

Advancing Green Energy: Screening Extremophiles and Enzymes for Low Carbon Biofuel Production

Anjali Gupta¹, Shubham Pandey¹, Bhavna Parmar¹, Ashwini Chauhan¹,
Kuo-Wei Huang^{2*}, Ram Karan^{1*}

¹Department of Microbiology, University of Delhi South Campus, New Delhi,
India, 110021

²KAUST Catalysis Center and Division of Physical Science and Engineering, King Abdullah
University of Science and Technology, Thuwal 23955-6900, Saudi Arabia

*Corresponding author

ABSTRACT

The rising human population and ongoing developments are driving global energy demand and will continue to rise 25–50% by 2050. Currently, most energy is generated from non-renewable fossil fuels, which significantly contributes to greenhouse gas emissions and global warming. This highlights an urgent need for sustainable energy alternatives like biofuels. Utilizing lignocellulosic waste including agricultural residues and forest biomass—for second-generation biofuel production holds great promise for both the environment and the economy. Extremozymes, known for their stability under extreme conditions such as high salinity, elevated temperatures, and extreme pH, are particularly suited for biofuel production. The discovery and application of such robust biocatalysts can enhance process efficiency, reduce production costs, and make biofuels more commercially viable. We isolated 150 microbial strains from diverse extreme environments, producing key biofuel enzymes such as cellulase and xylanase. We observed significant enzyme activity under haloalkaliphilic conditions (5-20% w/v salinity, pH 8.0-9.0). These strains also produced other industrially valuable enzymes, including amylase, protease, esterase, and lipase. Further optimization and scale-up of these biocatalytic processes could pave the way for sustainable, low-carbon biofuel production on an industrial scale. These results demonstrate the promise of extremophiles and their enzymes for sustainable biofuel generation and industrial processes, paving the way for a greener tomorrow.

Keywords: Biofuels; Renewable fuels; Sustainability; Biocatalysts; Biotechnology; Extremophiles; Extremozymes.

How to Cite

Anjali Gupta, Shubham Pandey, Bhavna Parmar, Ashwini Chauhan, Kuo-Wei Huang, Ram Karan, “Advancing Green Energy: Screening Extremophiles and Enzymes for Low Carbon Biofuel Production”, *AIJR Abstracts*, p. 30, Mar. 2025.

