Photosynthesis requires catalyzed thiol-disulfide exchange reactions in the chloroplast lumen

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Photosynthesis in plants and algae occurs in the thylakoid, a membrane bound compartment in the chloroplast. The thylakoid membrane is a specialized membrane converting light energy into ATP and reducing power. This process requires the operation of multimeric protein complexes and numerous bound pigments and cofactors. A fundamental problem in plant biology concerns how these complexes are assembled and the cofactors bound to the proper subunit. My research addresses these problems in two major model organisms of plant cell biology: *Arabidopsis thaliana* and the green alga *Chlamydomonas reinhardtii*. The occurrence of disulfide-bonded proteins in the thylakoid suggests that thiol/disulfide chemistry in this compartment might be required for the assembly and/or activity of the complexes involved in photosynthesis. However the molecular identity of the redox components controlling thiol/disulfide chemistry and their importance for photosynthesis have remained unknown. In the plant *Arabidopsis thaliana*, we have identified LTO1 (Lumen Thiol Oxidase 1), a novel sulfhydryl oxidase at the thylakoid membrane, whose activity is required for the assembly of Photosystem II, a multimeric enzyme needed for light capture. In the green alga *Chlamydomonas reinhardtii*, CCS5 (Cytochrome C Synthesis 5) is a thylakoid membrane anchored protein with a lumen facing thioredoxin-like domain. We show that CCS5 is a component of a trans-thylakoid redox pathway and is recruited for the biogenesis of cytochromes c, which are hemoproteins involved in photosynthesis. CCS5 operates by reducing a disulfide at the heme binding site of apocytochrome c, a prerequisite for cytochrome c assembly. Our results highlight the role of thiol-disulfide chemistry as a catalyzed process in the biogenesis of the photosynthetic chain.

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