

Green Synthesis Nanoparticles Review: Sun Protection Based on Silver Nanoparticles Made From Extract Rhizome Galangal and Ketapang Leaf

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Abstract: Sunlight that contains UV-A and UV-B can have harmful effects on the skin, this can be anticipated by using sun protection. Sun protection is a product that aims to protect the skins from damage caused by exposure to UV rays from the sun. One of the technologies for making sun protection is nanoparticles. Synthesis of silver nanoparticles was used by chemical reduction method using ketapang leaf extract (*terminalia catappa*), and kencur rhizome extract. This reviews aims to show that production of silver nitrate nanoparticles (AgNPs) conjugated with ethyl p- methoxycinnamate (EPMS), and AgNPs with an alloys of hydroxycinnamic acid (AHNP) compounds which can be used as raw materials for sunscreen .In the characterization of UV-Vis nanoparticles Spectrophotometer , Particles size Analyzer (PSA), Scanning electrons Microscope (SEM), X-Ray Diffraction (XRD), and transformation infrared spectroscopy fourier (FTIR) are used. The extraction results obtained ethyl p-methoxycinnamate (EPMS) in the form of crystals with a percent rendering of 2.3%. EPMS characterization with a Uv-Vis spectrophotometer obtained a maximum wavelengths of 308nm, colloidal silver gives an absorption peak at a wavelength around 400-500 nm which shows a typical plasmons absorption peak of silver nanoparticles and the results of FTIR analysis at waves number 1701.27 cm⁻¹ indicates the presence of carbonyl group (C=O) and 1165.97 cm⁻¹ the presence of the CO group. In the color indicator, the formation of AgNPs is indicated by a clear color change to an orange color, while in the FTIR, an oxidation process due to the reduction process of silver nanoparticles. There is an absorption band with wide and strong intensity at ν 3446.79 cm⁻¹ due to the presence of OH groups from phenol and OH groups from poly acrylic acid , and the sizes of silver nanoparticles in PSA shows an average sizes of 92.48nm. The SEM results show a mono-spread form. As well as the results of XRD measurements indicate the presence of silver nanoparticles with a cubic crystal system.

Keywords: Sunscreen , AgNPs , kencur rhizome extract, ketapang leaf extract.

Introduction

Indonesia is a tropical country full of sunshine throughout the year (Rahmawati et al, 2018). The sun can emit various kinds of light visible or invisible. Sunlight that can be seen is light that is emitted in waves of more than 400nm, while sunlight with a wavelength of 10nm-400nm which is called ultra violet light cannot be seen with the naked eye (Theresia, 2014). In some ways ultra

violet rays are beneficial to humans, namely to synthesize Vitamin D and also function to kill bacteria. However, apart from the benefits mentioned above, ultra violet rays can be detrimental to humans if exposed to human skin for too long (Rizkita et al, 2022). Radiation UV rays can cause skin damage, skin disorders such as acne, dull skin, uneven skin, oily skin and skin that looks older, blemishes black, and can cause skin cancer (Isfardiyana & Safitri, 2014). As prevention

happening damage skin the The use of sunscreen, which is part of a series of cosmetics, can prevent ultraviolet rays from entering the skin (Tranggono & Latifah, 2021). Cosmetic preparations containing sunscreen are usually stated on the label with the strength of SPF (Sun Protecting factor). In manufacture of sun protection can used technology nanoparticles for increase power sun protection against ray sun. The current development of silver nanoparticles has been applied in various fields, one of which is the addition of silver nanoparticles in cosmetic preparations. Nanoparticles are particles with a nanometer size, which is around 1–100 nm (Hosokawa et al, 2007). The size of the silver nanoparticles is very small compared to the body's cells, so the silver nanoparticles can enter and exit easily into the body's cells without interfering with the work of the cells .

Silver nanoparticles are non- toxic to human skin. In addition, nanoparticles are antioxidants and can ward off free radicals. On nanoparticles silver there is content antioxidants as flavanoids, phenolics, and steroids. Antioxidants have the ability to increase the growth of new cells in the blood. Protection of skin tissues and layers against sun damage is also enhanced by the presence of antioxidants. On review journal this time, we want showing that nanoparticles could used as a renewable alternative for Becomes agent antioxidants as sun protection from plant endemic to Indonesia namely rhizome galangal and leaf katapang.

