

EXAM 1

1. Function of hexoses.

- **Glucose: “grape sugar”**
 - is the **most important** sugar of carbohydrate:
 - Glucose is the **main sugar** in blood
 - Glucose is one of **major sources** of energy in the body.
 - In the liver and other tissues, glucose is converted to all carbohydrates in the body e.g. glycogen, galactose,
- **Galactose:**
 - It can be **converted** into **glucose** in the liver.
 - It is **synthesized** in mammary gland to make the lactose of **milk** (milk sugar)
- **Fructose: “fruit sugar”:**
 - It can be **converted** into **glucose** in the **liver**.
 - It is the **main sugar** of **semen**.
- **Mannose:**
 - A constituent of many **glycoproteins**.

2. Refsum’s disease.

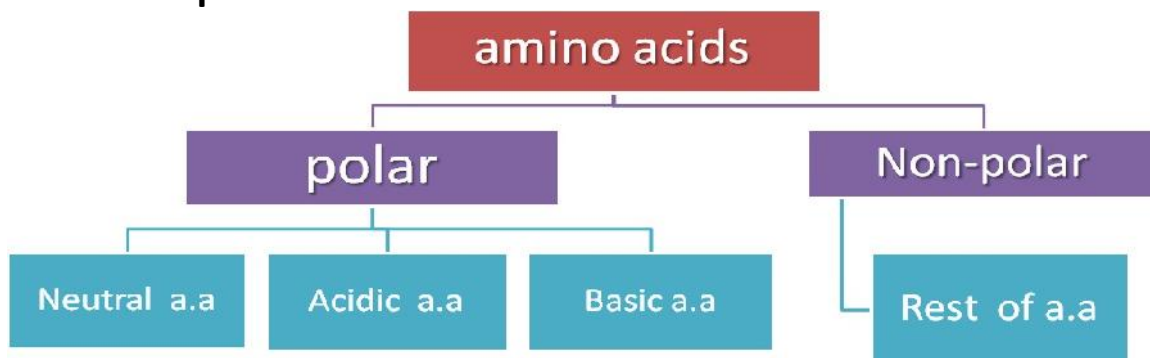
A. Phytanic acid (18C):

- Some **milk** products contain branched chain fatty acids called **Phytanic acid** it contains 4 methyl groups at position 3, 7, 11 and 15 carbons.

B. Refsum’s disease:

1. It is caused by inability of **oxidation** of Phytanic acid this leads to its accumulation in plasma and tissues.
2. Manifestations: nervous tissue damage in the form of **blindness** and **deafness**.

3. Polar and non-polar amino acids.



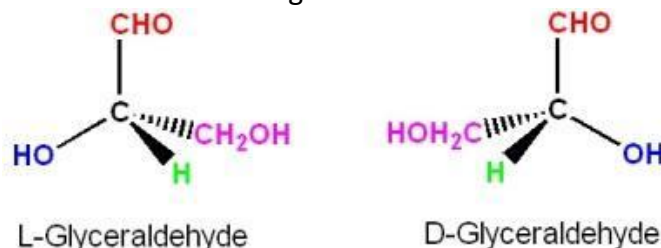
4. Optical isomerism.

Def: It is the ability of substance to present in more than one form (isomer).

- Substance containing one asymmetric carbon atom has 2 isomers.
- A substance containing 2 or more asymmetric carbon atoms can exist in a number of isomers $=2^n$ where **n** is the number of asymmetric carbon atoms.

• **What is the definition of (Configuration) (Enantiomers):**

- The simplest carbohydrate is **Glyceraldehyde** that has one asymmetric carbon atom. So it has 2 optically active forms: L and its mirror image D forms and it's called **Reference sugar**.



• **What is the definition of (Anomeric carbons & anomers):**

- **Anomeric carbon:** is the asymmetric carbon atom obtained from active carbonyl sugar group: C1 in **aldoses** and C2 in **ketoses** after cyclization.
- **Anomers:** These are isomers obtained from the change of position of hydroxyl group attached to the anomeric carbon e.g. α and β glucose are 2 anomers. Also α and β fructose are 2 anomers.

• **What is the (functional group isomerism) (Aldose-Ketose isomerism):**

- It is the type of isomer that has the same molecular formula but differs in functional group.

