
Light on the photocytes of a brittle star: a combinatorial microscopy approach

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Abstract

The brittle star *Amphiura filiformis* is classically present in muddy environments along the European shores. This burrowing species emits a blue light at the level of its arms when mechanically stimulated [1,2]. The fact that some echinoderm species are able to produce light has been known for more than two hundred years [3]. However, the distribution and fine morphology of the luminous areas including the luminous cells -the so-called photocytes-, as well as the biochemistry of the reaction [4,5] are still globally unclear and understudied. Using macrophotography with brilliance intensification, light-microscopy, scanning and transmission electron microscopy, immunofluorescence microscopy and X-ray microtomography, we investigated the fine structure of the photogenous tissues and cells within the brittle star adult tissues. Photocytes appear intimately associated with the spine nerve plexus as well as with mucus cells and pigment cells. Ultrastructural modifications of the photocytes were observed during light-emission. Additional data on the enzyme involved in the bioluminescence reaction were also used to specifically immunolocalise the photocytes. Finally, our study highlighted the complex structure of the brittle star spine whose calcareous skeleton is most probably involved in light guidance of the naturally-produced luminescence signal.

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References

Mangold, E. (1907). Leuchtende Schlangensterne und die Flimmerbewegung bei Ophiopsila. Pflügers Archiv European Journal of Physiology, 118(11), 613-640.

Reichensperger, A. (1908). Die drüsengebilde der ophiuren. Z Wiss Zool, 91, 304-350.

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Viviani, D. (1805). *Phosphorescentia maris quatuordecim lucescentium animalculorum novis speciebus illustrata*. typ. J. Gioffi.

Shimomura, O. (2006). *Bioluminescence: chemical principles and methods*. World Scientific.

Mallefet J. et al. (2013). *Echinoderms in a changing world*, Blakema, 293.

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