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# GREEN SYNTHESIS OF SILVER NANOPARTICLES USING *POMEGRANATE PEEL EXTRACT*

Chemistry

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## ABSTRACT

An eco-friendly and easiest biosynthesis of silver nanoparticles via using Pomegranate peel extract and 1 mM AgNO3 had been discussed in this paper. It was characterized by UV-Vis spectrum, Fourier Transform Infrared Spectroscopy (FT-IR), Scanning Electron Microscopic (SEM) analysis and TEM analysis. In UV-Vis spectra a strong resonance appears at 370 nm on the surface of silver nanoparticles (AgNPs). The reducing agent nature of pomegranate peel extract is examined via Fourier Transformation Infrared Spectroscopy. The scanning electron microscopic (SEM) analysis and Trasmission Electron microscope analysis shows nanoparticles with the average particles size ranges about 50 nm and 5-50 nm. Further the antibacterial activity of AgNPs was evaluated against Staphylococcus aures, Escheria coli, Micrococcus Flavus, Bacillus subtilis, and Bacillus pumilus *pathogens*.This methodology is simple and economical and also no any hazardous chemical as reducing or stblizing agents is used to synthesize AgNPs

## KEYWORDS

Pomegranate peels Extract, AgNPs, Green synthesis, Ecofreindly, FTIR.

## INTRODUCTION

Nanotechnology is said to be an emerging field having broad range of application in Science and Technology related to manufacturing new materials at the nanoscale level[1]. The word "nano" means one billionth a meter or 10-9. The word Nanotechnology was given by Professor Noria Taniguchi in the year 1974. "Nano" is a Greek word synonymous to dwarf and its mean the extremely small. Nanoparticles are beginning building blocks of nanotechnology[2]. Nanoparticles is gaining attention in the present century because they posses potential chemical, optical and mechanical properties[3]. Nanoparticles improved properties of larger particles of the bulk materials. These new properties are derived due to the variation in their specific characteristics such as size, distribution and morphology of the particles. Nanoparticles shows decrease in the size of the particles with higher surface area to volume ratios. Higher Specific surface area is important to catalytic activity and other related properties such as antimicrobial activity of AgNPs4-6. The biological effectiveness increase on the account of a rise in surface energy with increase in specific surface area of nanoparticles. Noble metals, such as silver, gold and platinum nanoparticles are widely applied in products such as shampoos, soaps, detergent, shoes, cosmetic products, and toothpaste that are directly come in contact with the human body, rather than medical and pharmaceutical application. The metallic nanoparticles due to their large surface area to volume ration showed good antibacterial properties. Because of this reason the researchers show much more interest in it due to the growing microbial resistance against metal ions, antibiotics and the development of resistant strains[4]. Silver is well known noble metal which possesses as a disinfecting property. Due to this property in its nanoparticles forms it induces strongly their ability in applications in medicine to culinary items. A number of methods are used such as facile method[5], thermal decomposition of silver compounds[6], electrochemical[7], sonochemical[8], and microwave assisted process[9] and recently via green chemistry route[10] for the synthesis of silver nanoparticles. But Unfortunately, most of them have drawback such as use of hazardous chemicals, low yield, high temperature requirements, difficult and wasteful purifications. Therefore, there is a need to develop environmentally friendly cheap processes for its synthesis without using expensive and toxic chemicals. Biosynthetic methods such as nanoparticle synthesis via using plant extracts have emerged as a simple and viable alternative to chemical synthetic procedures. Synthesis of nanoparticles by using plant materials will be more advantageous, because it does not require harsh condition such as intracellular synthesis and multiple purification steps or the maintenance of microbial cell cultures. In this paper we have the discussed about the synthesis of silver nanoparticles using Pomegranate peel extract. The synthesized nanoparticles were confirmed by its change in colour and it is characterized by UV-Visible spectroscopy, Fourier transform infrared (FTIR),the size of the nanoparticles was observed by SEM (Scanning Electron Microscope) and TEM. Furthers its antibacterial activity to inhibit different pathogenic bacterial growth were studied.

## MATERIALS AND METHODS

Pomegranate peel was collected from fruit shop. The plant was named as Punica granatum. Glass apparatus and the pomegranate peel were initially washed properly with distilled water. The peel was washed again with distilled water and further kept for air dried. 15 g of peel was weighted out and added in 150 ml of distilled water in 200 ml Erlenmeyer flask and keep for boiling for 15 minutes. With the help of Whatmann filter paper (NO.3), the boiled materials were filtered to collect peel extract which was used as such for metal nanoparticles synthesis. Further 100 ml of 1mM aqueous solution of silver nitrate was prepared. Next to this 5 ml of filtrate was further added and kept for 24 hours incubation with shaking. After 24 hours the brown colour development confirms the formation of silver nanoparticles. In aqueous solution the bioreduction of Ag+ ion was monitored by UV-visible spectroscopic.

UV Visible spectroscopic analysis of silver nanoparticles was carried at room temperature on UV-2600 series Shimadzu spectrophotometer at a resolution of 1nm.

