Steady-State P800 Oxidation Kinetics Indicate That Heliobacterial Phototrophy is Light-Limited

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The heliobacteria are a family of phototrophic bacteria known for their unique production of bacteriochlorophyll *g* and for their use of the simplest known Type I reaction center. In this work, we characterize P800 oxidation kinetics in whole cells of *Heliomicrobium modesticaldum* under the continuous illumination that is more consistent with *in vivo* conditions, an area of research that remains largely unexplored. When assayed at 800 nm, whole cells display a large bleaching immediately upon illumination by actinic light, corresponding to the production of $P800^+$. The initial bleaching typically reaches a maximum intensity at 10 - 30 ms, at which point a slower, partial recovery leads to a steady-state that is smaller than the initial bleaching. The effects of charged redox reagents, in particular ferric ammonium citrate, and the cytochrome *bc* complex inhibitor azoxystrobin, demonstrate that this recovery phase is due to forward donation to $P800^+$ from cytochrome *c*. A steady-state kinetics analysis comparing the effects of actinic intensity on the rate of P800 oxidation to that of P700 oxidation in spinach chloroplasts and whole cells of *Synechococcus* sp. PCC 7002, suggest that the heliobacterial reaction center is inherently light-limited. In support of a light-limited model, light saturation profiles of untreated cells compared to those treated with ferric ammonium citrate indicated that only 32% of the P800 pool is oxidized during continuous illumination. Taken together, these results indicate that, in stark contrast to all other known phototrophs, phototrophy in the heliobacteria is light-limited.