TRIACYL GLICEROLS

Usman Sumo Friend Tambunan
Arli Aditya Parikesit

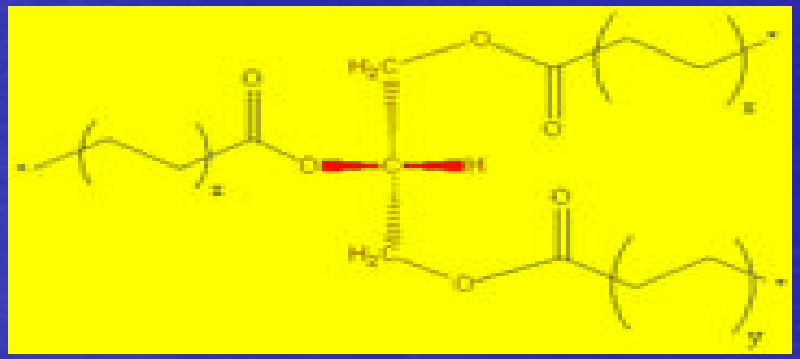
Bioinformatics Group
Department of Chemistry
Faculty of Mathematics and Science
University of Indonesa

Energy in Triacylglycerols

- *Triacylglycerols* are highly concentrated stores of metabolic energy because they are *reduced* and *anhydrous*.
- The yield from the complete oxidation of fatty acids is about 9 kcal g-1 (38 kJ g-1), in contrast with about 4 kcal g-1 (17 kJ g-1) for carbohydrates and proteins.
- The basis of this large difference in caloric yield is that fatty acids are much more reduced.

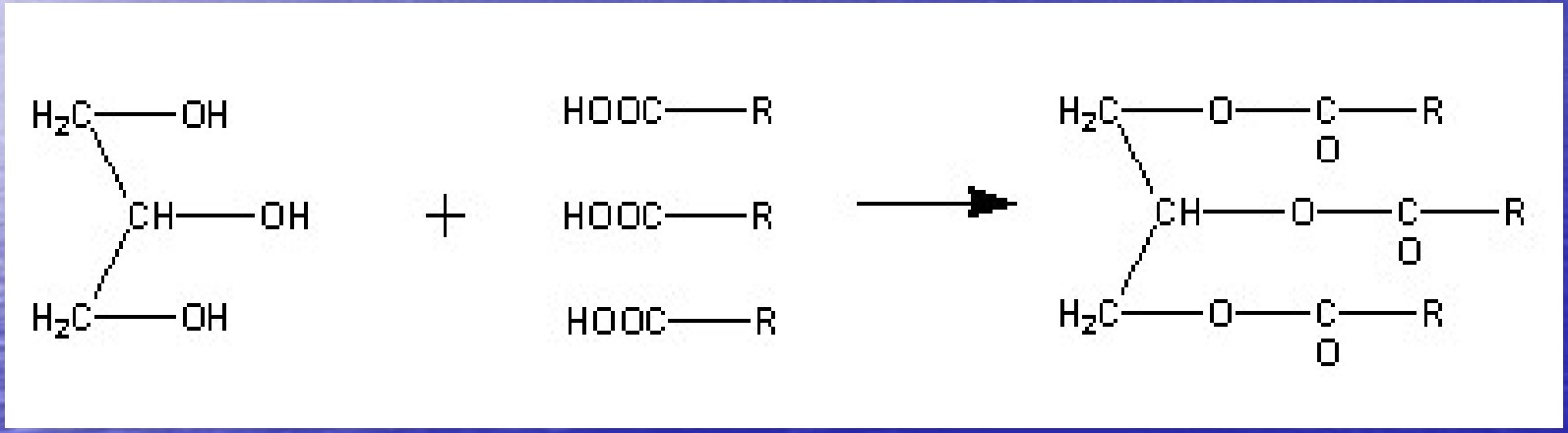
Chemical structure of Triacylglycerol

- The chemical formula is RCOO-**CH2CH**(-OOCR')**CH**2-OOCR", where R, R', and R" are longer alkyl chains. The three **fatty acids** RCOOH, R'COOH and R"COOH can be all different, all the same, or only two the same.



