

Engineering Admission Program 2020

BIOLOGY

Lecture : B-03

Chapter 03: Cell Chemistry







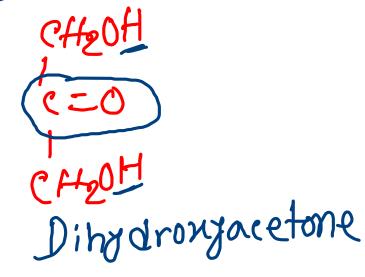


Carbohydrates

Formula $(CH_2O)_n$

- Carbohydrates are polyhydroxy aldehydes or polyhydroxy ketone or their derivatives. Their alternative name is hydrates of carbon.
 - ☐ Ratio of C, H, O is 1: 2: 1
 - □ about 50-80% of dry weight of plants.

9bjeeraldehyde





Characteristics of Carbohydrates

- They are granular (sugar), fibrous (cellulose) and powder like substances.
- They are sweet (sucrose) or tasteless (cellulose).
- Turns into ash if heated.
- Mostly soluble in water





Functions of Carbohydrates



- ✓ They act as the main source of energy for organisms and produce energy Source of energy Stored substance Others by being oxidized.
- ✓ Acts as structural component of supporting tissues of plants.
- ✓ Provides carbon skeleton to structural components of the plant.
- ✓ (Used as lubricant in the bone joints.)
- ✓ Deoxyribose sugar for DNA formation and ribose sugar for RNA formation are must...
- ✓ Many components of our basic demand, such as food, clothes, habitat comes from carbohydrate.
- ✓ Cellulose gives protection and rigidity to plant.

stored substance: storeh

plant: storeh

Alimny Chapter 3:

Biology 1st Paper

Chapter 3 : Cell Chemistry





a. Based on taste: 2 types

- (i) Sugar
- Tastes sweet, granular, water soluble.
- Examples: glucose, fructose, sucrose
- (ii) Non-sugar
- Doesn't taste sweet, agranular, water insoluble.
- Examples: starch, cellulose, glycogen, dextrin





Classifications of Carbohydrates

| Based on struc | tural molecule, carbohydrates are divided into 4 types. |
|--|--|
| (1) Monosaccharide | Yields one monosaccharide on hydrolysis. Such as- glucose |
| (<mark>/</mark> i) <u>Dis</u> accharide | Yields 2 monosaccharides on hydrolysis. Such as- maltose, sucrose, cellobiose, lactose. |
| (iii) Oligosaccharide | Yields 3-10 monosaccharides on hydrolysis. Such as- raffinose (trisaccharide) |
| (iv) Polysaccharide | Yields many monosaccharides on hydrolysis. Such as- starch, glycogen, cellulose. |



Classification of corbohydrates C. On the basis of reducibility.

- A. Reducing Sugar: e.g.: Monosoccharides, Disaccharides
- B. Non Reducing Sujar: eg: Sucrose Polysaccharides

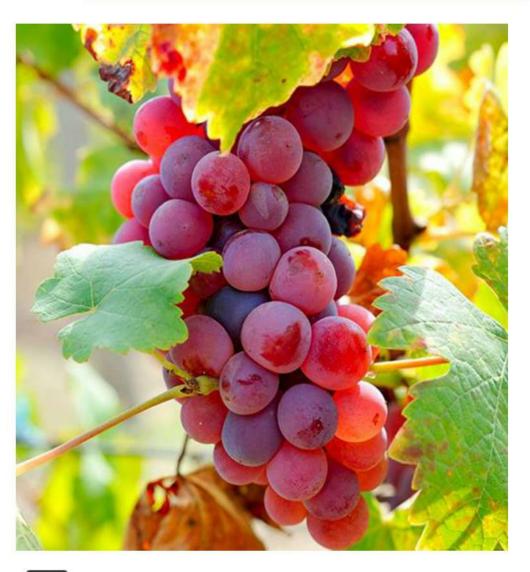
Monosaccharides



| | • Carbon number is 3-10 | | | |
|---|--|---------------------------------------|--------------------|--|
| | Type | Aldose sugar | Ketose sugar | |
| | Triose $(C_3H_6O_3)$ (smallest | Glyceraldehyde | Dihydroxy acetone | |
| | carbohydrate) | \sim \sim | | |
| ~ | Tetrose $(C_4H_8O_4)$ | Erythrose | • Erythralose | |
| ~ | Pentose (C ₅ H ₁₀ O ₅) | Pibose, Xylose, Deoxyribose C5 Hro 04 | Ribulose, Xylulose | |
| * | Hexose $(C_6H_{12}O_6)$ | y Glucose, Galactose, Mannose | •/Fructose | |
| | | | | |



