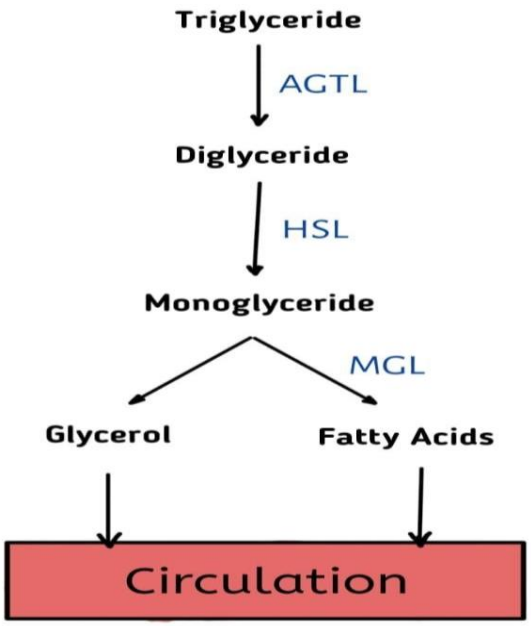
LIPID METABOLISM

- Lipid metabolism is the synthesis and degradation of lipids in cells, involving the breakdown and storage of fats for energy and the synthesis of structural and functional lipids, such as those involved in the construction of cell membranes.
- In animals, these fats are obtained from food and are synthesized by the liver.

LIPOLYSIS

- Lipolysis is a metabolic process that breaks down triacylglycerols (TAGs) into glycerol and free fatty acids (FFAs) through hydrolysis.
- It usually occurs in fat adipocytes and is used to mobilize stored energy during fasting or exercise.
- The major enzymes involved in lipolysis are adipose triglyceride lipase or ATGL, hormone-sensitive lipase or HSL, and monoglyceride lipase or MGL.



BETA OXIDATION OF FATTY ACIDS

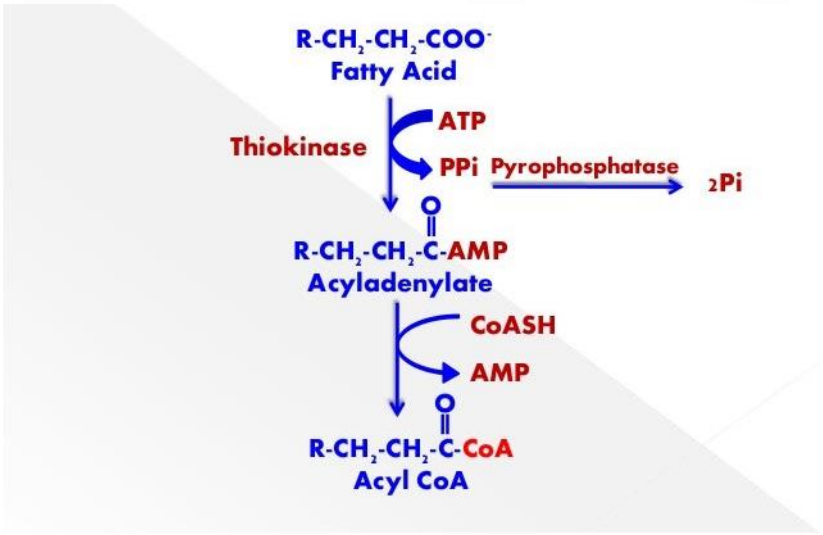
- Beta-oxidation is the catabolic process by which fatty acid molecules are broken down in the cytosol in prokaryotes and in the mitochondria in eukaryotes cell lacking mitochondria (e.g. RBC) to generate acetyl-CoA.
- Acetyl-CoA enters the citric acid cycle while NADH and FADH2, which are co-enzymes, are used in the electron transport chain.
- It is referred as "beta oxidation" because the beta carbon of the fatty acid undergoes oxidation to a carbonyl group.

Steps in beta-oxidation of fatty acids:

1. Activation of Fatty acid
2. Transport of fatty acyl coA into mitochondria
3. Beta- oxidation

Step I: Activation of fatty acid

- Fatty acid is converted to fatty acyl CoA by thiokinase or fattyacyl CoA synthetase.
- This reaction occurs in cytoplasm and activated by ATP and coenzyme A, and fatty acyl-CoA is formed. Short-chain fatty acids are activated in mitochondria.
- The ATP is converted to AMP and pyrophosphate (PPi), which is cleaved by pyrophosphatase to two inorganic phosphates (2 Pi).
- Because two high-energy phosphate bonds are cleaved, the equivalent of two molecules of ATP is used for fatty acid activation.

