

MicroReview

Photobiology of microorganisms: how photosensors catch a photon to initialize signalling

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Summary

Photobiological processes are relevant for microorganisms for energy generation, protection against excess and/or damaging radiation, and for signalling. In this review we give an overview of the knowledge on the functioning of photosensors in microorganisms, with special emphasis on the conformational changes that lead to signal generation and transduction. Light is absorbed by specific chromophores, which are tuned, by their proteinaceous environment, to function optimally. These chromophores belong to three classes: tetrapyrroles, polyenes and aromatics. The chemical structure of photosensing pigment/protein complexes has been resolved for many of the photobiological processes that have a characteristic sensitivity in the visible and infrared part of the spectrum of (solar) radiation. However, knowledge about the structure of photoreceptors responsible for several physiologically well-characterized photoresponses to UV- and blue light is still lacking. For a limited number of phototransduction processes, the details of light-induced signal transfer are beginning to be understood in atomic detail. This applies particularly to two photosensors involved in phototactic responses in bacteria: sensory rhodopsin I (SR-I) from *Halobacterium salinarum* and photoactive yellow protein (PYP) from *Ectothiorhodospira halophila*. The SR-I system is of special interest because the transducer accepting the signal from SR-I was recently identified as Htr-I, a homologue of the methyl-accepting chemotaxis proteins which have

been characterized in *Escherichia coli*. PYP, on the other hand, may be the first photosensor to actually reveal all relevant details of the kinetics, thermodynamics, and molecular motion of light-induced signal generation, through an understanding of how the photo-isomerization of the chromophore forces the sensor protein into the signalling state. Here we compare these photosensors and discuss common themes in the initiation of photosensory signal transduction in microorganisms in terms of the molecular properties of photosensors and their signalling state.

Light, colours, energy, signals, damage, protection and the definition of photosensors

Understanding the ability of living organisms to absorb visible photons, leading to the formation of excited molecules that are biologically relevant, is the essential issue of photobiology. This absorbance of light generally occurs through proteins, which themselves, however, do not absorb light of wavelengths greater than 300 nm. In spite of this, a broad range of proteins display absorbance bands in the visible region of the spectrum of electromagnetic radiation (i.e. these are coloured proteins) as a result of the chromophores with which they are associated. Light absorbance by coloured proteins is not always of biological relevance (e.g. this is the case with myoglobin). Nevertheless, in several of these chromophoric proteins, electronic excitation by visible light initiates a biological response to the incoming radiation; these are called photoreceptor proteins.

Light absorbance by such photoreceptors can be associated with different biological functions. First, light can be used as an energy source for maintenance and growth: photosynthesis. Second, it can be involved in diminishing the deleterious effects of otherwise damaging radiation: photoprotection. Third, light absorbance can lead to a biologically relevant signal transfer: photosensing. The conservation of light energy in photosynthesis is discussed at length elsewhere (e.g., see Mathies, 1995).

Light can be both dangerous and harmful. Upon absorption of a visible photon by a photoactive protein, the immediate surrounding of the chromophore heats up some 200 K in the picosecond to microsecond time-domain (Li and Champion, 1994). This makes it easy to imagine

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Photobiology Of Microorganisms

Ian Pickup



Photobiology Of Microorganisms:

Adopting the Melody of Term: An Psychological Symphony within **Photobiology Of Microorganisms**

In a world consumed by screens and the ceaseless chatter of instantaneous connection, the melodic splendor and emotional symphony created by the published term frequently disappear into the back ground, eclipsed by the persistent sound and disturbances that permeate our lives. However, located within the pages of **Photobiology Of Microorganisms** a marvelous fictional prize overflowing with natural emotions, lies an immersive symphony waiting to be embraced. Crafted by a wonderful composer of language, this interesting masterpiece conducts readers on an emotional trip, skillfully unraveling the concealed melodies and profound impact resonating within each carefully constructed phrase. Within the depths with this poignant evaluation, we shall explore the book is central harmonies, analyze their enthralling writing fashion, and submit ourselves to the profound resonance that echoes in the depths of readers souls.

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