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Silver Nanoparticals Synthesised Via Borohydride: Characterization and Antimicrobial Assessment Against MDR Bacteria *E. coli*

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Abstract: Silver nanoparticles (Ag NPs) among the nanomaterials have appeared numerous improved properties, that empowered analysts in different areas of science to create unused made items. Ag NPs is recognized with its biocompatibility , easy to synthesis and appeared modern physicochemical properties, adjacent to the distinguished antibacterial action towards microorganisms. In this research we Ag NPs have been synthesized using Sodiumborohydrate as a reduction agent (Borohydrate method) or strategy. The outcome nanoparticals was characterized with Uv-Vis which appears peck absorbance at 410 nm which acclimate the changed color of silver nitrate to golden yellow color of silver nanoparticles and by SEM which reveled 50 nm approx. in a circular shape. E-coli as gram-ve pathogenic microscopic organisms have been utilized to assess the cytotoxic efficiency of Ag NPs using hole diffusion strategy. distinct zones of inhibition around the hole, suggesting that the silver nanoparticles effectively inhibit the growth of E.coli. This result has significance to address with the increasing problem of antibiotic resistance.

Keywords: *Borohydrate Method, Silver Nanoparticles, MDR, Pathogenic E. coli.*

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I. INTRODUCTION

Scientists from a wide range of disciplines have been interested in nanoparticles as a result of their distinctive physicochemical characteristics, which set them apart from their bulk state. The primary problem with nanoparticles is their size-depends feature, which increased reactivity by expanding the surface range relative to the volume ratio [1]. Examples of developed biocide are cobalt [2], zinc oxide [3], and press [4 and 17]. Silver particles have shown proven antibacterial properties in comparison to the over-specified antimicrobials [5]. Because silver nanoparticles (Ag NPs) have antibacterial effects against a wide range of pathogenic bacteria, researchers have been motivated to develop a number of industrial products with biocidal qualities, including textiles, food wrapping, sunblock, and agricultural products and healthcare solutions. [6].

Ag NPs are capable of being combined in a variety of ways to create stable, extremely concentrated NPs that significantly affect the growth of tiny organisms. In recent years, a number of analysts have expressed interest in employing silver nanoparticles being an effective way of eliminating a wide range of bacteria [7]. NPs can interfere with the functioning of cells in a number of ways by interacting with certain dynamic sites of the pathogens' cell surface [8 and 18]. In overall, the configuration of free radicals, which stimulates the hazardous character of tiny particles, accepts non-reduction force. In any case, composition is one of the elements that mostly define its hazardous consequences [9]. The chemical reaction involving phosphorous clusters and silver nanoparticles is an essential feature of the antibacterial property of silver nanoparticles because the cell film comprises a lot of enriched in sulfur proteins [11]. When silver nanoparticles are released, they can bind to protein materials, resulting in chemical activation and phosphorous buildup of DNA, which significantly reduces the activity of the replication process of DNA. Tall microorganisms form or pass through as a result of this, giving rise to bacteria with distinctive traits [12]. The presence of large amounts of tiny silver atoms (NPs) with a dimension of less than 10 nm appears to be producing cellular destroys due to their chemical reactions with membrane film, cytoplasmic components, and nucleic contaminants [13]. Silver nanoparticles were created using the borohydrate reducing process, their characteristics were examined, and their effects on the pathogenic microbes *E. coli* were assessed.

II. MATERIALS AND METHODS

The present research has been accompanied in the college of Biotechnology of Al-Qasim Green university. Silver nitrate Reagent World, sodium borohydride CHD. Bacterial picked medium was supplement agar media, Spectrophotometer and Scaning Electronic Microscopic (SEM) have employed to characterize resulted of Ag NPs.

