Topic: TCA Cycle or Krebs cycle

B.Sc. Botany (Sub.) II

Group: C

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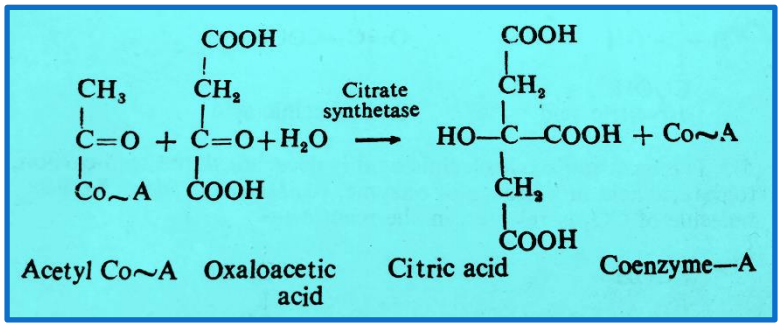
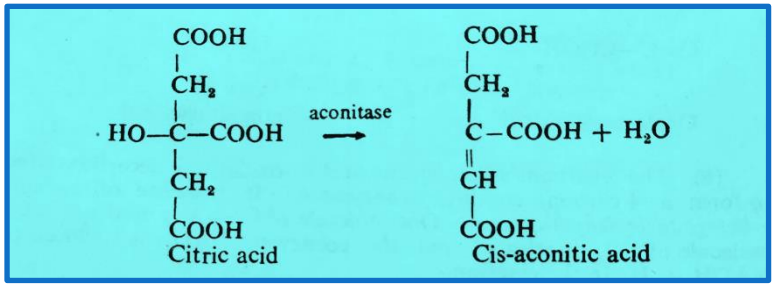
Aerobic oxidation of pyruvic acid through a series of reactions was studied in detail by Hans Krebs (1943) and hence, the pathway was termed as Krebs cycle. The Krebs cycle is also known as tricarboxylic acid cycle (TCA cycle) or citric acid cycle. Once the pyruvic acid is produced by glycolytic breakdown of glucose in the cytoplasm, it is converted to a 2 carbon acetyl CoA by decarboxylation reaction. The acetyl CoA enters into the mitochondria. Further breakdown involves a series of reactions of Krebs cycle given below-

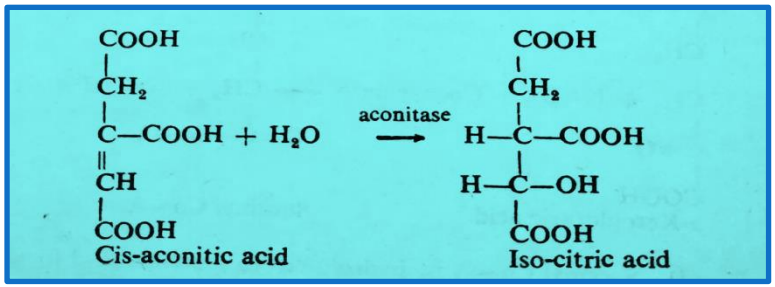
i. The 2-carbon acetyl CoA is added to a 4-carbon oxalo acetic acid to form a 6 carbon citric acid in presence of a 'condensing enzyme' citrate synthetase. The reaction utilizes one molecule of H2O and releases Coenzyme A.



ii. Citric acid is dehydrated to form cis-aconitic acid in presence of enzyme *aconitase*.

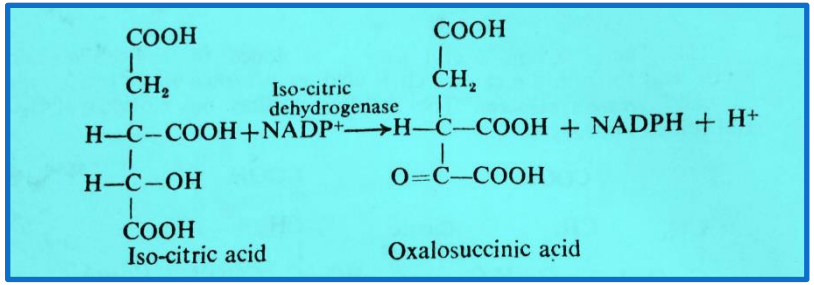


iii. Cis-aconitic acid reacts with one molecule of water to form iso-citric acid in presence of enzyme *aconitase*.

