

Vitamins are designated by..

BIOMOLECULES

Continued from 1st March

Denaturation of proteins: The process which changes the physical and biological properties of a protein is called denaturation. The denaturation is caused by changes in P^H, temperature, presence of some salts or certain chemical agents.

- Denaturation is carried out by
 - a) Change in pH, which breaks down hydrogen bonds and electrostatic attractions.
 - b) Adding reagents like urea that form stronger hydrogen bonds with protein groups.
 - c) Adding detergents like sodium dodecyl sulphate (or) organic solvents which associate with non polar groups of protein and interface with hydrophobic interactions.
 - d) Heating or agitation which causes disruption of attractive forces.
- Denaturation can be carried out without effecting the primary structure of protein

Denaturation may be reversible or irreversible. **Ex:1** The coagulation of egg white on boiling is an irreversible denaturation.

Renaturation is the reverse of denaturation. **Ex:2** Curdling of milk which is caused due to the formation of lactic acid by bacteria present in milk .

- Reverse process of denaturation is called renaturation which is possible in DNA.

Enzymes: Enzymes are biological catalyst produced by living cells which catalyze the biochemical reactions.

- Life is possible due to the co-ordination of various chemical reactions in living organisms
- Digestion of food, absorption of appropriate molecules and ultimately production of energy etc sequence of reactions occur slowly in the body under very mild conditions. These occurs with the help of certain biocatalysts are called enzymes

- The mechanism of an enzymes as catalyst will be. $E + S \rightarrow ES \rightarrow EI \rightarrow EP \rightarrow E + P$ Here E = enzyme, S = substrate, ES = complex, EI = intermediate, P = product.

- These are simple or globular conjugated proteins. These are highly specific.
- If once they are utilised in the reaction, they get deactivated such that in the further reaction they must be replaced by synthesis in the body.

- Enzymes are needed only in small quantities. Enzymes reduce the magnitude of activation energy. For Example, activation energy for acid hydrolysis of sucrose is 6.22 KJ/mol , while the activation energy is only 2.15 KJ/mol when hydrolysed by the enzyme sucrase.

- An enzyme contain a non-protein part called **prosthetic group**.

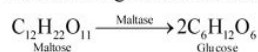
- The prosthetic group covalently bonded with enzyme component is called **co-factor**.

- The prosthetic group attached to the enzyme at the time of reactions are called **co-enzymes**.

Ex: 5-Deoxy adenosil group is the coenzyme to the vitamin B₁₂.

- Almost all the enzymes are globular proteins.
- Enzymes are very specific for a particular reaction and for a particular substrate.

They are generally named after the compound **Ex:** The enzyme that catalyze hydrolysis of maltose into glucose is named as maltase.



- Sometimes enzymes are also named after the reactions in which they are used.

Ex: the enzymes which catalyze the oxidation of one substrate with simultaneous reduction of another substrate are names as oxidoreductase enzymes.

The important enzymes are:

Enzymes Reaction catalysed

1. Urease Urea → CO₂ + NH₃
2. Invertase Sucrose → Glucose + Fructose
3. Maltase Maltose → 2 Glucose

4. Amylase Starch → n Glucose
5. Pepsin Proteins → Polypeptides → α-Amino acids
6. Trypsin Polypeptides → α-Amino acids
7. Carbonic anhydrase H₂CO₃ → H₂O + CO₂
8. Nuclease DNA, RNA → Nucleotides
9. Lactase Lactose → Glucose + Glucose
10. Emulsin Cellulose → n Glucose
11. RNA Polymerase Ribo nucleotide triphosphates → RNA
12. DNA Polymerase Deoxy nucleotide triphosphate → DNA



Some other points in proteins and aminoacids: The lack of the essential aminoacids in the diet causes diseases like Kwashiorkor

- The rotation about C-N bonds is hindered and because of this hindered rotation, the peptide bond can show geometrical isomerism.
- Biological Membranes mainly consists of phospholipids and proteins
- The phospholipids are arranged in a double layer with their polar heads pointing outside and non-polar tails into the interior of the membrane
- The protein components of the membranes are either embedded in the bilayer or are attached to either side of the membrane.

Vitamins

- **Introduction:** Vitamins are naturally occurring low molecular weight carbon compounds, which are essential dietary factors.

These are required in minute quantities for the maintenance of normal health of organisms. The term "Vitamin": for such substances was introduced by Dr. Funk.

Their absence in the human body causes deficiency diseases or disorders.

They participate in the production of co-enzymes and also in the regulation of biochemical processes.

Plants can synthesise all vitamins. Animals can synthesise few but not all vitamins.

Human body can synthesise vitamin 'A' from carotene.

Some members of vitamin - B - complex and vitamin K are synthesized by microorganisms present in intestinal tract of human beings.

Vitamins are widely distributed in nature in plants and animals. All cells in the body can store vitamins to some extent.

Vitamins have varied chemical structures. Vitamins are designated by English alphabets A, B, C, D, E, K.

Excess or low levels of vitamins cause different diseases.

Classification: Vitamins are classified into two broad groups. These are

- (a) Fat soluble vitamins
- (b) Water - soluble vitamins

Fat soluble vitamins: Vitamins A, D, E and K are fat soluble. Liver cells are rich in fat soluble vitamins (Vitamins A & D)

Water soluble vitamins: Vitamins C and B-complex are water soluble. These are present in much smaller amounts in cells.

Functions in bio systems: Vitamins in low concentrations catalyze biological reactions.

