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Photoprotection properties of marine photosynthetic organisms grown in high ultraviolet exposure areas: Cosmeceutical applications

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ABSTRACT

Seaweeds have been identified as promising sources of bioactive substances for the cosmeceutical industry, especially by their photoprotection capacity. Accordingly, this study aimed to evaluate the photoprotective properties of extracts from macroalgae and one marine lichen. Samples of 22 species of macroalgae and one marine lichen, were collected along the southern Iberian Peninsula. Hydroethanolic extracts were prepared from algal and marine lichen lyophilized biomass. Ultraviolet (UV) and visible absorption spectra, polyphenol content, antioxidant activity, mycosporine-like amino acid content and composition were analyzed. In order to quantify the photoprotection capacity of the extracts against different biological effects, two new indices were used, i.e., effective solar absorption radiation (%ESAR) and extract photoprotection index (EPI), considering the radiation absorbed and transmitted by the extract, respectively. In the ultraviolet spectrum, *Porphyra umbilicalis* and *Pyropia elongata* presented the highest absorbance values at 330 nm, while *Ulva lactuca* showed a prominent peak at 290 nm. In the visible spectrum, a fucoxanthin peak (450 nm) was strongly evident in extracts from the brown algal species, while green algal extracts presented characteristic chlorophyll *a* and *b* peaks at 447, 620 and 664 nm. Polyphenol content and antioxidant activity were much higher in *Sargassum vulgare*, *Carpodesmia tamariscifolia*, *P. umbilicalis* and *Lichina pygmaea* in comparison to the other species. *P. umbilicalis* and *Bangia atropurpurea* showed the highest amount of mycosporine-like amino acids. *S. vulgare* and *P. umbilicalis* extracts presented the highest values of potential photoprotection against all analyzed biological response according to the different action spectra. *S. vulgare* and *P. umbilicalis* showed an increase in %ESAR values associated with an increase in the concentration of their extracts. Considering the analyzed species, our results suggest that *S. vulgare* and *P. umbilicalis* could be potential sources of photoprotective extracts. The potential use of these species in cosmeceutical products is discussed.

1. Introduction

Ultraviolet (UV) radiation that reaches the Earth's surface is divided into UV-B (290–320 nm), UV-AII (320–340 nm) and UV-AI (340–400 nm) [1]. In algae and other photosynthetic organisms, UV radiation may play important roles, influencing photoperiodic responses and aspects of metabolic development [2]. On the other hand, UV radiation is easily absorbed by molecules, such as DNA and proteins, and can present harmful effects, such as the generation of reactive oxygen species (ROS) [3,4].

Both UV-A and UV-B can be absorbed by biomolecules of the human skin. UV-B radiation is fully retained by the stratum corneum and upper layers of the epidermis, while UV-A penetrates more deeply [5]. UV-B radiation is also absorbed by DNA, causing direct damage such as mutations and the formation of toxic byproducts. UV-A radiation is strongly related to the formation of ROS, altering and inducing the expression of a series of collagen and elastin degrading enzymes, resulting in photoaging responses. In general, both UV-A and UV-B radiation induce mutations that can result in carcinomas [5,6].

Exposure of human skin to UV radiation can produce short-term effects, such as erythema (skin redness), sunburn and pigmentation, as well as long-term effects, such as photoaging responses, carcinomas,

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