UNIT 3:
FOOD NUTRIENTS

1. Macro & Micronutrients
2. Energy requirements
3. Dietary requirements.
4. Dietary Guidelines
5. RDA's

VITAMINS

- The term ‘vitamine’ derives from the word ‘vital amine’ which means essential nitrogenous compounds.
- The term was coined by Polish Scientist, Funk, who gave the name ‘vitamine’ to anti-beriberi substance.
- However with the discovery of more vitamins, it was soon realized that all the vitamins are not nitrogenous compounds; but all vitamins are essential for health.
- Vitamins are complex chemical substances, required by the body in very small amounts.
The vitamins are a chemically disparate group of compounds with a variety of functions in the body.

What they have in common is that they are organic compounds that are required for the maintenance of normal health and metabolic integrity.

Vitamins are required in very small amounts, of the order of milligrams or micrograms per day, and thus can be distinguished from the essential fatty acids and the essential amino acids, which are required in larger amounts of grams per day.

In order to demonstrate that a compound is a vitamin, it is necessary to demonstrate both that deprivation of experimental subjects will lead to the development of a more or less specific clinical deficiency disease and abnormal metabolic signs, and that restoration of the missing compound will prevent or cure the deficiency disease and normalize metabolic abnormalities.

1. VITAMIN A

Vitamins A was discovered in the early nineteenth century by Dr. McCollum and Davis.

Vitamin A occurs in several forms: as retinal, as retinal, as an aldehyde and as retinoic acid. These several forms may be referred to as vitamin A.

In its pure form, vitamin A is a pale yellow crystalline compound and occurs naturally in animals.

It is soluble in fat solvents but insoluble in water, and is relatively stable to heat, acids and alkalies.

It is easily oxidized and rapidly destroyed by ultra-violet radiation.

Vitamin A Functions

1. Vitamin A is required for normal vision in dim light.
2. Vitamin A is required to maintain the integrity of epithelium, especially the membranes that line eyes, the mouth and the gastrointestinal, respiratory and genitourinary tracts.
3. Vitamin A is essential for normal skeletal and tooth development.
4. It has a probable role in the immunological defence mechanism of the body.
5. Cell differentiation.
1. VITAMIN A

Food Sources
- Only animal foods contain vitamin A as such: fish-liver oil, milk, butter, whole milk cheese, liver and egg yolks contain good quantities of vitamin A.
- Vitamin A is not present in plant foods, but its precursor, carotene is present which is converted into vitamin A in the body.
- Carotene is present in plants with green and yellow colorings. There is a direct correlation between the greenness of a leaf and its carotene content.
- Green leafy vegetables: spinach, turnip tops, beet greens, coriander leaves, curry leaves.
- Yellow vegetables: carrot, sweet potatoes, pumpkin.
- Yellow fruit: papaya, mango, apricots, peaches.

Recommended Daily Allowances
- One IU of Vitamin A is equal to 0.3 mcg of retinol or 0.6 mcg of Beta-carotene.

1. VITAMIN A

Deficiency
1. Xerophthalmia is an eye manifestation arising due to vitamin A deficiency.
   - Blinding, as a result of xerophthalmia, and is an important public health problem in Zambia.
   - Night blindness → conjunctival xerosis → Bitot’s spot → Keratomalacia → Irreversible blindness.
2. The degeneration and keratinization of the epithelium.
3. Dry and scaly skin is an important symptom of a deficiency of this vitamin - toad's skin.

2. VITAMIN D

- Isolated in crystalline form in 1930 and was called calciferol.
- Vitamin D is a group of sterol compounds possessing antirachitic properties, but only two are of nutritional interest.
  - (i) Vitamin D2 or Ergocalciferol found in plants and
  - (ii) Vitamin D3 or cholecalciferol which occurs in animal cells and activates in the skin on exposure to ultraviolet light.
- Pure Vitamin D are white, crystalline compounds which are soluble in fats and fat solvents, but insoluble in water.
- They are stable to heat, alkalis and oxidation.
2. VITAMIN D

**Function**
- Regulates the absorption of calcium and phosphorus from the intestinal tract.
- Regulates calcification of bones and teeth.
- Regulates the enzyme ‘alkaline phosphatase’ which regulates the release of phosphate organic compounds.