Materials and Methods

On journal review this explain quote methods for make nanoparticles , characterization nanoparticles , and test bioactivity veil Sun from a number of article related . The journal under review is entitled Synthesis Silver Nanoparticles Uses Bioreductor Extract Leaf Ketapang (*Terminalia catappa*) (Payapo et al, 2016) and Its Potential As Sunscreen, Green Synthesis Conjugated Silver Nanoparticles (Agnps). Ethyl Parametok Cinnamon (Epms) As Ingredients veil Surya (Agustina et al, 2018)

Preparation Extract Ingredients Natural For Making Nanoparticles

On Making Nanoparticles, second the journal we refer to use stages same method that is prepare extract ingredients the first natural is ketapang leaf powder (*Terminalia catappa*) as much as 20grams was macerated in stages with n-hexane, chloroform and ethyl acetate for 1 x 24 hours several times and filtered. The maserate obtained was then evaporated to obtain n - hexane , chloroform and concentrated ethyl acetate extracts (Payapo et al, 2016). Then method second could use The method of dry powder of kencur rhizomes was weighed as much as 1 kg and macerated with 96% ethanol for 1 x 24 hours. The maserate obtained from the extraction was concentrated until approximately 100 mL of concentrated macerate was obtained. Maserate is cooled in the refrigerator until white crystals form. The crystals formed were filtered using a Buchner funnel. The crystals are dissolved in hot 70% ethanol and heated until rapidly dissolved. Then add water slowly while stirring. The addition of water was stopped right after the solution became cloudy. Extracts the later will used for making earlier nanoparticles especially characterization first the extract use EPMS for prove group contained functions then for confirm results test antioxidants later. (Agustina et al, 2018).

Characterization Extract Ingredients Natural For Determination Activity Antioxidant

On the characterization process this aim for determine content chemical extract ingredients natural for making Nanoparticles. Characterization process this could use Uv -Vis for know the presence of EPMS and AgNPs, FTIR for know functional group, color indicator, as well as SEM for know shape morphology nanoparticles, and PSA as instrument for know size nanoparticles. (Agustina et al, 2018) (Payapo et al, 2016)

Making Reagent Nanoparticles

Reagent for make nanoparticles with help extract ingredients natural could use react AgNO₃ solution with Extract ingredients nature. Making AgNO₃ reagent, 1 mM AgNO₃ solution was prepared by dissolving 0.085gr of the powder AgNO₃ with aquabides in a 500ml volumetric flask up to the mark and homogenized. Then a 1%

PAA solution was made by weighing 1gr of PAA and dissolved with aquabides in a 100ml volumetric flask to the mark (Payapo et al, 2016)

Synthesis Nanoparticles

On second extract ingredients natural used the same synthesis with method addition compound chemistry. The first on extract leaf ketapang synthesized with method mix AgNO₃ solution in n-hexane extract, extract ethyl acetate, extract chloroform, and leaf water extract ketapang as bioreductor. A total of 0.5 ml each extract mixed in 20 mL of 1mM AgNO₃. Solution left react for 2 hours then added to in 2 ml PAA (poly acrylic acid) 1% solution then stirer for 2 hours. (Payapo et al, 2016)

Then on extract rhizome galangal synthesized with dissolving silver nitrate with distilled water (1mm) then mixed with 1.5g glycerol. Then stirrer and maintained at 90°C and EPMS (50 mg in 10 mL ethanol) was added to the solution, then stirred and observed for the reaction based on the color change for 70 minutes. (Agustina et al, 2018)

Characterization Nanoparticles

Extract characterization leaf ketapang use indicator color, UV-Vis spectrum and ph at 1 day, 2 days, 3 days and 7 days. Colloid nanoparticles the characterized use PSA for know size nanoparticles. The solution was then centrifuged to obtain precipitated nanoparticles which were then dried in an oven at 100° C. The dried product was then characterized using FTIR and XRD to determine the functional groups involved, particle shape, elemental composition, and product size (Payapo et al, 2016)

For nanoparticles silver extract galangal characterized use UV-Vis spectrophotometer in the wavelength range of 400-500 nm, FTIR analysis to determine the functional groups of compounds, and Scanning analysis electrons Microscope (SEM) for determination of AgNP morphology. Meanwhile, the determination of the size of the nanoparticles is carried out using Particle size Analyzer (PSA) (Agustina et al, 2018)

