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Research Article

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Nano-Biotechnology: Developing Nano-silver coated cotton fabrics by means of bio-synthesis of silver nanoparticles using *Aspergillus terrues* strain (MTCC9618) against *staphylococcus aureus*

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Abstract

Biosynthesis of silver nanoparticles, especially fungal mediated method is given attention in the development of new drugs for resistance pathogens, molecular diagnosis, drug delivery therapy and in catalytic sensor due to its cost effective, none toxicity and eco-friendly. The present study focused on the fungal mediated biosynthesis of silver nanoparticles using Aspergillus terrues strain (MTCC 9618). The synthesized nanoparticles was monitored by spectrophotometer SEM, XRD and its band gap was determined by Tuac equation. After while the fungal crude cells was exposed to 5mM silver nitrate the reduction reaction was recorded according to red shift colorchange. Based on ultra violet spectrophotometeran absorbance was recorded in a distinct pick around 430nm - 450nm and also the band gab was determined using Tuac equationsuch that 2.08eV, 2.02eV, 2.0eV and 1.96eV at about 10min, 30min, 12h and 24h respectively. The AgNPs coated cotton fabrics was developed through direct exposed to extracellular metabolites and 100ppm colloidal solution of AgNPs. The antimicrobial efficacy of the synthesized AgNPs coted cotton fabrics against gram positive Hospital staphylococcus aureus pathogenstrains was conducted by disk diffusion assay. In which the antimicrobial efficacy of coated cotton-Ag against human pathogens was proofed how the staphylococcus aureus had susceptible too and (16mm) zone of inhibition was recorded. Based on disk diffusion assay at 10ug/mL minimum inhibition concentration (MIC)10.5 mm inhibition zone was noted consequently, this study accomplished that Aspergillus terreus strain mediated biosynthesis of silver nanoparticles is cost effective, time saving, eco-friendly and small spherical (<10nm) had produced against to Physio-chemical means. The bio-synthesized silver nanoparticles cotton fabrics publicized that a higher efficacy of antimicrobial activity against staphylococcus aureus and the result was considerable suggested in widely range used in textile and pharmaceutical industries to enrich durability, strength, quality of products against a clinical pathogens application as well bad odor and spoilage of dusts from fabrics.

Keywords: Nano-biotechnology, Convergence, Aspergillus Terrues, AgNPs, Coated Fabrics, Antimicrobial Efficacy

Introduction

Today, Nano and biotechnology are coming together and converge one another to cross boundary between life health science and physical engineering in which understanding of the life and matters at genic and atomic level is the basic and fundamental principle of this day emerging technologies. Nanoparticles opens new era and has given emphasized in the development of innovative and economical tools since nanoparticles ability makes an extraordinary property due to the repulsions and attraction force of atomic bond at a molecular level [1]. Nanoparticles has come to be high large surface area to volume ratio, variety of shape, size of fine particles and balanced gap band (Eg) due to rearrangement of atoms and electrons jumps when diminished the bulk materials into fine particles through scientific techniques [2,3].

Among all techniques, biosynthesis of nanoparticles are very important since it has none side toxicity effect on a target valid expanse. Using of microbial extracellular and intracellular is an alternative, approaches in synthesis is of silver nanoparticles. Thus, Microbial method is suggested since they are simple, cost effective, nontoxic and environmental friendly [4].

Lately, the utilization of biological systems, especially fungi, has emerged as a novel method for the production of silver nanoparticles (SNPs). Fungal production of nanoparticles at large scale in bio- Nano factories ismore likely relevant in silver, gold, platinum and cadmium nanoparticle manufacturing. the fungal mycelia Int J Nanotechnol Nanomed, 2019 that provide a much higher surface area than bacteria and which leads high production of secondary metabolites and easy affinity between nitrate reductase enzymes, use as capping agent and metal ion solutionin conversion of nanoparticles as well handle the down processing easily [5, 6, 7]. There are researches report over the production of fungal strains like *Aspergillus fumigatus* was produced silver nanoparticles extracellularly, when the crude cell had challenged with $AgNO_3$ solutions. Correspondingly as per Al-othman et al. described the process of biosynthesis SNPs by using *Aspergillu terreus* (KC462061) and the results showed the particles

of SNPs are spherical in shape and steady statewithout significant agglomeration[7,8].

Todate, application of silver nanoparticles have been widespread whereas it has been used as catalytic, biosensor and anti-microbial prospects, especially, antimicrobial properties of silver nanoparticles is focused due to the outbreak drug resistance pathogens and difficulty of treat them by existence antibiotic mode of actions [9]. Such that those nanoparticles has suggested to apply for coating and dressing of biomedical tools, cotton fabrics and protecting of biofilms culturing over fabric [10, 11].

In this study, we selected fungal biosynthesis using *Aspergillus terrues* strain (MTCC 9618) because of in addition to its cost effective and environmental friendly, such procured strain is a new and needs supplementary studies in biosynthesis of improved AgNPs and coated cotton fabrics production is an emerging technologies so as to enhance the quality of products in textile and pharmaceutical industries demands against bacterial pathogens.

