Cellular machineries devoted to Rubisco – Nature's predominant CO_2 fixing enzyme

M. Hayer-Hartl

Max Planck Institute of Biochemistry, Department of Cellular Biochemistry, Martinsried, Germany

Photosynthesis is a fundamental process in biology as it converts solar energy into chemical energy and thus, directly or indirectly, fuels all life on earth. The chemical energy is used to fix atmospheric CO_2 and produce reduced carbon compounds in the Calvin-Benson-Bassham cycle. The key enzyme for this process in all photosynthetic organisms is ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco), which is responsible for the conversion of an estimated amount of ~10^{11} tons of CO_2 per annum into organic material. Rubisco is the most abundant enzyme in nature, owing in part to its low catalytic turnover rate and limited specificity for CO_2 versus O_2. Recent forecasts suggest that global food production will need to rise more than 25 % by 2050 to meet the ever growing demand. Thus, Rubisco has long been a target for reengineering with the goal of increasing crop yields.

The major form of Rubisco is a hexadecameric complex, consisting of 8 large (RbcL) and 8 small (RbcS) subunits. In recent years it has become evident that the Rubisco enzyme requires assistance from multiple molecular chaperones for its folding, assembly and functional maintenance.