

Crassulacean Acid Metabolism (CAM)

Schemes showing the different pathways or patterns of CAM are shown in Fig. 8.28.

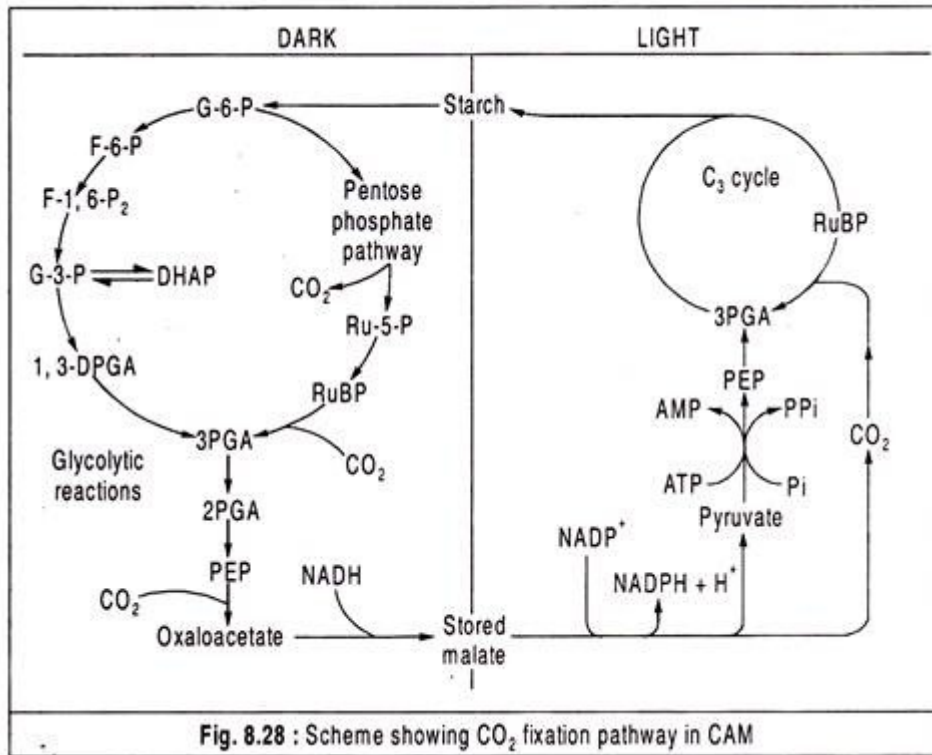


Fig. 8.28 : Scheme showing CO₂ fixation pathway in CAM

CO₂ fixation pathway in dark requires the breakdown of starch to produce PEP, the substrate for carboxylation by PEPcase. Like C₄ plants, this enzyme catalyzes the reaction of PEP with CO₃⁻ to produce oxaloacetate, which is reduced to malate by NAD-malate dehydrogenase.

It was previously thought that a double carboxylation involving both RuBPCase and PEPcase was required since PEP formation was thought to be produced from PGA derived via RuBP carboxylation by RuBPCase.

Sutton and Osmond (1972) have re-examined the situation and concluded that double carboxylation is inconsistent with the labelling pattern of malate after fixation of ¹⁴CO₂ in dark and that glycolysis is the more possible route for PEP formation and a single carboxylation by PEPcase will be necessary.

Decarboxylation of malate may take place by one of the three pathways as in C₄ photosynthesis. In Crassulaceae, direct decarboxylation of malate occurs either by NAD-ME which is mitochondrial or by NADP-ME located in the cytoplasm.

Pyruvate resulting from malate decarboxylation is converted to PEP by pyruvate P_i dikinase located in the chloroplast as in C₄ plants. CAM plants belonging to certain families like Liliaceae, Asclepiadaceae and Bromeliaceae have low levels of NAD-ME and high levels of PEP carboxykinase.

In these plants, malate is oxidized to oxaloacetate by mitochondrial NAD-malate dehydrogenase. Then oxaloacetate is decarboxylated by PCK probably present in the chloroplast. The CO₂ produced by any one of the decarboxylation steps is re-fixed by RuBPCase and the usual C₃ cycle.

Pyruvate or PEP resulting from malate decarboxylation may be oxidized to CO_2 by mitochondrial TCA cycle and re-fixed by C_3 photosynthesis. Isotope experiments with labeled pyruvate have shown that the major pathway is its reductive conversion to triose phosphate and gluconeogenesis directly to sugars.

Formation of PGA from pyruvate is a cytoplasmic reaction since enolase and phosphoglyceryl mutase have been located in the cytoplasm. Reduction of PGA to triose phosphate can take place either in the cytoplasm by NAD-linked dehydrogenase or more likely in the chloroplast by NADP-linked dehydrogenase.