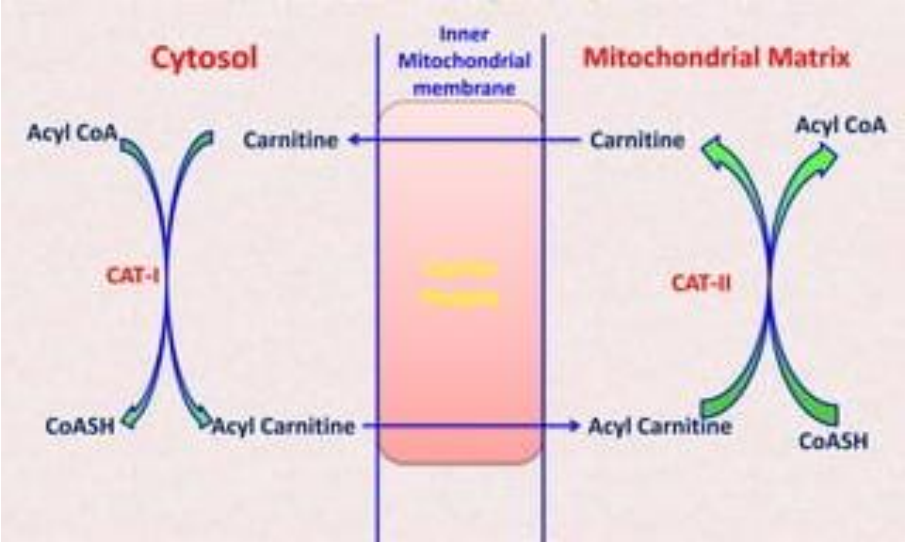


Step II: Transport of acetyl coA into mitochondria

- The inner mitochondrial membrane doesn't permit fatty acids to pass through it. The activated FA enter mitochondria through carnitine shutter.

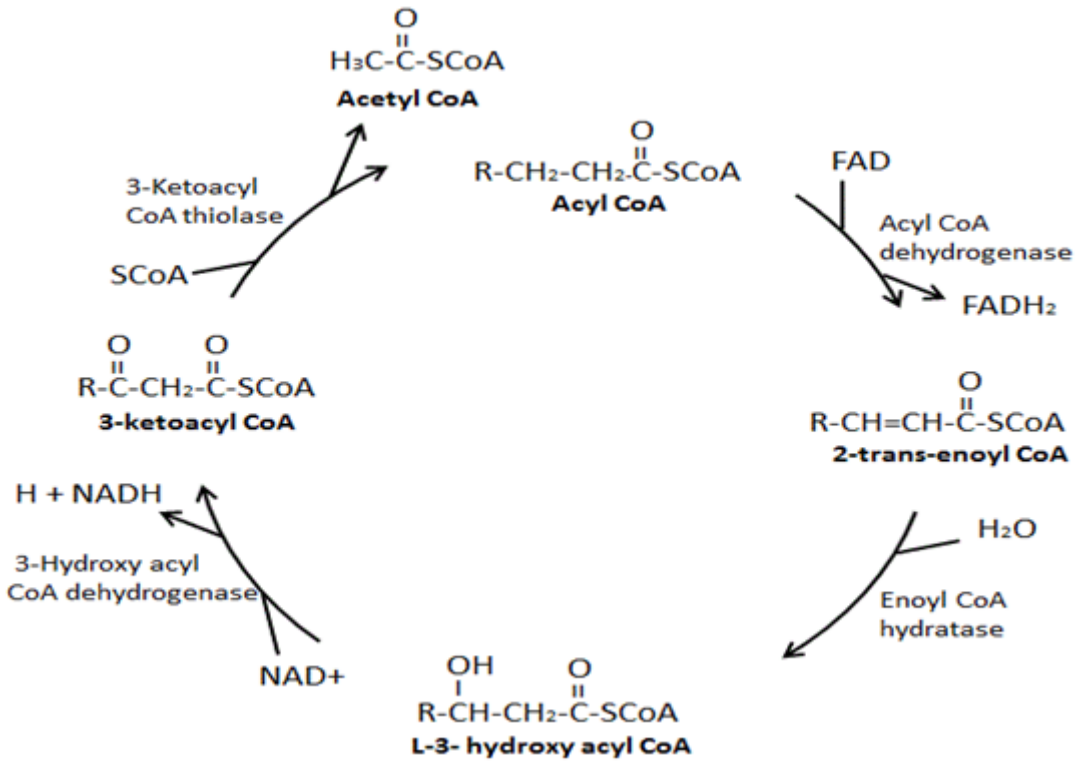
This occurs in 4 steps:

- Fatty acyl coA is transferred to carnitine to form fatty acyl carnitine.
- This is catalyzed by enzyme carnitine acyl transferase I (CAT-I) present on outer surface of mitochondria.
- Then acyl carnitine enters into matrix through carnitine shutter.
- Fatty acyl carnitine is converted into fatty acyl CoA by an enzyme carnitine acyl transferase II (CAT-II) formed in inner mitochondrial membrane.
- The carnitine is released and return to cytosol for re-use.



