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Mycosynthesis of Silver Nanoparticles, Their Characterization and Antimicrobial Activity

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Abstract:*The use of the Fungus Penicillium species for the synthesis of silver nanoparticles was discussed in the present paper. The prepared nanoparticles were characterized by using UV-visible spectrophotometry, X-ray diffraction analysis, Transmission Electron Microscopy. The surface plasmon resonance peak observed at 413 nm in UV-visible spectra confirm the formation of silver nanoparticles. (TEM) images revealed that the particles were spherical with size in the range between 11 nm to 20 nm. Surface area electron diffraction pattern revealed the crystalline nature of silver nanoparticles with face centred cubic geometry. The synthesized silver nanoparticles were evaluated for the antimicrobial activity against Gram Positive bacteria S.aureus. and displayed the zone of inhibition 21mm in diameter.*

Key words:*Biosynthesis, silver nanoparticles, UV-visible spectroscopy, XRD, TEM, antimicrobial activity.*

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I. Introduction

The assembly of atoms or molecules bound together in a diameter or size in the range between 1nm to 100 nm [1] form the nanoparticle. Particles having the size greater than 2 nm are known as nano crystal while the particles with the size less than 2nm are nanoclusters. Due to exclusive optical, electrical, and electronic properties of metal nanoparticles, they found applications in various fields like agriculture, medicine, catalysis [2], sensing, biolabelling etc. Silver and its compounds are known for their practice in antimicrobial activities. It is well known that silver nanoparticles exhibited excellent optical, electrical and thermal properties, hence useful in various fields such as sensing, catalysis, biolabelling, medical, agriculture etc. The antimicrobial activity of the silver nanoparticles against Gram-positive and Gram-negative bacteria such as *S. Aureus* [3,], *B. Subtilis* [4], *E. coli* [5] etc. was reported in literature. The conventional physical and chemical methods are found to be hazards as they are using toxic chemicals in the preparation of nanoparticles. Also, these methods require bulky and expensive instruments. Hence biological methods are important for the synthesis of nanoparticles as these methods are simple, environmentally benign. This technique involves the use of plants extract [6] and microorganisms, algae, bacteria fungi, etc. Among thesemicroorganism use fungi is becoming more popular because of its simplicity in the growth mechanism, fast growth of biomass, rapid synthesis and large-scale production. Fungi such as *Fusarium oxysporum [7], Aspergillus Flavus[8,9], Aspergillus Niger [10]* etc. have shown their ability for the extracellular synthesis of silver nanoparticles.
Here we report the rapid synthesis of silver nanoparticles which exhibit good antimicrobial activity against B. Subtilis.

II. Materials and methods

Chemical and Ingredients

Silver nitrate was purchased from Sigma Aldrich. Potato dextrose broth was used of HI media. The fungus culture *penicillium species* (NCIM 1313) was obtained from National Chemical Laboratory culture collection centre, Pune.

Synthesis of silver nanoparticles

The cell filtrate of the fungus penicillium species was prepared as described by Hemath et. al. [11].For the preparation of silver nanoparticles 25 ml of cell filtrate was mixed with equal amount of 1mM AgNO3 in Erlenmeyer flask. The flask was then kept in an orbital shaker and incubated at 110 rpm for 24 h.

III. Characterization of silver nanoparticles

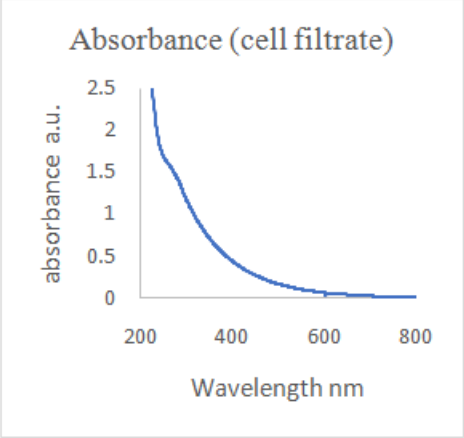
The formation of silver nanoparticles was observed visually and then confirmed by using UV-visible spectrometer (Shimadzu 2450) scanningin the range between 200 nm to 800 nm. For structural information the

synthesized silver nanoparticles were subjected to X-ray diffraction analysis. The information about size and morphology of the silver nanoparticles was achieved from Transmission electron microscopy. For this purpose, a drop of colloidal solution of silver nanoparticles was kept on carbon coated copper grid and allowed to dry in air to form a film. The formed film was used for TEM characterization. The antimicrobial activity of silver nanoparticles was evaluated against *Staphylococcus aureus* by disc diffusion method [12]. The sample disc P16 impregnated with 100 µl of colloidal solution of silver nanoparticles was placed on nutrient agar plates and incubated at 37^0C for 24 h.

