Green Chemistry Synthesis of Modified Silver Nanoparticles

Huda Ismail AL-Rubaye¹, Baidaa k. AL-Rubaye², Entisar E. Al-Abodi³, Enaam Ismail Yousif⁴.

Chemistry Department, College of Education for Pure Science, Ibn Al-Haitham, University of Baghdad.
entesaree2020@gmail.com

Abstract

The important aspect of this unconventional approach is that eco-friendly, commercially available and straightforward method was used to prepare Silver Nanoparticles by using AgNO₃ and curcumin solution as agent factor. The (TEM), (XRD), and (FTIR) was used to characterise these silver nanoparticles (AgNPs). Two types of bacterial isolates were used to indicate the antibacterial activity silver nanoparticles which prepared by curcumin solution, Gram negative like (Escherichia Coli E. Coli), & Gram positive (Stapha Urous). The results exhibit that silver nanoparticles synthesized by curcumin solution has effective antibacterial activities.

Keywords: AgNPs, curcumin solution.

1. INTRODUCTION

The novel metal nanoparticles have grabbed the attention of researchers in chemical, medicine, engineering and biological fields due to their unique characteristic properties 1-7. Interestingly, classification of nanoparticles may be depend in the way in which they were manufactured, for environmentally friendly procedures. Recently, natural sources have received much interest and
seem to be the best approaches to quantitative biosynthesis of nanoparticles such as vitamins, plant extracts, biodegradable polymers, sugars and microorganisms as reducing and capping reagents 8-9. Polyphenols is play a key role in some of these approaches which can found in tea, red grape and turmeric10-11. In recent decades, it has been understood that curcumin is the main polyphenol in turmeric which has been used as a reducing and stabilizing reagent in synthesis of Ag and Au nanoparticles 12-14. Furthermore, it is believe that utilize metal nanoparticles have a potential bioactivity for novel anti-viral and anti-inflammatory therapies.

In this work silver nanoparticles (AgNPs) have been synthesised due to its unique antimicrobial property which is opens the door to utilize them in cosmetic products and clothing. Furthermore, silver possesses a high electrical conductivity more than (Au and Cu), which makes it a significant candidate for the conductive inks manufacturing. Another impact is represented by the associated high surface plasmon resonance (SPR), which is measure the adsorption of material at the Ag nanoparticles (AgNPs) surface.

2-Methodology

In this work in order to gain access to the curcumin silver nanoparticles (AgNPs), we chose turmeric powder as commercially available. The first step includes preparing of curcumin solution [1] by adding 0.5g of plant (curcumin powder) to 100 ml of water, then the mixture was heated for 30 minutes at 85 °C. The mixture was filtered by using filter paper (Whatman, no. 1) to obtain a smooth solution of curcumin plant in water.

The next stage was to get the silver nanoparticles. 10 ml of (AgNO₃, 0.1 M ) with curcumin solution (3 ml ), have been mixed in a conical flask (50 ml), then heated for 1 hour at 60 °C [2]. The formation of silver nanoparticles (Ag-NPs) was characterised due a change of color from (yellow – brownish) [Figure 1]. Finally, in order to collect the Ag nanoparticles, the solution was centrifuged at 4000 rpm for five minutes, dried and then fully characterised by FT-IR, XRD and TEM.

3. Results and discussion

3.1 Characterization

The important aspect of this unconventional approach is that eco-friendly, commercially available and straightforward method. The transmission electron microscope (TEM) morphologies, X-ray differeection (XRD), & Fourier transform infrared analysis (FTIR) was used to characterise these silver nanoparticles (AgNPs).

Figure 2 exhibits prominent peak at 420 cm⁻¹ due to silver nanoparticles and the peak at 3448 cm⁻¹ of hydroxyl group, while the peak at 1380cm⁻¹ due to NO₂ group from silver nitrate [3].
Figure (1). FTIR Spectroscopy of Silver Nanoparticles

The XRD studies of the synthesized nanomaterials at the range of $2\theta$ (10 - 80°). The X-ray diffraction patterns at the range of $2\theta$ (10 - 80°)., of the Ag-NPs prepared using AgNO$_3$ with curcumin as agent factor are shown in Figure 3. The reflections (which correspond to Ag metal with face centered cubic fcc symmetry), which were indexed as 20 values of 38.78, 45.35, 67.03 and 78.92 nm$^{-1}$, respectively (JCPDS 04-0783)[4]. The range size of silver nanoparticles can be determined by using the Debye - Scherrer relation [5].

$$D = \frac{K \lambda}{\beta \cos \theta}$$

Where D is the size of grain, K is the (shape factor) (0.9 - 1), while $\lambda$ is the wave length of X-ray (1.5418 Å), and $\theta$ is the Bragg angle, $\beta$ is the width of the XRD peak. From this equation, the average grain size of silver nanoparticles is (31.17nm).

Figure (2). The X-Ray Diffraction of Silver Nanoparticles

Figure 3 represents the Transmission Electron Microscope (TEM) analysis pictures of Silver nanoparticles with particles size is about 35.92nm.
3.2 Antibacterial Activity

Two types of bacterial isolates were used to indicate the antibacterial activity silver nanoparticles which prepared by curcumin solution, Gram negative like (Escherichia Coli, E Coli), & Gram positive like (Stapha Urous). Figures 5 exhibits that silver nanoparticles synthesized by curcumin solution has active antibacterial efficiency as indicated by determine their zone of inhibit , which was 18mm for E Coli, and 19mm for Stapha Urous.

Figure(3). Transmission Electron Microscope (TEM) Analysis of Silver Nanoparticles

Figure(4). Antibacterial Activity of Silver Nanoparticles
CONCLUSION

The main purpose of our research was to describe, Silver Nanoparticles prepared by using AgNO₃ and curcumin solution as agent factor. The important aspect of this unconventional approach is that eco-friendly, commercially available and straightforward method. The (TEM), (XRD), and (FTIR) was used to characterise these silver nanoparticles (AgNPs). Two types of bacterial isolates were used to indicate the antibacterial activity silver nanoparticles which prepared by curcumin solution and silver nitrate, Gram negative (Escherichia Coli E Coli), and Gram positive (Stapha Urous). The results exhibit that silver nanoparticles synthesized by curcumin solution has effective antibacterial activities.

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