International Journal of Public Health Excellence (IJPHE)
Vol. 2, No. 1, December 2022, pp. 360~368
Journal Homepage: https://ejournal.ipinternasional.com/index.php/ijphe
ISSN: 2809-9826, DOI: 10.55299/ijphe.v2i1.233

Gel Formulation of Lipid Nanoparticles and Zn Nanoparticles of Okra Fruit Extract (Abelmoschus Esculentus L.) and Sunscreen Activity Test

Christina Astutiningsih [1], Ebta Narasukma Anggraeni [2]
[1,2] Sekolah Tinggi Ilmu Farmasi Yayasan Pharmasi, Semarang, Indonesia

Article Info

Article history:

Received November 30, 2022
Revised December 04, 2022
Accepted December 16, 2022

Corresponding Author:

Christina Astutiningsih,
STIFAR Pharmacy Semarang Foundation
Jl. Lieutenant General Sarwo Edhi Wibowo Km-1, Plamongansari, Semarang-Indonesia
Email: christinaastutiningsih@gmail.com

ABSTRACT

Depletion of the ozone layer and environmental pollution has a negative impact on the skin because these conditions make it easier for UV rays to damage the skin and even cause skin cancer. One of the efforts made to reduce the harmful effects of UV rays can be overcome with quality cosmetic products using nanotechnology. This study aims to formulate a lipid nanoparticle gel with okra fruit extract as the active substance and the Zn nanoparticle gel with okra fruit extract as bioreduction. Lipid nanoparticles were prepared from lecithin phospholipids and okra fruit extract by heating at 600°C and sonification for 30 minutes. Meanwhile, Zn nanoparticles were prepared by adding Zn acetate extract to okra fruit extract in a ratio of 1:9 and heating for 90 minutes. Zn nanoparticles of fruit extracts have a wavelength of 360-380. The average particle size of lipids was 140.734 ± 4.53nm, while the average particle size of Zn nanoparticles was 136.79 ± 6.41nm. The physical characteristics of the gel from lipid nanoparticles are as follows: viscosity of 4225 pcs; pH 7.53; spreadability of 4.54 cm and adhesion of 5.65 seconds while the viscosity of the Zn nanoparticle gel was 4123 pcs; pH 7.24; spreading the power of 4.11 cm and adhesion power of 5.42 seconds. Lipid nanoparticle gel preparation of okra fruit extract has an SPF value of 20.1076, erythema is 0.2172% and percent pigmentation is 0.2295%, while Zn nanoparticle gel has an SPF value of 21.7865, erythema is 0.2173% and percent pigmentation is 0,2105%.

Keywords: Gel, Lipid Nanoparticles, Zn Nanoparticles, Okra Fruit, Sunscreen

1. INTRODUCTION

Excessive exposure to sunlight, especially light with a wavelength of 200-400nm or what is called UV light, can cause erythema, and premature aging which can even lead to skin cancer. To overcome the negative impact of UV rays can be overcome by using sunscreen [1]. Sunscreen is a cosmetic product that has therapeutic efficacy on the skin for the treatment of photoaging, hyperpigmentation, and others.

Cosmetics may contain synthetic or natural ingredients. Cosmetics derived from natural or herbal ingredients are becoming increasingly popular in the field of beauty because most women choose natural products over synthetic products because they have relatively few side effects. The ability of an ingredient to improve skin function depends on the formulation and delivery system to reach the active target in sufficient quantities to deliver and release the active ingredient from the carrier [2]. One approach that can be used in delivering herbal cosmetics is a nanoparticle-based delivery system.

In this study, the nanoparticles that will be made are lipid nanoparticles. Lipid nanoparticles are nano-sized particles composed of lipid molecular components. Lipid-based nanoparticles have several advantages such as low toxicity for in vivo testing, the ability to improve physical properties, improve drug encapsulation, and great potential in drug release [3]. Lipid nanoparticles were prepared by forming soy lecithin phospholipid nanoliposomes by heating and stirring. Soy lecithin contains unsaturated fatty acids and has excellent skin penetration and high compatibility in the body [4]. Lipid nanoparticles can combine the lipophilic and hydrophilic properties of preparations [5].

