Synthesis of Silver Nanoparticles Using Novel Chemical Solution Method as Antibacterial Applied on Cosmetic Cotton Balls

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Abstract: This research aimed at preparing silver nanoparticles using the Novel chemical method, obtained as a black precipitate silver NPs. The sample was examined by using digital spectrometer device to find a degree of absorbency and its wavelength and particle by mathematical equation. Microbiology tests were carried out to determine the effectiveness of the sample in killing bacteria using the dilution method. After dissolving Silver NP`S in 5% acetic acid concentration, and covering the cotton balls with a solution of silver NPs to test the effectiveness of the sample using Two different concentrations of (0.5ml/g), and (0.25ml/g) and using two types of bacteria which causes skin blisters *staphylococcus* and *streptococcus* it is found that more concentration of the silver NPs solution has increased of killing both types of bacteria by *staphylococcus* (100%) and *streptococcus* (75%).

Keywords: Silver nanoparticles, Cosmetic cotton, Antibacterial application.

1. INTRODUCTION

1.1. Nanoscience

Synthesis of noble metal nanoparticles for applications such as catalysis, electronics, optics, environmental and biotechnology is an area of constant interest [4]. Gold, silver and copper have been used mostly for the synthesis of stable dispersions of nanoparticles, which are useful in areas such as photography, catalysis, biological labeling, photonics, optoelectronics and surface-enhanced Raman Scattering (SERS) detection [5]. Silver nanoparticles are of interest due to the exclusive properties (*e.g*. size and shape depending optical, electrical and magnetic properties) which can be incorporated into antimicrobial applications, biosensor materials, composite fibers, cryogenic superconducting materials, cosmetic products and electronic components [6]. Silver bio-nanoparticles (Ag NPs) have been known to have inhibitory and bactericidal effects.

Resistance to antimicrobial agents by pathogenic bacteria has emerged in recent years and is a major health problem [7]. Several physical and chemical methods have been used for synthesizing and stabilizing silver nanoparticles [8]. The most popular chemical approaches, including chemical reduction using a variety of organic and inorganic reducing agents, electrochemical techniques, physicochemical reduction and radiolysis are widely used for the synthesis of silver nanoparticles.

1.2. Nanoparticles

Nanoparticles are being viewed as fundamental building blocks of nanotechnology. The most important and distinct properties is that they exhibit larger surface area to volume ratio. They exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology [9]. Advances over the past two decades reveals that the Silver Nanoparticles (NPs) possess unique optical, electrical and catalytic properties [10, 11]. During the past few years, the field of silver NPs preparation has witnessed tremendous growth in synthetic sophistication and depth of characterization [12]. Photochemical method of silver nano particles is prepared by using high molecular weight carbohydrate and carbohydrate-based dendrimers as reducing and stabilizing agent [13, 14]. A number of preparation routes have been reported for the synthesis of silver nanoparticles. For example, facile method, thermal decomposition of silver compounds, electrochemical, son chemical, microwave assisted process and recently via chemical route [15, 16]. The solvothermal method was also employed to synthesize silver nanoparticle. This technique is based on thermal decomposition of metallic compound in organic solvent and has been successfully applied for the synthesize of various types of nano sized metal oxide with large surface area, high crystallinity and high thermal stability. The influences of reaction conditions, viz., type of sol-vents, concentration of precursors and

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E-ISSN: 2311-8792/23

reaction temperature, on the physical properties of the synthesized nanorods as well as mechanism were studied [17]. Different approaches have been used to synthesize silver nanowires. The template-directed approaches were the most effective and widely used. macro porous membranes, mesoporous materials, carbon nanotubes, DNA channels, organic nanotube arrays and silica gels have been used as physical templates to guide the growth of nanowires. Though above-mentioned methods can ensure a good control over morphology of final product and allow obtaining metal wires with high aspect ratios, the additional removal of these physical templates may complete the synthetic procedures and limit the scale at which materials can be synthesized [18].

