CHARACTERISTIC GREEN SYNTHESIS OF GOLD NANOPARTICLES USING CENTELLA ASIATICA EXTRACT

Mingle A Pistanty[1)], Okid Parama Astirin[2)], Soerya Dewi Marliyana[3)], Solichatun [4)]

[1)] Cenderawasih University
[2)] Sebelas Maret University

Correspondent author: minglepistanty@gmail.com

ABSTRACT

Synthesis nanoparticles gold (AuNPs) in friendly environment the more interesting attention , especially to its characteristics. Centella asiatica is plant medicine that is rich in flavonoid and triterpenoid content that plays a role as agent reducer and stabilizer experience in the process of synthesis green. Research This aiming For to characterize synthesis green nanoparticles gold (AuNPs) using extract Centella asiatica. Synthesis done with react extract ethanol leaf Centella Asiatica with $HAuCL_4$ solution at temperature space . Characterization is done with use UV-Vis spectroscopy, FTIR, and SEM. The results showed the formation of AuNPs in the form of round with an average diameter of 74-99 nm and a surface plasmon peak at 530-547 nm. FTIR analysis indicates existence involvement group phenolic and carbonyl in the reduction and stabilization process. Activity test antioxidant show improvement significant compared to extract pure. Findings This show that the AuNPs results synthesis use Centella Asiatica potential as material active in product biocosmetics natural, offering effectiveness and safety through approach technology safe, friendly nanoparticles environmental and sustainable.

Keywords : *Characteristic, Gold Nanoparticles, Centella asiatica , AuNPs*

INTRODUCTION

Nanoparticles gold (AuNPs) into attention wide in industry cosmetics because characteristic optics, biocompatibility, and potential therapeutic (1) . Approach synthesis green that utilizes extract plant as agent reducer and stabilizer offer more solutions friendly environmental and sustainable. *Centella asiatica* a plant drug known traditional with the name pegagan, contains compound major bioactives such as triterpenoids, flavonoids, and acids phenolics which have activity antioxidant and anti- aging. Compounds This potential used in AuNPs synthesis green , which can utilized in application cosmetics For maintenance anti- aging and antioxidant skin (2).

Study previously has show that synthesis green and characterization nanoparticles use zinc oxide in extract *Centella Asian* can used for synthesize nanoparticles zinc oxide with controlled size and morphology. Research results From FTIR, the peaks at wavenumbers 650 cm^{-1} and 415 cm^{-1} indicate the stretching of Zn-O. Through X-ray diffractogram, 11 peaks appear for ZnO-NPs, and the most intense peaks (100), (002) and (101) indicate the hexagonal quartzite structure. SEM images show the smallest size range of the obtained ZnO-NPs is about 100 nm to 200 nm with a mixture of rod and spherical shapes. Surface Plasmon Resonance (SPR) of ZnO-NPs is shown at 375 nm (3) .

Novelty scientific from study This is development method synthesis green AuNPs using extract *Centella Asiatica* For known its characteristics. In the development of AuNPs, there have been used in various product biocosmetics like anti- aging creams, facial masks, and deodorants, characteristic antibacterial and anti -inflammatory properties. However, the synthesis of AuNPs is chemical often involves material dangerous, so approach green use extract plant become a better alternative safe and friendly environment. Synthesis of AuNPs conventional lots involving use material chemistry dangerous that can cause impact negative to environment and health human beings. In addition, not yet There is research that examines in a way deep characteristics obtained from AuNPs synthesis using extract *Centella asiatica*. Therefore that is needed research that can develop method environmentally friendly synthesis of AuNPs environment so that able to be applied in the industrial world. The purpose of study This is For develop method synthesis green AuNPs using extract *Centella asiatica* as agent reducers and stabilizers and characterize characteristic physical and chemical properties of the resulting AuNPs.

METHOD

Materials and Reagents

This study used fresh leaves *of Centella asiatica* obtained from Tawangmangu. The leaves were cleaned with running water, then dried at room temperature and ground. The main reagents included $HAuCl_4 \cdot 3H_2O$ solution (≥99%, Sigma-Aldrich), distilled water, and ethanol (4) .

