



University of Jordan
Faculty of Medicine



Medical Committee
The University of Jordan

Introduction to
BIOCHEMISTRY

Lecture #: (.....6.....)

Sheet

Slides

Other

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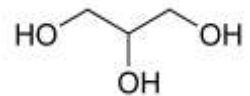
Price:

Review

- Lipids are composed of two main connected parts :
 - **Alcohol**
 - Sphingosine
 - Glycerol
 - **Fatty Acids** (3 in number)
 - Saturated
 - Long Chain
 - Medium Chain
 - Short Chain
 - Unsaturated
 - Monounsaturated
 - Polyunsaturated
- Lipids are classified into :
 - **Simple**
 - **Neutral** (Triacylglycerol)
 - Glycerol is the backbone
 - 3 hydrocarbon chains of fatty acids are attached to it
 - **Waxes**
 - **No** glycerol in their structure
 - **Long** chain of **monohydric** alcohol
 - Connected to fatty acids
 - **Compound** (Conjugated / Complex)
 - Have a lipid's structure
 - With Glycerol or Sphingosine
 - Connected to a **non-lipid** structure, some examples :
 - Sulfur
 - Phosphorus
 - Protein
 - Amino Group
 - Carbohydrate
- **Glycerol** :
 - Has 3 carbons
 - Two peripheral ones are called Alpha
 - Central one called Beta
- **Sphingosine** :
 - Serine + Any fatty acid
 - Because Serine's structure has N, it can be linked to other structures
- In Glucose, the hydroxyl group at Carbon 4 is projecting downwards, if it's projecting upwards then it's Galactose.

Acetyl : 2 Carbons

Acyl : Undefined number of Carbon



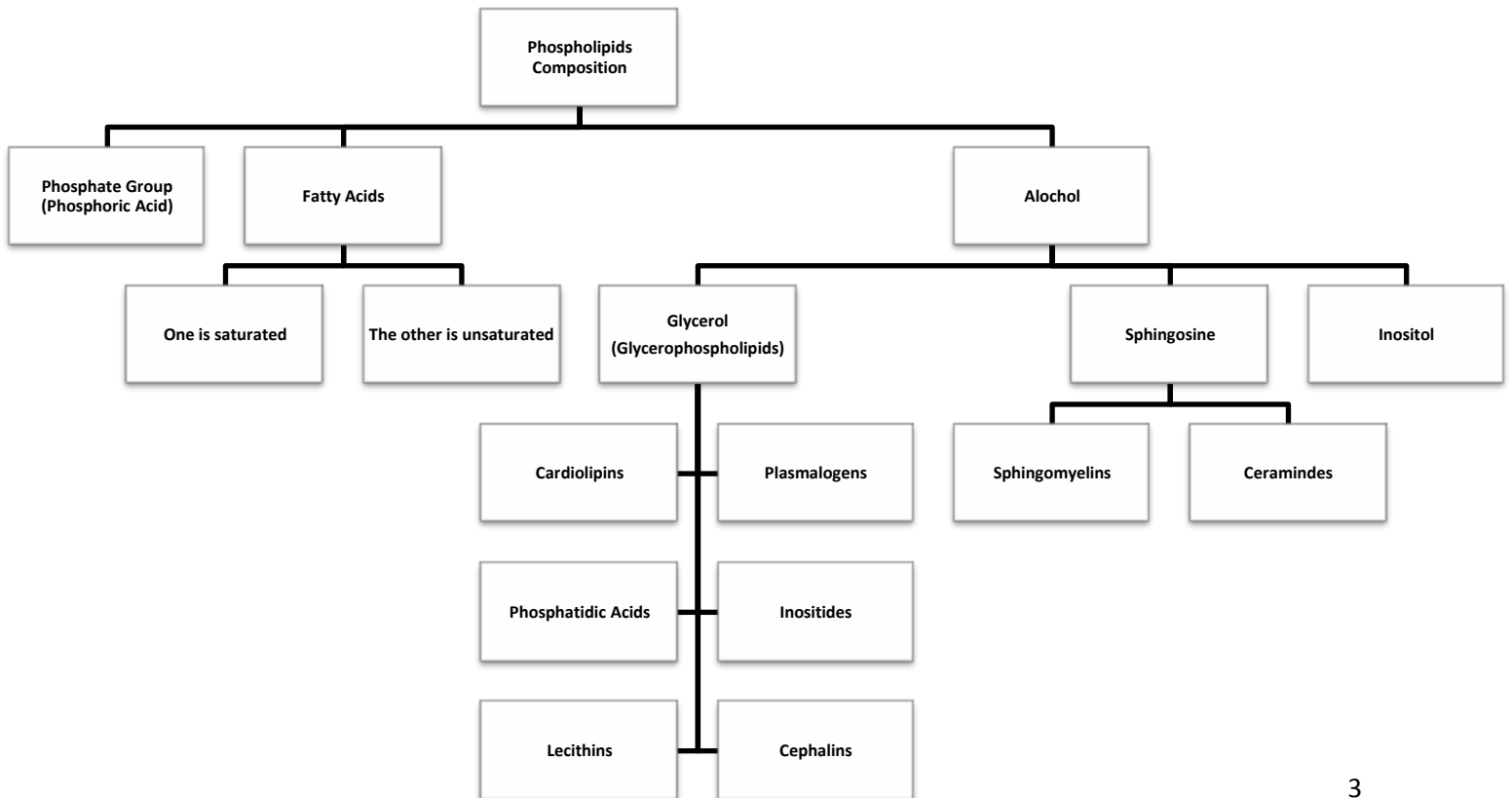
Please make sure you read the slides while reading this sheet because not everything in them was mentioned during the lecture.

