

LECTURE 9: Vitamins and minerals

Classification of vitamins

- Vitamins are classified based on their solubility in water or fats
- Fat soluble vitamins are A, D, E, K & water soluble vitamins are B & C.

Vitamin A

- Three forms that are active in the body: Retinol, Retinal and Retinoic acid collectively called as Retinoids
- Beta carotene is the pro vitamin of vitamin A
- Vitamin A is present in vegetables that contain yellow pigment called Carotenes.

Functions of Vitamin A

- Essential for the formation of rhodopsin and normal functioning of the retinal for clear vision in dim light
- Participates in protein synthesis and cell differentiation, supports growth and reproduction
- Beta carotene acts as an antioxidant

Sources of Vitamin A

- Sources of vitamin A- butter, ghee, egg, milk, curd
- Sources of beta carotene- green leafy vegetables, mango, carrot, Jack fruit, amaranth

Deficiency Symptoms

- Deficiency causes nutritional blindness, night blindness
- Eye ball loses moisture, white appearance and results in dryness of eyes (Xerosis)
- Raised muddy dry triangular patches (Bitots spots)
- Redness and inflammation of the eyes with gradual loss of vision
- central portion of the eye loses transparency leading to total blindness (Xerophthalmia)

Vitamin D

- Synthesized in the body in adequate amounts by exposure to sunlight, essential for bone growth and calcium metabolism
- Helps in deposition of calcium in the bones denser and stronger
 - Deficiency of Vitamin D Leads to decreased absorption of calcium causing muscular tetany rickets in children, osteomalacia in adults
- Rickets primarily affects children and is manifested as faulty deposition of calcium on the bones, bowing of legs, deformities of ribs, slow eruption of teeth, malformed & decay prone teeth
- Osteomalacia in adults – Quality of the bone is reduced
- Occurs in women not exposed to sunshine especially low calcium level
- Symptoms- Softening of the bones, deformities of the limbs, spine, demineralization of the bones, pain in lower back and legs, frequent bone fractures

Requirement & Sources

- butter, yolk, cheese, milk, spinach and cabbage
- ICMR recommends adequate exposure to sunlight at least 5min /day
- Deficient cases are recommended to take 400 micro grams/day

Vitamin E

- Required for reproduction

- Primary antioxidant in the body and serves to protect PUFA from oxidation in cells and maintain integrity of cell membrane
- Protect RBC from haemolysis
- Reduces platelet aggregation
- Essential for iron metabolism & maintenance of immune function • Prevents accumulation of lipid breakdown products

Deficiency

- Uncoordinated movement, weakness & sensory disturbances, Causes hemolytic anemia in infants
- Defective functioning of the retina leading to permanent blindness in infants
- Reproductive failure
- Requirement & sources
- Food sources- vegetable oils, sunflower seeds, eggs, almonds, safflower oil, butter, cereal grains, sesame & mustard oil are good sources

Requirement

– Linked to that essential fatty acids and is required at 0.8 mg/g of essential fatty acid

Vitamin K

- Anti-haemorrhagic factor
- Essential for activation of prothrombin-injured tissue releases thromboplastin that catalyses prothrombin formation and vitamin k catalyses conversion of prothrombin to thrombin which further activates fibrinogen to form fibrin leading to clotting

Sources

- Dark greens, fruits, tubers, dairy and meat products, seeds
- Vitamin K as supplement is not recommended because it is synthesized in the lower intestine by colonic bacteria
- Deficiency arises in infants resulting in delayed blood clotting and haemorrhage
- Deficiency does not occur in adults.

MINERALS

- Inorganic substances that are classified as macro and micronutrients based on the amount needed by humans/day
- Macro minerals are vital to health and that are required in the diet by >100 mg/day and those by < 20 mg/day are micro-minerals
- Essential macro minerals are calcium, sodium, phosphorus, magnesium, sulphur, potassium, and chloride
 - Important micro minerals are iron, zinc, copper, cobalt, fluoride, manganese, chromium, iodine, and molybdenum

Mineral Function and their sources

- Na is required for fluid balance, nerve transmission, and muscle contraction. Table salt, vegetables, processed meat, bread are some sources of Na.

- Cl is required for fluid balance. Table salt, processed meat, soy sauce, milk are some sources.
- K Proper fluid balance, nerve transmission, muscle contraction. Whole grains, legumes, milk, fruits & vegetables are some sources.
- Ca is required for healthy bones and teeth, immune system health, nerve functioning, blood pressure regulation, Bone formation and proper calcification of bone, Tooth formation, Ca is essential for clotting of blood, Ca regulates permeability of the capillary walls and ion transport across cell membrane, Essential for contraction of heart and skeletal muscle, Ca acts as an activator for enzymes renin and pancreatic lipase. Hyper parathyroidism, Vitamin D deficiency, Tetany occurs when calcium in the blood drops below the critical level.
- P Required for maintaining acid-base balance, healthy bones, essential for the storage and release of ATP molecules, Phosphatases play an important role as buffers, Phospholipids are major components of cell membrane and intra cellular organelles, Phosphate is an essential part of DNA and RNA.
- Only 20-30% of Ca and P is absorbed and is facilitated by vitamin D.
- Ca and P - Requirements • Adult – 400, pregnant woman – 1000, children 0-15 years – 400-600 mg/day. Deficiency – osteoporosis is a condition found primarily among middle aged and elderly woman (poor absorption and utilization, dietary inadequacy, decreased levels of oestrogen) where the bone mass of the skeleton is diminished. Ragi, gingelly seeds, cumin seeds, drumstick leaves, milk and milk products, whole bengal gram, meat, fish, and poultry, eggs, milk are some sources of Ca and P.
- Mg is needed for making protein, muscle contraction. Nuts and seeds, legumes, leafy green vegetables are some sources.
- Sulfur Present in protein molecules. Eggs, meat, milk, legumes, nuts are some sources.

MICROMINERALS • Also known as trace elements

Iron

- total body iron is 4g in adults, exists in a complex form in our body, present as: –
Iron porphyrin compounds
- haemoglobin in RBC, myoglobin in muscle
- Enzymes – peroxidases, cytochrome oxidase, succinate dehydrogenase
- Transport and storage forms – transferrin and ferritin

- **Food Sources**

- Heme iron (absorbed and utilized better) is obtained from animal tissues, and non-heme from plant foods
- ragi, green leafy, jaggery, dried fruits, dates, enriched and fortified cereals and breads

- **Iron Functions**

- Iron forms a part of the protein
- Forms a part of myoglobin
- As part of enzymes iron catalyses many reactions
- conversion of beta carotene to active form of vitamin A
- Synthesis of carnitine, purines, collagen
- Detoxification of drugs in the liver
- Deficiency due to poor intake and absorption leads to nutritional anaemia – occurs when levels fall below 12 g/dl, condition that results from the inability to maintain a normal haemoglobin concentration

NUTRITIONAL ANAEMIA

- Defects in the structure, function of the epithelial tissues
- Paleness of skin and the inside of the lower eyelid is pale pink
- Finger nails become thin and flat and eventually spoon shaped (Koilonychia)
- If not treated leads to cardiovascular and respiratory changes leading to cardiac failure
 - Symptoms include fatigue, breathlessness, palpitations, dimness of vision, susceptibility to infection.