Materials and Methods

Sample and materials collections

Aspergillus terrues strain (MTCC 9618) for synthesis of AgNPs was procured from the Microbial Type Culture Collection and Gene Bank (Chandigarh, India) and the culture was maintained on potato dextrose agar slant which was Himedia and containing (potato infusion, 200grm; dextrose, 20grm; agar, 15grm/L and pH (at 28°C) 5.1 ± 0.2) with chloramphenicol 50mg (to control bacterial growth) [12]. *Staphylococcus aureus* (gram-positive cocci) strain was obtained from school of medical microbiology department; Sharda Hospital and strains were stored at microbiology laboratory in Sharda University for further processes. The fungal culture plate was incubated at room temperature (28 ± 2°C) for seven days. The produced pigment of *Aspergillus terreus* strain was confirmed by cell colony pigments and microscopic morphology analysis on the basis of the peer reviewed literatures. Microscopic was done with mycelia the selected fungal isolate using lacto phenol cotton blue test [13]. Whereas the rest of culture was kept for succeeding process.

Biomass production and crude cell extraction for Synthesis of silver Nanoparticles

Intended for synthesis of silver nanoparticles, the biomass of fungus cell was harvested. *Aspergillus terreus* strain was cultured in potato dextrose broth media (PDB) Himedia which comprehends the same constituents and procedures as of the potato dextrose agar (PDA) except agar. The broth medium flask was inoculated with spore and incubate at 28°C on a rotary shaker (120 rpm) for seven days. The biomass was harvested through filtration techniques (Waterman filter paper No. 1) and extensively washed by sterilizing distilled water several times to remove any component of used medium. Weighted 25 gram of the fresh filtered biomass and dissolved in the flask containing 100 ml Milli-Q deionized water. The flask was incubated at 28°C on a rotary shaker (120 rpm) for 24 h.

Biosynthesis of Silver Nanoparticles (AgNPs)

The biomass was filtered and the crude cell filtrate of Aspergillus terreusstrain was collected for further analysis and for biosynthesis of silver nanoparticles. Then 90ml sterile crude cell filtrate was mixed to 5mM of 10ml $AgNO_3$ in 250ml an Erlenmeyer flask and incubated on orbital shaker at 200 rpm at 28°C for 24h. According to the main factors of the biosynthesis, silver nanoparticles (AgNPs) was concentrated at 10,000 rpm for 10 minutes twice (LAPTOP centrifuge; 20,000rpm) and then dehydrated the pellet in dry hot plate for further characterizations and application.

Band Gap Determinations

Metallic has zero band gab and no need of energy require for jumping electrons to excite state so that those bulk materials have a conductive properties rather than semiconductor behavers. For evaluating the synthesized silver nanoparticles its semiconducting characters, the minimum optical transition required energy to excite an electron from ground state to conduction band was determined by using Tuac equation based on the UV- spectrum data which is defined as:

$$(\alpha h\nu) = A\,(h\nu - E_g)^n \qquad (1)$$

Where, A is a constant, hν is photon energy, E_g is the allowed energy gap, n = ½ for allowed direct transition and n =2 for allowed indirect transition. The band gap was determined by

$E_g = 1240/\lambda$ (eV)

Therefore; for direct transition Eq. (1) becomes

$$(\alpha h\nu) = A(h\nu - E_g)^{1/2} \qquad (2)$$

The variation of biosynthesized silver nanoparticles of $(\alpha h\nu)^2$ and (hν) were showed as per the progressive of reaction [14]. The band gab energy was gotten by extrapolated the Tuac linear adjacent region to $(\alpha h\nu)^2 = 0$

Characterization of synthesized of silver nanoparticles (AgNPs)

The reduction potential of the cells against silver salt including binding affinity of the colloidal solution and the synthesized silver nanoparticles was monitored based on the of surface plasmon resonance (SPR) absorption spectroscopy spectrum using (Shimadzu UV-2550) operated at a resolution of 1nm.The dry powder form of AgNPs was used for scanning electron microscope (SEM) and the micrograph of the particles were determined its particles size, shape and morphology. The purity of the AgNPs was also conducted using the EDS Energy-Dispersive X-ray Spectroscopy (200 V to 30 kV; 800,000x).

0.5 g of dried powder of silver nanoparticles was used for x-ray diffraction (XRD) analysis. XRD patterns were recorded on RINT2000 vertical goniometer operated at a voltage of 50 kV and current of 200 mA with Cu Kα radiation (λ = 1.5405 Å), and the XRD diffracted intensities were recorded from 30° to 80° at angle of 2θ. Based on the XRD data, the crystal structure and its crystal size were estimated using Scherer's equation by determine the full width at half maximum (FWHM) at (111) Bragg reflection.

Coating of Nano Silver Cotton Fabrics

To activate the fabrics, 20cm×20cm dimension pieces of cotton fabrics cotton fabric was immersed into 30ml of aqueous solution of solution of 6M of KOH and waited for 5minutes at room temperatures. And then left out the activated cotton fabrics washed out using distilled water several time till remove all suspended . In next steps, kept in agitate the activated fabrics into 5mMof 100ml $AgNO_3$ at 150rpm for 30mints. And then transferred the fabrics to the 100ml of crude cell extract and agitated for 30 mints again. Left out the cotton fabrics and dried in a hot oven at 60° for 50mints.