EX: Fructose & glucose One contains **Ketone** group (C=O) and the other contains **aldehyde** group (-CHO). Both are isomers.

• **What is the definition of (Epimers):**

- **Epimers** are isomers having more than **asymmetric carbon**, all are same except only one is different Glucose, galactose and mannose are epimers.
 - a. **Glucose & Mannose** are epimers at carbons 2.
 - b. **Glucose & Galactose** are epimers at carbons 4.

5. Eicosanoids.

A. **Definition:** These are **cyclic** compounds that derived from **arachidonic acid** (eicosatetraenoic)(20 C) after cyclization of its carbons chain to form a ring.

- Hormone like molecules produced by most mammalian cells
- Active within the cell in w' they are produced (autocrine) or on adjacent cells (paracrine)
- Have many physiological & pathological & Pharmacological actions

B. Components of eicosanoids:

1. **Prostanoids:** which comprise **prostaglandins**, **prostacyclins** and **thromboxanes**.

a) **Prostaglandins (PG)**

- 1) **PGE₂**: vasodilatation, relaxation of the uterus and intestine.
- 2) **PGF₂** : vasoconstriction, **contraction** of the uterus and intestine.

b) **prostacyclins**

- They cause **vasodilatation** and **inhibit** platelets aggregation

c) **thromboxanes**

- They **cause** platelets aggregation

2. **Leukotriens (LT):**

- a) They are present in **leucocytes**, **platelets** and **mast cells**.
- b) They cause **chemotaxis** **i.e.** Collection of white blood cells at the site of inflammation (\uparrow vascular permeability).

6. Zwitter ion & isoelectric pH.

Amphoteric properties and isoelectric point of amino acids = have both basic (-NH₂) and acidic (-COOH) groups.

- Monoamino-monocarboxylic acids present in aqueous solutions as **zwitter ion**: It is the amino acid that carries both positive and negative charges. It is electrically neutral and cannot migrate in electric field.

- **Isoelectric pH** (isoelectric point: P_i): it is the pH at which the zwitter ion is formed.

1) Each amino acid has certain pH at Which zwitter ion is formed.

2) This pH is at midway between the pK values of the carboxyl and amino groups.

3) Example: alanine

i- In strongly acidic pH (at pH zero) alanine is present mainly in the form of positively charged molecule. Its pK (P_{K1}) = 2.34

ii- By adding NaOH, the carboxyl group loses its proton (H⁺) and alanine carries both positive and negative charges (zwitter ion).

iii- By adding more NaOH, the solution becomes strongly alkaline, and (-NH₃) group will lose its proton and alanine will become negatively charged. Its pK (P_{K2}) = 9.69.

$$\begin{aligned} \text{PI for alanine} &= \frac{pK_1 + pK_2}{2} \\ &= \frac{2.34 + 9.69}{2} = 6.105 \end{aligned}$$

7. Compare between (Sugar derivatives).

1- **Sugar acids**: are produced by oxidation of **carbonyl carbon**, **last carbon** or **both**.

1. **Aldonic acids**: oxidation of **carbonyl carbon** to **carboxylic** group gives **Aldonic acid** e.g. glucose is oxidized to gluconic acid.

2. **Uronic acids**: oxidation of **last hydroxyl carbon** gives **uronic acid** e.g. glucose is oxidized to glucuronic acid.

3. **Aldaric acids**: These are **dicarboxylic** acids produced by oxidation of **both** carbonyl carbon and last hydroxyl carbon e.g. glucose is oxidized to glucaric acid (saccharic acid).

2- **Sugar alcohols**: Monosaccharides, both aldoses and ketoses may be reduced at **carbonyl carbon**, to the corresponding **alcohol**:

Sugar	Sugar alcohols	Function
Glucose	sorbitol	
Mannose	Mannitol	
galactose	Dulcitol	
Glyceraldehyde dihydroxyacetone	glycerol	Structure of Triacylglycerol (TAG) & phospholipid
Ribose	ribitol	Structure of riboflavin (vitamin B2)
Inositol	myoinositol	Structure of phospholipid It acts as precursor of 2 nd messenger
Fructose	mannitol and sorbitol	

3- Deoxysugars:

1. Are sugars in which one of the **hydroxyl groups** has been **replaced** by hydrogen atom i.e. one oxygen is missed.
2. Occurring in nucleic acid DNA.
3. **L-Fucose** (6-deoxyL-galactose)(methyl pentose): enters in glycoproteins & and BL.group AG.

