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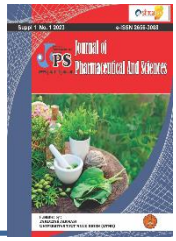

Green synthesis nanosilver using dadap serep (*Erythrina Subumbrans* (Hassk.) Merr) stem extract

Green synthesis nanoperak menggunakan ekstrak batang dadap serep (*Erythrina Subumbrans* (Hassk.) Merr)

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ABSTRACT
Dadap serep stems contain secondary metabolite compounds of flavonoids, saponins, isoflavonoids, alkaloids and lectins which can act as reducing agents in the biosynthesis of nanosilver. This research aims to determine the effect of the concentration of liquid extract of dadap serep stem on the green synthesis silver nanoparticle (AgNPs) process. The aqueous extract of dadap serep stem reacted with one mM $AgNO_3$ in a ratio of volume 1: 1 (FI), 1: 2 (FII), and 2: 1 (FIII). Characterization of AgNPs includes Surface Plasmon resonance (SPR) using UV/Vis spectrophotometer at wavelengths of 300-700 nm, particle size, and zeta potential using a particle size analyzer (PSA). The result showed that the SPR of AgNP values is 429-436 nm. AgNPs FI, II, and III particle sizes were 66.13 nm, 75.76 nm, and 75.96 nm, respectively. The PDI values below 0.5 confirmed that the distribution of nanoparticles was uniform. The most stable nanoparticle is Formula I.

Keywords: *dadap serep, Erythrina Subumbrans (Haks.)Merr, silver nanoparticle.*

ABSTRAK
Batang dadap serep mengandung senyawa metabolit sekunder flavonoid, saponin, isoflavonoid, alkaloid dan lektin yang dapat berperan sebagai reduktor dalam biosintesis nanosilver. Penelitian ini bertujuan untuk mengetahui pengaruh konsentrasi ekstrak cair batang dadap serep terhadap proses green sintesis nanopartikel perak (AgNPs). Ekstrak air batang dadap serep direaksikan dengan 1 mM $AgNO_3$ dengan perbandingan volume 1:1 (FI), 1:2 (FII), dan 2:1 (FIII). Karakterisasi AgNPs meliputi *surface plasmon resonance* (SPR) menggunakan spektrofotometer UV/Vis pada panjang gelombang 300-700 nm, ukuran partikel, dan potensial zeta menggunakan Particle Size Analyzer (PSA). Hasil penelitian menunjukkan nilai SPR AgNPs adalah 429-436 nm, sedangkan ukuran partikel AgNPs FI, II, dan III adalah 66,13 nm, 75,76 nm, dan 75,96 nm. Nilai PDI di bawah 0,5 menunjukkan bahwa distribusi nanopartikel seragam. Nanopartikel paling stabil terdapat pada formula I.

Keywords*: dadap serep, Erythrina Subumbrans (Haks.)Merr, silver nanoparticle.*

INTRODUCTION

The advancement of science and technology has resulted in various nanotechnology investigations that might lead to innovations in materials and manufacturing, health care, and medicine. Silver nanoparticles have emerged as essential nanoparticles in biomedical applications. It generally has antimicrobial, antiviral, antifungal, anti-inflammatory, and anticancer activities (Beyene, Werkneh, Bezabh, & Ambaye, 2017; Blanco et al., 2017; Lara, Garza-Treviño, Ixtepan-Turrent, & Singh, 2011; Lara, Ixtepan-Turrent, Garza-Treviño, & Rodriguez-Padilla, 2010).

Silver nanoparticles may be made in various ways, including chemical, biological, and physical methods. Natural reduction, also known as eco-friendly or green manufacture of silver nanoparticles, refers to using plant extract in the chemical reduction process." This is achieved without the use of harmful chemicals. The biological approach is more accessible and less expensive but has a negligible environmental effect because unreacted synthetic compounds and their disposal are no longer toxic (Beyene et al., 2017; Islam, Jacob, & Antunes, 2021).