In addition, this research will also produce Zn nanoparticles which will be produced through the green chemistry method because it uses plant extracts for bioreduction. Among the biological systems, plants are preferred for the biosynthesis of Zn nanoparticles because of the rich diversity of plant-providing phytochemicals and their

potential as sunscreens. The biosynthesis of nanoparticles will involve secondary metabolites from plants such as flavonoids, terpenoids, and so on [6]. In this research, the natural material that will be used to produce lipid nanoparticles or Zn nanoparticles is an okra fruit extract. Okra fruit is rich in biotic substances such as polysaccharides, fats, polyphenolic fibers, and also contains secondary metabolites such as hydroxyl, carboxyl, and flavonoid amino groups [7]. So, it has the potential as a chelating agent, bioreductor, and stabilizing agent in the synthesis of nanoparticles.

Flavonoids contained in okra fruit are quercetin compounds. Quercetin is the largest flavonoid about 60-75% of the total flavonoid compounds in Okra fruit [8]. The content of phenolic compounds in plants is thought to have antioxidant activity so that they can protect the skin from UV rays. The ability of a compound as an antioxidant will be directly proportional to the ability of the compound as a skin protector or sunscreen. An increase in sunscreen activity is indicated by a greater value of Sun Protection Factor (SPF) [9] and an increase in antioxidant potential is indicated by a decrease in IC50 value.

Okra fruit extract on lipid nanoparticles is used as an active substance while on Zn nanoparticles it is used as bioreduction. ZnO nanoparticles can be synthesized by the green synthetase method using okra fruit extract. The content of flavonoids contained in okra fruit extract plays a role in forming nano-sized particles in the nanoparticle synthesis process by reacting with metal salts [10]. Based on previous research, the flavonoid content in the ethanol extract of okra fruit was 319.18 mg/100g [11].

In this study, lipid nanoparticles and Zn nanoparticles were formulated as topical preparations, namely in the form of gel preparations because these preparations have good penetration ability and will be used to improve the aesthetics and ability of lipid nanoparticles and Zn nanoparticles. With a good penetration ability of the active substance of the preparation, it is expected to increase the ability of the preparation as a sunscreen. The development of both nanoparticle and nanolipid preparations needs to be characterized using a Uv-Vis spectrophotometer and an IR spectrophotometer and PSA. The physical properties of gel preparations can be viewed from their physical parameters, namely homogeneity, pH, viscosity, spreadability, and adhesion. Sunscreen activity was carried out in vitro by determining the SPF value, percentage of erythema, and percentage of pigmentation.

2. METHOD

A. Research Tools

Glassware, Rotary evaporator, UV Spectrophotometer, IR Spectrophotometer, Particle Size Analyzer, pH meter, Viscosimeter, mortar and stamper, blender, adhesiveness tester, spreadability tester, oven, muffle furnace, analytical balance, hot plate, magnetic stirrer, sonicator, weights, spreadability test equipment, adhesion test equipment, object glass.

B. Research Materials

Okra fruit obtained from the Toroh area, Purwodadi; $Zn(CH_3COO)_2.2H_2O$) (Brand), soybean lecithin; triethanolamine; carbopol; aqua dest; propyleneglycol; triethanolamine; and glycerin from Bratachem; ethanol pa (Merck).

C. Research procedure

1. Preparation of Okra Fruit Extract

The okra fruit was cut into pieces and 10 grams were taken and heated with 100 mL distilled water for 10 minutes at 85^0C. After that, the water extract is cooled and filtered.

2. Preparation of Okra Fruit Extract Lipid Nanoparticles as Active Substances

Lipid nanoparticles were made by weighing 12 grams of soy lecithin, then reducing the particle size in a mortar, and then dispersing it homogeneously in 200 ml of aquabidest at 60^0C. The lecithin and aquabidest suspension were blended at high speed for approximately 1 minute. The suspension was then sonicated until it became homogeneous. Then the lecithin suspension was put into the sonicator bath with 80 ml of okra fruit extract at 60^0C for 30 minutes [4].

3. Preparation of Okra Fruit Extract Zn Nanoparticles

10 ml of okra fruit extract mixed with 0.15M $ZnCH(COO)_2.2H_2O$ with a ratio of 1:9 stirred for 1 hour at 85^0C. Then added NaOH to pH 8. The mixture was stirred continuously for 1 hour and allowed to stand for 12 hours. The solid formed was centrifuged at 4000rpm for 10 minutes and distilled water. The solids were dried at 100^0C for 6 hours and then a calcination process was carried out in a muffle furnace at 450^0C for 4 hours [12].

