

# Green synthesis of silver Nano particles by using (Rheum) extract and its anti-bacterial activity

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## ARTICLE INFO

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Silver Nano particles (Ag NPs) ,  
Surface Plasmon Resonance (SPR),  
stability.

## ABSTRACT

Silver nano particles have wide potentials in the medicine and other fields. There are many approaches used to synthesis Ag NPs: Chemical, physical and green approach. Green approach favored over other methods, because it is simple, ecofriendly, cheap. In this work we synthesized Ag NPs using stem of Rheum. This plant used by humans as dietary material ,and found in the hills .Added silver nitrate solution to Rheum extract gradually, appear yellow color solution indicated on formation Ag NPs as a result of Surface Plasmon Resonance. Ag NPs was characterized by using different techniques , uv-visible spectroscopy, x-ray diffraction, atomic force microscopy, scanning electron microscopy and Zeta potential which provide that Ag NPs was stable without addition stabilizing agent .Ag NPs used in medical field as active anti-bacterial against three pathogens bacteria, Staph-aureus G+,proteus G+,E-coli G-.

## Introduction

**Nano technology** is the technique which deals with materials have size ranged between 1-100 nm .It is interred to the different fields in the science by producing new materials in medicine and industry. The materials at nano scale have new properties if compared with bulk materials Silver nano particles (Ag NPs) is one of important nano materials ,its have many fine properties ,and use it in various fields in medicine and industrial products<sup>1</sup> .Many methods fabricated to synthesis Ag NPs and other nano particles as physical<sup>1</sup> ,chemical and green method<sup>1</sup> .Other methods involved using microwave<sup>1</sup> and gamma ray<sup>1</sup>.Green synthesis favored over other methods because it is simple ,clean,

cheap, safe while chemical and physical methods almost involve using harsh chemicals or cost physical techniques .Silver nano particles(Ag NPs ) have different use in he medicine as anti-bacterial ,anti-fungal ,anti-viral ,ant-cancer .Other use in medical field as coating in surgery devises .Also its used in the industry.

Preparation of Rheum extract. 200 gm from Rheum were collected from different hills in Sulaimania and washed with distilled water. The stem of plants are dried in hot air oven at 40 Co for 1 hour, then cut to small parts. 10 gm from resulting Rheum was boiled with 50 mL of distilled water between 80-90 C° for 10 minutes (properly stirring during heating). Then the resulting solution was filtered to get a Rheum extract.

## Synthesis of silver nanoparticles

50 mL of the aqueous solution of 0.001 M silver nitrate was mixed with 50 mL of filtered Rheum extract solution .The nanoparticles were formed within the

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addition of silver nitrate with heating at 25 C° for 30 minutes at a dark place. Yellow color appearing is an indicator for formation Ag NPs. The resulting product characterized by various techniques as UV-Vis spectrophotometry, Scanning Electron Microscope (SEM), X-ray diffraction (XRD), Atomic Force Microscopy (AFM), and Zeta potential and applied as anti-bacterial against three pathogen's bacteria.

**Results and discussion**

It contain various active chemicals as phenolic acid, poly phenols, carboxylic acids, and tannins. Selected the Rheum extract to be reducing agent and stabilizing agent .Added silver nitrate solution gradually to Rheum extract at 35 Co .Appear color solution was firs indicator on formation Ag NPs .The reaction was very slowly in acidic medium as well as Ag NPs un stable in the same medium, occurred agglomeration in Ag NPs after 15 days as shown in figure 1.

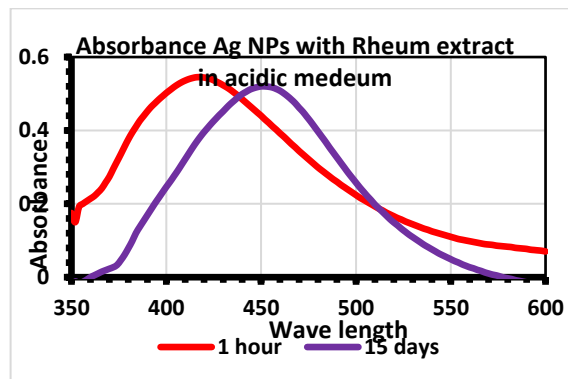


Figure 2. Change in color and absorbance Ag NPs in acidic medium.

