OPEN ACCESS International Journal of Applied Biology

ISSN : 2580-2410
eISSN : 2580-2119

Synthesis of Silver Nanoparticles from Padina australis Seaweed Extract as Bioreductor

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Abstract

The synthesis of silver nanoparticles was carried out using silver nitrate solution as a precursor and Padina australis seaweed as a bioreductor. This study aims to obtain silver nanoparticles through the green synthesis method using Padina australis seaweed extract. The process of forming silver nanoparticles was carried out by adding Padina australis seaweed extract to 1mM AgNO3 solution. The nanoparticles were characterized using a UV-Vis spectrophotometer instrument. The results of the UV-Vis spectrum analysis showed that the best nanoparticle synthesis was shown in the 0.5% concentration extract with a duration of 30 minutes with a synthesis temperature of 70°C, with an absorbance peak at a wavelength of 445.00 nm. Based on visual observation, the extract turned reddish brown

Article History
Received December 21, 2021
Accepted June 14, 2022

Keyword
Green synthesis;
silver nanoparticles;
Padina australis;
bioreductor

Introduction

Nanotechnology is an important field in the field of modern research. The development of nanoparticle technology or often called nanotechnology. In general, nanotechnology can be defined as a technology for designing, manufacturing and applying structures/materials with nanometer dimensions. Nanotechnology is not only limited to how to produce nanometer-sized materials or particles, but has a broader understanding including how to manufacture and find out the use of new properties that arise from nanomaterials that have been made (Ariyanta,2014).

Nanoparticles are nano-sized particles around 1-100 nm. Materials with nanoparticle structures generally have different properties from the original structure. These various properties can be modified through controlling particle size, regulating chemical composition, surface modification, and controlling interactions between particles. Currently, various types of nanoparticles have been synthesized, such as gold, silver, iron, zinc, and metal oxide nanoparticles (Prasad, 2013).

The nanoparticle synthesis method is based on three process approaches, namely chemical, physical, and biological (Iravani et al., 2014). However, both these physical and chemical methods use excessive chemicals which can cause environmental pollution. Therefore, an alternative method was developed in the synthesis of nanoparticles or nanomaterials based on the concept of green chemistry, namely the green synthesis method.

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The green nanoparticle synthesis method is a synthesis method that forms metal nanoparticles with the help of natural materials derived from organisms (plants and microorganisms) both land and sea (Asmathunisha & Kathiresan, 2013).

The synthesis of silver nanoparticles was carried out using silver nitrate (AgNO3) solution as a precursor and plants as an alternative bioreductant in synthesizing silver nanoparticles. *Padina australis* contains phenolic compounds and high antioxidant activity This antioxidant content is used as an alternative bioreductant in synthesizing silver nanoparticles. The functional groups of these secondary metabolites work by donating electrons to Ag+ ions to produce Ag nanoparticles (Nursid et al., 2017).

Materials and Methods

The study was carried out in May-September 2021 in the Integrated Laboratory, Department of Biology and Science Building, Faculty of Mathematics and Natural Sciences, Hasanuddin University. The materials used in this study were *Padina australis* seaweed, AgNO3, NaOH, aquabidest, aluminum foil and filter paper.

Seaweed cleaned, dried with aerated. Then the dried seaweed is mashed with a blender until it becomes powder, then sieved using a sieve. Then, the *Padina australis* seaweed extract was made. First of all, *Padina australis* seaweed simplicia powder was weighed 10 grams. Added 80 ml of aquabidest. The addition of aquabidest is done little by little until the powder is completely wetted and submerged. Filter the extract using a funnel using filter paper, the pulp obtained is added with 20 ml of aquabidest then filtered into the same Erlenmeyer, then added aquabidest to 100 ml. The extract was diluted with an equivalent concentration of 0.125%; 0.25% and 0.5%, the results of these dilutions are then referred to as test extracts.

