A model by which plants adapt their photosynthetic metabolism to light intensity

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Researchers from the University of Seville and the Centro Superior de Investigaciones Científicas have proposed a model that explains the molecular mechanism used by plants to adapt their photosynthetic mechanism to light intensity.

Photosynthesis is the Earth's primary production process for organic material and oxygen. During the day, CO2 fixation and photosynthetic metabolism remain active in plant chloroplasts via a regulatory mechanism in which redox systems like thioredoxins (TRXs) play a central role. The chloroplastic TRXs use ferredoxin (Fd) reduced by the photosynthetic flow of electrons, connecting the metabolic regulation with the light. In addition, the chloroplasts have NTRC, an additional redox system, exclusive to photosynthetic organisms, which, as occurs in heterotrophic organisms, uses NADPH as reducing power.

Photosynthesis inevitably generates oxidising agents such as hydrogen peroxide, which can be harmful. For this reason, the chloroplasts have protective systems like 2-cys peroxiredoxins (2CP), whose activity depends on NTRC, and so an antioxidant function has been proposed for this enzyme. However, later studies have shown the participation of NTRC in metabolic processes regulated by TRXs, like starch and chlorophyll synthesis. These results suggest a profound interrelationship between redox systems based in Fd (TRXs) and NADPH (NTRC) and antioxidants by means of a mechanism with an unknown molecular base.

The authors of this study have shown that the functioning of

photosynthetic metabolism and its adaptation to unpredictable changes in light intensity depend on the redox balance of the peroxiredoxins (2CP), which act by integrating the complex redox regulation systems of the chloroplasts. These results, obtained from the model species Arabidopsis thaliana, signify an important advance in the knowledge of photosynthesis and suggest new biotechnological approaches for increasing both the photosynthetic rate of CO2 fixation and the consequent production of organic material.

More information: Juan Manuel Pérez-Ruiz et al. NTRC-dependent redox balance of 2-Cys peroxiredoxins is needed for optimal function of the photosynthetic apparatus, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1706003114

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