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Optimization And Characterization of Silver Nanoparticle Biosynthesis Using Parijoto Fruit (*Medinilla speciosa*) Water Extract With Box-Behnken Design

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Abstract: Silver nanoparticles in the medical field are used as additives in vaccines, anti-diabetic agents, wound and bone healing, biosensors and anticancer therapy in medical applications. One of the plants that can act as a reducing agent in the biosynthesis of silver nanoparticles is the parijoto fruit (Medinilla speciosa). This study aims to optimize and characterize the biosynthesis of silver nanoparticles from the water extract of parijoto fruit (M. speciosa) with a box-behnken design. The method used in this study starts from the manufacture of water extract of parijoto fruit (M. speciosa) then continued with the biosynthesis of silver nanoparticles. The formula for the biosynthesis of silver nanoparticles will be optimized with a box-behnken design and characterized by Particle Size Analyzer (PSA), Fourier Transform Infrared (FTIR), and Transmission Electron Microscopy (TEM). The results obtained in this study will be analyzed using descriptive techniques. The optimization results with the Behnken box design showed an optimal formula with an extract concentration of 1%, a sonication time of 6 minutes, and a sonicator pulser of 30. The particle size obtained was 85 ± 0.1 nm with a PI of 0.486 ± 0.006 and a zeta potential of -27.3 ± 1.5. The FTIR spectrum showed C=O, C-O and O-H groups indicating flavonoid compounds as bioreductant agents. The morphology of silver nanoparticles showed instability. (4) Conclusions:the optimization of silver nanoparticles from parijoto fruit water extract (M. speciosa) have been discovered used the Box-Behnken design and has good silver nanoparticle characteristics.

Keywords: Box-Behnken; formulation; silver nanoparticles; parijoto fruit water extract; *M. speciosa*

1. INTRODUCTION

Nanotechnology is a technology that can reduce large objects to a nanometer scale, known as nanoparticles. One of them type nanoparticles that are often used moment This that is nanoparticles silver. Silver nanoparticles are non-toxic to human skin and are noble metals with good optical quality, although they are more affordable than gold [1]. Silver nanoparticles have special properties, namely they are smaller in size, making them possible to be applied in various functions. Silver nanoparticles in the medical field are used as additives in vaccines, anti-diabetic agents, wound and bone healing, biosensors and anticancer therapy in medical applications [2]. Nanoparticles can be synthesized by *green synthesis* involving many organic chemicals such as phenols, flavonoids, and other compounds that can donate electrons for the reduction of $Ag^{+\,ions}$ to Ag^{0}. [3]One of the plants that contain compound chemistry organic the is fruit parijoto (*Medinilla speciosa*).

Parijoto fruit (*M. speciosa*) is a fruit that grows in Indonesia, especially in Kudus Regency, Central Java. Local people usually consume parijoto fruit (*M. speciosa*) by boiling it or eating it raw for herbal treatment of diarrhea, mouth ulcers and to increase fertility in pregnancy programs. However, this method of consumption has low bioavailability of natural compounds, making it difficult for the body to absorb. To increase the absorption of its active compounds, parijoto fruit (*M. speciosa*) can be processed into nanoparticles [1]. Parijoto fruit (*M. speciosa*) has been proven to contain fat, protein,

carbohydrates and saponin, glycoside, tannin and flavonoid compounds [4]. These active compounds make parijoto fruit (*M. speciosa*) have the potential to be used in *green synthesis* of silver nanoparticles.

Previous research has formulated Parijoto fruit (M. speciosa) into a Self-Nanoemulsifying Drug Delivery System (SNEDDS). Parijoto fruit (M. speciosa) formulation into silver nanoparticles has not been done [5]. Moreover, the formulation of nanoparticles using the Box-Behnken method that has been is nano lipid carriers of pioglitazone [6]. Therefore, this research has a high novelty because no one has done similar research before.

In this study, *green synthesis* of silver nanoparticles was carried out with a reducing agent of parijoto fruit water extract (*M. speciosa*) containing flavonoids and tannins to reduce silver ions into silver nanoparticles. Flavonoid compounds can bind to sugar so that they are more easily dissolved in water compared to ethanol which has a lower compound attraction [7]. Therefore, the use of water solvents was chosen in the parijoto fruit extraction process (*M. speciosa*). The use *of expert design* software in formulation can be prepared make it easier identification of optimal formula for nanoparticles silver. Research This can become innovation new in utilise fruit local Indonesian at the same time help development technology nanoparticles silver.