Monosaccharide: Glucose



Dextrose/grape sugar/corn sugar $C_6H_{12}O_6$

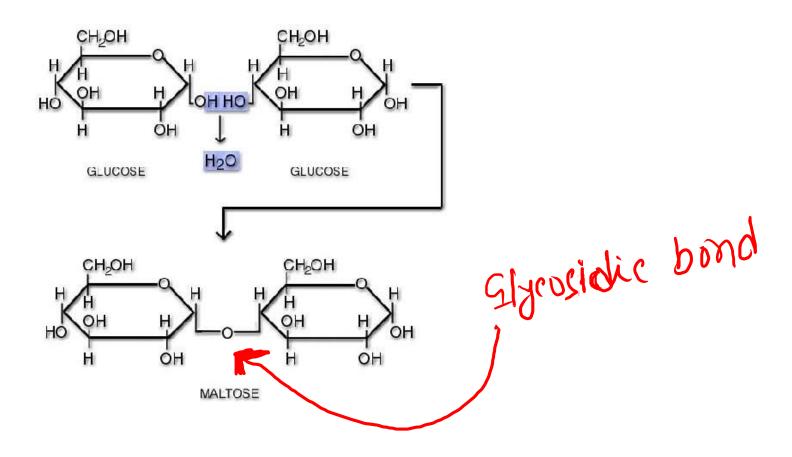
- It is called grape sugar as it is found in 12-30% in ripe grape.
- Primary substance of cellular respiration is glucose.

Use:

- ✓ Well known diet. Provides quick energy to patient.
- Used in synthessis of vitamin C.
- V Used in preservation of fruits.

 Somthesis Calcium Gluconate





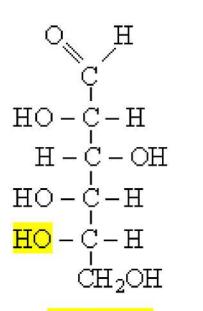
Types of Glucose

D-glucose

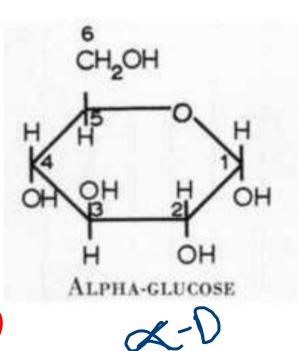
Deglucose

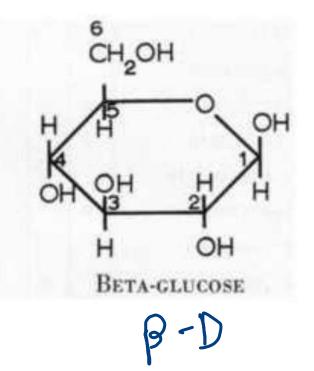
Deglucose

Deglucose



L-glucose
Levoralator)







Monosaccharide: Fructose

Fructose/Fruit Sugar

 $C_6H_{12}O_6$ (isomer of Glucose)

- most ripe sweet fruit and honey contain fructose
- ✓ Used in production of different sweet food





Disaccharides

| formula | $C_{12}H_{22}O_{11}$ | |
|---------|---|--|
| Example | Maltose, sucrose, cellobiose, lactose etc | |

Sucrose or sugar:

- Soluble in water.
- White granular organic substance. Melting point is 188°C.
- Sucrose is twice as sweet as glucose



- Sugar-cane sap has 15% sucrose. So it is called sugar-cane sugar or beat sugar.
- Sucrose is the main disaccharide of plants.
- Carbohydrate produced in leaf is supplied to different organs as sucrose.
- ✓ Main raw material of honey is sucrose





Disaccharides

Cellobiose = Chrose typicose

Produced by two β –Glucose units

√Maltose:

Produced by Two molecules of α – Glucose.

Relative sweetness:

| Sugar | Relative sweetness | Sugar | Relative sweetness |
|-----------|--------------------|-----------|--------------------|
| ✓ Sucrose | 100 | Lactose | 16 |
| Glucose | 74 | Saccharin | 500 |
| Fructose | 173 | | |
| Moltose | 32 | | |



Poll Question-01

What is the number of carbon atoms in glucose molecule?

- (a) 5
- (b) 4
- (c) 6
- (d) 7



Oligosaccharides

3-10 molecules of monosaccharide are produced on hydrolysis.

Example

Trisaccharide

Pentasaccharide • Verbascose

• Raffinose

Tetrasacharide • Stachyose, Scorcose

Disaccharide and trisaccharide

Maltose Glucose + Glucose

Glucose + Fructose Sucrose

Glucose + Glucose Cellobiose

Glucose + Galactose Lactose

Glucose + Fructose + Galactose Raffinose



Polysaccharides

$$(C_6H_{10}O_5)_n$$

- ☐ Insoluble in water and not sweet.
- ☐ Starch, Glycogen, Cellulose, Hemicellulose, Inulin, Dextrinetc

Types of polysaccharides

- (a) Structural polysaccharide: Cellulose, Pectic acidetc.
- (b) Stored polysaccharide: Starch, Glycogen.