Secondly, same procedure was applied as activate the fabrics above, but fabrics kept into exclusively synthesized of silver nanoparticles of 100 ppm colloidal solutions for comparison of the cotton-Ag potential and then finally the efficacy of antimicrobial action was tested.

Antimicrobial Efficacy of AgNPs Coated Cotton Fabrics

The antimicrobial efficacy of cotton-Ag was determined against gram positive hospital strain *Staphylococcus aureus* (from school of medical microbiology department, Sharda University Hospital)) by disc diffusion methods. The pathogen strain was swapped and cultured on Mueller Hinton Agar (MHA) media (Himedia). Different synthesized of cotton silver coated fabrics was put on each bacterial culture. Alongside, the antimicrobial activity of the biosynthesized AgNPs were investigated by putting on the paper disk 10 μg, 20 μg, 30 μg /ml of AgNPsand $AgNO_3$ and crude cell extract as control. After incubation of the bacterial culture at 37°C for 24h, the diameter zone of inhibition was recorded using scales. The experiment was done triplicate.

Results and Discussions

Aspergillus terreus Strain Pigment Productions and Microscopic Confirmations

After broth culture of 5 to 7 days, produced pigment of *Aspergillus terreus* (*MTCC9618*) strain was determined by cell colony pigments and microscopic morphology analysis as per peer reviewed literatures. The morphological characters of the culture was demonstrated as deep yellowish in color (Fig 1A) and the microscopic lacto phenol blue cotton observation (Fig. 1B) showed vegetative hyphae, conidial heads globose to loosely radiate and blue stained 4x magnification Thus, makes the strain especial character in absorbing and interaction between mycelium and metallic ions for surplus nanoparticle productions.

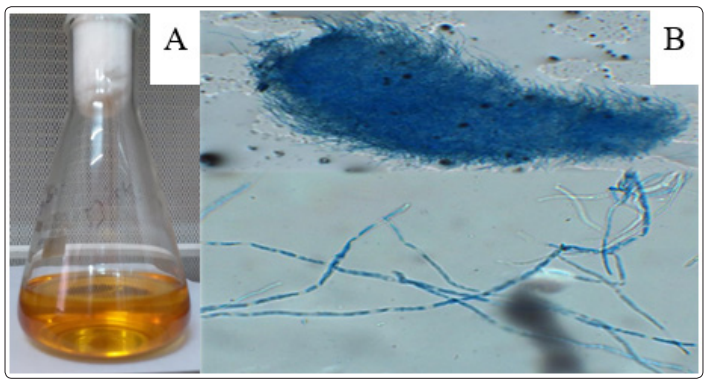

Figure 1: (A) The a yellowish pigment of *Aspergillus terrues* strain (MTCC 9618) showed high level bioactive metabolites productions and (B) vegetative hyphae and conidial heads of the strains

Biomass Production for Crude Cell Extract

Aspergillus terrues strain was cultured for consecutive four to seven days at 28°C in 120rpm, the colonies subjected for production of pigments. The four days clear yellowish pigment with suspension of ball like fungal cells showed that the lesser maximum bioactive compounds production of the strain as compared to seven day old brown pigment production (Figure 2). The production of biomass and extracellular metabolites increased as of the time table of culturing the cells.

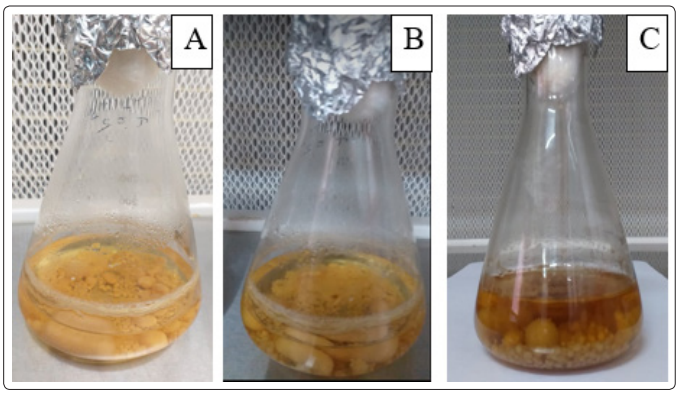

Figure 2: A yellowish ball like structure agitated Aspergillus terrues strain after incubating for four days, young culture (A) five days, intermediate (B) and for seven days, old culture (C) at 28°C

Bio-synthesis of Silver Nanoparticles (AgNPs)

In this study, we have synthesized silver nanoparticles (AgNPs) by reducing silver nitrate salt using crude cell filtrate of *Aspergillus terrues* strain (MTCC 9618) as reducing agent. After incubation of the 90ml of crude cells with 5mM of 10ml of $AgNO_3$ solution at 28°C for 24h different progressive color intensity from a yellowish to deep brown was visualized. Based on the literatures, staring color change boldly indicated that the reduction of silver nitrate salts into silver nanoparticles and the intense of color progressively shift to red-brown in each time intervals for 24h (Figure 3A & B). After 24h the color change was stationary which specified that that the reaction of the synthesis of silver nanoparticles had been reached at equilibrium position, but the control silver nitrate was not changed at all (Figure 3C). The strains projected as an outstanding performance in biosynthesis of silver nanoparticles without using of any hazard chemical and physical treatment. Thus, efficient synthesis of AgNPs with short period of time at room temperature and kept the zeta-potential stability due to spatialized bioorganic extracellular was miracle of strains natural biodiversity in nature.

