'Safety valve' protects photosynthesis from too much light

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Photosynthetic organisms need to cope with a wide range of light intensities, which can change over timescales of seconds to minutes. Too much light can damage the photosynthetic machinery and cause cell death. Scientists at the Carnegie Institution were part of a team that found that specific proteins in algae can act as a safety valve to dissipate excess absorbed light energy before it can wreak havoc in cells.

The research, performed mostly by Graham Peers in the laboratory of Krishna Niyogi from the University of California, Berkeley, included researchers at the University of Münster, Germany, and used a mutant strain of the single-celled green alga Chlamydomonas reinhardtii, originally isolated at the Carnegie Institution, to show that a specific protein of the light harvesting family of proteins plays a critical role in eliminating excess absorbed light energy. A mutant lacking this protein, designated LHCSR, suffered severely when exposed to fluctuating light conditions.

"Photosynthetic organisms must be able to manage absorbed light energy," says study co-author Arthur Grossman of Carnegie's Department of Plant Biology, "and the LHCSR proteins appear to be critical for algae to eliminate absorbed light energy as heat as light levels in the environment fluctuate, becoming potentially toxic."

Grossman points out that photosynthetic organisms have developed a number of different mechanisms for managing the absorption of light energy and that these different mechanisms may be tailored to the

diversity of environments in which organisms have evolved. Some have evolved in deserts where both light levels and temperatures can be very high while others have evolved in alpine environments where the light levels can be very high and temperatures very low.

"As we understand more about the ways in which the environment impacts the evolution of the photosynthetic machinery, we may be able to introduce specific mechanisms into plants that allow them to better manage absorbed light energy, which in turn would let them survive harsher environmental conditions" Grossman says, "which would have obvious benefits for agriculture."

He also notes the current interest in using algae to generate biofuels, and the possibility of cultivating algae in deserts, where solar input can be extremely high. As he states, "If we are going to attempt this we have to make sure that we use the right algae that can thrive and produce oils at high levels under harsh environmental conditions. It's possible that we can also tailor various features of the photosynthetic machinery to let algae use light energy more efficiently and suffer less damage under extremely high light and temperature conditions, but I would emphasize that there are many extreme challenges associated with the creation of such robust, commercially viable strains."

More information: The research appears in the 26 November issue of *Nature*.

Source: Carnegie Institution