The synthesis of nanoparticles begins with reacting 0.425 grams of AgNO3 powder was dissolved in aquabides to a volume of 250 mL and homogenized to make 1 mM AgNO3 solution. 1 mM AgNO3 solution was pipetted as much as 20 mL for each concentration of seaweed which had been diluted equally (0.125%; 0.25% and 0.5%) and each solution was put into a glass bottle, then 10 mL of grass extract was added sea of *Padina australis* by ratio (1:3).

The test extracts of each concentration were added with AgNO3 with stirring. After obtaining a homogeneous mixture of the test extract and a solution of AgNO3 metal salt, then heated with stirring at the synthesis temperature (70°C) for 30 minutes. The absorbance of this solution was observed every 15 minutes (t0; t15; t30) with a spectrophotometer, to monitor the formation of silver nanoparticles.

Results and Discussion

The synthesis of silver nanoparticles in this study used the green synthesis method. The silver metal precursor used in this study was AgNO3 salt, a bioreductant from *Padina australis* seaweed extract. The synthesis was started by dissolving AgNO3 with *Padina australis* seaweed extract. The treatment being tested is to vary the volume of seaweed extract. The formation of silver nanoparticles can be seen from the results of the UV-Vis spectrum of the solution. Measurements using a UV-Vis spectrophotometer on a solution of seaweed extract were carried out in the absorbance range of wavelength 200 nm - 800 nm. The results of the UV-Vis spectrophotometer indicate that the reduction reaction has taken place and silver nanoparticles have been formed.

Table 1.Measurement of Absorbance of Each Concentration of Silver Nanoparticle Solution of *Padina australis* Seaweed Extract at a temperature of 70°C.

NO.	Treatmen (Concentration	Heating Duration (Minutes 0,15, dan 30)	Absorbance (nm)
1.	0,5%	0 minutes	449,00
2.	0,5%	15 minutes	445,50
3.	0,5%	30 minutes	445,00
4.	0,25%	0 minutes	451,00
5.	0,25%	15 minutes	449,00
6.	0,25%	30 minutes	445,00
7.	0,125 %	0 minutes	449,00
8.	0,125%	15 minutes	445,00
9.	0,125%	30 minutes	445,00

The results of the UV-Vis spectrophotometer listed in Table 1 were 0.5%, 0.25% and 0.125% minutes respectively 0.15.30 synthesis of silver nanoparticles from *Padina australis* seaweed extract resulted that the sample showed the formation of silver nanoparticles characterized by the presence of absorption peak absorbance at a wavelength of 445 nm to 451 nm.

The results showed that the best absorbance values were at concentrations of 0.5% minute, 0.15 and 30. In Table 1 it can be seen that the UV-Vis spectra of silver nanoparticles increased the absorption peak value from 0 minutes to 30 minutes. The increased absorbance indicated that the process of formation of silver nanoparticles increased from 0 minutes to 30 minutes. This also shows that the optimum time for the synthesis of silver nanoparticles is at a synthesis time of 30 minutes with a wavelength of 449.00 nm.

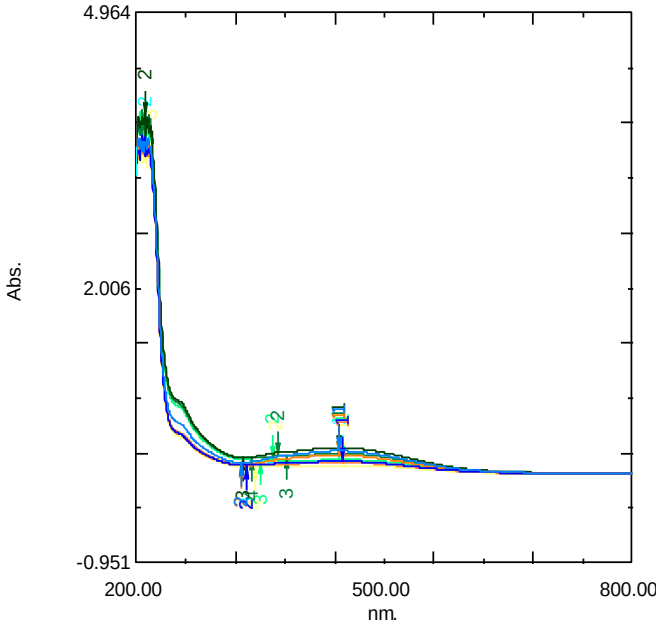

Figure. 1 The absorbance of the solution with increasing time in the synthesis of silver nanoparticles using Padina australis seaweed extract at a temperature of 70°C.

