SUMMARY

Biosurfactants are surface-active compounds produced by microorganisms. One source of biosurfactants is endophytic bacteria. Geothermal environments possess distinctive physicochemical characteristics, such as unique pH, temperature, and mineral composition. These conditions make geothermal areas highly promising habitats for the exploration of microorganisms capable of producing bioactive metabolites, including biosurfactants with superior properties and biological activities.

This research began with the identification of isolate D9 through morphological characterization and molecular analysis to determine its taxonomic relationship. Subsequently, biosurfactant production was carried out, and the optimum production time was determined based on the bacterial growth curve. Biosurfactant activity was evaluated through oil dispersion and emulsification index (E24) assays. Characterization was performed using methylene blue and Biuret tests to determine the ionic properties and biosurfactant class, followed by Fourier Transform Infrared Spectroscopy (FTIR) and Gas Chromatography–Mass Spectrometry (GC-MS) analyses. Biological activities were assessed through antibacterial testing against Propionibacterium acnes, antioxidant assays using DPPH, ABTS, and Ferric Reducing Antioxidant Power (FRAP) methods, and anti-inflammatory assays using protein anti-denaturation and protease inhibition methods.

The identification results indicated that isolate D9 is a Gram-positive bacterium closely related to Exiguobacterium indicum and Exiguobacterium acetylicum. The highest biosurfactant production was achieved during the early stationary phase at 132 h, with an oil dispersion diameter of 5.1 cm. The emulsification index (E24) of Bs-D9 reached 95%, nearly equivalent to that of sodium dodecyl sulfate (SDS) at a concentration of 1000 ppm. The methylene blue and Biuret tests showed that Bs-D9 is an anionic biosurfactant and does not belong to the lipopeptide class. FTIR and GC-MS analyses suggested that Bs-D9 belongs to the glycolipid group. The antibacterial activity of Bs-D9 against Propionibacterium acnes showed minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values of 150 ppm and 200 ppm, respectively. Antioxidant activity yielded IC_{50} values of 64.30 ppm (DPPH), 24.95 ppm (ABTS), and 115.30 ppm (FRAP). The anti-inflammatory activity was evaluated through a protein anti-denaturation assay and a protease inhibition assay, with IC_{50} values of 14.15 ppm and 330 ppm, respectively. Overall, Bs-D9 demonstrated significant biological potential, particularly as an antibacterial, antioxidant, and anti-inflammatory agent, highlighting its potential application as a natural active ingredient in skin care formulations.