COST EFFECTIVE GREEN SYNTHESIS OF SILVER NANOPARTICLES FROM RED ONION PEELS AQUEOUS AND ETHANOL EXTRACTS AND THEIR ANTIMICROBIAL ACTIVITY

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Abstract
Introduction: Due to the increasing commercial demand for nanoparticles because of their wide applicability in various areas such as in electronics, catalysis, chemistry, energy etc, green synthesis of silver nanoparticles (AgNPs) has gained much interest from chemists and researchers since it is a cost-effective and eco-friendly technique.
Aim: The aim of this study is to investigate the use of red onion peel extract as a reducing agent for silver nanoparticles synthesis and to assay for its antimicrobial property.
Method: In the present study, AgNPs were synthesized from 1 mM $AgNO_3$ solution through the aqueous and ethanol extracts of red onion peels. The nature of AgNPs synthesized was primarily characterized by UV-visible spectroscopy. The antibacterial potential of synthesized AgNPs was compared with that of standard antibiotic, Gentamycin by agar well diffusion method.
Results: The antibacterial activity results revealed that AgNPs synthesized from aqueous and ethanol extract of red onion peels showed significant zones of inhibition than the standard drug used against the majority of tested organisms except for *Rhizopus* and *Salmonella typhi*. *Rhizopus* was found to be two-fold sensitive to AgNPs of aqueous extract of red onion peels than AgNPs of the ethanol extract.
Conclusion: AgNPs from aqueous and ethanol extract of red onion peels showed broad spectrum antibacterial activity and may be a good alternative therapeutic approach in future.
Keywords: Green synthesis, Silver nanoparticles, Red onion peels, UV-Visible spectroscopy, Antimicrobial activity.

1.0 INTRODUCTION

One of the most important areas of nanotechnology is the application of nanoscale materials, ranging from 1 to100nm (Sankar & Dipak, 2015). However due to unique properties such as optical, chemical, electronic, photo-electrochemical, catalytic, magnetic, and biological labeling properties, silver nanoparticles (AgNPs) has been found to be popular among other types of nanoparticles (Sharma, Yngard, & Lin, 2009). Various methods have been reported for the synthesis of NPs including chemical reduction of Ag^+ to AgNPs with or without stabilizing agents, such as sonochemical (Kumar, Smita, Cumbal, Debut, & Pathak, 2014), photochemical (Callegari, Tonti & Chergui, 2003)electrochemical (Yin, Ma, Wang & Chen, 2003), sol–gel method (Raffi, Akhter & Hasan, 2006), ionic-liquid-supported method (Kumar, Smita, Cumbal, Debut & Pathak, 2016), γ-rays (Wang, Zhang, Ma, Zhang, Xu, & Peng, 2013) and biological techniques plants (Peddinti & Vanga, 2017).The green synthesis of AgNPs using plant extract is preferred to other synthesis method because it has dual properties of stabilizing and as an emulsifying agent (Brajesh, Kumari, Luis Cumbal & Alexis, 2016). It is also cost effective and environmentally benign (Nagababu & Umamaheswara, 2016). According to Rimal, Sakthivel & Murthy, (2013), AgNPs synthesized biologically could be of immense use in medical and biomedical textiles because of their efficient antimicrobial properties.

Onion plant is one of the most widely cultivated and used plants, and its bulb is used as both food and medicine. They are used as important ingredients of various food items because they possess strong, characteristic aromas and flavors. Report has revealed that onion possesses various biological properties, including antibiotic, antidiabetic, antioxidant, antiatherogenic, and anticancer effects (Corea , Fattorusso, & Lanzotti, 2005). In the present investigation, aqueous and ethanol extracts of red onion peels were used to synthesize a simple, low-cost and green method of AgNPs. Prepared nanoparticles were characterized primarily by UV-Visible spectroscopy and their antibacterial activity were also attempted as there is no earlier report on the green synthesis of Onion Peels AgNPs.

2.0 MATERIALS AND METHOD

2.1 CHEMICALS:

All the chemicals used were of analytical grade; Silver nitrate, Mueller Hinton agar

2.2 PLANT SOURCE:

The onion peels were obtained from the local market. The peels were washed thoroughly with tap water and then with distilled water.

2.3 PREPARATION OF SAMPLE:

2.3.a. Ethanol Extraction :

100gm of onion peels was soaked in 500ml of ethanol for 72hours. The extract was prepared using rotary evaporator.
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2. 3.b. Aqueous Extraction:

100gm of onion peels was weighed into 100ml of distilled water and boiled at 60ºC for 30mins. It was then filtered and centrifuged at 1000 rpm for 10 min and the supernatant was collected and stored at 4°C for further analysis.