Sunscreen Activity Test

Test antioxidants this can use in-vitro method on nanoparticles silver leaf ketapang cartered by making an alloy solution between hydroxy acids cinnamic with silver nanoparticles (AHNP) with concentration 16 µg/ml, 17 µg/ml, 18 µg/ml, 19 µg/ml, 20 µg/ml. Sunscreen activity was determined from the SPF value of the sample which was analyzed using a UV- Vis spectrophotometer (Payapo et al, 2016). Whereas on nanoparticles silver from extract galangal characterized use 3 methods, namely calculating the percentage of transmission of erythema, the percentage of transmission of pigmentation and the value of Sun Protection Factor (SPF) using a UV-Vis spectrophotometer by observing the absorption of the EPMS-conjugated AgNPs sample solution tested, which is 200 ppm at a wavelength of 292-372 nm while for EPMS samples without AgNPs at a concentration of 1000 ppm. In testing sunscreen is categorized as a sunblock if the transmission value is erythema sunblock and provides protection against UV exposure at low concentrations (200 ppm) which is categorized as ultra protection with an SPF value of 36.4 while EPMS without AgNPs conjugation is at a concentration of 1000 ppm with an SPF value of 38.4. It can be concluded that small concentrations of EPMS-conjugated AgNPs samples have ultra-protective power when compared to those without AgNPs conjugates (Agustina, et al, 2018)

Determination Score Transmission Erythema (Agustina , et al, 2018)

Erythema and pigmentation transmission values were obtained by multiplying each transmission value (T) with the erythema effectiveness factor (Fe) and pigmentation (Fp) at the wavelengths that cause erythema and pigmentation. The percentage of erythema can be calculated by the formula :

$$\% \text{ Transmission Erythema: } T_e = \frac{\sum Ee}{\sum Fe} = \frac{\sum(T \times Fe)}{\sum Fe}$$

While the percentage of pigmentation can be calculated by the formula:

$$T_e = \frac{\sum Ee}{\sum Fe} = \frac{\sum(T X Fe)}{\sum Fe}$$

$$T_e = \sum Ee$$

Results and Discussion

Characterization Extract Ingredients Natural Nanoparticles

EPMS crystals were obtained from kencur rhizomes (*Kaempferia galangal*) using 96% ethanol macerate concentrated to about 100 mL and stored in a refrigerated refrigerator to obtain crystals. The crystals obtained were recrystallized to obtain EPMS crystals. Then produce EPMS crystals which are yellowish white in color with a yield of 2.22%.

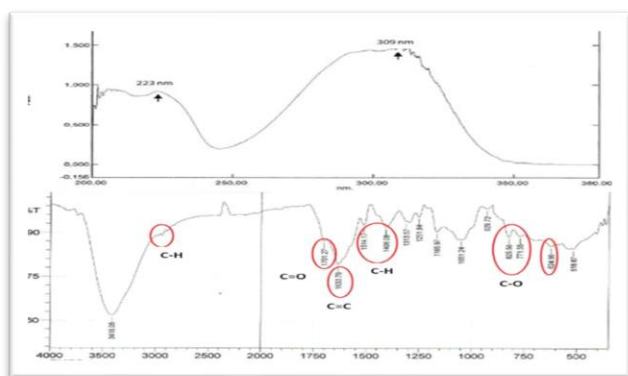


Figure 1. Spectrum pattern of (a) Uv-Vis and (b) FT-IR Spectrophotometer from EPMS rhizome kencur (Agustina et al, 2018)

Figure 1a yields pattern UV-Vis spectral with 2 peaks composite, that is at 223nm (pattern spectral aromatic conjugated) and 309nm (pattern spectral cinnamoyl present of EPMS). Characterization more carry on conducted with FT-IR analysis (Fig. 1b). Analysis FT-IR Analysis this conducted with frequency 500-4000 cm⁻¹.