2. MATERIALS AND METHODS

Materials used in study This that is Fresh parijoto fruit (*Medinilla speciosa*) obtained from Tlogo Putri Street, Kaliurang , Sleman Regency, Yogyakarta, Indonesia, silver nitrate ($AgNO_3$) Merck, paper filter whatman number 1, and distilled water from the Laboratory Pharmaceutical Technology of Islamic University of Indonesia. The tools used in study This that is a set tool Iwaki glass, ultrasonicator model 150 VT ultrasonic homogenizer, Micropipette Socorex, *Particle Size Analyzer* (PSA) (Horiba, SZ-100 series), UV-Vis Spectrophotometer (Hitachi U-2810), *Fourier Transform Infrared* (FTIR) (Perkin Elmer *Spectrum Two System* L160000A), and *Transmission Electron Microscope* (TEM) (Tecnai G2 20S- *Twin*).

2.1. Determination

Parijoto plants (*Medinilla speciosa*) obtained from Jalan Tlogo Putri, Kaliurang, Sleman Regency, Yogyakarta will be selected for fruit determination. The determination process of parijoto fruit (*M. speciosa*) was carried out at the Laboratory of the Faculty of Biology, Gajah Mada University (UGM), Yogyakarta.

2.2. Extraction

Extraction of parijoto fruit (*M. speciosa*) was carried out using the infundation technique, namely by soaking the raw plant material in a solvent at a certain temperature for 15 minutes. The raw plant material used in this study was fresh parijoto fruit (*M.* speciosa) that was ripe and purplish red. While the solvent used was distilled water. Fresh parijoto fruit (*M. speciosa*) as much as 20 grams was soaked in 100 mL of distilled water at a temperature of 90 ^{o}C for 15 minutes until a red liquid extract solution was obtained. After fruit water extract parijoto (*M. speciosa*) cold , done filtering with paper filter whatman number 1 [8].

2.3. Identification Compounds in the Extract

Compounds in the water extract of parijoto fruit (*M. speciosa*) will be identified using the Thin Layer Chromatography (TLC) method with quercetin as a standard comparator. The silica gel GF 254 plate as the stationary phase will be activated using an oven at a temperature of 105°C for 15 minutes. After that, the extract and standard will be spotted on the plate using a capillary tube. After drying, the plate is inserted into *a chamber* containing a saturated mobile phase of chloroform: acetone: formic acid (8:2:4 drops). The plate that has been eluted to the specified limit is removed from the chamber and sprayed using $AlCl_3$. The spots formed on the standard and extract will be observed under visible light, UV 254 light, and UV 366 light, then the *Retardation Factor* (Rf) value of the spots is determined [9].

2.4. Formulation of Silver Nanoparticles

Manufacturing formulation nanoparticles silver use fruit water extract parijoto (*M. speciosa*) will conduct with help *Box -Behnken design*. The independent variable (X) used in determine the formulation, namely concentration extract (%) (X_1), time sonication (minutes) (X_2), and pulser strength (X_3) used. Each variable has been determined its minimum and maximum limits as listed in Table 1.

Table 1. Optimization Variables of Silver Nanoparticle Formula

	Minimum	**Maximum**
Concentration extract (%) (X_1)	1	5
Sonication time (minutes) (X_2)	3	6
Pulser (pulserate) (X_3)	30	50

Box-behnken design will design 15 silver nanoparticle formulas as in Table 2. The formula is made by preparing 15 vials, each filled with 1 mM $AgNO_3$ 3000 µL and adding parijoto fruit water extract (*M. speciosa*) (X_1) according to the concentration determined by *Box-behnken design*. Each vial is then sonicated using a sonicator with sonication time (X_2) and pulser strength (X_3) which have also been determined by *Box-behnken design* [10].

Table 2. Silver Nanoparticle Formulation using *Box-Behnken Design*

Run	**Concentration extract (%) (X_1)**	**Sonication time (minutes) (X_2)**	**Pulser (pulse rate) (X_3)**
1	3	3	50
2	1	6	40
3	1	4.5	30
4	5	4.5	50
5	3	6	50
6	3	6	30
7	3	4.5	40
8	3	4.5	40
9	5	6	40
10	1	3	40
11	3	3	30
12	5	3	40
13	1	4.5	50
14	5	4.5	30
15	3	4.5	40

After sonication, each vial was then coated with aluminum foil and given a different label. All vials were then stored in a closed container and observed for changes in 2 days. Silver nanoparticles made from the *box-behnken design formulation* will be checked using PSA. The data generated from PSA, namely particle size (Y1) , *polydispersity index* (Y2) , and zeta potential (Y3) will be the dependent variables in this study. Independent data and dependent data will be re-entered into *the box-behnken design* to obtain the optimal formula.

