

Lipids: L1

P.1

* Lipids are heterogeneous

* They contain C, H, O, They can also contain P, N, S

Common property of lipids:

1. insoluble in water
2. soluble in nonpolar solvents
3. Can be utilized
4. contain (FA) or derived from (FA)

Biomedical importance:

1. high caloric energy
2. important dietary intake (constituents) because of
 - 1. Fat soluble vitamins
 - 2. essential fatty acids
3. protective coating on the surface, around certain organs to keep them in position
4. It serves as:
 - thermal insulator: in the subcutaneous tissues
 - electrical insulator: allow rapid propagation of depolarization waves along myelinated nerves
5. As a cell surface component: they are concerned with:
 1. cell recognition
 2. tissue immunity
 3. species specificity
6. constituents of cell membrane & regulate membrane permeability
7. Fat (lipid) + Protein \rightarrow lipoprotein \rightarrow serve as transporting ~~lipids in the blood~~ lipids in the blood
8. hormones \rightarrow metabolic regulators
9. Lipid bio chemistry \rightarrow understanding many areas of interest \rightarrow
 \rightarrow Like: Obesity, atherosclerosis, the importance of polyunsaturated fatty acids

Classification:-

- تصنيف
أولي
- * Simple: (alcohol + F.A) :
 - 1. True fats: F.A + glycerol esters
 - 2. Waxes: F.A + long chain alcohol
 - * Complex: (alcohol + F.A + Group): esters
 - * Derived & associated

⇒ Alcohols :

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1. Glycerol: trihedric (contains 3 hydroxyl groups (OH))

Characteristics: 1. colorless 2. syrupy liquid
3. sweet 4. very hygroscopic

2. Sphingosine: Amino alcohol, can be phosphorylated.

Sphingosine $\xrightarrow{\text{Phosphorylated}}$ sphingosine-1-phosphate (signal molecule)

Derivatives commonly found as constituents of biological membranes

⇒ Fatty acids (F.A)

Properties: 1. Aliphatic monocarboxylic organic acids

2. Obtained mostly from hydrolysis of natural fats and oils such as: (triglycerides & phospholipids)

3. Most naturally occurring (F.A) have an EVEN number of carbon atoms from 4 to 28

Naming F.As : 3 ways

العربي : من ذرة الكربوكسيل وتأخذ رقم !
اللاتيني : من الذرة المرتبطة بذرة الكربوكسيل وتأخذ α
(ω) : من أبعد ذرة عن الكربوكسيل تأخذ (ω)

باختصار
للتوضيح
الرجاء العودة
للعناوين

Classification of (F.A):

* According to chain length:

Low (F.A): 2 - 10

Acetic acid (2C) (vinegar)

Butyric acid (4C) (butter)

Caproic acid (6C) (butter)

High (F.A): more than 10

Palmitic 16 C (Body fat)

Stearic 18 C (Body fat)

Arachidic 20 C (Peanut oil)

* Oleic 18 C (Body fat, olive oil) ω 9

* Linoleic 18 C (vegetable oil) ω 6

* α -Linolenic 18 C (vegetable oil) ω 3

* Arachidonic 20 C (vegetable oil) ω 6

* DHA 22 C (oily fish) ω 3

Note: Long-chain FA cannot cross the blood-brain barrier. Whereas free short-chain FA can cross it.

Classification of F.A

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* According to saturation :-

1. Saturated F.A (no double bond)

2. unsaturated F.A : 1. **Monounsaturated**
2. **Polyunsaturated**

Note: Double bonds in fatty acids usually have the cis-configuration which causes a kink in the chain

Note 2: Check the packing of F.A at slide 14 (**h&h, p&h**)

* Biological classification of F.A

1. Essential fatty acids : 1. They are polyunsaturated F.A
2. can not be synthesized by mammals and must be obtained from plant or fish

2. Non essential F.A : 1. These are saturated F.A or monounsaturated F.A
2. Mammals can synthesize them

3. Relatively essential F.A: can be synthesized in the body from essential F.A. So it becomes essential if its precursor is missing

⇒ Essential F.A (EFAs):

* Omega-3 and omega-6 F.A are Essential

* Best dietary sources are: **ω3** : oil rich fish (sardine, salmon, mackerel)
ω6 : vegetable oils (corn oil, sunflower oil)

* Importance of F.A : they synthesize prostaglandine, leukotrienes which regulate body function such as: blood clotting, inflammation etc.