Polysaccharide: Starch

 $(C_6H_{10}O_5)_n$

Starch is of two types.

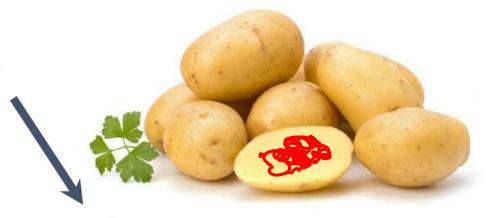
Such as-

- a) amylose and
- b) amylopectin.
- ☐ Almost 78/75-80% of molecular weight of starch is amylopectin and 22/20-25% is amylose.
- ☐ Amylose is made of 200-1,000 glucose molecules.
- ☐ 2,000-2,00,000 glucose molecules constitute amylopectin
- ☐ Largest starch particle- Potato.
- ☐ Smallest starch particle- Rice.



Polysaccharide: Starch

 $(C_6H_{10}O_5)_n$



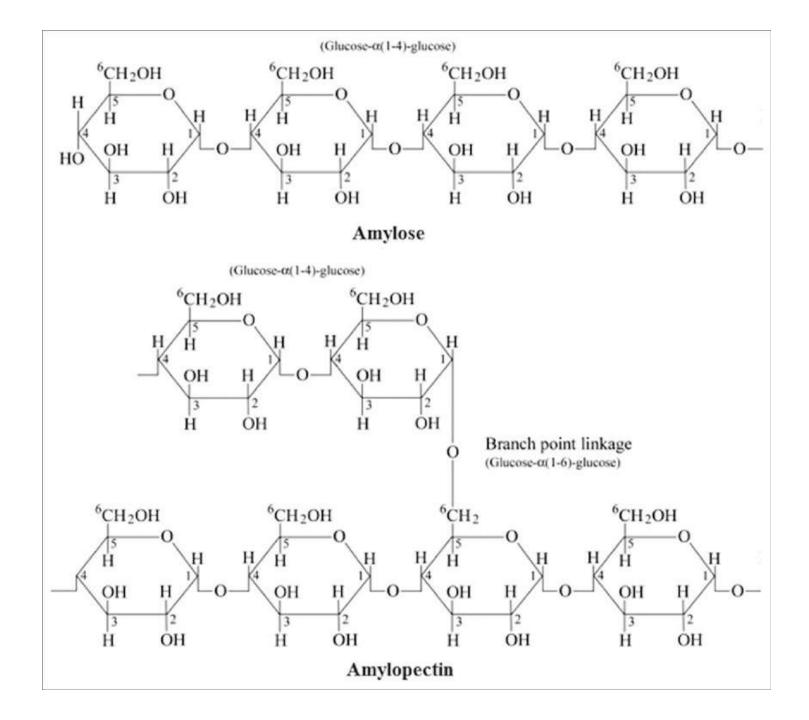
Amylose

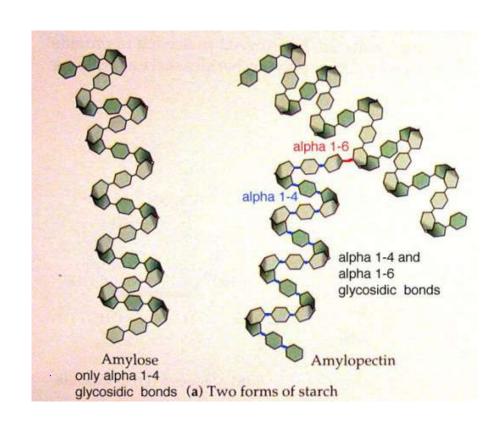
- Glucose-1,4- Linkage
- · No chain but no branch
- 22% of starch
- blue color in iodine solution

Amylopectin

- Glucose-1,4-1,6-linkage
- · Chained, branched
- 78% of starch
- Red color in iodine solution purple







Polysaccharide: Starch

- ☐ It is odorless, colorless and tasteless, white soft non-granular powder-like organic substance.
- They are soluble in water, ether and alcohol in normal temperature.
- They form blue color in iodine solution.



- ✓ Most of the glucose produced in photosynthesis is transformed to starch.
- ✓ Starch is preserved as stored food in plants.
- ✓ Staple food of animal kingdom and humans is starch. Rice, wheat, maize, potato, barley etc. has 70-80% starch.