2.5. Characterization of silver nanoparticles

2.5.1. Particle Size Analyzer (PSA)

Particle size analyzer used for measure particle results preparation nanoparticles silver with difference percentage of volume of extract, time sonication and pulser sonicator . The results of the analysis obtained that is distribution size particles, *Polydispersity Index*, and zeta potential [10]. Analysis results Then compared to with prediction from *box- built design* for determine level its accuracy (results analysis / value prediction).

2.5.2. Fourier Transform Infrared (FTIR)

Functional groups in nanoparticles silver measured with FTIR (*Fourier Transform Infrared)* instrument. Extract sample single and nanoparticles silver placed in receptacle sample FTIR instrument and analyzed for identify group functional in range number wave 4000-450 cm $^{-1}$ with resolution 4 cm $^{-1}$ [11].

2.5.3. Transmission Electron Microscopy (TEM)

Observation morphology size particles and structures nanoparticles silver fruit water extract parijoto (*M. speciosa*) can done with *transmission electron microscopy* (TEM). The copper grid on the TEM instrument will drip solution nanoparticles silver Then dried with vacuum. Next, the copper grid the will placed in the specimen holder in TEM instrument for analyzed [11].

2.6. Data Analysis

Result data experiment will analysis descriptive for now characterization nanoparticles that have been formed. Analysis techniques descriptive is technique data analysis used for detailing and describing the data that has been obtained [12].

3. RESULTS AND DISCUSSION

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

3.1. Determination

Plant parijoto own three type species that have differences in characteristics its morphology. In the study This used fruit colored parijoto red dark. Substance color red dark on the fruit parijoto used as material main in formation nanoparticles silver. Identification plant parijoto done for test species fruit parijoto used in a way qualitative. Testing conducted in the Laboratory Systematics Plants, Faculty Biology, Gadjah Mada University, Yogyakarta with results analysis in Number: 00585/ S.Tb ./III/2024 shows that plants used Already in accordance that is plant parijoto with species *Medinilla eximia* (Jack) Blume who has synonym *Medinilla speciosa* Blume.

3.2. Extraction and Identification

Parijoto fruit water extract obtained through the infusion extraction method has a striking fresh aroma. Visually, this extract shows a dense purplish red color without the presence of coarse particles that can be seen after the filtration process. The texture is liquid with low viscosity, making it easy to dissolve in water well. The extract was analyzed using the Thin Layer Chromatography (TLC) method to see the presence of flavonoid compounds in the parijoto fruit water extract (*M. speciosa*) with a standard quercetin comparison. The mobile phase mixture used was chloroform: acetone: formic acid (8:2:4 drops). Silica gel plate GF 254 was used as the stationary phase in this process. After that, the TLC process was continued by spraying $AlCl_{3\ reagent}$ to clarify the phenolic compounds in the standard and extract.

TLC Results in Figure 1. show that spots are only found in the standard section, while there are no spots in the extract section. The spots found in the standard look yellowish green with an Rf value of 0.56. The yellowish green color after spraying with $AlCl_3$ indicates the presence of flavonoid compounds which are included in the phenolic compound group [13]. The absence of spots in the extract section is thought to be because the compounds found in the water extract of parijoto fruit (*M. speciosa*) contain more polar compounds. The TLC plate used was *silica gel* GF 254 which is polar so that it is possible that the compounds in the extract bind to the TLC plate which causes the compounds not to elute upwards. In addition, the mobile phase used, namely a mixture of chloroform: acetone: formic acid (8:2:4 drops) is non-polar so that polar compounds are difficult to elute upwards.

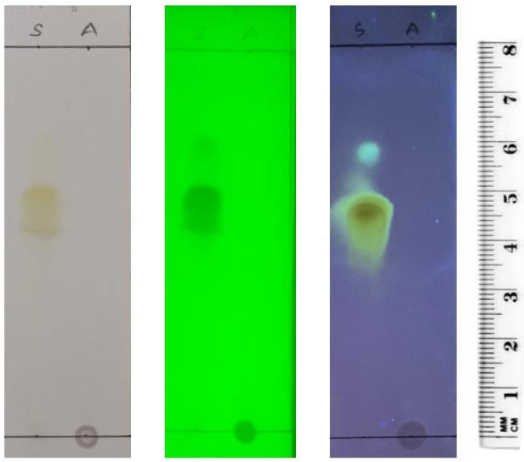

Figure 1. Thin Layer Chromatography Results under visible light (left), UV 254 lamp (middle) and UV 366 lamp (right) after being sprayed with $AlCl_3$. Mobile phase: chloroform mobile: acetone: formic acid (8:2: 4 drops). Stationary phase: silica gel plate GF 254