2.4 Green synthesis and Characterization of silver nanoparticles

The method of Olugbemi, 2019 was adopted for the green synthesis of silver nanoparticles from onion peel aqueous and ethanol extract with appropriate modifications. In brief 20 ml each of aqueous and ethanol onion peel extract was added with two separate flask containing 80 ml of 1mM silver nitrate ($AgNO_3$) solution.
The development of colloidal brown and light brown solutions for the ethanol and aqueous extracts respectively indicated the formation of AgNPs. For further confirmation of AgNPs formation, the colloidal brown and light brown solutions were subjected to Ultraviolet-Visible Spectrometry.

2.5 Antimicrobial activity of red onion peels AgNPs

The AgNPs synthesized from aqueous and ethanol extract of red onion peels were tested for their antimicrobial activity against pathogenic bacteria including *S.aureus, E.coli, Sal.typhi, Aper.Niger, Rhizopus* by agar well diffusion method as described by Nagababu & Umamaheswara, (2016). 100 µl of sample prepared by dissolving 100 µg of nanoparticle material in 1 ml of dimethyl sulfoxide (DMSO) was placed Into each agar well. In a separate well, DMSO was also dispensed to maintain the control. The plates were incubated at 37°C for 24 hrs. After incubation, the diameter of the zone of inhibition was measured. The experiment was carried out in duplicates.

3.0 RESULT

3.1 Synthesis and characterization of silver nanoparticles

Addition of the ethanol and aqueous extracts of red onion peel to $AgNO_3$ solution resulted in changes of color of the reaction mixture from pinkish red to colloidal brown and light yellow indicating AgNP formation.

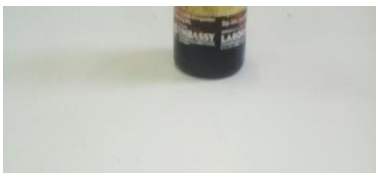
a)  b) 

Figure 1-a) A**gNps synthesized from ethanol extract of red onion peels**
b) A**gNps synthesized from aqueous extract of red onion peels**

