Glyoxylate Cycle

Vertebrates cannot convert fatty acids or the acetate derived from them, to carbohydrates. Conversion of phosphoenol pyruvate to pyruvate and of pyruvate to acetyl Co-A is so, exergonic as to be essentially irreversible. If a cell cannot convert acetate into phosphoenol pyruvate, acetate cannot serve as the starting material for the gluconeogenic pathway, which leads from phosphoenol pyruvate to glucose.

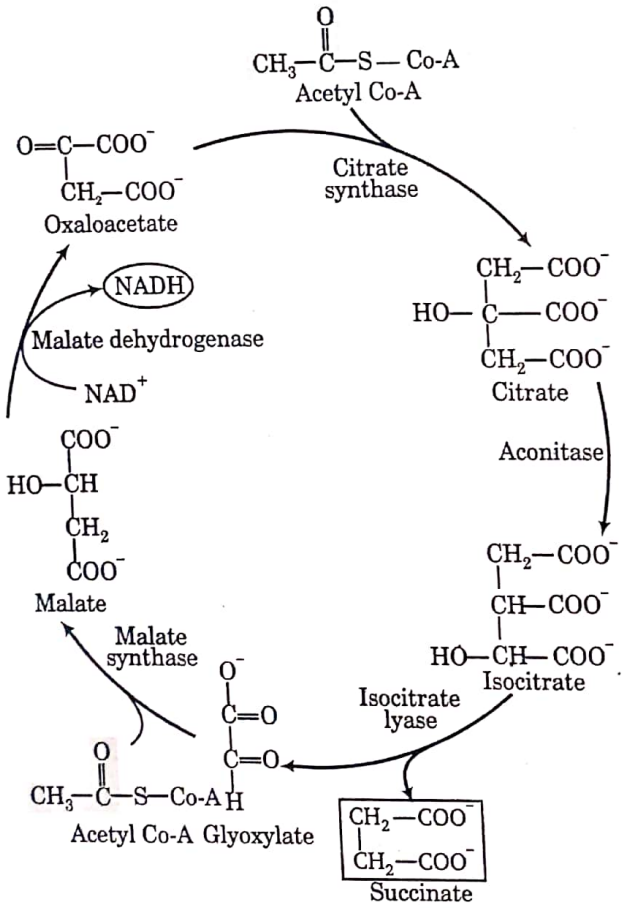

Fig. 3.37 Glyoxylate cycle

Citric Acid and Glyoxylate Cycles are Coordinately Regulated

The reactions of the glyoxylate cycle (in glyoxysomes) proceed simultaneously with and mesh with, those of the citric acid cycle (in mitochondria), as intermediates pass between these compartments.

