ABSTRACT

The study is focused on the therapeutic applications of manganese oxide nanoparticles (MnO-NPs) developed using environment-friendly biological approach. Hydrogel was extracted from Quince (*Cydonia oblonga*) seeds and manganese oxide nanoparticles were synthesized from potassium permanganate precursor. The optical characterizations of synthesized particles were performed via Ultraviolet-Visible spectroscopy (UV-Vis analysis) and Fourier transform infrared spectroscopy (FTIR) while the morphological attributes were determined using Scanning electron microscopy (SEM) with Energy dispersive X-ray (EDX). MnO-NPs solution showed a peak of maximum absorption at 290 nm in the UV-Vis region. The FTIR analysis of hydrogel revealed the existence of alcohol, alkanes, carboxylic compounds, amine, and sulfoxide functional groups. The absorption peak at around 503.03 $cm^{-1}$was due to MnO-NPs, while other peaks ranging from 3232.42 to 1032.57 cm^{-1} indicated the existence of bio-components of hydrogel act as reducing or capping agents. SEM images showed morphology of MnO-NPs as rounded–shaped with average particle size of 83 nm. EDX spectrum identified the elemental composition and weight percentages of manganese (8.43) and oxygen (38.27) atoms. Antimicrobial activity was assessed against three different bacterial pathogens i.e., Gram-positive (*Bacillus licheniformis*) and Gram-negative (*Escherichia coli* and *Aeromonas*). The activity of MnO-NPs towards tested strains was comparable to standard drug i.e., Rifampicin. . Lowest concentrations of MnO-NPs to inhibit bacterial growth and kill bacterial strains were determined as 106.6667 and 156.6667, 66.66667 and 133.3333, 100 and 133.3333 mg for *B. licheniformis*, *E. coli* and *Aeromonas*, respectively. Time kinetics of anti-biofilm activity of MnO-NPs showed the mean values as 20.5 ± 0.03, 30.0 ± 0.03 and 21.0 ± 0.04 for *B. licheniformis*, *E. coli* and *Aeromonas*, respectively. In-vivo wound healing activity was carried out and the effect of MnO-NPs encapsulated hydrogel film in fusion with exosomes was studied in comparison with no treatment and exosomes application. MnO-NPs encapsulated hydrogel film in fusion with exosomes accelerated wound healing to a greater extent than the exosomes-only treatment.