Light-driven electron transport in Heliobacteria

Gregory Orf[1], Shreya Shaw[1], Sabrina Leung[1], Karim Walters[2], Patricia Baker[1], John H. Golbeck[2] and Kevin E. Redding[1*]
[1]School of Molecular Sciences, Arizona State University
[2]Dept. Biochemistry & Molecular Biology, Pennsylvania State University
[*]Kevin.Redding@asu.edu

The heliobacteria, a family of anoxygenic phototrophs, possess the simplest known phototrophic system, utilizing a homodimeric Type I reaction center (RC) within only 2 subunits (PshA and PshX) and lacking any peripheral antenna complexes. Although they are photoheterotrophs in the light, the heliobacteria can also grow fermentatively on pyruvate in the dark like their clostridial cousins. They are likely the result of a lateral gene transfer of genes conferring phototrophy (e.g., RC subunits, bacteriochlorophyll synthesis). I will discuss how we created a transformation system, and how we have leveraged the endogenous CRISPR/Cas system to create the means to cleanly delete genes from the chromosome of *Heliomicrobium modesticaldum*. Using this technology, we have launched a genetic study of the light-driven cyclic electron transport pathways within this organism. Mutants lacking the genes for the RC (*pshA*) or cytochrome *bc* complex (*petABCD*) are nonphototrophic and exhibit a >100-fold slower re-reduction of cyt *c* after a laser flash. Mutants lacking the minor RC subunit PshX are phototrophic but show a slight drop in RC levels and the loss of a low-energy pigment. Deletion mutants of each of the 3 genes encoding a small di-cluster ferredoxin shown to bind and be reduced by the acceptor side of the heliobacterial RC resulted in no effect, indicated functional redundancy within the ferredoxin pool.