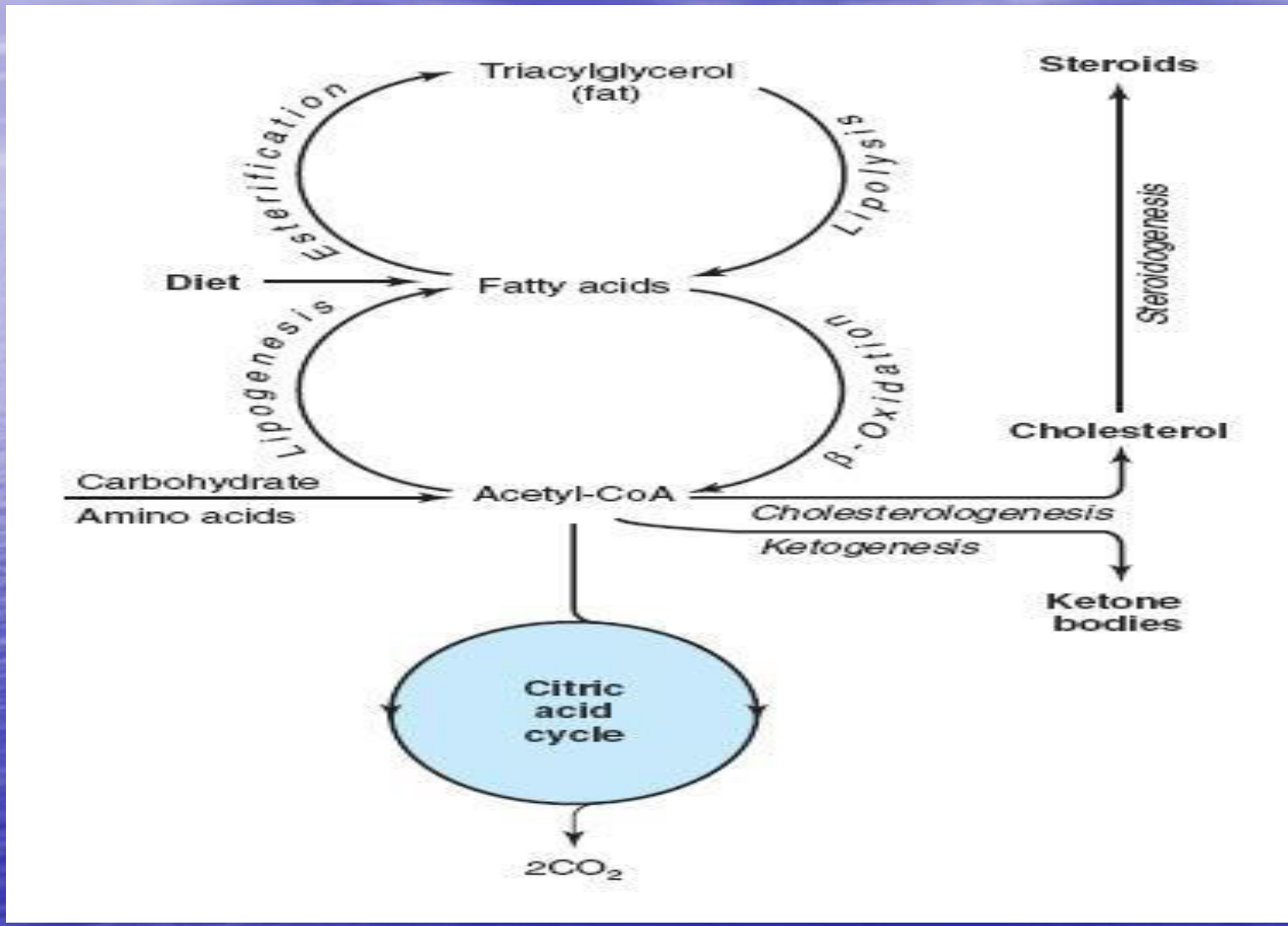
Biosynthesis of Triacylglycerol

- Esterification process



glycerol fatty acid TAG

- The major dietary lipid for human, animal and plant are *triacylglycerols*, *sterols*, and *membrane phospholipids*. Fatty acids may be oxidized to acetyl-CoA (*β-oxidation*) or esterified with glycerol, forming triacylglycerol (fat) as the body's main fuel reserve.


Triacylglycerol
(fat)
Esterification
Lipolysis
Diet
Fatty acids
Lipogenesis
β-Oxidation
Carbohydrate
Amino acids
