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Review

UV-Protective Compounds in Marine Organisms from the Southern Ocean

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Received: 12 July 2018; Accepted: 12 September 2018; Published: 14 September 2018

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Abstract: Solar radiation represents a key abiotic factor in the evolution of life in the oceans. In general, marine, biota—particularly in euphotic and dysphotic zones—depends directly or indirectly on light, but ultraviolet radiation (UV-R) can damage vital molecular machineries. UV-R induces the formation of reactive oxygen species (ROS) and impairs intracellular structures and enzymatic reactions. It can also affect organismal physiologies and eventually alter trophic chains at the ecosystem level. In Antarctica, physical drivers, such as sunlight, sea-ice, seasonality and low temperature are particularly influencing as compared to other regions. The springtime ozone depletion over the Southern Ocean makes organisms be more vulnerable to UV-R. Nonetheless, Antarctic species seem to possess analogous UV photoprotection and repair mechanisms as those found in organisms from other latitudes. The lack of data on species-specific responses towards increased UV-B still limits the understanding about the ecological impact and the tolerance levels related to ozone depletion in this region. The photobiology of Antarctic biota is largely unknown, in spite of representing a highly promising reservoir in the discovery of novel cosmeceutical products. This review compiles the most relevant information on photoprotection and UV-repair processes described in organisms from the Southern Ocean, in the context of this unique marine polar environment.

Keywords: antarctica; UV radiation; ozone hole; climate change; marine organisms; sunscreen; UV-absorbing molecules; antioxidants; DNA repair; cosmeceuticals

1. Introduction

Ultraviolet radiation (UV-R) is one of the most critical abiotic factors for life on Earth. In spite of the beneficial effects, sunlight can also threaten living organisms, and excessive UV-R of certain wavelengths can promote damage in their molecular machineries. Such deleterious processes can alter marine ecosystems productivity, thus affecting species diversity, ecosystem stability, trophic interactions, and global biogeochemical cycles [1] (Figure 1).

The ozone layer in Earth's atmosphere acts as a shield by absorbing biologically harmful solar UV-B (290–315 nm). However, each spring, large ozone holes develop over the Southern Hemisphere, increasing the amount of UV-B that reach the Antarctic marine environments [2]. The ecological consequences of springtime ozone depletion are directly correlated with the tolerance of species to