* The Ideal ratio of $\omega6 : \omega3$ being from 3:1 to 5:1

* EFA's deficiency can result in abnormalities like: **التهاب المفاصل**

* Check point 4 and 5 at slide number 22

Fatty acids full classification:

إعداد

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Name	Saturation	Omega (ω)	essential	Found in
Acetic acid 2c	Saturated	—	non essential	vinegar
Butyric acid 4c	=	—	=	Butter
caproic acid 6c ^{↑ short}	=	—	=	Butter
Palmitic acid 16c ^{↓ long}	=	—	=	Body fat
Stearic acid 18c	=	—	=	Body Fat
Arachidic acid 20c	=	—	=	Peanut oil
Oleic acid 18c	Monounsaturated	ω9	=	Body fat, olive oil
Linoleic acid 18c	Dienoic acid	ω6	essential	vegetable oil
α-Linolenic acid 18c	Trienoic acid	ω3	essential	vegetable oil
Arachidonic acid 20c	Tetraenoic acid	ω6	Relatively essential	vegetable oil
DHA 22c	Hexaenoic acid	ω3	essential	oily fish

* DHA : Docosa-Hexa-enoic acid

* Check out the structures and the nomenclature slide 11 to slide 20

* Acetic, Butyric, caproic acids and DHA are able to cross the blood-brain barrier

⇒ Simple Lipids:

True fats (neutral fats): ^{alcohol} glycerol + ^{carboxylic acid} ^{various} fatty acid → True fat (ester)

* if all 3 OH of glycerol are esterified → triacylglycerol (TAG; TAG₃)

Physical properties (depend on fatty acids component):

1. Melting point: 1. increase as the number of carbon in the chain increase ^{علاقة طردية}

2. increases as the number of double bonds decrease ^{علاقة عكسية}

2. TAG rich in UNsaturated (cis) → liquid at room temperature → **Oils**

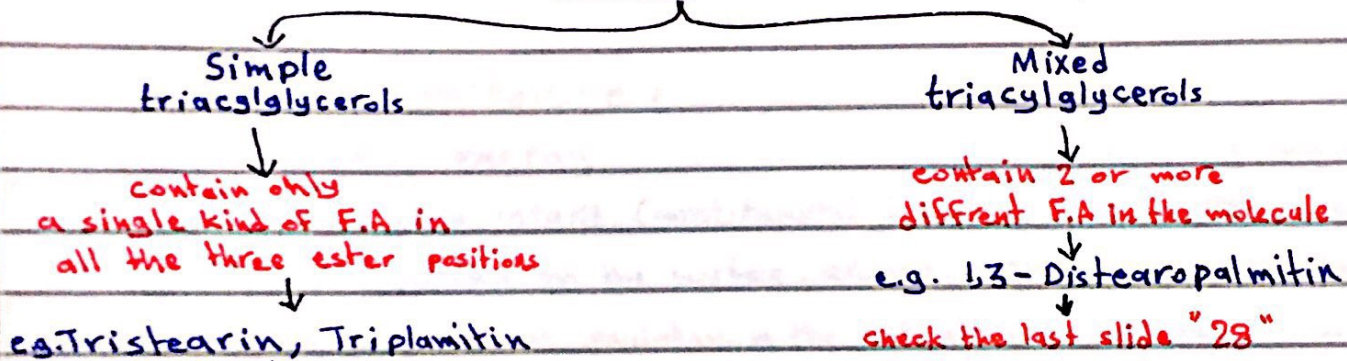
TAG rich in Saturated F.A → semisolid or solid at room temp → **Fats**

Biological importance of True fats:

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1. reserve food ^{stored at} depot fat ⁱⁿ subcutaneous tissues ^{depote} mobilized ^{fat is} during starvation ^{to} produce energy \rightarrow it's amount is variable.
That's why true fats are known as **variable element of fat**
2. Most compact form in which energy can be stored
3. Supporting material in some parts of the body **as around the Kidney**

Classification of triglycerides (TG; TAG)



Note: Palmitic, stearic and oleic are the three most abundant F.A

Lipids L.2:

Derived & associated lipids:

1. Fatty acids
2. Alcohol glycerol, sphingosine, cholesterol" Discussed earlier
3. ~~1~~ Monoacylglycerol & diacylglycerol
4. ~~1~~ Steroids
5. ~~1~~ Carotenoids
6. ~~1~~ Fat soluble vitamins (D, E, K, A)

Note: (1+2+3) are derived from simple and compound
(4+5+6) are associated with lipids. And all of them possess the **general physical characteristics of lipids**