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Marine alternative to hyaluronic acid?

Marine Alternative zu Hyaluronsäure?

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Background Information

Advantages of biotechnological cosmetic actives

Biotechnology encompassing the use of living microorganisms to obtain natural molecules for a specific use, such as cosmetic ingredients with particular benefits. This technology allows to obtain complex molecules, which could be impossible to get through chemical reactions, due to technical or economic limitations. In fact, the use of science and engineering in the manufacturing processes helps to achieve an optimal bioprocess performance, which yields a right growth and maximal productivity of a microorganism. The result is the obtention of well-defined molecules and with a greater reproducibility.

Marine ecosystems

The sea covering around 70% of our planet's surface and representing the highest percentage of the living biosphere in the planet is the greatest source of biodiversity. Marine environments are completely different from terrestrial ones. As marine microorganisms live in complex and/or extreme ecosystems, and can be exposed to high levels of salinity, temperature and pressure gradients, toxic elements, oxidative conditions, etc., they have had to develop several ways of protecting themselves, against these environmental attacks.

Intertidal rocky shores are highly dynamic systems that are exposed to a combination of harsh factors, such as wave action, thermal and desiccation stress, UV exposure and nutrient depletion. The relative frequency of these fluctuations poses both physical and biochemical challenges to microorganisms which live in this environment¹.

Organisms that inhabit these areas suffer from desiccation when the tide recedes. The removal of water from cells, the storage of cells in the air-dried state, and the rewetting of air-dried cells impose physiological constraints that few organisms can tolerate. Water molecules are critical components of reaction mechanisms; they contribute to the stabilities of proteins, DNA, and lipids; and they confer a structural order upon cells. The removal of that water can, depending on the quantity removed, cause mild, moderate, severe, or extreme water deficit².

Exopolysaccharides

Desiccation appears to induce the production of copious amounts of microbial exopolysaccharides (EPS), presumably of a highly hygroscopic nature. As the atmospheric exposure of intertidal habitats after emersion also produces desiccation stress on extant microbial communities, it is reasonable to hypothesise that these habitats are likely to harbour diverse bacteria capable of producing polysaccharides³.

Polysaccharides occur as important constituents of plant and microbial cell walls, either as storage polysaccharides or as biopolymers known as exopolysaccharides secreted by microorganisms.

The production of EPS is a general property of microorganisms in natural environments and it has been shown to occur both in prokaryotic – Bacteria, Archaea – and in eukaryotic – algae, fungi – microorganisms. Bacterial polysaccharides possess a wide variety of properties that may not be found in more traditional polymers of plant origin.

In recent years, there has been a growing interest in the isolation and identification of new microbial polysaccharides that might have novel uses. Due to their many interesting physical and chemical properties, e.g., stabilising, suspending, thickening, gelling, coagulating, film-forming, and water retention capability, polysaccharides have found applications in many industrial sectors, e.g., in detergents, cosmetics⁴.

The exopolysaccharides (EPS) synthesised by microbial cells vary greatly in their composition and hence in their chemical and physical properties. Some are neutral macromolecules, but the majority are polyanionic due to the presence of either uronic acids (D-glucuronic acid being the commonest, although D-galacturonic and D-mannuronic acids are also found) or ketal-linked pyruvate. Inorganic residues, such as phosphate or rarely sulphate, may also confer polyanionic status⁵.

Microorganisms inhabiting intertidal zones have developed several activities to protect themselves, from heavy waves, tidal action and intermittent exposure to UV-radiation. Different marine bacterial strains with different physiological and biochemical characteristics from sources of marine environments can produce EPSs with different chemical structures and bioactivities. Although many of these EPSs present unique properties, the search for new EPS-producing microorganisms is still promising. In fact, marine bacteria have become increasingly popular and novel sources of EPSs⁶.