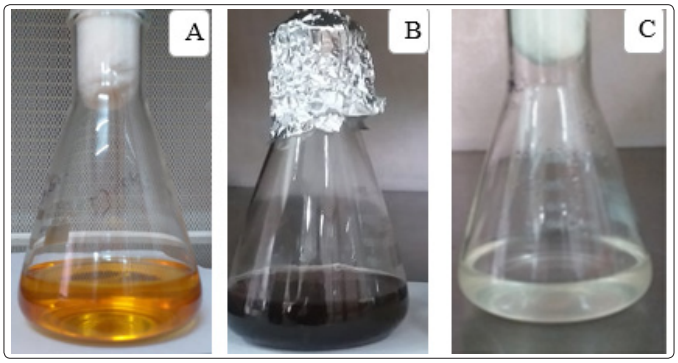

Figure 3: The crude cell extract from *Aspergillus terrues* strain (MTCC 9618) before mixing of $AgNO_3$ (A) and after 24h addition of $AgNO_3$ (B), control silver nitrate salt (C).

UV- Visible Spectral Analysis

Understanding the stability, affinity, concentration and kinetic energy of the synthesized silver nanoparticles is the most suggested technical procedures during synthesis of every nanoparticles. Every time intervals of starting from fraction of minutes upon 2min, 5min, 10 min, 12h and 24h the visualized color change was recorded (Figure 4A) . The color change shifts towards red was

due to the size, shape and crystallite distribution of the synthesized silver particles since there was the binding affinity of electrostatic attraction and repulsion force between colloidal solution and silver nanoparticles. The reaction was showed that the progressive color change continuously since no evidence proved that the aggregation of silver nanoparticles for 24h. Surface plasm on resonance (SPR) of the oscillation of free conduction electron was also detected through visible spectrumin the range of 300nm to 700nm absorbance in which there was the distinct peak at around 430nm to 450nm wave length (λ). The resultant was good scientific evidence that at around the peak of 450nm, the formation of small spherical silver nanoparticles were recorded without agglomeration in the aqueous solutions [15]. It also some was absorbance at around 300nm might be related to the presence of active extracellular bioorganic proteins, enzymes. Accordingly this reports, there were abroad range of silver nanoparticles stability at about 430nm- 450nm in every time interval of 10min, 30min, 12h and 24h such result was just proved the direct correlated the electron transfer of functional group of extracellular secondary metabolites and silver nanoparticles during biosynthesis. However, the control solution of the crude cells extracted which was perfumed without substrate of silver nitrate in which disclosed that no recording evidence of distinct peak absorption value from the range 300nm to 700nm. Nevertheless, at about the range of 300nm there was recorded progressive decline broad absorbance of the cell extract alone which was an absolute pointer of the short stability of the charge transfer among functional groups (Figure 4A).

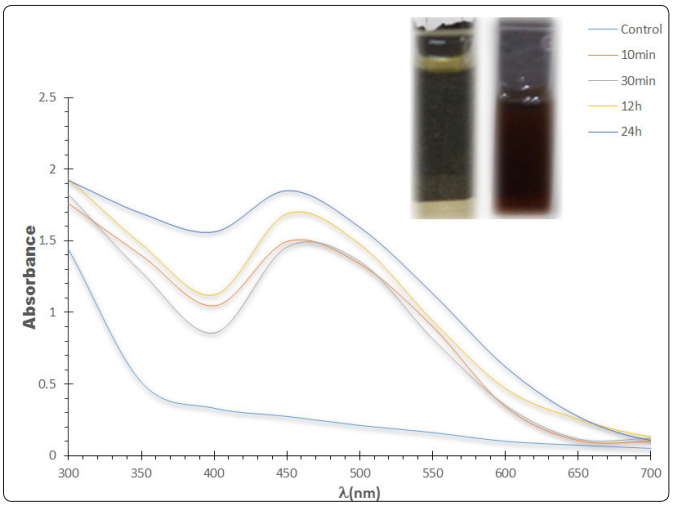

Figure 4A: UV- visible absorbance spectra recorded after $AgNO_3$ solution reduced by exposing within *Aspergillus terrues* strain crude cells in every time interval.

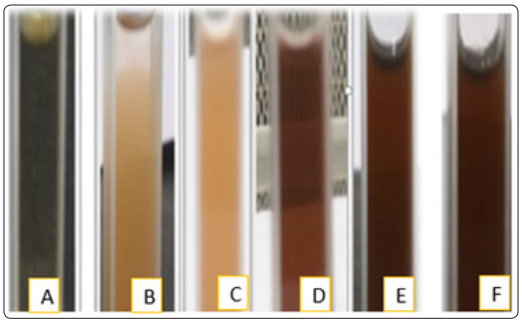

Figure 4B: UV- visible color change starting from colorless to red shit charge after $AgNO_3$ solution reduced by exposing within Aspergillus terrues strain crude cells in a given time interval control cell filtrate (A), 2min (B), 5min (C), 10min (D), 30min (E) and after 24h (F)