**Food Sources**
- Vitamin D occurs only in foods of animal origin. Fish liver, liver, eggs, and butter contain useful amounts.
- Another cheap source of vitamin D is sunlight. Exposure to ultraviolet rays of the sun converts the precursor of vitamin D (7-dehydrocholesterol) present in the skin to its active form.

**Recommended Daily Allowances**
- The recommended daily allowances of vitamin D are not fully known for the present. 200 IU of vitamin D can be taken as a tentative value.

2. VITAMIN D - Structure

**Deficiency**
- Deficiency of vitamin D leads to rickets in children, a condition in which the level of calcium and phosphorus is always low.
  - Rachitic rosary – swelling or bending of ribs
  - Knock-knee – bowed legs, curvature of vertebral column and deformities of the pelvic bones.
  - Softening of the skull, particularly in infants and the delayed closing of fontanelle is another feature of the deficiency of this vitamin.
  - Osteomalacia, in adults, a condition in which bones become fragile so that they are susceptible to fracture.
  - Osteoporosis, a condition in which bones become porous and break easily.
3. VITAMIN E

- Vitamin E consists of a group of chemical substances called ‘tocopherols’.
- Alpha-tocopherol is the compound possessing the greatest vitamin E activity.
- High temperature and acids do not affect the stability of this vitamin, but oxidation takes place in the presence of rancid fats or lead and iron salts.
- Decomposition occurs in ultraviolet light, alkalies and oxygen.

3. VITAMIN E

**Functions**

1. The primary role of vitamin E is to act as an anti-oxidant. By accepting the oxygen, it helps to prevent the oxidation of vitamin A in the intestine, thereby sparing vitamin A.
2. Vitamin E reduces the oxidation of the polyunsaturated fatty acids, thereby helping to maintain the integrity of the cell membranes.
3. Vitamin E plays a part in the formation of RBC’s in the bone marrow.
4. It helps in releasing the energy from carbohydrates and fats, through the synthesis of a coenzyme Q.
5. In some animals vitamin E is required to prevent the sterility.

3. VITAMIN E

**Food Sources**

- Many vegetable oils
- Wheat germ oil and cotton seed oil
- Dark-green leafy vegetables, nuts, legumes, as well as whole-grain cereals.
- Foods of animal origin - liver, heart, kidney, milk and eggs
- Human milk

**Recommended Daily allowances**

- The vitamin E requirement is linked to that of essential fatty acids. The requirement of vitamin E suggested is 0.8 mg/g of essential fatty acids.

**Deficiency**

- Vitamin E deficiency results in increased haemolysis (break down) of the red blood cells leading to anaemia.
- Premature infants also shows a low level to tocopherol.
4. VITAMIN K

- Dr. Dam (1935) found that a ‘Koagulation Vitamin’ was necessary to prevent fatal haemorrhages in chicks by promoting normal blood clotting.
- Vitamin K is found in nature in two forms:
  1. K1 occurs in alfalfa and
  2. K2 is produced by bacterial synthesis.
- These are soluble in fat, heat STABLE, but are unstable to alkalies, strong acids, oxidation and light.

**Function**

1. Vitamin K is essential for the formation of prothrombin and other clotting proteins by the liver.
2. Vitamin K probably also participates in oxidative phosphorylation in the tissues.

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B Complex vitamins

**Main Functions**

- Shiny healthy hair and skin
- Tender normal gums
- Good teeth
- Strong healthy bones
- Good appetite

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4. VITAMIN K

**Food sources**

- The variation K mainly occurs in plants - Green leaves of plants such as spinach, cabbage, cauliflower; Among animal foods, pork liver is a good source.

**Recommended Daily Allowances**

- The variations in intestinal synthesis and in the diet have made it impossible to establish a daily allowance.