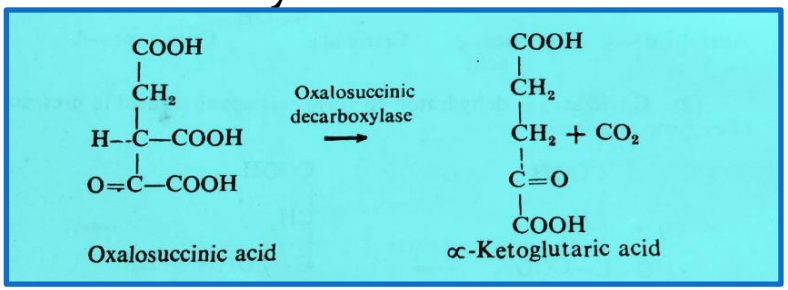


iv. Iso-citric acid is oxidized to form oxalosuccinic acid in presence of enzyme *isocitric dehydrogenase*. One molecule of $NADP^+$ is reduced to $NADPH^+ H^+$ in the reaction.

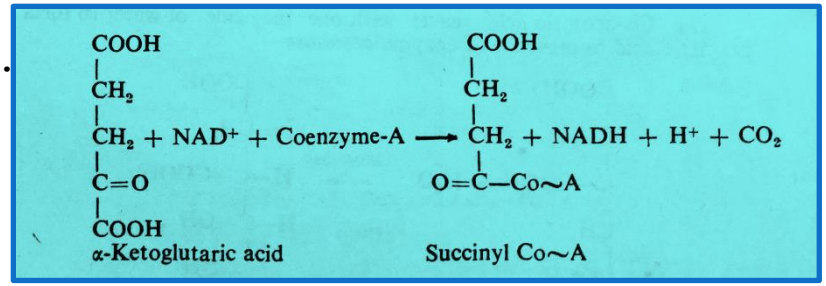
NAD^+.



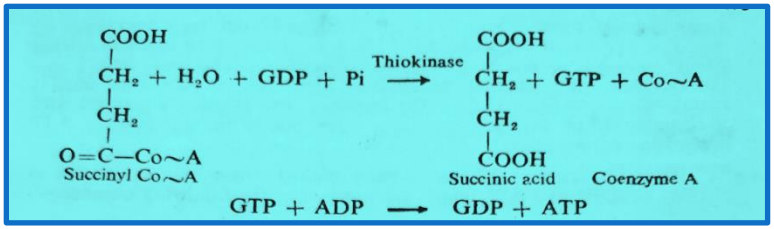
v. The 6-carbon oxalosuccinic acid is decarboxylated to 5-carbon, α-ketoglutaric acid in presence of enzyme *oxalosuccinic decarboxylase*. One molecule of CO_2 is released in the reaction.



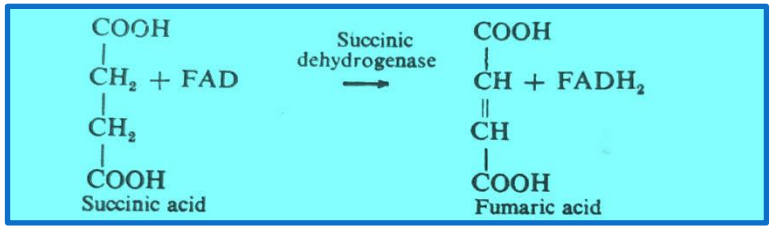
vi. The 5 carbon, α-ketogutaric acid is oxidatively decarboxylated to form a 4 carbon, succinyl coenzyme A, in presence of enzyme α-ketoglutaric dehydrogenase. One molecule of CoA is used up. One molecule of CO_2 is released and the coenzyme NAD^+ is reduced to $NADH + H^+$ in the reaction.



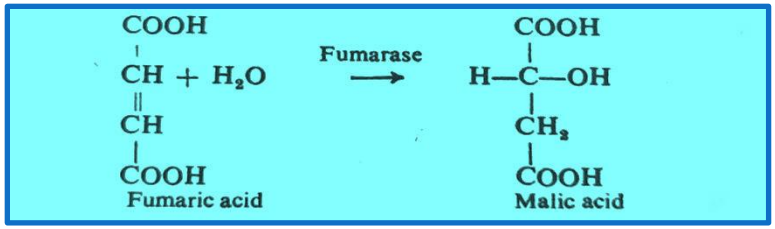
vii. Succinyl CoA is hydrolysed to succinic acid in presence of enzyme *succinic thiokinase*. One molecule of H_2O is used up and CoA is released. One molecule of GDP (guanosine diphosphate) is converted to GTP (guanosine triphosphate) in the reaction. The process is termed substrate phosphorylation. The GTP can react with ADP to form ATP plus GDP.