➤ *Synthesis of Ag NPs*

Silver nanoparticles were synthesized via chemical reduction strategy or (Borohydride method) [14]. Where 100 ml aqueous of NaBH4 0.001 mM was added drowsily to 100 ml of 0.015mM $AgNo_3$ under ambient conditions and continually starring intended for 30 minutes at room temperature up to the color altered to golden yellow. The suspension of Ag NPs was reserved in a darks jar to keep it away from light and used for further experiments.

➤ *Antibacterial Resistance Evaluate.*

Antimicrobial activity of Ag Nps was experienced against Gram-ve *E. coli*. These bacteria were grown in nutrient agar medium, where 20 ml of the medium was dispensed into Petri Dish to acquire uniform depth and allowed to solidify completely . To guarantee the organisms' confluent development, the inoculum suspension was streaked across the media's surface using a sterile cotton swab. Antibiotic discs containing 30 mg of amoxicillin, 10 mg of tobromycin, and 10 mg of cefotaxim have been placed on the dishes that were being cultivated with *E. coli.*

➤ *Antimicrobial Effect of Ag NPs.*

The antimicrobial effect of Ag NPs have been examined with pathogenic bacteria *E- coli* and via well diffusion method (30). An agar media has been poured into disinfected Petri dish plates, allowed to 30 min to solidify. The plates were mopped with 100 µl of microbial entities and positioned the former prepared holes, the experiment was conceded out in triplicates. The plates were kept at 37°C for 24 h, and at that time the zone of inhibition was accurately measured and analyzed.

III. RESULT AND DISCUSSION

Chemical reduction or borohydride methods have been used to synthesize silver nanoparticles [14]. When NaBH4 is added as a reduction agent to the the water-based solution containing silver nitrite, a golden yellow color is produced, which signifies the formation of silver nanoparticles. When sodium borohydride was added, the color of silver nitrate, which is colorless, changed, indicating that the silver ion had been reduced into metal silver nanoparticles. The similar outcome was achieved by Pryshchepa and colleagues in 2020. Nevertheless, the UV-Vis spectrophotometer examination of the produced silver nanoparticle solution reveals an absorption peak at 410 nm, confirming the complete conversion of silver nitrate to silver nanoparticles (Figure 1).

