Int J Pharm Bio Sci 2016 Jan; 7(1): (P) 7 - 11

Research Article **Nanotechnology**

International Journal of Pharma and Bio Sciences **ISSN 0975-6299**

BIOFABRICATION OF SILVER NANOPARTICLES FROM FRUITS WASTE EXTRACT AND THEIR APPLICATION TOWARDS ANTIMICROBIAL ACTIVITY

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ABSTRACT

The development of uniform nanoparticles has been intensively pursued because of their technological and fundamental scientific importance. In this work, we have formulated a simple and effective procedure for biofabrication of silver nanoparticles (AgNPs) using fruit waste extract. The resulting AgNPs were characterized by UV-Visible spectroscopy, Fourier Transform Infra Red (FT-IR) Spectroscopy and Transmission electron microscopy (TEM) techniques. The UV-visible spectra of the silver nanoparticles showed an adsorption peak at 410 nm. The TEM image reveals that the uniformly dispersed AgNPs with a uniform size and shape in the average size of 6 nm. Biosynthesised AgNPs were studied for antimicrobial activity against the human pathogenic bacteria's (*Proteus, Klebsiella*). These nontoxic nanoparticles which can be prepared in a biosynthesis method prove to be potential candidates for medical applications.

KEYWORDS: **Silver nanoparticles, biofabrication, antibacterial activity, Pathogenic bacteria's**

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1. INTRODUCTION

The word nanotechnology is emerging and rapidly developed during the last decades and due to its applications is one of the most important in the field of science and technology at the nanoscale level[1]. Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology[2]. However, there is still need for economic, commercially viable as well environmentally clean synthesis route to synthesize silver nanoparticles[3]. Currently there are several methods for the production of nanoparticles like chemical and physical methods. Greener way of synthesis nanoparticles provides an advantageous over chemical and physical method as it is eco friendly, cost effective and there is no need to use high temperature, pressure and toxic chemicals for large scale synthesis. Silver nanoparticles are used in a wide range of applications such as cosmetics, medical devices, pharmaceuticals, food ware, clothing, water purification and antimicrobial properties. *Klebsiella* is well known to most clinicians as a cause of community-acquired bacterial pneumonia, occurring particularly in chronic alcoholics[4] and showing characteristic radiographic abnormalities due to a severe pyogenic infection which has a high fatality rate if untreated. *Proteus mirabilis* is the most frequent cause of infection-related kidney stones. In the present study we have explored the synthesis of silver nanoparticles using single and mixed fruit waste extract of *Punica granatum* (Pomegranate) and *Citrus aurantium (Orange)*. Size and morphological studies confirmed by UV spectroscopy, FTIR and TEM. Further the efficacy of the silver nanoparticles was evaluated towards antimicrobial activity against different pathogenic bacteria such as *Proteus and Klebsiella*.

2. MATERIALS AND METHODS

2.1 Preparation of fruit extract

The fruits wastes are collected from the local market then wash it distilled and cut it into small pieces. Then transferred into 20 ml double distilled water and boiled for 2 minutes. The extract obtained was filtered using Whatmann No1 filter paper and the filtrate was collected and stored at 4° C for further studies.

2.2 Preparation of SNP

5ml of fruit extract has added to 45ml of 0.1mM of silver nitrate solution and mix the solution well, rapidly the color of the solution has turned which implies that the reduction was completed within a short period (2 min) with the appearance of yellowish brown color which confirms the formation of silver nanaoparticles (Scheme 1). The obtained SNPs were analysed by using UV-Visible spectroscopy, FT-IR and TEM.

2.3 Antibacterial activity

Muller Hinton Agar was poured into Petri dishes. After solidification test strains (*Klebsiella and Proteus*) were swabbed in the media separately[4]. Antibiotic disc (Amikacin) was placed on the plates. The extract 05µl, 10µl, 15µl was introduced into the disc were incubated at 37°C for 24 hrs. Microbial growth was determined by measuring the diameter of the zone of inhibition. A control with standard antibiotic was kept for all test strains and the control activity was deducted from the test and results were recorded.

3. RESULTS AND DISCUSSION

3.1. Characterization of silver nanoparticles

3.1.1. UV-Visible spectroscopy

Fig. 1 shows the UV–visible absorption spectra recorded for the formation of silver nanoparticles using mixed fruit waste extract (pomegranate fruit and orange fruit) as a reducing agent. The UV-Visible spectrum of silver nanoparticles shown in Fig. 1 clearly indicates the absorption band at 410 nm which is a typical due to surface plasmon resonance (SPR) band. There are no peaks located around 335 and 560 nm, indicated the absence of nanoparticle aggregation. Broadening of peaks indicated that the particles are polydispersed[5,6].