3.3. Formulation of Silver Nanoparticles

The use of *design expert software* to develop silver nanoparticle formulation using *box-behnken design* begins with optimizing the concentration of parijoto fruit water extract (*Medinilla speciosa*) (X1), the sonication time used (X2), and the power of the sonicator pulser (X3) used. Sonication using ultrasonic aims to produce stable silver nanoparticles. Ultrasonic will vibrate the agglomerated nanoparticles, causing fragmentation. Longer sonication times release greater energy so that the distribution of nanoparticles is faster and more even [14]. The optimization results show that silver nanoparticles from parijoto fruit water extract (*Medinilla speciosa*) are formed in the extract concentration range of 1-5%, sonication time of 3-6 minutes, and sonicator pulser of 30-50.

Table 3. Equation between independent variables (X) and dependent variables (Y)

Parameter	Equation
Particle size	$9{,}56250(X_1)-11(X_2)-3{,}13917(X_3)+1{,}68333(X_1X_2)-0{,}028750(X_1X_3)$ $+0{,}236667(X_2X_3)-2{,}18229(X_1^2)-0{,}801852(X_2^2)+0{,}032208(X_3^2)$
Polydispersity index (PI)	$0{,}458167$ (PI (Y_2)) $= 0{,}003500(X_1)-0{,}013333(X_2)+0{,}004675(X_3)$
Zeta potential	-27,81292 (Zeta potensial (Y_3)) $= 1{,}26875(X_1)-0{,}166667(X_2)-$ $0{,}013750(X_3)$

The Equation between independent variables (X) and dependent variables (Y) as shown as Table 3. Positive values for each variable indicate a synergistic effect, meaning that increasing the value of the variable will increase the resulting response. Conversely, negative values indicate an antagonistic effect between the variable and the observed response. Box-Behnken design illustrates the response of the relationship between the varied variables to the resulting PI (Y_2) value (Figure 2), the polydispersity index result (Y_2) (Figure 3), and the zeta potential response (Y_3) (Figure 4).

The results of the ANOVA statistical test for particle size (Y_1) followed a *quadratic model* with a p value < 0.05, which was 0.0346, indicating the significance of the model. The R-squared value obtained was 0.9115, indicating that the response data followed the model well. The closer to the value of 1, the R- *squared* indicates a high level of fit between the model and the observation data. Analysis of particle size (Y_1) showed that the relationship between the independent variables (extract concentration (X_1), sonication time (X_2), and pulser power (X_3)) with particle size (Y_1) gave

significant results. This indicates that the independent variable (X) significantly affects particle size (Y_1).

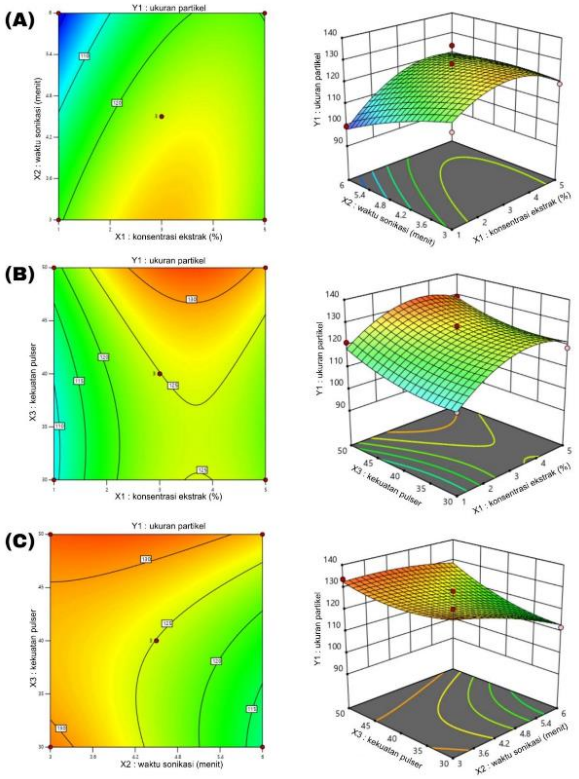

Figure 2. Response graph of the relationship between the independent variable (X) and the particle size results (Y_1)

