CARBON FIXATION

Photosynthesis booster

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Ribulose-1,5-bisphosphate carboxylase–oxygenase (Rubisco) is the core enzyme responsible for carbon fixation in primary producers, which include green plants, photosynthetic algae and cyanobacteria. In today's atmosphere, Rubisco works slowly, and this slow rate of CO_2 fixation limits the growth rate of many crops. Algae have found a way to make Rubisco run faster, by packing it in a special membraneless organelle called the pyrenoid, into which they pump CO_2 to a high concentration using a CO_2 concentrating mechanism (CCM).

Pyrenoids were identified more than two centuries ago, but the dynamics and molecular networks of this special organelle in algae have long remained enigmatic. Recently, two related studies led by Martin Jonikas at Princeton University were published in parallel to elucidate the protein composition, protein–protein interactions and dynamics of the pyrenoid in the green alga *Chlamydomonas reinhardtii*.

Using 3D fluorescence time-lapse confocal microscopy, Rosenzweig et al. visualized the dynamics of the pyrenoid matrix during chloroplast division in living algae cells and concluded that pyrenoids primarily undergo fission during division, and they can also be assembled de novo. In situ cryo-electron tomography (cryo-ET) and fluorescence recovery after photobleaching (FRAP) analyses strongly suggest that pyrenoids are liquid-like and have internal component exchanges. To discern the protein components and their interactions within pyrenoids, Mackinder et al. developed a high-throughput fluorescent protein tagging and affinity purification mass spectrometry pipeline in *C. reinhardtii*. They discovered new candidate CCM players, including three new protein layers of the pyrenoid and 89 pyrenoid-localized proteins. Protein–protein interactome data further contribute to the proposed working model of CCM and indicate promising future research directions.

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