3.1.2. FT-IR spectroscopy

Figure 2 show the FT-IR spectrum of silver nanoparticles prepared from mixed fruit waste extract. The bands at 3400 cm^{-1} and 2945 cm^{-1} were assigned to the stretching of primary and secondary amine, while their corresponding vibration seen at1641 cm^{-1}. The band at 1392 cm^{-1} can be considered to the C-N stretching vibration of aromatic group. The band at 2698 cm^{-1} related to C-H vibration[7,8].

3.1.3 TEM analysis

Figure 3 illustrates the structure and size of the silver nanoparticles by using TEM analysis. The result which clearly indicates that the formed nanoparticles are in the size range from 5 to 10 nm, well dispersed and uniform spherical shape was identified.

3.1.4. Antimicrobial activity

Figure 4 shows the effective lethal effects towards human pathogenic bacteria's like (*Klebsiella, and Proteus*) using fruit waste extract mediated silver nanoparticles. This result may obtained by silver catalyzed di sulfide bonds which cause the damage of their composition with the antibiotic (Amikacin). Figure 4 which clearly indicates the zone of inhibition was found out with (*Klebsiella and Proteus*) when compared with other bacteria, respectively. The zone of inhibition of antimicrobial activity was tabulated in Table 1.

Table 1 (a)
Zone of inhibition of Silver Nanoparticles for antibacterial activity

S.No	Organisms	5µl of SNP	10µl of SNP	15µl of SNP	Control *(Amikacin)*
1	*Klebsiella*	8	8.7	10.1	9.1
2	*Proteus*	6	8.3	8.7	7.8

