

## ABSTRACT

### Silver Nanoparticle biosynthesis and Bacterial Cellulose production by novel microorganisms: Characterization, bioactivity, and application towards bioremediation

Microorganisms obtained from kombucha tea (a worldwide consumable fermented beverage) include the following microbial strains namely *Glucanoacetobacter kombuchae* (RG3<sup>T</sup>), *Papiliotrema laurentii* (Y24<sup>T</sup>), and *Pichia manschurica* (CD1<sup>T</sup>) have been used to biosynthesize Silver Nanoparticle (Ag-NPs/NPs). The produced nanoparticles from each strain were assessed for both physical characterizations by various instrumental methods like TEM, SEM, DLS, Zeta Potential, FESEM, XRD, Ft-IR, etc. *Glucanoacetobacter kombuchae* (RG3<sup>T</sup>) (RG3-NPs) have been accessed for various bio-activities like broad-spectrum antibacterial effects towards a variety of Gram-positive and Gram-negative bacteria. Also, antioxidant, and cytotoxic properties against cell lines like MCF-7, HEPG-2, and Triple negative human breast cancer (TNBC) showed the nanoparticle superior efficiency. Therefore, it can be concluded that RG3-NPs points itself to be a significant bio-material with antibacterial, cytotoxic, and antioxidant properties.

Other strains like *Papiliotrema laurentii* (Y24<sup>T</sup>) and *Pichia manschurica* (CD1<sup>T</sup>) along with the characterization has also been accessed for the efficient degradation of 4-Nitrophenol (Y24-NPs), Azo dyes like Congo red and Malachite green (CD1-NPs). Further, NPs have been used to detect the presence of Fe(III)(Y24-NPs) and Hg(II)(CD1-Nps) in an aqueous solution with a detection limit of 1.8 M in the linear range of 5–150 M for Fe(III) and for Hg(II) it was 2.1.04 nM in the linear range of 10-80 nM. Both the NPs were tested for reusability and it was found that Y24-NPs were 94% reusable while CD1-NPs is 96%. The study, therefore, shows that both Y24-NPs and CD1-NPs hold great potential for environmental remediation with significant catalytic activity and reusability. Further, *Glucanoacetobacter kombuchae* (RG3) has been able to successfully produce Bacterial Cellulose (BC). The pro-

duced cellulose has been characterized by SEM, FESEM, XRD, FT-IR, and other properties like water holding and retention capacity, swelling rate, porosity, and tensile strength. Along with the characterization the produced Bacterial cellulose was further tested for other activities like industrial dye removal and antibacterial and cytotoxic effects. The produced Bacterial Cellulose, therefore, shows good efficiency that is to be applied in the field of filtration and bioremediation. Bacterial Cellulose and Silver Nanoparticles by the strain RG3T have been merged to produce a bio-composite. Characterization assessments were done by SEM, FESEM, XRD, FT-IR, DLS, and UV-Vis Spectroscopy. Bioactivity by antibacterial and cytotoxic potential has been measured successfully. Therefore, the bio-composite shows itself to be an antibacterial, cytotoxic, catalytic agent for filtration and bioremediation.

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