Diversity of Thermophilic Archaea and Possible Applications at Al-Lith Hot Spring, Saudi Arabia

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ABSTRACT

Hot spring is rich in microbial diversity and a valuable resource for many industrial and medical applications which helped revolutionize many aspects of microbial studies for science and scientists. Thermophilic archaea are extreme prokaryotes that can live and thrive in Hot Springs with high temperatures and are known for unique metabolic pathways and resilience. Their unique adaptation has helped in significant biotechnological applications such as thermostable enzymes DNA polymerase and can play an important role in extracting metals. Exploring the microbial diversity of Al-Lith Hot Spring not only enhances our understanding of extremophiles but also opens avenues for innovative applications in biotechnology, pharmaceuticals, and environmental management. This study aims to uncover the potential of thermophilic archaea from this unique geothermal site for various industrial and scientific advancements. Samples were collected from the hot spring water, sediment, and wet shore. Total genomic DNA was extracted from the collected samples. Then, DNA samples were prepared for shotgun metagenomic sequencing to explore and point out the diversity of archaea and their Potential applications. Bioinformatic analysis revealed The archaeal kingdom of the SS sample showed (1%), SW (2%), and (0.8) in the total microbial community across the three samples, 28 phyla, the most abundant species was, *Candidatus Nitrosotenuis chungbukensis by 35% in the respected genus, Thaumarchaeota_archaeon_N4* by 92% in there respected phylum, Euryarchaeota_archaeon_SM23-78 14%, all those species showed the highest in there respected phylum's. *Candidatus Nitrosotenuis chungbukensis and Thaumarchaeota_archaeon_N4* Is a nitrogen fixation achaeas that play an important role in nitrogen cycle, it has a potential application in wastewater, agriculture, and environmental applications. While Euryarchaeota_archaeon_SM23-78 is well known for various metabolic capabilities including methanogenesis, halophily, and thermophily, it is , Methanogenesis utilizing methane into biofuel, and decomposing organic material in anaerobic environments it has potential application in developing biotechnological enzymes of tolerating high salt concentration it has potential in renewable energy production, environmental remediation,

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and industrial biotechnology. We conclude that the biotechnological applications can explore and improve our understanding of the treasures from research that can lead the Kingdom of Saudi Arabia to a better sustainable country to achieve the Saudi vision of 2030.

Keywords: *Microbial Diversity*, Hot Spring

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