IV. Result and discussion

UV-visible spectroscopic measurements

Figure 1 Cell filtrate treated with AgNO3



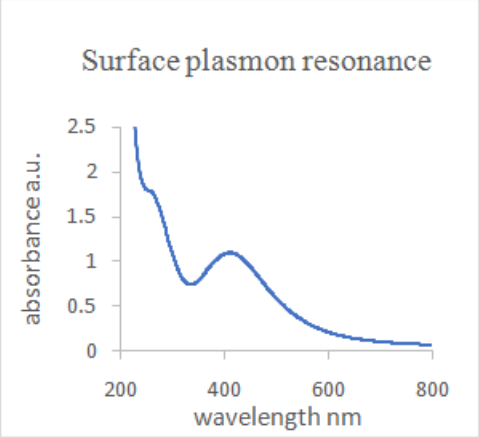


Figure 2 (a) UV-visible spectra of cell filtrate **Figure 2(b)** UV-visible spectra of cell filtrate with AgNO3

The change in colour of the reaction medium from pale yellow to brown within 24 h was the first indication for the formation of the silver nanoparticles [13]. Fig.2(a) shows the UV-visible spectra of the cell filtrate with the absorption peak appeared at 260 nm which may be attributed to aromatic amino acids of proteins [14].Fig.2(b) depicts the UV-visible spectra of the cell filtrate treated with 1 mM silver nitrate solution. It displayed the surface plasmon resonance peak at 413 nm which is the characteristic signature of the silver nanoparticles [15].

X-ray diffraction analysis

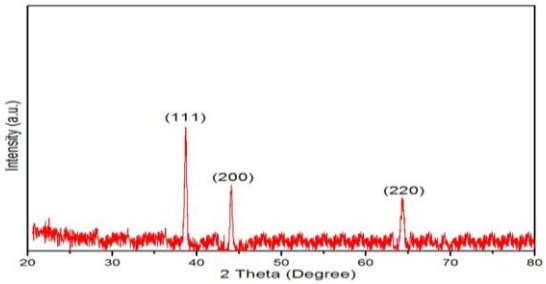


Figure 3 X-ray diffraction pattern of silver nanoparticles

Diffraction pattern of the prepared silver nanoparticles is shown in Figure 3. Peaks are recorded at 2ɵ values 38.4^0,44^0 and 78^0 corresponding to (111), (200) and (220) planes of silver and matches well with the standard powder diffraction card of JCPDS, silver file No. 04-783. This exhibits the crystalline nature of the nanoparticles with face centred cubic geometry.

Transmission Electron Microscopy

TEM micrographs are presented in figure 4(a) revealed that the synthesized particles were spherical in shape and in the size range between 11 nm to 20 nm. The particles were well dispersed but with some agglomeration. SAED pattern of the silver nanoparticles shown in Fig. 4(b) specified that the particles were crystalline in nature with face cantered cubic structure.

