

HISTOPATHOLOGY - FIRST COURSE

LAB -15- CARBOHYDRATES



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قسم تقنيات المختبرات الطبية

Third Stage

المرحلة الثالثة

محاضرة رقم 15

Lecture No. 1

الجانب العملي

Practical

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1. Title Slide

- **Main Title:** Carbohydrates
- **Subtitle:** Structure, Classification, and Biological Functions
- **Visual:** An image of a Glucose molecule or a food plate rich in carbohydrates (e.g., fruit, bread).

INTRODUCTION AND DEFINITION

- What are Carbohydrates?: Organic compounds also known as **Saccharides**. The most abundant biomolecules in nature. Named based on their general empirical formula: $C_n(H_2O)_n$ ("hydrated carbons").
- **Chemical Definition**: Polyhydroxy aldehydes or polyhydroxy ketones, or substances that yield them upon hydrolysis.
- **Primary Function** (Energy): They serve as the major and fast energy source for most living organisms.

3. Molecular Structure

•Functional Groups:

- **Aldehyde Group** : Found in Aldoses (e.g., Glucose).
- **Ketone** : Found in Ketoses (e.g., Fructose).

•Chirality:

- Contain chiral centers (asymmetric carbon atoms).
- Introduce the concept of **Stereoisomers** and their biological importance.

- **D and L Designation:**Based on the arrangement of the hydroxyl group on the most distant chiral carbon from the aldehyde/ketone group.
- The D-form is the predominant and biologically significant configuration in living systems.
- **Ring Structure (Cyclization):** Most monosaccharides exist as cyclic (ring) structures (Pyranose or Furanose) in aqueous solutions.

4. Classification of Carbohydrates

Carbohydrates are classified based on the number of monomer (simple sugar) units they contain:

A. Monosaccharides: The simplest sugar units; they cannot be hydrolyzed into smaller units.

- **Key Examples:**

- **Glucose:** The blood sugar, primary source of cellular energy.
- **Fructose:** Fruit sugar, a ketohexose.
- **Galactose:** Found in milk sugar (Lactose).

- **Nomenclature:** Classified by the number of carbons (Triose, Pentose, Hexose) and the functional group (Aldose or Ketose).

B. Disaccharides

- **Definition:** Composed of two monosaccharide units linked by a **Glycosidic Bond.**

- **Key Examples:**

- **Sucrose:** Glucose + Fructose (Table sugar).
- **Lactose:** Glucose + Galactose (Milk sugar).
- **Maltose:** Glucose + Glucose (Malt sugar).

C. Polysaccharides :Long chains (hundreds to thousands) of monosaccharide units.

•**Classification by Function:**

Type	Example	Structure	Function
Storage	Starch (in Plants)	Chains of Amylose and Amylopectin	Energy storage in plants.
	Glycogen (in Animals)	Highly branched chains of Glucose	Energy storage in liver and muscles.
Structural	Cellulose (in Plants) Long, unbranched chains	Long, unbranched chains (beta-linkages)	Major component of plant cell walls.
	Chitin (in Fungi, Arthropods)	Polymer of N-Acetylglucosamine (NAG)	Main component of exoskeletons.

5. Biological Functions of Carbohydrates

•1. Primary Energy Source:

- Broken down via glycolysis and the Krebs cycle to produce ATP.

•2. Energy Storage:

- Stored as Glycogen (animals) and Starch (plants).

•3. Structural Support:

- Cellulose (plant cell walls) and Chitin (arthropod exoskeletons).

4. Cell Recognition and Communication: Sugar components of Glycoproteins and Glycolipids on the cell surface are crucial for cell-to-cell signaling and immunity (e.g., blood groups).

5. **Essential Components:**Part of nucleic acids (Ribose and Deoxyribose in RNA and DNA).

6. Clinical and Nutritional Significance

- Diabetes Mellitus:** Disorder of blood glucose regulation due to insulin deficiency or resistance.
- Lactose Intolerance:** Inability to digest lactose due to a deficiency of the lactase enzyme.
- Dietary Fiber:** (e.g., Cellulose) Indigestible carbohydrates vital for digestive health, gut motility, and disease prevention.

❖ Conclusion

- Brief summary highlighting the versatility and essential nature of carbohydrates in biochemistry and life.
- **Discussion Question:** How does the specific structural linkage (e.g., alpha vs. beta glycosidic bonds) influence the biological function of polysaccharides?

References

- [1] Bancroft JD, Gamble M. Theory and Practice of Histological Techniques. 7th ed. Churchill Livingstone; 2013.
- [2] Rosai J. Rosai and Ackerman's Surgical Pathology.

Any questions?

*Thank
You*