

## **Dissertation Abstract**

In photosystem II (PS II) membranes, chloride is not an absolute requirement but is needed for optimal oxygen evolution. In PS II membranes, depleted of chloride by dialysis against chloride-free buffer the oxygen-evolution rate was 50 % of the rate seen in chloride-sufficient PS II membranes. PS II can exist in two inter-convertible states with vastly different anion-binding properties. Saturation of the binding site with chloride in either binding mode restores oxygen-evolution activity to similar levels. In this thesis details of the reactivation abilities, affinity properties and kinetics of binding of several monovalent anions are reported. The turnover of the OEC in chloride-depleted PS II membranes was examined by observation of the periodic appearance of the  $S_2$  state multiline EPR signal as a response to a series of laser flashes. The oscillatory pattern of the multiline signal in depleted membranes was similar to that in chloride-sufficient membranes and the signal yield indicated that all chloride-depleted centers were actively turning over. With fluoride, which inhibits the oxygen-evolving activity completely no oscillation pattern was observed in the EPR signal. A model for the role of chloride in PS II function is proposed which involves the participation in a proton-relay network with charged amino acid side chains. Such a network is suggested to facilitate proton transfer from the manganese cluster to the medium.

A set of spinach plastocyanin (Pc) mutants has been constructed to provide further insight into the electron transfer process between Pc and photosystem 1 (PS I) and the importance of the two acidic patches. It was found that both acidic patches are involved in the electron transfer. The strongest impairment for the electron transfer was found with mutations in the large acidic patch. Further, two different models have been proposed to account for the Pc and PS I interaction. One, which includes a conformational change of the Pc-PS I complex that precedes the electron transfer step (assumed to be irreversible) and another where no conformational change occurs, the electron transfer step is reversible and where dissociation of product is explicitly taken into account. To be able to discriminate between the two suggested models, the effect of added magnesium ions on the kinetics were investigated. At high concentrations of Pc, the ionic strength was found to be consistent with the model involving a conformational change but not with the model where the electron transfer is reversible. One of the residues in the small acidic patch, Glu60, seems to be responsible for the major part of the dependence of the kinetics on ionic strength.