Bioresource Technology 124 (2012) 495–499

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Short Communication

Silver-nano biohybride material: Synthesis, characterization and application in water purification

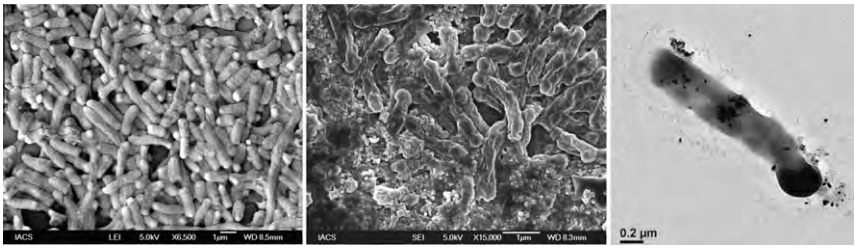
Sujoy K. Das [a,*], Md. Motiar R. Khan [b], Arun K. Guha [b], Akhil R. Das [c], Asit Baran Mandal [a]

[a] Environmental Technology Laboratory, Council of Scientific and Industrial Research (CSIR) – Central Leather Research Institute (CLRI), Chennai 600 020, India
[b] Department of Biological Chemistry, Indian Association for the Cultivation of Science, Kolkata 700 032, India
[c] Polymer Science Unit, Indian Association for the Cultivation of Science, Kolkata 700 032, India

HIGHLIGHTS

- Green silver nanoparticles (AgNPs) have been synthesized on the surface of *Rhizopus oryzae*.
- The obtained AgNPs are highly monodisperse and spherical having ~15 nm size.
- The synthesized silver nano-biohybride have been employed for purification of water containing pesticides and microorganisms.
- AgNPs on silver nano-biohybride strongly adsorb organophosphorous pesticides due to soft–soft interaction.
- Rupture of bacterial cell wall occurred after interaction with silver nano-biohybride material.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 20 June 2012
Received in revised form 16 August 2012
Accepted 19 August 2012
Available online 31 August 2012

Keywords:
Silver nanoparticles
Rhizopus oryzae
Pesticide adsorption
Antibacterial activity

ABSTRACT

A green chemical synthesis of silver nanoparticles (AgNPs) through *in situ* reduction of silver nitrate ($AgNO_3$) by a fungal strain of *Rhizopus oryzae* is described along with the promising eco-friendly role of the synthesized nano-silver bioconjugate (NSBC) material in water purification process. The NSBC has been characterized using UV–vis spectroscopy, high resolution transmission electron (HRTEM) microscopy, and Fourier transform infrared (FTIR) spectroscopy. The NSBC exhibits strong antibacterial activity against *Escherichia coli* and *Bacillus subtilis* and high adsorption capacity towards different organophosphorous pesticides. Fluorescence and electron microscopic images reveal NSBC binds on the bacterial cell wall, which cause irreversible membrane damage eventually leading to cell death. Proteomic analysis further demonstrates down regulation of protein expression, inhibition of cytosolic and membrane proteins and leakage of cellular content following binding of NSBC with bacterial cell wall. NSBC has been exploited to obtain potable water free from pathogens and pesticides in one step process.

1. Introduction

Pesticide contamination in ground water due to indiscriminate use in agricultural practices, poses a serious threat to human health (Zolgharnein et al., 2011). Further the presence of pathogenic bacteria in potable water aggravates the problem (Hillie and Hlophe, 2007). Thus it is an essential prerequisite to reduce the concentration of pesticides to permissible limit and pathogens from potable water but difficult to achieve using conventional treatment technology. Recent advances in nanoscience focus on development of nanotechnology based water treatment methodology (Pradeep and Anshup, 2009). The nanoscale silver materials usually in the range of 1–100 nm in at least one dimension is of

* Corresponding author. Tel.: +91 4424437132; fax: +91 4424911589.
E-mail addresses: sujoy@clri.res.in, sujoydasiacs@gmail.com (S.K. Das).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.08.071