



Green Synthesis of Silver Nanoparticle from Photograph Wastewater Using *Hylocereus Undatus* Skin Extract

IS FATIMAH* and ARSY FARIDHATUNNISA

Chemistry Department, Universitas Islam Indonesia, Kampus Terpadu UII, Jl. Kaliurang Km 14, Sleman, Yogyakarta, 55581, Indonesia.

*Corresponding author E-mail: isfatimah@uii.ac.id

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ABSTRACT

Green synthesis of nanoparticle utilizing plant extract is developing technique recently. A relative cheap and non-hazardous substance is an advantageous for this. Regarding to the potency of dragon fruit (*Hylocereus undatus*), this research employed the extract of dragon fruit waste (skin) and also photography waste as sources for synthesis. Effect of preparation method was studied by varying reflux and microwave irradiation method. Bioreductor of *Hylocereus undatus* was prepared by maceration of dried *Hylocereus undatus* skin. The extract was mixed with photograph wastewater followed by reflux and aging method separately. The nanoparticle formation was measured by using UV-Vis spectrophotometry and particle size analyzer. The nanoparticle solution was tested for antibacterial activity antioxidant activity by DPPH method. The result indicates that the extract of *Hylocereus undatus* is potential to be used as bioreductor in silver nanoparticle synthesis. The nanoparticles are found to have particle size in between 20-100nm. Nanoparticles are active antioxidant. The antioxidant activity of derived nanoparticles is influenced by method in that by reflux method the antioxidant activity is at around 88% while by 00% while by aging method the activity is 81.78%. Both values are higher compared to synthesis by using silver standard solution with the same methods.

Keywords: *Hylocereus undatus*, nanoparticle synthesis, bioreductor

INTRODUCTION

Nanotechnology is one of recent technology that has many advantages. The application of Nanotechnology is not only for delivering some drugs in pharmacy's field, but also can be used for industry and daily life. By the size <100 nm, the possibility of interacting particles to form a conjugate in molecular and cellular level will increase¹.

Within the nanotechnology scheme, synthesis of metal nanoparticles is usually obtained by chemical and physical approaches, one of these is by using plant extract as green reductor. Besides inexpensive, it is also considered friendly-environment and the use of plant extract has economically advantageous due to its availability². Many reports present the potency of some plants extract containing flavonoid,

flavon, polyphenol, natural dyes and some organic functional group for silver nanoparticle (Ag NPs) production^{1,3}.

Red dragon fruit (DF) has known as fruit with antitumor, antioxidant, and anti-inflammatory activity. Red dragon fruit contains β -amyrin 23.39%; γ -sitosterol 19.32%; octadecane 9.25%; heptacosane 5.25%; campesterol 5.27%; nonacosane 5.02%; trichloroacetic acid, hexadexyl ester 5.21% and dominated extract was determined as triterpenoids 23.39% and steroids 19.32%⁴⁻⁶. Red dragon is easily to grow but there is no information for skin utilization. From the characteristic and contents of red dragon fruit consist of polyphenol and reduction potential, it can be predicted that the content of its skin is also potential for reduction in the metal nanoparticles synthesis.

In other side, photography wastewater is one of potential chemical waste from industrial activities containing silver metal waste. In fact that the content of photography waste is silver in major, the trial on utilization of photography waste as source for synthesis of Ag NPs is interesting topic. By combining the potency of red dragon fruit skin extract and photography waste, purpose of this research is to study is the potency of Ag metal content in photography waste water and extract of red dragon fruit extract in synthesis of Ag NPs. Evaluation of NPs formation was performed by UV-Visible spectrophotometric analysis, particle size analysis and antioxidant activity test by using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method.

MATERIALS AND METHOD

Materials

Silver nitrat, DPPH, methanol, and ethanol were purchased from Merck-Millipore (Germany). Red dragon fruit was obtained from Sleman District, Yogyakarta, Indonesia. Photography wastewater was obtained from Clinical laboratory in Sleman District, Yogyakarta, Indonesia. From analysis by using atomic absorption spectroscopy (AAS) Perkin Elmer, it is found that the concentration of Ag in water is 2×10^{-4} M.

Preparation of plant extract

Deagon fruit (DF) skin was washed by water before drying at 60 °C for 24 hours. 3.5 g skin of

dried DF skin was macerated in ethanol: water (1:1) solvent over shaking for 15 minutes. The red solution was then filtered off from the mixture and furthermore called as dragon fruit extract (DFE).

