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BACTERIAL CELLULOSE PRODUCTION FROM OIL PALM FROND JUICE AND ITS IMPREGNATION WITH SILVER NANOPARTICLES FOR ANTIBACTERIAL WOUND DRESSING

TAN SOU MIN[1]; NOR SYAHIRAH ABD KARIM[1]; SHAHRIL MOHAMAD[1]; JUNAIDI ZAKARIA[1]; MOHD HAFIZ ARZMI[2]; HASSAN FAHMI ISMAIL[3] and ROHANA ABU[1]*

ABSTRACT

Bacterial cellulose-silver nanoparticles (BC-AgNPs) composite was prepared for a bacterial wound dressing. The oil palm frond (OPF) juice was utilised as a low-cost raw material for BC production. The AgNPs were incorporated in the BC composite by thermal reduction of 1 mM silver nitrate for their antibacterial agent. The BC-AgNPs composite had dense nanofibrils with an average diameter of 61.5 ± 1.0 nm as shown in the field emission scanning electron microscope (FESEM) images. The composite had a crystallinity index of 86.5% and the nanoparticles had a face-centred cubic geometry with a crystal size of 26.5 nm as determined by X-ray diffraction analysis (XRD). The Ag content was 1.463 mg/100 cm² in the composite analysed by atomic absorption spectrophotometry (AAS). 10.4% of the total Ag content was released from AgNPs in 72 hr as measured by inductively coupled plasma mass spectrometry (ICP-MS). The composite also demonstrated excellent antibacterial action against Staphylococcus aureus, giving a 29 ± 0.8 mm inhibition zone by the disk diffusion assay. Pure BC composite exhibited no cytotoxicity effect on the HSF1184 fibroblast cells and 10%-40% BC-AgNPs composite extracts were compatible with the cell growth. The study suggests the BC-AgNPs composite is a good material for antibacterial wound dressing.

Keywords: bacterial cellulose, oil palm frond, silver nanoparticles, wound dressing.

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INTRODUCTION

The developments of new value-added products from agricultural biomass as low-cost raw materials are of great prospects in various fields such as biocompost, biofuel, bioplastic and biomaterial (Aziz *et al*., 2023; Harrison *et al*., 2023). Most palm oil-producing countries like Malaysia and Indonesia contribute significant biomass resources including oil palm trunk (OPT) and oil palm frond (OPF). The OPF is generated after fruit harvesting at the plantation area and it was estimated that 42 million tonnes yr^{-1} of OPF were abundantly available (Gan *et al*., 2023). Various value-added products have been developed due to the availability of biomass resources from the sustainable Malaysian palm oil industry (Parveez *et al*., 2023; Rashidi *et al*., 2022). The current industrial utilisation of OPF is in producing paper, animal feed, bio-alcohol, bio-char and biogas (Gan *et al*., 2023; Norrrahim *et al*., 2022; Zakaria *et al*., 2023). More recently, the OPF juice which contains high-carbon sugars has been found suitable to be utilised as a low-cost fermentation medium for bacterial growth in bacterial cellulose production (BC) (Lim *et al*., 2022; Mohamad *et al*., 2022; Said Azmi *et al*., 2023).

[1] Faculty of Chemical and Process Engineering Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, 26300 Kuantan, Pahang, Malaysia.

[2] Department of Fundamental Dental and Medical Sciences, Kulliyyah of Dentistry, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia.

[3] Institute of Marine Biotechnology, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia.

* *Corresponding author e-mail: rohanaa@umpsa.edu.my*