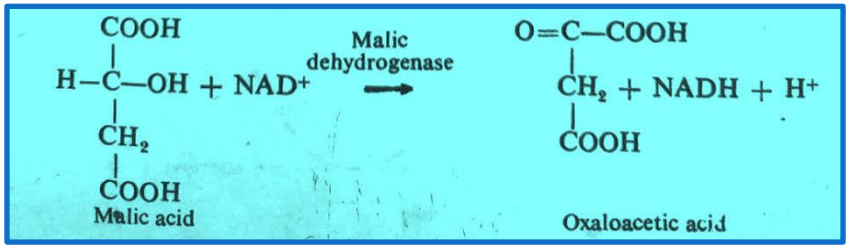
viii. Succinic acid is oxidized to fumaric acid in presence of enzyme succinic dehydrogenase. The coenzyme-FAD is reduced to FADH2 in the reaction-



ix. One molecule of H2O is added to fumaric acid to form malic acid. The reaction is catalyzed by enzyme- *fumarase*



x. Malic acid is oxidized to oxaloacetic acid in presence of enzyme –*malic dehydrogenase*. One molecule of NAD^+ is reduced to $NADH + H^+$ in the reaction



Significance of TCA cycle

- The most important role of TCA cycle is to provide energy for metabolism in plants.
- It also provides raw material for various anabolic processes.
- Respiration provides energy for the reduction of nitrate to ammonia which is further used up in the synthesis of amino acids.
- They act as the final common pathway for the oxidation of carbohydrates, lipids and proteins, since glucose, fatty acids and many amino acids are all metabolised to acetyl CoA.

- This cycle serves as the mechanism by which much of the free energy liberated during the oxidation of carbohydrate, lipids and amino acids is made available.
- TCA cycle is of further significance since it has dual or amphibolic role thus providing precursor compounds for biosynthesis of other biomolecules (amino acids, fatty acids, and glucose).

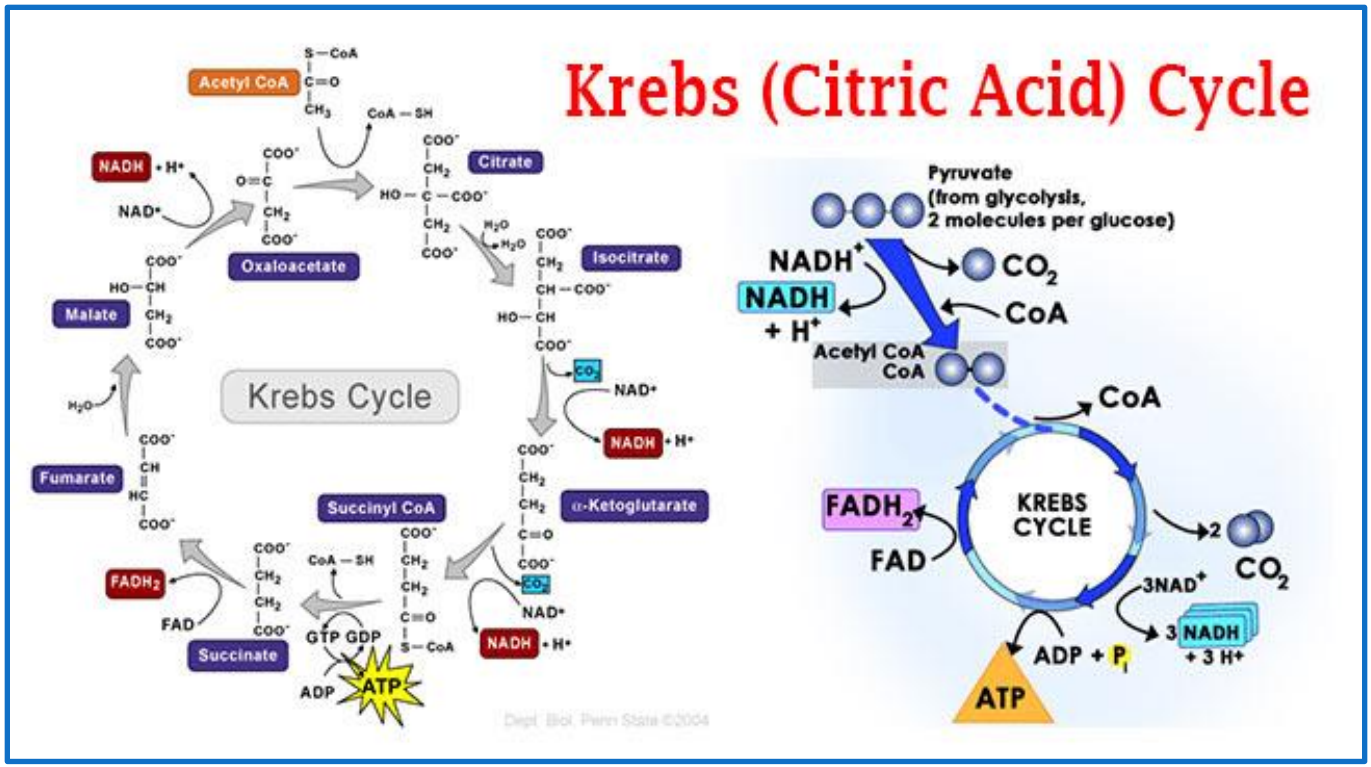


Fig. TCA Cycle (Krebs cycle)