JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

MICROBIAL SYNTHESIS OF SILVER NANOPARTICLES AND ITS ACTIVITY AGAINST SELECTED HUMAN BACTERIAL PATHOGENS

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Abstract:

An eco-friendly production of nanoparticles is an advanced step in the field of nano bio technology. Recently, microorganisms have been explored as potential biofactory for synthesis of nanoparticles. Silver nanoparticles is one of the greatest and fascinating nanomaterial's that are involved in biomedical applications. In this present study aim to focus on biosynthesis of silver nanoparticles and evaluate the potential effect of silver nanoparticles as antibacterial agent against pathogenic microbes and its characterization.

Key words: *Escherichia coli*, silver nanoparticles, antibacterial activity, UV.SEM,FTIR

Introduction:

Nanotechnology play an increasing role in many key technologies of the new millennium and it finds application in various areas of medication, preliminary from diagnosis, therapeutic drug delivery to the treatment of many diseases. Silver nanoparticles are one of the hopeful products within the field of nanotechnology because of their wide range of applications in bactericidal activity. The use of microorganisms in the synthesis of nanoparticles emerges as an eco-friendly and exciting approach.

Biosynthesis of AgNPS is an eco-friendly approach by using different biological sources such as plants and microorganisms like bacteria, fungi, and actinobacteria (Narayanan and Sakthivel, 2010). Synthesizing nanoparticles with desired size and composition are of great interest, as they provide solutions to various environmental and technological challenges. Many microorganism capable of producing AgNPs. Very few studies are reported on *Actinobacteria* being capable of synthesizing nanoparticles (Mcleod *et al.*, 2003).

Microbes can adapt in higher concentrations of metals and have the potential to reduce inorganic materials into NPs through their extracellular or intracellular routes (Salem, S.S.; Fouda. (2021)

However, concern has been raised on the toxicity of chemical agents used in silver nanoparticles synthesis. Thus, it is essential to develop a biological approach for the production of silver nanoparticles without using hazardous substances to the human health and environment. Silver nanoparticles have increased immensely due to its wide range of applications in different fields (Morones, J.R *et al*.,2005).

Currently, the applications of nano materials is becoming increasingly important in order to address the problems associated with material sciences, including solar energy conversion, photonics (Setua *et al*., 2007), The present work provides explicit information on the synthesis, characterization and antibacterial efficacy against bacterial pathogens. Synthesis of nanoparticles is unique and their applications in bioremediation, agriculture, medicine and their future prospects.

Materials and Methods

Bacteria was isolated from collected water samples using serial dilution method. The plate was incubated overnight in the incubator at 37ºC. Each developing colony in the plate developed from a single cell. The isolated bacteria underwent biochemical tests. Broth was subjected for centrifugation and the obtained supernatant was treated with Silver nanoparticles, synthesized nanoparticles were characterized using UV-Vis spectroscopy, FTIR,SEM and its antibacterial activity.

Synthesis of silver nanoparticles

Escherichia coli was cultured in LB medium to produce the biomass for biosynthesis. The culture flask was incubated on an orbital shaker at 37ºC. The biomass was harvested after 24 and centrifuged .150ml culture supernatant was added separately to the reaction vessels containing silver nitrate at a concentration of 0.1 g/l. The reaction between these supernatant and silver ions was carried out in bright conditions and another reaction mixture without silver nitrate was used as control.

Agar well diffusion method

Silver nanoparticles synthesized using microbial filtrate is tested for its potential antibacterial activity against bacterial isolates such as *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae.*

Results and discussion

Colonies were identified according to their biochemical characterization. Gram staining indicates gram negative rod shaped bacteria (Fig.1). Table (1) showed that positive test for catalase but negative test for gram staining. Kithar R. *et al*., and Forbes *et al*., suggested that such characteristics usually coming in accordance with those belonging to *E. coli*

Malarkodi *et al*. (2013) reported that the UV-Vis spectral band corresponds to the surface plasmon resonance at 410 to 430 nm. In the present experiment, the UV-Vis spectrum of silver nanoparticles showed 440 nm (Fig.2) which indicates the formation of silver nanoparticles. In this present experiment The bands are seen in 1635.64 it indicated the presence of alcohol, aliphatic amines, aromatic compounds, primary or secondary amines and halogen group. The peak appeared at 3707.33 presence of phenol. The bands seen at 2990.75cm-1 are assigned to the alkenes. Stretching vibrations of secondary amines. The FTIR spectrum of silver nanoparticles exhibits the N-H vibration of NH+3 at 3707.33cm-1 and 3220.85cm-

1. The peak appeared at 1699.67 cm-1 was indicated that the presence of aminoacid, nitro compound, and aromatic functional group. Naveen *et al*., (2010) observed that the representative spectra of nanoparticles obtained manifest absorption peaks located at about 3843.68cm-1 (-NH group of amines), 3597.73cm-1 (-OH group of phenols), 2080.65cm-1 (aromatic – CH stretching), 1631.66 cm-1 (- NHCO of amide) and 767.16cm-1 (C – CI).

