RESEARCH ARTICLE

Characterization and Biological Activity of Green Synthesis Silver Nanoparticles

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ABSTRACT

This study has been carried out to synthesis of silver nanoparticles using green synthesis by using *Streptomyces sp.*.that isolating from soil and Investigation the antifungal activity of it. Results showed that silver nanoparticles were synthesized using *Streptomyces sp* in the presence of silver nitrate, and the color change to brown. UV-vis spectrophotometer appears to peak in wavelength at 420 nm, which is prescribed for silver nanoparticles. Also, microscope images by Scanning electron microscopy (SEM), showing the size of Ag nanoparticles in range 15–50 nm. Results of antifungal activity explain the ability of biosynthesis silver nanoparticles to inhibition the growth of fungus *T.rubru*m.

Keywords: Green synthesis, Silver nanoparticles, *Streptomyces, T.rubrum*.

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INTRODUCTION

Nanotechnology research is one of the emerging research areas where science is used to manufacture new compounds in the nano level. Generally, nanoparticles range between 0.1–1000 nm and consist of two methods: top-down and bottom-up. Optical and electrical features And exclusive thermal that is integrated into products ranging from photovoltaic cells to biological and chemical sensors. Silver nanoparticles are of great importance among metallic nanomaterials because of the physical and chemical properties.[1] Ag has traditionally been used to prepare biological NP for the treatment of infectious diseases. Many reports have shown that the application of AG inhibits microorganisms, such as bacteria, fungal viruses, insects, and nematodes. Mainly, Ag NP attacks the cell wall (by enhancing cell wall permeability and releasing cell wall components), mitochondria (by influencing ATP generation mechanism), protein (By clinging bonds to the second sulfide or sulfhydryl), DNA (by binding base pairs) of pathogenic microorganisms, and nematodes. Mainly, Ag NP attack the cell wall (by enhancing the permeability of the cell wall and releasing the cell wall components), mitochondria (by affecting the ATP generation mechanism), protein (by clearing the disulfide or sulfhydryl bonds), and DNA (by binding to the base pairs) of the pathogenic microorganisms.[2] There are many types of methods for synthesis of nanoparticles using chemical and physical agents. These methods involve the usage of hazardous solvent and toxic compounds.[3] Several ways have been developed for the biological synthesis of nanoparticles from salts of corresponding metals.[4] Thus this study used An extracellular synthesizes AgNPs by *Streptomyces sp.*

MATERIAL AND METHODS

The strain of microorganisms

Streptomyces sp. isolated from soil by using dilution method, *Trichophyton rubrum* which obtain from the laboratory of microbiology/college of education /university of AL-Qadisiyah.

Synthesis of silver nanoparticles

Streptomyces was cultivated in nutrient Broth medium and incubate at 37ºC on closing rotary shaker (100 rpm for 72 hours). The broth was. The biomass was filtered, and the cell filtrate was collected, and 10 mL of 1 mM ($AgNO_3$) add into 50 mL of filtered, pale-yellow before the addition of silver ions, after that changed to yellowish-brown at the end of the reaction.[5]

UV –spectrophotometer analysis

Optical characters of the synthesized silver nanoparticles and $AgNO_3$ were studied by analyzing the UV-Vis specter using spectrophotometer at room temperature.

FTIR analysis

The chemical groups found in nanoparticles were studied using FTIR (Birkin Elmer, USA).

Scanning electron microscopy (SEM)

We used the SEM technique for measuring nanoparticle size of silver. and analyzed results of it by using the Image J program

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Antifungal activity

This test was performed by disk (5mm) from fungus colony, inoculated the center of dishes containing the center of the SDA containing 10% of nanoparticles and other non-contain of nanoparticles as compared treatment.the dishes incubated at 37 C for 14 days, the growth was monitored by measuring the radial growth.[6]

RESULTS AND DISCUSSION

Synthesis of silver nanoparticles

The change in color from yellow to brown to the mixture indicates the formation of silver nanoparticles (Figure 1). This change occurs due to the stimulation of surface Plasmon vibrations with Nanoparticles particles.[7]

