicterus in infants with low birth weight

- During posttranslational processing, the glutamic acid residues on the osteocalcin prohormone are carboxylated by the enzyme gamma glutamyl carboxylase, which requires Vitamin K as a cofactor
- Chemically, intrinsic factor is a glycoprotein
- Niacin can be synthesized in human beings from tryptophan
- Folic acid co-enzymes are specifically concerned with metabolic reactions involving the transfer of one carbon moiety
- In vitamin A deficiency, Bitot spots appear on cornea
- Pellagra is more common in people whose staple diet is maize
- Selenium regulates throid hormones and work together with Vitamin E to reduce free radicals generated in the cell
- Dicumarol is an anticoagulant that acts as a Vitamin K antagonist
- Vitamin C enhances iron absorption
- Vitamin B_{12} deficiency can be made by measuring the urinary excretion by methyl malonic acid
- First hydroxylation of Vitamin D occurs in liver
  Second hydroxylation of Vitamin D occurs in kidney
- Vitamins synthesized in our body
  1. Vitamin D – produced when skin is exposed to sunlight
  2. Vitamin K – synthesized by bacteria in gut
  3. Niacin – synthesized from tryptophan
  4. Biotin – synthesized by bacteria in gut
- Biotin is a coenzyme for five carboxylase enzymes
- Ileum of GIT is related with absorption of Vitamin B_{12}
- Proline and lysine are acted upon by Vitamin C to undergo hydroxylation
- Transketolase activity is affected by thiamine deficiency
- Vitamin K activates certain clotting factors by carboxylation of glutamic acid residues
- Consuming raw eggs on a regular basis for an extended time causes biotin deficiency because avidin present in egg white tightly binds biotin unavailable for intestinal absorption
- Pantothenic acid is a component of coenzyme A
- Coenzyme A is involved in transacetylation
- When amount of carbohydrates is increased in diet, the requirement of thiamine is increased
- Cobalt is present in Vitamin B_{12}
- Cheilosis – fissures at the angles of mouth
- Glossitis – inflammation of the tongue
- Dark adaptation time is increased in Vitamin A deficient individuals
- Administration of high levels of folate can mask Vitamin B_{12} deficiency
- Pernicious anemia is treated with intra-muscular or high dose oral vitamin B_{12}
- Deficiency of Vitamin B_6 can be induced by isoniazid
- High doses of niacin used to treat hyperlipidemia
- Excess Vitamin A can increase incidence of fractures
- Vitamin K is produced by intestinal bacteria