4. Wavelength Determination

Maximum wavelength measurement is the first step to determining Zn nanoparticles. Zn nanoparticle indicators are wavelengths with maximum absorbance in the range of 360-380nm [13].

5. Size Determination of Lipid Nanoparticles and Zn Nanoparticles

The formation of lipid nanoparticles and Zn nanoparticles can be determined by the Particle Size Analyzer (PSA) test.

6. Gel Formulation

In 100 ml of lipid nanoparticles or Zn nanoparticles, 3 grams of carbopol was expanded for 24 hours. Then carbopol 3% w/v as much as 50 grams then added TEA in a mortar and stirred until homogeneous for about 5 minutes. Then put the Carbopol and TEA mixture into the blender and add propylene glycol and glycerin and blend for about 5 minutes at low speed.

Table 1. Gel Formulas for Lipid Nanoparticles and Zn Nanoparticles

Ingredient	Weight (grams)
Carbopol 3% b/v	50
Propylene glycol	30
Glycerin	60
Triethanolamine	2,4

7. Determination of the physical characteristics of the gel

Organoleptic: observations made included the color and smell of the gel preparation of lipid nanoparticles and Zn nanoparticles from okra fruit extract [13].

Homogeneity Test: lipid nanoparticle gel and Zn nanoparticles from okra fruit extract taken sufficiently placed on top of the glass object and covered with another glass object then the two glass objects are pressed, the layers are observed visually, nanolipid gel and okra fruit nanoparticles said to be homogeneous if the color of the preparation is evenly mixed [14].

pH test: measurement of the pH of the preparation with a pH meter of the preparation lipid nanoparticle gel and Zn nanoparticles from okra fruit

Viscosity test: preparation viscosity lipid nanoparticle gel and Zn nanoparticles from okra fruit extract using a Brookfield DV-1ME viscometer)

Stickiness test: as much as 0.25 gram lipid nanoparticle gel and Zn nanoparticles from okra fruit extract placed between 2 glass objects whose area has been determined, then pressed with a load again for 5 minutes. The glass object is mounted on the test equipment, the load weighing 50 grams is released and the time is recorded until the two glass objects are released [15].

Spreadability test: carried out by comparing the diameter of the distribution of the preparation lipid nanoparticle gel and Zn nanoparticles from okra fruit extract on the glass plate after loading. The experiment was continued each time with the addition of a load weighing 50 grams and allowed to stand for 1 minute, recording the diameter of the gel spread until a constant spreading power was obtained [15].

8. Sunscreen Activity Test

Determination of the effectiveness of sunscreen is done by determining the SPF value in vitro with a spectrophotometer [16]. Okra fruit extract, lipid nanoparticles, Zn nanoparticles, and both gel preparations were weighed 0.5 gram dissolved in ethanol up to 25 ml, and then read on the spectrophotometer. The absorbance spectrum of samples in solution was read at wavelengths between 290 and 375. nm with intervals of 5. The value of SPF, percent erythema and percent gel pigmentation of lipid nanoparticles and Zn nanoparticles of okra fruit were calculated using mathematical equations [17,18].

3. RESULTS AND DISCUSSION

3.1. Phytochemical extraction and screening

Okra fruit extract contains several secondary metabolite compounds including flavonoids, alkaloids, tannins, steroids/triterpenoids, this can be proven from the results of screening and identification by TLC of aqueous extracts to be used for the manufacture of lipid nanoparticles and Zn nanoparticles. The results of the identification can be seen in table 1 below.

Table 2. Results of Phytochemical Screening and TLC Tests of Okra Fruit Aqueous Extract

class	Extract	
	Chemical identification	**TLC identification**
Phenolic	Blue black	+ Rf 0.83 stain
tannins	Blue black	+ Rf 0.83 stain
Flavonoids	Orange amyl alcohol coating	+ Rf 0.73 stain
Saponins	+ Stable foam	+ yellow stain Rf 0.39
Triterpenoids	+ green	+ Rf 0.31 green stain
Alkaloids	With a brick red precipitate dragendrof	+ brown orange stain Rf 0.74
	With a white precipitate dragendrof	
	With a brick red precipitate dragendrof	

The okra fruit extract is made with water as a solvent so that the extract can be used as bioreduction in the formation of Zn nanoparticles because that is a requirement for bioreducing compounds in the formation of nanoparticles. For the formation of lipid nanoparticles, the water extract is used as an active substance with the consideration that there are many secondary metabolites are capable of providing sunscreen activity, especially the phenolic, flavonoid and terpenoid groups. The biosynthesis of nanoparticles itself is also thought to involve secondary metabolites from plants such as terpenoids and flavonoids [19].