**Deficiency**

- Deficiency usually occurs due to faulty absorption or due to liver disorders that affect the synthesis of prothrombin.
- Dietary deficiency is rather unusual.

4. VITAMIN B1 (THIAMINE)

- Thiamine hydrochloride is a white crystalline substance with a faint yeast-like odour and a salty, nut-like taste.
- It is readily soluble in water but not in fat solvents or fats, heat labile, sensitive in heat in neutral or alkaline solutions.

**Functions**

1. It is essential for the utilization of carbohydrates in the body
2. Thiamine is also essential for the maintenance of good appetite and normal digestion.
3. It has a role in brain metabolism as the deficiency causes neurological and nervous disorders.
4. VITAMIN B1 (THIAMINE)

**Food Sources**
- Important sources are dried yeast, wholegrain cereals and pulses, oilseeds and nuts especially groundnuts, Meat fish eggs,

**Recommended Daily Allowances**
- The recommended daily allowance is 0.5 mg/1000 Kcals.

**Deficiency**
- The clinical manifestations of thiamine deficiency are beri-beri and wernick’s encephalopathy.
- Beri-beri exists in three forms-dry, wet and infantile beri-beri.
- Manifestations of minor thiamine deficiency are loss of appetite, absence of ankle jerks, knee jerks and presence of calf tenderness.

4. VITAMIN B2 (RIBOFLAVIN)

**Food Sources**
- The richest source is dried yeast. Among the good sources are milk, liver, meat eggs, kidney and growing leafy vegetables.

**Recommended Daily Allowances**
- The recommended daily allowances is 0.6 mg/1000 Kcals.

**Deficiency**
- Ariboflavinosis is one of the most common of the deficiency diseases. Signs suggestive but not specific include:
  1. Angular stomatitis: the patients develop cracks on both the sides (angles of upper and lower lips) of the mouth
  2. Cheilosis: The lips develop cracks and become red
  4. Redness and burning sensation in the eyes and visualization of the cornea.
  5. Scrotal or vulva dermatitis.

5. NIACIN OR NICOTINIC ACID

**Food Sources**
- White needle-like bitter tasting crystals.
- It is moderately soluble in hot water, but only slightly soluble in cold water; It is stable to heat, alkalis, acids light and oxidation and unstable to reduction.
- Niacin occurs in two forms:
  1. Niacin
  2. Penaain form i.e. tryptophan. Human body can make 1 mg of vitamin from 50 to 60 mg of tryptophan.

**Functions**
- 1) Niacin is rapidly converted in the body to nicotinamide, which is a component of coenzymes which are essential for the metabolism of carbohydrates, fats and proteins.
- 2) It is also essential for the normal functioning of skin, intestinal tract and the nervous system.
5. NIACIN OR NICOTINIC ACID

Food Sources
- Poultry, meat and fish are the good sources. Peanuts is also among good sources. Whole grains are fair sources of niacin. Potatoes, legumes and some green leafy vegetable contain fair amount of niacin.
- Germination and fermentation enhances the value of niacin in the food.

Recommended Daily Allowances
- The recommended daily allowances if 6.6 mg/1,000 K. cals.

5. NIACIN OR NICOTINIC ACID

Deficiency
- Niacin deficiency results in pellagra.
- Pellagran involve the gastrointestinal tract, the skin and nervous system. Early signs include fatigue, headache, backache, loss of weight and loss of appetite. Nausea and vomiting are followed by diarrhoea (i.e. loose motion is present).
- A characteristics symmetrical dermatitis especially on the exposed surfaces of the body—hands, forearms, elbows, legs, knees and neck—appear.
- Neurological symptoms include dizziness, confusion, poor memory and irritability of disease.
- The classic ‘D’ are the final stages i.e. dermatitis, diarrhoea, dementia and death.

6. VITAMINE B6 (PYRIDOXINE)

Food Sources
- Foods rich in pyridoxine are meat, poultry and fish. Potatoes, sweet potatoes are fair sources. Whole grain cereals are also good sources.

