*Sys Rev Pharm 2020; 11(2): 462 – 465*
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453

# Green Synthesis of Gold Nanoparticles using Pineapple Extract and Study their Analytical Characterization and Antibacterial Activity

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*Article History:* *Submitted: 25.11.2019* *Revised: 18.01.2020* *Accepted: 20.02.2020*

## ABSTRACT
Many methods were used to synthesize nanomaterials but, in this study, we used a simple and ecofriendly method for preparation of gold nanoparticles (AuNPs) called the green method. This method was rapid and cheap. Some factors were affected on the preparation of AnNPs such as the temperature and the concentration of Au ions. the color of the solution was ruby red because of formation AuNPs, and gave absorption peaks between 520-540 nm. TEM images contributed by studying morphology of AuNPs. The shape was almost spherical and its size ranged between 20-70 nm. Stability of Au NPs was investigated by measuring the absorption spectra of the gold colloidal sol prepared at various times. This work involved study of amikacin, Trimetho, Doxycycline and Gentamicin against *E. coli* bacterium. We noticed increasing in inhibition zones area from 11341.6 $mm^2$ to 2207.2 $mm^2$, 616 mm to 1964.4$mm^2$, respectively when we used synergistic effect of Au NPs with antibiotics..

**Keywords**: Green synthesis, synergistic effect, pineapple extract, UV-Visible spectrum, antibiotic.

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**DOI:** 10.5530/srp.2020.2.70



## INTRODUCTION
Nanoparticles are being known that particles have two or three dimensions and its size round between 1- 100 nm [(1)]. These particles have many significant features make it the ordinary material in diffident industries such as drugs [(2)] and environmental applications [(3)] and catalysis [(4)]. The surface area for metallic nanoparticles was the first factor which gave its much attention for the researchers [(5)]. There are many properties depending on the shape and surface area for particles as optical and magnetic moment so that metallic nanoparticles morphology was essential difference factor with bulk materials [(6)]. Metallic nanoparticle shaves various colors depending on oscillations of electrons on surface particles which called Plasmon phenomena [(7)] . Gold nanoparticles (AuNPs) have wide range in visible region according to particle size and shape, it has yellow to ruby color colors because Plasmon phenomena [(8)]. Silver nanoparticles (AgNPs) also have maximum wave length at visible region between 400 to 500 nm and it have yellow color, its color change to orange or pink according increase of particle size [(9)]. Recent studies use simple methods synthesis metallic nanoparticles such as gold and silver [(10)]. In addition, UV-Vis spectroscopy has unique properties such as simplicity, speed, sensitivity, ease, and selectivity towards various types of nanoparticles. it does not need a long period time for measurement as well as it is not necessary to be calibrated to determine the characterization of colloidal suspensions particle [(11, 12)]. AuNPs have broad applications in medicine field [(13)] as anticancer [(14)] and anti-microbial [(15)]. Other studies used silver nanoparticles at different applications as anti-bacterial [(16)] and anti-virus [(17)], and spectra). Color of Au NPs was ruby red as shown in figure 1. anti-breast cancer [(18)]. Many researches were succeeding in synthesis gold, silver, and zinc nanoparticles by using multiple methods physical [( 19)], chemical [(20)] and green methods [(21)].

## MATERIAL AND METHOD
### Materials
All chemicals were supplied by MERCK Company-Germany and pineapple was amassed from the local market.

### *Instrument*
Synthesis of gold nanoparticles the use of pineapple extract
10 grams of fresh pineapple fruits were reduce to small pieces then put in in conical flask [500ml] with 240 ml of distilled water. The mixture was heated to 50-60 C0 for 30 minutes then filtered by Watman filter paper. 10 ml from 10mM two HAuCl4.3H2O solution was added to 240 ml of the plant extract with heating and proceed stirring for 15 minutes at 60-70 °C. Change of color solution to ruby red gave the first indicator about formation gold nanoparticles AuNPs.

## RESULTS AND DISCUSSION
### UV–Vis spectral analysis
The UV-Vis spectrum for gold nanoparticles solution shows a peak in the visible region at 530 nm. Theoretically, AuNPs have an absorption peak between 500-550 nm (visible )

Figure 1: Color of synthesized Au NPs.

Appear of this color because phenomena called Surface Plasmon Resonance (SPR) produce because oscillation of electrons on the surface of Au NPs so that shade of synthesized AuNPs depending on shape and size of nanoparticles as shown in figure 2.

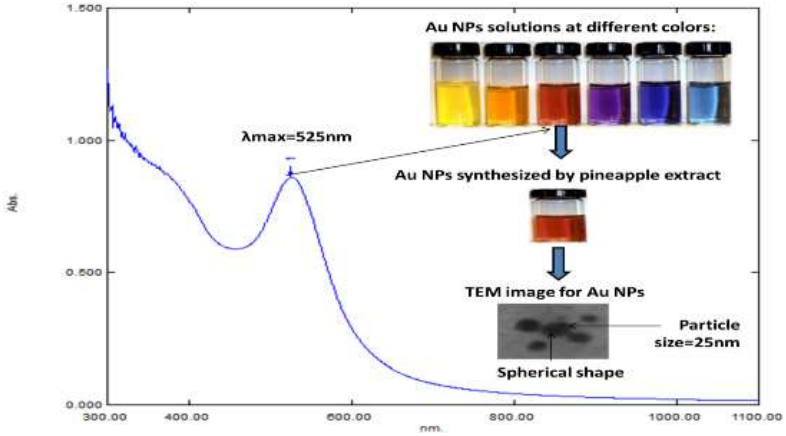


Figure 2: UV-Vis spectrum of synthesized Au NPs TEM (Transmission electron microscopy)

Scanning Electron Microscope analysis (SEM).
SEM photos proved the presence of small particles with diameter ranged between 20 to 60 nm. This study was showing that the structure of Au NPs was almost spherical with heist resolution. Some particles aggregated in the sample so that its size was above 60 nm as shown in figure 3.]