Band Gab Determinations

Metallic has zero band gab and no need of energy require for jumping electrons to excite state so that those bulk materials have a conductive properties rather than semiconductor behavers. For evaluating the synthesized silver nanoparticles its semiconducting characters, the minimum required energy to excite an electron from ground state to conduction band was determined by using Tuac equation based on the UV- spectrum data which is defined as:

$$(\alpha h\nu) = A(h\nu - E_g)^n \quad (1)$$

Where, A is a constant, hν is photon energy, E_g is the allowed energy gap, n = ½ for allowed direct transition and n =2 for allowed indirect transition. The band gab was determined by

$$Eg = 1240/\lambda \text{ (eV)}$$

Therefore; for direct transition Eq. (1) becomes

$$(\alpha h\nu) = A(h\nu - E_g)^{1/2} \quad (2)$$

In figure (4) the variation of biosynthesized silver nanoparticles of (αhν)2 and (hν) were showed asper the progressive of reaction. The band gab energy was gotten by extrapolated the Tuac linear adjacent region to (αhν)2 = 0

The band gab energy (eV) for the prepared sample of silver nanoparticles at 10min, 30min, 12h and 24h were determined. And got the result such that 2.08eV, 2.06eV, 2.0eV and 1.96eV respectively. After 10min and 24h synthesis of the silver nanoparticles, there was a little declining of 2.08eV and 1.96 eV respectively, which is excessed the actual conduction band of bulk materials of silver metals (Figure 5). Thus, proofed that the biosynthesized silver nanoparticles have semi conducting characteristic due to surface plasmon resonance effect of the particles. This semi conductive properties of the AgNPs give us some scientific information's how semi biosynthesized silver nanoparticles has applied on an optical electron biomaterials. Typically, surface plasmon resonance (SPR) biomedical devices used for biochemical and biological sensor analysis system in medical and molecular biology researches. There was reports on silver nanoparticles semiconducting electrodes those applied as biosensor in detecting of Cl-ions in urine sample [16]. For smaller size particles at 1omin, the band gab energy has increased since a few number of atoms agglomerate and makes less atomic force of attraction between the conduction electrons and silver ion nanoparticles. Conversely, after 24h, the band energy of silver nanoparticles for larger size particles has decreased due to the large number of atoms formed together and makes strong attraction bond force between conduction electrons and silver nanoparticles.