Polysaccharide: Cellulose

- ☐ It is insoluble in water or common solution.
- □ Not sweet
- ☐ It does not give any color in iodine solution
- No nutrition value
- ☐ Main structural component of plants |
- ☐ Cotton has 94% linen has 90%, wood has 60%/50% cellulose.
- ☐ Grasses have 30-40% and soil with organic matter have 40-70% /70% cellulose.
- 90% of plant fibers is cellulose.





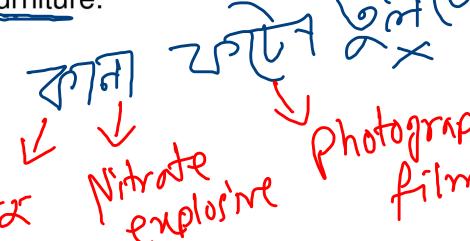


Polysaccharide: Cellulose



Use:-

- ✓ Plant cell wall is made up of cellulose.
- ✓ It is a main component of paper and garments industry. It is used to manufacture tissue and filter paper and packaging materials.
- ✓ Used as nitrate explosive.
- ✓ Used in building materials and furniture.
- ✓ Used in biotechnology.

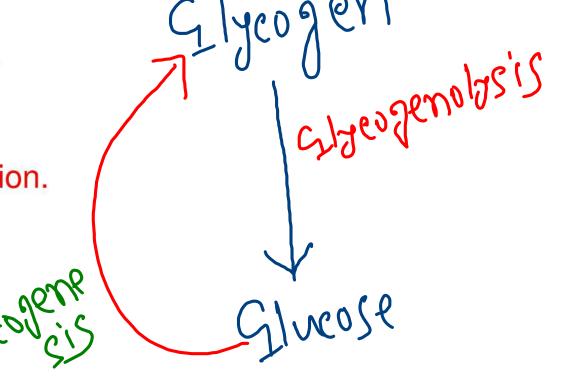




Polysaccharide: Glycogen

Each branch of glycogen has 10-20 α – D glucose units.

- ☐ It is white powder-like organic substance.
- ☐ It is easily soluble/partial soluble in water.
- Converted to glucose by glycogenolysis.
- □ Produces suspension in cold water.
- ☐ Forms reddish purple color in iodine solution.





Polysaccharide: Glycogen

USE:-

- ✓ Glycogen in muscle gives energy.
- ✓ Glycogen of liver is converted to glucose and flows in blood.
- ✓ Controls the normal level of sugar in blood.





Amino acid

- ☐ Discoverer: Scientist Emil Fischer
- □ Total more than 28 amino acids are found in plants and animals among which the number of protein amino acids is 20.)
- \square Almost all amino acids found in human body are α -amino acid
- ☐ Soluble in water
- One or more amino acids form protein by peptide bonds

Amino Acid Structure

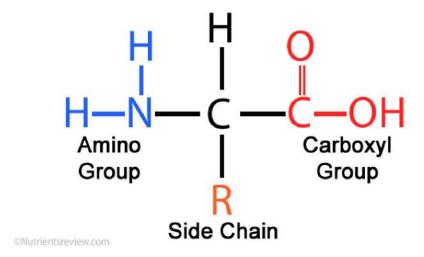


Amino acid

Functions:

- Protein synthesis.
 - Plays role in body structure.
 - synthesis of some enzymes,
- Helps in urea synthesis
- Immunity of body is increased.
- Produces melanin pigment present in hair and choracoid layer of eyes |

Amino Acid Structure





Classifications of Amino acids (protein amino

| Based on dietary importance, divided into 2 typesa | |
|--|---|
| (i) Essential amino acids | They are not synthesized inside body. Example: Leucine, Isoleucine, Lysine, Methionine, Threonine, Valine, Phenylalanine and Tryptophane (8 amino acids) Arginine and Histidine is essential for babies. So, essential amino acids for babies are 10 in number. |
| Non-essential amino acids | These can be synthesized in the body. 12 in numbers. 10 in case of babies. |



Essential Amino Acids:

