ROLE OF VITAMINS AND MINERALS IN NUTRITION (Relates to man)

I. Vitamins

- The word vitamine (vital - essential, amines - amino compounds) was proposed by Funk (1912).
- He defined it as an **accessory food factor which is essential for growth and healthy maintenance** of **the body.**
- Later it was found that all vitamins were not amines. Hence the letter 'e' was removed and now they are referred to as vitamins.
- They do not provide energy or body building materials.
- But they are essential for energy transfer and regulation of metabolism.
- Some vitamins form parts of many enzymes. Deficiency of vitamins leads to deficiency disorders. There are two types of vitamins, namely, **fat soluble vitamins and water soluble vitamins.**

A. Fat soluble vitamins :

- A, D, E and K are the fat soluble vitamins. They need bile juice for absorption. They are transported to all parts by lymph.

1. Vitamin-A:

- Its chemical name is **retinol.** It is commonly called **anti xerophthalimic vitamin.**
- The main sources of vitamin-A are fish liver oils, milk, butter, egg yolk etc.
- In plants vitamin-A is in the form of β-carotene (provitamin-A).
- In the liver and intestine, β-carotene becomes Vitamin-A. It is rich in carrots, green leafy vegetables etc.
- Vitamin-A plays an important role in growth and activity of epithelial tissues and a vital role in vision.
- It is essential for resynthesis of rhodopsin (visual purple) in retina.
- Deficiency of Vitamin-A leads to **nyctalopia** (night blindness), **xerophthalmia** (dryness of cornea, swollen eye lids) and **keratomalacia** (dry and scaly skin).

2. Vitamin-D :

- The chemical name of vitamin-D is **calciferol.** It is commonly called **antiricketic vitamin** or **sunshine vitamin.**
- The main sources of this vitamin are fish liver oils, milk, butter, egg etc. Mammalian skin can synthesise vitamin-D in presence of sun light *(i.e.*. U.V. rays).
- Vitamin-D is important for calcium metabolism and it increases the absorption of calcium and phosphorus from the intestine and is thus necessary for formation of healthy bones and teeth.
- Deficiency of Vitamin D in children leads to **rickets** (bones fails to calcify properly leading to bow legs, knok-knees, ribs become deformed leading to pigeon breast) and in adults to **osteomalacia** (bones become soft and fragile).
- Over doses of Vitamin D (hyper vitaminasis of vitamin D) causes nausea, head ache, kidney damage, calcification of soft tissues etc.

3. Vitamin E :

- The chemical name of vitamin E is **tocopherol.** Its common name is **anti-sterelity vitamin.** The sources of E-Vitamin are wheat germs oil, nuts, wheat and maize etc.
- This vitamin acts as an anti oxidant. It maintains health and integrity of muscles by controlling the oxidation of polyunstaturated fatty acids.
- Vitamin-E plays an important role in functioning of gonads.
- Deficiency of vitamin-E leads to sterelity in males, abortion in females, besides **muscular dystrophy.**

4. Vitamin K :

- The chemical name of vitamin K is **naphtho quinone.**
- It is commonly known as **antihaemorrhagic vitamin.**
- It is found in green leafy vegetables, tomato, cheese, eggs, liver etc. Intestinal microbes also synthesise vitamin K.
- It is necessary for the formation of prothrombin, which is required for clotting of blood.
- Deficiency of K-vitamin leads to delay in blood clotting process leading to loss of more blood even from minor wounds.

Water soluble vitamins :

- **B** and **C** vitamins are water soluble vitamins. They are directly absorbed by the intestine and are carried to all parts by blood.