3.2. Formulation of Lipid Nanoparticles and Zn Nanoparticles

The lipid nanoparticles obtained were yellow-orange in color and had a characteristic odor of soy lecithin, while the Zn nanoparticles had a clear yellowish color with a characteristic odor of okra fruit. Lipid nanoparticles of okra fruit extract and Zn nanoparticles which will then be formulated into gel preparations can be seen in Figure 1 below.

(a) (b)

Figure 1. Lipid Nanoparticles (a) and Zn Nanoparticles of Okra Fruit Extract (b)

The formation of lipid nanoparticles can be identified after the Particle Size Analyzer (PSA) test and the value of the polydispersion index are carried out. The results of the liposomes that are made are yellow-orange turbid, liposomes with a cloudy color are possible because not all of the lecithin added forms liposomes perfectly and is still a colloidal or micelle dispersion [20].

The formation of Zn nanoparticles can be immediately identified by measuring the maximum wavelength using a UV-Vis spectrophotometer, if the Zn nanoparticles formed have a wavelength of 360-380nm, it means that Zn nanoparticles have been formed. To find out the size of the particles can be supported by measurement data with PSA. This is one of the advantages of Zn nanoparticles compared to lipid nanoparticles, namely the success of the formulation can be known after manufacture. In this study, the wavelength measurement was carried out after 24 hours of storage. The average wavelength measurement results of Zn nanoparticles are 372.4nm. These wavelengths indicate that Zn nanoparticles can already be formed.

To determine the formation of Zn nanolipids and nanoparticles from okra fruit extract, particle size measurements were carried out using a PSA instrument. PSA measurement results can be seen in table 3 below.

Table 3. Particle Size Analysis (PSA) of Lipid Nanoparticles and Zn Nanoparticles with Okra Fruit Extract

Replication	Nanolipids		Zn Nanoparticles (nm)	
	Particle size(nm)	Polydispersion Index	Particle size(nm)	Polydispersion Index
1	141, 42	0.288	137.54	0.214
2	139.76	0.312	133.81	0.239
3	144, 87	0.287	142.98	0.254
4	140.98	0.311	130.97	0.243
5	136.64	0.296	138.65	0.275
Average	140.73±		136,79±	

The results of measuring the particle size of the okra fruit extract lipid nanoparticles were larger than the Zn nanoparticles, this was because the okra fruit extract was added to the lipid nanoparticles which act as active compounds so that the colloidal dispersion could not form completely thus affecting the size of the lipid nanoparticles. While the okra fruit extract on Zn nanoparticles acts as a bioreductor on Zn acetate and can produce nanoparticles with a smaller size.

The polydispersion index is a measure of the distribution of molecular masses in a particular sample. The smaller the polydispersity index value, the more stable the formula of a preparation made, this is because the greater the polydispersity index value indicates that the particles formed are not uniform, so the formula will flocculate quickly. The polydispersity index values obtained in this study can be said to be good because they fall into the range of 0.08 – 0.7 which is the mean value of the polydispersity index in general. The polydispersity index is said to be poor if it has a size > 0.7 because it is very polydispersity and shows a very wide distribution of particle sizes so sedimentation is likely to occur.

Analysis with the t test at the 95% confidence level obtained a p value of 0.22. Thus the mean particle size and polydispersion index of lipid nanoparticles and Zn nanoparticles were not significantly different. This is because the extract on the okra fruit Zn nanoparticles will initiate the Zn acetate reduction reaction which will reduce the particle size but in the lipid nanoparticles, the particles will be reduced by the colloidal dispersion reaction of lecithin(4). The ZnO nanoparticles formed have an average particle size that is smaller than standard ZnO which has a size of 318.90nm [6].