Biosynthesis of Ag NPs

Biosynthesis of Ag NPs was conducted by mixing 5 mL of DFE with 95 mL of standard silver solution (10^{-3} M). Two varied method: aging and reflux for 2 h were applied. In order to evaluate the potency of PW as Ag source, similar procedures were applied for PW. The samples are designated as Ag NPs and Ag NPs (PW) for the nanoparticles obtained by using standard solution of Ag NO³ and PW respectively.

Characterization of silver nanoparticles

Characterization of Ag NPs was conducted by using UV-Vis Spectrophotometer (HITACHI U-2010) and particle size analyzer HORIBA-X, HORIBA Scientific (Kyoto, Japan).

Antioxidant activity

The antioxidant activity of Ag NPs was determined by DPPH method. DPPH solution was prepared in 95 % methanol. 0,2 mL extract of skin Red Dragon Fruit was diluted by 2 mL methanol and the mixture mixed with 2 mL freshly prepared DPPH and wait for 30 minutes. The solution was analyzed for absorbance at 517nm using UV-Spectrophotometer. Control sample was prepared without the addition of any extract and nanoparticles. The mixture of ethanol : water, 12.5 : 12.5 mL was used as blank.

RESULT AND DISCUSSION

Synthesis of Ag NPs

The formation of Ag NPs during synthesis can be monitored by using UV-Visible spectrophotometry analysis. Ag NPs express the plasmon resonance formation at the range of 300-400 nm. Some factors affecting the formation of plasmon resonance are the method of reaction, pH, mixture composition, etc. In this research, effect of method was varied. Based on many papers reported the synthesis over reflux method, in this investigation the comparison on reflux method and aging method as well as the comparison with the use of silver solution were conducted. The spectra are presented in Figure 1.

UV-Vis Analysis results indicated that there is a specific spectra at around 550nm correspond

to the content of active compounds in DFE which is also appeared by red color of the extract. As the extract was mixed with AgNO₃ solution, there is an intense peak at 390nm as indication of nanoparticles formation along the disappearance of 550nm peak. Those specific peaks at around 380nm–410nm are the indication of plasmon resonance formation^{2,7}. The corresponding peak was shifted to 400nm after aging and into 409 nm after refluxing process. The shifts are related to reduction reaction of Ag⁺ solution by the extract and express the change of nanoparticles size. Similar trend is also found in the PW utilization as silver ion source. From the comparison, the use of PW gives slightly lower wavelength compared to that is presented by Ag NPs by using Ag standard solution. The formation of Ag NPs can be interpreted from visual change of the color during the synthesis (Figure 2).

Furthermore, the formation of Ag NPs was studied by particle size analysis with dynamic

scattering method and the results are depicted in Figure 3.

From the particle size distribution it is confirmed that DFE produced nanoparticle formation as indicated by the mean size of Ag NPs obtained by silver solution at around 103-112 nm. By comparison on the effect of reflux method it is found that refluxing gives smaller nanoparticle size. Similar pattern is also depicted by the utilization of PW as Ag source. However, a specific finding was appeared by Ag NPs from PW in that the aging method did not give nanoparticle since the particle distribution lays on more than 5000 nm. Refluxing gives smaller size in the heterogeneous distribution with the modal pores at 100nm and 3000nm. The patterns suggest the temperature effect during silver reduction. Fast reduction obtained during reflux method accelerate the formation of nanoparticle and minimize the aggregation of particles as shown by the aging method. The phenomenon is related to that was