1.3. Silver Nanoparticle and Surface Chemistry

When nanoparticles are, in solution, molecules associate with the nanoparticle surface to establish a double layer of charge that stabilizes the particles and prevents aggregation. Aldrich Materials Science offers several silver nanoparticles suspended in a dilute aqueous citrate buffer, which weakly associates with the nanoparticle surface [19]. Synthesis of nanomaterials with controlled morphology, size, chemical composition, and crystal structure, and in large quantity, is a key step toward nanotechnological applications. Nanostructured materials have attracted the attention of researchers not only by their unique chemical and physical properties but also by their potential application in many fields, which has stimulated the search for new synthetic methods for these materials. These materials consist of small grains with sizes below 100 nm. Metal oxide nanoparticles have attracted a great deal of attention from researchers for both their fundamental size-dependent optoelectronic properties and their wide range of applications.

Silver oxide nanostructures have attracted significant consideration because of their potential application in fabricating nano-scale electronics, optical to biological micro-devices, electron field emission sources for emission displays, and the surface electron field emission sources for emission displays, and the surface enhanced Raman property with controlled shape and morphology. It displays wide group of derivatives (Ag_2O, Ag_2O_3, and Ag_3O_4) that attracted considerable attention, mainly owing to the widespread uses of oxides. In nanotechnology and nano structural materials, sensors have been playing a major role in the development of very accurate, highly-sensitive, and reliable devices. Silver oxide nanocrystals and thin films have been intensively pursued for promising applications such as photovoltaic materials, important components in optical memories and plasma photonic devices. Silver oxides crystallize in different types of crystal structures, leading to a variety of interesting physicochemical properties such as electronic, optical, catalytic and electrochemical properties. Among various chemical synthesis methods for preparation of metal oxides of large surface area, a sol-gel process offers several advantages over other methods, better homogeneity, controlled stoichiometry, high-purity, phase-pure powders at a lower temperature and flexibility of forming dense monoliths, thin films or nanoparticles. Sol-gel method is widely applied in preparation of nano- Ag_2O powder. Usually, heat post treatment at high temperature is necessary for removal of organic compounds and to acquire perfect nano crystalline Ag_2O. However, it is very difficult to maintain the nanometric-scale structure of a material when it is subjected to heat-treatments. The heat treatments steps are fundamental to achieve an optimal combination of mechanical, catalytic and electronic properties. This paper deals with the preparation of silver oxide nanoparticles using the wet chemical method. The prepared nanoparticles were characterized by powder X-ray diffraction analysis, SEM, TEM, UV-analysis and dielectric studies.

1.4. The Bactericidal Effect of Silver Nanoparticles

The development of new resistant strains of bacteria to current antibiotics has become a serious problem in public health; therefore, there is a strong incentive to develop new bactericides. This makes current research in bactericidal nanomaterials particularly timely. Bacteria have different membrane structures which allow a general classification of them as Gram-negative or Gram positive. The structural differences lie in the organization of a key component of the membrane, peptidoglycan. Gram negative bacteria exhibit only a thin peptidoglycan layer (~2–3nm) between the cytoplasmic membrane and the outer membrane; in contrast, Gram-positive bacteria lack the outer membrane but have a peptidoglycan layer of about 30 nm thick. Silver has long been known to exhibit a strong toxicity to a wide range of micro-organisms; for this reason, silver-based compounds have been used extensively in many bactericidal applications. It is worth mentioning some examples such as inorganic composites with a slow silver release rate that are currently used as preservatives in a variety of products; another current application includes new compounds composed of silica gel microspheres, which contain a silver thiosulfate complex, that are mixed into plastics for long lasting antibacterial protection. Silver compounds have also been used in the medical field to treat burns and a variety of infections. The bactericidal effect of silver ions on micro-organisms is very well known; however, the bactericidal mechanism is only partially understood. It has been proposed that ionic silver strongly interacts with thiol groups of vital enzymes and inactivates them. Experimental evidence suggests that DNA loses its replication ability once the bacteria have been treated with silver ions. Other studies have shown evidence of structural changes in the cell membrane as well as the formation of small electron-dense granules formed by silver and sulfur. Silver ions have been demonstrated to be useful and effective in bactericidal applications, but due to the unique properties of nanoparticles nanotechnology presents a reasonable alternative for development of new bactericides. Metal particles in the nanometer size range exhibit physical properties that are different from both the ion and the bulk material. This makes them exhibit remarkable properties such as increased catalytic activity due to morphologies with highly active facets.