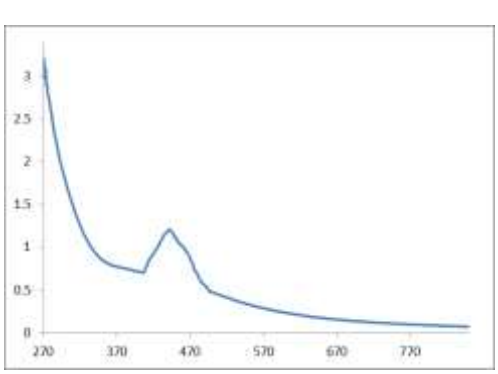
In the present experiment, biosynthesized silver nanoparticles are spherical in nature and some undefined morphology with traces of agglomeration. Vanmathiselvi *et al*. (2012) the SEM micrograph shows nanoparticles aggregates. Shivakrishna *et al*. (2013) reported that the biosynthesized silver nanoparticles are in small and spherical in shape.

Sondi and Salopek-Sondi *et al*. (2004) reported that the antimicrobial activity of silver nanoparticles on gram-negative bacteria was dependent on the concentration of Ag nanoparticles, and was closely associated with the formation of pits in the cell wall of bacteria. In the present study reported that the biosynthesized silver nanoparticles shows high inhibitory effect (28) on the growth of *Klebsiella pneumoniae* and the moderate inhibitory effect (12) on the growth of *Staphylococcus aureus.*(Plate.1)

Fig.1 Visual inspection of silver nanoparticles

Fig.2 Biosynthesized silver nanoparticles

Fig.2 UV-Vis and FTIR Spectra of Silver Nanoparticles



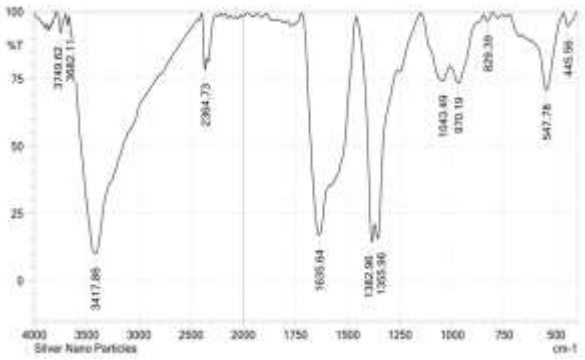


Fig .3 Scanning electron microscopic view of silver nanoparticles

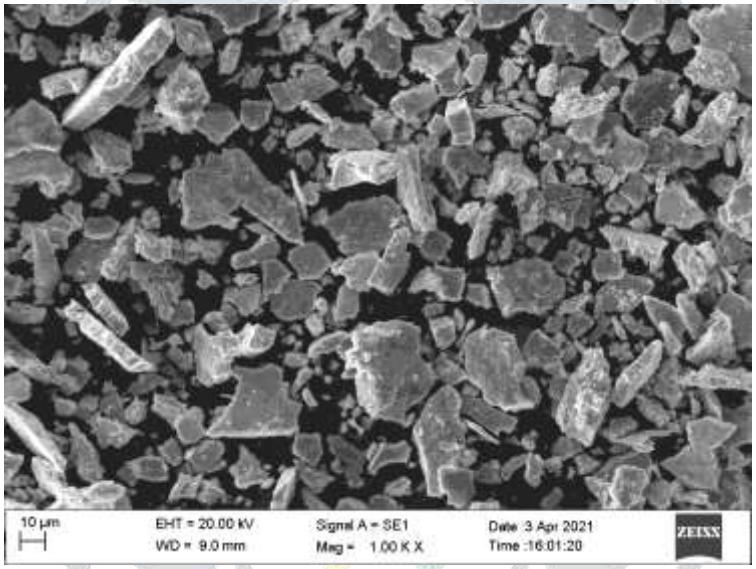


Plate .1 Biochemical test for *Escherichia coli*

Gram staining

Catalase test

S.NO	Name of the test	Result(+/-)
1	Gram staining	-
2	Catalase	+

- positive
- Negative

Plate :2 Antibacterial activity of silver nanoparticles using well diffusion method

Pseudomonas aeroginosa

Staphylococcus aureus

Klebsiella pneumoniae

Conclusion

Biosynthesis of silver nanoparticles are having a lot of applications in various fields like antimicrobials, preservatives, paints, biosensors and cosmetics. So improving of nanoparticles synthesis is the major object in the field of synthesis of silver nanoparticles. The usage of bacteria is good approach to the production of eco-friendly and costs effective. Biologically synthesized silver nanoparticles having a broad spectrum of antibiotic against the common urinary tract infecting pathogen *Escherichia coli,* one of the common bacteria with pathogenic strains and are relatively resistant towards synthetic drugs. Biobased nanoparticles will giving a good prospect for the maximum fabrication and it is very useful for many silver based applications.

Acknowledgement

The authors acknowledged the Managing Board,V.V.Vanniaperumal College for Women, Virudhunagar for providing financial assistance and permitting us to utilize internet facilities and Laboratory to complete this project in effective manner.

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