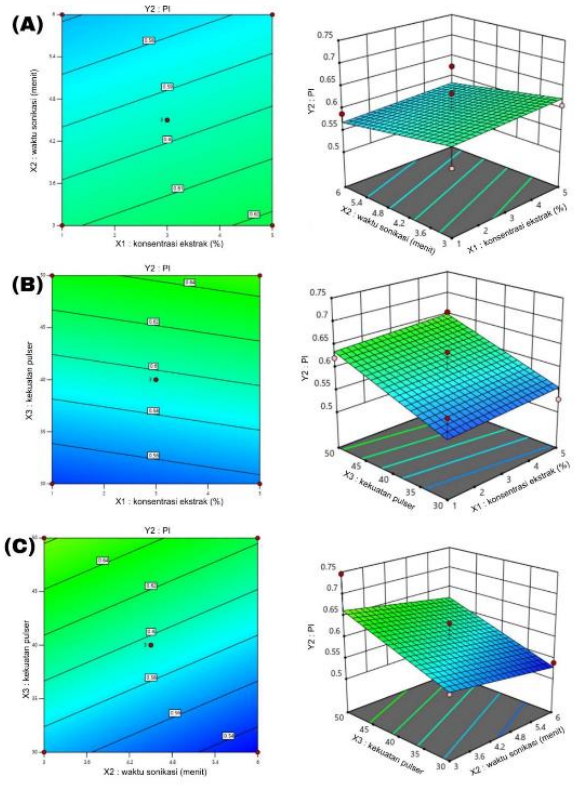

Figure 3. Response graph of the relationship between the independent variable (X) and the polydispersity index result (Y_2)

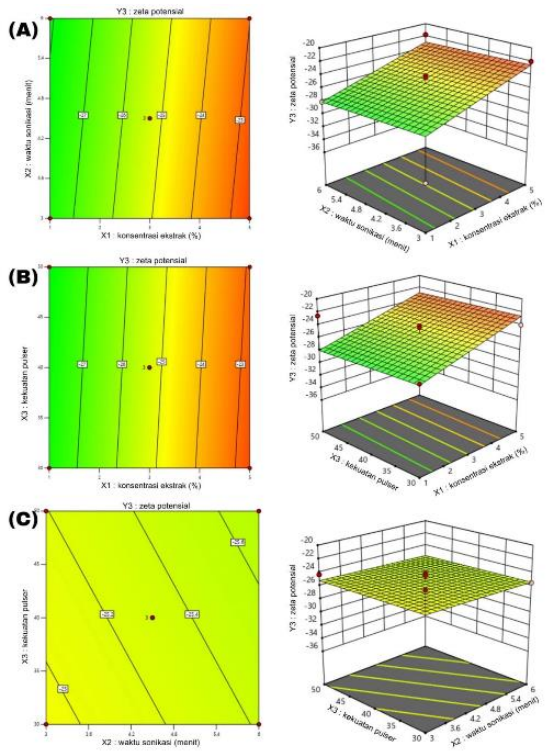

Figure 4. Response graph of the relationship between the independent variable (X) and the zeta potential result (Y_3)

The results of the ANOVA statistical test for the polydispersity index (PI) (Y_2) follow a linear model with a p value>0.05, namely 0.0531, which indicates the insignificance of the model. The R-squared value obtained is 0.4886, which shows level moderate compatibility between the model and observational data . The more approach value 1, R-squared indicates that the response data follow the model with good . PI (Y_2) analysis show that connection between variable independent (extract concentration (X_1), sonication time (X_2), and pulser power (X_3)) with PI value (Y_2) No significant. This means that the independent variable X) No give significant influence to PI value (Y_2) in this study.

The results of the ANOVA statistical test for zeta potential (Y_3) showed that the data followed a linear model with a p value> 0.05, which was 0.1885, indicating no significance to the model. The R- *squared value* obtained was 0.3410, indicating how well this model fits the observed data. The closer to the value of 1, the R- *squared* indicates a better level of fit between the model and the observed data. From the analysis of zeta potential (Y_3), it was concluded that the relationship between the independent variables (extract concentration (X_1), sonication time (X_2), and pulser strength (X_3)) with zeta potential (Y_3) was not significant. This means that the independent variable (X) No give significant influence to zeta potential value (Y_3) in this study.

The formation of silver nanoparticles that have been formulated by *box-behnken design was tested using the Particle Size Analyzer (PSA)* instrument. The results can be seen in Table 3. PI (Polydispersion Index) describes the uniformity of particle size distributed in the tested sample. The PI value will be better if it approaches 0. The average reading results of particle size and PI obtained can be seen in Table 4, namely particle size of 85 ± 0.1 nm and PI 0.486 ± 0.006. These results indicate that the particle size and PI of silver nanoparticles obtained are within the range of good silver nanoparticle sizes, namely 1-100 nm and PI less than 0.8.

