Comparative Effects of Anion Supplementation on the Acceptor Side of Photosystem II

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In Photosystem II (PSII), the non-heme iron (NHI) stabilizes Q_A and Q_B redox states, which mediates the electron transfer between plastoquinone acceptors, and regulates recombination pathways. Because the NHI is ligated by bicarbonate and amino acid residues, its coordination environment is strongly influenced by ionic composition, making it a key regulatory site for photosynthetic electron transport. *Picochlorum oklahomense,* a halotolerant green alga capable of thriving across a wide salinity range, provides a model system to examine how anions influence PSII function. To study ion-specific effects, cultures were supplemented with anions spanning the spectrochemical series (HCO_3^-, Cl^-, Br^-, I^-, F^-, NO_3^-, SO_3^{2-}) and their impact on Q_A^- redox kinetics and charge recombination were analyzed using chlorophyll fluorometry. Q_A^- redox analysis showed that addition of halides caused a decrease in the Q_A^--Q_B^- transfer time, suggesting a facilitation of electron transfer due to modulation of either protonation of the semiquinone or local redox poise. Nitrite and sulfite slowed electron transfer, with sulfite additionally limiting the Q_A^--Q_B transition. Fast repetition rate fluorometry studies suggest that strong field-directing ions caused limitation of quinone access to the Q_B site. The mildly beneficial halide effect on electron transfer may be localized to the depletable bicarbonate side responsible for protonation of Q_B. Nitrite appears to limit Q_B turnover, while sulfite fully inhibits the operation of PSII. The totality of sites of activity of sulfite are not clear, but Q_A^- redox modulation supports that it is affecting the acceptor side.