Optogenetic Vector Systems for Regulating Gene Expression in Cyanobacteria

Amit Srivastava, PhD
Laboratory of Photosynthesis
Institute of Microbiology of the Czech Academy of Sciences,
Centre Algatech, Třeboň 379 01, Czech Republic

Light plays a crucial role in influencing all forms of life on Earth. In photoautotrophs, sunlight primarily catalyzes photosynthesis but also regulates various cellular, morphological, and physiological processes. These processes are largely controlled by phytochromes, a family of photoreceptor proteins that sense red and far-red light. Phytochromes, with their ability to function as light-gated switches, are promising candidates for optogenetics, an approach that enables precise control and monitoring of biological processes with high spatiotemporal resolution using optical proteins. Integrating optogenetic systems into the cyanobacterial synthetic biology toolbox enhances bioproduction capabilities and supports metabolic engineering efforts aimed at the sustainable production of biochemicals beneficial to society. In our recent work, I utilized a cyanobacterial phytochrome, RfpA, specific to FaRLiP (Far-red light photoacclimation) cyanobacteria, to construct an optogenetic expression vector applicable in both *E. coli* and cyanobacteria for biotechnological applications. Additionally, I identified a novel cyanobacteriochrome with potential for developing new optogenetic tools.