

**Bacteriophytochromes are photochromic histidine kinases using a biliverdin chromophore**

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Phytochromes comprise a principal family of red/far-red light sensors in plants. Although phytochromes were thought originally to be confined to photosynthetic organisms, we have recently detected phytochrome-like proteins in two heterotrophic eubacteria, *Deinococcus radiodurans* and *Pseudomonas aeruginosa*. Here we show that these form part of a widespread family of bacteriophytochromes (BphPs) with homology to two-component sensor histidine kinases. Whereas plant phytochromes use phytychromobilin as the chromophore, BphPs assemble with biliverdin, an immediate breakdown product of haem, to generate photochromic kinases that are modulated by red and far-red light. In some cases, a unique haem oxygenase responsible for the synthesis of biliverdin is part of the BphP operon. Co-expression of this oxygenase with a BphP apoprotein and a haem source is sufficient to assemble holo-BphP *in vivo*. Both their presence in many diverse bacteria and their simplified assembly with biliverdin suggest that BphPs are the progenitors of phytochrome-type photoreceptors.