Figure 1
UV-Visible spectrum of Silver Nanoparticles

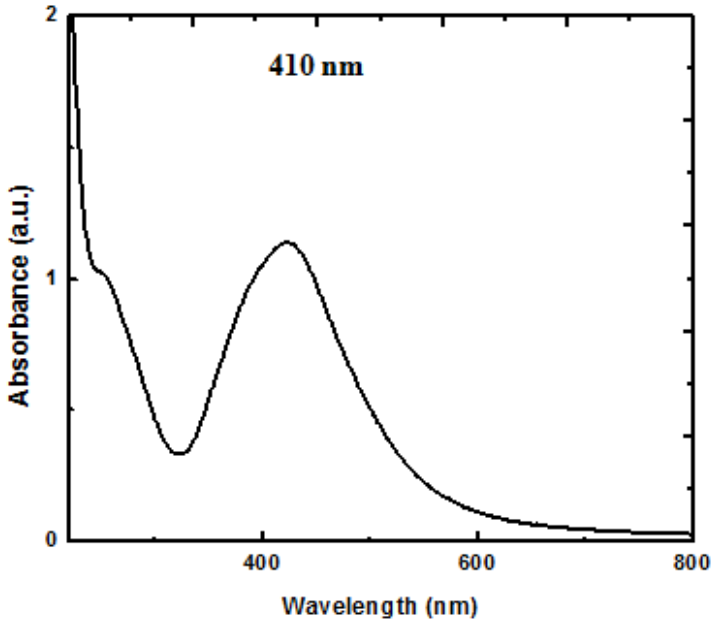


Figure 2
FT-IR spectrum of Silver Nanoparticles

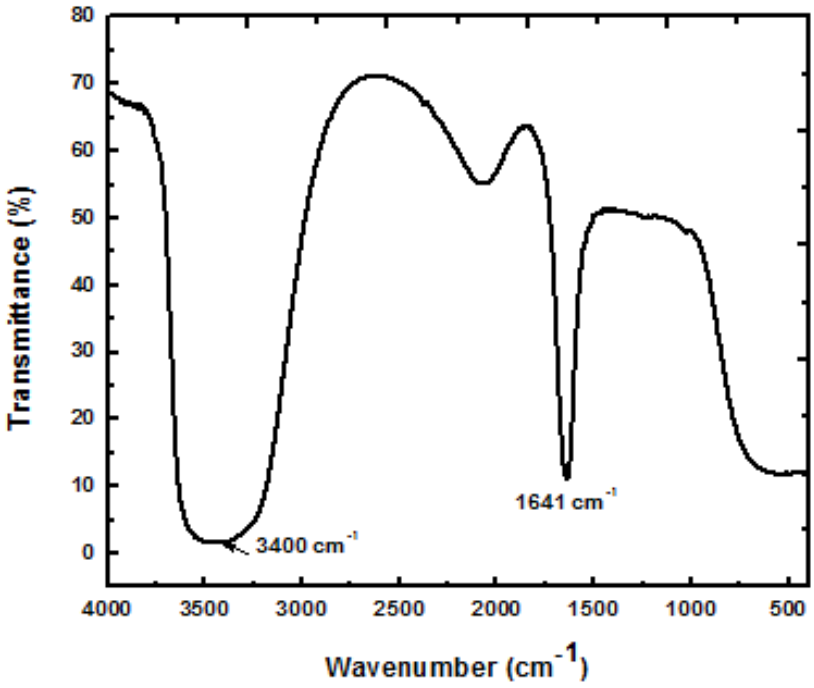


Figure 3
TEM image of Silver Nanoparticles

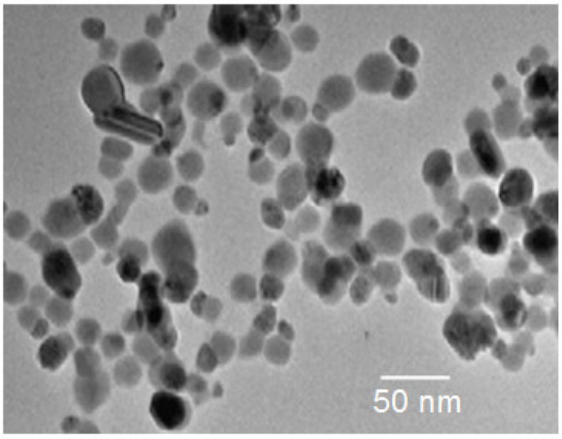
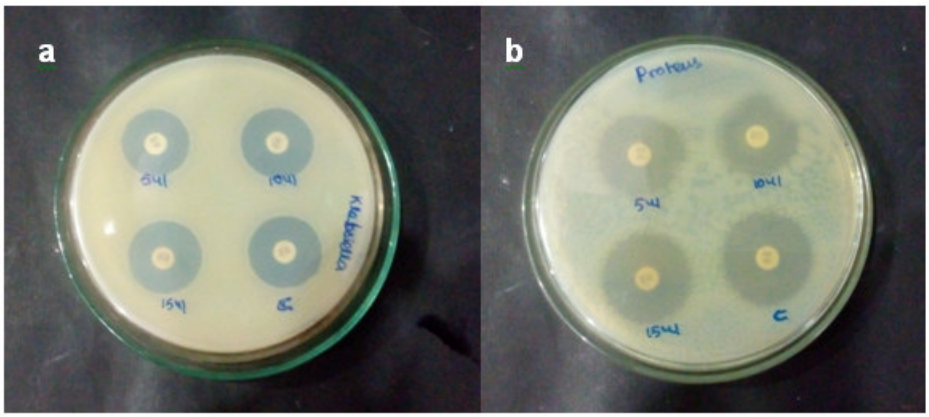
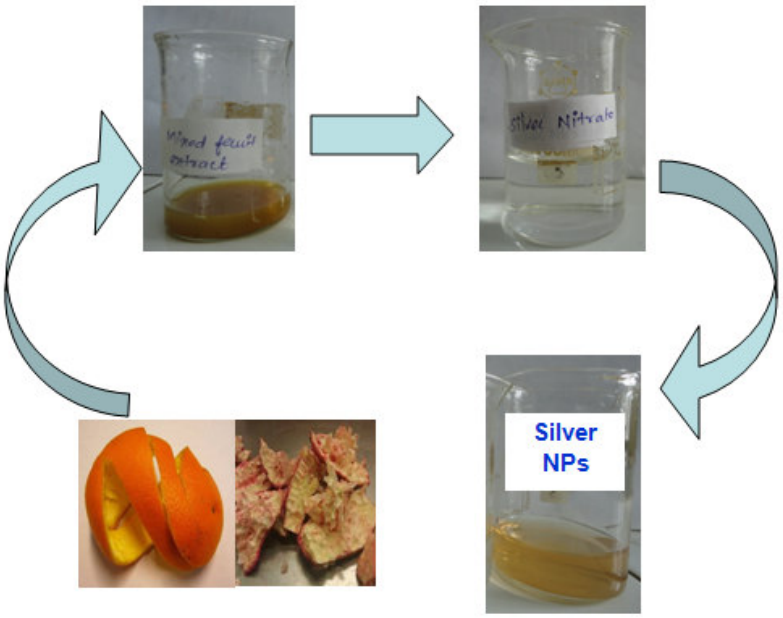


Figure 4
Zone of inhibition (a) Klebsiella and (b) Proteus



Schematic representation of silver Nanoparticles formation using mixed fruit peel waste extract



4. CONCLUSION

The current study has illustrated the biofabrication of silver nanoparticles from fruits waste materials. The size and shape of the nanoparticles forms a basis for the wide variety of applications. These nanoparticles have shown tremendous antimicrobial activity against for bacteria (*Klebsiella and Proteus*) which was clearly proved by agar diffusion method**.** Since this is the most advantages method as it is not hazard to the environment as well as it consumes less time to synthesis bio silver nanoparticles will explore broad range of applications in its anti-microbial drugs development.

ACKNOWLEDGEMENT

One of the authors, T. Somanathan would like to thank the Department of Science and Technology (DST) for the award of Fast Track Young Scientist Award and also for providing financial support (SR/FT/CS-111/2011).

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