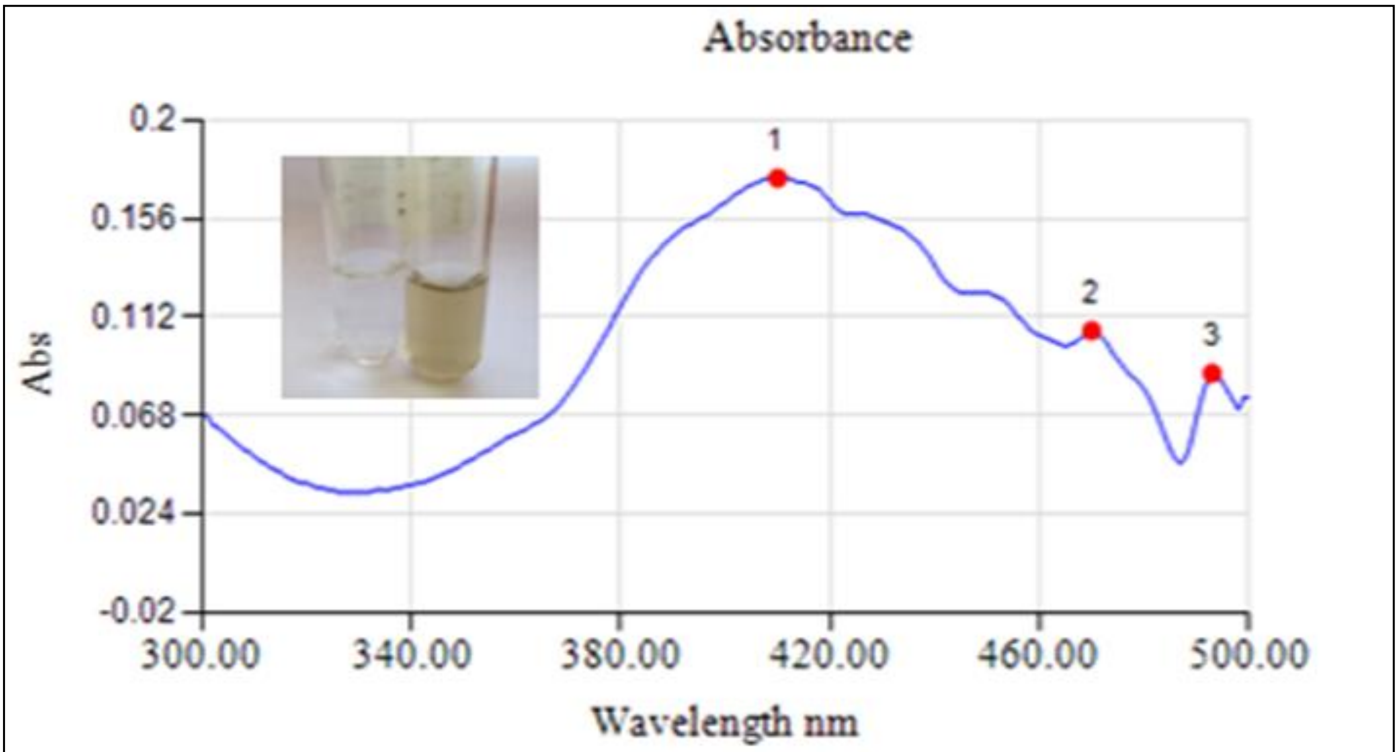

Fig 1 UV–Vis spectra. Appearing of golden yellow color indicate the synthesized of Ag NPs after adding sodium borohydride to $AgNo_3$ alongside with the intense clear peak at 410 nm which confirm the synthesized Ag NPs.

SEM has exposed the dimension and morphology of Ag NPs with demonstrations size ring out distributed below 50 nm in diameter and spherical form Figure 2.