Table 1. Data from the analysis of the FT IR spectrum of the EPMS compound kencur rhizome (Agustina , et al, 2018)

No.	Frequency (cm -1)	Range (cm-1)	Prediction
1	2933,83	Near 3000 (<)	CH (stretch)
2	1701.27	1820-1660	C=O (stretch)
3	1633,76 and 1514,17	1660-1450	C=C (aromatic)
4	1408.09	1475-1365	C-H (sp2 sp3)
5	1165.97 and 1051,24	1300-1000	C-O (stretch)
6	825.50	1000-800	scent (substituted)

The results of the interpretation of the IR spectrum are shown in Table 1. Figure 1b shows a wave number of 2933.83cm⁻¹, a wave number characteristic of the stretching vibrations of bonds between aromatic groups (CH). Then at 1701.27cm⁻¹ it shows the presence of a carbonyl group (C=O) and mainly shows EPMS properties. Then appeared in the wave number region 1165.97 and 1051.24cm⁻¹, indicating the presence of an ester/ether (CO) group, and in the wave number region 825.5cm⁻¹ the structure was replaced by ethyl p-methoxycinnamate (EPMS).



Name Extract	Beginning of synthesis	The day I	Day II	Day III	IV day
n - hexane (A)					
chloroform (B)					
Ethyl acetate (C)					
Water (D)					

Table 2. Colors sample solutions A (n- hexane extract), B (chloroform extract), C (extract ethyl acetate), D (water extract) for 7 days leaf katapang, and E (process of reducing the ion pH. synthesis process nanoparticles silver) (Payapo et al, 2016)

Characterization color solution conducted for know influence time contact to formation nanoparticles silver on Table 2. Sample A (n - hexane extract), B (extract chloroform), C (extract

ethyl acetate) and D (aqueous extract). Characterized that change color observed from time to time. After synthesized, solution Samples A, B, and C do not changed color from day first until day to seven. This show that silver ion reduction process no happen because existing compound on extracts A, B, and C which play a role as reducing agent no react with AgNO_3 precursor. Sample D is clear moment stirring started, after hushed up for 4 hours of color solution Becomes yellow and after 1 day color solution Becomes yellow brownish,

Color solution Becomes dark along time. Change this signify the process of reducing the ion pH. synthesis process nanoparticles silver, which is measured for 7 days. The addition of 1% PAA in the synthesis process in environment sour solution pH no changed. from the synthesis process 1 day to 7 days because the 1% PAA is not reduce Ag^+ but stabilize size nanoparticles silver results synthesis.

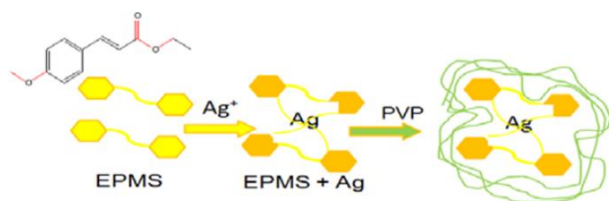


Figure 3. Illustration of the mechanism for the formation of AgNPs (Agustina et al, 2018)

On figure 2. Shows formation the AgNPs that occur are indicated changed from clear turn orange. This is formation indicator AgNPs when the discoloration begins then changes from orange to red could added PVP as a stabilizer. Up to 0.5 grams of PVP in the 40th minute added to prevent discoloration and the increase in absorption also begins to decrease. And at the figure 3. That explain how mechanism for the formation og AgNPs

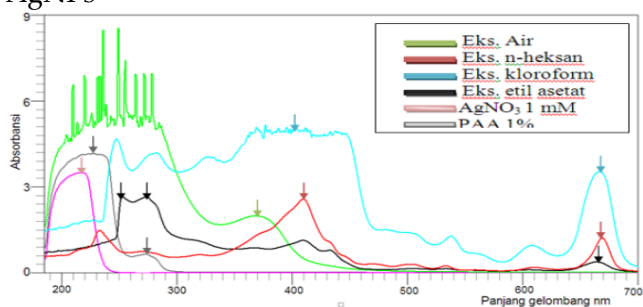


Figure 4. UV-Vis absorption spectrum of n -hexane extract, chloroform, ethyl acetate, water, 1% PAA solution and 1mM AgNO_3 solution leaf ketapang (Payapo et al, 2016)