4- Amino sugars: in these sugars, the **hydroxyl** group attached to **C2** is replaced by an **amino** or an **acetylamino** group.

- 1) Amino sugars are constituents of **glycoproteins**, **gangliosides** and **glycosaminoglycans**.

2) Examples:

- a) **Glucosamine**: It enters in **heparin** and **hyaluronic acid**.
- b) **Galactosamine**: It enters in **chondroitin sulphate**.
- c) **Mannosamine**: It enters in **neuraminic** and **sialic acids**.

5- Amino sugar acids:

1. Formed by addition of **amino sugars** and **some acids**.

2. Examples:

- 1- **Neuraminic acid** = Mannosamine + pyruvic acid.
- 2- **Sialic acid** or **N-acetylneuraminic acid** (NANA) = Neuraminic acid + acetate.
3. Enter in structure of **glycoproteins** & **glycolipids**.

N.B: hydrolytic products of (NANA): Mannosamine + pyruvic acid + acetic acid

6- Glycosidic bond and glycosides:

- A. **Glycosidic bond**: It is the bond between a **carbohydrate** and another Compound to form a **complex carbohydrate**.

1. This bond is between the **hydroxyl** group of **anomeric** carbon of monosaccharide (carbon 1 in aldoses or carbon 2 in ketoses) and another compound which may be:

- a) **Another monosaccharide** to form **disaccharide** glycosides as maltose, lactose and sucrose.
- b) **Aglycone** i.e. non-carbohydrate to form **glycoside**.

2. N and O-glycosides:

- a) If the monosaccharide is attached to — OH group of another sugar or aglycone, the resulting structure is an **O-glycoside** and the bond is called: acetal link.
- b) If the monosaccharide is attached to — NH₂ of aglycone, the resulting structure is N-glycoside.
- c) All **sugar-sugar glycosidic bonds** are **O-type** linkage. If the first sugar is glucose, the resulting compound is **glucoside**, if galactose, a **Galactoside** and so on.

B. Examples of glycosides:

1. **Disaccharides**: discussed later.
2. **Sugar nucleotide** as **ATP**, **GTP** and **other nucleotides**: aglycone here is purines And pyrimidines.
3. **Glycolipids**: as cerebrosides.
4. **Glycoproteins**.
5. **Cardiac glycosides**:
 - a) Aglycone here is steroid.
 - b) Cardiac glycosides such as digitalis are important in medicine Because of their action on heart.

8. Rancidity.

- **Definition:** It is a toxic reaction of triacylglycerols. It is due to oxidation of its unsaturated fatty acids content by oxygen of the air, bacteria or moisture, It leads to unpleasant odor or taste of oils and fats.
- **Types of rancidity:**
 - a. Oxidative rancidity: Fatty acids are oxidized at double bonds giving peroxide.
 - b. Ketonc rancidity: produces aldehyde and ketone with characteristic taste.
 - c. Hydrolytic rancidity: triacylglycerols are hydrolyzed by bacterial enzymes into glycerol and fatty acids. The free fatty acids can then undergo further auto-oxidation with free radicals.
- **Enhancement of rancidity:** This can be done by certain substances as:
 - a) Free radicals as reactive oxygen species.
 - b) Lead or copper.
 - c) Heme compounds.
 - d) **The enzyme:** lipoxygenase found in platelet.
- 4. Detection of rancidity:** By **copper acetate** test that detects the free hydrolyzed fatty acids.
- 5. Prevention of rancidity:** The addition of antioxidant delays or prevents the process of rancidity, Examples of antioxidants are:
 - a) Vitamins: as vitamins E "**tocopherol**" and C "**ascorbic acid**".
 - b) Substances containing -SH group, e.g. cysteine amino acid.
 - c) Avoidance of oxygen of the air, bacteria or moisture.