The antimicrobial effects of silver (Ag) ion or salts are well known, but the effects of Ag nanoparticles on microorganisms and antimicrobial mechanism have not been revealed clearly. Stable Ag nanoparticles were prepared and their shape and size distribution characterized by particle characterizer and transmission electron microscopic study. The antimicrobial activity of Ag nanoparticles was investigated against yeast, *Escherichia coli*, and *Staphylococcus aureus*.

1.5. Problem Statement

In this research silver oxide nanoparticles is to be synthesized and used its high performance against bacterial, also have a unique healing and antimicrobial properties. Chemical method is used to synthesize instead of other methods because of a good final result, less toxicity, and less cost and time. So first of all is to answer questions about if silver oxide nanoparticles which were prepared by chemical method is good enough to kill the bacteria, and the silver oxide nanoparticles after coating the cotton to treat the skin from blisters or not.

1.6. Objectives

1. Preparation of silver oxide nanoparticles by chemical method.
2. Testing performance of the silver oxide nanoparticles against the bacteria.
3. Application the silver oxide nanoparticles on cotton.
4. Testing the performance of silver oxide nanoparticles inside the cotton.
5. Using it for cosmetic to treat the blisters.

1.7. Properties of Silver Nano Particles

Human beings are often infected by microorganisms such as bacteria, molds, yeasts and viruses in the living environment. Research in antibacterial material containing various natural and inorganic substances has been intensive [20]. Metal nanoparticles (Me-NPs), which have a high specific surface area and a high fraction of surface atoms, have been studied extensively due to their unique physicochemical characteristics including catalytic activity, optical properties, electronic properties, antimicrobial activity and magnetic properties [21]. Among Metals NPs, silver nanoparticles (Ag-NPs) have been known to have inhibitory and bactericidal effects [20]. It can be expected that the high specific surface area and high fraction of surface atoms of Ag-NPs will lead to high antimicrobial activity as compared with bulk silver metal [20]. The combined effects of Ag-NPs with the antibacterial activity of antibiotics have not been studied.

1.8. Biological Properties of Silver Nanoparticle

Silver compounds were shown to be effective against both aerobic and anaerobic bacteria by precipitating bacterial cellular proteins and by blocking the microbial respiratory chain system [22-27]. Before the advent of silver nanoparticles, silver nitrate was an effective antibacterial agent used clinically [28-31].

1.9. Optical Properties of Silver Nanoparticle

There is growing interest in utilizing the optical properties of silver nanoparticles as the functional component in various products and sensors. Silver nanoparticles are extraordinarily efficient at absorbing and scattering light and, unlike many dyes and pigments, have a color that depends upon the size and the shape of the particle. The strong interaction of the silver nanoparticles with light occurs as the conduction electrons on the metal surface undergo a collective oscillation when excited by light at specific wavelengths known as a Surface Plasmon Resonance (SPR), this oscillation results in unusually strong scattering and absorption properties. In fact, silver nanoparticles can have effective extinction (scattering + absorption) cross sections up to 10 times larger than their physical cross section. The strong scattering cross section allows for sub 100 nm nanoparticles to be easily visualized with a conventional microscope. When 60 nm silver nanoparticles are illuminated with white light they appear as bright blue point source scatters under a dark field microscope. The bright blue color is due to an SPR that is peaked at a 450 nm wavelength. A unique property of spherical silver nanoparticles is that this SPR peak wavelength can be tuned from 400 nm (violet light) to 530 nm (green light) by changing the particle size and the local refractive index near the particle surface. Even larger shifts of the SPR peak wavelength out into the infrared region of the electromagnetic spectrum can be achieved by producing silver nanoparticles rod or plate shapes [19].

