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King Saud University

Green Synthesis, Characterization, and Anticancer Potential of Silver Nanoparticles Synthesized from *Artemisia monosperma*

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INTRODUCTION

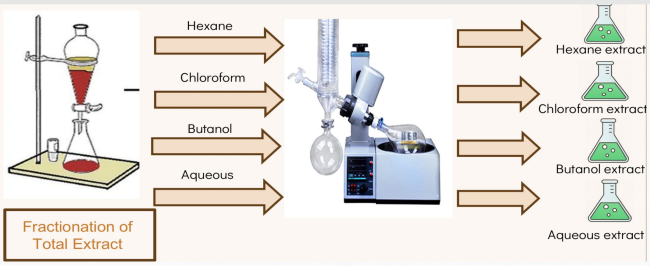
The green synthesis of silver nanoparticles using plant extracts has received extensive attention in the recent years for the development of anticancer agents. Therefore, this study was aimed to synthesize silver nanoparticles (AgNPs) using *Artemisia monosperma* and evaluation of its anticancer potential against human breast cancer cells (MCF-7).

OBJECTIVES

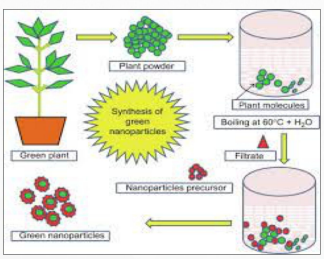
1. Preparation of various extracts of *A.monosperma.*
2. Assessment of cytotoxicity of *A. monosperma extracts* in MCF-7 cell line.
3. Synthesis of AgNPs from the most active extract of *A. monosperma*.
4. Characterization of green synthesized AgNPs using physiochemical techniques.
5. Determination of anticancer potential of green synthesized AgNPs in MCF-7 cell line by MTT and NRU assay.
6. Determination of generation of ROS induced by AgNPs using DCFH-DA dye in MCF-7 cell line.

METHODS

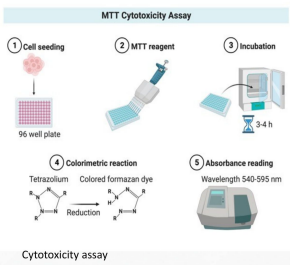
The synthesized AgNPs were characterized by UV-visible spectroscopy, Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), and X-ray diffraction (XRD) techniques. Further cytotoxic potential of AgNPs was studied by MTT and NRU assays. Additionally, cell death inducing ability of AgNPs was examined by cellular morphological identification and ROS generation.



Preparation of extract of Artemisia monosperma



Synthesis of nanoparticles of Artimisia monosperma



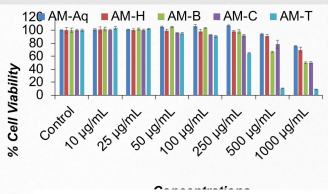
Cytotoxicity assay

DISCUSSION and CONCLUSIONS

These results indicated that AgNPs were successfully synthesized using *Artemisia monosperma* and demonstrated the potential anticancer activity against MCF-7 cells. Therefore, it could be a potential therapeutic agent against cancer diseases.

RESULTS

UV-visible spectroscopy showed the maximum absorption at 430 nm which verified the presence of AgNPs. The SEM and TEM images showed that AgNPs were spherical in shape with an average particle size of 40-60 nm. FTIR analysis showed the presence of various functional group. XRD showed that green synthesized AgNPs were crystalline in nature. The XRD pattern was in good agreement with that of face-centered-cubic form of metallic silver. The EDS data showed that percentage weight of Ag was 80.34%. The AgNPs exhibited a concentration-dependent cytotoxicity against MCF-7 cells. AgNPs were also found to induce morphological changes and ROS production post 24 h exposure.



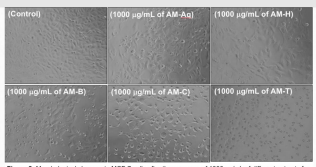


Figure 2: Morphological changes in MCF-7 cells after the exposure of 1000 µg/mL of different extracts for 24 h. Cell images were grabbed using a phase contrast inverted microscope at 20 × magnification.

