
Deeper into the mechanistic approach of the shark luminescence control

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Abstract

Slendertail lanternshark, *Etmopterus molleri*, displays a hormonal control to regulate its bioluminescence. Luminous organs, photophores, are composed of a cup-shaped pigmented cells enclosing the emitting cells, photocytes, surmounted by a multilayer cell zone called the iris-like structure (ILS) and topped by one or several lens cells. ILS cells, acting as a light organ shutter, contains many cells endowed with melanin pigments allowing the modulation of the light output. Previous studies demonstrated that prolactin (PRL) and melatonin (MT) trigger the emission of light, while alpha melanocyte stimulating hormone (α -MSH) inhibits the luminescence. These hormones are known to be involved in the regulation pathway of vertebrate skin pigmentation for shallow-water sharks. In this study, we investigated the effect of proteins involved in the pigmentation pathway on the light emission: adenocorticotrophic hormone (ACTH), cAMP-dependent protein kinase (PKA), protein kinase C (PKC) but also the two main cytoplasmic motor of vesicle movement in cells, dynein and kinesin proteins. ACTH acting as a melanin pigment degranulation factor, active PKA and PKC acting on the pigment granule dispersion by phosphorylating attachment sites of kinesin to microtubules. Kinesin is responsible for intracellular centrifugal movement of pigment granule, conversely to dynein which carry organelles on microtubules to the center of the cells. Results demonstrated, first, that ACTH inhibits the light emission like α -MSH. The implication of pigmentation pathway on the bioluminescence control is highlight by several evidences. These results suggest a functional switch from the skin pigmentation control to the luminescence control mechanism through the melanocyte pigmentation within the ILS cell layer. The ancestral mechanism of countershading to camouflage the body and mimic the background in the shallow-water sharks was hypothetically coopted for the counterillumination system of the lanternshark and possibly bioluminescent sharks in general.

Keywords: Luminescent shark / Etmopteridae / hormonal control / pigmentation / intracellular pathway / pharmacology

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