Extremophiles: A Source of Pharmacologically Important Biomolecules

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ABSTRACT

Extremophiles are microorganisms that can survive and thrive in extreme conditions, such as high temperatures, salinity, fluctuations in pH, acidity, pressure, alkalinity, radiation, dryness, and more. These microorganisms are adapted to these environments and have developed survival mechanisms, including genetic changes leading to molecular modifications allowing thermostability and other properties linked to their resistance to harsh conditions. Extremophiles, with their adaptations, are found in bacteria, fungi, and microalgae, and it is essential to highlight that their bioproducts have special characteristics. For instance, enzymes from psychrophiles from polar regions and glaciers are adapted to cold environments, increasing the number of unsaturated fatty acids; a charged cell wall with teichurono peptide and teichuronic acid or polyglutamic is found in extremophiles that inhabit soda lakes. Several other adaptations are reported. Due to the diversity of microorganisms and their unique properties, this group has become the focus of various biotechnological applications spanning multiple sectors, including cosmetics, bioenergy, food processing, agriculture, dairy, bioremediation, and the pharmaceutical industry. Bioactive compounds and enzymes with antimicrobial, anticancer, and immunomodulatory properties have several applications in the pharmaceutical/medical sector, where they can be used to develop novel drugs and therapies for treating complex diseases. Peptidases such as thermolysin obtained from *Bacillus thermoproteolyticus* are used *to* synthesize dipeptides. It had been demonstrated that Extremophilic fungi produce various compounds with anticancer effects in culture cells, such as Cryptosporin synthesized by *Acaromyces ingoldii* isolated from deep-sea sediment and Engyodontiumones H by *Engyodontium album* from Marine sediment. Extremophile microalgae produce biotechnological products, including pigments, oils, and proteins. The pigments are potent antioxidants promoting the stimulation of the immune systems against several diseases, including coronary heart disease, besides their potential use in sunscreen. Ectoin, a secondary metabolite produced by halophiles, is applied in the pharmaceutical industry in health-promoting and therapeutic

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activities. All these characteristics make extremophiles a valuable natural source of bioproducts with a wide range of applications.

Keywords: Extremophiles, Bioactive compounds, Therapeutic compounds, Antioxidants

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