Green and sustainable silver nanoparticles for waste water treatment

Meryam Sardar and Nafeesa Khatoon

Department of Biosciences, Faculty of Natural Sciences,
Jamia Millia Islamia, New Delhi-110025, India.

Email : msardar@jmi.ac.in

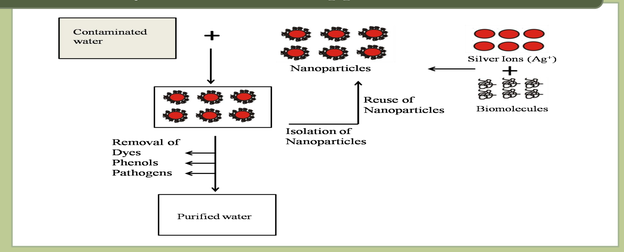
INTRODUCTION

Nanoparticles represent a promising new technology for wastewater remediation, not only because of their high treatment efficiency, but also for their cost effectiveness, as they have the flexibility for in situ and ex situ applications. Among nanoparticles, nanosilver has become one of the most popular nanoparticles due to its many applications and relatively low manufacturing costs. Fast urbanization causes increased discard of both treated and untreated wastewaters to surface water. This waste water if treated efficiently may be further reused for domestic and industrial purposes. Hence it is essential to develop, a cost effective and environmentally benign technique for the treatment of contaminated waste water.

OBJECTIVES

- Biosynthesis and characterization of silver nanoparticles using plant leaf extract
- To study the effect of biosynthesized silver nanoparticles on physical and chemical parameters of river Yamuna.
- To study the catalytic activity of biosynthesized silver nanoparticles.
- To study the effect of biosynthesized silver nanoparticles in dye removal of reactive dyes

Scheme for synthesis and its applications



METHODOLOGY

Synthesis of silver nanoparticles

5 gm of fresh plant leaves
↓
Washed properly and chopped finally
↓
Heated at 60ºC in 100 ml 50% ethanol for 10 min
↓
Allow to cool and filter
↓
Dilute 1:1 with double distilled water
↓
Incubate 1:9 leaf extract with silver nitrate (2mM) at 60ºC
↓
Centrifuge at 2000g for 20 min at 4ºC

CONCLUSIONS

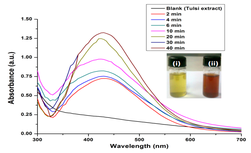
- The present study shows that the plants are the excellent biomaterials for the synthesis of silver nanoparticles at large scale.
- The biosynthesized silver nanoparticles are effective in lowering the contaminants such as BOD, TDS and bacterial load from river Yamuna.
- The biomolecules present in the plants dictates the properties of the nanoparticles therefore *O. sanctum* assisted silver nanoparticles shows good catalytic behaviour in reducing the p- nitrophenol to p-aminophenol whereas *A. annua* assisted not.
- The *O. sanctum* assisted silver nanoparticles shows better removal of dye as compared to *A. annua* assisted .
- This green catalyst will greatly reduce the cost incurred in bioremediation.
- The synthesized nanoparticles can be used for the design of low cost water filters.

REFERENCES

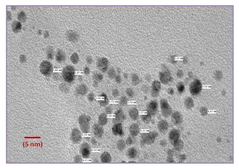
1. Y. Ju-Nam, J.R. Lead, *Sci. Total Environ.* **2008**, 400, 396.
2. P. Banerjee, S. Sau, P. Das and A. Mukhopadhyay , *Nanosci Technol*. **2014**,1, 1-6.
3. Sasa Gu, Stefanie Wunder, Yan Lu, and Matthias Ballauff *J. Phys. Chem. C* . **2014**, 118, 18618−18625.

RESULTS & DISCUSSIONS

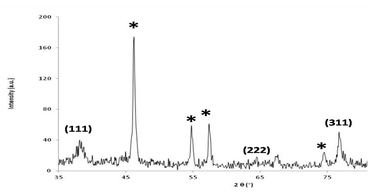
Biosynthesis and Characterization of silver nanoparticles



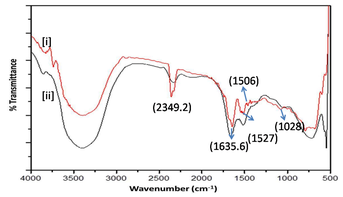
UV-VIS spectra recorded as function of time for the synthesis of *O.sanctum* mediated AgNps.



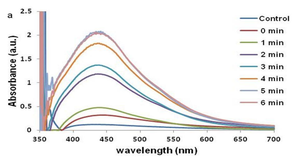
TEM of AgNps synthesized from *O.sanctum* leaf extract.



