

Article

UV Photoprotection, Cytotoxicity and Immunology Capacity of Red Algae Extracts

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Abstract: This study was designed to evaluate the potential use of algal extracts in cosmeceuticals, including factors related to biosecurity. The aqueous crude extracts of *Hydropuntia cornea* and *Gracilaria longissima* showed a good photoprotective capacity (Sun Protection Factor, SPF) due to, among other reasons, the presence of five types of mycosporine-like amino acids (MAAs) detected by high pressure liquid chromatography-photodiode array detector (HPLC-PDA) and electrospray ionization mass spectrometry (ESI-MS) (Palythine, Asterina-330, Shinorine, Porphyra-334, and Palythanol). The toxicity of the extracts was evaluated by the MTT assay, which is based on the metabolic reduction of MTT [3-(4,5-dimethylthiazol-2-yl)-diphenyl tetrazolium bromide] by the action of the mitochondrial enzyme succinate dehydrogenase. This assay was carried out in vitro in three cell lines: one related to the immune system (murine macrophages of the immune system: RAW264.7) and two human cell lines related to the skin (gingival fibroblasts: HGF, and immortalized human keratinocytes: HaCaT). Both extracts showed no cytotoxic activity in both types of human cells, whereas they showed cytotoxicity in murine tumor cells of the immune system (macrophages: RAW264.7). On the other hand, the immunological activity in the murine macrophage RAW264.7 was studied at a concentration lower than 100 $\mu\text{g mL}^{-1}$ and lower than the EC_{50} , and evaluated by the production of pro-inflammatory compounds through an immunosorbent assay linked to enzymes such as tumor necrosis factor- α (TNF- α) or anti-inflammatory/proinflammatory enzymes such as interleukin-6 (IL-6). Both algae extracts induced the biosynthesis of TNF- α and IL-6. The production of TNF- α was much higher than that observed in the control (at a concentration of the aqueous extract higher than 5 $\mu\text{g mL}^{-1}$). These results support the theory that the extracts of *H. cornea* and *G. longissima* actively induce the production of cytokines. In summary, the extracts of these species did not show cytotoxicity in human cells, and they present with immunomodulatory and photoprotection capacity.

Keywords: cytotoxicity; cytokine production; interleukin-6; mycosporine-like amino acids; photoprotection; red algae extracts; tumor necrosis factor- α

1. Introduction

The cytotoxic effects of algal extracts on different cell lines are currently being studied largely due to the safety requirements of the cosmetic industry [1,2]. Within these studies, cytotoxic activity in cancer and tumor cell lines has become one of the most important specificities of algae; in fact, many species have shown such bioactive effects [3,4]. Additionally, the dermocosmetic industry is investigating the application of new components in their products that have cytotoxic effects in melanoma and other skin disorders [5], but without cytotoxic activity in dermal cells [6]. The algal