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Effect of sunflower oil and olive oil concentration on the sunscreen activity of *Syzygium myrtifolium* Walp. leaves extract cream

Pengaruh konsentrasi minyak bunga matahari dan minyak zaitun terhadap aktivitas tabir surya krim ekstrak daun pucuk merah (*Syzygium myrtifolium* Walp.)

Clara Situmorang[1*], Maria Elvina Tresia Butar-Butar[1], Sister Sianturi[2]
[1]*Study Program of Pharmacy, Dirgahayu School of Health Sciences, Samarinda, East Kalimantan, Indonesia 75122*
[2]*Faculty of Forestry, Mulawarman University, Samarinda, East Kalimantan, Indonesia 75123*

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✉ * E-mail Author: clara.situmorang98@gmail.com

ABSTRACT

Red shoot leaves contain flavonoid compounds that have potential as sunscreens because they can absorb ultraviolet rays, so they can be used as natural active ingredients for making sunscreen creams. The purpose of this study was to test the SPF value of red shoot leaves extract cream with a combination of sunflower oil and olive oil with 7 formulation, F1 (1 : 0) ; F2 (0 : 1) ; F3 (0.5 : 0.5) ; F4 (0.75 : 0.25) ; F5 (0.25 : 0.75) ; F6 (1 : 1) ; F7 (0 : 0). The UV-Vis Spectrophotometry method was used to determine the SPF value of the cream which refers to the Mansur equation and obtained the SPF value of the cream preparation F1 4.337; F2 3.822; F3 4.713; F4 5.090; F5 6.523; F6 5.551; and F7 5.271. The physical evaluation results of the three best formulas, namely F5, F6, and F7 in the organoleptical test of the preparation are brown, semi-solid, have a distinctive smell and meet the homogeneity requirements. After 28 days of storage, pH approximately 6.0, the adhesion of F5 1.18; F6 0.96; F7 0.56. The spreadability of F5, F6, and F7 met the parameters, namely, 5-7 cm. Viscosity with variations in concentration increased and the stability of the cream preparation was stable at room temperature storage, cycling test, centrifugation test with no phase separation. Based on the research conducted, F5 is the best formula.

Keywords: *sunscreen, SPF, Syzygium myrtifolium, sunflower oil, olive oil*

ABSTRAK

Daun pucuk merah mengandung senyawa flavonoid yang berpotensi sebagai tabir surya karena dapat menyerap sinar ultraviolet, sehingga dapat digunakan sebagai bahan aktif alami untuk membuat krim tabir surya. Tujuan dari penelitian ini adalah untuk menguji nilai SPF dari krim ekstrak daun pucuk merah dengan kombinasi minyak bunga matahari dan minyak zaitun dengan 7 formulasi, F1 (1 : 0); F2 (0 : 1); F3 (0.5 : 0.5); F4 (0.75 : 0.25); F5 (0.25 : 0.75); F6 (1 : 1); F7 (0 : 0). Metode UV-Vis Spektrofotometri digunakan untuk menentukan nilai SPF dari krim yang merujuk pada persamaan Mansur dan diperoleh nilai SPF dari sediaan krim F1 4.337; F2 3.822; F3 4.713; F4 5.090; F5 6.523; F6 5.551; dan F7 5.271. Hasil evaluasi fisik dari ketiga formula terbaik, yaitu F5, F6, dan F7 dalam uji organoleptik sediaan berwarna coklat, semi-padatan, memiliki aroma khas dan memenuhi syarat homogenitas. Setelah 28 hari penyimpanan, pH sekitar 6.0, adhesi F5 1.18; F6 0.96; F7 0.56. Daya sebar F5, F6, dan F7 memenuhi parameter, yaitu, 5-7 cm. Viskositas dengan variasi konsentrasi meningkat dan stabilitas sediaan krim stabil pada penyimpanan suhu ruangan, uji siklus, uji sentrifugasi tanpa pemisahan fase. Berdasarkan penelitian yang telah dilakukan F5 merupakan formula terbaik.

