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Research Article

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# Hydrothermal synthesized Ag nanoparticles using bioreductor of gambier leaf extract (*Uncaria gambier* Roxb)

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**ABSTRACT**

*Synthesis of silver nanoparticle using Gambier leaves (Uncaria gambier Roxb) extract and diethanol amine (DEA) as stabilizer has been done successfully. Synthesis process was prepared by using the hydrothermal method. The results were characterized using UV-Vis, XRD and TEM. UV-Vis analysis showed that DEA as stabilizer has effective to control of stability and production of silver nanoparticle colloid. XRD analysis demonstrated peaks of silver which was suitable with the standard peaks of silver. TEM images conformed that synthesis using this method produced very fine particle with particles size of around 25 nm.*

**Keywords:** silver nanoparticle, bioreductor, hydrothermal, stabilizer

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## INTRODUCTION

Silver nanoparticles (AgNPs) are one of the promising products in the nanotechnology industry because it has been used widely as an anti-bacterial agent, food storage, coatings on textiles, and application environment. Silver nanoparticles can be synthesized in various ways such as by the physics, chemistry, and biology methods. But after the last few years, several methods have been replaced by a biosynthetic chemistry because it can reduce the toxic effects, more economical, and improve quality [1-3] One favorable process to produce of AgNPs is the biosynthesis. The commonly process in biosynthesis is to use the plants as reducing agents.

Extracts of plants which could potentially be used for the synthesis of silver nanoparticles is one of them is plant gambier (Uncaria Gambir Roxb) because gambier contains polyphenols which are expected to reduce Ag (I) into Ag (0). Several studies have been subsequently reported the using of capping agents on the synthesis of AgNPs [4]. To the best of our knowledge, no reports have been published on AgNPs structures formed upon modification with diethanolamine (DEA).

In this study, conducted the optimization of the use of gambier and looking for an effective method on formation of AgNPs. The addition of stabilizer to control and view the crystal stability was also performed. The result of AgNPs was further characterized by UV-Vis, XRD, SEM and TEM.

## EXPERIMENTAL SECTION

**Material and Chemical**

The materials and chemical used in this work were AgNO3 (Batraco), Dietahanolamine, DEA (Merck), distilled water. All the chemicals were analytical grade and used in this experiment without further purification.

**Preparation of Gambir Extract**

Gambier leaves dried without sunlight. Dried gambier crushed by using a grinder. Subsequently, 10 g gambier taken and put in a 250 mL erlenmeyer containing 100 mL of distilled water. The solution was boiled for one hour. The result is filtered and the filtrate is stored in a clean container and can be used as bioreductor.

**Synthesis of Silver Nanoparticles**

Into the 5 mM of AgNO3 solution is added to extract the volume ratio 10: 1. The mixture stirred with variation of time 2-12 hours in order to obtain the optimum time. The synthesis with this method was done variations with and without stabilizer. To view the Ag colloidal stability, DEA was added to solution with variations concentration of 1-3% b/v. To improve the quality of the crystals, hydrothermal process is carried out. The mixture was added to an autoclave and heated in an oven for 5 - 24 hours at a temperature of 180oC. Results centrifuged and the sediment was filtered, dried in an oven.

**Characterization**

UV-Vis spectroscopy (SECOMAM, 51000) is used to observe absorbance of the extract and colloidal nanoparticles. To observe the crystallinity of the results of the synthesis used X-ray Diffraction (XRD) (X-pert Powder PAN Analytical). Characterization with scanning electron microscope (SEM) (Hitachi, S-3400 ) and transmission electron microscope (TEM) (JEOL JEM 1400) were conducted to explore the morphology of the surface of the sample is obtained.