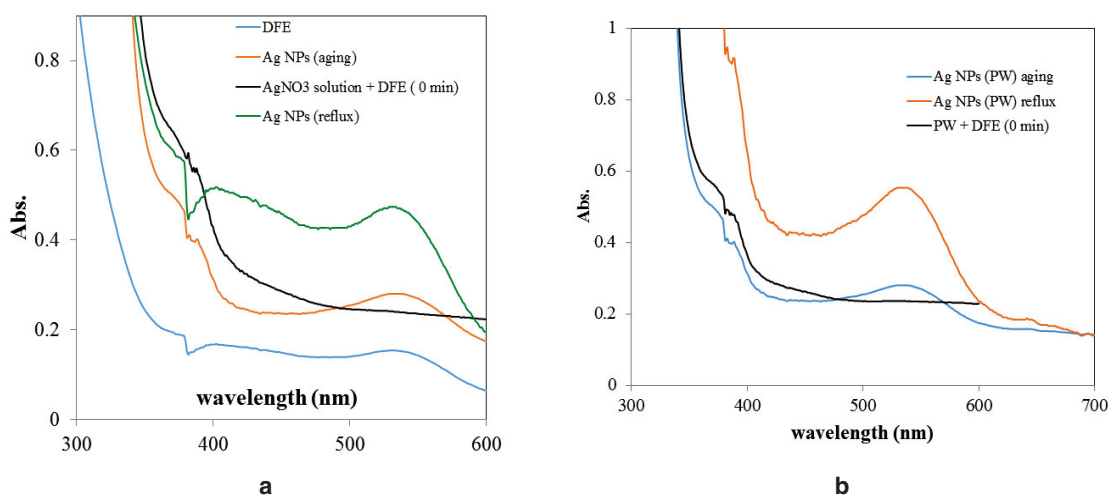


Fig. 1.: The change of UV-Vis spectra during Ag NPs synthesized by using (a) AgNO₃ solution (b) PW

Table 1: Data of antioxidant activity of Ag NPs

No	Ag precursor source-method	Initial Absorbance (517nm)	Final Absorbance (517nm)	Antioxidant Activity (%)
1	Ag NPs (reflux)	0.931	0.126	86.47
2	Ag NPs (aging)	0.834	0.262	68.59
3	Ag NPs PW (reflux)	0.656	0.073	88.87
4	Ag NPs PW (aging)	0.697	0.127	81.78

reported by previous investigation on the thermal effect in silver reduction toward size and shape of nanoparticles⁸.

Antioxidant activity

Antioxidant activity of Ag NPs was evaluated by DPPH assay. The test has been the most accepted model for evaluating the free radical scavenging activity of any new drug and potential agent. When a solution of DPPH is mixed with that of a substance that can donate a hydrogen atom, then this gives rise to the reduced form (Diphenylpicrylhydrazine; non radical) with the loss of this violet colour⁹. The color

was measured at 517 nm and antioxidant activity was measured by following equation:

$$\text{Antioxidant Activity} = \frac{(Abs_i - Abs_f)}{Abs_i} \cdot 100\% \quad \dots(1)$$

With Abs_i and Abs_f are initial and final absorbance respectively.

The result of tests are listed in Table 1.

Data in Table 1 confirmed that Ag NPs obtained from PW solution exhibit antioxidative activity with the activity at around 81-88% while Ag

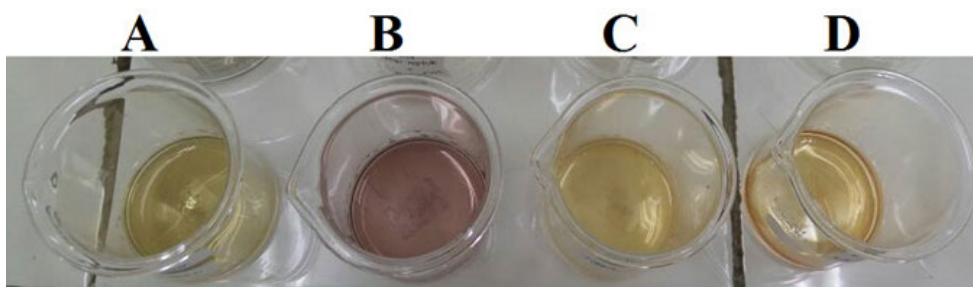
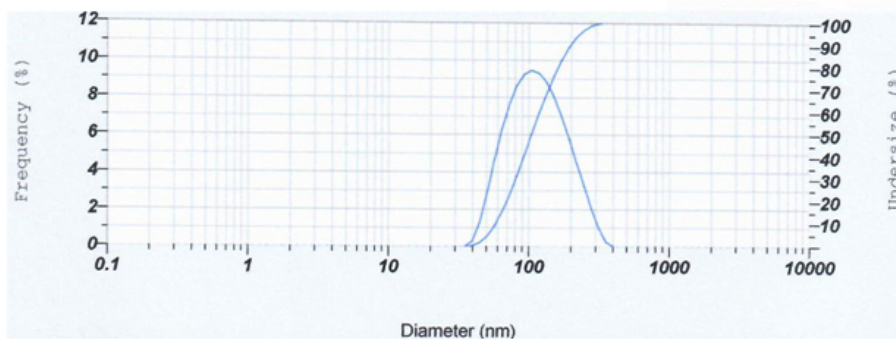
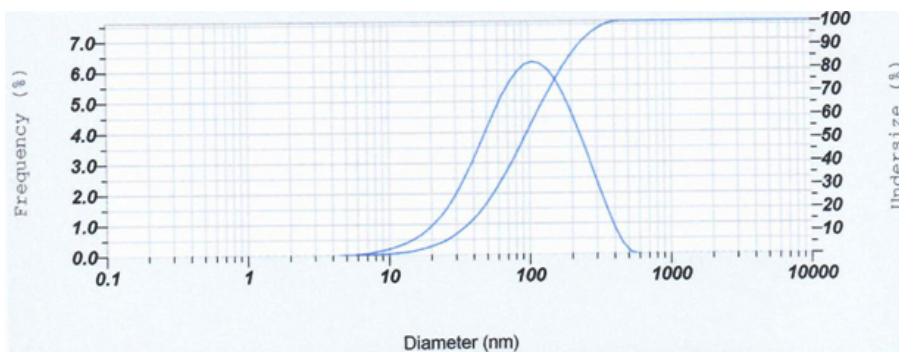


