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Biogenic synthesis of silver nanoparticles and its use in cellulose-gelatin nanocomposite film for food packaging application

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INTRODUCTION

- The biosynthesis of Ag NPs using wild and indigenous species exhibiting potential biological activity has not been explored to a large extent.
- The current investigation was intended to develop simple, stable and eco-friendly technique for the fabrication of silver nanoparticles (Ag NPs) using flavonoid enriched flower extracts of *M. longifolia* and *Diospyros melanoxylon* fruit extract.
- The aim of the proposal is focused on preparing biogenic, non-toxic AgNPs incorporated cellulose-gelatin polymer blend matrix for active food packaging applications.

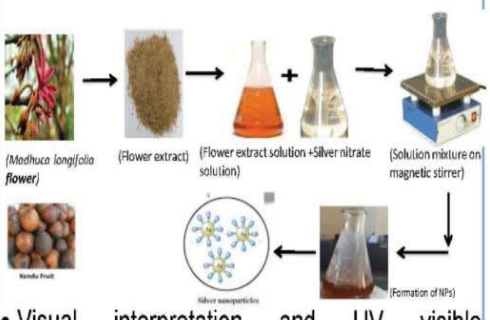
OBJECTIVE

The specific aims of this research project are mentioned as below:

1. Synthesis and characterization of Ag NPs using flavonoid enriched *M. longifolia* flowers extract and *Diospyros melanoxylon* fruit extract
2. Formulation of cellulose-gelatin-biogenic Ag based nanocomposite film.
3. Evaluation of formulated cellulose-gelatin-biogenic Ag based nanocomposite film for food packaging application

METHODOLOGY

Collection of plant materials, preparation of aqueous extract and synthesis of Ag NPs.



- Visual interpretation and UV visible spectroscopy.

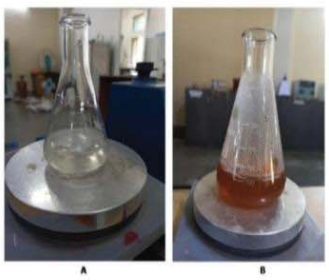
- **Characterization of Ag NPs and Film**

I. Particle size, zeta potential and polydispersity index measurements by Dynamic Light Scattering (DLS), Surface morphology by Scanning Electron Microscopy (SEM)
II. Molecular interaction study by Fourier transformation infrared (FTIR) spectroscopy analysis

- Antimicrobial activity Gram negative bacteria *E.coli* (ATCC 8739) by agar well diffusion assay.
- Antimicrobial activity of cellulose-gelatin-biogenic Ag based nanocomposite film by Disc Diffusion method

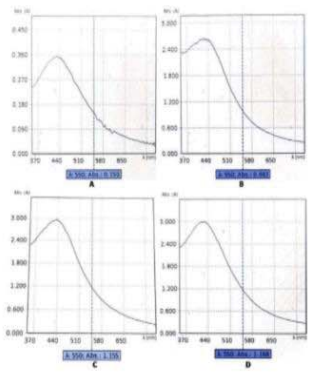
RESULTS AND DISCUSSION

1. Visual observation :



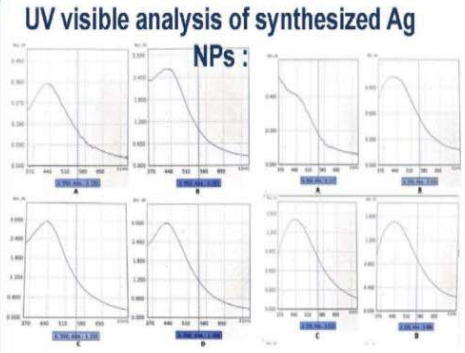
[Ag NPs formation using flower extracts of *M. longifolia*. A color change from (A)colorless to (B) dark brown after 20 min and too dark brown after 60 min at 80 ^{0}C]

2. UV- visible spectrum analysis:



(Role of temperature and time in the synthesis of Ag NPs by the plant extract of *M. longifolia* [(A) Room temperature for 24 hours (B) 60^{0}C for 20 mins (C) 80 ^{0}C for 20 mins (D) 80 ^{0}C for 1 hour] }

UV visible analysis of synthesized Ag NPs :



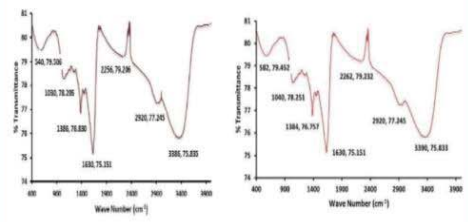
[The stability of synthesized nanoparticles at different time intervals [(A)80 ^{0}C for 1 hours (B)24 hr, (C) 48 hr, (D) 72 hr]

3. Dynamic light scattering study(DLS):

Parameters	Ag NPs *M. longifolia*	Ag NPs *D. melanoxylon*
Size (Mean ± SD)	178 ± 72.34 nm	125 ± 80.75 nm
Poly dispersity index (PDI)	0.349	0.233
Zeta potential (Mean ± SD)	-13.6 ± 6.46 mV	-14.8 ± 5.33 mv

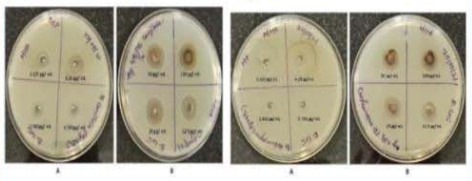
Physical properties of biosynthesized Ag NPs from *M. longifolia* and *D. melanoxylon*

4. FTIR analysis:



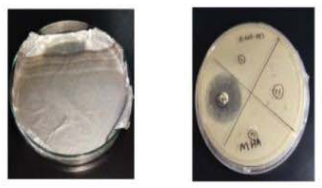
Fourier-transform infrared spectroscopy (FTIR) spectra of from the plant biogenic Ag NPs synthesized extracts of *M. longifolia* and *D. melanoxylon*.

5. Antimicrobial activity :



Ag NPs (*M. longifolia*) **Ag NPs (*D. melanoxylon*)**

[The zone of inhibition of biosynthesized Ag NPs (100 µg/mL-0.781 µg/mL) from *M. longifolia* flower extract and *D. melanoxylon* fruit extract against *E.coli* (ATCC 8739) as evaluated by agar well diffusion assay]



Synthesis and characterization of cellulose-gelatin-biogenic Ag based nanocomposite film

CONCLUSION

- The physical properties confirmed the stability of Ag NPs and suitability of use in biomedical application.
- The secondary structure of proteins in the *Madhuca longifolia* were not altered due to the interaction with NPs and these proteins played a measure role as capping agents.
- So, the Ag NPs showed very effective antimicrobial activity against *E. coli* (ATCC 8739) even at a lower concentration in comparison to the crude plant extract.
- The above results demonstrated the potential use of biosynthesized Ag NPs with flavonoid enriched capping agents in biomedical applications.
- Cellulose-gelatin-biogenic Ag based nanocomposite film was successfully synthesized and preliminary study confirmed effective antimicrobial activity
- Further characterization studies would prove the use of biogenic, non-toxic Ag NPs incorporated cellulose-gelatin polymer blend matrix in active food packaging applications.

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