The manufacture of nanoparticles using this biosynthetic method involves secondary metabolites such as flavonoids, phenolics, terpenoids, phenols, steroids, glycosides, polysaccharides, saponins, alkaloids, tannins, proteins, and amino acids that can reduce Ag^{+} to Ag^{0} in the form of AgNPs (Siddiqi, Husen, & Rao, 2018). Dadap serep stems contain secondary metabolites of flavonoids, saponins, isoflavonoids, alkaloids, and lectins (Rukachaisirikul et al., 2007).

It is crucial to adopt the green synthesis approach to produce nanosilver through the utilization of Dadap Serep (Erythrina Subumbrans (Hassk.) Merr) stem extract. Numerous studies have showcased the effective green synthesis of silver nanoparticles (AgNPs) by employing plant extracts as reducing agents. For instance, Ahmed et al. (2016) reviewed the application of plant extracts in AgNP synthesis for antimicrobial purposes, emphasizing the potential of Boerhaavia diffusa plant extract as a reducing agent. Ramesh et al. (2015) also reported the green synthesis of AgNPs using plant extracts, highlighting the nanoparticles' antibacterial activity. Moreover, Das et al. (2020) discussed the successful synthesis of AgNPs using the leaf extracts of Erythrina suberosa, a plant related to Dadap Serep. These studies offer valuable insights into the green synthesis of AgNPs with plant extracts, supporting the feasibility of utilizing Dadap Serep stem extract for this purpose.

Furthermore, the investigation of the phytochemical activity of Erythrina subumbrans, as indicated by Tiwari & Singh (2023) and Bero et al. (2009), reveals the presence of bioactive compounds in the plant. This underscores the potential of Dadap Serep stem extract as a viable source for the green synthesis of AgNPs. Additionally, the assessment of the sun protection factor (SPF) value of Dadap Serep by Masyita et al. (2022) further emphasizes its potential bioactivity. The green synthesis of AgNPs using plant extracts, the phytochemical activity of Erythrina subumbrans, and evaluating its SPF value collectively support the green synthesis of nanosilver using Dadap Serep stem extract.

Based on the content of these secondary metabolites, the dadap serep extract has the potential as a reducing agent in the biosynthesis of nanosilver. This study aims to determine the effect of the concentration of liquid extract of dadap serep stem on the green synthesis silver nanoparticle (AgNPs) process.

MATERIAL AND METHOD

Material

The materials used for biosynthesis of AgNPs are Silver nitrate (Merck, Darmstadt, Germany), Dadap serep stem (obtained from the village of Mendalo Indah, Muaro Jambi, Jambi, Indonesia, and has been determined at the Faculty of Science and Technology of the University of Jambi), Aqua demineralization (PT. Bratachem, Indonesia).

Aqueous extract dadap serep stem preparation

Dadap serep stems were collected and washed for the preparation of aqueous extract. The branches were cut and dried in an oven for 24 hours. Thoroughly weighed the dadap serep stem and added aqua demineralization to obtain a 7.5 mg/ml. The mixture was heated to 90^{0}C for 15 minutes. After cooling, the liquid extract was filtered using Whatman No.1 paper and stored at 4°C.

Biosynthesis of Silver Nanoparticles

The concentration of silver nitrate ($AgNO_3$) solution used in the biosynthesis of nanosilver was one mM. Biosynthesis was carried out by mixing the extract of dadap serep stems with an $AgNO_3$ solution. A comparison of the concentration of silver nitrate solution and extracts of dadap serep stem was shown in Table 1.

Table 1. The composition of material for the synthesis of AgNPs.

