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Discovering Enzybiotics in Metagenomes: Innovative Enzymes as Sustainable Alternatives to Antibiotics

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Abstract:

The global rise in antibiotic resistance has necessitated the exploration of innovative and sustainable alternatives to traditional antibiotics. This study introduces "enzybiotics," enzymes derived from metagenomic datasets that target and degrade bacterial cell components such as DNA, polysaccharides, and proteins, as a promising solution. Enzybiotics disrupt bacterial growth and biofilm formation through various mechanisms, such as degradation of cell walls, disruption of DNA replication, and interference with essential metabolic processes[1,2] . Leveraging metagenomics, the study of genetic material from environmental samples allows access to diverse microbial communities[3,4]. These include those from extreme habitats and plant/animal microbiomes, which offer a source of novel enzymes with unique functionalities[5–7]. Advanced bioinformatics pipelines and machine learning techniques enable the efficient mining of metagenomic data, prediction of enzymatic activities, and prioritization of high-potential candidates. Unlike conventional antibiotics, enzybiotics offer versatility and function independently or synergistically to prevent or degrade biofilms. This dual-action capability positions enzymes as robust biocatalysts for applications in food safety, healthcare, agriculture, and environmental sustainability.

State-of-the-art biotechnological tools, including protein engineering, domain swapping, and high-throughput DNA sequencing, have enhanced the discovery and optimization of these enzymes. This research not only highlights the immense potential of enzybiotics to revolutionize biotechnological processes but also underscores their critical role in addressing pressing global challenges, such as antibiotic resistance and microbial spoilage.

This research demonstrates the potential of enzybiotics as sustainable alternatives to traditional antibiotics. By integrating metagenomics and advanced biotechnological tools, this study paves the way for novel solutions to combat antibiotic resistance and to promote environmental and human health.

Key words: metagenomic, enzybiotics, biotechnological tools, antibiotic resistance.

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