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ANTIMICROBIAL ACTIVITY OF SILVER NANOPARTICLES SYNTHESIZED FROM NOVEL *STREPTOMYCES* SPECIES

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In this paper we report the antibacterial activity of silver nanoparticles synthesized from novel strain of *Streptomyces* sp. The novel silver nanoparticles exhibited a tremendous potential antibacterial activity against the multi drug resistant gram positive and gram negative bacterial strains. The zone of inhibiton seems extremely good showing a relatively large zone of inhibition in both gram positive and gram negative bacterial strains. To the best of our knowledge this is the first report on the antibacterial activity of silver nanoparticles synthesized from *Streptomyces* sp.

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1. Introduction

Due to the outbreak of the infectious diseases caused by different pathogenic bacteria and the development of antibiotic resistance the pharmaceutical companies and the researchers are searching for new antibacterial agents [1] In the present scenario nanoscale materials have emerged up as novel antimicrobial agents owing to their high surface area to volume ratio and its unique chemical and physical properties [2,3] Nanotechnology is emerging as a rapidly growing field with its application in science and technology for the purpose of manufacturing new materials at the nanoscale level [4] Nanotechnology is a field that is burgeoning day by day making an impact in all spheres of human life.[5] The word “nano” is used to indicate one billionth of a meter or 10^{-9}. The term nanotechnology was coined by Norio Taniguchi a, researcher at the university of Tokyo, Japan [6] “Nanotechnology” is the application of science to control matter at the molecular level. It is the most promising field for generating new applications in medicine. Silver nanoparticles (AgNPs) have emerged as an arch product from the field of nanotechnology. Over the last few years due to its good conductivity, chemical stability, catalytic and antibacterial activity [7,8,9] silver has gained much of the interest. The diversity and importance of their applications has generated a great deal of interest in developing versatile methods to synthesize silver nanoparticles with well-defined and controlled properties. [10].

Although various chemicals and biochemical methods are being explored for production of AgNPs. Microbes are exceedingly effective in this process[11] biosynthesis of silver nanoparticles from bacteria, fungi, yeast, plants, fruits and so on have been reported.[12,13,14,15,16].Colloidal silver solutions (CSS_s) have an increased interest due to their antimicrobial properties, with large applications including pharmacology, human and veterinary medicine, food industry, water purification [17].For a long time silver has been known to have a disinfecting effect and has found applications in traditional medicines culinary items [18] silver has known to be a metal that come into use even before Neolithic revolution. Even the Greeks used it for cooking and to keep water safe. The first recorded medicinal use of silver was reported

during 8th century [19].Thus nanoparticles of silver have aptly been investigated for their antimicrobial properties [20].Nanoparticles of silver have thus been studied as a medium for antibiotic delivery [21].Antimicrobial activity of silver nanoparticles have been studied by various researchers especially on *E. coli, S. aureus* [22,23,24] thus in the present study an attempt was made to see the antibacterial activity of silver nanoparticles synthesized from novel strains of *Streptomyces* sp. AgNPs have been previously synthesized from *Streptomyces* sp [25].

2. Materials and methods

2.1 Cultures

Seven bacterial strains both gram positive and gram negative (*S. aureus, S. epidermidis, E. coli, S. typhi, Pseudomonas aueroginosa, Klebsiella pneumonia, Proteus vulgaris*) which were multidrug resistant strains, were obtained from navodaya medical college Raichur, cultures were maintained at 4 ^{o}C on nutrient agar slants.

2.2 Media used

Muller Hinton agar and broth were procured from Hi media laboratories Mumbai, India.

2.3 Silver nanoparticles (AgNPs)

Silver nanoparticles were obtained from our lab by previous synthesis from novel *Streptomyces* sp [25].

2.4 Antibiogram Scale

Hi antibiotic zone scale for the measurement of zone of inhibition was also obtained from Hi Media Laboratory, Mumbai, India

2.5 Antibiogram studies

Silver nanoparticles synthesized from novel *Streptomyces* sp were tested against multi drug resistant strains of both Gram positive (*S. aureus, S. epidermidis*) and Gram negative strains (*E. coli, S. typhi, Pseudomonas aueroginosa, Klebsiella pneumonia, Proteus vulgaris*) by well diffusion method [26]. Pure cultures were subcultued in Muller Hinton broth for 24 h at 37 ^{o}C. Wells of 5 mm diameter were made on Muller Hinton agar plates using gel puncture. Each strain was swabbed uniformly into the individual plates using sterile cotton swabs. Using sterile micropipette 20 µlts (0.002mg) of the sample of nanoparticle solution was poured onto each of the wells at the centre in all the plates. After incubation at 35 ^{o}C for 24 h the different levels of zone of inhibition were measured using the Hi antibiotic zone scale.