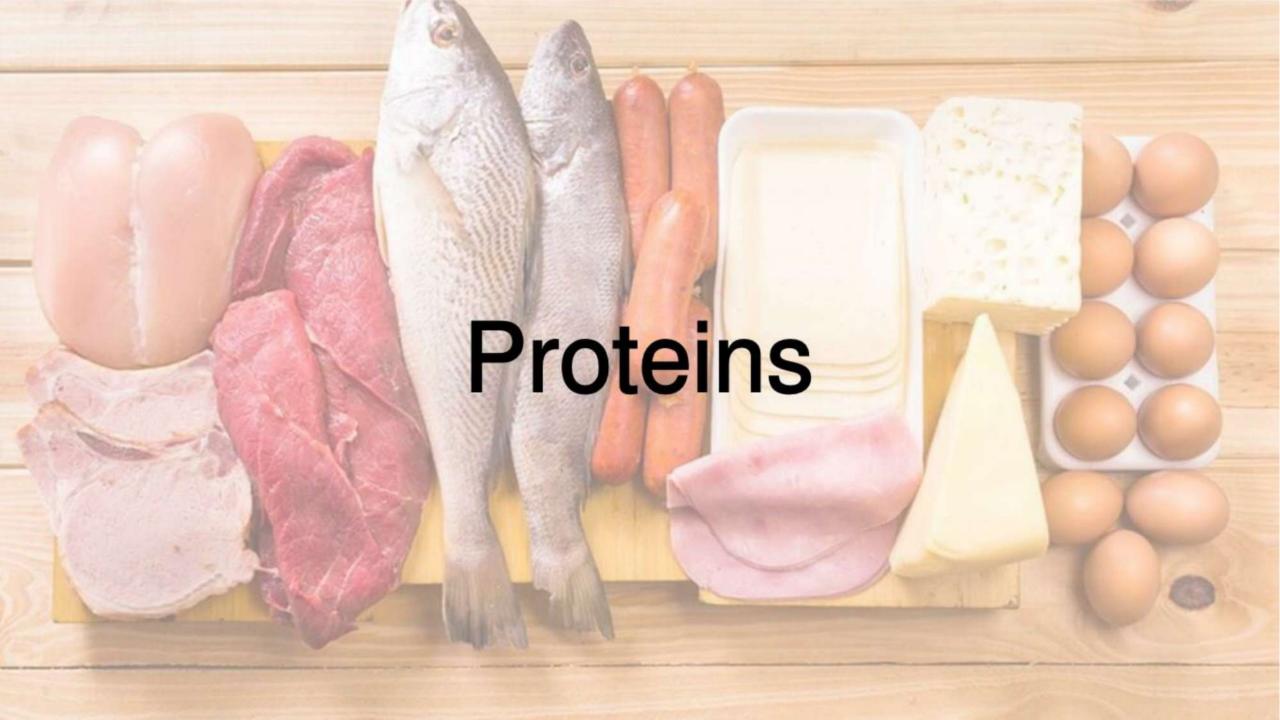
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Poll Question-02

How many amino acids are obtained from protein?

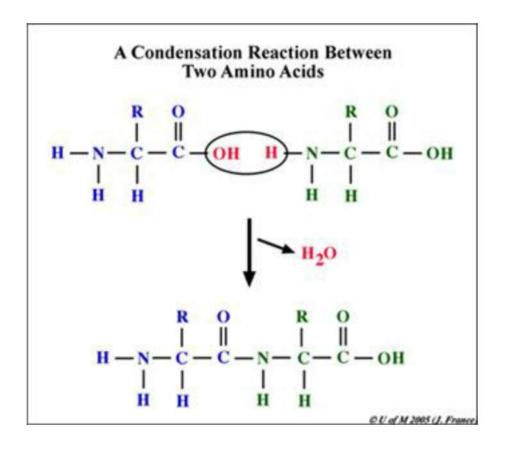
- (a) 8
- (b) 20
- (c) 26
- (d) 64





Proteins

- Naming: G. Mulder
- □ 100 or more amino acids form protein by peptide bond
- Protein is 50% of dry weight of animal body
 - Peptide: An amino acid chain bound with peptide bonds
 - Polypeptide: Must have amino acids more than 50
 - ☐ Smallest protein (insulin) can have 75 amino acids whereas the largest protein can have 40,000 amin acid residues



Characteristics of Proteins

| It is composed of carbon, hydrogen and nitrogen. It also contains |
|--|
| sulphur, iron and copper. |
| Protein is colloid type |
| Many physical and chemical process can change nature of protein. |
| Protein is soluble in water |
| Amino acids are found in hydrolysis of protein. |
| Protein coagulates in presence of acid. Molecular structure is changed |
| in this process. |



Simple Proteins

| Name | Water solubility | ✓Heat Coagulation | Source |
|----------|------------------|-------------------|---|
| Albumin | + | + | Albumin in egg white, lactalbumin in millk, Mosel el blood serum (plasma) |
| Globulin | - | + | Egg yolk, serum globulin (blood plasma), muscle (myosin globulin). |
| Histone | + | - | More seen in nucleus and nucleic acid. |



Simple Proteins

| Name | Water Solubility | Heat Coagulation | Maize Source Barley |
|------------------------------|------------------|---------------------|---|
| Prolamine | - | - | Zein, Glicden, Hordein |
| Protamine (Smallets protein) | + | - | Sperm of Samon fish -> Samon Clup |
| Glutelin | - | - | wheat, rice > Orgzenin |
| Scleroprotein | - | - | Collagen of bone and skin, keratin of nail, skin etc. and tenon of bone |