One instrument that can used for analyze nanoparticles is UV-Vis spectrophotometer. Resonance plasmons surface (SPR) being measured with related UV-Vis spectrophotometer with color solution nanoparticles silver. The SPR n-hexane extract leaf ketapang and extract galangal absorb energy on long wave λ max 669 nm, extract chloroform absorb energy on long wave λ max 667 nm and extract ethyl acetate absorb energy on long wave λ max 667 nm absorbs λ max 664.50 nm and absorb water extract energy on long wave λ max 664.50 nm λ max 368 nm 1 mM AgNO_3 solution absorbs energy at λ 216.50 nm whereas 1% PAA solution absorbs energy at λ max 273 nm. Pattern uptake and long wave maximum is base for monitor formation nanoparticles silver, deep Thing colloid silver give peak uptake on long wave around 400-500 nm, indicating peak typical plasma absorption from nanoparticles silver (Wibowo et al, 2018) .

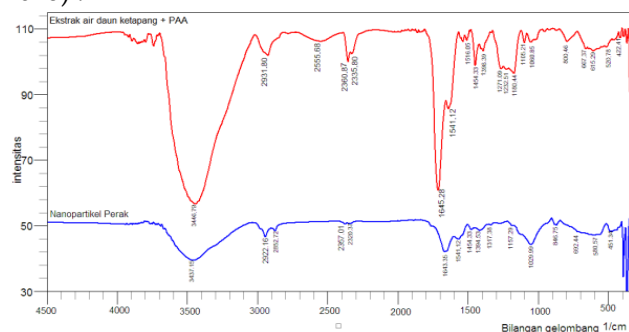


Figure 5 . AgNP FTIR results Leaf Ketapang (Payapo et al, 2016)

FTIR silver nanoparticles extract leaf ketapang. It can be seen that the wavelength spectrum of the aqueous extract of ketapang leaves changes before and after reduction at figure 5. Absorption at ν (wave number) 3446.79 cm^{-1} appears in the IR spectrum of aqueous extract of ketapang leaves, this absorption shows a typical absorption of the O-H group with a wide and strong band. The absorption of the C=O group with sharp peaks at ν 1645.28 cm^{-1} and 1080.85 and 1106.21 cm^{-1} is the absorption of the C-O group. At the same time, the amount in the IR spectrum of the silver nanoparticles was reduced by the aqueous extract of ketapanga leaves. Waves in the O-H, C=O and

CO groups with wave numbers of 3437.15 cm⁻¹, 1643.35 cm⁻¹ and 1029.99 cm⁻¹ respectively. The shift in wavelength is clearly visible between the aqueous extract of ketapanga leaves and the silver nanoparticles. Changes in wave number indicate an interaction between the functional groups and silver nanoparticles due to the oxidation process caused by the reduction process of silver nanoparticles. The absorption band with broad and strong intensity v 3446.79 cm⁻¹ is caused by the OH groups of phenol and the OH groups of polyacrylic acid groups.

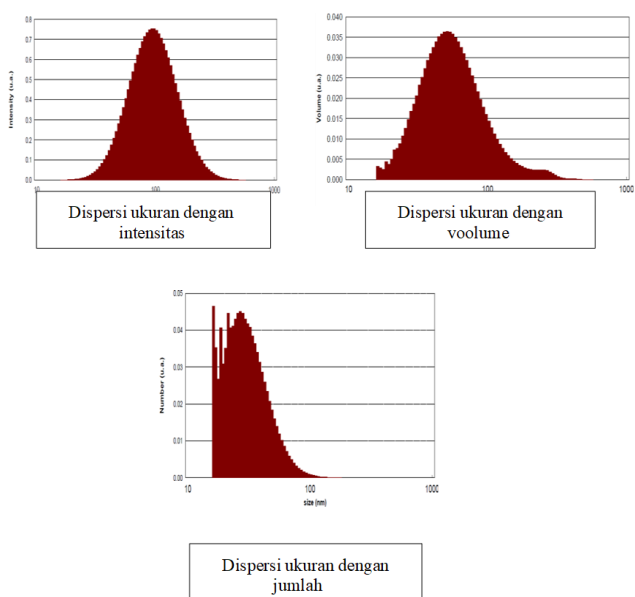


Figure 6. AgNP PSA Analyst leaf ketapang water extract based on intensity, volume and amount dispersion (Payapo et al, 2016)

