On the relative contributions of the PSII-dependent and Nda2-dependent pathways to the hydrogen photoproduction in Sulfur-depleted cells of Chlamydomonas reinhardtii.

Renaud Leclerc*, Emmanuel Mignolet*, Fabrice Franck and Claire Remacle

1 Lab. Of Genetics of the Microorganisms, 2 Lab. of Photobiology, University of Liege, Bvd du Rectorat 27, B-4000 Liège, Belgium

These authors contributed equally to the work

Introduction

Previous studies on anaerobic H₂ photoevolution by C. reinhardtii under sulfur-deprivation (S-deprivation) have established that two pathways co-exist in this process (ref. 1):

- the PSII-dependent pathway, in which water photolysis provides the electrons to the hydrogenase through the whole photosynthetic electron transport chain;
- The PSII-independent pathway, in which electrons are first donated to the PQ pool by non-photocatalytic reduction and are further energized through PSI. It was shown recently that a type II dehydrogenase, Nda2, catalyses this PQ reduction at the expense of NAD(P)H in C. reinhardtii (refs. 2 and 3). NAD(P)H is thought to arise from starch catabolism (ref. 1).

The relative contributions of these two pathways is matter of debate. On the one hand, it was shown that the inactivation of Nda2 leads to important decrease of photoevolution in S-deprived cultures of C. reinhardtii (refs. 2 and 3). NAD(P)H is thought to arise from starch catabolism (ref. 1):

The latter results suggest that H₂ photoevolution is essentially PSII-dependent.

We have used two RNAi cell lines (S1 and S2), which lack the chloroplastic, type II dehydrogenase Nda2 (ref. 2), in order to re-investigate the importance of non-photoevolution in S-deprived cultures of C. reinhardtii. In the same experimental system, the effect of DCMU was also assayed in order to evaluate in the same conditions the dependence of hydrogen production on PSII activity.

The S1 and S2 lines are differently affected in the expression of Nda2. The protein is not detected in S2 while traces subsist in S1.

Protocol

Results

Conclusions

- The PSII-independent pathway is Nda2-dependent.

- From our results, it appears that the sum of the apparent capacities of the PSII-dependent and Nda2-dependent pathways makes more than the actual H₂ photoevolution rate. This suggests either that the two pathways cannot operate independently from each other, or that there are indirect effects of the absence of one or the other pathway.

References