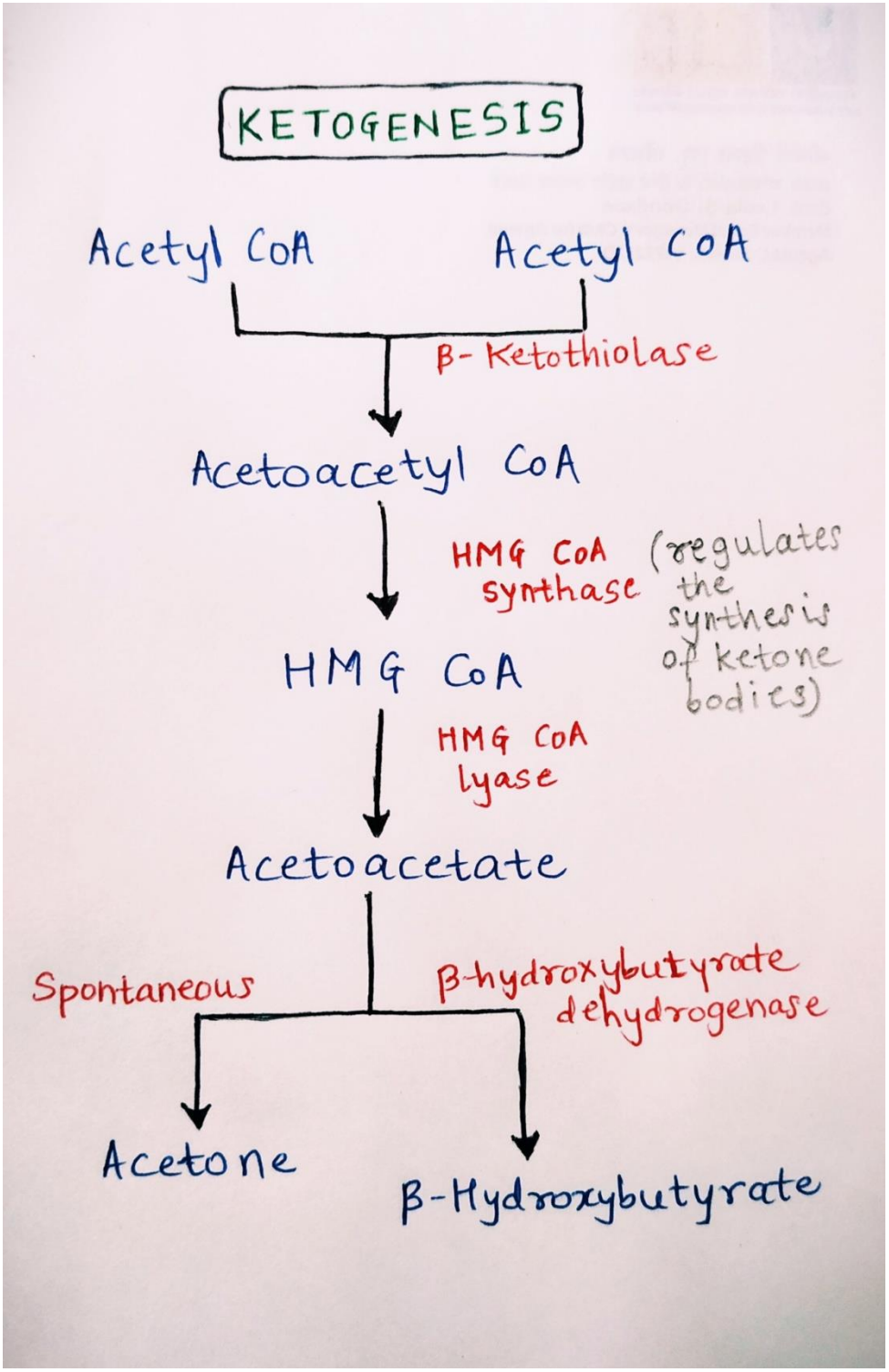
Mitochondrial Fatty Acid β-Oxidation

- Fatty acid β-oxidation is the process of breaking down a long-chain acyl-CoA molecule to acetyl-CoA molecules.
- The number of acetyl-CoA produced depends upon the carbon length of the fatty acid being oxidized.
- This process involves a variety of enzymes, with the four main enzymes involved in fatty acid β-oxidation being, in order, acyl-CoA dehydrogenase, enoyl-CoA hydratase, hydroxyacyl-CoA dehydrogenase, and ketoacyl-CoA thiolase.
- At the end of each β-oxidation cycle, two new molecules are formed, an acetyl-CoA and an acyl-CoA that is two carbons shorter. Additionally, during β-oxidation NADH and FADH2 are formed.



KETOGENESIS

- Ketogenesis is a metabolic pathway that produces ketone bodies, which provide an alternative form of energy for the body .
- The body is constantly producing small amounts of ketone bodies that can make 22 ATP each in normal circumstances, and it is regulated mainly by insulin.
- In a state of ketosis, ketone body production is increased when there are decreased carbohydrates or increased fatty acids.
- However, ketoacidosis can occur if too many ketone bodies accumulate, such as in cases of uncontrolled diabetes


KETOGENESIS
Acetyl CoA
Acetyl CoA
β-Ketothiolase
Acetoacetyl CoA
HMG CoA synthase
(regulates the synthesis of ketone bodies)
HMG CoA
HMG CoA lyase
Acetoacetate
Spontaneous
β-hydroxybutyrate dehydrogenase
Acetone
β-Hydroxybutyrate

KETOLYSIS

The catabolism of β-hydroxybutyrate (β-HB) and acetoacetate for fuel is known to contribute to the development and health of the nervous system.