The results of determining the size distribution of aqueous silver nanoparticles using PSA are shown in Fig Figure 6. Shows that the sample measured using PSA has a size of silver nanoparticles based on intensity dispersion which is 106.16 nm, based on volume 65.14 nm, based on amount is 31.14 nm so that the average size obtained is 92.48 nm

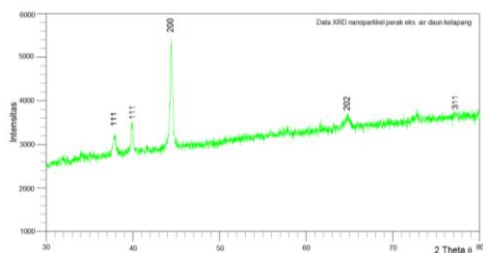


Figure 7. Nanoparticle XRD pattern silver (Payapo et al, 2016)

XRD analysis aims for determine the crystal size of nanomaterials through quantitative and qualitative analysis on the identification of diffraction patterns and peak intensities. The XRD pattern of silver nanoparticles can be seen in Figure 7. The peaks of the silver nanoparticle diffraction pattern are clearly shown at 2θ values, namely 37.85°, 39.86°, 44.41°, 64.70°, and 77.38° with FWHM values (Full widths at Half Maximum) respectively 0.3853, 0.2877, 0.3254, 0.6038, and 0.3300 and miller indices respectively {111}, {200}, {202}, and {311}. The diffraction pattern of silver nanoparticles is found at diffraction peaks of 38.11°, 44.30°, 64.44° and 77.40° which are indicated by Miller indices (111), (200), (220), and (311). Based on the JCPDS database, the results of XRD measurements indicate the presence of silver nanoparticles with a cubic crystal system.

Table 3. Size Nanoparticles silver based on FWHM value (Payapo et al, 2016)

No. 2θ (deg) (nm)	Height (cps)	FWHM (deg)	Size particle
1 37,85	286	0.3853	42,47
2 39,86	444	0.2877	59
3 44,41	44,41	0.3254	53,48
4 64,70	190	0.6038	31,74
5 77,38	59	0.3300	63,48

Figure 8 shows the results of measurements using SEM which show that the AgNPs particles give a mono- disper spherical shape. The addition of glycerol in the AgNPs synthesis process helps in the formation of mono- dispersed AgNPs. However, at a certain magnification the resulting AgNPs still form aggregates. It is also obtained based on PSA measurement results Figure 7 which shows the diameter of the AgNPs particle size obtained an average value of 182 nm

Figure 8 . Measurement results (a) SEM at 10 μm and 200 μm magnification, (b) PSA Agustina et al, 2018)

Concentration	% Transmiss Erythema	% Pigmentation Transmission	Category	SPF	Category
AgNPs			3	Sumb	36.
EPMS	0.1		1.6	lock	4
conjugation	55				Protect ion ultra
ppm					
EPMS			7.	Sumb	
1000	0.0		51	lock	38.46
ppm	78				protect ion ultra

Determination SPF value (Sun Protection factor) (Agustina , et al, 2018)

The UV - Vis spectrophotometer was first calibrated using 70% ethanol and 1 mL was put into the cuvette. Absorption curves were made in cuvettes with wavelengths between 290-320 nm, ethanol pa was used as a blank. Then the average absorption was determined with an interval of 5 nm. The absorbance of each concentration was recorded and then the SPF value was calculated

$$CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Test Sun Protection Activities (Agustina , et al, 2018)

The EPMS-conjugated AgNPs sample solution tested was 200 ppm at a wavelength of 292-372 nm while for the EPMS sample without AgNPs it was at a concentration of 1000 ppm. The data from Table 13 shows that AgNPs conjugated with EPMS at a concentration of 200 ppm can be categorized as a sunblock with an SPF value of 36.4, while EPMS without AgNPs conjugate at a concentration of 1000 ppm has an SPF value of 38.4. It can be concluded that small concentrations of EPMS-conjugated AgNPs samples have ultra-protective power when compared to those without AgNPs conjugation.

Table 4. Calculation results of % erythema transmission, percentage of pigmentation and SPF (Green Synthesis Silver Nanoparticles (Agnps) Conjugated Ethyl Paramethoxy Cinnamate (Epms) as a Sunscreen Material) (Agustina et al, 2018).