Types of compound lipids

Triacylglycerols with one fatty acid removed and replaced with a non-lipid compound.

▪ Phospholipids

- Also called *Phosphatides*
- Attached to **phosphate group** (Phosphoric acid)
- **Present in :**
 - **All animal and plant cells**
 - **Major** constituent of cell membranes and sub-cellular organelles
 - Myelin sheaths covering nerves.
 - Brain
 - Liver
 - Blood
- **Importance :**
 - **Blood-clotting**
 - They help platelets aggregates when free in the bloodstream
 - **Signal Transduction**
 - It is the process of sending a message (signal) from outside of the cell to the inside or vice versa.
 - The cell membrane separates the two different environments from each other and it controls the signal transduction process.
 - **Essential fatty acids source**
 - When broken down, the two fatty acids in its structure can be essential.



- **General Structure :**
 - **Phosphate Group** (Phosphoric Acid)
 - Can be bound to a nitrogenous base.
 - Phospholipids are classified according to **the existence and type of nitrogen base they're attached to.**
 - **Fatty Acid part** (Two in number)
 - One is saturated
 - The other is unsaturated
 - **Alcohol Part** (*Phospholipids can be classified according to alcohol type*)
 - **Glycerol**
 - **Glycerophospholipids** exist in two forms depending on the carbon to which the P group is attached
 - α : Attached to *peripheral* carbon
 - β : Attached to *central* carbon
 - **Types** (*Classified according to nitrogen base attached*)
 - **Phosphatidic acids** : No nitrogen base
 - **Lecithins** : Choline nitrogen base
 - Choline's structure is **nitrogen connected to 3 methyl groups and one acetyl group.**
 - **Present in :**
 - Brain : α type
 - Egg yolk : β type
 - Liver : Both types
 - **Common Fatty Acids** : (*Review their structures from slides*)
 - Stearic
 - Palmitic
 - Oleic
 - Linoleic
 - Linolenic
 - Arachidonic
 - Involved in the structure of **lung surfactants**
 - Snake **venom** contain an enzyme *Lecithinase*.
 - The body's reaction to venom can vary between a **small allergic reaction and death** depending on strength and concentration of venom.
 - Hemolysis : Breakdown
 - $Lecithin \xrightarrow{Lecithinase} Lysolecithin$ (*RBC Hemolysis*)
 - **Cephalins** (Kephalins) : Ethanolamine / Serine / Theronine
 - Were first isolated from the brain, hence the name.
 - Found in **all** cells and membranes
 - Constituent of **Thromboplastins** which **accelerate blood clotting.**

Lung Surfactants :

- Proteins and lipids manufactured at the alveoli to cover the lung.
 - Glucocorticoids are secreted from the adrenal glands.
 - Influence the alveoli by motivating to produce these lipoprotein structures.
- Create negative pressure around the lung to help it inflate and deflate (Breathing)
- Protects the lungs by activating macrophages to kill pathogens.
- Improves gas exchange around the alveoli.
- Deficient in premature babies (RDS : *Respiratory Distress Syndrome*) because the adrenal glands aren't mature enough.