UV-Vis Spectroscopy

The absorption spectra of ultraviolet radiation is the most widely used method for characterizing the optical properties and the electronic structure of nanoparticles, where the absorption ranges of diameter and the aspect ratio of nano-particles.[8] Figure 2 shows the visible ultraviolet spectra of silver nanoparticles The absorption spectra of the reaction medium at the 420 nm wavelength confirmed the formation of nanosilver Also, the absorbance in the range of 420–450 nm has been used as an indicator to the reduction of Ag^{+} to metallic Ag^{0} [4]

FTIR analysis

The FTIR spectroscopy studies were performed by investigating the reasonable mechanism behind the formation of these SNPs and providing information on functional groups. The representative spectra of the SNPs are shown in Figure 3 There is a distinct peak in the region 1314.23 cm-1 due to the presence of extended vibrations of alcoholic acids, carboxylic acids, ethers and esters, and functional sites of nanoparticles associated with nanoparticles.[9]

Scanning electron microscopy (SEM) Images

SEM analysis shown in Figure 3,and this results indicated the presence of silver nanoparticles with varies sizes ranging 15-50nm. The images show that most of the particles are spherical with a smooth surface.

Figuge 1: (a) filter of *Streptomyces sp*, (b) synthesized Ag Nps

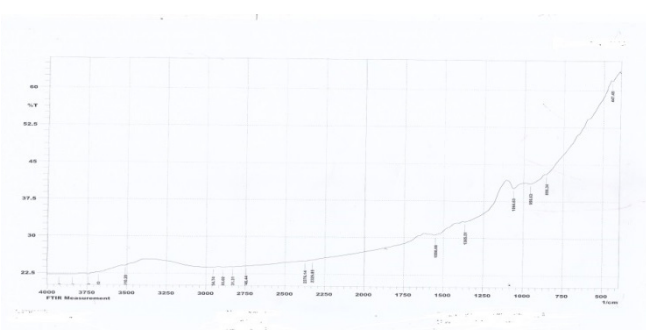

Figure 3: FT-IR spectrum analysis of silver nanoparticles

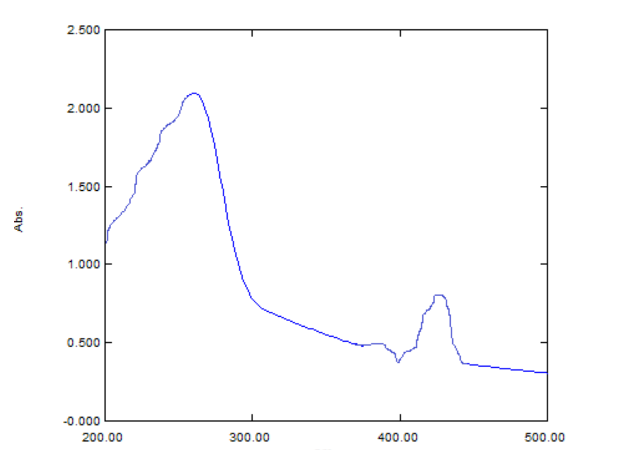

Figure 2: VIS absorption spectra of Ag nanoparticles

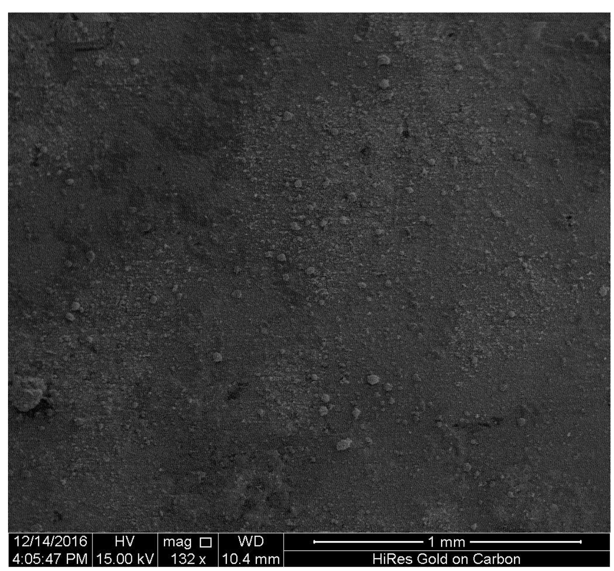

Figure 3: ESM sections of the biosynthesis of AgNps with size (15-50nm)