Synthesis of Gold Nanoparticles

$HAuCl_4$ 1 mM solution was prepared as a gold precursor. Ethanol extract of *Centella asiatica* was added gradually into the $HAuCl_4$ solution with a ratio of 1:10, then incubated at 60°C for

25 minutes with constant stirring. Variations in the concentration of green synthesis using pegagan extract were made in stages starting from 1%, 2%, and 3% but with a fixed ratio of 1:10. The color change of the solution from yellow to purplish red indicates the formation of gold nanoparticles (5) .

Characterization of Nanoparticles

Characterization was carried out to identify the morphology, particle size, distribution, and functional groups involved in the synthesis is UV-Vis Spectroscopy: UV-Vis spectrum was recorded between 400–800 nm to confirm the formation of gold nanoparticles based on the Surface Plasmon Resonance (SPR) peak. FTIR (Fourier Transform Infrared Spectroscopy): Used to identify active functional groups in the extract that play a role in the reduction and stabilization of nanoparticles. SEM (Scanning Electron Microscopy): Observing particle morphology and size. Zeta Potential: Measures particle size distribution (6) .

Data Analysis Techniques

The UV-Vis, FTIR, and SEM spectra data were analyzed qualitatively and quantitatively using relevant software such as OriginLab, ImageJ, or the device's built-in software.

RESULT

Visual Indication of Formation Gold Nanoparticles

The results of visual observation show change color solution from yellow young become red purplish after addition extract *Centella Asiatica* to in solution $HAuCl_4$, indicating formation nanoparticles gold (AuNPs). Changes This caused by the excitation of a typical surface plasmon resonance (SPR) nanoparticles gold . Red color purplish is SPR characteristics of AuNPs. This indicates the success of the reduction process of Au^{3+} ions to Au^0 by compounds bioactive in extract plants . Research results this in line with research by (7) which also reported change color similar moment use extract plant as agent reducer .

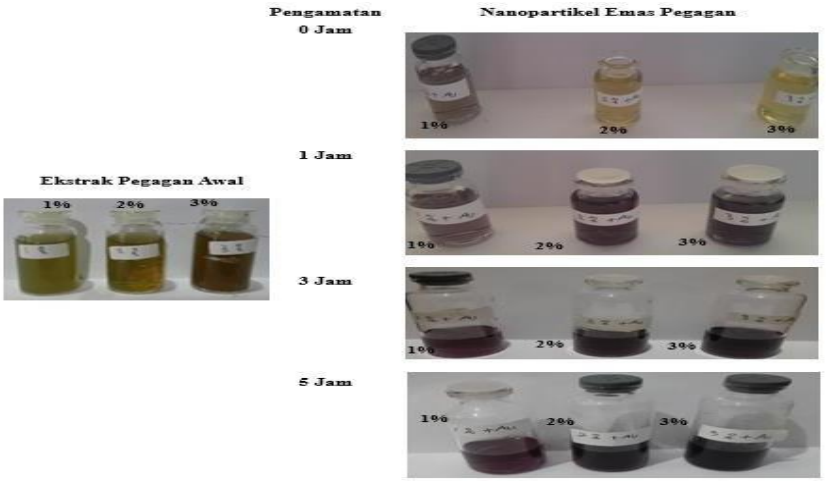


Figure 1Indication of AuNPs Gold Nanoparticles Extract Gotu kola with Concentration 1%, 2%, 3%

UV-Vis Spectrum

Formation nanoparticles gold in research this marked with existence absorption typical peak plasmon resonance at long wavelength 500-600 nm waves and changes color from yellow clear become purple (7) . In the research This obtained long $HAuCl_4$ wave namely 298 nm and after done synthesis happen shift bathochromic to long waves in the range of 536-547 nm which indicates the formation of AuNPs. According to Sigma Aldrich (2022), nanoparticles gold measuring 5-100 nm if analyzed use UV-Vis spectrophotometry has long wave maximum that is range between 515-572 nm. This is supported study (8) which has been succeed synthesize nanoparticles gold use bioreductor fruit noni with results long wave range 502.1 – 582.9 nm.