1.10. Chemical of Synthesis of Silver Nanoparticles

The most common approach for synthesis of silver nanoparticles is chemical reduction by organic and inorganic reducing agents. In general, different reducing agents, such as sodium citrate, ascorbate, sodium borohydride ($NaBH_4$), elemental hydrogen, polyol process, tollens reagent N, N-Dimethylformamide (DMF) and poly (ethylene glycol)-block copolymers are used for reduction of silver ions (Ag+) in aqueous or non-aqueous solutions. The aforementioned reducing agents reduce silver ions (Ag+) and lead to the formation of metallic silver (Ag0), which is followed by agglomeration into oligomeric clusters. These clusters eventually lead to formation of metallic colloidal silver particles [49, 50]. It is essential to use protective agents to stabilize nanoparticles during the course of silver nanoparticle preparation, and protect the nanoparticles that can be absorbed on or bind onto nanoparticle surfaces, avoiding their agglomeration. The presence of surfactants comprising functionalities (*e.g.* thiols, amines, acids and alcohols) for interactions with particle surfaces can stabilize particle growth, and protect particles from sedimentation, agglomeration or losing their surface properties. Polymeric compounds such as poly(vinyl alcohol), poly(vinylpyrrolidone), poly(ethylene glycol), poly (methacrylic acid) and polymethyl methacrylate late have been reported to be effective protective agents to stabilize nanoparticles [51].

1.11. Applications

Silver nanoparticles are of interest due to the unique properties (*e.g.* size and shape depend on optical, electrical and magnetic properties) which can be incorporated into antimicrobial applications, biosensor materials, composite fibers, cryogenic superconducting materials, cosmetic products and electronic components [61]. These particles also have many applications in different fields such as medical imaging, nano composites, filters, drug delivery and hyperthermia of tumors [62, 63]. Silver nanoparticles have drawn the attention of researchers due to their extensive applications in areas such as integrated circuits [64] sensors, biolabeling, filters [65], antimicrobial deodorant fibers, cell electrodes, low-cost paper batteries (silver nanowires; [68] and antimicrobials [20, 66, 67, 69].

Silver nanoparticles have been used extensively as antimicrobial agents in health industry, food storage, textile coatings and a number of environmental applications.

1.12. Antibacterial Applications of Silver Nanoparticles

Silver nanoparticles have important applications in the field of biology such as antibacterial agents and DNA sequencing [70]. Silver has been known to exhibit strong toxicity to a wide range of microorganisms (antibacterial applications). Scientists have long known that silver ions, which flow from nanoparticles when oxidized, are deadly to bacteria Schmidt-Ott. Silver nanoparticles are used just about everywhere, including in cosmetics, socks, food containers, detergents, sprays and a wide range of other products to stop the spread of germs.

Silver ions delivered by nanoparticles to bacteria promote lysis, the process by which cells break down and ultimately die, which makes silver nanoparticles a superior and widely used antibacterial agent. As antibacterial agents, AgNPs were applied in a wide range of applications from disinfecting medical devices and home appliances to water treatment. One use of silver ion or metallic silver as well as silver nanoparticles can be exploited in medicine for burn treatment, dental materials, coating stainless steel materials, water treatment, and sunscreen lotions [69].

2. MATERIAL AND METHODS

2.1. Synthesis of Silver Oxide Particles

In current study, wet chemical route was employed for the silver oxide particle synthesis. This study had conducted and compared two different routes of silver oxide particle synthesis. In the Route 1, the pH of the solution mixture was not controlled or adjusted. The pH of the solution mixture was allowed to change accordingly after the reaction took place. In the Route 2, the pH of the solution mixture was fixed at the range of pH 9.8 to pH 10. Addition of the NaOH solution was employed to maintain the solution pH until the completion of the reaction. Some of the details of the Route 1 and Route 2 were further discussed in the following sections.