Conjugated Proteins

| Has a non-protein part (prosthetic group). | | | |
|--|--|--|--|
| Classification | | | |
| (i) Nucleoprotein | Found in chromosome. | | |
| (ii) Glycoprotein/mucoprotein | Found in cell membrane. | | |
| (iii) Lipoprotein | Plasma protein of human blood. | | |
| (iv) Chromoprotein | Cytochrome, biliprotein, carotenoid, chlorophyll, hemoglobin. | | |
| (v) Metalloprotein | • Has Fe, Mg, Mn, Zn etc; this type of protein is seen in siderophilin and celoplasimin. | | |
| (vi) Phosphoprotein | Found in caesinogen of milk and vitelin of egg. | | |
| (vii) Flavoprotein | Remains attached to FAD. | | |
| | | | |



Functions of Proteins



- Proteins act as stored food in cell
 - formation of different organelles and cell membrane.
 - Regulates reaction of body as enzymes
 - Creates antibody and keeps body disease free.
 - Histone activates nuclues and nucleic acid.
 - snake venom protein
 - Hemoglobin
 - Defensive protein
 - Interferon is cellular protein.
 - Hormones required for animal body are produced. Such as insulin, STH, LTH.





Poll Question-03

Which one is the smallest simple protein?

- (a) Protamine
- (b) Prolamine
- (c) Globulin
- (d) Albumin



Poll Question-04

Which one is not a simple protein?

- (a) Albumin
- (b) Glycoprotein
- (c) Protamine
- (d) Globulin



Enzymes

Catalyst



Enzymes



- Enzyme is protein. Optimum pH: 6-9.
- These are heat labile,
- Enzyme can accelerate the rate of reaction being present in a small amount.
- Enzyme only speeds up reaction rate but doesn't change reaction equilibrium.
- Enzymes are specific in their action.
- Enzymes are only produced in living cell
- water is required for their activity.



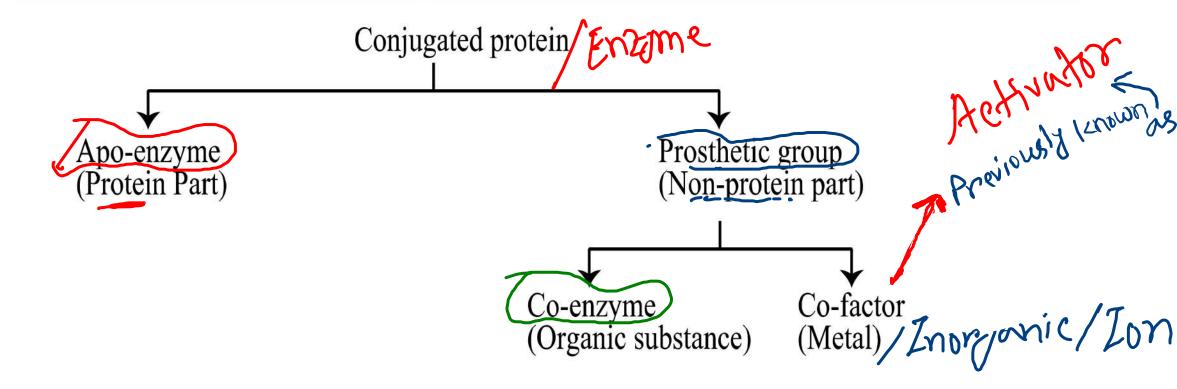
Classifications of Enzymes

(i) Simple Enzymes

(only proteins)

(ii)Conjugated Proteins

(have non protein groups)



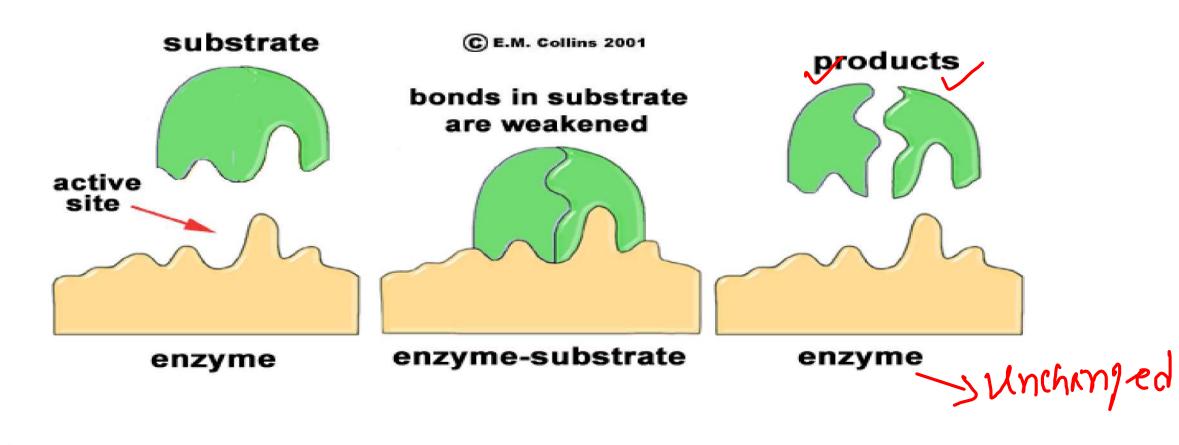


Biology 1st Paper Chapter 3 : Cell Chemistry

Mechanism of Enzyme function

1 Lock and key theory

Proponent is Emil Fischer.