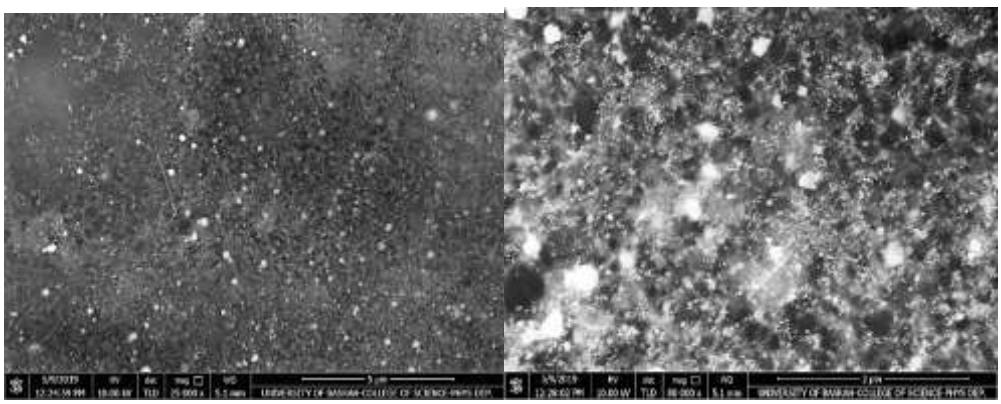

Figure 3:SEM images for synthesized Au NPs.

3.3. Transmission Electron Microscope analysis (TEM)
TEM images showed that organized gold of nanoparticles by using pineapple extract was in the Nanoscale and its size ranged between 20-30 nm as shown in figure 3. The shape of the nanoparticle used to be almost spherical with high resolution. This study was very essential in the study of morphology AuNPs .

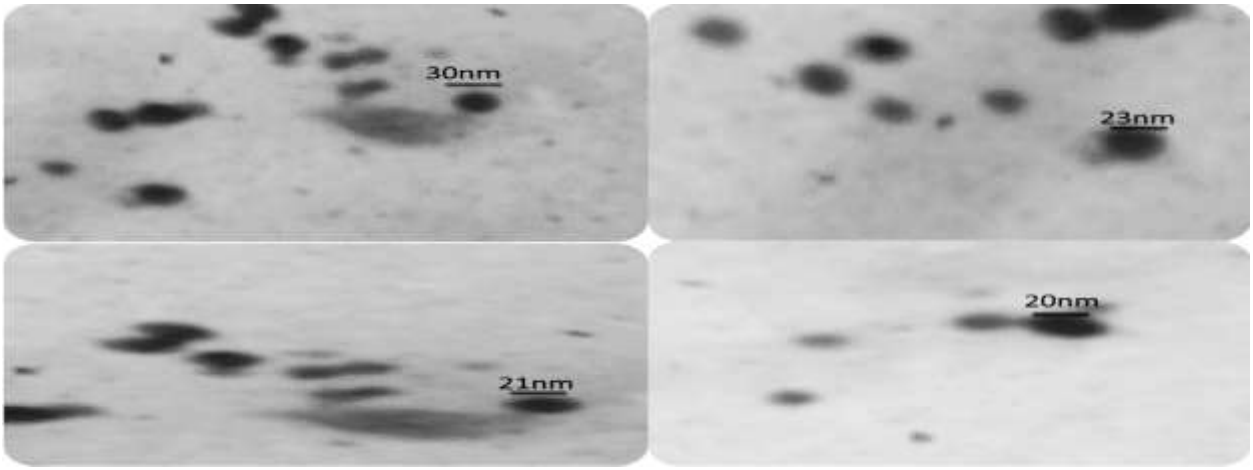


Figure 4- TEM images for synthesized Au NPs.

The combination test between antibiotics and gold nanoparticles

The check has been done by injection of 10 microliters of gold nanoparticles solution into a growth media containing the earlier mentioned antibiotics in addition to bacteria. The cultured media was incubated at 37 °C for 18-24h.

Anti-bacterial activity

Gold nanoparticles have distinct uses in the medical field, in this work, we used synthesized AuNPs as antibacterial by using the simple technique (well diffusion assay). The results showed that Au NPs were lively anti-bacterial against E. coli. Inhibition of growth E. coli by synthesized AuNPs with different sorts of antibiotics. (22.23) .

Table 1- Area of inhibition zones for E. *coli* growth by using some antibiotics with AuNPs.

| Antibiotic | Area of inhibition i($mm^2$) without Au NPs | Area of inhibition ($mm^2$) with Au NPs |
|---|---|---|
| Trimetho | 358.6 | 737,4 |
| Doxycycline | 10 | 717,2 |
| Gentamicin | 804.6 | 1886.6 |
| AMIKACIN | 616 | 1964.4 |
| LEVOFLOXACIN | 1134.6 | 2207.2 |

## CONCLUSION

In this study, we organized AuNPs that were characterized using different techniques; the formation of ruby pink color was the first indicator of synthesis Au NPs because of Plasmon phenomena. TEM images improve that synthesized AuNPs in the nano range (20-30) nm and particle shape was spherical.

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