3. Results and discussions

3.1 Antibacterial activity of silver nanoparticles (AgNPs) against pathogenic bacteria

The antibacterial activity of silver nanoparticles was investigated against various pathogenic bacteria of Gram positive (*S. aureus, S.epidermidis*) and Gram negative strains (*E. coli, S. typhi, Pseudomonas aueroginosa, Klebsiella pneumonia, Proteus vulgaris*) using well diffusion technique fig-1(a-g). control is also maintained in which no zone of inhibition is observed (fig.1h) The diameter of inhibition zones around each well with AgNPs is represented in table-1. The highest antimicrobial activity was observed against *S. typhi*, followed *by S. epidermidis, S. aureus, Pseudomonas aeroginosa, Proteus vulgaris, E. coli* and the least was noticed against *Klebsiella pneumonia*. Silver has been used for its well known antimicrobial properties since roman time however the advances in generating AgNPs have made possible a revival of the use of silver as a powerful bactericide [27]. Many researchers [28] used *Escherichia coli* as a model for gram negative bacteria and proved that AgNPs may be used as an antimicrobial agent. Other workers [29] also opined that the AgNPs have an antimicrobial effect on *S. aureus and E. coli*. In the present study 0.002 mg of the nanoparticles was taken as final product for antimicrobial assay. The

antibacterial activity of the bionanoparticles for *S. typhi* was maximum (40 mm) followed by *S. epidermidis* (38 mm), *S. aureus* (36 mm), *Pseudomonas aerogenosa* (35 mm) *Proteus vulgaris* (34 mm) and *E.coli* (34 mm) *Klebsiella Pneumonia* (30 mm).

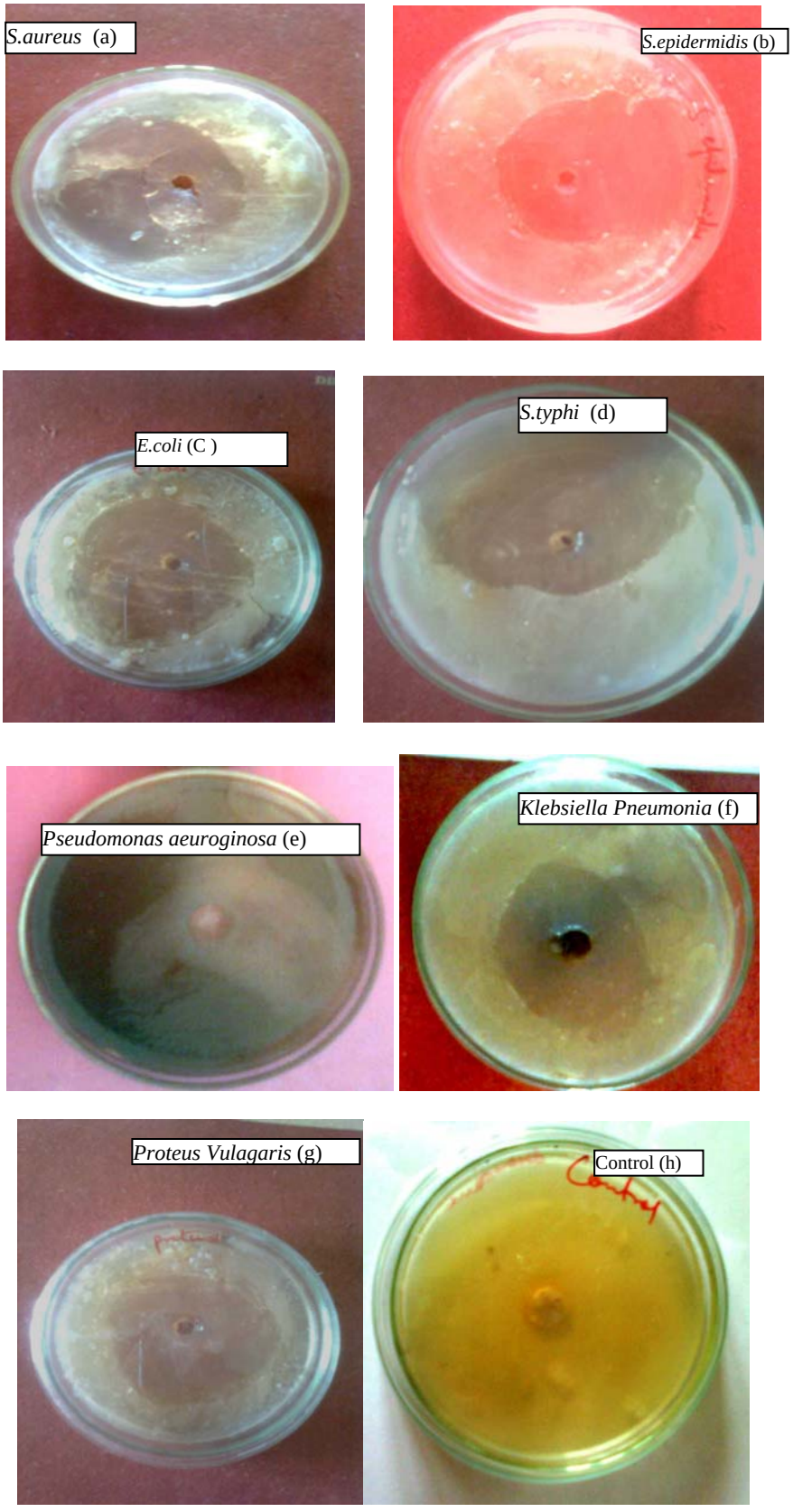

Table 1. Zone of inhibition (mm) of nanoparticles against bacterial strains tested.

Organism	Zone of inhibition (mm)
S. typhi	40
S. epidermidis	38
S.aureus	36
Pseudomonas aeruginosa	35
Proteus vulgaris	34
E.coli	34
Klebsiella pneumonia	30

4. Conclusions

In conclusion we have reported the antibacterial activity of AgNPs over multidrug resistant bacteria's (both Gram positive and Gram negative) The zone of inhibition using Hi antibiotic zone scale clearly shows that all the bacterial strains which were resistant to antibiotics are highly susceptible to silver nanoparticles. Thus it is proven from this study that the silver nanoparticles synthesized from *Streptomyces* species seems to be promising and effective antibacterial agent against the multidrug resistant strains of bacteria. `

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