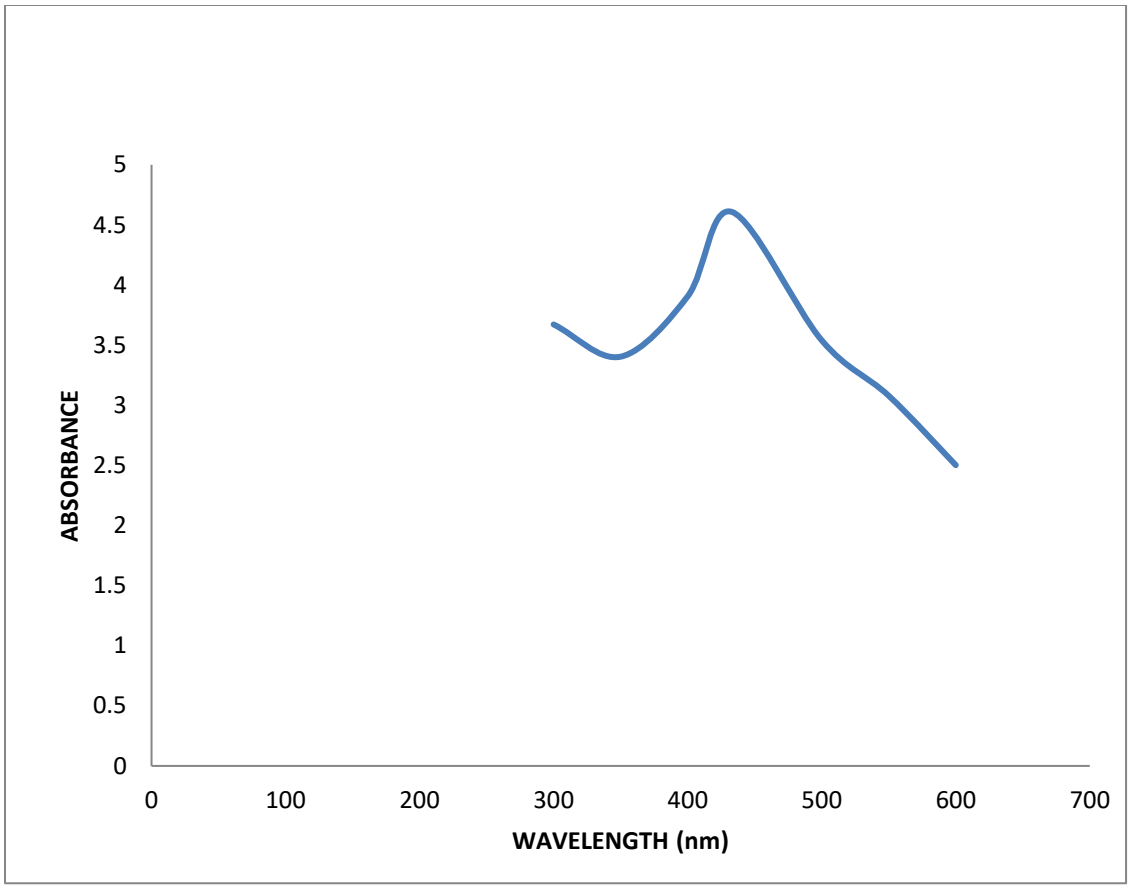


Figure 1: Ultraviolet-visible spectra of silver nanoparticles of ethanol extract of red onion peels after 24hours of incubation

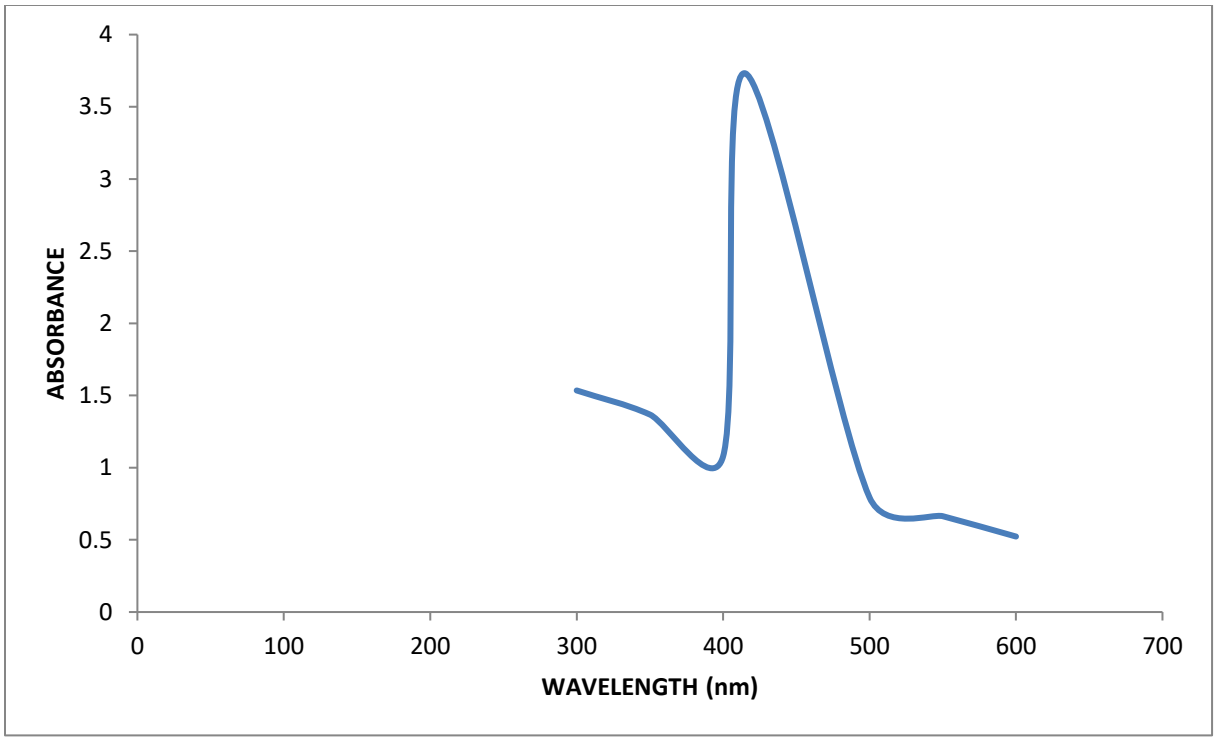


Figure 2: Ultraviolet-visible spectra of silver nanoparticles of aqueous extract of red onion peels after 24hours of incubation

The peak observed at 433 nm and 415nm for the AgNps of aqueous and ethanol extract respectively (Fig. 2 and 3) was the characteristic band for silver nanoparticles apart from that no other peak was observed in the spectrum, which confirms that the synthesized products are of silver only.