Acetyl-CoA
Steroids
Steroidogenesis
Cholesterol
Cholesterologenesis
Ketogenesis
Ketone
bodies
Citric
acid
cycle
2CO2

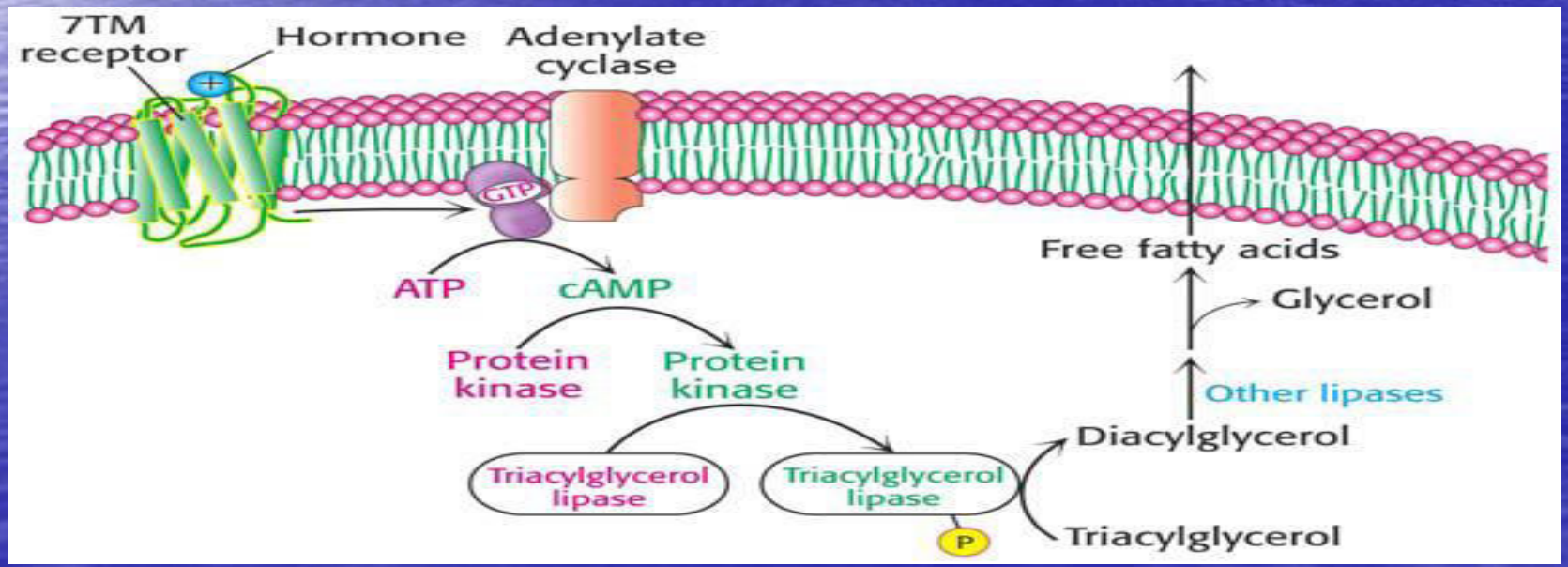
- Furthermore, triacylglycerols are nonpolar, and so they are stored in a nearly anhydrous form, whereas much more polar proteins and carbohydrates are more highly hydrated.
- The glycogen and glucose stores provide enough energy to sustain biological function for about 24 hours, whereas the triacylglycerol stores allow survival for several weeks.

