Structural Basis for the Ferredoxin-dependent Electron Transfer

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Plant-type ferredoxin (Fd) is an electron transfer protein with a [2Fe-2S] cluster, carrying one-electron to Fd-dependent enzymes that are important for assimilatory and regulatory reactions in photosynthetic organisms. In chloroplasts, Fd is reduced by Photosystem I (PSI) and primarily oxidized by Fd-$NADP^+$ reductase (FNR) involved in $NADP^+$ reduction, which is called "linear electron transfer". Electron transfer from PSI to Fd is realized by a protein-protein complex formation suitable for an efficient redox reaction. After the inter-molecular electron transfer, this complex dissociates quickly, which is a reason for the high turnover of the light-driven photosynthetic electron transfer reaction. Besides Fd and PSI, this transient protein-protein interaction is also realized for other Fd-dependent enzymes such as FNR. Although Fd-dependent enzymes vary in molecular size and prosthetic groups, they all specifically recognize Fd and form a fully functional electron transfer complex even without any common Fd-binding motif or fold. To understand the structural basis for the dynamics and efficiency of the electron transfer reaction around Fd, we have studied the electron transfer complexes such as Fd:FNR[1], Fd:SiR [2], and Fd:PSI [3] by X-ray crystallography combined with NMR spectroscopy. In order to understand the alternative photosynthetic electron transport chain named "cyclic electron transfer", we also studied the photosynthetic complex 1 (NDH1) using a multidisciplinary approach including Cryo-electron microscopy for structural characterization [4].

References

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