Route 1

20 g of the PEG was dissolved in1 liter of the distilled water before being heated up to 50 ^{0}C Figure (**6**). The solution was stirred for another 1 hour to ensure all PEG was completely dissolved to form a homogeneous solution. Aqueous PEG solution obtained was then filtered to remove impurities, if any. Silver nitrate solution prepared using 0.5 g of silver nitrate salt was added into the PEG solution prepared under a constant stirring rate and at constant temperature of 50 ^{0}C. pH of the solution was not controlled. The solution was continuously stirred for 1 hour to complete the chemical reactions. After the formation of the particles, the solution was filtered through the filter paper to separate the particles from the mother solution. Particles obtained were rinsed with distilled water several times before it was rinsed again using ethanol. The particles were dried in oven at 60 ^{0}C overnight.

Route 2

All the steps employed in the Route 2 were similar to that of Route 1, except where the addition of the silver nitrate solution was followed by the pH adjustment. The solution mixture pH was set at pH 9.8 to 10 throughout the reaction process. During the pH adjustment, NaOH solution of 0.1 M was slowly added into the solution mixture when the solution pH was reducing.

2.2. Spectrometer

The Spectrometer device was used to calculate nice transflective via optical spectroscopy regulations from the transflective and either calculate the absorbency for the sample, and form nice absorbency calculate size particles the sample, obtained for three curves, firstly curve about the absorbency and second curve for nice surface plasma resonance and finally curve for the particles size in mettles per nice surface plasma resonance actinometer after that was calculated by equation.

$$d = \exp(\beta 1\ Aspr/A\lambda - \beta 2)$$

- d≡particle size
- β1≡ 1/slope
- β2≡intercsct

2.3. Preparation of Bacterial Suspensions

One ml aliquots of a 24 hours broth culture of the test organisms were aseptically distributed onto nutrient agar slopes and incubated at 37° C for 24 hours. The bacterial growth was harvested and washed off with 100 ml sterile normal saline, to produce a suspension containing about 10^8- 10^9Colony Forming Unit C.F.U/ ml. The suspension was stored in the refrigerator at 4° C till used. The average number of viable organisms per ml of the stock suspension was determined by means of the surface viable counting technique. Serial dilutions of the stock suspension were made in sterile normal saline solution and 0.02 ml volumes of the appropriate dilution were transferred by micro pipette onto the surface of dried nutrient agar plates. The plates were allowed to stand for two hours at room temperature for the drops to dry and then incubated at 37 °C for 24 hours. After incubation, the number of developed colonies in each drop was counted. The average number of colonies per drop (0.02 ml) was multiplied by 50 and by the dilution factor

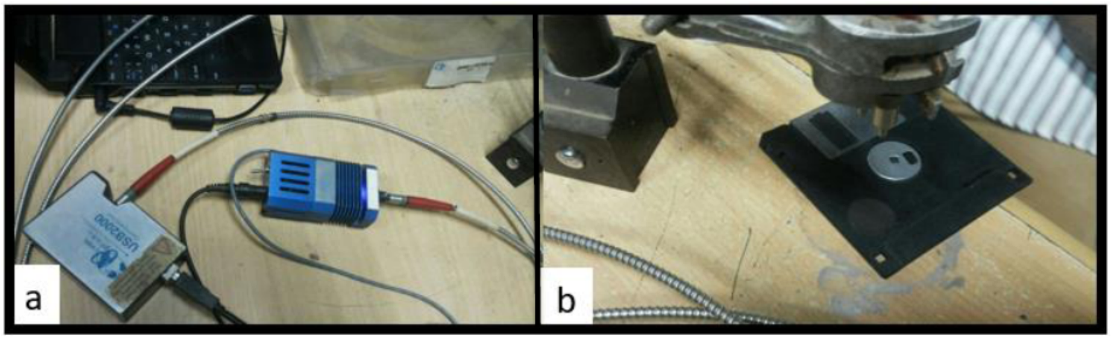

Figure 1: **a**) Showing the connectors of spectrometer **b**) showing the disc of the spectrometer.

to give the viable count of the stock suspension, expressed as the number of colony forming units per ml suspension. Each time a fresh stock suspension was prepared. All the above experimental conditions were maintained constant so that suspensions with very close viable counts would be obtained.