Kata Kunci: tabir surya, SPF, *Syzygium myrtifolium*, minyak bunga matahari, minyak zaitun

1. PENDAHULUAN

Skin is the body's outermost organ that serves as a protective barrier and is often exposed to sunlight containing ultraviolet (UV) rays.[1,2] UV-A rays (320-400 nm) can cause pigmentation and damage DNA resulting in premature aging of the skin. UV-B rays (290-320 nm) cause sunburn, irritating reactions and skin cancer. UV-C rays (200-280 nm) when exposed for too long can cause skin cancer because it has the highest radiation energy.[3–5]

One of the efforts to reduce the adverse effects of UV rays is by using sunscreen. Sunscreen can protect and minimize the effects of exposure to UV-A rays and UV-B rays on the skin whose activity is expressed based on the SPF (Sun Protection factor) value.[4,6–8] SPF values in sunscreens vary from 2-50 and a minimum SPF value of 15 is recommended to block 95% of UV-B radiation.[9] Commercial sunscreen products that contain synthetic chemicals such as Titanium dioxide can be carcinogenic.[10] Octocrylene and PABA (p-aminobenzoic acid) derivatives can cause irritating reactions with burning and phototoxicity.[11] Therefore, the use of natural ingredients that have sunscreen activity can be used to avoid the side effects of chemicals.

Some research results regarding the utilization of natural ingredients that have activity as sunscreens include, among others, soursop juice has an SPF value of 17.247 with ultra protection.[12] Puspita & Puspitasari's research (2014), buas-buas leaf extract has a flavonoid content of 3.70 ± 0.02% which is high enough to affect the SPF value of 38.28 which is included in ultra protection.[13] Aris & Ilmi's research (2022), temu ireng rhizome extract at a concentration of 200 ppm has flavonoid levels and SPF values of 13.78% and 4.541 respectively where the higher the total flavonoid content, the higher the SPF value.[6]

The leaves of red shoots (*Syzygium myrtifolium* Walp) contain secondary metabolite compounds including flavonoids, tannins, saponins, triterpenoids, and alkaloids.[14] The use of natural ingredients containing compounds that have antioxidant activity, such as flavonoids, has the potential as sunscreens due to the presence of chromophore groups (conjugated single double bonds) that are able to absorb UV rays both UV-A and UV-B, thus preventing their exposure to the skin.[15,16] The content of red shoot leaves responsible for antioxidant activity is anthocyanins, which belong to the flavonoid group.[17,18] The ability of red shoot leaves as an antioxidant is shown by the IC50 value of 25.83 mg/L which is categorized as having strong antioxidant activity.[19]

Based on the above background, red shoot leaves need to be developed for its utilization as a sunscreen. One of the preparations formulated as a sunscreen is cream. The cream preparation was chosen because it is easy to spread on the skin, easily absorbed, and dries quickly. The cream was designed with sunflower oil and olive oil as ingredients, both of which have antioxidant activity with IC50 values of 88.372 mcg/mL and 51.28% respectively.[19] This study will test the SPF value of red shoots leaf extract formulated in cream form. The red shoots leaf extract cream will be tested for its potential through testing the SPF value using the UV-Vis Spectrophotometry method and evaluating the physical characteristics of the cream preparation.

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2. METHODS

Materials

The tools use in this study included a refrigerator (Toshiba), oven (Memmert UN55), UV-Vis Spectrophotometer (Shimadzu UV-1800), analytical balance, waterbath, viscometer Brookfield (BYK-Gardener 7565 Brookfield), centrifuge (LC-04S), hot plate, blender, pH meters, object glass, 40 mesh sieve, and laboratory glassware (Pyrex®). The materials use in this study included ethanol pro analysis 96% (Merck), ethanol 96% (technical), sunflower oil, olive oil, TEA (triethanolamine), lipomulse luxe, stearic acid, disodium EDTA (Ethylene diamine tetra-acetic acid), isopropyl myristate, glycerin, dimethylol-5-5-dimethylhydatoin (DMDM hydantoin), Meyer reagent, Bouchardat reagent, Dragendorff reagent, FeCl3, Mg powder, concentrated HCl, 1 N HCl, glacial CH3COOH, H2SO4, distilled water, filter paper, and aluminum foil.