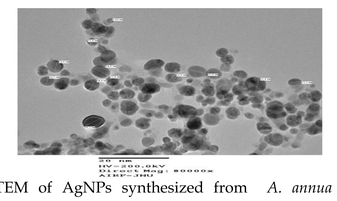
XRD of the *O.sanctum* mediated AgNps



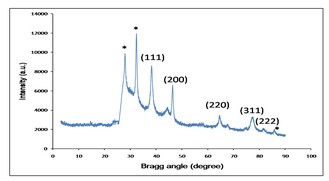
FTIR spectrum of [i] AgNps and [ii] *O.sanctum* leaf extract recorded by making KBr discs with AgNPs.



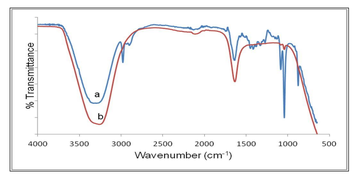
UV-VIS spectra recorded as function of time for the synthesis of AgNPs mediated by *A. annua* leaf extract.



TEM of AgNps synthesized from *A. annua* leaf extract.



XRD of the *A.annua* mediated AgNps



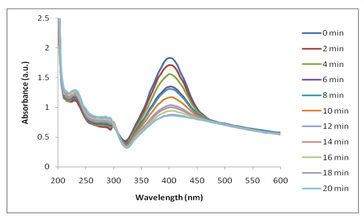
FTIR spectrum of [b] AgNps and [a] *A.annua* leaf extract recorded by making KBr discs with AgNPs.

Bioremediation

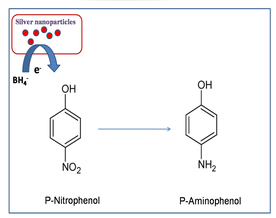
Parameters	Control	Tulsi mediated AgNps	Artemisia mediated AgNps
Smell	Pungent	No odour	No odour
pH	4.3	7.4	7.8
Colour	Pale yellow	clear	Very light yellow
TDS (ppm)	859	100	230
DO (mg/L)	1.7	6.6	4.4
BOD (mg/L)	26	3	15.6
Bacterial load (cfu)	336	14	19

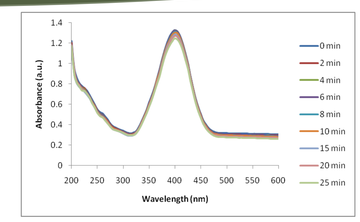
Physico-chemical parameters of untreated and treated Yamuna water sample

Catalytic activity of biosynthesized silver nanoparticles

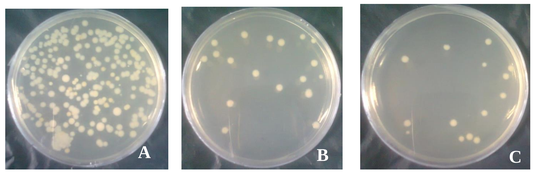


UV-VIS spectra of reduction p-nitophenol by $NaBH_4$ catalyzed by *O. sanctum* mediated AgNps.

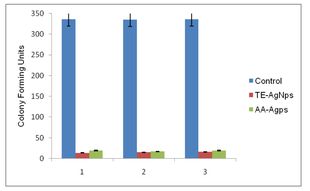




UV-VIS spectra of reduction p-nitophenol by $NaBH_4$ catalyzed by *A.annua* mediated AgNps.

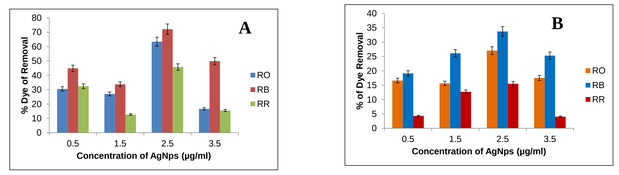


Colony forming units of untreated Yamuna water (A) and treated yamuna water by *Ocimum sanctum* assited (B) and *Artemesia annua* (C) assisted assisted silver nanoparticles.



Reusability of biosynthesized silver nanoparticles where control represents untreated Yamuna water, TE-AgNps and AA-AgNps are *Ocimum sanctum* and *Artemesia annua* assisted silver nanoparticles respectively.

Dye removal by biosynthesized silver nanoparticles



Effect of *Ocimum sanctum* (A) and *Artemisia annua* (B) assisted silver nanoparticles concentration on dye removal .

ACKNOWLEDGEMENT: Authors are thankful for ICMR and UGC for financial support.