Table 1UV Vis Spectrum of Gold Nanoparticles Extract Gotu kola with Concentration 1%, 2%, 3%

Sample	Con cent ration	Average 1 hour λ max	1 hour absorbance	3 hours λ max	3 hours absorbance	24 hours λ max	24 hours absorbance	72 hours λ max	72 hours absorbance	120 hours λ max	120 hours Absorbance	168 hours λ max	168 hours absorbance
Gold Nanoparticles Extract Gotu kola	1%	541	0.540	541	0.549	541	0.582	536	0.617	538	0.769	541	0.373
	2%	543	0.723	543	0.720	543	0.678	543	0.434	544	0.702	544	0.571
	3%	547	0.648	546	0.648	547	0.633	544	0.568	542	0.633	540	0.532

The UV-Vis spectrum shows peak absorption maximum in length waves 538– 547 nm, which is characteristics typical SPR from nanoparticles gold . Top position This to signify particle size small and scattered Good in the medium. Displacement peak show influence condition synthesis (pH, temperature, time) incubation, ratio extract: $HAuCl_4$) (9) .

FTIR Analysis

The FTIR spectrum shows existence group function hydroxyl (-OH), carbonyl (C=O), and amine (NH_2) in extract *Centella Asiatica* before and after synthesis. Shift peak to signify involvement clusters this in the reduction and stabilization process of AuNPs. The active groups identified. Flavonoids, triterpenoids, and saponins in extract act as agent reducer and stabilizer. Research by (10) also mentions involvement group hydroxyl in reduction of Au^{3+}.

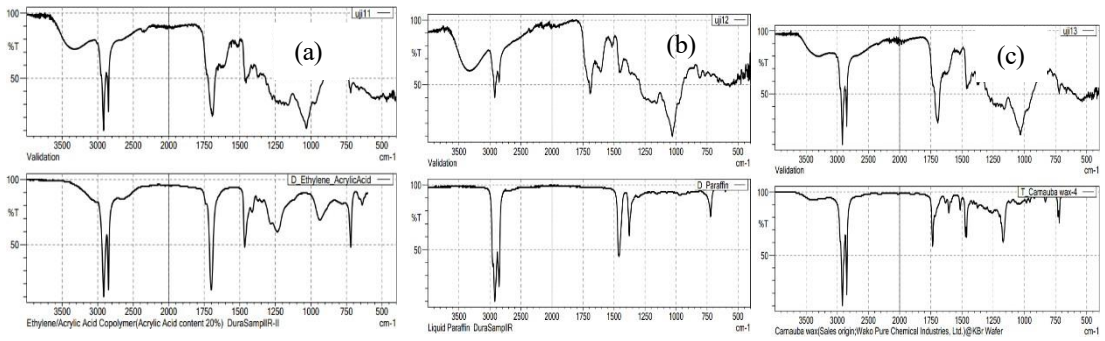


Figure 2FTIR Results of Gold Nanoparticles Extract Gotu kola with Concentration 1% [(a)] , 2% [(b)] , 3% (c)

SEM and Size Particle

SEM image shows that nanoparticles shaped round with average size 70-100 nm. Distribution particle relatively uniform and not show aggregation significant. This indicates effectiveness extract in prevent agglomeration. Content phytochemicals functioning as a guarding capping agent stability particles. Study by (11) take notes size more particles large (10–100 nm).