Yellow color result by (SPR) surface Plasmon resonance which depend on oscillation of electron about surface of silver nano particles .Characterized Ag NPs using uv-visible spectroscopy ,and obtain on max wave length at 422 nm .Ag NPs was stable more than 3 months ,didn't change in ax wave length with the time .

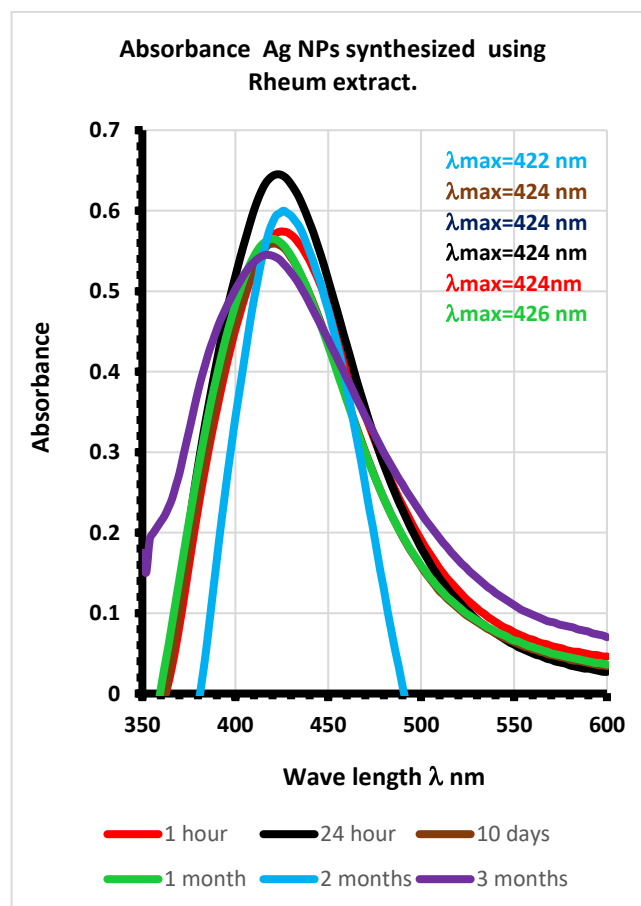


Figure 3. Absorbance Ag NPs with Rheum extract.

X-ray diffraction “model: Pp analytical empyrean) with cu  $\alpha$  radiation ( $\lambda$ ) of 0.154 nm at the department of Physics, Koya University” provide formation Ag NPs crystals, by presence diffraction at 38.6 o corresponding with 110, which have shape face center cubic. Appear weak peaks at 44o, 54, 65, indicated on formation Ag NPs protected by polymer layer so that d spacing value was high (8.55 Å). Appear broad peak at 25 o indicated on presence polymers. The size particles calculated using Debye Scheres which give average arranged between (7-22) nm.

$2\theta$	FWHM	$\beta = \pi / 180 * \text{FWHM}$	$\text{Cos } \theta$	$D = K \lambda / \beta \cdot \text{Cos } \theta$
10	0.05	0.0008	0.997	17.4nm
25	0.055	0.0009	0.976	15.8nm
38	0.06	0.001	0.944	15.3nm
44	0.052	0.009	0.925	7.2 nm
54	0.11	0.0019	0.888	8.6 nm
65	0.14	0.0024	0.842	8.6 nm

:Average of size crystals =12 nm

$2_{-}$ Value	Plane	Element	Phase
38	111	Ag	Cubic
44	200	Ag	Cubic
54	220	Ag	Cubic
65	311	Ag	Hexagonal

Atomic Force Microscope measured in instrument “Phywe ,England” ,it was necessary to study topography of surface Ag NPs using AFM. The measurement provide that Ag NPs have spherical shapes and its size around 1-90 nm, and average of size particles equaled 20 nm .