Solution having nanoparticles was centrifuged at 9,000 rpm for 15 minutes. The resulting suspension was redispersed in 100 ml of sterile distilled water and further analyzed by IRTracer-100 Shimadzu for FTIR. After that the purified silver nanoparticles were dried to powder form and analyzed by Fbquanta 200 Scanning Electron Microscopy (SEM) and TEM for the structure, average size identification and composition The silver nanoparticles synthesized using Pomegranate Peel extract was tested for antimicrobial activity. Approximately 25ml of molten and cooled media (Mullar-Hinton agar) was poured into sterilized Petri dishes.

To check for any contamination to appear the plates were left overnight at room temperature .The bacterial test organisms were grown in nutrient broth. 0.1ml from 10-8 dilution of different pathogenic bacteria suspension was spread on Muller-Hinton agar plates. Filter discs (5mm in diameter) were filled with already synthesized silver nanoparticles and placed on the plates. The plates were then incubated at 38◦C for 24 hrs and the zone of inhibition was measured in nm.

## RESULTS AND DISCUSSION

Various chemical and biological methods have been employed for the synthesis of silver nanoparticles. Currently using plant materials, synthesis of silver nanoparticles are getting more popular[11, 12] In this methodology, when we are adding the pomegranate peel extract to the aqueous solution of the silver nitrate the colour of the reaction medium changed from colourless to brown. As shown earlier.

The brown colour indicated the reduction of silver ion and the formation of silver nanoparticles where as the control $AgNO_3$ solution did not show any colour change (Figure 1).

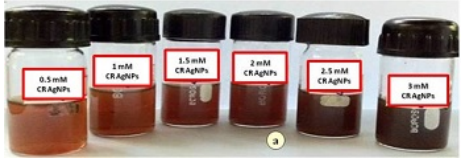
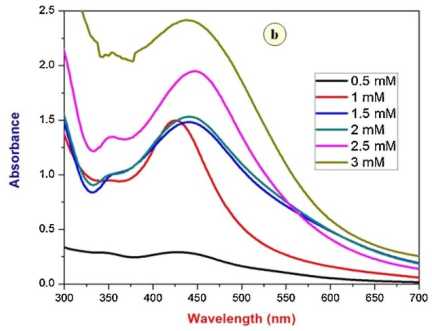


**Figure 2, showed the UV-Vis spectrum of silver nanoparticles.**




A characteristics surface Plasmon absorption bands were observed at 371 nm after 24hrs incubation[13].

FT-IR is used to identify the possible biomolecules responsible for the reduction of Ag+ ions to AgNPs by pomegranate peel extract the major peak at 3371 cm-1and other peaks were obtained at 1635 cm-1 1373 cm-1, 2924 cm-1 respectively.

The bands at 3371 cm-1 and 2924 cm-1 were assigned to the stretching of primary and secondary amines respectively, while their corresponding vibrations seen at 1635 cm-1. The band observed at 1373 cm-1 can be assigned to the C-N stretching vibrations of aromatic groups[14].

Scanning Electron Microscopy (SEM) and TEM technique was employed to visualize the size and shape of silver nanoparticles. The dried silver nanoparticles were mounted on a copper grid.

The formations of silver nanoparticles as well as their morphological dimensions in the TEM and SEM study demonstrated that the average size was 5-50 nm (Figure.3 and 4) with inter particles distance[15].

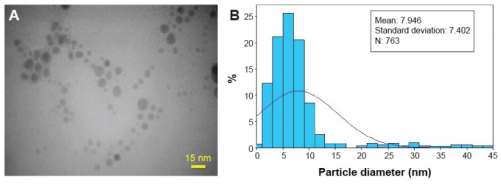



Figure 3 Transmission electron microscopy image and corresponding histogram showing particle size distribution of prepared AgNPs.

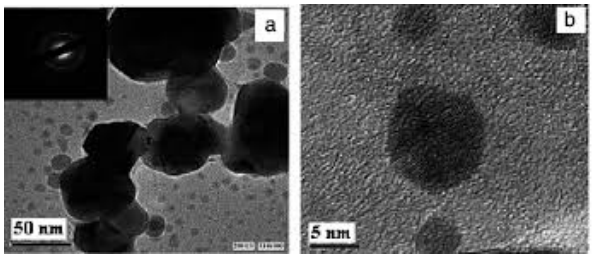



**Figure 4**

AgNPs synthesized via using pomegranate peel extract which acts as a reducing agent has exhibited potential antibacterial activity against S. aureus and E. coli. Streptomycin used as positive control. Inhibition zone of 25mm was observed against S. aureus by 2.2mg/ml concentration of silver nanoparticles.

Major mechanism from which silver nanoparticles shows antibacterial properties was either by anchoring or penetrating the bacterial cell wall and modulating cellular signaling by dephosphorylating peptide substrate on tyrosine residues[16]

## CONCLUSION

In this experiment, pomegranate peel extract was used as reducing and capping agent and it is capable of producing AgNPs at room temperature.This method has many advantages like, low cost, economic viability, eco friendly etc. Analytical techniques such as UV-visible spectroscopy, FT-IR, SEM and TEM are applied to characterize the synthesized nanoparticles. The results showed the synthesis of AgNPs with average size of 5-50 nm. The silver nanoparticles synthesized using pomegranate peel extract showed maximum antibacterial activity against generally found bacteria.

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