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An efficient thermotolerant and halophilic biosurfactant-producing bacterium isolated from Dagang oil field for MEOR application

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Dagang Oil field (Petro China Company Limited) is one of the most productive oil fields in China. In this study, 34 biosurfactant-producing strains were isolated and cultured from petroleum reservoir of Dagang oil field, using haemolytic assay and the qualitative oil-displacement test. On the basis of 16S rDNA analysis, the isolates were closely related to the species in genus Pseudomonas, Staphylococcus and Bacillus. One of the isolates identified as Bacillus subtilis BS2 were selected for further study. This bacterium was able to produce a type of biosurfactant with excessive foam-forming properties at 37ºC as well as at higher temperature of 55ºC. The biosurfactant produced by the strain BS2 could reduce the surface tension of the culture broth from 70.87 mN/m to 28.97 mN/m after 8 days of incubation at 37ºC and to 36.15 mN/m after 20 days of incubation at 55ºC, respectively. The biosurfactant showed stability at high temperature (up to 120ºC), a wide range of pH (2 to 12) and salt concentrations (up to 12%) offering potential for biotechnology. Fourier transform infrared (FT-IR) spectrum of extracted biosurfactant tentatively characterized the produced biosurfactant as glycolipid derivative. Elemental analysis of the biosurfactant by energy dispersive X-ray spectroscopy (EDS) reveals that the biosurfactant was anionic in nature. 15 days of biodegradation of crude oil suggested a preferential usage of n-alkane upon microbial metabolism of BS2 as a carbon substrate and consequently also for the synthesis of biosurfactants. Core flood studies for oil release indicated 9.6% of additional oil recovery over water flooding at 37ºC and 7.2% of additional oil recovery at 55 ºC. Strain BS2 was characterized as an efficient biosurfactant-producing, thermotolerant and halophillic bacterium and has the potential for application for microbial enhanced oil recovery (MEOR) through water flooding in China's oil fields even in situ as adapted to reservoir chemistry and temperature.