Silver nanoparticles have specific surface plasmon resonance. If a mixture contains silver nanoparticles, absorption will occur at wavelengths between 400-450 nm (Notriawan, 2020). This is in accordance with research conducted by Oktaviani, et al (2015) where the

synthesized samples formed at absorbance wavelengths of 400 nm to 450 nm are silver nanoparticles. The large number of silver nanoparticles can be seen from the absorbance value (Saeb et al., 2014) suggesting that the higher the absorbance, the greater the number of silver nanoparticles.

According to Handaya et al (2010) samples formed at wavelengths of 400 nm to 450 nm are silver nanoparticles (Ag0). While the sample formed at a wavelength of 370 nm to 400 nm is a silver ion (Ag+). After the synthesis process, the formation of Ag+ means that not all Ag+ has been reduced to Ag0 so that the maximum wavelength of the synthesized colloid is still less than 400 nm.

After 30 minutes, 0.2 M NaOH was added dropwise and observed for a color change. The formation of silver nanoparticles is not only seen from the results of the UV-Vis spectrum. Other parameters can also confirm the formation of silver nanoparticles can be seen by changing the color of the solution.

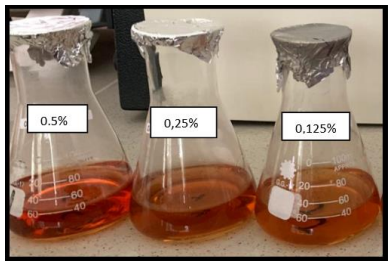

Figure 2. Concentrations of 0.5%, 0.25%, and 0.125% minute 0.

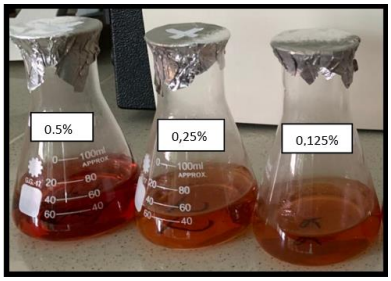

Figure 3. Concentrations of 0.5%, 0.25%, and 0.125% minutes 15.

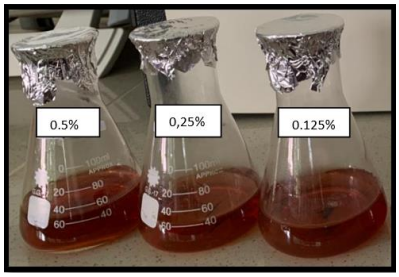

Figure 12. Concentrations of 0.5%, 0.25%, and 0.125% 30 minutes.

Based on visual observations of the results of this study in Figures 7,8 and 9, the solution of AgNO3 and *Padina australis* seaweed extract produced has formed silver nanoparticles with a change in the color of the solution with the addition of 0.2 M NaOH and over time, heating from light yellow to reddish brown.

This is in accordance with research conducted by Haryani et., al (2016) which states that one indicator of the formation of silver nanoparticles in this solution is characterized by a change in color from yellowish to reddish brown with increasing time.

The occurrence of changes in colloid color in the formation of silver nanoparticles is caused by the oxidation-reduction process. The color change of the solution in the synthesis of silver nanoparticles occurs due to surface plasmon resonance and reduction of silver ions (Erjaee et al., 2017).

Conclusion

Based on the results of this study, it can be concluded that the seaweed extract of Padina australis is able to act as a bioreductant in the process of synthesizing silver nanoparticles. The effect of the concentration of silver nanoparticles in Padina australis seaweed extract obtained, the greater the concentration of silver nanoparticles in *Padina australis* seaweed extract, the greater the absorbance value.

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