

*Dedications*

*To my parents*

*To my husband*

*To my brothers, my sisters*

*And To my sons*

## **Acknowledgements**

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## Abbreviations

AgNPs	Silver nanoparticles
CLZ	Clotrimazole
UV-Vis	Ultra – violet – Visible Spectrophotometer
FTIR	Fourier Transform Infrared
TEM	Transmission electron microscopy
DMSO	Dimethyl sulfoxide
MIC	Minimum inhibitory concentration
M. D. I. Z	Mean diameter of growth inhibition zone
<i>B.s</i>	<i>Bacillus subtilis</i>
<i>S.a</i>	<i>Staphylococcus aureus</i>
<i>E.c</i>	<i>Escherichia coli</i>
<i>P.a</i>	<i>Pseudomonas aeruginosa</i>
ATCC	American Type Culture Collection
LSPR	Localized surface Plasmon resonance
ROS	Reactive oxygen species
FICI	Fractional inhibitory concentration index
SPR	Surface Plasmon resonance

## Abstract

The objective of the present study was to prepare, characterize silver nanoparticles /antibiotics complexes and examine their antibacterial activities. Silver nanoparticles were prepared using chemical reduction method (sodium citrate) and characterized by UV/Vis, FTIR and TEM. The results have shown the characteristic UV absorption at 415 nm. Furthermore, TEM analysis demonstrated the presence of spherical, rod and hexagonal of silver nanoparticles.

The infrared spectrum of Clotrimazole exhibited a characteristic peak of C= N at  $1594\text{ cm}^{-1}$ , which showed significant shifts to  $1585\text{ cm}^{-1}$  in the infrared spectra of the Clotrimazole+AgNPs complexes, which confirmed the participation of the C= N group in the complexation process

The infrared spectrum of Tinidazole exhibited a characteristic peak of C=N at  $1760\text{ cm}^{-1}$ , which showed significant shifts to  $1621\text{ cm}^{-1}$  in the infrared spectra of the Tinidazole+Ag NPs complexes, which confirmed the participation of the C= N group in the complexation process.

A comparison of the relevant IR spectral bands of clotrimazole and tindiazole with the silver nanoparticle indicated shifts in the frequencies as well as reductions in the band intensities, which proved the formation of charge transfer complexes. These shifts were due to changes in the electronic structures and molecular symmetries of reactants upon complex formation.

The Antibacterial activity of Ag nanoparticles alone and in combination with the antibiotics such as clotrimazole and tindiazole against *Staph. aureus* , *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa*, showed a significant increase in antibacterial activity of antibiotics in the presence of

silver nanoparticles, a high synergistic activity of nanoparticles with clotrimazole against *Staph. Aureus* was observed.

## المستخلص:

الهدف من هذه الدراسة تحضير معقدات الفضة النانوية مع المضاد الحيوي ثم اختبار فعاليتها تجاه البكتريا. تم تحضير الفضة النانوية بطريقة الاختزال الكيميائي في وجود سترات الصوديوم ، وبعد تعريض العينة الي جهاز مطيافية الاشعة البنفسجية دلت النتائج علي تكون جسيمات الفضة النانوية حيث كانت اعلي قمة 415 نانوميتر

وعند تحليل العينة في جهاز المجهر الالكتروني النافذ لمعرفة شكل الجسيمات وحجمها وجد ان حجم الجسيمات في شكل قضيب و سداسي مضلع.

مطيافية الاشعة الحمراء لمركب الكلوتريمازول اظهر وجود امتصاصية للرابطة  $C=N$  عند الطول الموجي 1594 سم<sup>-1</sup> ووجود ازاحة واضحة لنفس الرابطة عند 1585 سم لمعقد الكلوترومازول مع الفضة النانوية مما يدل علي تكون المعقد عند هذه الرابطة.

مطيافية الاشعة الحمراء لمركب التينديزول اظهر ايضا امتصاصية للرابطة  $C=N$  عند 1760 سم<sup>-1</sup> ووجود ازاحة واضحة لنفس الرابطة عند الطول الموجي 1621 سم<sup>-1</sup> لمعقد التنديزول مع الفضة النانوية مما يدل علي تكون المعقد عند هذه الرابطة.

تم اختبار نشاط البكتريا تجاه محلول الفضة النانوية ووجد ان لها نشاط ملحوظ تجاه اربع انواع من البكتريا وهي *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas (aeruginosa)*

تم اضافة نوعين من المضاد الحيوي (كلوتريمازول ، تيندازول) الي عينة الفضة النانوية لزيادة فعالية المضاد الحيوي تجاه البكتريا ووجدت زيادة ملحوظه في فعالية المضاد تجاه البكتريا.

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