Article

FFa 8

Cyanobacterial Lactate Oxidases Serve as Essential Partners in N2 Fixation and Evolved into Photorespiratory Glycolate Oxidases in Plants.

Hackenberg C, Kern R, Hüge J, Stal LJ, ..., Kopka J, Shiraiwa Y, Bauwe H, Hagemann M

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Comments

No comments yet.

Evaluations

Classification Key

Evaluated by Wagner Araujo and Alisdair Fernie NEW 16 Aug 2011

This interesting work from Hackenberg and colleagues advances our understanding of the evolution of photorespiration. This work is very important, since it provides significant insights into the evolution and conservation of the photorespiratory pathway.

The photorespiratory pathway has been extensively studied, and it has been demonstrated to be of crucial importance for organisms performing oxygenic photosynthesis, such as cyanobacteria, algae, and of course plants, particularly in actual high-oxygen containing environments {1,2}. The recovery of phosphoglycerate during photorespiration is accompanied by considerable carbon and energy losses, making photorespiration a prime target for crop improvement {1}.

In this work, Hackenberg et al. searched for glycolate oxidase (GOX) homologs in a range of organisms including bacteria, algae, and plants. They were able to find homologs of the well-characterized spinach (Spinacia oleracea) GOX in both cyanobacteria and algae. It is worth mentioning that this result is in good agreement with recent findings {2}, which similarly demonstrated that GOX-like proteins are found in nitrogen-fixing cyanobacterial species and show that GOX in photosynthetic eukaryotes was in the genome of the cyanobacterial endosymbiont that gave rise to the plastid.

The GOX-like proteins from Nostoc and from Chlamydomonas reinhardtii showed high L-lactate oxidase (LOX) and low GOX activities, whereas glycolate was the preferred substrate of the phylogenetically related At-GOX2 from Arabidopsis thaliana.

By using an elegant range of biochemical approaches, the authors of this work provide circumstantial evidence that LOX functions as an oxygen scavenger that allows the bacteria to use atmospheric nitrogen as their nitrogen source even in high-oxygen atmospheres, whereas in plants it has evolved into GOX, responsible for glycolate oxidation during photorespiration.

The origin of GOX-based photorespiration in the green algal lineage may have played an important role in the subsequent appearance of land-adapted plants.

The combined expertise of the authors of this intriguing paper facilitated the production of a great paper, which at the same time challenges current thinking and supports previous physiological findings, raising new questions about the origin of photorespiration and its role in land-adapted plants.

References:
{1} Bauwe et al. Trends Plant Sci 2010, 15:330-6 [PMID:20403720].
{2} Kern et al. Photosynth Res 2011, Jan 11, Epub ahead of print [PMID:21222161].

Competing interests: None declared

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Rating 8
Must Read

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