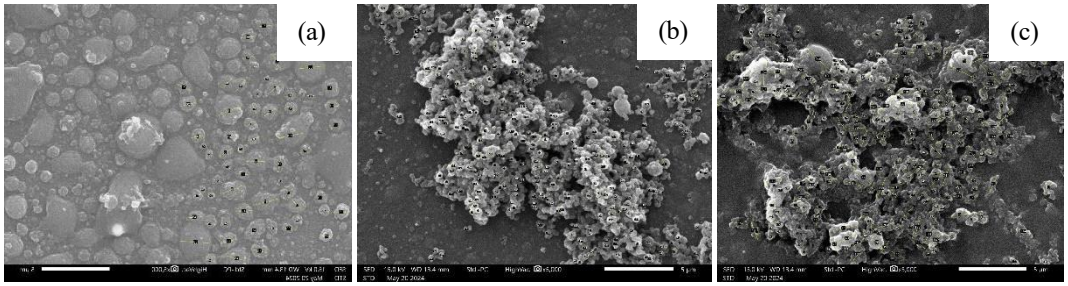
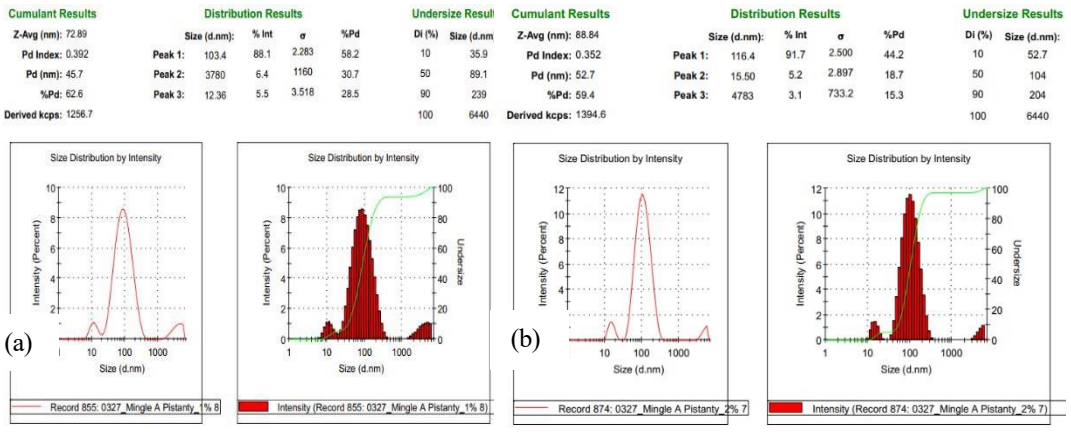


Figure 3SEM Image Results 5000x Magnification Gold Nanoparticles Extract Gotu kola with Concentration 1% [(a)] , 2% [(b)] , 3% [(c)]

Characterization using *Scanning Electron Microscopy* (SEM) aims for know form morphology layer surface. In the study This nanoparticles gold formed in measure using SEM by sampling or no in a way overall. From the SEM results with 5000x magnification visible that grains nanoparticles gold own structure surface with form uniform grains .

Quantitative characterization nanoparticles gold use *Particle Size Analyzer* (PSA) for determine the average diameter size of nanoparticles gold in a way overall . Data obtained in the form of a diagram showing the average diameter size of nanoparticles gold that has been succeed synthesized along with quantity and distribution size nanoparticles gold. Characterization results use *Particle Size Analyzer* can observed in figure 4. Characterization results with using known PSA in a way overall average size of nanoparticle diameter gold that has been succeed synthesized with different concentrations of 1, 2, and 3% range between 74-99 nm. The resulting nanoscale prove that extract gotu kola own potential as agent production in making nanoparticles gold with indicator the change size particle gold from size 2 mm becomes size >100 nm.



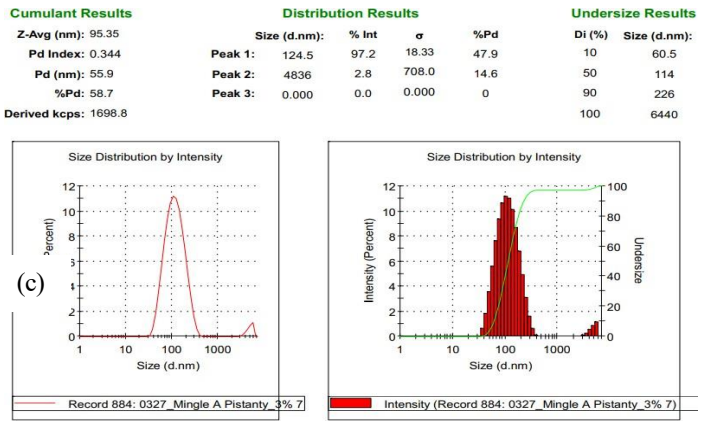


Figure 4Measurement Results using PSA Gold Nanoparticles Extract Gotu kola with Concentration 1% [a] , 2% [b] , 3% [c]