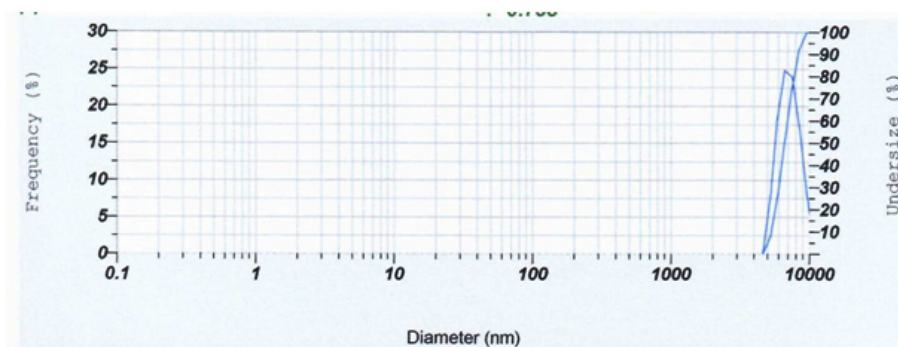
Fig. 2: AgNPs synthesized from (a) Ag standard solution using reflux method (b) Ag standard solution using aging method (c) PW using reflux method (d) PW using aging method



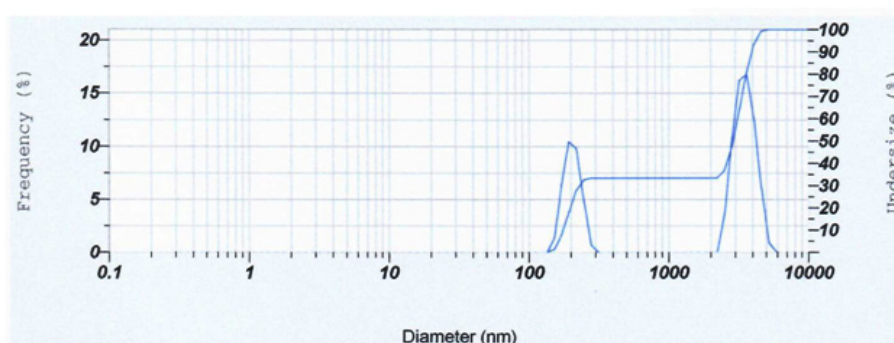
(a)



(b)



(c)



(d)

Fig. 3: Particle size distribution of Ag NPs obtained by (a) Ag standard solution using reflux method (b) Ag standard solution using aging method (c) PW using reflux method (d) PW using aging method

NPs obtained from Ag standard solution have lower activity. Ag NPs obtained from PW over reflux method gives higher antioxidant activity (88.87%) compared to Ag NPs over aging method (81.78 %). From the pattern, the data suggest the effect of refluxing method to give higher activity.

form nanoparticles and affected by the source of Ag solution as well as biosynthesis mechanism. From compared experiments, photograph wastewater expressed the potency in Ag NPs formation over reflux method. The Ag NPs demonstrated the antioxidant activity.

CONCLUSION

From the data it is concluded that dragon fruit extract has potential to be reductor in Ag NPs biosynthesis. The extract show the capability to

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