

## ABSTRACT

The present study focused on the potential of spent black tea extract as an inexpensive raw material harboring strong antibacterial, antioxidant and a reducing agent to synthesize SBT. The research hypothesized that the spent black tea properties will be imparted to synthesized AgNPs. The study explored the role of SBT-AgNPs as the antibacterial and antioxidant agent. The study then tested the SBT-AgNPs potential as dye removal agent from industrial water waste, which is in itself a challenging task underscoring the complex waste water composition. In order to achieve the objective, spent black tea was treated with various solvents and various parameters were studied to achieve the right extract and finally the optimization was translated to successful SBT-AgNPs formation and optimization. The AgNPs were thoroughly compared against free AgNPs. The characterization of SBT-AgNPs were achieved by UV/Vis spectroscopy, fourier transform infrared spectroscopy, scanning electron microscopy, x-ray diffraction, zeta potential and zeta sizer. The UV/Vis spectroscopy determined the surface plasmon resonance at 423 nm. The FTIR exhibited the peaks at 3272.6028, 2084.9451, 1640.0288 and 566.5553/ cm. The XRD analyzed the hkl corresponding to (111), (200), (220), (311) planes at  $2\theta$  theta deg 38.3°, 40.8°, 64.5°, 74.2°. The scanning electron microscopy gave the plate like round shaped morphology of the AgNPs. The zeta potential was examined to be -17.5 mv and size distribution by intensity of 157.6 d.nm was observed. The antibacterial activity was determined against the bacteria such as *Lactobacillus sp.*, *Staphylococcus aureus*, *Escherichia coli*, and *Bacillus licheniformes*. The antioxidant activity was examined by DPPH assay with ascorbic acid as standard and compared against spent black tea extract and free AgNPs. With an impressive activity of 87.12% at 100% concentration of DPPH, it showed remarkable antioxidant potential. The degradation activity was examined by photocatalytic removal of malachite green and methylene blue dyes from textile waste water. The textile waste water showed a decrease of methylene blue and malachite green by 58.3 and 43.47% which was remarkably significant owing to presence of the complex factor in the natural environment. The spent black tea potential as a raw material for the synthesis of AgNPs must be explored more to unravel the underlying procedures as to how properties of AgNPs can be enhanced further. In the future, it can be hoped that further studies will be conducted to improve the activity of AgNPs by expanding the goodwill collaboration of spent black tea and other food wastes.