9. Biologically active peptide (enumerate & discuss one of them).

A. **Glutathione:**

- **Definition:** it is a **Tripeptide** formed of three amino acids: glutamate cysteine and glycine. It is also called "**glutamyl-cysteinyl-glycine**".
- Glutathione is commonly **abbreviated** as **G-SH** where -SH indicates the sulfhydryl group of cysteine and it is the most active part of the molecule.
- **Functions of glutathione:**
 - 1- Defense mechanism** against certain toxic compounds (Detoxification).
 - 2-Absorption of amino acid:** glutathione has a role in transport of amino acids across intestinal cell membrane.
 - 3- Protect against cell damage and hemolysis of RBCs:** Glutathione breakdown the hydrogen peroxide (H_2O_2) which causes cell damage and hemolysis.
 - 4- Activation of some enzymes.**
 - 5- Inactivation of insulin hormone.**

B. **Hormones**

- 1. Insulin** and **glucagon** from Pancreas.
- 2. Vasopressin** and **oxytocin** from posterior pituitary gland.

C. **β -Lipotropin:**

- Is polypeptide produced by anterior pituitary.
- Is the precursor of **β -endorphin**.
- **β -endorphin** acts as neurotransmitter and neuromodulator.
- It has **analgesic effect** powerful **18-30** times than morphine.

D. **Bradykinin:**

E. **Atrial natriuretic peptide:**

- 1.** It is a peptide produced by specialized cells in the **heart** and **nervous tissue**.
- 2.** It stimulates the production of **dilute urine** (opposite to vasopressin).

10. Compare between (Amylopectin & glycogen).

AMYLOPECTIN	GLYCOGEN
<ul style="list-style-type: none"> - Outer layer of starch - Constitutes 80-85% of the granule and formed of branched chain. - Each chain is composed of 24-30 glucose units linked together by α 1 - 4 glycosidic bond and α 1 - 6 glycosidic bond at branching points. - Gives red color with iodine. 	<ul style="list-style-type: none"> - Animal starch - Highly branched chain - Each branch is composed of 12-14 glucose units. - Gives reddish violet color with iodine.

11. Gaucher's disease.

Cerebrosides:

- **Structure:**
 - Formed of **ceramide** + \rightarrow **Glucose (glucocerebroside).**
 - \rightarrow **Galactose (galactocerebroside).**
 - \rightarrow **Cerebronic OR Nervonic**
 - FA contain **24** carbons
- **Functions:**
 - 1- Cerebrosides are present in many tissues especially in the brain and myelin of nerve fibers.
 - 2- They act as insulators of nerve impulse.
- **Gaucher's disease:**
 - **Def:** Accumulation of cerebrosides (sphingolipids) in phagocytes due to deficiency of " **β glucocerebrosidase**" enzyme.
 - **Manifestations:** mental retardation, hepatomegally and bone disorder.

12. Peptide bond.

- **Definition:** It is a covalent bond formed between the carboxyl group of one amino acid and the amino group of another.
- **Mechanism:**
 - it is formed by removal of water.
 - Peptide formation needs energy getting from hydrolysis of ATP
- **Characters:**
 - Peptide bond is semi-rigid bond i.e. no free rotation can occur around bond axis.

13. Compare between (Hyaluronic acid & Heparin).

Type	Structure	Site	Functions
Hyaluronic acid	Glucuronic acid.	- Cartilage.	- Lubricant in joints.
		- Synovial fluid.	- Makes cartilage Compressible .
	N-acetyl glucosamine NO Sulfate.	- Connective tissue.	- Cell migration during Wound repair .
		- Vitreous humor of the eye.	- Cell migration during Morphogenesis .
Heparin	Induronic acid with sulfate on C ₂ .	- Mast cells (intracellular compound) in the wall of blood vessels.	- Anticoagulant.
	Glucosamine with sulfate on C ₂ and C ₆ .		

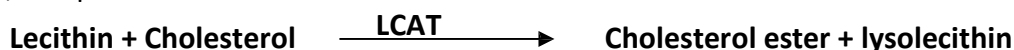
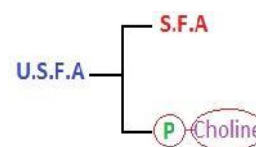
14. Phosphatidyl Choline.

