Biosurfactant-Producing Potential of *Bacillus licheniformis* PW2 for Microbial Enhanced Oil Recovery

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Abstract

The search for efficient biosurfactant-producing microorganisms is an important step toward developing environmentally sustainable technologies for microbial enhanced oil recovery (MEOR). This study aimed to evaluate the biosurfactant-producing potential of *Bacillus licheniformis* PW2, isolated from formation water of the Akingen oil field in Western Kazakhstan, for potential applications in oil production.

Strain PW2 was identified by 16S rRNA gene sequencing, showing 99.15% sequence similarity to B. licheniformis (GenBank accession number: OP565017). Genetic analysis revealed the presence of both the lchAA and srfAA genes, which are associated with the biosynthesis of lichenysin and surfactin, respectively. Cultivation in the presence of crude oil resulted in a crude extract yield of 0.25 g/L. Fourier-transform infrared (FTIR) spectroscopy of the crude extract revealed absorption bands consistent with lipid- and peptide-associated functional groups, suggesting the presence of lipopeptide-type biosurfactant compounds. The culture supernatant reduced surface tension to 40.05 mN/m. In the oil spreading assay, a clearing zone of 2.9 ± 0.2 cm was observed, while the emulsification index after 24 h reached 61.2 ± 0.3%.

Bacillus licheniformis PW2 is a promising candidate for further investigation as a producer of lipopeptide-type biosurfactants. Its surface-active properties, genetic profile, and origin from oil-field formation water support further evaluation of its applicability in MEOR technologies.