3.3. Gel Formulation

Furthermore, lipid nanoparticles and Zn nanoparticles were formulated into gel preparations. The gel was made with a composition of carbopol, triethanolamine, propylene glycol, glyceryl, and a system of lipid nanoparticles and Zn nanoparticles of okra fruit extract. Carbopol is used as a hydrophilic gel base, triethanolamine is a weak base that functions to neutralize carbopol solutions and increase the consistency of carbopol solutions. Propylene glycol and glycerin are used as humectants to keep the preparation moist and skin moist when used. In this study, a combination of glycerin and propylene glycol was used because glycerin as a humectant usually causes a heavy and tacky feeling when used, so it needs to be combined. Evaluation of the gel characteristics of lipid nanoparticles and Zn nanoparticles included organoleptic, homogeneity, pH, viscosity, spreadability, adhesion and lotion type. The results of the gel produced in the formulation can be seen in Figure 3 below

(a) (b)

Figure 3. Okra Fruit Extract Nanolipid Gel (a) and Okra Fruit Extract Zn Nanoparticles (b)

The results of testing the physical characteristics of the two resulting gels can be seen in table 4 below.

Table 4. Test Results for Physical Characteristics and Gel Stability of Lipid Nanoparticles and Zn Nanoparticles of Okra Fruit Extract

Physical characteristics	**Gel**	
	Lipid Nanoparticles	Zn nanoparticles
Organoleptic Color Smell Consistency	 Orange yellow Typical gel	 Pale yellow Typical gel
Homogeneity	homogeneous	homogeneous
pH	7,53	7,24
Viscosity	4225	4123
Spreadability (cm)	4.54	4,11
Stickiness (seconds)	5.65	5,42

The results of the organoleptic evaluation showed that the preparation of lipid nanoparticles was orange yellow and Zn nanoparticles were pale yellow. In testing, the homogeneity of the two formulas showed a homogeneous preparation. The homogeneity test aims to determine the mixability of each ingredient in the preparation. The requirement for a gel preparation is that if it is applied to a piece of glass it does not show any spots or coarse grains between the constituent components of the gel. The homogeneity of preparation will affect the effectiveness of therapy because it relates to the same drug levels for each use. If the preparation is homogeneous, it is assumed that when using or taking the active substance levels will always be the same [19].

Furthermore, the evaluation of the pH of the gel preparation was carried out which aims to determine whether the pH of the gel produced corresponds to the pH of the skin. The suitability of the skin pH with the pH of the topical preparation affects the skin's acceptance of the preparation. Based on the pH value of all formulas, the pH of the gel meets the requirements for the pH of the preparation, namely 4.5-8 [20]. Gels that have a pH that is too alkaline can cause the skin to dry out, whereas if the pH is too acidic, it will cause irritation [21]. The resulting pH value was then subjected to statistical analysis which showed that the pH data of all gel preparations showed no significant difference.

In this study, the viscosity measurement used a Brookfiled viscometer. The viscosity requirement according to SNI 1996 is 2000-50,000, so the gel preparation of lipid nanoparticles and Zn nanoparticles from okra fruit extract fulfills these physical requirements. The higher the viscosity will increase the resistance of the preparation to flow which will affect the activity of the sunscreen, spreadability and adhesion. However, a preparation that is too thick will make it difficult to use it on the skin so that its spread is limited. The resulting viscosity was then subjected to statistical analysis which showed that the viscosity data of all gel preparations showed no significant difference. The viscosity of the preparation is affected by the carbopol composition, because carbopol acts as a gel former which will form a gelling matrix [22].

According to Ulaen [21], the criteria for a good semi-solid preparation are in the range of 5-7cm spreadability. Great spreading power indicates that the diffusion of the preparation will be better and more even. The results of the physical characteristics of the gel preparations of lipid nanoparticles and Zn nanoparticles of okra fruit extract fulfilled the spreadability range requirements of 7.63-7.02. It can be seen that the difference in the viscosity of the preparation is inversely proportional to the spreading power of the preparation, namely the higher the viscosity of the preparation, the smaller the spreading power. The resulting spreadability was then subjected to statistical analysis which showed that the spreadability data from the preparations showed no significant differences.

