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ORIGINAL RESEARCH ARTICLE

Genome Sequencing Revealed the Biotechnological Potential of an Obligate Thermophile *Geobacillus thermoleovorans* Strain RL Isolated from Hot Water Spring

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Abstract In the present study, we report the draft genome sequence of an obligate thermophile *Geobacillus thermoleovorans* strain RL isolated from Manikaran hot water spring located atop the Himalayan ranges, India. Strain RL grew optimally at 70 °C but not below 45 °C. The draft genome (3.39 Mb) obtained by Illumina sequencing contains 138 contigs with an average G + C content of 52.30%. RAST annotation showed that amino acid metabolism pathways were most dominant followed by carbohydrate metabolism. Genome-wide analysis using NCBI's Prokaryotic Genome Annotation Pipeline revealed that strain RL encodes for a cocktail of industrially important hydrolytic enzymes glycoside hydrolase, α-and β-glucosidase, xylanase, amylase, neopullulanase, pullulanase and lipases required for white biotechnology. In addition, the presence of genes encoding green biocatalyst multicopper polyphenol oxidase (laccase) and an anticancer enzyme L-glutaminase reflects the significance of strain RL in gray and red biotechnology, respectively. Strain RL is a thermophilic multi-enzyme encoding bacterium which could be the source for the recombinant production of biotechnologically significant enzymes. In, addition whole cells of strain RL may be used in bioremediation studies.

Keywords Thermophile · *Geobacillus thermoleovorans* · Draft genome · Hydrolytic enzymes · Bioremediation · Biotechnology

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Introduction

The thermophilic microorganisms possess several properties which have made them suitable for commercial applications [1]. The natural habitat for thermophiles ranges from deep volcanoes to hydrothermal systems and hot water springs. The human-created environments including compost, different industrial processes and water heaters are some other important habitat of thermophiles [1, 2]. As a consequence of their unique physiological adaptations, thermophilic microorganisms have enzymes which withstand high temperature. Thermostable enzymes are industrially important due to their stability under different processing conditions. The great stability of thermozymes under high temperatures, acidic and alkaline pH, solvents and detergents has raised the demand for bio-prospection of enzymes from thermophilic microorganisms [3, 4].

In recent years, thermophilic *Geobacillus* species have emerged as sources of various thermostable enzymes [5–11]. *Geobacillus stearothermophilus* has been extensively studied for xylanase production [6, 12, 13]. In addition, *Geobacillus* sp. HTA426 has been used for the production of thermophilic cellulase [14]. Moreover, *Geobacillus* species are known for the production of bacteriocins, exopolysaccharides, and biofuel, and also