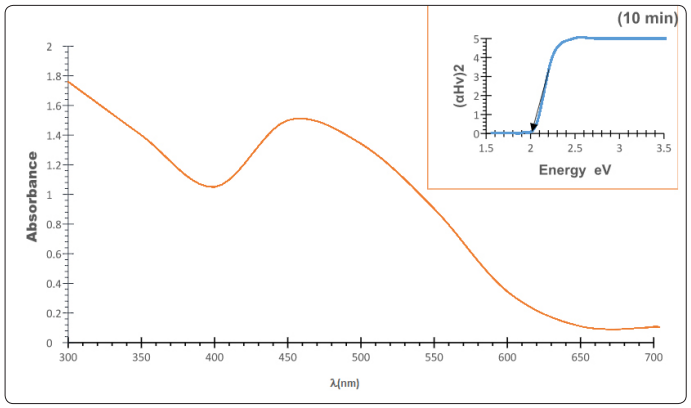

Figure 5(A): UV- spectra Vs band gab (E_g) of AgNPs during the first 10

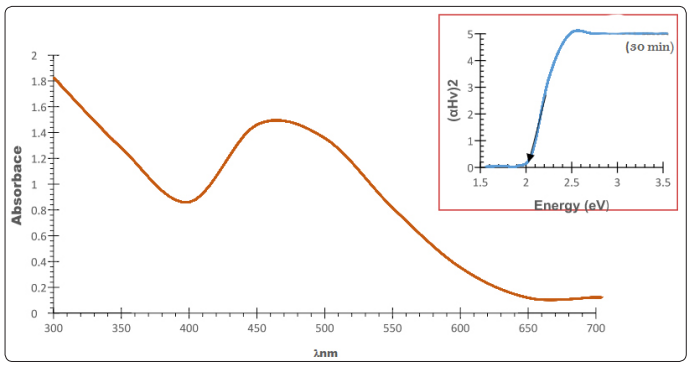

Figure 5(B): UV- spectra Vs band gab (E_g) of AgNPs during the first 30min

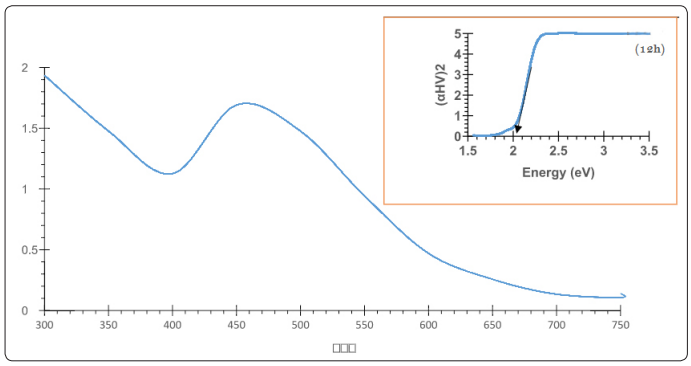

Figure 5(C): UV- spectra Vs band gab (E_g) of AgNPs during the first 12h

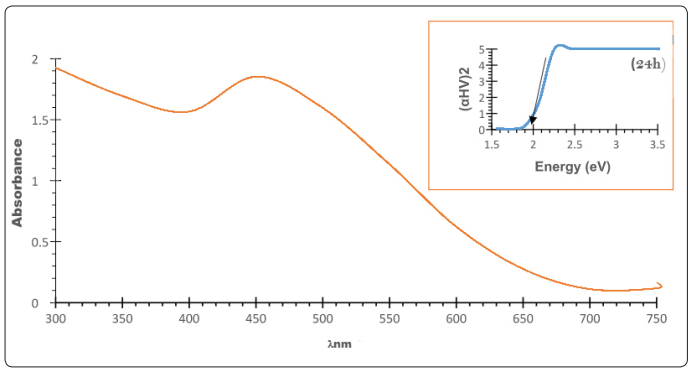

Figure 5(D): UV- spectra Vs band gab (E_g) of AgNPs during the first 24

Scanning Electron Microscope (SEM) Analysis

The morphology, size and shape of the synthesized silver nanoparticleswas evaluated since once synthesized the nanoparticles its multi-application are determined by its own size, shape and crystal structure. Accordingly to the SEM analysis the shape of the particles were heterogeneously spherical, polygonal, and columnar. The threshold analysis of an average size of the synthesized nanoparticles was recorded less than 10nm and broadly taken high particles counts in the range of 3nm – 6nm (Figure 6)

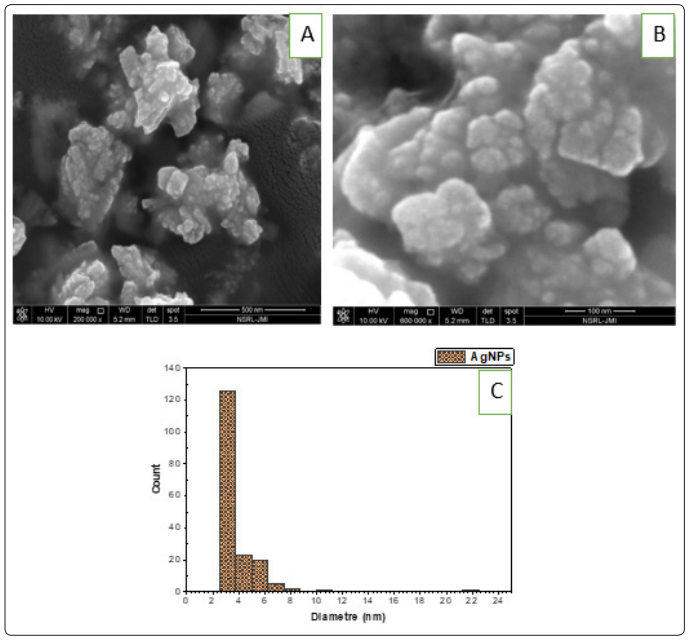

Figure 6: Scanning Electron Microscope (SEM) image of biosynthesized of AgNPs with different magnifications and scales 500, 000xat 500nm (A), 600,000x at 100nm scale (B) and size distribution of the AgNPs (C).

EDS Energy-Dispersive X-Ray Spectroscopy

Each elements has own energy dispersive character when the x-ray energy apply on it and in which it is possible to determine the purity of elements in the given sample. The EDS Energy-Dispersive X-Ray Spectroscopy reports was showed that the dispersal of elements on produced silver nanoparticles. Silver elements (Ag) was recorded at 3keV in high pick of count per seconds per electron volt (cps/eV) and proved that synthesis of silver nanoparticles figure (7). Some impurities may come during biosynthesis through media residual contamination and extracellular metabolites.

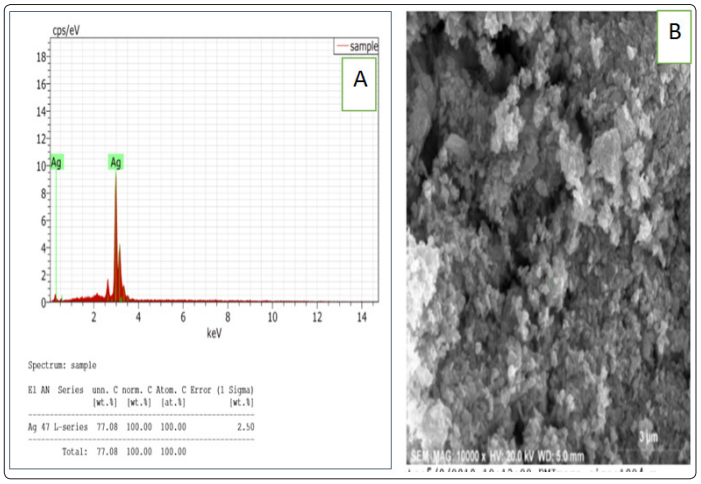

Figure 7: EDS Energy-Dispersive X-Ray Spectroscopy spectrum and percentage report of Ag element on the biosynthesized silver nanoparticles micrograph Aspergillus terrues strain (A) and morphology of AgNPs (B)