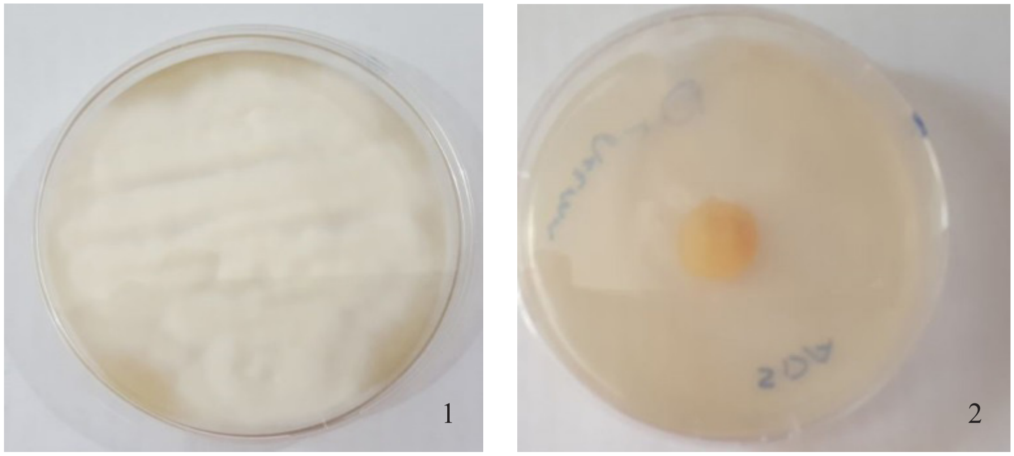

Figure 4: Effect of biosynthesis of Ag Nps on *T.rubrum*
1 = colony of fungus in present Ag nanoparticles, 2 = control treatment

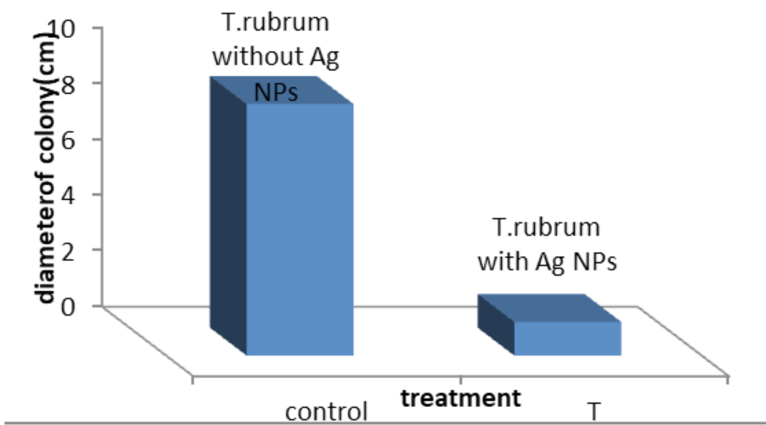

Figure 5: Effect of biosynthesis of Ag Nps on *T.rubrum*

Results of the present study have shown that Streptomyces sp. has the ability to reduce Ag from respective ion sources. This agreement with many studies that green synthesis of Ag Nps from microorganisms.[10,5]

Antifungal activity

Antifungal activity for sliver nanoparticle produced by Streptomyces sp.was tested against dermatophyte fungus *T.rubrum*.Figures 4,5 show The antifungal effect of biologically silver nanoparticles was investigated against *T.rubrum*, causing skin infections. Growth inhibition of fungus by silver nanoparticles was compared with control treatment. These results do agree with[11], which found that green synthesis of Ag nanoparticles has antibacterial activity. Size and shape of nanoparticles are more effective on the antifungal activity.[12]

The reason for the inhibitory effects of silver nanoparticles its wide surface area for size, and this lead to a reaction of this particle with cell wall of a microbe to make an imbalance in the cellular permeability.[13,14]

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