- There are two distinct advantages in storing metabolic energy as fatty acids.

1. Fatty acids are mainly composed of –CH2- groups which are fully reduced. Therefore, the oxidation of these reduced carbons will yield more energy than oxidized forms of carbon.
2. Because fatty acids are lipids, they are hydrophobic. They do not need to be solvated in contrast to carbohydrates such as glycogen.

Metabolism of Triacylglycerol in Adipose tissue

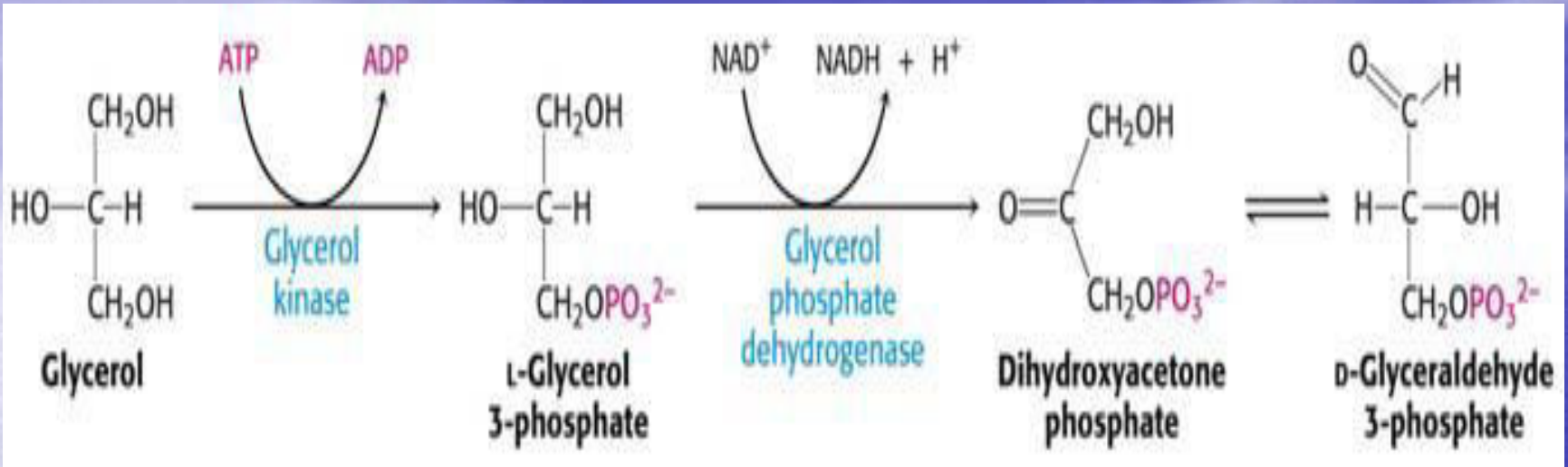
- The fatty acids stored in the adipose tissue are mobilized in response to hormone messengers such as epinephrine, norepinephrine, glucagon and adrenocorticotropic hormone.



Source of Glycerol

- The glycerol formed from lipolysis is absorbed by the liver where it is phosphorylated by glycerol kinase to glycerol-3-phosphate which is then reduced by glycerol phosphate dehydrogenase into dihydroxyacetone phosphate which can be converted into glyceraldehyde 3-phosphate by triose phosphate isomerase.

- The fate of the triose phosphate formed from glycerol can be used in both glycolytic and gluconeogenic pathways depending on the needs of the organism.



Conclusion

- So, the largest amount of biologically available energy in triacylglycerols is in the fatty acid portion, because of its chemical structure.

References

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