Recommended Daily Allowances
- There recommended allowance is for adult is 1.5 mg/day.

Deficiency
- The deficiency of this vitamin causes convulsions, dizziness and vomiting.
- Other symptoms are cheilosis, glossitis and abdominal pain.

Functions
- Vitamin B6 is the coenzymes for a large number of enzyme systems, most of which are involved in amino acid metabolism.
- It plays a role in the conversion of
  - (a) tryptophan to niacin
  - (b) linoleic to arachidonic acid
  - (c) interconversion of amino acids.
7. FOLIC ACID

- Folain is a generic term for folic acid, pteroylglutamic acid and other compounds having the activity of folic acid.
- It consists of three linked components: a pteridine grouping, paraaminobenzoic acid, and glutamic acid, an amino acid.
- Pure folic acid occurs as a bright yellow crystalline compound, only slightly soluble in water; easily oxidized in an acid medium and is sensitive to light.

Functions
- 1. It is required for the synthesis of DNA.
- 2. It is also required for the normal production of red blood cells in the bone marrow.
- 3. It is also required for the oxidation of amino acid phenylalanine to tyrosine.

Recommended Daily Allowances

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<th>Group</th>
<th>Male</th>
<th>Female</th>
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<tbody>
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<td>Adult</td>
<td>400</td>
<td>400</td>
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<tr>
<td>Pregnancy</td>
<td>500</td>
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<td>500</td>
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<tr>
<td>Children</td>
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Deficiency
- Folic acid deficiency results in:
  1. Megaloblastic anemia,
  2. Glossitis
  3. Gastrointestinal disturbances.

8. VITAMIN B12 (CYANOCOBALAMIN)

Characteristics
- This vitamin is the only cobalt containing substance essential for health.
- It occurs as deep red needle like crystals which are slightly soluble in water.

Functions
- 1. It helps in the synthesis of nucleic acid and nucleoproteins.
- 2. It is essential for the maturation of red blood cells in bone marrow.
- 3. It is also required for the metabolism of nervous tissues.

Food Sources
- It is present only in the foods of animal origin. Liver, meat, eggs and milk are good sources.

Deficiency
- Deficiency of this vitamin leads to pernicious anaemia.
- Macrocytic anaemia and degenerative changes of the nervous system may result after gastroectomy.
- It is seen that vegetarian diet, deficient in vitamin B12 lead to retarded growth but do not produce anaemia.
9. VITAMIN C (ASCORBIC ACID)

Vitamin C is a white crystalline compound of relatively simple structure and closely related to monosaccharide sugars.

It is easily destroyed. It is highly soluble in water, heat, light, alkalis, oxidative, enzymes and trace.

VITAMIN C (ASCORBIC ACID)

Functions
1. It is required for the formation and maintenance of collagen,
2. Vitamin C is necessary for the production of tissues for quick post operative healing and for the maintenance of previously formed scar.
3. It plays an important role in the normal metabolism of the amino acids.
4. It helps in easy absorption of iron from gastro-intestinal tract by the reduction of ferric iron to ferrous ion.

VITAMIN C (ASCORBIC ACID)

Deficiency
- Deficiency of ascorbic acid results in
- Defective formation of the intercellular cementing substance collagen,
- Fleeting joint pains,
- Irritability,
- Retardation of growth in infants and children,
- Anaemia,
- Shortness of breath,
- Poor healing of wounds and
- Increased susceptibility to infections are some of the signs of deficiency.
- Gross deficiency of ascorbic acid result in Scurvy, a disease characterized by swelling, and bleeding of gums, multiple hemorrhages, anaemia and weakness.

Recommended Daily Allowance of Ascorbic acid

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<thead>
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<th>Group</th>
<th>Ascorbic acid mg/day</th>
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<tr>
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<tr>
<td>Pregnant</td>
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<tr>
<td>Lactating</td>
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<tr>
<td>Infants</td>
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<td>children</td>
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