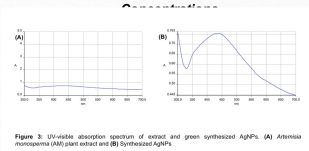


Figure 3: UV-visible absorption spectrum of extract and green synthesized AgNPs. (A) *Artemisia monosperma* (AM) plant extract and (B) Synthesized AgNPs.

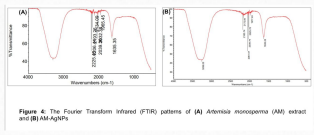


Figure 4: The Fourier Transform Infrared (FTIR) patterns of (A) *Artemisia monosperma* (AM) extract and (B) AM-AgNPs

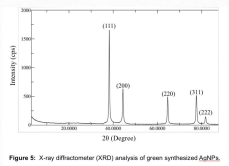


Figure 5: X-ray diffractometer (XRD) analysis of green synthesized AgNPs.

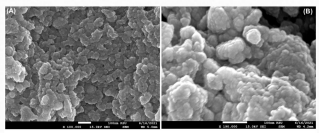


Figure 6: Scanning electron Microscopic (SEM) Images of Green synthesized silver nanoparticles (AgNPs) at (A) Low and (B) High magnification power.

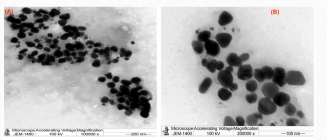


Figure 7: Transmission Electron Microscopic images of green synthesized silver nanoparticles by using *Artemisia monosperma* plant extract at 200 nm (A) and 100 nm (B) magnification, respectively.

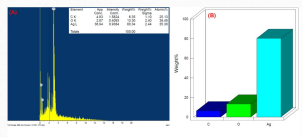


Figure 8: (A) EDX spectrum of silver nanoparticles synthesized by using extract of *Artemisia monosperma* and (B) Bar chart showing the weight percent of Ag (light blue) in the EDX study.

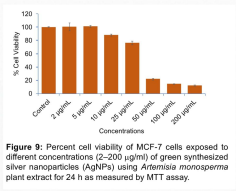


Figure 9: Percent cell viability of MCF-7 cells exposed to different concentrations (2–200 µg/ml) of green synthesized silver nanoparticles (AgNPs) using *Artemisia monosperma* plant extract for 24 h as measured by MTT assay.

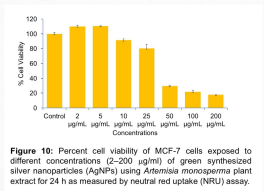


Figure 10: Percent cell viability of MCF-7 cells exposed to different concentrations (2–200 µg/ml) of green synthesized silver nanoparticles (AgNPs) using *Artemisia monosperma* plant extract for 24 h as measured by neutral red uptake (NRU) assay.

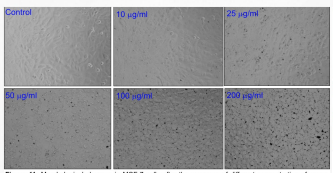


Figure 11: Morphological changes in MCF-7 cells after the exposure of different concentration of green synthesized silver nanoparticles (AgNPs) for 24 h. Cell images were grabbed using a phase contrast inverted microscope at 20 × magnification.

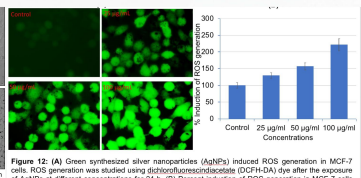


Figure 12: (A) Green synthesized silver nanoparticles (AgNPs) induced ROS generation in MCF-7 cells. ROS generation was studied using dichlorofluorescindiacetate (DCFH-DA) dye after the exposure of AgNPs at different concentrations for 24 h. (B) Percent induction of ROS generation in MCF-7 cells following the exposure of 25, 50 and 100 µg/mL of AgNPs for 24 h.

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