Table 4. Results of nanoparticle formulation silver use *box- built design*

Run	Extract concentration (%) (X_1)	Sonication time (minutes) (X_2)	Pulser (pulserate) (X_3)	Particle Size (nm) (Y_1)	PI (Y_2)	Zeta potential (mV) (Y_3)
1	3	3	50	133.7 ± 0.9	0.746 ± 0.006	-24.3 ± 0.6
2	1	6	40	99.4 ± 0.2	0.588 ± 0.012	-28.1 ± 3.3
3	1	4.5	30	108.7 ± 1.1	0.585 ± 0.033	-27.5 ± 2.1
4	5	4.5	50	129 ± 1.5	0.654 ± 0.022	-24.2 ± 2.6
5	3	6	50	124.3 ± 0.9	0.570 ± 0.033	-28.7 ± 0.6
6	3	6	30	111.9 ± 0.4	0.539 ± 0.019	-25.5 ± 1.2
7	3	4.5	40	121.9 ± 0.6	0.567 ± 0.016	-26.6 ± 0.6
8	3	4.5	40	124.5 ± 2.9	0.543 ± 0.016	-24.1 ± 1.2
9	5	6	40	123.7 ± 0.9	0.624 ± 0.032	-21.8 ± 0.4
10	1	3	40	115.2 ± 0.6	0.564 ± 0.022	-34.1 ± 3.9
11	3	3	30	135.5 ± 2.6	0.564 ± 0.048	-21.7 ± 1.2
12	5	3	40	119.3 ± 0.5	0.607 ± 0.057	-22.0 ± 1.0
13	1	4.5	50	121.2 ± 0.5	0.621 ± 0.026	-22.6 ± 0.6
14	5	4.5	30	118.8 ± 0.5	0.529 ± 0.077	-24.0 ± 0.2
15	3	4.5	40	128.4 ± 1.6	0.634 ± 0.060	-24.4 ± 2.5

The previous *Box-Behnken design* predicted that the particle size to be produced would be 92.9 nm, the PI value would be 0.521, and the zeta potential would reach -27.9 mV with *a desirability* of 0.327. The similarity between the results and predictions was calculated by dividing the analysis results by the predicted value. This similarity calculation was carried out to determine the level of accuracy of the model predicted by *the Box-Behnken design*. The measurement results showed that the particle size obtained was 85 nm, with a similarity of 91% compared to the prediction from the Box-Behnken *design*. The measured PI value was 0.486 with a similarity of 93% to the initial prediction from *the Box-Behnken design*. In addition, the measured zeta potential value was -27.3 mV with a similarity of 97% to the previous *Box-Behnken design prediction*. Sample instability can be evaluated by analyzing its particle size distribution. One indicator of particle instability is through observing the area of its particle size distribution. From the results of particle distribution measurements in Figure 6, it can be seen that the size distribution in the optimal formula shows a peak concentrated in one range. These results indicate that the particle size distribution of silver nanoparticles from parijoto fruit water extract in the optimal formula is well spread.

Previous research results on the formation of silver nanoparticles using the biosynthesis method showed a color change from clear to brownish yellow. This change is caused by the phenomenon of surface plasmon excitation vibrations in silver nanoparticles, which is triggered by the conversion of Ag^{+} ions to Ag^{0}. This phenomenon has an important role in the reduction and stabilization process in the formation of silver nanoparticles [10]. In the study of silver nanoparticle biosynthesis using parijoto fruit water extract, a color change from clear to brownish yellow occurred within 48 hours (Figure 5).

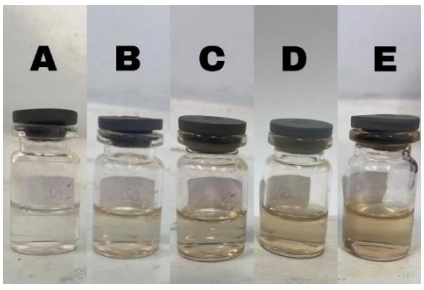

Figure 5. Color changes in silver nanoparticles (A) 1st hour (B) 20th hour (C) 24th hour (D) 40th hour (E) 48th hour

