# Chapter 29
# Extremophiles as a Source of Biotechnological Products

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## ABSTRACT

*Extremophile and extremozyme capabilities to uphold catalytic actions under extreme situations open up a varied array of biotechnological applications. Extremophiles are a rich supply of biocatalysts used for innumerable purposes. Bioactive molecules and enzymes isolated from organisms inhabiting risky environments being used in biological innovation pipelines and pharmaceutical have positive claims. The species biodiversity has favourable reservoir of the unexploited amalgams with biotechnological significance. Prospective solicitations of extremozymes, chiefly as catalysis of multistep progressions, quorum sensing, bioremediation, biofuel, biodiversity and prospecting, biomining, and genetic technology are explored. To boost the biotechnological uses of extremozymes, research and development efforts are needed to address hurdles such as extremophile culture, gene expression in host cells, and extremozyme bioprocessing. Extremophiles can be a resource for innovative biotechnological comprising industrial biotechnology, agriculture, medical, food, and environmental biotechnology.*

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## INTRODUCTION

The term extremophile was coined by Mac Elroy in 1974, more than a quarter-century ago. An extremophile is a relative term, as what is "extreme" for one entity may be "essential" for another's survival. Extremophiles are organisms that potentially grow in extreme environmental conditions. Some groups of organisms are competent to survive in multiple harsh conditions. The intense environmental condition can include temperature, pressure, radiation, salt conditions, pH, oxygen condition, redox potential (Rothschild & Mancinelli, 2001). Extremophiles are classified as thermophiles (Higher temperature 55-113°C), psychrophiles (Low and below 0°C), halophiles (High salinity), acidophiles. Alkalophilic (alkaline or acidic pH), piezophiles (higher pressure), saccharophiles (high sugar concentration), metallophiles (resistance for heavy metal), and polyextremophiles (Two or more extreme environments). Numerous taxonomic studies have revealed that these species are classified broadly into three groups: Archaea, Bacteria, and Eukarya. (Dalmaso, Ferreira, & Vermelho, 2015). Biotechnology has a crucial part in day-to-day lives from food and drinks like lactose-free milk (Coker & Brenchley, 2006), Bioinsecticide (Rubio-Infante & Moreno-Fierros, 2016), Enzymes like cellulase (Miettinen-Oinonen & Suominen, 2002), lipases (Joseph, Ramteke, & Thomas, 2008). Extremozymes are enzymes that function in extreme or unusual physicochemical conditions, such as extreme heat and cold, low pH and pressure, high salinity, low water activity, low oxygen, and so on. In many industries which utilize proteins, enzyme processing is carried out in extreme conditions, which include high or low temperature, pH, and salinity with an intervention of biotechnology and extremophiles, which can prevent the deproteination and loss of activity of enzymes. In this chapter, we initially discuss the extremozymes and their successful industrial and biotechnological applications, further followed by the application of extremophiles in biomining, biofuel production in industries where they can be the source of invaluable components through the application of biotechnology. Flow chart of outline extremophiles classification and application is described in figure 1. A number of reports and reviews highlight the advancement of methods for investigating extremophiles, including the use of proteomics for studying extremophiles and a multiplex approach for quantifying fine-scale temperature-induced proteome alterations. Modern biotechnological approaches can generate or activate the radiation-responsive metabolites, pigments, and enzymes they create to produce effective pharmaceuticals, including anti-cancer treatments, as well as antibiotics and commercially important agricultural goods. The benefits of extremozymes in the fields of therapeutics and biotechnology, on the other hand, have not been proven. The purpose of this article is to explain the tactics that bacteria adapt to flourish in radiation-rich settings, as well as their possible applications in biotechnology and therapeutics.

## EXTREMOZYME

The extremozyme is the enzyme from thermophilic, psychrophilic, acidophilic, alkaliphilic, and halophilic microorganisms, which are resistant to extreme environmental conditions. Due to their biodegradability and exceptional stability, extremophilic microbes are a source of extremozymes with an extensive range of commercial uses. Cold-tolerant extremozymes, acid-tolerant extremozymes, alkali-tolerant extremozymes, and salt-tolerant extremozymes have all helped to generate a varied range of resistant biomolecules for industrial purposes. (Ricardo Cavicchioli, Siddiqui, Andrews, & Sowers, 2002).