Lecithin (Phosphatidyl Choline):

- **Structure:** Formed of **phosphatidic acid** + **Choline**.

- **Functions:**

- Enters in the structure of **cell membrane**.
- Acts as **lipotropic** factor. I.e. prevent fatty liver.
- Forms cholesterol ester, Cholesterol esters are transported to the liver, and excreted with bile, this prevent **atherosclerosis**.



- Lecithin acts as body store of **Choline**. Choline is important for:

- i- **Nerve transmission.**

- ii- **Transmethylation:** It acts as methyl donor

- **Dipalmityl lecithin** (i.e. lecithin which contains 2 palmitic acid residues) Act as a **surfactant in lung**

- Dipalmityl lecithin is continuously secreted by the lung cells in the alveolar wall, forming a monolayer over the watery surface of the alveolus and so lowers the surface tension this helps expiration and inspiration
- **During expiration**, the surfactant becomes solid under pressure. This prevents the adherence of alveolar wall.
- **During inspiration**, The surfactant makes the lung easier to expand.

- ❖ **Respiratory distress syndrome** (hyaline membrane disease):

- In premature babies, lungs **do not** secrete enough surfactant. This leads to lung collapse and death from respiratory failure.
- **Treatment** of this case needs putting the premature babies in incubator and administration of surfactant locally in the lung.

15. Lipoproteins.

Def: These are complex lipids formed of lipids conjugated with protein.

Site: They are present in c.m, mitochondria and plasma (plasma lipoproteins).

Function: Plasma lipoproteins convert water **insoluble** lipids into water **soluble** complexes. This facilitates transport of lipids between blood and different tissues.

FRACTION	SOURCE	MAIN LIPID	ptn Amount	Types
chylomicrons	Intestine	TG	2%	A, B ₄₈ , C & E.
VLDL	Liver	TG	12%	B ₁₀₀ , C & E
LDL	Blood from chylomicrons and VLDL	Cholesterol, esters and phospholipids	22%	B ₁₀₀
HDL	Liver	Cholesterol, esters and phospholipids	50%	A, C, D & E.
FFA.Albumin	Adipose tissue	FFA	99%	Albumin

16. Secondary structure of ptn (α -helix & β -pleated sheets)

- **Definition:** It is the **spatial** relationship of adjacent **amino acid residues**.
- **Bonds responsible: Hydrogen bond:** It is the bond between the hydrogen of **-NH** group of one amino acid residues and the carbonyl oxygen (**C=O**) of the fourth one
- **Mechanism:**
 1. Secondary structure results from **interaction of adjacent amino acid residues (first and fourth)**.
 3. There are **2** main forms of secondary structure **α -helix** and **β -pleated sheets**:

The α -helix	β -pleated sheets
<p>- Shape & formation: It is a rod like structure with the peptide bonds coiled tightly inside and the side chains of the residues (R) extending outward from the chain.</p> <p>- Characteristics:</p> <ol style="list-style-type: none"> 1) Each (C=O) of one amino acid is hydrogen bonded to the (-NH) of the next fourth amino acid in the chain (1\rightarrow4) 2) The complete turn distance equals 54 nm. 3) Each turn contains 3.6 amino acids residues. 	<p>- Shape & formation:</p> <ol style="list-style-type: none"> a) This structure is formed between two or more separate polypeptide chains. It may also be formed between segments of the same polypeptide chain. b) Hydrogen bond is also responsible for its formation. It occurs between (-NH) group of <u>one</u> chain (or segment) and (C=O) of group of <u>adjacent</u> chain (or segment). <p>- Two types of β-sheets are present:</p> <ol style="list-style-type: none"> 1) Parallel β-sheets: in which the two polypeptide chains run in the same direction. 2) Antiparallel β-sheets: in which the two polypeptide chains run in opposite direction.

Easy way to

Biochemistry

with

Dr. Mahmoud Ettaweel



Ettaweel Biochemistry
334 likes · 3 talking about this

Update Page Info 2 Follow

Education
صفحة طبية خاصة بمادة biochemistry للدكتور محمود الطويل ..
لوفى اى حاجه مش فاهمها اسأل وان شاء الله هتلاقى الاجابه :

334 Likes

<https://www.facebook.com/EttaweelBiochemistry1>