The adhesion test aims to determine the ability of the gel to stick when applied to the skin. The greater the adhesive power of lipid nanoparticles and Zn nanoparticles from okra fruit extract, it is expected that the contact of the gel with the skin will be longer. The adhesive power is directly proportional to the viscosity, if the resulting viscosity is large, the adhesive power produced will also be longer. The adhesion test is related to the length of time the preparation can be attached to the skin so that it affects the absorption of the active substance. The contact time of the active substance with the skin for a long time will maximize the release of the active compound. The standard for good adhesion for semisolid preparations is more than 4 seconds [23]. The results of the physical characteristics of the gel preparations of lipid nanoparticles and Zn nanoparticles had a natural adhesion of more than 4 seconds, namely 5.23 – 5.27 seconds. Gel contact time with the skin is longer and produces a maximum effect. The resulting adhesiveness was then subjected to statistical analysis which showed that the adhesiveness data of all gel preparations showed no significant differences.

3.4. Sunscreen Activity Test

Subsequent research was conducted to determine the ability of lipid nanoparticles, Zn nanoparticles, and gel preparations as sunscreens. This study compared the activity of each sunscreen with the parameters of the SPF value, percentage of erythema and percentage of pigmentation. Determination of sunscreen activity is done by calculating

the SPF (Sun Protecting Factor) value, this value can be used as an indicator of the effectiveness of a substance as a UV protector. The higher the SPF value, the greater its ability to protect against sun exposure which is calculated using a mathematical equation [17,18]. The test results for lipid nanoparticles, Zn nanoparticles, and gel from the two nanoparticles as sunscreen with the parameters SPF, % erythema, and % pigmentation can be seen in the table below.

Table 5. Sunscreen Activity Test Results

Sample (replication)	SPF value	% Erythema	% pigmentation
Okra Fruit Extract			
1	15.6542	0.2125	0.3006
2	16.9852	0.2350	0.3242
3	16,1986	0.2192	0.3002
4	15.8754	0.2213	0.3222
5	17.8791	0.1977	0.3154
Average	16.5185	0.2231	0.3125
Lipid Nanoparticles			
1	22.1824	0.2125	0.2576
2	23.2316	0.2139	0.2885
3	21.3190	0.2192	0.2765
4	20.5087	0.2213	0.2643
5	24.2098	0.1977	0.2876
Average	22.2903	0.2129	0,2749
Zn nanoparticles			
1	24.1225	0.1425	0.2441
2	25.2514	0.1350	0.2412
3	23.8692	0.1329	0.2431
4	21,6743	0.1221	0.2416
5	25.7153	0.2098	0.2229
Average	23.7265	0.1465	0.2403
Lipid Nanoparticle Gel			
1	18.5654	0.2081	0.2198
2	19.6765	0.2125	0.2406
3	20.8761	0.2350	0.2187
4	19.6548	0.2392	0.2432
5	21.7653	0.1913	0.2254
Average	20.1076	0.2172	0.2295
Zn Nanoparticle Gel			
1	19.8977	0.2190	0.2111
2	21.9875	0.2166	0.2123
3	22.6587	0.1898	0.2012
4	22.6232	0.2243	0.2092
5	21.7654	0.1978	0.1987
Average	21.7865	0.2173	0.2105

In addition to the SPF value, the percent erythema and pigmentation percentage values were also determined. The smaller the percent erythema and pigmentation percentage values, the less UV light is being transmitted, so it has great activity as a sunscreen [24]. Lipid nanoparticle gel and Zn nanoparticles of okra fruit extract as sunscreen are considered good because of their ability to protect the skin as indicated by an SPF value above 15 [25]. The SPF value of lipid nanoparticles and Zn nanoparticles has increased.

Based on the results of the calculation of the value of % Te dam % Tp <1%, the preparation can be categorized as a total sunblock. Sunblock is a product that protects the skin by reflecting ultraviolet rays.The use of nanoparticles in sunscreen preparations and other cosmetic preparations aims not only to increase activity, but also to achieve long lasting effects and increase the stability of preparations. Nanoparticle preparations have advantages as sunscreens because they have excess free energy and a larger surface area so they are able to provide better activity because they are able to absorb more UV light which results in a higher SPF value. SPF of nanoparticle lipid and nanoparticle Zn from okra fruit extract can be increased from the extract but experienced a slight decrease after being formulated. Analysis with the t test at the 95% confidence level obtained a p value of 0.02 meaning that there was significant difference in the activity of sunscreenform okra fruit extract with lipid nanoparticles and nanoparticles Zn. particle size and polydispersion index of lipid nanoparticles and Zn nanoparticles were not significantly different. Analysis with the t test at the 95% confidence level obtained a p value of 0.015 meaning that there was not significant difference

in the activity of sunscreenform okra fruit extract with lipid nanoparticles and nanoparticles Zn. particle size and polydispersion index of lipid nanoparticles and Zn nanoparticles were not significantly different.