Factors effecting enzyme's mechanism

Temperature

Rate of enzyme activity is the most between 35°C and 40°C This temperature is called "absolute temperature".

In case of most enzymes, favorable pH is between 6-9

Optimum pH of different enzymes are:

Pepsin → 2.0

Invertase $\rightarrow 4.5$

Cellobiase $\rightarrow 5.0$

Urease $\rightarrow 7.0$

Trypsin $\rightarrow 8.0$





Factors effecting enzyme's mechanism

☐ Metal

Mg⁺⁺, Mn⁺⁺, Co, Ni increases enzyme activity/Activitor

Ag, Zn, Cu,can decrease enzyme activity/ Inhibitor

Mater 1

☑ Concentration of substrate, enzyme and product

Activator and inhibitor can alter the reactions



Uses of enzymes

□ Cellulase

Bcellwage

- Cellulase enzyme is used in coffee processing.
- It is also used in pharmaceuticals.

- The enzyme found in yeast that ferments sugar to ethyl alcohol and carbon dioxide is called zymase.
 - Zymase enzyme extracted from yeast is used to cure maldigestion.

☐ Urobilase

Used to melt clotted blood of brain and artery.

7 Trypsin

- American ophthalmologist Dr. Joseph Spina has done operation of cataract by using trypsin.
- □ Pectin
- Removes muddy state of fruit juice.



Poll Question-05

Which one is a component of enzyme?

- (a) Lipid
- (b) Monosaccharide
- (c) Protein
- (d) Glycoprotein





Characteristics of Lipids

| Colorless, tasteless and odorless. |
|--|
| Lipid is converted to fatty acid and glycerol. |
| Insoluble in water. |
| Lighter than water, so floats on water. |
| Its melting point rises with its molecular weight. |
| Lipids that are solid at room temperature are called fat and lipids that are |
| liquid are called oil. |
| Lipid has no specific melting point. |



Classifications of Lipids

| (a) Simple lipid | Fat, oil, wax. |
|--------------------|--|
| (b) Compound lipid | Phospholipid, glycolipid, sulpholipid etc. |
| (c) Derived lipid | Steroid, terpenes, rubber etc. |



Simple Lipids

| · Two types- fats and oils. | | |
|---|--|--|
| · Stored as food in fruit and seed. | | |
| Provides energy and food for growing tree during germination of seed. | | |
| · 24-36 carbon atoms are present in one molecule of wax. | | |
| Soluble in water, made of unsaturated fatty acid. | | |
| Chemically inert; because, they have no double bonds in hydrocarbon | | |
| chain. | | |
| Simple Upio | | |
| | | |

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No×

Conjugated Lipids

Phospholipid:

- ✓ Structural component of cell membrane and membrane of other organelles.
- ✓ Acts as ion carrier.
- ✓ Phospolipid helps in blood coagulation.
- ✓ Plant oil is rich in phospholipid.
- □ Example: phosphatidic acid, lecithin, cephalin etc., plasmaly en





Conjugated Lipids

Glycolipid:

- ✓ Plays role in the formation of photosynthetic organelle.
- ✓ Helps in photosynthesis.
- ✓ Glycolipid has been detected in the seed of sunflower and cotton.
- ✓ Glycolipid is more in plant chloroplast.

Lipoprotein:

- ✓ Mainly acts as structural component of cellular organelles.
- ✓ Involved in electron transport system of mitochondria to help in production of energy.
- ✓ Mitochondria, microsome, nucleus, lamelle of chloroplast, plasma protein of human blood.



Lipid derivatives

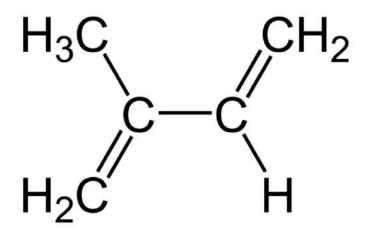


Steroid:

☐ These are isoprenoid compound 27-29 carbon atoms. .

Steroids that have one or more hydroxyl group are called sterol. Example: Cholesterol, stigmasterol, ergosterol, β sistosterol, digitalin.