Discussion

Silver nanoparticles (AgNPs) can be produced from a variety of methods including photochemistry, sonochemistry, ultrasonic radiation, solvothermal synthesis, polyols and chemical reduction of silver ions with or without stabilizing agents (Guzmán et al, 2008) Development of other methods of synthesizing AgNPs can be done using the green technique synthesis. Green synthesis is a method for making AgNPs by utilizing natural materials as bioreductors (Makarov et al, 2014). On figure 1 on EPMS (ethyl paramethoxy cinnamat) obtained from kencur rhizomes (*Kaempferia galangal*) which involves an extraction process by maceration method using 96 % ethanol and

crystallization which involves cooling on Uv-Vis obtained long wave 223nm (spectrum pattern conjugated aromatic) and 309nm (spectrum pattern cinnamoil contained in EPMS). Whereas on figure 2 FT-IR. FT-IR analysis aims to identify the groups that are bound to the synthesized complex compound. This analysis was carried out at a frequency of 500-4000 cm^{-1} . The results of the interpretation of the IR spectrum are shown in table 1 states that the wave number 2933.83 cm^{-1} is a specific wave number for the bond stretching vibration between C-H in the aromatic group then on long waves 1701.27 cm^{-1} indicates the presence of a carbonyl group (C=O) and specifically shows the characteristics of EPMS. 1165.97 and 1051.24 cm^{-1} indicate the presence of an ester/ether group (C-O) and is substituted at the para position shown in the wave number region of 825.5 cm^{-1} . Ethyl cinnamic esters such as ethyl paramethoxy cinnamic (EPMS) is one of the most abundant chemical compounds in kencur rhizomes and is a very important part in the cosmetic industry because it has benefits as a whitening agent and antiaging or aging in skin tissue (Rosita et al, 2006)

Next on indicator color formation nanoparticles silver (Agnps) occurs change color from clear color to orange. This is an early identification indicating the formation of AgNPs. When the color change began to change from orange to reddish then 1% P AA was added as a stabilizer . This change indicates the occurrence of ion reduction process. The most effective stabilizer used is polymer 3 which functions to prevent agglomeration. Some polymers that have been used as stabilizers, among others poly vinyl alcohol (PVA), poly vinyl pyrrolidone (PVP), poly ethylene glycol (PEG), poly styrene sulfonate (PSS), poly acrylic acid (PAA) and chitosan (Marliyana et al, 2006). Whereas on FTIR instrument (figure 5) of reduced silver nanoparticles using water extract of ketapang leaves shows a shift in number. waves in the O-H group, C=O and C-O groups with wave numbers 3437.15 cm^{-1} , 1643.35 cm^{-1} , 1029.99 cm^{-1} respectively. The shift in wavenumber indicates that there is an interaction between the functional groups and the silver nanoparticles due to this oxidation process due to reduction process of silver nanoparticles.

Whereas PSA results (figure 5) were obtained The size of the silver nanoparticles based on the intensity dispersion is 106.16 nm, based on the volume of 65.14 nm, based on the amount is 31.14 nm so that the average size obtained is 92.48 nm. XRD analysis (figure 7) aims for determine the crystal size of nanomaterials through quantitative and qualitative analysis on the identification of diffraction patterns and peak intensities. The XRD pattern of silver nanoparticles shows the presence of silver nanoparticles with a cubic crystal system or mono-dispersive. Figure 7 shows the results of measurements using SEM which show that the AgNPs particles give a mono-dispersive spherical shape.

Conclusions

Based on results study could concluded that AgNPs could conjugated with EPMS rhizomes kencur that shows characteristics shape spherical monodisperse, though aggregation no could avoided during the synthesis process. AgNPs EPMS conjugated can used as ingredients active in category veil solar, give protection to exposure UV light on concentration low (200ppm), classified ultraproductive with an SPF of 36.4. Otherwise on n-hexane extract, chloroform and leaf water ketapang (*Terminalia catappa*) can used as agent bioreduction in synthesis nanoparticles silver, and no formed nanoparticles silver with help extract ethyl acetate. Solution mixture sour hydroxycinnamate and nanoparticles silver could function as veil Sun with SPF value 2.22; 2.63; 2.8; 2.99 and 3.39 as well capable protect skin from UV-B rays. The more tall concentration solution sour hydroxycinnamate, increasingly tall activity veil Sun.

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