I. Vitamin-B complex :

- Several vitamins have been grouped as B-complex because of their similarities in distribution in common natural sources.
- Most of the vitamins of B-complex acts as co-enzymes.
- Main sources of B-complex group of vitamins are liver, milk, eggs, kidneys, fish, cereals, pulses, nuts, peas, beans, green leafy vegetables etc.

a. Vitamin B_1 :

- Chemical name of this vitamin is thiamine. It is commonly known as **anti beri-beri factor.**
- B_1 plays an important role in growth and proper functioning of nervous system.
- It acts as a co-factor for enzymes involved in carbohydrate and amino acid metabolism.
- Deficiency of B_1 causes **beriberi** (partial paralysis of smooth muscles of gastrointestinal tract, and skeletal muscle paralysis), and **polyneuritis** (degeneration of myelin sheath leading to impaired relexes, loss of appetite, stunted growth in children).

b. Vitamin B_2:

- Chemical name of vitamin B_2 is **riboflavin.**
- It is a component of two co-enzymes, namely, flavin mono nucleotide (FMN) and flavin adenine di nucleotide (FAD), which are involved in intermediary metabolism.
- Deficiency of B_2 results in **cheilosis** (dryness of lips resulting in cracking of lips and corners of mouth), glossitis (inflammation of tongue) and **keratitis** (inflammation of skin, itching etc.) and Seboric dermatitis (scalu and greasy skin on nose and ears.

c. Vitamin B_6:

- Chemical name of vitamin B_6 is pyridoxine. It acts as a **co-enzyme** for many enzymes involved in protein metabolism and also helps in the production of antibodies. Helps in utilisation of Fe in haemoglobin synthesis.
- This vitamin is synthesised by the intestinal microbes and hence there is no deficiency in adults. In children, deficiency cause convulsion.
- Its deficiency also causes hypochromic microcytic anaemia.

d. Vitamin B_{12}:

- Chemical name of vitamin B_p is **cyanocobalamin**. It is necessary for maturation of RBC, formation of Methionine and take part in the synthesis of DNA.
- Deficiency of B_{12} leads to **pernicious anaemia** [enlarged RBC, erythropenia], degenerative changes in spinal cord etc.,

e. Niacin or nicotinic acid :

- It is commonly called **anti pellagra vitamin.** It is a part of co-enzymes like NAD and NADP which are essential for the formation of ATP in electron transport system.
- Deficiency of this vitamin causes pellagra, characterised by diarrhoea, dermatitis and **dementia** (dementia is due to disturbances of nervous system).

f. Folacin or **folic acid**:

- This vitamin plays an important role in synthesis of adenine, guanine and thymine required for the formation of DNA and RNA.
- Take part in the formation of RNA. It also take part in the formation of WBC.
- It also takes part in formation and maturation of RBC and WBC. Deficiency of folic acid leads to macrolytic anaemia, delays in replication of DNA, **leucopenia etc.**

g. Pantotnenic acid:

- It is a constituent of co-enzyme A, which is essential for several metabolic activities. It is also synthesised by intestinal microbes.
- Deficiency of this vitamin causes poor growth, early aging and premature greying of hair.

h. Biotin :

- It acts as a co-enzyme for carboxylases. It is a sulphur containing vitamin. Biotin deficiency is reported from persons who consume raw eggs.
- Raw egg white contains a protein **avidin** which antagonises biotin.

2. Vitamin C :

- Chemical name of vitamin C is **ascorbic acid.** Main sources of this vitamin are citrus fruits (lime, orange), green leafy vegetables, fresh potatoes, tomatoes etc.
- This vitamin maintains the matrix of cartilage, bone and dentine and the integrity of endothelium.
- C vitamin provides resistance, helps to dissolve cholesterol in blood, wound repair and enhances absorption of iron. Deficiency of C vitamin leads to **scurvy,** characterised by skin eruptions, swollen and bleeding gums of teeth, haemorrhage, poor healing of wounds etc.

Minerals :

- Minerals are inorganic substances required for the body. They form about 4% of body weight. They are classified into macronutrients and micronutrients.