3.4. Characterization of Silver Nanoparticles

3.4.1. Particle Size Analyzer (PSA)

PI (Polydispersion Index) describes the uniformity of particle size distributed in the tested sample. The PI value will be better if it approaches 0. The average reading of particle size and PI obtained can be seen in Table 3, namely particle size of 85 ± 0.1 nm and PI 0.486 ± 0.006. These results indicate that the particle size and PI of silver nanoparticles obtained are within the range of good silver nanoparticle sizes, namely 1-100 nm and PI less than 0.8. The previous Box-Behnken design predicted that the particle size to be produced would be 92.9 nm, the PI value would be 0.521, and the zeta potential would reach -27.9 mV with a desirability of 0.327. The similarity between the results and predictions was calculated by dividing the analysis results by the predicted value. This similarity calculation was carried out to determine the level of accuracy of the model predicted by the Box-Behnken design. The measurement results showed that the particle size obtained was 85 nm, with a similarity of 91% compared to the prediction of the box-behnken design. The measured PI value was 0.486 with a similarity of 93% to the initial prediction of the box-behnken design. In addition, the measured zeta potential value was -27.3 mV with a similarity of 97% to the previous box-behnken design prediction. Sample instability can be evaluated by analyzing its particle size distribution.

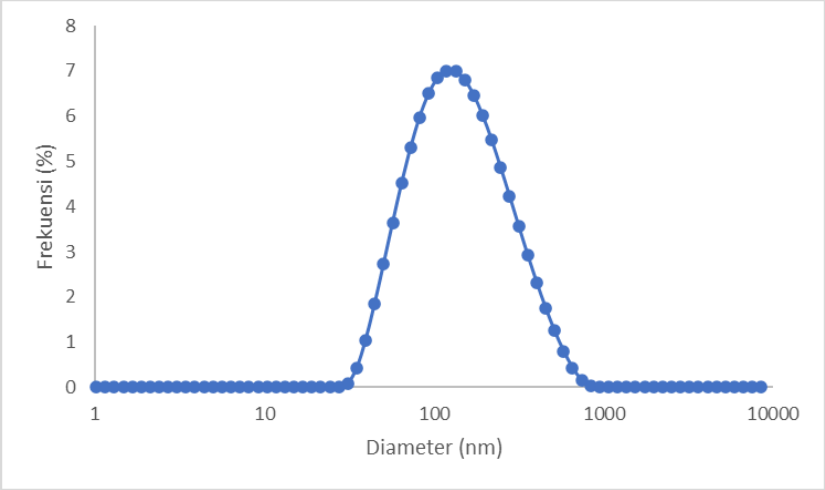

Figure 6. Particle size distribution graph of the optimal formula

One indicator of particle instability is through observation of the area of particle size distribution. From the results of particle distribution measurements in Figure 6, it can be seen that the size distribution in the optimal formula shows a peak concentrated in one range. These results indicate that the particle size distribution of silver nanoparticles from parijoto fruit water extract in the optimal formula is well spread.

3.4.2. Fourier Transform Infrared (FTIR)

Measurement with FTIR tool aims to determine the functional groups that play a role in reducing $Ag^{+\,ions}$ to Ag^{0} in the manufacture of silver nanoparticles. The results of the measurement of the optimum formula silver nanoparticles with the FTIR tool in Figure 7 show 4 observed band peaks, namely 3322.83 cm^{-1}, 2128.00 cm^{-1}, 1634.61 cm^{-1}, and 1261.43 cm^{-1}. Comparison of the FTIR spectrum profile of parijoto fruit water extract with silver nanoparticles in Table 5 shows a peak shift in the band 3308.57 cm -1 to 3322.83 cm -1 indicating the presence of stretching vibrations of OH bonds originating from phenolic or alcohol compounds.

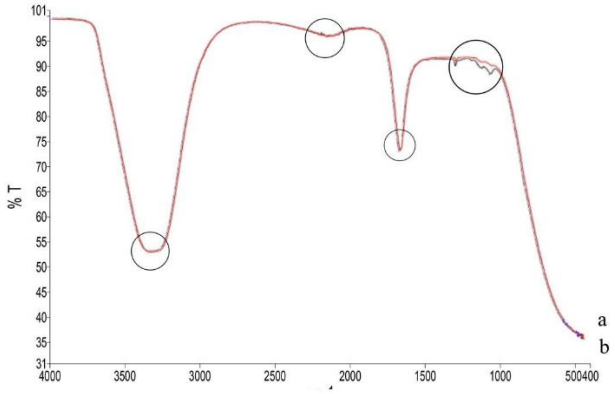

Figure 7. FTIR spectrum of (a) water extract of parijoto fruit and (b) silver nanoparticles with optimal formula