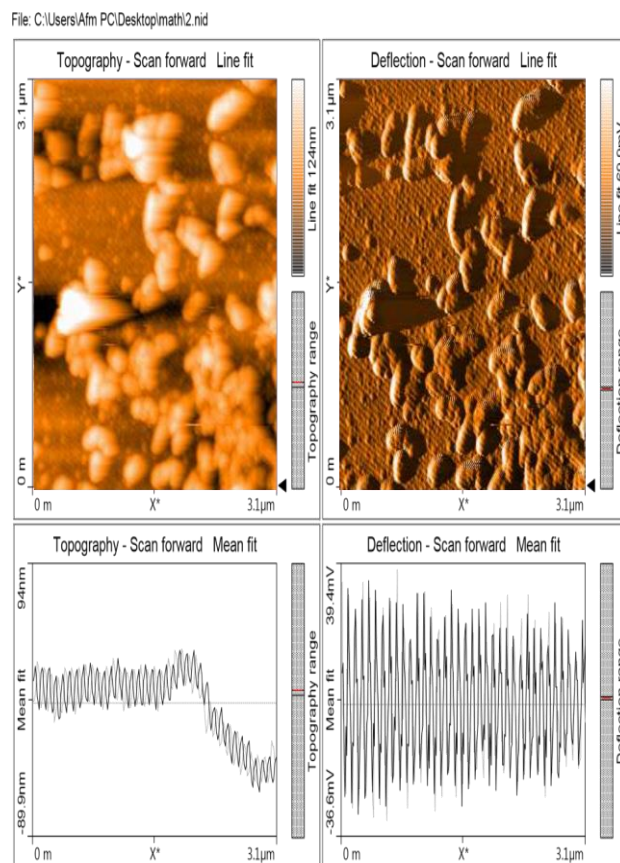
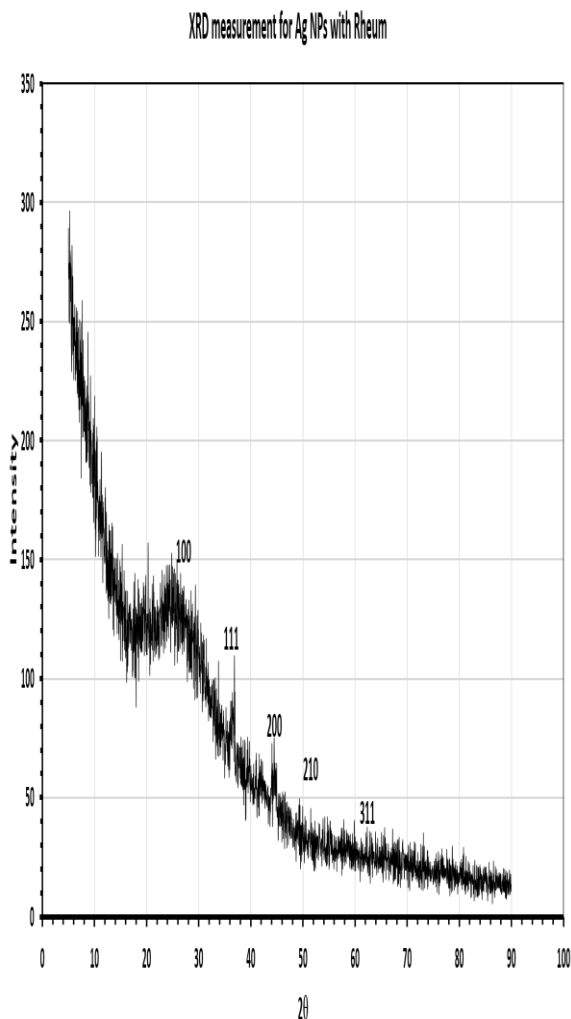


Figure 4. XRD measurement for Ag NPs with Rheum extract.