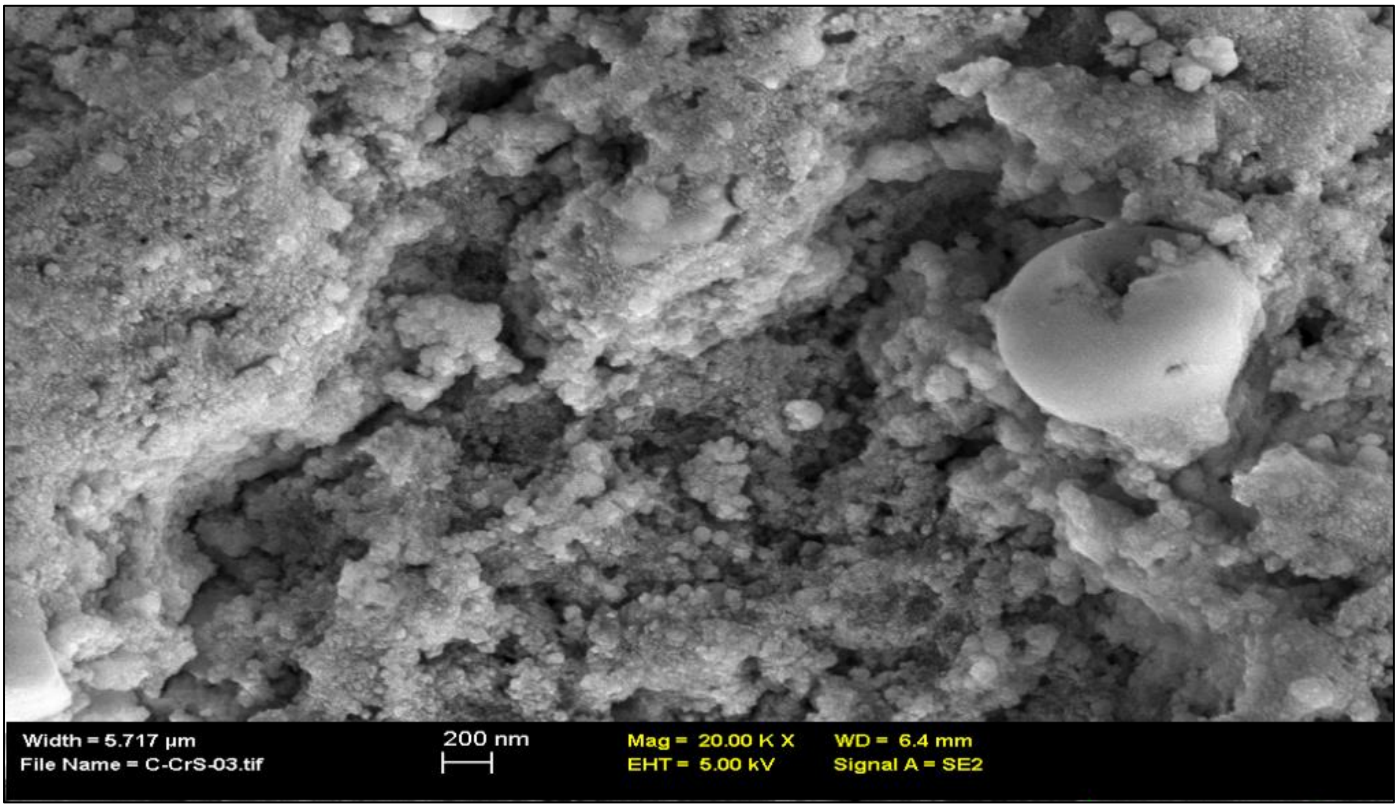

Fig 2 Scanning Electron Microscopy (SEM) Image of Ag NPs.

➢ *Antibiotic Ssusceptibility Test*

Antibiotic discs containing 30 mg of amoxicillin, 10 mg of tobramycin, and 10 mg of cefotaxime, respectively, were put on Petri dishes that were cultivated by *E. coli* and incubated for 48 hours with 37 Co. The results indicate that *E. coli* is resistant to all three medicines since no zone of inhibition shows up, confirming the bacterial strains' resistance (figure 3).

