

Bacterial bilin- and flavin-binding photoreceptors

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The growing number of prokaryotic sequenced genomes reveals a wide distribution of open reading frames (ORFs) that putatively encode for red- and blue light sensing photoreceptors. They comprise the bilin-binding phytochromes, the flavin-binding cryptochromes, and the LOV and BLUF proteins, indicating that about 1/4 of bacteria do possess at least one of these photosensory proteins. The distribution of red- and blue-light sensors among different prokaryotic phyla and classes, and their functional activity as light-switched systems are the subject of this perspective. These photoreceptors were originally found in plants by following the associated physiological responses induced by the respective spectral irradiation. Genome-based approaches now assign a photochemical/physiological function to the heterologously expressed gene product. Database searches demonstrate several genes of one category in prokaryotes, indicating the presence of more than one type of red- or blue light sensing properties, but also show a combination of proteins with both spectral sensitivities. According to their nature as biological sensors, these photoreceptors are equipped with signalling domains, initiating a cellular response, thereby constituting modular systems switchable by light. Many of these signalling domains were already described for other stimuli, e.g., osmo-regulation, oxygen, hydrogen, chemicals, or pH, and are now found associated with the red- as well with the blue light sensing domain. Following the characterization of their photochemistry, for several of these bacterial photoreceptors physiological functions are now assigned.