X-ray Diffraction (XRD) Analysis

The crystal nature of the particles shows the atomic arrangement and pattern of molecules in meaning full order. The particle phase and crystal size of the synthesized silver nanoparticles was detected accordingly X-ray diffraction planes patterns. XRD pick intensity was measured at (111), (200), (220) and (311) Face Centered Cubic (FCC) model lattice plane of at 2θ angles of 31.08, 38.46, 46.45, and 77.36respectively. The resultant was in good covenant with the unit cell of the face centered cubic (fcc) structure from the Joint Committee on Powder Diffraction Standards (JCPDS Card No.: 04-0783), Release 2007, PA, USA, 2007 with a lattice parameter of a = 4.077 Å. some intense diffraction peaks were at 2θ angles of 29.5, 45.02, 51.26 and 59.42 recorded , but at angle of 29.5 obstructed might be relate to AgO_2 However, accordingly to the SEM and XRD data profiles others pick appear due to the involvement of metabolites and dextrose media residues during groundwork in biomass production and cell filtrate extract process (Figure 8) [17].

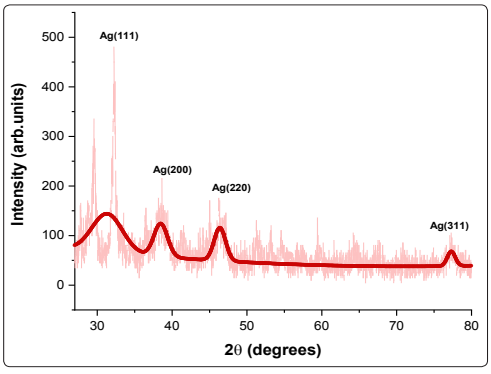

Figure 8: XRD patterns (roughness and smoothness) representing for the synthesized silver nanoparticles using Aspergillus terrues strains

Based on Scherer's equation,we have estimated the crystal size of the silver nanoparticles those synthesized by fungus mediated Aspergillus terrues strain using the full width at half maximum (FWHM) intensity of the peakin Gauss model and an average diameter of the particles was 8.5±4.48 nm (Mean ± SEM) Table1).

Using Scherer's formula:

$$D = \frac{0.91\lambda}{\beta Cos\theta}$$

Where, D=diameter of crystal in (nm), λ=0.15406nm, β= (FWHM) in (rad) and cos θ/2)

Table 1: XRD data for estimating crystal size of biosynthesis of AgNPs using Aspergillus terreues strains (MTCC9618)

Peak position (2θ)	FWHM	Miller Indices	Cristal size (nm)
31.08165	5.23776	(111)	1.574290449
38.46299	2.00524	(200)	4.19591587
46.45491	1.30121	(220)	6.643813486
77.36369	0.47142	(311)	21.58751424
Cristal size range			1.5 - 21.5
Average crystal size (mean ± SEM)			8.5 ± 4.4

Coating of Nano Silver of Cotton Fabric

Cotton fabrics have high durability, with robust and smooth surface materials which is highly favored for good absorption of Nano silver [18]. So that cotton fabrics are an accepted textile type in silver nanoparticle coating research. In this study the interaction between cotton fabrics and biosynthesis silver nanoparticles was done. An agitated white cotton fabrics in extracellular aqueous solution of *Aspergillus terrues* strains was pigmented into yellowish brown. Those result displayed that the interaction or aggregation of the silver nanoparticles and activated cotton fabrics (Figure 9). Today, less durability of fabrics due to microbial contaminations makes economical loss in poor society along prevalence of skin boil infections caused through *staphylococcus aureus*. In addition to thatusing of silver nano coated pharmaceuticalwound cotton and related able to prevent wound infection.

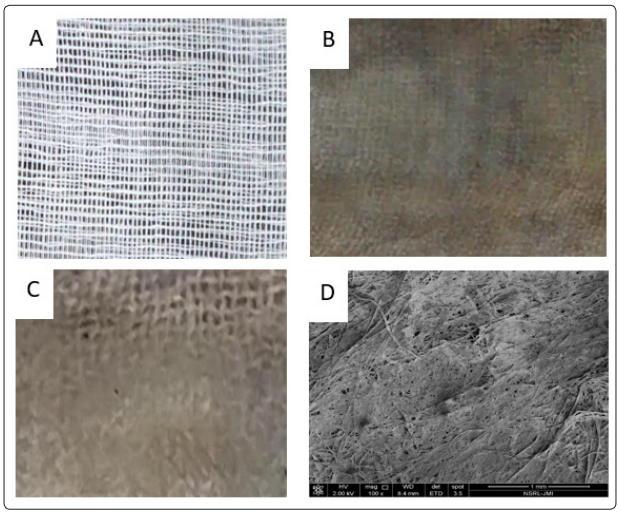

Figure 9: Micrograph and photograph images of biosynthesis of AgNPs coated cotton fabrics untreated fabrics (A), activated fabrics exposed to extracellular extract (B), activated cotton fabrics immersed into 100ppm and biosynthesis AgNPs (C) and micrograph of cotton-Ag (D)

In figure 9(A) untreated cotton fabrics were smooth surface and widen gab of each thread patterns. An activated cotton fabrics had well-organized soaked the silver nanoparticles and the particles were distributed evenly with rough surface figure 9(B) in which

may be the free charge of the metabolites functional groups strongly fix to the fiber of the activated cotton fabrics since the product was flattened imaginings. Whereas treated of cotton fabrics at 100ppm of silver nanoparticle of colloidal solutions were noted unevenly distribution of Nano silver particles.