Formula	Volume (ml)	
	AgNO3 one mM solution	Dadap serep stem liquid extract.
I	7,5	7,5
II	5	10
III	10	5

Characterization of Silver Nanoparticles

UV-VIS Absorption Spectroscopy was a technique to analyze light absorption within the ultraviolet and visible regions of the electromagnetic spectrum. In this instance, a Shimadzu UV-1800 spectrophotometer from Japan was utilized. This spectroscopic method was valuable for measuring light absorption and evaluating the quality of materials. It was used to ascertain the synthesis of silver nanoparticles via spectral analysis. The process involved recording UV-VIS spectra of the produced silver nanoparticles using a spectrometer. The scanning was conducted continuously across the 200 nm to 800 nm wavelength range. Distilled water was employed as a reference substance for calibration and adjustment of the baseline. It enabled the characterization and confirmation of the formation of silver nanoparticles through the distinctive absorption patterns observed within this wavelength range. The Particle Size Analyzer (PSA) (Horiba SZ-100, Japan) was utilized to determine the size, polydispersity index, and zeta potential of the AgNPs.

RESULT AND DISCUSSION

The characteristics of nanosilver were visually shown by changes in the color of the AgNO3 solution from clear to yellowish-brown. The results showed that alteration in formulas I, II, and III indicated the formation of AgNPs (Fig. 1). According to Arvizo et al. (2010), Changes in color to yellowish-brown stated the appearance of AgNPs, which had absorbance values previously reported in the range of 400-450 nm with a single peak. Surface plasmon resonance (SPR) stimulation caused color shifts during AgNP production (Pertiwi, Suwaldi, Setyowati, & Martien, 2019). The SPR values produced on AgNPs were 429-436 nm.

Figure 1. AgNO3 solution one mM (a), AgNPs (b)

The particle size of nanosilver produced from FI, FII, and FIII with extract concentrations of 7.5 mg/ml was 66.13 nm, 75.76 nm, and 75.96 nm (Table 2). The three formulas at each concentration had a particle size value of less than 100 nm with a polydispersity index (PDI) value of the PDI scale ranging from 0 to 1. Near-zero PDI values suggested homogenous dispersion, while values greater than 0.5 indicated substantial heterogeneity (Danaei et al., 2018).

The zeta potential was a measurement of particle repulsion force. Electrostatic repulsion stabilized the colloidal solution, which was rejected. The larger the repulsive force among rejected particles, the closer the particles will be to one another, forming aggregates—nanoparticles below stable nanoparticles with a zeta potential of +/-30 mV (Islam et al., 2021). Stable nanoparticles were found in Formula I based on the result.

CONCLUSION

The research results show that the effect of the concentration of liquid extracts of dadap serep stem in green synthesis AgNPs is that the higher the extract concentration, the SPR value and particle size will be. The best Formula is FI.

Table 2. Value of particle size, PDI, and zeta potential of formulas I, II, and III

Formula	Particle Size (nm)	Polydispersity index	Zeta Potential (mV)
FI	66.13 ± 0.91	0.269 ± 0.03	-54.4 ± 3.38
FII	75.76 ± 3.17	0.330 ± 0.05	-47.37 ± 2.11
FIII	75.96 ± 4.90	0.194 ± 0.16	-27.87 ± 2.85

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REFERENCES

Ahmed, S., Ahmad, M., Swami, B., & Ikram, S. (2016). A review on plant extract mediated synthesis of silver nanoparticles for antimicrobial applications: a green expertise. Journal of Advanced Research, 7(1), 17-28. https://doi.org/10.1016/j.jare.2015.02.007

Arvizo, R. R., Miranda, O. R., Thompson, M. A., Pabelick, C. M., Bhattacharya, R., Robertson, J. D., … Mukherjee, P. (2010). Effect of nanoparticle surface charge at the plasma membrane and beyond. Nano Letters, 10(7), 2543–2548. https://doi.org/10.1021/nl101140t

Bero, J., Frederich, M., & Quetin-Leclercq, J. (2009). Antimalarial compounds isolated from plants used in traditional medicine. Journal of Pharmacy and Pharmacology, 61(11), 1401-1433. https://doi.org/10.1211/jpp.61.11.0001

Beyene, H. D., Werkneh, A. A., Bezabh, H. K., & Ambaye, T. G. (2017). Synthesis paradigm and applications of silver nanoparticles (AgNPs), a review. Sustainable Materials and Technologies, 13, 18–23. https://doi.org/10.1016/j.susmat.2017.08.001

