Title

Uncovering Evolutionary and Ecological Insights through Comparative Genomics of Purple and Green Sulfur Bacteria

Authors

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Abstract

The goal of this study is to perform a comparative genomic analysis between Purple Sulfur Bacteria (PSB) and Green Sulfur Bacteria (GSB) to investigate genetic similarities and differences that shape their ecological strategies and evolutionary adaptations. Sulfur bacteria are essential components of the global sulfur cycle, but the genomic basis underlying their habitat preferences and metabolic specialization is not fully understood. These bacteria can survive in places that include hypersaline lakes, marine sediments, hot springs, and other sulfur-rich environments where PSB and GSB play complementary but ecologically distinct roles.

This study applies orthology-based clustering (Ortho-Venn3) and phylogenomic analyses to identify conserved and lineage-specific protein families, focusing on genes involved in sulfur metabolism, phototrophy, pigment biosynthesis, and adaptation to extreme environments. By examining orthologous gene clusters, we highlight both core genomic elements that unify PSB and GSB as well as distinct genetic innovations that differentiate the two groups. Particular attention is given to pathways supporting sulfur oxidation and reduction, light-harvesting complexes adapted to different wavelengths, and stress-response mechanisms that promote survival in the diverse ecological niches.

The expected outcome is to establish a genomic framework that links specific genetic traits with environmental adaptation, offering insights into the evolutionary divergence between PSB and GSB and their contributions to biogeochemical cycling. Ultimately, this work seeks to deepen our understanding of how genomic differences underpin their ecological function, while laying the foundation for future studies of microbial evolution in sulfur-based ecosystems.