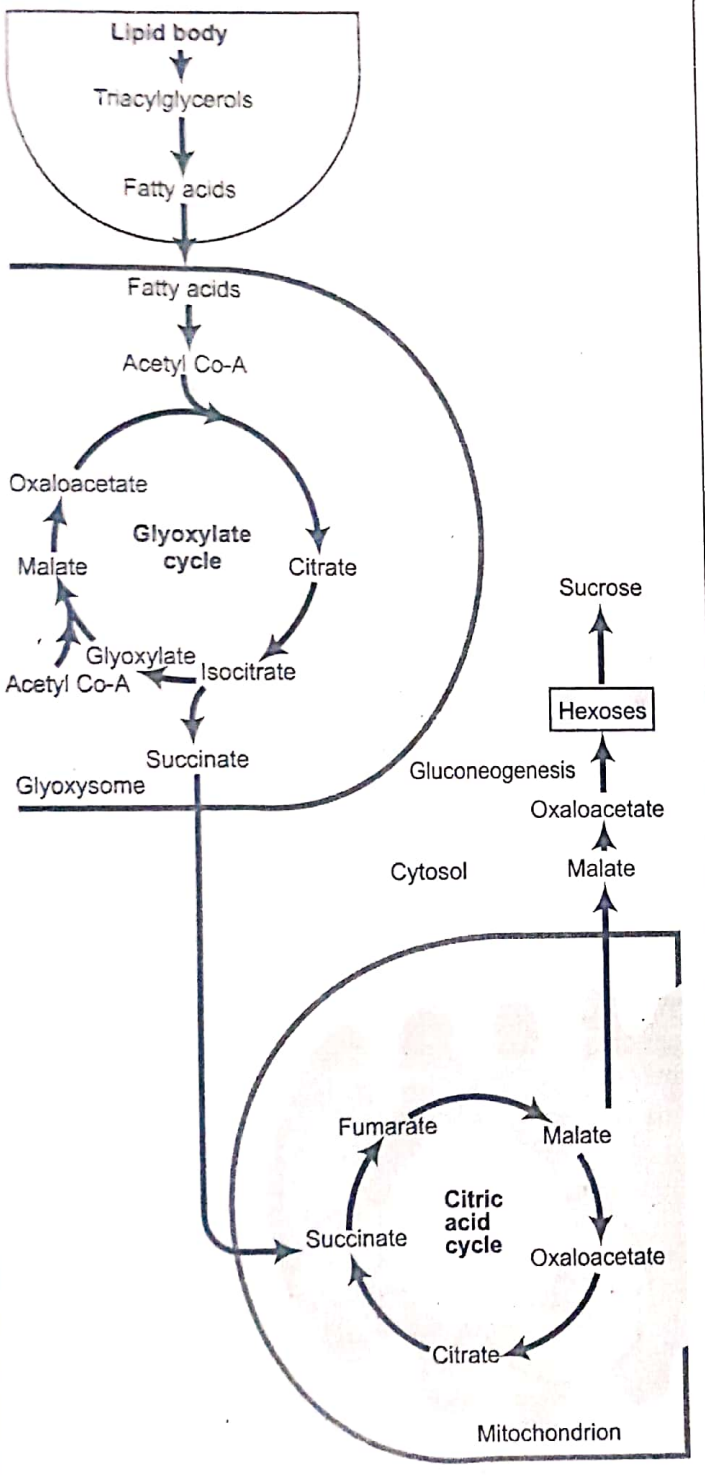

Fig. 3.38 Relationship between the glyoxylate and citric acid cycles

Lipids

Lipids are a group of naturally occurring organic compounds that are soluble in non-polar organism solvents but insoluble in water. They are composed of C, H and O in form of fatty acid and glycerol.

Biosynthesis of Fatty Acids

Fatty acids are synthesized by an **extra mitochondrial system**, which is responsible for the complete synthesis of palmitate from acetyl Co-A in the cytosol. The synthesis of long-chain fatty acids (lipogenesis) is carried out by two enzyme systems, acetyl Co-A carboxylase and fatty acid synthase.

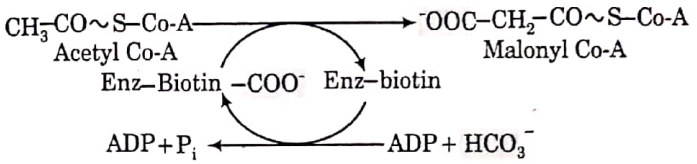

Fig. 3.39 Biosynthesis of malonyl Co-A

Fatty Acid Catabolism

The oxidation of long-chain fatty acids to acetyl Co-A is a central energy-yielding pathway in many organisms and tissues. In higher plants, acetyl Co-A serves primarily as a biosynthetic precursor, only secondarily as fuel.

Oxidation of Fatty Acids

Mitochondrial oxidation of fatty acids takes place in three stages. In the first stage is β-oxidation of fatty acids undergo oxidative removal of successive two-carbon units in the form of acetyl Co-A, starting from the carboxyl end of the fatty acyl chain.

