Dissertation Abstract

In photosynthesis, light energy is used to drive the transport of electrons from water to $NADP^+$, through a series of membrane-bound and soluble redox-proteins. This is called the photosynthetic electron-transfer chain, and plastocyanin (Pc) which is a small, soluble, Cu containing protein is an important link in this chain. It works as an electron carrier between cytochrome (Cyt) b_6f and photosystem 1(PS1). Pc picks up one electron from Cyt *f* in the Cyt b_6f complex, and transfers it to the photooxidized chlorophyll pigment P700 in PS1. This thesis deals with the properties of Pc that are important for the interaction with its redox partners and thereby also for an efficient electron transfer reaction.

Crystal structures of the G8D single- and the G8D/L12E double-mutants of spinach Pc, at different redox states and pH-values, have been solved. Analyses of these structures reveal that the surface of the hydrophobic patch is very important for the complex-formation between Pc and PS1, and this further strengthens the idea that the surfaces must be highly complementary to each other for a strong binding.

Moreover, the redox-induced structural changes also occur in the small acidic patch. These structural changes seem to be coupled via a hydrogen-bond network from the hydrophobic patch residue, Gln88 to Glu59 in the small acidic patch via Tyr83 and Ser85. Evidence for this can also be found in the structure of the triple mutant G8D/K30C/T69C, where a similar hydrogen bond network exists.

We also wanted to investigate whether the affinity towards PS1 is different for reduced and oxidized Pc. In this study Ag- and ZnPc were used as redox-inert metal substituted inhibitors to the electron transfer reaction from Pc to PS1 and served as analogues of the reduced and oxidized forms of Pc, respectively. The results clearly indicate that the reduced form has a stronger binding to PS1 than the oxidized form.

Together these results suggest an electron transfer model where the electron transfer between Pc and PS1 is reversible in the complex. This depends on a lowered driving force (lowered difference in reduction potential) between Pc and PS1 in the complex, as compared to the free forms. This is a thermodynamic consequence of different dissociation constants for the two redox forms.

Keywords: electron transfer, plastocyanin, photosynthesis, hydrophobic patch, acidic patch, copper