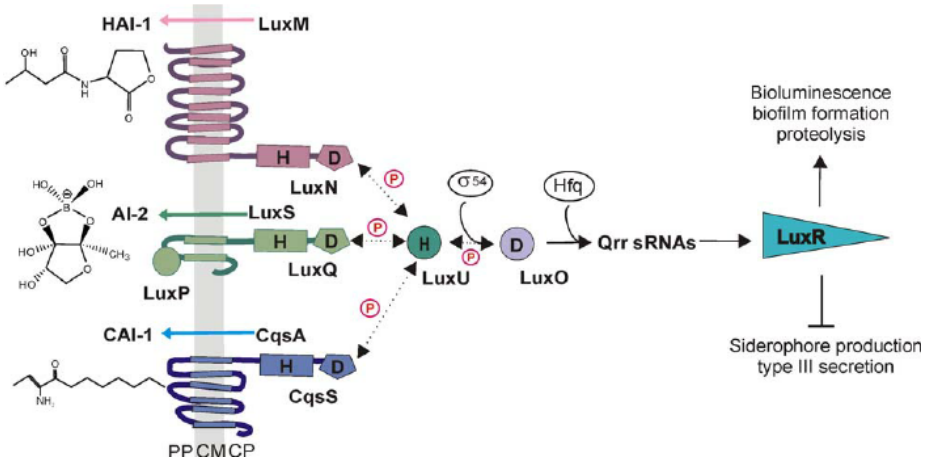
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	生物發光蛋白減少照射陽光的傷害 (Bioluminescent Proteins Reduce Solar Damage)
生物系統 LIVING SYSTEM	哈維氏弧菌 (*Vibrio harveyi*)
功能類別 FUNCTIONS	#以生物發光刺激 DNA 修復 #生物發光以自由基引發劑及活性氧提供釋放光子所需的能量 #將電離紫外線輻射活性物質引導至發光途徑用以消除有害物質 #Stimulates DNA repair by activation of the photoreactivation process #Bioluminescence uses radical initiators or reactive oxygen species in order to provide the energy required to release a photon #Channeling some of the reactive species produced by the ionizing UV radiation into their bioluminescent pathways in order to eliminate the harmful substances
作用機制標題	哈維氏弧菌透過將紫外線能量引導至生物發光蛋白來保護自己免受紫外線輻射的破壞性影響。 (Vibrio harveyi bacteria protect themselves from the damaging effects of UV radiation by channeling the UV energy to bioluminescent proteins.)
生物系統/作用機制示意圖 (確認版權、註明出處；畫質)	 (Anetzberger, Claudia & Reiger, Matthias & Fekete, Agnes & Schell, Ursula & Stambrau, Nina & Plener, Laure & Kopka, Joachim & Schmitt-Kopplin, Ph & Hilbi, Hubert & Jung, Kirsten. (2012). Autoinducers Act as Biological Timers in Vibrio harveyi. PloS one. 7. e48310. 10.1371/journal.pone.0048310.

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

生物發光是細菌的一種有些令人困惑的適應結果。與大型的多細胞生物不同，細菌不會利用生物發光的特性來捕捉獵物或尋找配偶。最近的研究甚至顯示了，在正常條件下，生物發光細菌無法與自身的不發光細菌共同競爭，因為它們在看似無用的發光過程中浪費了大量的能量。然而，當暴露在紫外線下時，能夠執行生物發光的菌株最終在培養產物中占非常大的比例。這顯示了生物發光在某種程度上與防止電離輻射所造成的傷害有關。研究表明，生物發光需要自由基誘發劑或活性氧來提供釋放光子所需的能量。可以想像，細菌能夠將電離紫外線輻射產生的一些活性物質引導到其生物發光途徑中，以消除對其有害的物質。

Bioluminescence is a seemingly confusing adaptation for bacteria. Unlike large multicellular organisms, bacteria do not use it to catch prey or find mates. Recent research has even shown that under normal conditions, bioluminescent bacteria cannot compete with non-luminescent versions of themselves since they are wasting so much energy on the seemingly useless process. However, when exposed to UV light, the luminescent strains eventually came to dominate the cultures. This suggests that the bioluminescence is somehow related to preventing damage from the ionizing radiation. Research has demonstrated that bioluminescence requires radical initiators or reactive oxygen species in order to provide the energy required to release a photon. It is conceivable that bacteria are capable of channeling some of the reactive species produced by the ionizing UV radiation into their bioluminescent pathways in order to eliminate the harmful substances.

文獻引用 (REFERENCES)

「這表明，如果沒有選擇壓力，發光對細菌來說是不利的，這可能是由於消耗了大量細胞能量。然而，當重複相同的實驗但用低紫外線劑量照射培養物時，發光細菌在照射後不久就開始占主導地位。」 (Czyż et al. 2003: 140)

「涉及分子氧的化學氧化反應符合這一標準（O. Shimomura, Bioluminescence: Chemical Principles and Methods (World Scientific, Toh Tuck Link, Singapore, 2006))，這可以解釋為什麼生物發光反應的主要機制涉及過氧化物鍵的斷裂 (Rees J. F., et al., The origins of marine bioluminescence: Turning oxygen defence mechanisms into deep-sea communication tools. J. Exp. Biol. 201, 1211 (1998)) 」 (Widder et al. 2010:704)

“[T] This indicates that, without a selective pressure, the luminescence is a disadvantage for bacteria, perhaps due to consumption of significant portion of cell energy. However, when the same experiments were repeated but cultures were irradiated with low UV doses, luminescent bacteria started to predominate shortly after the irradiation.”(Czyż et al. 2003:140)

“[T]Chemical oxidation reactions involving molecular oxygen fit this criterion (O. Shimomura, Bioluminescence: Chemical Principles and Methods (World Scientific, Toh Tuck Link, Singapore, 2006)), which may explain why the primary mechanism operating in bioluminescent reactions involves the breakdown of a peroxide bond (Rees J. F., et al., The origins of marine bioluminescence: Turning oxygen defence mechanisms into deep-sea communication tools. J. Exp. Biol. 201, 1211 (1998)).”

參考文獻清單與連結 (REFERENCE LIST) **Harvard 或 APA 格式**

Czyż, A., Plata, K. and Węgrzyn, G. (2003), Stimulation of DNA repair as an evolutionary drive for bacterial luminescence. Luminescence, 18: 140-144. (https://doi.org/10.1002/bio.715)
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