Antimicrobial Efficacy of Nano Silver Coated Cotton Fabrics

Bio-synthesized silver nanoparticles treated cotton fabrics was revealedthat strong antimicrobial efficacy against the Hospital strain of Staphylococcus aureus (*S. aureus*) Figure 10. *Aspergillus turres* strain extracellular metabolites treated fiber cotton had microbicidal effect whereas AgNPs colloidal solution soaked cotton had biostatical effect which inhibited the bacteria growth around the piece of cotton fabrics. However, there was unrestricted bacterial growth on untreated cotton fabrics (Figure 9). The study noted that *Aspergillus turres* strain mediated extracellular metabolites had good potential in biosynthesis of nanosilver coated fabrics resulting biocidal applications in better way of colloidal solution of the nanoparticles synthesis methods. In figure 10 (A2), the coated cotton fabrics diffused and killed the bacterial growth and was appeared an inhibition zone around the cotton-Ag (16mm) and also no luxuries bacterial growth was recorded on fabrics which was treated with 100ppm colloidal solution of AgNPs in Figure 10 (A2), but had biostatical effects. However, in control of $AgNO_3$ and extracellular crude cell extract nothing inhibition zone was noted down in figure 10 (A3) and (A4) respectively. Along side we had established disk diffusion assay in figure 10 (B) luxuries bacterial growth of bacterial was recorded in control of crude cell extract and $AgNO_3$. 10μg/ml of $AgNO_3$ inhibited (7.16±.44mm), 20 10μg/ml of AgNPs more inhibited (12±.28mm), than 30 of AgNPs less inhibited (11±.28mm). Accordingly, the disk diffusion assay high concentered cannot diffuse very well, but the coated fabrics get enough surface area and absorb the media water content in order to migrate the particles in all direction.

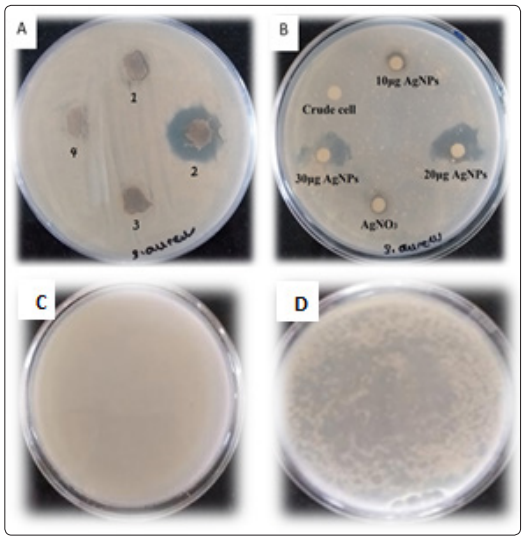

Figure 10: Antimicrobial efficacy assay of Silver nanoparticles (SNPs) coated cotton fabrics against Hospital strains of *Staphylococcus aureus* (*S. aureus*);cotton fabrics cured with 100ppm colloidal solution of AgNPs (A1), extracellular bioactive metabolites treated cotton-Ag fabrics (A2), $AgNO_3$ treated (A3), crude cell extracttreated fabrics (A4), whereas disk diffusion assay of biosynthesis AgNPs at different concentrations against *Staphylococcus aureus* (S. aureus) (B) AgNPs coated cotton fabrics Disk diffusion assay.

So that the reason might be the aggregation of small silver nanoparticles has been increased while the concertation of the nanoparticles enlarged and also which might cause negative effect on kinetic of the particles so the diffusion migration rate may obstruct. Second reason might be the commotional structure of the cell wall also. Resulting the particles have to very fine and getting enough space to pass the cell wall and plasma member of the bacterial. Once the particle entered and passed the cell wall getting to the target site and deregulate the viability of the bacteria. The coated fabrics could rebel water molecules and dust particles such that, AgNPs coated cotton fabric has given good promising research for treatment of cotton garments in textile and pharmaceutical industries so as to enhance durability, strength, quality, odor and multi functionality of commodity against pathogenic bacteria.

Conclusion

Biosynthesis of silver nanoparticle intimidate by Aspergillus turres (MTTC9618) strains from the Microbial Type Culture Collection and Gene Bank (Chandigarh, India) was found in better way as compare to the previously studies. It had gotten easy, cost-effective, small stable spherical, an average less than 10nm sized AgNPs at room temperature in fraction of minutes without any assembly of hazard chemicals and physical treatments. On the application side, biosynthesized of AgNPs coated cotton fabrics was found good potential absorbing nano silver and capable to biocidal of the pathogenic *Staphylococcus aureus* gram positive bacteria. The biosynthesis of AgNps in coating of cotton fabrics for antimicrobial efficacy using *Aspergillus turres* strains have an excellent promising for green synthesis of nanoparticles and its impended products in textile and pharmaceutical industries so as to enhance garments durability, quality, odor and various way of functioning.

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