3.2 The antimicrobial activity

The chart of zones of inhibition are given in Fig 4. The antibacterial activity results revealed that aqueous and ethanol AgNPs showed significant zones of inhibition than Gentamycin, the standard drug used against the majority of tested organisms except for *Rhizopus* and *Salmonella typhi*. *Rhizopus* was found to be two-fold sensitive to AgNPs of aqueous extract of red onion peels than AgNPs of the ethanol extract.

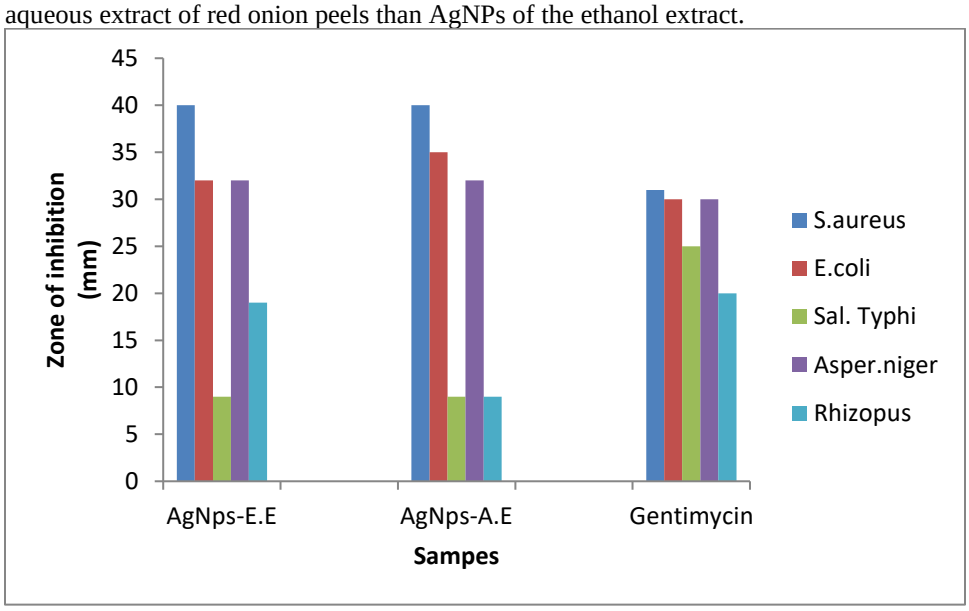


Figure 4- Zone of inhibition of samples

AgNps-E.E- Silver nanoparticles of ethanol extract of red onion peels
AgNps-A.E- Silver nanoparticles of aqueous extract of red onion peels

DISCUSSION

An important step in the field of application of nanotechnology is the fabrication of reliable and cost effective process for the synthesis of metallic nanoparticles (Kirubha & Alagumuthu, 2015). Silver nanoparticles was synthesized from ethanol and aqueous extract of red onion peels. The synthesis was confirmed by colour changes from red to dark brown and light brown for both extracts respectively due to the reduction of silver ions to silver nanoparticles (Safaepour, Shahverdi,Shahverdi, khorramizadeh, & Gohari, 2009).

Report has shown that Plasmon resonance absorption band due to the combined vibration of electrons of AgNPs in resonance with light wave shows an absorption spectra between 400-490nm confirming the formation of spherical AgNPs (Balashanmugan & kalaichelvan, 2015). The silver nanoparticles synthesized from ethanol extract of red onion peels had an absorption spectra of 433nm (Figure 2) while silver nanoparticles synthesized from aqueous extract of red onion peel had an absorption spectra of 415nm (Figure 3). This confirms further the synthesis of silver nanoparticles from both extract used. A similar absorption spectra was reported for AgNps of onion extract (Antariksh, Ravi &Rajendra, 2010 ; Eman, 2017).

The antimicrobial activity results revealed that AgNPs synthesized from ethanol and aqueous extracts of red onion peels showed significant zones of inhibition than the standard drug used against the majority of tested organisms except for *Rhizopus* and *Salmonella typhi*. *Rhizopus* was found to be two-fold sensitive to AgNPs of aqueous extract of red onion peels than AgNPs of the ethanol extract. This result confirms that specially formulated metal nanoparticles have good antimicrobial activity. (Jose, Jose, &Alexandra 2005) and support the utilization of AgNps of ethanol and aqueous extracts of red onion peel in the management of infectious diseases.

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