

Protein kinases and phosphatases involved in the adaptation to changing light conditions

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Photosynthetic organisms have the ability to adapt to changes in light conditions in a variety of ways. One of these processes is state transition in which balancing of the light excitation energy absorbed by the light-harvesting systems of photosystem II (PSII) and photosystem I (PSI) leads to an optimal photosynthetic yield under limiting light conditions. A screen for *Chlamydomonas* mutants deficient in state transitions has revealed a duo of conserved thylakoid protein kinases, Stt7 and Stl1 in *Chlamydomonas* with their Arabidopsis orthologs STN7 and STN8, respectively (1, 2). Stt7/STN7 is activated during a transition from state 1 to state 2, when PSII is preferentially stimulated, and phosphorylates the light-harvesting system of PSII. Part of this antenna is then displaced from PSII to PSI. The process is reversible as preferential stimulation of PSI leads to the inactivation of Stt7/STN7 and to the dephosphorylation of LHCII and its return to PSII. A comparative phosphoproteomic analysis with wild type and the *stt7* mutant showed that under state 2 conditions several Stt7-dependent phosphorylations occur both in the major and minor LHCII proteins (3). Moreover phosphorylation of Stl1 in state 2 also depends on Stt7 suggesting the existence of a thylakoid protein kinase cascade (3). Because of the key role of Stt7/STN7 in light acclimation, we have initiated a structure function analysis of this kinase. Site directed mutagenesis revealed that two conserved Cys in the N-terminal region are essential for its activity. We have also shown that the Stt7 kinase is part of a high molecular weight complex (3). High resolution BN gel electrophoresis revealed the presence of a core Stt7 complex and several Stt7 supercomplexes under state 2 conditions. Recently we identified the PPH1 phosphatase from Arabidopsis which is specifically required for the dephosphorylation of LHCII during a state2 to state 1 transition (4). Thus the Stt7/STN7 kinase /PPH1 phosphatase pair is specifically involved in the reversible phosphorylation of LHCII during state transitions.

1. Depège et al. (2003) Science 299, 1572- 1575
2. Bellafiore et al. (2005) Nature 433, 892-895.
3. Lemeille et al. (2009) Plos Biol. 7, 664-675.
4. Shapiguzov et al. (2010) Proc. Natl. Acad. Sci. USA