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ORIGINAL ARTICLE

Bio-hybridization of nanobactericides with cellulose films for effective treatment against members of ESKAPE multi-drug-resistant pathogens

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Abstract

The rapid expansion of drug-resistant pathogens has created huge global impact and development of novel antimicrobial leads is one of the top priority studies in the current scenario. The present study aims to develop bio-hybridized nanocellulose films which comprise of phytogenic silver nanobactericides. The nanobactericides were synthesized by treating 1 mM silver nitrate with aqueous extract of *Chamerion angustifolium* which reduced the metal salt to produce polydispersed nanobactericides which were tested against the members of ESKAPE drug-resistant communities. The synthesized silver nanobactericides were subjected to characterization with UV–visible spectra which displayed maximum absorbance at 408 nm. The bio-molecular interaction of phyto-constituents to mediate synthesis and stabilization of nanobactericides was studied with Fourier-transform infrared spectroscopy (FTIR) which depicted functional groups associated with nanobactericides. The crystalline nature was studied with X-ray diffraction (XRD) which showed Bragg's intensities at 2θ angle which denoted (111), (200), (220), and (311) planes. The morphological characteristics of silver nanobactericides were defined with transmission electron Microscopy (TEM) image which displayed polydispersity of silver nanobactericides with size ranging from 2 to 40 nm. The synthesized nanobactericides showed a significant activity against MRSA strain with 21 mm zone of inhibition. The minimal inhibitory concentration of silver nanobactericides to inhibit the growth of test pathogens was also determined which ranged between 0.625 and 1.25 µg/ml. The silver nanobactericides were bio-hybridized onto nanocellulose films produced by *Komagataeibacter xylinus* B-12068 culture strain. The films were dried to determine the mechanical properties which showed increased in Young's modulus and tensile strength in comparison with control bacterial cellulose films. Overall, the results obtained in the present investigation are promising enough to report bactericidal activity of bio-hybridized nanobactericidal films against ESKAPE. These communities are reported to cause severe threats to all forms of lives irrespective to their habitats which can lead to huge economical crisis.

Keywords ESKAPE · Bio-hybridization · Silver nanobactericides · Phytogenic · Bactericidal activity

Introduction

Bio-hybridization is a process of modulation of bioactive molecules with structural components (Gao and Maruyama 2012). The outcome of the hybridization results in enhancement or upgradation of desired activity (Ma et al. 2016). The exact definition of bio-hybridization is yet to be completely elucidated, but, however, there has been a significant progress to obtain multifold applications based on the principle of bio-hybridization (Syed et al. 2016). The concept of bio-hybridization is implemented in developing implants, regenerative medicines, bioreactors, biosensors,

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