- ✓ Much of the cholesterol is found in animal body.)
- ✓ But purple yum (chupri alu) has the highest amout of cholesterol.
- ✓ Ergosterol is found in yeast and Neurospora.
- ✓ Digitalin is used in the treatment of heart.d'iseose





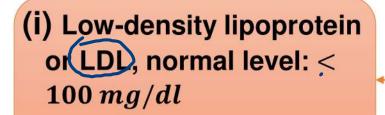
Derived Lipids

Cholesterol:

- Produced in liver.
- \square Normal level in blood is 0.15 1.20%

Importance:

- ✓ High amount of cholesterol in human blood is harmful. Possibility of heart disease (coronary thrombosis) increases if cholesterol level is high.
- ✓ Excess amount of cholesterol in blood can block the lumen of artery.
- ✓ Female has more HDL than male.
- ✓ High HDL in blood is not bad, but high LDL is very dangerous.



Two types of Cholesterol

(ii) High-density lipoprotein or HDL, normal level: > 40 mg/dl



Derived Lipids

√erpenes:

- ☐ Composed of 10-40 isoprenoid units.
- ☐ Used in barnish and production of aromatic cosmetics.
- ☐ Found In Tulsi/Holy Basil and Mint

Rubber:

- ☐ Composed of 3,000-6,000 isoprene units.
- ☐ Source: Fieus elastic is a natural rubber plants.
- Rubber is used to manufacture different rubber materials (tire).

 Hover brosilensis

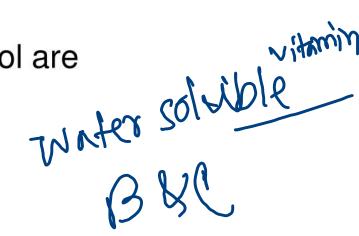






Importance of Lipids

- X
- ✓ Lipid remains as stored food in animals.
- ✓ Fat preserved under animal skin acts as heat insulator.
- Phospholipid and glycolipid are structural components of cell membrane.
- ✓ Lipid soluble vitamins are A, D, E and K. ADEK
- ✓ Some lipids such as lipoprotein, hormone and cholesterol are synthesized from lipid.
- ✓ Phospholipid also acts as an ion carrier.
- ✓ Terpene-like lipids produce aroma in plants.





Poll Question-06

Which creates fragnance in plant?

- (a) Terpinoid
- (b) Glycolipid
- (c) Triglyceride
- (d) Steroid

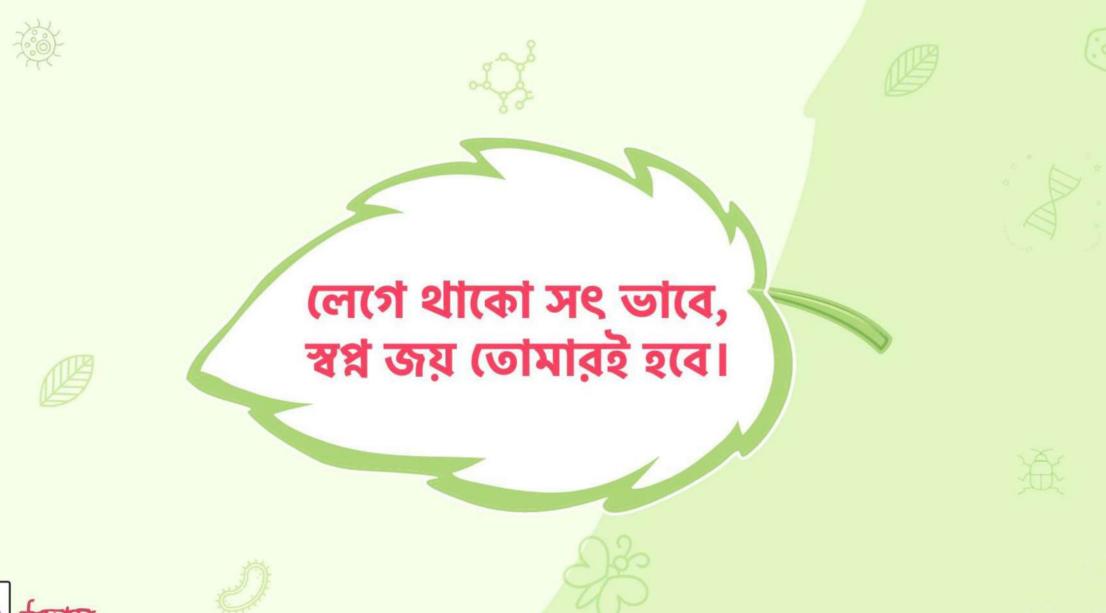


Poll Question-07

Which one is not an example of simple lipid?

- (a) Fat
- (b) Oil
- (c) Rubber
- (d) Wax







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