2.4. Disc Diffusion Methods

The paper disc diffusion method was used to screen the antibacterial activity of Nano solution and performed by using Mueller Hinton Agar (MHA). The experiment was carried out according to the National Committee for Clinical Laboratory Standards Guidelines (NCCLS, 1999). Bacterial suspension was diluted with sterile physiological solution to 10^8CFU/ ml (turbidity = McFarland standard 0.5). One hundred microliters of bacterial suspension were swabbed uniformly on surface of MHA and the inoculum was allowed to dry for 5 minutes. Sterilized filter paper discs (Whatman No.1, 6 mm in diameter) were placed on the surface of the MHA and soaked with 20 µl of a solution of each Nano solution. The inoculated plates were incubated at 37 °C for 24 h in the inverted position. The diameters (mm) of the inhibition zones were measured.

2.5. Dilution Methods

The aim of broth and agar dilution methods is to determine the lowest concentration of the assayed antimicrobial agent (Minimal Inhibitory Concentration, MIC) that, under defined test conditions, inhibits the visible growth of the bacterium being investigated. MIC values are used to determine susceptibilities of bacteria to drugs and also to evaluate the activity of new antimicrobial agents.In the agar dilution method, the medium is inoculated with the test organism and the samples to be tested are mixed with the inoculated medium. The material is inoculated and the growth of the microorganism is viewed and compared with control culture which does not contain the tested sample. The experiment is repeated at various dilution of the test sample in the culture medium and the highest dilution at which the sample just prevents the growth of the microorganism (MIC) is determined.

Dilution tests on solid media involve addition of varying concentrations of Nano solution to measured volumes of agar medium which has been melted and cooled to 45-50° C, the resultant mixtures are then poured as plates into Petri-dishes or as slants into test tubes. Standardized inocula are seeded onto the surface of the medium and MIC read after an appropriate incubation period. In these methods, it is essential to test strains of known susceptibility with each series of unknowns in order to be sure against Nano solution deterioration, in- accuracies in dilution or variation in the medium.

Breakpoint concentrations of antibiotics are used to characterize antibiotic activity: the interpretive categories are susceptible, moderately susceptible (intermediate), and resistant. These concentrations are determined by considering pharmacokinetics, serum and tissue concentrations following normal doses, and the population distribution of MICs of a group of bacteria for a given drug.

2.6. Determination of Minimum Inhibitory Concentrations (Mics) by Agar Plate Dilution Methods

The principle of the agar plate dilution is the inhibition of the growth on the surface of the agar by the Nano solution incorporated into the medium. Plates were prepared in the series of decreasing concentrations of the nano solution in the following order 100, 50, 25, 12.5, mg/ml. The bottom of each plate was marked off into 6 segments. The organisms tested were grown in broth over night to contain 10^8 organisms per ml. Loop-full of diluted culture is spotted with a standard loop that delivers 0.001 ml on the surface of each segment and then incubated at 37 ºC for 24 hours.

The end point (MIC) is the least concentration of antimicrobial agent that completely inhibits the growth. Results are reported as the MIC in mg/ml.

2.7. Application of Silver Oxide Nanoparticles on Cotton

Silver oxide nanoparticles dissolved in acetic acid (5%) at 3 min, the pH was maintained around 7 - 7.5

2.7.1. Test of the Treated Cotton by Bacteria

Types of bacteria used in this study has been collected from local laboratories:

- Streptococcus pyogenes
- Staphylococcus

Devices uses:

- Incubator, Oven, Laminar flow, Autoclave,

Materials used:

- Pepton water, Baird parker, Blood agar, Cotton balls with different weights.