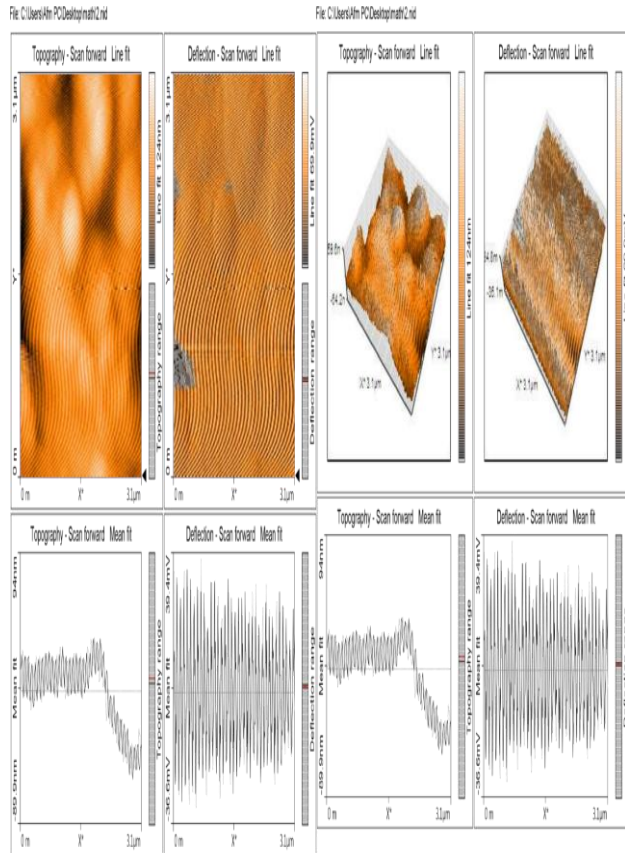


Figure 5. AFM images for Ag NPs with Rheum extract.

Study of the surface morphology of the Ag NPs synthesized using Rheum extract was reported by “Scanning Electron Microscope (SEM)”. The sample was coated by gold to increase conductivity of Ag NPs and obtain on clear image. The measurement show that Ag NPs have spherical shapes and its size 10-30 nm.

