The Role of Bicarbonate in *Limnospira maxima* Electron Transport Chain

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The cyanobacterium *Limnospira maxima* is unique in its ability to thrive under high concentrations of dissolved inorganic carbon (bicarbonate) because it uses bicarbonate as its major inorganic carbon source. Bicarbonate plays a major regulatory role in PSII, with the best-characterized site coordinated to the non-heme iron, which sits between acceptor plastoquinones Q_A and Q_B. To investigate the regulatory roles of bicarbonate in PSII, bicarbonate was depleted from a functional site of unknown location with sodium formate. Connectivity of antenna pigments to photosystems was observed via 77K spectrofluorometry in response to bicarbonate depletion, which showed loss of chlorophyll connectivity in PSII and dissociation of the phycobilisome. Chlorophyll fast repetition rate fluorometry revealed that bicarbonate depletion resulted in one population of PSII showing normal oscillations in water oxidation and another that stopped after two charge-separating events. This suggested that the water oxidizing complex remained active in the first fraction of centers. Q_A^- reoxidation kinetics showed that depletion causes the electron transfer time from Q_A to Q_B to have comparable time scales as the control, suggesting electron transfer to Q_B, forming semiquinone Q_B^-. As DCMU inhibits the second electron transfer, this suggests that an electron is being transferred to Q_B in bicarbonate-depleted *L. maxima* and must be affecting proton delivery that would yield plastoquinol PQH_2. Cytochrome b_6f redox kinetics revealed that under depletion, *L. maxima* experiences intense oxidation, which suggests a powerful PSI. P700 kinetics displayed a predicted delayed transfer of electrons to PSI, suggesting an effect of bicarbonate depletion there as well.