The Method of tests:

Preparation of 8 ml of pepton water in bottles for every bacterium Divided in the bottles as:

Control factors:

Media, Cotton, bacteria

The concentrations of the work on the two forms (A&B)

1) Prepare controllers, by adding bacteria to (c) and adding cotton to (b).
2) Vaccination of the diluted by bacteria and adding treated cotton to the diluted.
3) Save all bottles at 37°c for 24 hours.
4) After 24 hours cotton added to the diluted (b) and saved at 37°c for 24 hours again. A rest of the bottles transferred inside a solid media, determined according to the type of bacteria (BP-staph) or (BA-strapless), and injected for 48 hours.
5) Read the results and record observations after the specified time.

3. RESULTS AND DISCUSSION

During the preparation of the silver oxide particles, the pH of the solution was monitored continuously. However, in Route 1 method, no adjustment of the solution pH will be conducted. In Route 2 method, NaOH solution is introduced into the solution mixture to keep the solution pH at the range of pH 9.8 to pH 10 Figure (**2**). In both methods, the solution changes from no color to black color to indicate that the chemical reaction took place in the solution mixture Figure (**2**). After the completion of the chemical reaction which took place slowly, black precipitates of silver oxide particles were observed to be formed in the solution mixture Figure (**4**). The proposed chemical reaction according to reported study was represented by the chemical equation below:

$$2Ag^{+} + 2OH^{-} \rightarrow Ag_2O + H_2O \quad (1)$$

3.1. Results

Figure 2: Color change of silver nanoparticles a) PEG in 1 liter of distilled water with silver nitrate b) solution mixture pH9.8-10 c) added NaOH from no color to black.

Figure 3: Silver NPs after filtration.

$$d = \exp(\beta 1 \; Aspr/A\lambda - \beta 2)$$

- d≡particle size
- β1≡ 1/slope
- β2≡intercsct

∴ d= 14.7 nm

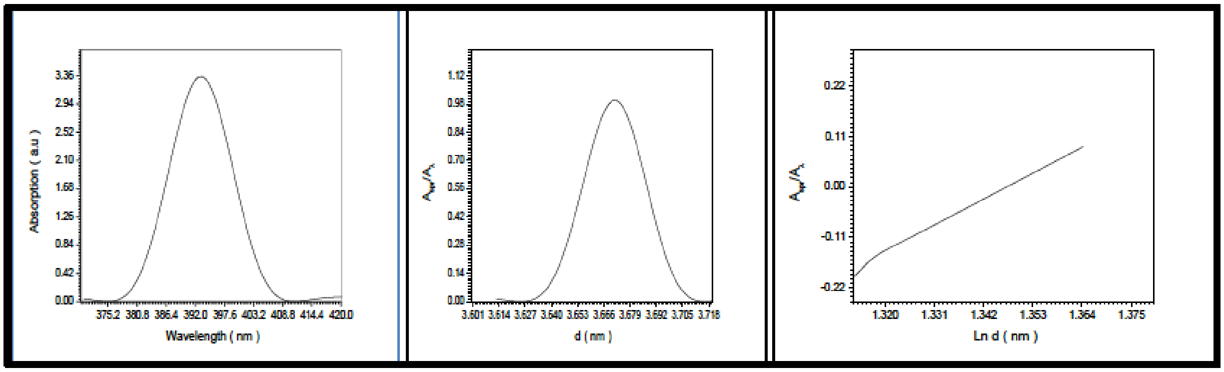

Figure 4: Curve (**1**): Spectrometer of sample of absorbency to silver oxide nanoparticles. Curve (**2**): Spectrometer of sample explains nice surface plasma resonance. Curve (**3**): Spectrometer explain size particles of silver oxide nanoparticles.

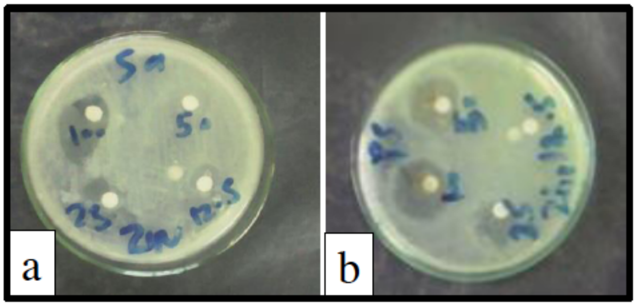

Figure 5: **a**) Staphylococcus is grown on agar plate with concentrations of silver NPs **b**) Pseudomonas is grown on agar plate with different concentrations of silver NPs nanoparticles.