In the second stage of fatty acid oxidation, the acetyl groups of acetyl Co-A are oxidized to CO_2 in the citric acid cycle, which also takes place in the mitochondrial matrix. Acetyl Co-A derived from fatty acids thus enters a final common pathway of oxidation with the acetyl Co-A derived from glucose *via* glycolysis and pyruvate oxidation.

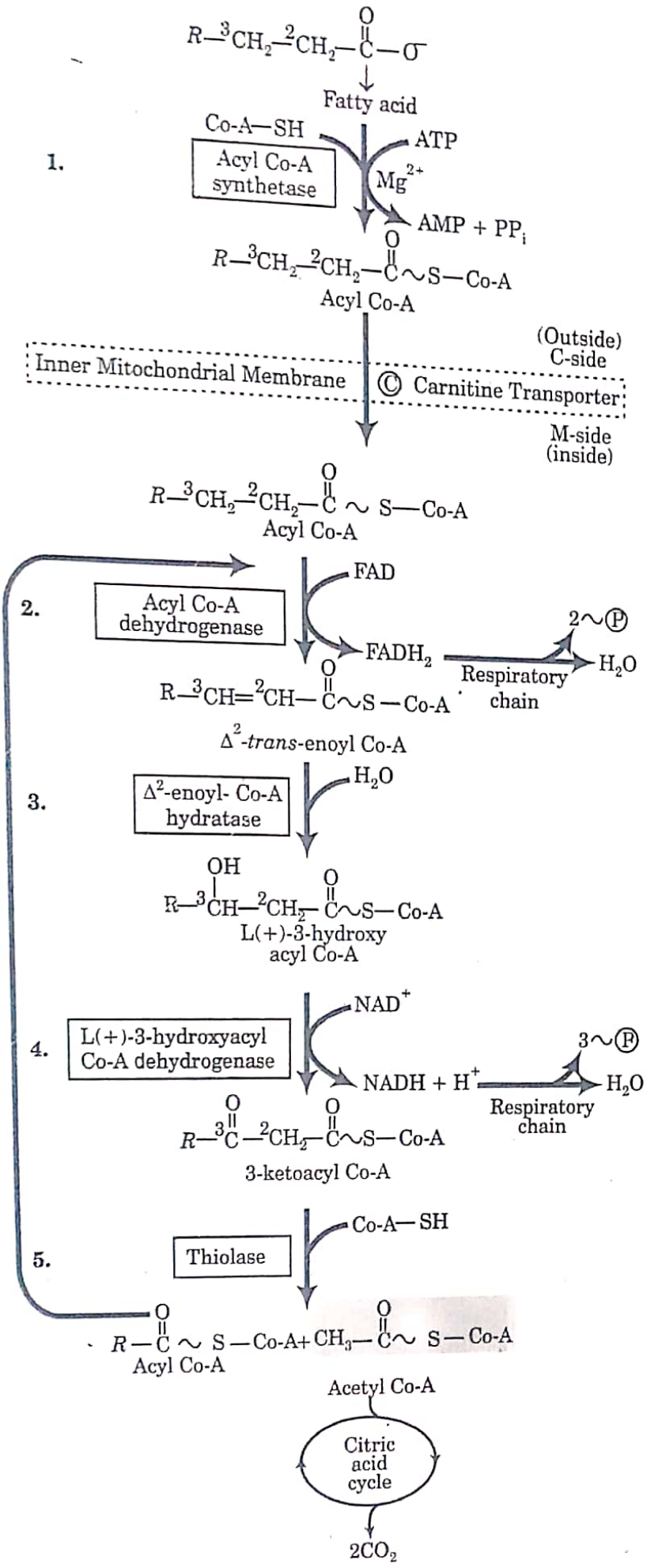

Fig. 3.40 β-Oxidation of fatty acids. Long-chain acyl Co-A is cycled through reactions 2-5, acetyl Co-A being split off, each cycle, by thiolase (reaction 5)