SYNTHESIS AND CHARACTERIZATION OF GOLD NANOPARTICLES USING TEAK LEAF EXTRACT *Tectona grandis*

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Abstrak. Ekstrak daun Jati telah berhasil digunakan dalam sintesis nanopartikel emas. Hal ini ditandai dengan terjadinya perubahan warna dari larutan emas yang berwarna kuning menjadi merah anggur setelah penambahan ekstrak daun jati serta panjang gelombang yang dihasilkan berada pada kisaran 500 – 600 nm yang menandakan bahwa nanopartikel emas telah terbentuk. Pertumbuhan dan kestabilan nanopartikel emas yang dihasilkan diamati dengan menggunakan Spektroskopi UV-Vis. Selama pengamatann selama 144 Jam kestabilan nanopartikel emas diperoleh setelah pengukuran 48 jam dengan panjang gelombang sekitar 567,5 -568 nm.

Kata Kunci : Nanopartikel emas, Sintesis, Daun Jati, Spektroskopi UV-Vis

Abstract. Teak leaf extract has been successfully used in the synthesis of gold nanoparticles. It is characterized by a color change of the solution from yellow to red wine after the addition of teak leaf extract to $HAuCl_4$ and the resulting wavelengths in the range of 500-600 nm that indicates that gold nanoparticles have been formed. Growth and stability of the gold nanoparticles produced using UV-Vis Spectroscopy. During observation during 144 hours the stability of gold nanoparticles after 48 hours with a wavelength of about 567.5 -568 nm.

Keywords : Gold Nanoparticles, Synthesis, Teak leaf, Spectroscopy UV-Vis

INTRODUCTION

Nanoparticles are very smooth particles and have sizes in the intervals of 1-100 nm as they have. Such nanoparticles may be metals, metal oxides, semiconductors, polymers, organic compounds, proteins or enzymes. Particularly noble metal nanoparticles have been applied in fields such as optics, electronics, biological sensors and catalysts (Awad, M.A., et al, 2015).

The properties that change in nanoparticles are usually related to physical and chemical phenomena. The first phenomenon is a quantum phenomenon as a result of the limited space of electrons and other carriers in the particle. This phenomenon impacts on some material properties such as transmitted color change, transparency, mechanical strength, electrical conductivity, and magnetization. The second phenomenon is the change in the ratio of the number of atoms that occupy the surface against the total number of atoms. This phenomenon impacts on changes in boiling point, freezing point, and chemical reactivity (Calagua, A., et al., 2015; Mikrajuddin & Khairurrijal, 2009).

The development of science about nanoparticles gave rise to a new method of synthesising nanoparticles by utilizing living things or so-called Green Synthesis nanoparticles. The principle of Green Synthesis of metal nanoparticles is to utilize plants or microorganisms as reducing agents. Microorganisms used such as bacteria, fungi and yeasts.

Shankar, et al (2004) reported that terpenoid and flavanoid in *A. indica* play a role to facilitate the reduction reaction because it has a surface active molecule. Jha, et al (2009), states that the compounds that play a role in the reduction process comprise several secondary plant metabolite compounds such as citronellol terpenoid and geraniol, ketone, aldehyde, amide and carboxylic acid.

Teak leaf (*Tectona grandis*) include plants in the family Verbenaceae that can be used as a natural dye because it contains anthocyanin pigment. Anthocyanins are pigments that can give blue, purple, violet, magenta, red, and orange in plant parts such as fruits, vegetables, flowers, leaves, roots, tubers, legumes, and cereals. Antosianin is a flavonoid compound that has the ability as an antioxidant. These pigments are non-toxic and safe to consume (Kembaren, et al, 2013; Fathinatullabibah, et al, 2014).

MATERIAL AND METHOD

Instruments

The instrument used include analytical scales, UV-Vis Spectrophotometer Shimadzu UV-2600, Magnetic Stirer, drop pipette, volumetric pipette, erlenmeyer, beaker, measuring flask, stirring bar, spray bottle.

Materials

Some of the materials used are teak leaves, aquades, aquabides, Whatmann no. 1, HCl 16 N, HNO_3 12 N, gold metal

Methods

1. Preparation of teak leaf extract

Teak leaf picked then washed to clean with aquades. After that, the leaves are cut into pieces and weighed 10 grams, then boiled with 50 mL of aquabides in 500 mL Erlenmeyer. Next, the stew was left to boil for 5 minutes. After reaching room temperature, boiled water is poured and filtered using Whatman No.1 paper. The water is then be used directly for the biosynthesis process. The water is stored in the refrigerator when not in use.

