World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:19, No:03, 2025

Application of a Porphyridium cruentum Exopolysaccharide as a Hyaluronic Acid-like Cosmetic Active Ingredient

Authors : F. Havas, M. Cohen, S. Krispin, J. Attia-Vigneau

Abstract : The work presented here demonstrates the Hyaluronic-acid like biological properties of an exopolysaccharide produced by Porphyridium cruentum, in the context of skin cosmetic applications. Red microalga Porphyridium cruentum has emerged as a promising candidate for biotechnological applications due to its unique biochemical profile and robust growth characteristics. In particular, this species is interesting for the sulfated exopolysaccharide (EPS) which produces as a key component of the defense mechanisms through which this alga can survive in the challenging intertidal and spray zone, without even a cell wall of its own. This EPS contains ca. 10% glucuronic acid, has a degree of sulfation of ca. 7%, and exists in a very wide range of molecular weights (140-6000 kDa). Found in the skin's extracellular matrix, the vital polysaccharide Hyaluronic acid (HA) plays important roles in tissue hydration, elasticity, and skin plumpness (volume). But with aging, HA production decreases, and the HA still produced can bear structural flaws and diminished functionality – reducing the skin's moisture retention capacity and firmness, and increasing wrinkles and other signs of aging. HA is commonly used as an anti-aging active, via injections or topically. While the former are costly, uncomfortable, and can have undesirable side effects, the latter is not always sufficiently effective. Porphyridium cruentum was cultivated outdoors in natural sunlight, in the Northern Negev desert of Israel, using vertical flexible sleeve reactors. The EPS was separated from the culture medium by crossflow ultrafiltration, generating a viscous gel containing ca. 1% of dry EPS. This gel was in turn incorporated at 1% in a simple model cream formulation, which was tested in a 28-day double-blind clinical trial on a population of habitual HA users, alongside two controls: a placebo, and a benchmark containing a combination of two different HA molecular weight ranges. The EPS delivered significant HA-like skin benefits in terms of plumpness, hydration, and radiance, and reduced signs of aging (wrinkles, skin roughness, and visible spots). Many of these effects were significant when assessed after as little as 1h and/or 24h (i.e. following a single application). Tellingly, the EPS generally equaled or exceeded the HA benchmark. In vitro, this EPS also significantly increased procollagen I production in normal human dermal fibroblasts. These results demonstrate this EPS's meaningful and swift HA-like biological activity, thereby indicating its potential for applications in cosmetic formulations, as a safe, natural, and arguably more powerful HA-like alternative. Combined with the relative ease of its cultivation, this contributes to Porphyridium cruentum's increasing attractiveness for applications in cosmetics, nutraceuticals, and pharmaceutical industries.

Keywords : cosmetics, exopolysaccharide, hyaluronic acid, microalga, porphyridium
Conference Title : ICABA 2025 : International Conference on Algal Biotechnology and Applications
Conference Location : New York, United States
Conference Dates : March 17-18, 2025