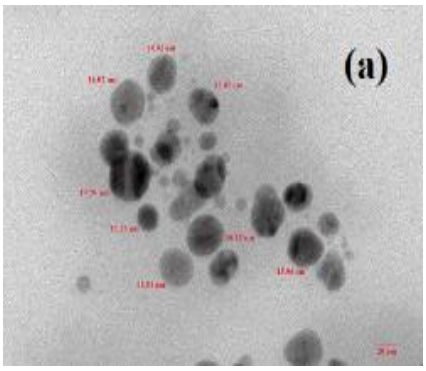


Figure 4(a) TEM image of synthesizedsilver nanoparticles

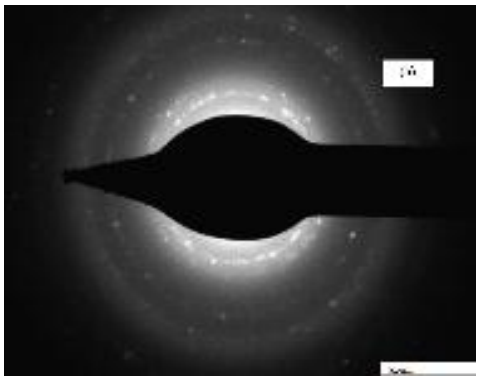


Figure 4 (b) SAED pattern of Ag NPs

V. Antimicrobial Activity

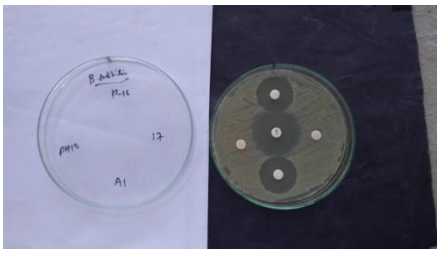


Figure 5 Antimicrobial activity of AgNO3

The antibacterial activity of the synthesized silver nanoparticles was shown in fig. 5. The zone of inhibition of diameter 21mm corresponding to the sample disc P16 exhibit the antibacterial performance of silver nanoparticles.

VI. Conclusion

The cell filtrate of *Penicillium species* has the ability for extracellular synthesis of silver nanoparticles in lesser time. These nanoparticles were found to be spherical in the size range 11 nm to 20 nm as revealed from the TEM images. SAED pattern indicates the crystalline nature of silver nanoparticles with fcc geometry. The antimicrobial activity exhibited by the nanoparticles have shown their potential for the alternative to present antibiotics in the field of pharmaceutics.

References

[1]. J. Jana, M. Ganguly and T. Pal, *Royal Socety of Chemistry, (6)*2016,86174-86211.
[2]. Liangwei Du, Qiuhong Xu, Meiying Huang, liang Xian, Jia-Xum Feng, *Material Chemistry and Physics, xxx*,2015,1-8.
[3]. D. Singh, V. Rathod, S. Ninganagouda, J. Hiremath, A. Kumaar Singh, and J. Mathew, *Bioinorganic Chemistry and Applications*, 2014,8pages.
[4]. A. M. Goswami, T. S. Sarkar and S. Ghosh, *AMB Express, 3:16*,2013,1-9.
[5]. D. K. Rahi and A. S. Parmar,*International Journal of Nanomaterials and Biostructures,4(3),*2014, 46-51.
[6]. B.Sadeghi, F. Gholamhoseinpoor, *Spectrochimica Acta Part A: Molecular and Biomolecular spectroscopy,134*,2015,310-315.
[7]. A. Ahamad, P. Mukherjee, S.Senapati, D. Mandal, M.I. Khan, R. Kumar,*Colloids Surface B. Biointerfaces(28),*2003,313-318.
[8]. N. Jain, A. Bhargava, S. Majumdar, J.C. Tarafdar and J. Panwar, *Nanoscale*, (*3*),2011,635-641.
[9]. *R.Manimozhi, R. Anitha,, International Journal of Pharmaceutics and Drug Analysis,Vol.2,issue 9,2014,*734-739.
[10]. *A.K. Gade,P.Bonde,A.P. Ingale,P.D.Marcato,N.Duran,andM.K.Rai,Journal of Biobased Materials and Bioenergy,vol.2,2008,1-5.*
[11]. H. Naveen, K.S. Gaurav Kumar, L. Karthik., B. Rao K.V., *Achieves of Applied Research*, 2010,2(6),161-167.

[12]. N. Savithramma,M.Linga Rao, K. Rukmini,and P. Suvarnalathadevi, *International Journal of Chem Tech Research,Vol. 3, No.3,* 2011, pp 1394-1402.
[13]. K.C. Bhainsa, S.F. D'Souza, *Colloids and surfaces B: Biointerfaces,47(2),*2006,160-164.
[14]. D SoheylaHonary, H. Barabadi, E.G. Fathabad and F. Naghibi,*Tropical Journal of Pharmaceutical Research12(1),*2013,7-11.
[15]. JM Pitark, VMSilkin, EVChulkov,PMEchenique, J *Optic Pure Applied Optic,(7),*2005,73-84.

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