Biosynthesis, characterization and antifungal activity of the green silver nanoparticles synthesized by a marine alga *Digenia simplex*

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**Keywords:**

*Digenia simplex*, Green biosynthesis, Marine algae, Silver nanoparticles

**Abstract:**

Silver nanoparticles synthesized biologically have been widely used in medicinal field, the synthesis of silver nanoparticles has been carried out by using the extracellular filtrate of the algal strain *Digenia simplex*. The synthesis of silver nanoparticles was identified primarily by changing the color of the extracellular filtrate and confirmed with the help of the study of XRD (X-ray diffraction), UV-visible analysis and IR spectroscopy. It was confirmed that the silver nano particles were constituted extracellularly by an extracellular reduce like enzymes.

The results obtained from the study of antifungal activities of the silver nanoparticles are very significant and indicate that the synthesized silver nanoparticles may have an important advantage over conventional antifungal antibiotics.

1-introduction:

In last few years, research in nanotechnology has been carried out extensively as nanoparticles possess increased structural integrity as well as unique chemical, mechanical, optical, electronic and magnetic properties compared to large particles of bulk materials (1). In the synthesis of nano particles, the various conventional processes like a number of chemical and physical methods including chemical reduction in aqueous or non-aqueous solution (2), micro emulsion (3), sono-chemical (4) and microwave-assisted (5) methods have been applied. Since the chemicals like organic solvents, hydrazine, sodium borohydride and N, N-dimethyl formamide utilized in the synthesis of metal nano particles are found to be highly reactive and biological hazardous, the chemically synthesized metal nano particles could not be accomplished with the biomedical field. On the other hand, the microbiologically synthesized metal nanoparticles are found to be eco-friendly, reliable, biocompatible and economic. It is reported from the ancient time that silver among the various metals has been considered as an effective antimicrobial agent, low poisonous agent and water purifying agent (6). Accordingly microorganisms such as an algae (7), fungi (8), actinomycetes (9) and plants (11, 12) have been used for the study of biosynthesis of silver nanoparticles. The synthesis of nanoparticles is intrinsically or extrinsically of which the extracellular process could be used preferably as it is less laborious and also is less costly. It is found that algae are more suitable than bacteria for the use of the synthesis of nano particles.

2-Materials and method

2.1 The source of the algae;

The marine alga *Digenia simplex* (Pillai., C.Agardh, 1832) one of red algal of the family Rhodomeidae was brought from the red sea from Egypt.

2.2 Preparation of silver nanoparticles;

10gm of the alga was powdered and extracted by using 95% ethyl alcohol. Centrifuged to get the supernatant and condensed to get the algal extract (13) .

The silver nitrate solution 10^-3M and the algal extract were added with ratio 9:1 with magnetic stirring for 45min, the color changes from the colorless of the alga to the grey red color indicating the formation of Ag-NPs[15].

2.3 Characterization of the Ag-NPs formation was by the change of color from the colorless of the alga to the grey red color, also by using the XRD analysis to detect the silver nanoparticles and the FT-IR spectrum to know the unique chemical, mechanical, optical, electronic and magnetic properties.

2.4 The antifungal activity by the prepared Ag-NPs:

2.4.1 The fungus;

The fungus; *Fusarium solani* and *Fusarium oxysporum* with 60mm diameter were isolated from the plant infecting fungus.

2.4.2 Media prepared: (PDA) potato dextrose agar, 200gm of potato was boiled in a liter of water till 10min, then 20gm of glucose and 20gm of the agar was added to the potato filtrate then completed to one liter [16].

2.5 -Results and Discussion:

3.1 Characterization of the Ag-NPs formation was by the change of color from the colorless of the alga to the grey red color, also by using the XRD detector grow the size of silver oxide formed 55nm and 90nm [Bookmark 1].

3.2 The antifungal activity of Ag-nps; 4-5mm zones of inhibition on the plates which were previously seeded by the fungus of interest. Then plates were incubated at 30°C for 5 days. The zone of inhibition was measured by a ruler and express in mm.

3.4 The fungus; *Fusarium oxysporum*; the fungus *Fusarium oxysporum* with 60mm diameter were isolated from the plant infecting fungus.

3.2 Media prepared; (PDA) potato dextrose agar, 200gm of potato was boiled in a liter of water till 10min, then 20gm of glucose and 20gm of the agar was added to the potato filtrate then completed to one liter [16].

**Figure (1)** The crystalline size of the silver nanoparticles measured by XRD (red and blue line);

**Main Graphics, Analyze View:** (Bookmark 1)

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**Figure (2)** indicate the crystalline nano silver oxide of the single peak.

3.3 The antifungal activity of Ag-nps; *F. solani* is known to infect soybeans, sometimes causing sudden Death Syndrome (SDS) like what happen with *Fusarium oxysporum* [Fig(7)], the results obtained from the study of antifungal activities of the silver nanoparticles are very significant and indicate that the synthesized silver nanoparticles may have an important advantage over conventional antifungal antibiotics.
The extracellular filtrate of the algae, Digenia simplex could synthesize silver nano particles from the aqueous solution of silver nitrate. Such type of the synthesis of silver nanoparticles may be considered as eco-friendly as it is free from any toxic chemicals or organic solvents. The synthesized silver nano particles are found to be relatively. So it can be considered as low cost process compared to the other processes, like chemical process as there is no requirement of any sort of capping agent for making the synthesized silver nano particles stable. In the present study it is found that the dimension of the synthesized silver nano particles is in the range of 55-90 nm. Investigation of antifungal activities of silver nano particles against some fungal strains. Indicated that it could be considered as a potential antifungal agent implicating its biomedical application.

5-REFERENCES:
[17] RRAM Media M127: Potato Dextrose Agar

5.4 Conclusion:
In order to determine the functional groups on Digenia simplex (ethanolic extract) and predict their role in the synthesis of silver nanoparticles, FTIR analysis was performed for the silver nanoparticles of the extract of Digenia simplex, the FTIR-spectrum is shown in [graph 4]. The presence of the three bands at 1101-239 nm, 2236-3282 nm, 630-860 nm may be assigned to carboxyl acid bands of some components in the extract and arises due to carbonyl-stretch and free-O–H stretch vibrations in the carbonyl linkages of the acids. The FT-IR-spectroscopic study has confirmed that the carbohydrates group forms amino acid residues and peptides of proteins have the stronger ability to bind metal, so that the proteins could most possibly form a coat covering the metal nanoparticles (i.e., capping of silver nanoparticles) to prevent agglomeration of the particles and stabilizing in the medium. This evidence suggests that the biological molecules could possibly perform the function for the formation and stabilizing of the silver nanoparticles in aqueous medium.