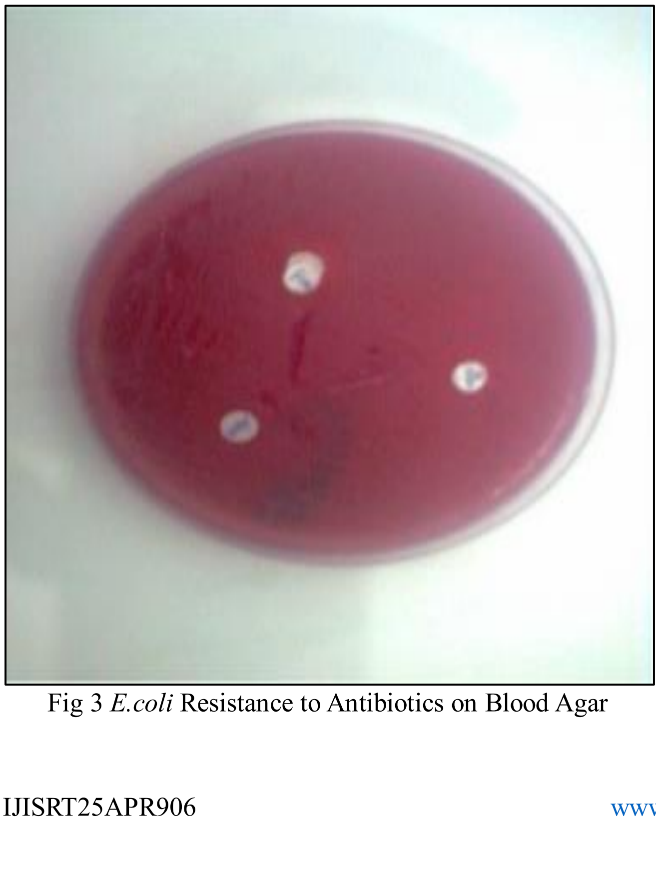

Fig 3 *E.coli* Resistance to Antibiotics on Blood Agar

➢ *Effect of Silver Nanoparticle on Pathogenic Bacteria*

The hole diffusion method was used to assess the antibacterial effect of silver nanoparticles (Ag NPs) against the Gram-negative bacterium *E. coli*. The estimated inhibition zone sizes in the Petri dish were precisely 14.49 mm, 7.61 mm, and 7.61 mm. The presence of clear zones of inhibition surrounding the holes demonstrated that the silver nanoparticles successfully block bacterial growth. (Fig. 5). Through electrostatic bonds, Ag NPs may adhere on to the bacterial surface and compromise the structure's strength [2]. Ag NPs' larger surface area-to-volume proportion is thought to be the cause of their enhanced antibacterial susceptibility [1]. The significant attraction of silver ions for sulfur groups found in cysteine, a crucial element of the membrane of bacterial cells, is connected to the inhibiting impact of silver nanoparticles, causing bacterial decomposition (Lei *et al.,* 2024). Ag NPs can enter bacterial cells because of their tiny dimensions and oligodynamic characteristics. Once inside, they interrupt vital metabolic processes, causing denaturation and eventually the death of cells. Their capacity to disrupt the imitation of DNA and the production of proteins, produce reactive oxygen species (ROS), as well as affect the membranes of bacteria gives them broad-spectrum antimicrobial activity. The developing issue of antibiotic development makes this finding especially urgent. Numerous conventional antibiotics are no longer effective against the widespread bacterium *E. coli*, which makes new strategies like nanoparticle therapy necessary. Ag NPs' ability to effectively combat resistant types of bacteria underscores their promise as workable solutions for therapeutic applications, such as wound treatments and medication delivery mechanisms.

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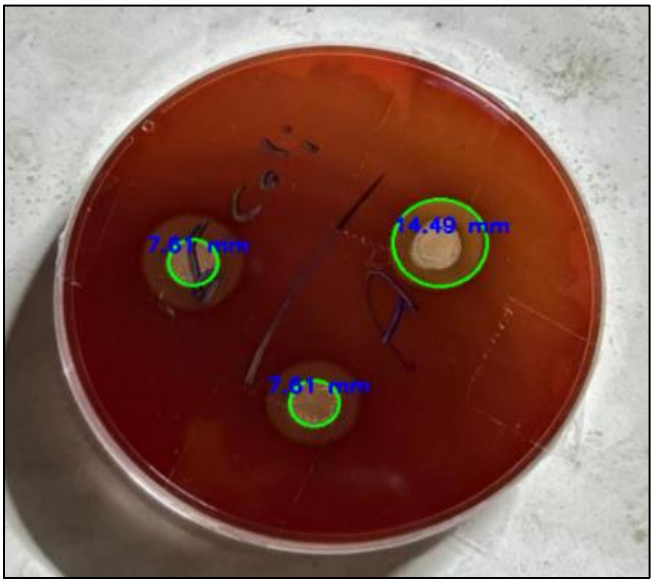

Fig 5 Silver Nanoparticles Inhibit the Growth of *E. coli* the Inhibition Zones have been Marked in Green on the Image, with their Corresponding Dieters Labeled in Blue Text

IV. CONCLUSION

Based on the above results, silver nanoparticles were formed successfully via borohydride as a reduction feature. The synthesizing was confirmed using UV-visible spectrophotometer and SEM to analyze their characteristics. AgNPs have shown antibacterial properties against pathogenic Escherichia coli. According to the outcime results, the above uncomplicated formula can limit the growth of MDR E. coli. This suggests that Ag Nps be included in the pharmaceutical design in order to accomplish the goal of producing intelligent antimicrobial treatments.

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