Shoe strings and egg openers

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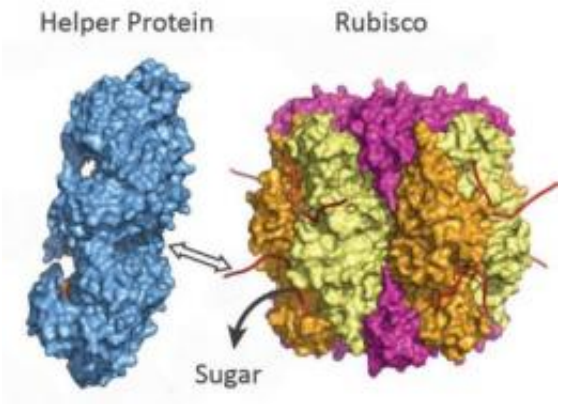

The helper protein (blue) pulls on one end of Rubisco (coloured) and frees up the sugar. The blockage is lifted. Credit: Manajit Hayer-Hartl / Max Planck Institute for Biochemistry

Photosynthesis is one of the most important biological processes. However, it is less efficient in plants than it could be. Red algae, in contrast, use a slightly different mechanism and are thus more productive. Scientists from the Max Planck Institute of Biochemistry (MPIB) in Martinsried near Munich, Germany, have now identified a so far unknown helper protein for photosynthesis in red algae.

"We could elucidate its structure and its intriguing mechanism," says Manajit Hayer-Hartl, MPIB group leader. "Comparing its mechanism to the one in green plants could help to design more efficient plants." Their work has led to two recent publications in *Nature* and *Nature Structural & Molecular Biology*.

Green plants, algae and plankton metabolize carbon dioxide (CO2) and water into oxygen and sugar in the presence of light. Without this process called photosynthesis, today's life on earth would not be possible. The key protein of this process, called Rubisco, is thus one of the most important proteins in nature. It bonds with carbon dioxide and starts its conversion into sugar and oxygen.

"Despite its fundamental importance, Rubisco is an enzyme fraught with shortcomings", says Manajit Hayer-Hartl, head of the Research Group "Chaperonin-assisted Protein Folding" at the MPIB. One of the problems is that Rubisco binds to the wrong sugar molecules that inhibit its activity. The inhibitors have to be removed by a special helper protein, called Rubisco activase. The Max Planck scientists discovered that during evolution two different Rubisco activases developed in plants and in red algae. They differ in structure and in their working mechanism.

The newly discovered Rubisco activase in red algae repairs useless Rubisco proteins by pulling on one end of the protein, like someone who opens a shoe string. In doing so, the helper protein opens the active centre of Rubisco and releases the inhibitory sugar. The respective Rubisco activase in green plants works more like an egg opener, squeezing the inactive Rubisco protein and forcing it to let go of the sugar molecules. "Understanding the structure and function of the two activase helper proteins should facilitate efforts in biotechnology to generate plants and microorganisms that are able to convert more CO2 into valuable biomass than nature does," hopes Manajit Hayer-Hartl.

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