Table 5. Functional groups from FTIR measurements

Wavelength (cm^{-1}) of Extract	Functional Group	Wavelength (cm^{-1}) of Silver Nanoparticles
3308.57	OH	3322.83
2123.24	C≡C	2128.00
1634.13	C=O amide	1634.61
1261.06	CO	1261.43

At the peak of the band 1634.13 cm^{-1} there is also a slight shift to 1634.61 indicating the presence of vibrations of the C = O amide bond. In addition, at the peak of the band 1261.06 cm^{-1} there is also a slight peak shift to 1261.43 cm^{-1} indicating the presence of stretching vibrations of the CO alcohol bond. The spectrum shift resulting from the FTIR reading shows that parijoto fruit water extract contains flavonoid compounds that act as bioreductant agents in the formation of nanoparticles as indicated by the presence of C = O, CO and OH groups [15].

3.4.3. Transmission Electron Microscopy (TEM)

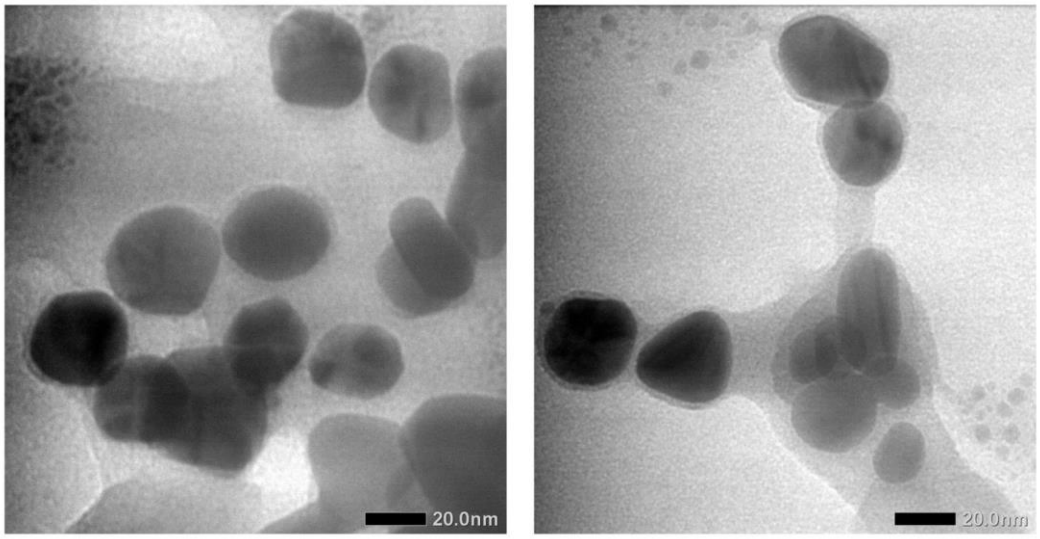

Figure 8. Morphology of silver nanoparticles optimal formula using Transmission Electron Microscopy (TEM)

In Figure 8, 2 different particles are seen, namely darker particles and lighter particles. The darker particles are silver nanoparticles while the lighter particles are thought to be parijoto fruit water extract that has not formed silver nanoparticles perfectly [16]. The results of testing using TEM on

silver nanoparticles in the optimal formula showed that there were non-uniform particles, with round, anisotropic, and rod shapes. In addition to describing form particles, TEM also provides information about size particles, with size about 20 nm in measurement this. This result different with results characterization using PSA, which records size particle around 85 nm. The difference shape and size particle This show existence aggregation in nanoparticles silver. Aggregation This to signify existence instability in nanoparticles silver, where the particles tend interact One each other through style between particle for form a larger cluster big along the walk time [11].

4. CONCLUSION

Biosynthesis nanoparticles silver use fruit water extract optimized parijoto (*Medinilla speciosa*) with help *box- behnken design* obtained the optimal formula with concentration fruit water extract parijoto (*Medinilla speciosa*) 1% and sonicated for 6 minutes with pulser power 30. *B ox-behnken design* can predict the response obtained from the optimal formula of a preparation with an accuracy level of more than 90%.

The characteristics of the optimal silver nanoparticle formula are that it has a particle size of 85 ± 0.1 nm, PI 0.486 ± 0.006, and zeta potential -27.3 ± 1.5 mV. It has a maximum wave absorption at a wavelength of 439.5 nm with an absorbance of 0.165. The FTIR spectrum shows the presence of C = O, CO and OH groups which indicate flavonoid compounds as bioreductant agents in the formation of nanoparticles. The morphology of silver nanoparticles in the optimal formula has varying shapes and sizes indicating the instability of silver nanoparticles.

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