- **Plasmalogens** : Ethanolamine / Choline
 - Has **unsaturated fatty alcohol** instead of fatty acid on **carbon 1**.
 - Has unsaturated fatty acid at Carbon 2.
- **Inositides**
 - **Sugar-based** *not* nitrogenous.
 - **Second messengers** during signal transduction :
 - **IP₃ and DAG** liberate Ca⁺² from their reservoirs. (*Hormone's action on cells*)
 - Diacylglycerol is a glycerol with 2 connected fatty acids.

Phosphatidyl – inositol – 4,5 – diphosphate $\xrightarrow{\text{Phospholipase C}}$ Diacylglycerol (DAG) + Inositol Triphosphate (IP₃)

You are expected to know the locations of molecules which place is indicated by its name.

- **Cardiolipins** :
 - They have **3 molecules of glycerol** connected by phosphate groups (Each phosphate connects to the peripheral carbon and their number is 2).
 - It has **4** fatty acids.
 - First isolated in the heart, hence the name.
 - Present in **all** cells
- **Sphingosine**
 - **Sphingophospholipids**
 - **Sphingomyelins**
 - When connected to a fatty acid and two nitrogenous bases
 - Sphingosine
 - Choline
 - Present in **nerves** and most structures with nervous tissue.
 - **Ceramides**
 - When sphingosine has **one** fatty acid attached to its amino acid.
 - Present in :
 - RBCs
 - Liver
 - Spleen
- **Inositol**
 - Nothing mentioned about it

- **Glycolipids**
 - Attached to **Carbohydrate**
 - Its alcohol is **Sphingosine**
 - Palmitic acid connected to Serine but on Serine's **oxygen is a slight modification** which can be from a monosaccharide, disaccharide or polysaccharide and glycolipids are classified accordingly.
 - **Types :**
 - **Cerebrosides**
 - Has **glucose or galactose** connected to its sphingosine
 - Related to the **cerebrum**
 - Present in *huge* amounts in **nervous tissue**.
 - **Sulfatides** (Sulfated cerebrosides)
 - Cerebrosides with **sulfate** on the sugar
 - **Gangliosides**
 - **Oligosaccharide** attached to the Sphingosine
 - Galactose
 - Acetylgalactoseamine
 - Fucose
 - Glucose
 - Acetylglucoseamine
 - **ABO blood grouping** : cereberoside with oligosaccharide
- **Lipoproteins**
 - Attached to **Protein**
 - Classified according to function :
 - **Structural**
 - Present in **cell membrane** and attached to **rodopsin the retina** in the eye
 - **Transport**
 - Present in the **blood plasma**
 - They transport and **carry lipids** through blood
 - Their proteins are **Apolipoproteins**
 - Their lipids are :
 - Cholesterol
 - Triacylglycerols

- Also classified according to **density** (*Fat has a lower density than water so whenever the lipid part increases, density lessens and vice versa with protein*)
 - **Chylomicrons**
 - 2% protein (Least Dense)
 - Lipids are long in nature so Chylomicrons' diameter is large
 - The main lipid in them is triacylglycerol
 - **Very Low Density Lipoproteins (VLDL)**
 - Higher protein content
 - Smaller diameter
 - Main lipid is triacylglycerol
 - **Low Density Lipoproteins (LDL)**
 - *Protein content increases along with this classification*
 - Protein constitutes almost 20% of it
 - Main lipid is 60% cholesterol and 40% phospholipids
 - Not healthy because of their high cholesterol content
 - **High Density Proteins (HDL)**
 - Main lipid is 60% phospholipids and 40% cholesterol
 - Healthy because of their smaller cholesterol content
 - Highest density because the protein constitutes up to 50% of it
 - Functions as a cholesterol scavenger because it abstracts any extra cholesterol in the blood
 - More in females than males