2. Preparation of $HAuCl_4$ gold solution 1000 ppm

Gold metal as much as 1 gram dissolved with 8 mL of mearegia while heated. The heating is done until gold is completely dissolved and nitric gas, and hydrogen gas has been produced. After the remaining water and HAuCl4 heating solution was stopped and the HAuCl4 solution was diluted in a 1000 mL measuring flask with aquabides. 8 mL of aquaregia was prepared by mixing 6 ml of

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HCl 16 N with 2 mL of HNO_3 12 N (HCl: HNO_3 = 3: 1).

3. Biosynthesis of Gold Nanoparticles

Biosynthesis of gold nanoparticles made by mixing a solution of $HAuCl_4$ and teak leaves boiled water. 10 mL of teak leaf ekstract was mixed into a 100 mL $HAuCl_4$ solution, then stirred for 2 hours. The formation of the gold nanoparticles marked by changing solution from yellow to red wine.

4. Characterization of Gold Nanoparticles with UV-Vis Spectroscopy

The gold nanoparticle solution formed was characterized by UV-Vis spectroscopy after 1 hour, 24 hours, 48 hours, 120 hours and 144 hours to see the stability of gold nanoparticles.

EXPERIMENTAL RESULT

In the biosynthesis of gold nanoparticles, the color change of the solution from yellow to red wine becomes an indicator of the formation of gold nanoparticles. The mixed solution consisting of $HAuCl_4$ solution added with ekstract of teak leaves was change of the color after 30 minutes.

The process of forming gold nanoparticles because of the ability of the compound leaf content of teak is Antosianin to reduce Au^{3+} ions into gold nanoparticles. The content of anthocyanin which is a flavanoid compound in teak leaf extracts allows the formation of gold nanoparticles. This is in accordance with the statement of Shankar et al (2004) which states that terpenoid and flavanoid contents act to facilitate the reduction reaction of nanoparticles because they have surface active molecules.

Characterization by UV-Vis Spectroscopy

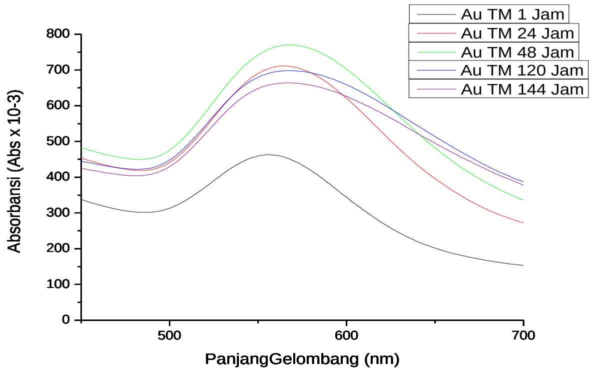

Figure 1. Spectrum of Gold Nanoparticle

Table 1. Wavelength and absorbance at various times

Times (Hours)	Wavelength (nm)	Absorbance
1	556,00	0,463
24	564,50	0,711
48	567,50	0,770
120	567,50	0,698
144	568,00	0,664

Observations at various time variations for 144 hours (Table 1) resulted in different wavelengths during measurements of 1 hour, 24 hours and 48 hours. This indicates that the nanoparticles produced are not very stable during storage. Significant wavelength shifts indicate that a stabilizer is needed in the synthesis of gold nanoparticles to avoid agglomeration and retain the size of the gold nanoparticles. The maximum wavelength indicates the size of the gold nanoparticles, the greater the maximum wavelength the greater the size obtained.

The wavelength becomes stable at 567.5-568.0 nm range after storage for 48 hours. This shows the tendency of the resulting gold nanoparticles to stabilize after 48 hours of storage. It is characterized by the wavelength produced during the storage period of 48 - 144 hours.

CONCLUSION

Research that has been done then it can be concluded that has been successfully synthesized gold nanoparticles using reducing teak leaf extract. The stability of gold nanoparticles was obtained after 48 hours measurement with a wavelength of about 567.5 -568 nm.

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