The ability of the gel of lipid nanoparticles and Zn naoparticles of okra fruit extract as a sunscreen is due to the fact that the samples contain phenol and flavonoid secondary metabolite compounds. Phenol and flavonoid compounds are reported to be able to absorb UV radiation so that they have photoprotection abilities. Absorption of UV light by flavonoids causes changes in the structure of flavonoids. The mechanism of flavonoids in protecting the skin from UV exposure is by absorbing UV rays that penetrate the skin. Flavonoids act as chromophores and have a structure in the form of conjugated double bonds [26]. Flavonoids that absorb UV light will excite electrons from the ground state to orbitals with higher energy [27]. Flavonoids in extracts or lotions will be able to absorb UV rays that hit the skin and when the electrons return to their original state, the absorbed UV rays are then emitted but with much smaller energy. UV light energy produced by flavonoids is converted into heat energy which is harmless to the skin. This mechanism will further minimize the appearance of erythema.

Flavonoid compounds contained in okra fruit extract which are also antioxidants will provide a synergistic effect in protecting the skin against UV radiation with different and complementary mechanisms because antioxidants will act as filters on the surface of the skin, absorbing or reflecting UV radiation and antioxidants work well in surface as well as into the deep layers of the skin, it also fights oxidative stress so as to provide more complete and stronger protection against sunlight.

4. CONCLUSION

Lipid nanoparticles and Zn nanoparticles from okra fruit extract have met the requirements as nanoparticles with an average size of lipid nanoparticles is 140.734 ± 453 and Zn nanoparticles is136,79 ± 641 The characteristics of the gel preparations of lipid nanoparticles and Zn nanoparticles of okar fruit extract fulfilled the requirements and had good stability. Okra Fruit extract average SPF is 16.5185. Lipid nanoparticle average SPF is 20.1076 and lipid nanoparticle gel SPF average is 23.7265 while Zn nanoparticles SPF average is 23.7265 and Zn nanoparticles gel SPF average is 21.7865.

ACKNOWLEDGEMENTS

The author would like to thank the College of Pharmacy Science Pharmasi Semarang Foundation which has provided funds to carry out this research in the Foundation Grant for the 2022 fiscal year

REFERENCES

[1] BD. W, S. M, F A. Comprehensive revie of Ultraviolet Radiation and The Current Status on Sunscreen. Journal Clin Aesthetic Dermatology. 2012;5(9):18.

[2] Draelos Z. Cosmetic Dermatology: Producys and Procedures. D DZ, editor. John Wiley & Sons. UK; 2016.

[3] Puri A. Lipid -Based Nanoparticles as Pharmaceutical Drug Crriers : From Concepts to Clinic. Natl Institue Heal Public Acces. 2010;26(6):523–580.

[4] Dwiastuti R, Noegrohati S, Istyastono EP. Pengamatan Formulasi dan Sifat Fisik Liposom Lesitin Kedelai Mengandung 4-n-Butiresorsinol. Institit Fis Amerika. 2016;160005:1–5.

[5] Dwinna R. Lemak Padat Nanopartikel Ceramide. J pharmascience. 2010;2(2):80–87.

[6] Shankar SS, Rai A, Ahmad A, Sastry M. Rapid Synthesis of Au, ag and bimetallic Au core-Ag Shell Nanoparticles Usinf Neem (Azadirach. 2004.

[7] Ayushi T, Prachee D, Gupta SK, Screened GW. Phytochemicals of A. esculentus leaves and their therapeutic role as an antioxidant. India Int J Pharmacogn Phytochem. 2016;8:1509–15.

[8] Kumar S, Dagnoko S, Haougui A, Ratnadass A, Pasternak N, Kouame C. Okra (Abelmoschus spp.) in West and Central Africa: potential and progress on its improvement. J Kebijak Pemerintah. 2010;5(25):3590–3598.