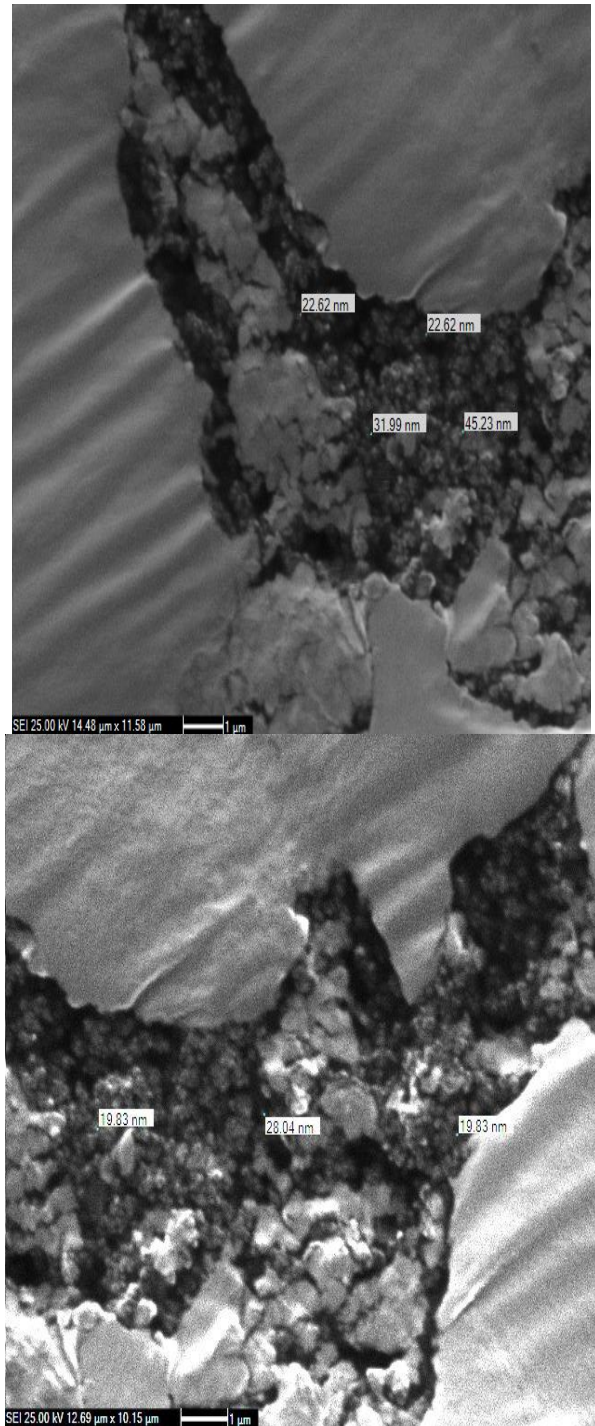


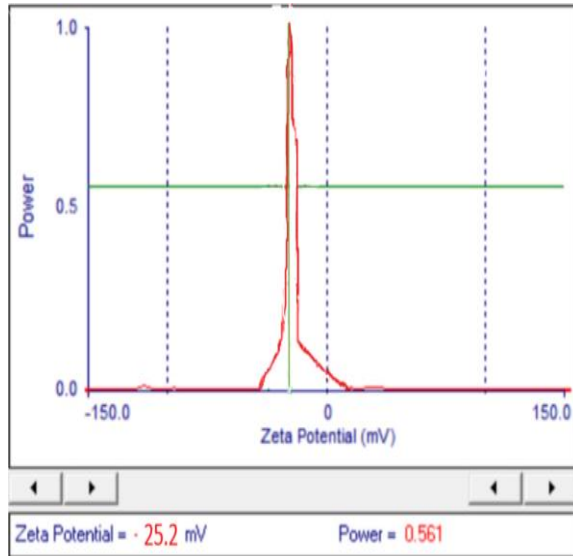
Figure 6. SEM images for Ag NPs with Rheum extract.

### Stability of Ag NPs by Zeta potential :

Stability of Ag NPs depend on repulsion between particles and velocity of particles. Value of zeta potential show that Ag NPs was stable and didn't undergo to the agglomeration because it has

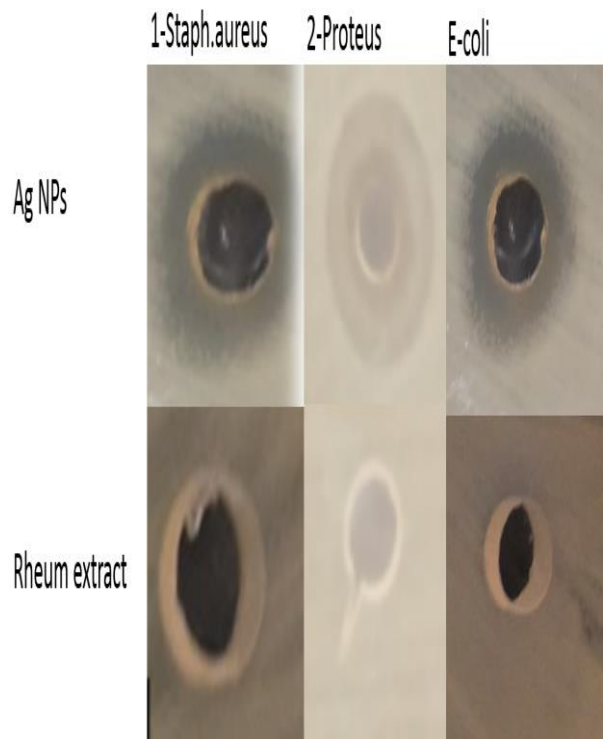
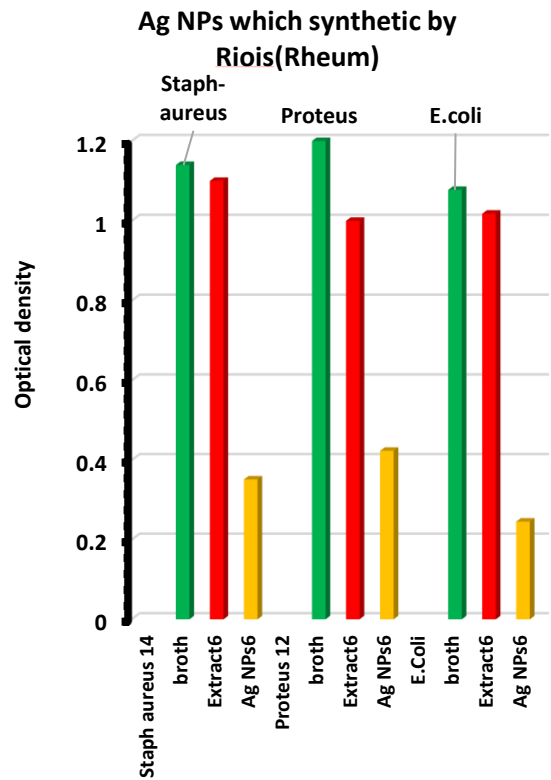