## RESULTS AND DISCUSSION

**Observation of colloidal silver particles**

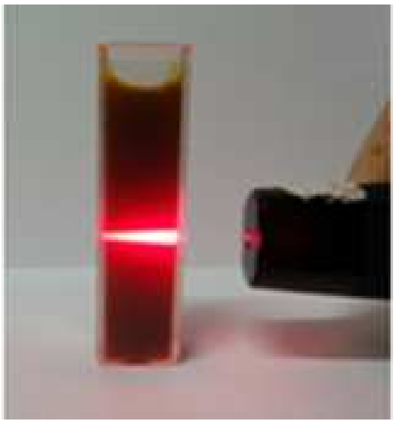

**Figure 1. Colloidal silver nanoparticles**

The process of irradiation with a laser beam is made to observe the colloidal stability by the effect Tyndall effect, electrostatic forces, and motion brown (Fig. 1). Judging from the resulting colloid, visible difference in the intensity of the color and intensity of light produced. For the synthesis without stabilizer, the intensity of the color is not too thick.As for the results of the synthesis of the stabilizer DEA, the intensity of the color is most concentrated. The resulting differences in light intensity due to differences in light scattering by the Tyndall effect due to the influence of a third colloidal which indicates that the more concentrated solution of the color and intensity of light produced by the smaller then the smaller the ability to scatter light. The small light scatter capability indicates that the particle size gets smaller and the resulting increased colloidal stability.

The colloidal stability affected the shift in wavelength. Increasingly shifted to areas bathochromic (long wavelength) indicates the greater ability of the agglomeration of the silver particles so that the deposition speed is also faster [3].

**Analysis of UV-vis spectroscopes**
Surface Plasmon resonance is the collective oscillation of electrons in a solid or liquid stimulated by incident light. The resonance condition is established when the frequency of surface electrons oscillating against the restoring force of positive nuclei. SPR in nanometer-sized structures is called localized surface Plasmon resonance [4].

From the results of the synthesis of the stabilizer DEA, λmax and absorbance values at 24 hours were 411 and 1,940. The measurement results show that the longer the reaction time, the value of λ max will be shifted toward shorter wavelengths (Fig. 2). This is because the DEA acts as a stabilizer and a capping agent that inhibits the growth of silver nanoparticles. Stabilizer will interfere with the growth or nanoparticle nucleation rate because of the polymer chains stabilizer.

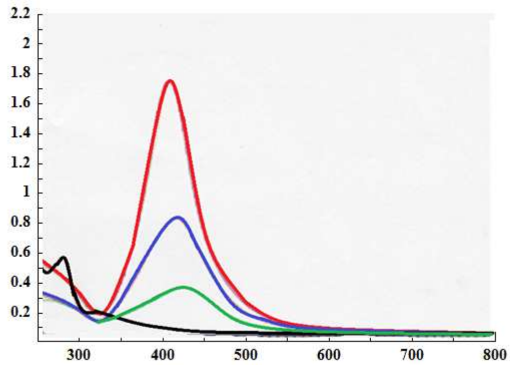


**Figure 3. UV-vis spectra of silver nanoparticles with a stabilizer DEA**

DEA has a tendency to produce hydroxyl ions react with the aldehyde group and form a carboxylic acid that releases an electron in a reaction which will reduce silver ions. Capsulated carboxylic acid form of the newly-formed nanoparticles which stops the growth of the particles and prevent agglomeration [5].