Blanco, J., Lafuente, D., Gómez, M., García, T., Domingo, J. L., & Sánchez, D. J. (2017). Polyvinyl pyrrolidone-coated silver nanoparticles in a human lung cancer cells: Time- and dose-dependent influence over p53 and caspase-3 protein expression and epigenetic effects. Archives of Toxicology, 91(2), 651–666. https://doi.org/10.1007/s00204-016-1773-0

Danaei, M., Dehghankhold, M., Ataei, S., Hasanzadeh Davarani, F., Javanmard, R., Dokhani, A., … Mozafari, M. (2018). Impact of Particle Size and Polydispersity Index on the Clinical Applications of Lipidic Nanocarrier Systems. Pharmaceutics, 10(2), 57. https://doi.org/10.3390/pharmaceutics10020057

Das, P., Majdalawieh, A., Abu-Yousef, I., Narasimhan, S., & Poltronieri, P. (2020). Use a hydroalcoholic extract of moringa oleifera leaves for the green synthesis of bismuth nanoparticles and evaluation of their anti-microbial and antioxidant activities. Materials, 13(4), 876. https://doi.org/10.3390/ma13040876

Islam, M. A., Jacob, M. V., & Antunes, E. (2021). A critical review on silver nanoparticles: From synthesis and applications to its mitigation through low-cost adsorption by biochar. Journal of Environmental Management, 281, 111918. https://doi.org/10.1016/j.jenvman.2020.111918

Lara, H. H., Garza-Treviño, E. N., Ixtepan-Turrent, L., & Singh, D. K. (2011). Silver nanoparticles are broad-spectrum bactericidal and virucidal compounds. Journal of Nanobiotechnology, 9(1), 30. https://doi.org/10.1186/1477-3155-9-30

Lara, H. H., Ixtepan-Turrent, L., Garza-Treviño, E. N., & Rodriguez-Padilla, C. (2010). PVP-coated silver nanoparticles block the transmission of cell-free and cell-associated HIV-1 in human cervical culture. Journal of Nanobiotechnology, 8(1), 15. https://doi.org/10.1186/1477-3155-8-15

Masyita, M., Sayekti, E., & Nurlina, N. (2022). Flavonoid compounds of the catechin from wungu (graptophyllum pictum (l.) griff) leaves and the sun protecting factor value. Jurnal Akademika Kimia, 11(1), 31-38. https://doi.org/10.22487/j24775185.2022.v11.i1.pp31-38

Pertiwi, R. D., Suwaldi, Setyowati, E. P., & Martien, R. (2019). Bio-Nanoparticles: Green Synthesis Of Gold Nanoparticles And Assessment Of Biological Evaluation. International Journal of Applied Pharmaceutics, 133–138. https://doi.org/10.22159/ijap.2019v11i6.34826

Ramesh, P., Kokila, T., & Geetha, D. (2015). Plant mediated green synthesis and antibacterial activity of silver nanoparticles using emblica officinalis fruit extract. Spectrochimica Acta Part a Molecular and Biomolecular Spectroscopy, 142, 339-343. https://doi.org/10.1016/j.saa.2015.01.062

Rukachaisirikul, T., Innok, P., Aroonrerk, N., Boonamnuaylap, W., Limrangsun, S., Boonyon, C., … Suksamrarn, A. (2007). Antibacterial Pterocarpans from Erythrina subumbrans. Journal of Ethnopharmacology, 110(1), 171–175. https://doi.org/10.1016/j.jep.2006.09.022

Siddiqi, K. S., Husen, A., & Rao, R. A. K. (2018). A review on biosynthesis of silver nanoparticles and their biocidal properties. Journal of Nanobiotechnology, 16, 14. https://doi.org/10.1186/s12951-018-0334-5

Tiwari, A. and Singh, M. (2023). Insights into the origin and therapeutic implications of benzopyran and its derivatives. Chemistryselect, 8(20). https://doi.org/10.1002/slct.202300220