Determination

The purpose of determination is to ensure the identity of the plants used. Determination was carried out at "Herbarium Mulawarman", Laboratory of Ecology and Conservation of Tropical Forest Biodeversity, Faculty of Forestry, Mulawarman University, Samarinda.

Preparation and sampel extraction

Red shoots are taken from the tops of leaves number 1-5, the drying process is carried out by oven at 40 °C. The dried symplisia was then pulverized using a blender and sieved with a 40 mesh sieve. 200 g of simplicia powder was macerated using 2 L of 96% ethanol for 3x24 hours at room temperature in a dark place while occasionally stirring at least three times a day. The macerate was filtered and the residue was remacerated with 2 L of the same solvent for 1x24 hours. The results of maceration and remaceration were concentrated using a water bath at 60°C until a thick extract was obtained. Then the yield obtained from the extraction process is calculated.[20]

Identification of secondary methabolites

a. Alkaloids
   The samples were put into 3 test tubes and 2-3 drops of Meyer, Bouchardat, and Dragendorf reagent solutions were added to each test tube. If there are alkaloids then with Meyer's reagent solution will form a white or yellow precipitate, with Bouchardat reagent solution will form a brown to black precipitate, with Dragendorf reagent solution will form an orange yellow precipitate. Samples are said to contain alkaloids if 2 of the 3 reactions above give a positive reaction.[20]
b. Tannins
   Samples are taken in a test tube and then dripped with 1% FeCl3 solution, blue-black or brownish-black color changes indicate the presence of tannins.[20]
c. Flavonoids
   Take the sample and add 0.05 mg of Mg powder and 1 mL of concentrated HCI, The color change is indicated by the formation of red, yellow or orange.[20]

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d. Saponins
Take a sample in a test tube added 10 mL of water while shaking for 1 minute, then add 2 drops of HCL 1 N. If the foam that is formed remains stable for about 7 minutes, then the positive results contain saponins.[20]

e. Phenols
The sample was added to hot distilled water and then cooled to room temperature. After cooling, 5 drops of 10% NaCl and 3 drops of FeCl3 solution were added. Positive results are indicated by a change in color to bluish black or greenish black.[20]

f. Steroids and Triterpenoids
A sample was taken and 10 drops of glacial CH3COOH and 2 drops of H2SO4 were added. The solution is shaken gently and left for a few minutes. Steroids give a blue or green color, while triterpenoids give a red or purple color.[20]

Formulation of Red shoots extract cream

The formulation of red shoots leaf extract cream designed using design expert can be seen in Table I. All the ingredients were weighed according to the formula in Table I. The oil phase consisting of lipomulse luxe, sunflower oil, olive oil, stearic acid and isopropyl myristate was melted on a hot plate and stirred until homogeneous, then heated at 70 °C. In a separate container, the aqueous phase consisting of TEA, 1/2 Glycerin, disodium EDTA, DMDM hydantoin, and distilled water was heated at 70 °C while stirring until homogeneous. Then, the oil phase is put into a hot mortar and then the water phase is poured little by little into the oil phase while stirring with a stamper until homogeneous until a creamy mass is formed. Next, red shoot leaves extract with 1/2 glycerin was added, homogenized and evaluated.

Table 1. Formulation of red shoots extract cream

Ingredients	Function	Concentration (%)						
		F1	F2	F3	F4	F5	F6	F7
Red shoot leaves extract	Active ingredient	0,125	0,125	0,125	0,125	0,125	0,125	0,125
Sunflower oil	Basis	1	0	0,5	0,75	0,25	1	0
Olive oil	Basis	0	1	0,5	0,25	0,75	1	0
TEA	Buffer	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Lipomulse luxe	Emulgator	4	4	4	4	4	4	4
Stearic acid	Lubricant	2	2	2	2	2	2	2
Disodium EDTA	Chelating agent	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Isopropyl myristate	Enhancer	2	2	2	2	2	2	2
Glycerin	Humectant	3	3	3	3	3	3	3
DMDM hydantoin	Preservatives	0,074	0,074	0,074	0,074	0,074	0,074	0,074
Aquadest	Solvent	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100