- The daily dose of vitamins for an individual depends on his or her age, size and rate of metabolism.
- Youngsters need higher quantities than elders.
- The need of vitamins for younger, growing children and pregnant women is higher.
- A lack of one or more vitamins leads to

characteristic deficiency symptoms.

- Multiple deficiencies caused by deficiency of multiple vitamins are also common.
 - The condition of vitamin deficiency is known as avitaminosis.
 - The sources, structures, physiological functions and deficiency diseases of vitamins are presented in the table.
- Some other points in vitamins:** Vitamin D is also called sunshine vitamin. Since it is obtained by sunlight irradiation of ergosterol present in oils and fats
- Vitamin B₁ is a derivative of pyrimidine as well as such it contains both N and S
 - Vitamin B₁₂ contains both N and P
 - Provitamins are the biologically inactive compounds which can be easily converted into biologically active vitamins
 - β-carotene is provitamin A



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Fat Soluble Vitamins Table				
Vitamin	Structure and formula	Sources	Functions	Deficiency Diseases
A (Retinol)	(an alcohol contains ionone ring and hydro carbon chain) C ₂₀ H ₃₀ O	Milk, butter, kidney, egg, yolk, liver, fish oil, rice polishing papaya, carrot	Essential for synthesis of visual pigments, growth and division of epithelial cells, strength of bones, healthy skin	Night blindness, xerophthalmia, degeneration of lacrymal
D (Calciferol or Ergocalciferol)	(a sterol) (Four rings and a side chain) three rings are 6-carbon rings and one ring is cyclopentane C ₂₈ H ₄₄ O	Synthesised in skin cells in sun light butter, liver, egg, fish oil and milk (Sunshine vitamin)	Regulates absorption of calcium and phosphorus in intestine, mineral deposition in bones and teeth	Rickets in children and osteomalacea in adults, brittle ness of bones
E (Tocopherol derivative) Anti sterility Vitamin	α,β,γ - Trimethyl tocopherol (an unsaturated alcohol, chromone ring with 3-methyl rings) C ₂₉ H ₅₀ O ₂	Green leafy vegetables, oils, wheat, animal tissue	Normal muscle functioning, essential for proper spermatogenesis, pregnancy, sythesis of coenzyme-Q, stores glycogen in muscle	Muscular dystropy sterility, necrosis of heart muscle
K (Anti Haemorrhagic vitamin or Phylloquinone)	(a naphthaquinone derivative) C ₃₁ H ₄₆ O ₂	Green leafy vegetables, synthesized bycolon bacteria, cow milk, cabbage, liver and intestinal flora	Essential for blood clotting (co-agation of blood)	Excessive bleeding in injury, poor coagulation of blood
B ₁ (Thiamine)	Contains pyridine & thiazole molecules (dimethyl amino pyridine) C ₁₂ H ₁₇ N ₂ SO ₂	Cereals, outer grain layers, yeast, milk, green vegetables	Healthy nervous system, major component of coenzyme cocarboxylase, required for carbohydrate aminoacid metabolism ATP+B ₁ → AMP+B ₁ pyrophosphates activates carboxyase	Beri- Beri, weak heart beat
B ₂ (Riboflavin)	(Flavin derivative) C ₁₇ H ₂₀ N ₄ O ₆	Yeast, vegetables, milk, egg, white, liver, kidney.	Combines with H ₂ PO ₄ to form FAD, FMN, essential for oxidative metabolism	Cheilosis, skin diseases, dark red tongue, swelling around mouth
B ₃ (Pantothenic acid)	(a dipeptide) C ₉ H ₁₇ O ₅ N	All food stuffs	Important component of co-enzyme-A required for oxidative metabolism	Dermatitis (Skin diseases) burning sensation of feet, graying of hair, feeling lot of stress
B ₅ (Nicotinic acid or niacin) Pellegrapreventing factor)	(Nicotinamide or pyridine derivative) C ₆ H ₄ N ₂ -COOH	Meat, yeast, milk, green leafy vegetables	Active group in coenzyme NADP, DPN, required for oxidative metabolism, Essential for growth	Pellegra, diarrhea, dermatitis, dementia
B ₆ (Pyridoxine)	(pyridoxyl phosphate) C ₈ H ₁₁ O ₅ N	Cereals, grains , yeast, egg yolk, meat	Important coenzyme in proteins and amino acid metabolism, synthesis of fats from carbohydrates	Chronic anaemia, dermatitis, convulsions, vomiting
B ₇ (Biotin or vitamin-H)	Heterocyclic S-containing monicaboxylic acid. It is called co-enzyme R C ₁₀ H ₁₆ N ₂ O ₅ S	Yeast, liver, kidney, milk	Essential for fat synthesis and energy production, synthesis of lipids	Skin diseases (dermatitis, increases in blood cholesterol)
B ₉ (Folic acid)	Contains glutamic acid, p-amino benzoic acid and pterin C ₁₉ H ₁₉ N ₇ O ₆ Pteroglutamic acid	Spinach leaf, intestinal bacteria	Essential co-enzyme for synthesis of DNA formation of RBC	Growth retardation, anaemia, gastrointestinal disorders
B ₁₂ Cyanocobalamin	(resembles heme. CO ³ is essential situated in corrin ring) C ₅₅ H ₇₀ O ₁₄ N ₁₄ PCo	Liver of ox, pig, fish, egg and curd	Synthesis of DNA, RNA and fats from carbo - hydrates, metabolism of nervous tissues of nervous system	Permicious anaemia (RBC deficient in haemoglobin, hyperglycoemia, degradation of vervous system

B-Complex is a mixture of B₁, B₂, B₃, B₅, B₆, B₉, and B₁₂