[9] Alhabsyi DF, Suryanto E, Wewengkang DS. Aktifitas antuoksidan dan Tabir Surya pada Ekstrak Kulit Buah Pisang Goroho (Musa acuminate L. Pharmacon. 2014;3(2):107–14.

[10] Makarov VV. Love AJ. SO V. Green nanotechnologies: synthesis of metal nanoparticles using plants. Acta Naturae. 2014;6(1):35–44.

[11] Panca PBC, D.R. L, D R. Phytochemical Screening and Determination of Total Flavonoid Levels of Okra (Abelmoschus esculenthus L. Fruit Extr J Kefarmasian. 2022;7(2).

[12] Azizi S, M.B A, Namvar F, Mohamad R. Green biosynthesis and characterization of zinc oxide nanoparticles using brown marine macroalga sargassum muticum aqueous extract. Mater Lett. 2014;116:275–277.

[13] EG. M, P M, D D, K B. Effect of Calcination Temperature on the size and optical properties of synthesized ZnO Nanoparticles. J Ovonic Res. 2016;12(2):75–80.

[14] Dewi R, Anwar E, Yunita KS. Uji Stabilitas Fisik Formula Krim yang mengandung Ekstrak Kang Kedelai (Glycine max). Pharm Sci Res. 2014;I(3):194–208.

[15] Ida N da. N, S.F. Uji Stabilitas Fisik Gel Ekstrak Lidah Buaya (Aloe vera. L) Maj Farm dan Farmakol. 2012;16(2):79–84.

[16] Z. A, H A, T N. Evaluasi Sifat Fisik Krim Ekstrak Jahe Merah (Zingiber officinale Rosc. Var Rubrum) sebagai Antinyeri. J Curr Pharm Sci. 2017;1(1):12–8.
[17] Walters HAD. Cosmeceutic Development. New York: Informa Helathcare, Inc; 2008.
[18] Mansur JS, M.N.R B, Mansur MCA, A., Azulay RD. Determinationof Sun Protection Factor by Spectrofotometry. An. Bras. Dermatol; 1986.
[19] Dutra EA, Costa DAG, Oliveira ERMK-H, Santoro M. Determination of Sun Protection Factor (SPF) of Sunscreens by Ultraviolet Spectrophotometry. Rev Bras Cienc Do Solo. 2004;
[20] Swastika A, Purwanto M. Aktivitas Antioksidan Ekstrak Sari Tomat (Solanum lycopersicum L. Tradit Med J. 2013;18(3).
[21] Standar Nasional Indonesia 164399 : Sediaan Tabir Surya. Jakarta: Standarisasi Nasional; 1996.
[22] Ulaen SP, Y.S. S, A R. Pembuatan Salep Anti Jerawat dari Ekstrak Rimpang Temulawak (Curcuma xanthorrhiza Roxb. J Ilm Farm. 2012;3(2):45–49.
[23] Maheswara L. Optimasi Formula Gel Ekstrak Buah Naga (. 2008.
[24] Setiawan T. Uji Stabilitas Fisik dan Penentuan Nilai SPF Krim Tabir Surya yang Mengandung Ekstrak Daun Teh Hijau (Camellia sinensis L. In: Oktil Metoksisinamat dan TiO2, Skripsi, FMIPA Program Studi Farmasi, UI Depok. 2010.
[25] Sopyan dkk. Formulasi Sediaan Lotion dari Ekstrak Klinik Buah delima 9Punica granatum0 sebagai tabir Surya. In: Departemen Farmasetika dan Teknologi Formulasi, Fakultas Farmasi Universitas Padjajaran. Jatinangor, Sumedang; 2016.
[26] Sisa, M., Bonnet, S. L., Ferreira, D., & Westhuizen, J. H. Photochemistry of Flavonoids. 2012. Moleculers, 15(8), 5196–245.
[27] Ebrahimzadeh M.A; Enayatifard R; Khalili M; Ghaffarloo M; Saeedi M; Charari JY. 2014. Correlation between Sun Protection Factor and Antioxidant Activity, Phenol ang Flavonoid Contents of Some Medical Plants. Iranian Jurnal of Pharmaceutical Research 13(3): 1041-1047