negative value equaled to 25, this measurement after 3 months of preparation Ag NPs as shown in figure(7) .



**Figure 7.Zeta potential for Ag NPs with Rheum extract.**

Figure 8: Growth inhibition assay of clinical isolate of Staphylococcus aureus , proteus and E-coli by synthesized AgNPs using Rheum extracts .. The pathogenic bacterial isolate was grown in nutrient broth for 24 h. The optical density (600nm) was fixed to be 0.4 ,and loop ful was swabbed on Mueller-Hinton agar plates. Wells were made using gel puncture and each well was loaded with 100  $\mu$ L of test sample. The plates were incubated at 37  $^{\circ}$ C for 24 h. The zone of inhibition was then measured .The control plates wells contained 100  $\mu$ L of Rheum extract only; whereas the other contain Ag NPs solutions.Rheum extract didn't form zone and inhibition while Ag NPs was form zone ranged between 14-20 mml,and inhibited growth of bacteria.



**Figure 8.Anti-bacterial activity for Ag NPs with Rheum extract.**

## Conclusions:

Green method is favored over other methods in synthesis silver nano particles, the reaction was rapid and occurred at room temperature. The prepared Ag NPs was stable more than 3 months without using other stabilizing agent because the Rheum contain large amount of poly phenols. All measurements show that product of reaction was Ag NPs, especially UV-Visible spectrophotometry and X-ray diffraction. Prepared Ag NPs by Rheum extract was active anti-bacterial against three pathogens bacteria.

## Acknowledgements

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## تحضير جسيمات الفضة النانوية بالطريقة الخضراء باستخدام مستخلص نبات الريواز

### ودراسة فعاليتها كمضاد بكتيري

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#### الخلاصة

جسيمات الفضة النانوية تمتلك مدى واسع من التطبيقات في مجال الطب. هناك عدة طرق معتمدة لتحضير هذه الجسيمات منها الطريقة الكيميائية، والطريقة الفيزيائية والطريقة الخضراء. الطريقة الخضراء مفضلة على باقي الطرق الأخرى لأنها طريقة بسيطة ورخيصة وصديقة للبيئة. في هذا البحث حضرت جسيمات الفضة النانوية باستخدام مستخلص نبات الريواز. هذا النبات يستخدم كغذاء في بعض الناطق وخصوصا المناطق الجبلية. أضيفت نترات الفضة بشكل تدريجي الى مستخلص نبات الريواز وظهور اللون الأصفر كان دليل على تكون جسيمات الفضة النانوية بسبب ظاهرة البلازمون التي تحدث على سطح جسيمات الفضة النانوية. شخّصت الجسيمات المتكونة بعدة طرق منها الطيف المرئي وانحراف الأشعة السينية والمجهر الإلكتروني الماسح ومجهر القوة الذرية. استقرارية الجسيمات تم قياسها بواسطة مقياس جهد زيتا الذي أثبت ان الجسيمات كانت مستقرة بدون إضافة عامل استقرار لها. الجسيمات المحضرة كانت لها فعالية عالية كمضاد بكتيري ضد ثلاث أنواع من البكتريا المرضية وهي الايكولاي، البروتيويس والسثاف ايريويس.