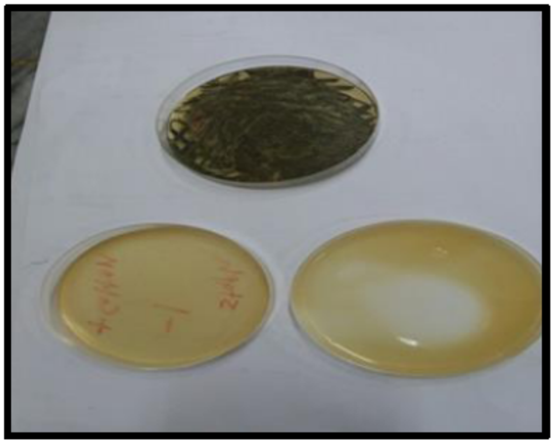

Figure 6: The bottles without cotton and the bottles contain treated cotton.

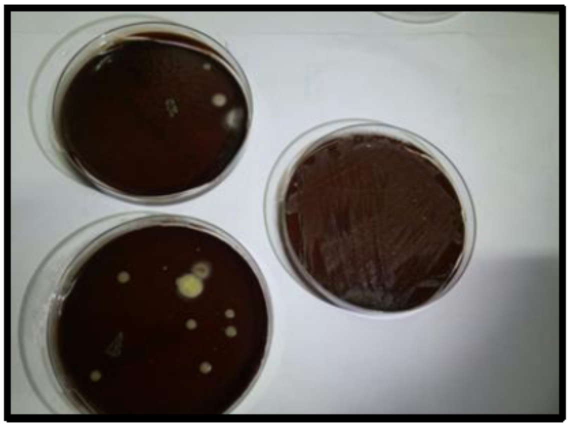

Figure 7: Shows effect the silver on the streptococcus and shows effect of silver NPs on the staphylococcus.

1) *Streptococcus pathogens*: found that silver oxide nano particles are not 100% effective, but its impact on the bacteria in diluted is shown clearly.

2) *Staphylococcus:* it found that the silver oxide nanoparticles are 100% effective against all bacteria in diluted.

3.2. Discussion

Prepared silver oxide nano particles used rout 2 instead of rout 1 because it has unique potential to control of pH.

Tested the silver oxide nano particles by spectrometer device obtained high absorbency, good wave length and from it obtained the particles size of silver oxide nano particles using the equation:

$$d = \exp(\beta 1\ Aspr/A\lambda - \beta 2)$$

- $d \equiv$ particle size
- $\beta 1 \equiv 1/\text{slope}$
- $\beta 2 \equiv$ intercsct

$\therefore d = 14.7$ nm

After testing antibacterial activity of silver oxide nano particles by using dilution method, and test it on two types of bacteria first type *staphylococcus* and the second type *pseudomonas* with different concentrations (100, 50, 25, 12.5 %) of silver oxide nano particle it is found that when the concentration of silver oxide it increases ability to contamination of bacteria.

By dissolving the silver oxide nano particles in diluted acetic acid (5%) and impregnated the cotton balls of weight (0.5g) in silver oxide solution and testing its performance to kill the bacteria. It is found that more concentration of silver oxide nano particles solution has increase killing of staphylococcus (100%) and the streptococcus (75%).

4. CONCLUSION AND RECOMMENDATIONS

The study aimed to synthesis of silver nanoparticles by the chemical method, and by spectrometer device. The sample was analyzed and each of wavelength, absorbability and the volume of material particles calculated, results have been explained in the form of charts (diagrams), and then test of the effectiveness of the sample to kill bacteria after covering the cotton balls have been done using material.

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Received on 01-01-2023 Accepted on 30-01-2023 Published on 24-02-2023

DOI: http://dx.doi.org/10.12974/2311-8792.2023.09.2