KN2 - From evolution to engineering of the Orange Carotenoid Protein

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In the majority of cyanobacteria, the Orange Carotenoid Protein (OCP) is a photoreceptor responsible for the thermal dissipation of excess light energy captured by the light-harvesting antenna as well as disarming reactive oxygen species (ROS), which are produced during oxygenic photosynthesis. Recently, new families of homologs of the constituent domains of the OCP have been identified (Bao, Melnicki et al., 2017, Melnicki, Leverenz et al., 2016, Lopez-Igual et al., 2016). Nine different clades of N-terminal domain (NTD) homologs have been identified across diverse cyanobacteria. These paralogs, named Helical Carotenoid Proteins (HCPs), are predicted to conserve both the all-helical fold of the NTD as well as residues specific for binding carotenoid (Leverenz et al., 2015, Melnicki et al., 2016). Homologs to the C-terminal domain (CTDHs), which also bind carotenoids, are also found in nearly every genome encoding an HCP (Kerfeld et al., 2017, Kerfeld et al., unpublished, Lechno-Yossef et al., 2017). The discovery of these new families of proteins sheds light on the evolution of the OCP-mediated photoprotective mechanism and provides the foundation for its fine-tuning and the re-purposing of OCP homologs for optogenetic applications.