Zeta Potential Analysis

The zeta potential value of 1% concentration is -34.60 mV, 2% concentration is -29.97 mV, 3% concentration is -25.80 mV. The results are show that nanoparticles own stability good colloidal . Load negative originate from group ionic on the surface particles . According to (12) values below ±30 mV indicate system stable to agglomeration .

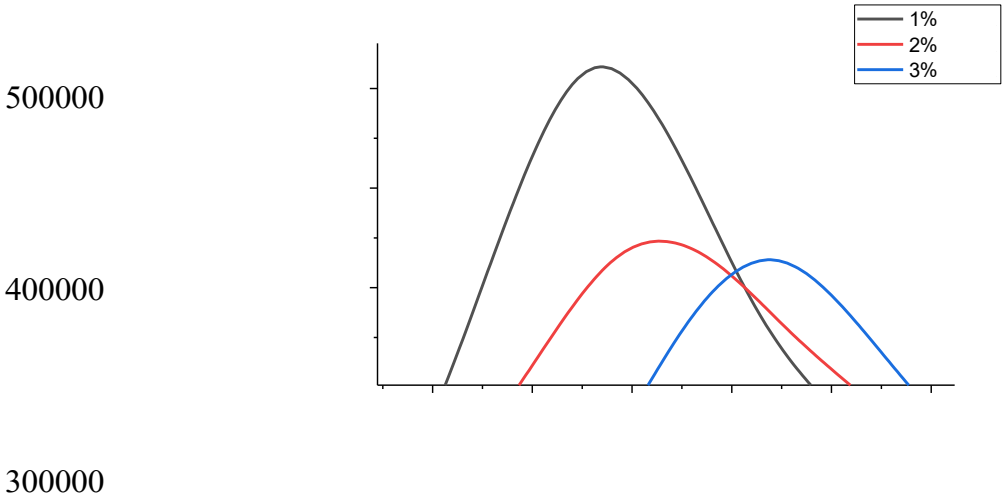


Figure 5Zeta Potential of Gold Nanoparticles Extract Gotu kola with Concentration 1%, 2%, 3%

Study This show that *Centella Asiatica* effective as agent reducer and stabilizer in synthesis nanoparticles friendly gold environmental, efficient, and non- need material chemistry dangerous. This is can contribute to the development green nanomaterial technology For application biocosmetics such as serums, creams, and sun screens, and in the field of biomedical, such as drug delivery, biosensors, and therapies cancer.

CONCLUSION

Study This succeed show that extract *Centella Asiatica* can used as agent effective reducer and stabilizer in synthesis nanoparticles gold (AuNPs) in friendly environment. Synthesis process marked with change color solution and confirmed through analysis UV-Vis spectroscopy with SPR peak at around 536-547 nm. Characterization using FTIR shows involvement group hydroxyl, carbonyl, and amine in the process of gold ion reduction and stabilization nanoparticles. SEM image shows morphology round with size average particle size 74-99 nm. The relative zeta potential value tall show that nanoparticles own stability good colloid without agglomeration.

Research result This give contribution to development method synthesis nanoparticles based on more plants safe and sustainable, especially with utilise potential phytochemicals from *Centella asiatica*. Going forward the results this can developed more carry on for application in biocosmetics product like cosmetics serum, cream , to sun screen. Biomedical industry such as system delivery drugs and agents antimicrobial, as well as improved its efficiency through reaction parameter optimization and integration other nanotechnologies.

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