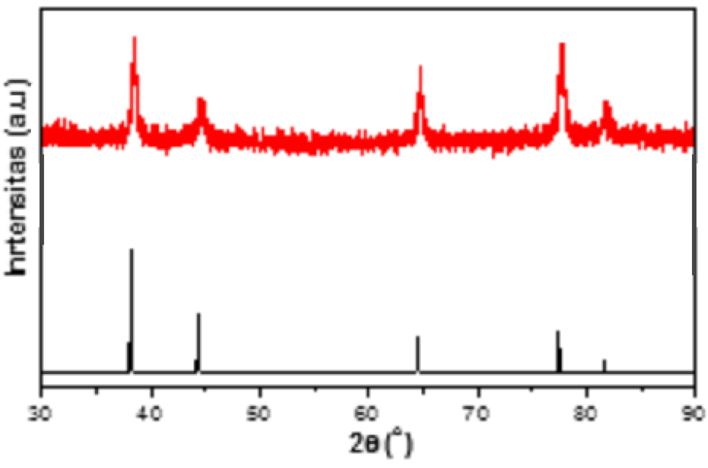


**Figure 4. Representative XRD patterns of synthesized silver nanoparticles (bottom = standard ICCPS)**

**X-Ray Diffraction (XRD)**
XRD analysis was used for determining the mean size of nanocrystallites in nanocrystalline bulk materials [7]. Figure 3 shows XRD analysis of silver nanoparticles with a concentration of 0.01 M $AgNO_3$ using hydrothermal method. XRD analysis shows the five diffraction peak of 38.110 (111); 44.230 (200); 64,450 (220); 77,430 (311); 81,470 (222) and orientation with a face centered cubic structure and which is suitable with ICDD (International

Centre for Diffraction Data 01-087-0718. From the measurement data can be determined crystal size using Scherrer equation, the mean particle size of nanoparticles has shown increment from 25 to 50 nm.

**Analysis of Transmission Electron Microscopy (TEM)**

TEM analysis showed that the particles formed are spherical that has been proven by Roychoudhury and Pal (2014) with an average particle size of 70 nm for silver nanoparticles synthesized without stabilizer [8]. The larger particle size indicated that the particle nucleation rateincreased during the synthesis process because of the lack of influence of stabilizer that will inhibit the rate of growth of the particles. For TEM results with stabilizer DEA, obtained a smaller particle size compared with the synthesis without stabilizer with size 25 nm with an anisotropic shape (Fig. 4). This indicates that the DEA could inhibit the growth rate of the particles and change the shape of silver nanoparticles because of the influence of structure containing amine groups. Amine group helped in chelating metal so it could inhibit the growth of nanoparticles and produced nanoparticles with a smaller size [9].

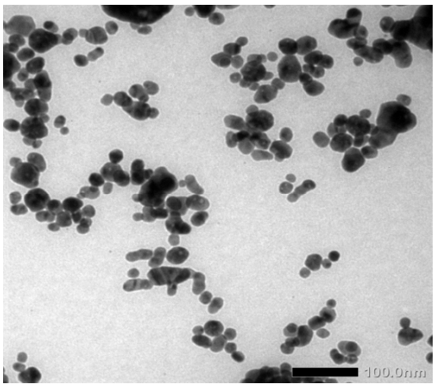


**Figure 4. Analysis of silver nanoparticles using TEM**

## CONCLUSION

Synthesis of silver nanoparticles from gambier leaf extract has been done successfully. UV-vis analysis provides information that the DEA is more effective use of stabilizers to produce silver with a particle size that is smaller than without stabilizer. XRD results showed a pattern of hydrothermal method Ag metal peaks that follow the standard. Crystallinity silver better to use the DEA stabilizer than without stabilizer. TEM results show that the DEA is effective to produce smaller particles with nanoscale with a size of about 25.

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## REFERENCES

[1] Haytham M.M. Ibrahim, *Journal of Radiation Research and Applied Sciences.* **2015**, 8, 265-275

[2] Ajitha B., Divya A., Harish G., Reddy S. *Research Journal of Physical Science.,* **2013**, 1(7), 11-14

[3] Aruna Jyothi Kora, Sashidhar Rao Beedu and Arunachalam Jayaraman, *Organic and Medicinal Chemistry Letters*, **2012**, 2:17, 1-10

[4] Aruna, A., Nandhini,R., Karthikeyan, V., Bose, P., *Asian Journal of Biomedical and Pharmaceutical Sciences*. **2014**, 4(34), 1-6

[5] Muramatsu, A and Mayashita T, Nanohybridizaton of organic-inorganic material, *Springer*, **2009**, 288.

[6] Desai, R., Mankad, V., Gupta, S, K., Jha, P, K., *Nanoscience and Nanotechnology Letters*., **2012**, 4(1), pp 30-34

[7] Monshi, A., Foroughi, M, R., Monshi, M, R., *World Journal of Nano Science and Engineering*, **2012**, 154-160

[8] Roychoudhury, P., Pal, R., *Indian Journal of Applied Research.* **2014**, 4, 69 – 72

[9] Quang, D, V., Chau, N, H. *Journal of Powder Technology*, **2013**, 1-6