A. Macro nutrients

S.No.	Name of nutrient	Sources	Functions	Deficiency
1.	Calcium	Milk, cheese, eggyolk, beans, cabbage, cauli-flower.	a) Calcium is a major component of bones and teeth. b) Calcium plays an important role in blood coagulation, muscle contraction. nerve irritability etc.	Deformity of bones, dental disorders. Osteporosis in adults and rickets in children
2.	Phosphorus	Milk, cereals, egg, fish, meat etc.	a) Phosphorus is a major comp-onent of bones and teeth. b) High energy molecules (e.g., ATP) and many co-enzymes contain phosphorus	Defective bones and teeth; rickets and oestomalacia.
3.	Sodium	Table salt, cheese oysters, wheat-germs, carrots, leafy vegetables etc.	a) Maintenance of ionic-water balance. b) Muscle contraction, nerve impulse propogation etc. c) Sodium salts of bile emulcify fats.	Muscle cramps, head-ache, nausea etc.
4.	Potassium	Chicken, beef, pork, banana, orange juice, potato etc.	a) Potassium is the main component In intracellular and extra-cellular fluid of muscles, especially cardiac muscles. b) It is essential for various metabolic activities	a) **Hyperkalemia** (elevated serum potassium) involved in renal failure, dehydration, cardiac failure etc. b) Hypokalemia (Low serum potassium) involved in muscle weakness, tachycardia paralysis etc.
5.	Magnesium	Cocoa, nuts, soyabenas	a) Combine with Ca and P in the complex salts of bone. b) Mg is important for protein and lipid metabolism.	Hyper excitability of nervous system; muscle tremor; convulsion.
6.	Chlorine	Table Salt	a) Essential for water balance and osmotic pressure regulation. b) Maintain acidbase equilibrium in blood (Chloride shift)	Vomiting; hypochloremic alkalosis

7.	Sulphur	Wheat germs, cheese, cabbage etc. Sulphur is also found in amino-acids like methionine, cysteine.	a) Formation of insulin. b) Essential for protein bio synthesis.	Stunted growth.

Micro nutrients :

These nutrients are required in very little quantities. Hence they are also called trace elements.

S.No.	Nutrient	Sources	Functions	Deficiency
1.	Iron	Liver, heart, kidney, egg, fish, leafy vegetables etc.	Iron is an important component of haemoglobin.	Anaemia
2.	Copper	Nuts, shell fishes, liver, kidney etc.	Essential for synthesis of haemoglobin and proper activity of certain enzymes.	Loss of weight, nutritional anaemia.
3.	Iodine	Sea foods, iodised salts etc.	Synthesis of thyroid hormones.	Thyroid hypertrophy.
4.	Manganese	Nuts, whole grains, vegetables, fruits etc.	Essential for bone formation, reproduction etc.	Sterelity
5.	Cobalt	Liver, kidneys	Essential for formation of red blood cells.	Anaemia, loss of weight, weakness. Excess cobalt leads to polycythemia
6.	Zinc	Meat, Liver, eggs,	Essential for growth, reproduction, tissue repair, healing, proper vision etc.	Hypogonadism, dwarfism.

Nutritional requirement & Balanced diet:

- The study of food stuffs and nutrition is called dietetics
- Carbohydrates general formula C_n $(H_2O)n$
- An adult needs 500grm carbohydrates per day
- 1 gram of carbohydrate yields 4.0 Kcal
- Nitrogen is the peculiar element of proteins
- Proteins are polymers of amino acids
- An average person needs 70 to 100 gram of protein per day
- 1 gram of proteins yields 4.0 Kcal
- Number of oxygen atoms is less than the carbon atoms in fats
- An average adult needs 50gm of fats per day
- 1 gm fat yields 9.0 Kcal energy
- Water in human body is 65%
- Human needs 5 to 6 glasses of water per day
- An imbalance of the total caloric intake is called **malnutrition**
- Deficiency of calories and specific nutrients is referred to as **under nutrition**
- Deficiency of proteins in normal caloric intake is **Kwashiorkor**
- Protein calorie under nutrition leads to a disorder called **Marasmus**
- Excess intake of food is **overnutrition**
- Excess intake of saturated fats is **hypercholesteroimea**
- Hypercholesteroimea leads cardiac disorders
- Excess intake of calories may produce obesity or over weight