 DOI : 10.21111/pharmasipha.v9i2

Determination of SPF value

The SPF value was determined by measuring the absorbance of the solution in each formulation using a UV-Vis Spectrophotometer in the wavelength range of 290-320 nm with an interval of 5 nm. Each cream was weighed 250 mg and then dissolved using ethanol p.a until the limit mark in a 25 mL volumetric flask so that a concentration of 10,000 ppm was obtained. Before being analyzed using an UV-Vis Spectrophotometer, the solution was centrifuged at 3000 rpm for 15 minutes. After that, 1 mL of ethanol p.a was inserted into the cuvette into the UV-Vis Spectrophotometer. Test absorption curve was made with wavelengths between 290-320 nm every 5 nm interval, ethanol p.a was used as a blank.[21] The absorbance results are used to calculate the SPF value with the formula as in Mansur (1986) using the equation 1.[22]

$$SPF = CF \times \sum_{320}^{290} EE\ (\boldsymbol{\lambda}) \times I\ (\boldsymbol{\lambda}) \times Abs\ (\boldsymbol{\lambda}) \quad (1)$$

CF : Correction factor (=10)
EE : Erythema effect spectrum
I : Intensity of light spectrum
Abs : Absorbance of the sample

The value of EE x I is constant, where the value has been determined and shown in Tabel 2.

Table 2. Standardized EE x I values used to calculate SPF values

No	Waveleght (λ)	EE x I
1.	290	0,0150
2.	295	0,0817
3.	300	0,2874
4.	305	0,3278
5.	310	0,1864
6.	315	0,0839
	Total	**1**

The absorption value obtained is multiplied by the EE x I value for each wavelength as shown in Table II. After that, the results of multiplying the uptake and EE x I are summed and multiplied by a correction factor of 10 to obtain the SPF value.[22]

Evaluation of cream characteristics

a. Organoleptic
   Organoleptical observations were made visually, by observing the color, odor, and texture of the cream.[23]
b. Homogenity
   The homogeneity test was carried out by weighing 0.1 g of cream then applied to the glass object evenly and then covered with another glass object. Then, it was

 DOI : 10.21111/pharmasipha.v9i2

observed that the cream preparation should show a homogeneous composition and the absence of coarse grains visually.[24]

c. Storage stability
Creams with various concentrations were stored at room temperature (15-30℃) for 28 days and then observed for shape, color, and odor.[25]

d. Cycling test
The test was carried out for 6 cycles. cycling test is one way to accelerate the evaluation of the stability of the preparation. The cream preparation is stored at a cold temperature of ± 4 °C for 24 hours and then removed and placed at a temperature of ± 40 °C for 24 hours, this process is counted as 1 cycle. The physical condition of the cream includes shape, color, and odor compared during the experiment with the previous preparation.[26]

e. Centrifuge
This test was conducted to determine the presence of phase separation in the cream preparation. Weighed 5 g of cream was put into an eppendorf tube and centrifuged at 5000 rpm for 30 minutes.[27]

f. pH test
The pH test was conducted using a pH meter calibrated using a neutral standard buffer solution (pH 7.01) and an acidic buffer solution (pH 4.01) until the device showed the pH. Weighed 1 g of cream that has been diluted with 10 mL of distilled water. Then, it was measured using a digital pH meter until it showed a constant pH. The cream should have a pH that matches the skin's pH, which is between 4.5 - 6.5.[26]

g. Viscosity
Viscosity test was conducted to determine the viscosity level of the cream preparation. The tool used is a brookfield viscometer. Weighed ± 50 g of cream, then the test was carried out using a size 4 spindle with a speed of 12 rpm. Lowered the spindle until it was immersed in the cream preparation. Then, turn on the viscometer while pressing the button and let the spindle rotate. The viscosity of a good cream ranges from 2000 cPs-50,000 cPs.[23,24,28]

h. Spereadability
Weigh 0.5 g of cream on an object glass and then cover it with another object glass on top. Then, a 500 g weight is applied for 5 minutes, the weight is removed and the two attached object glasses are released. Calculate the time taken for the two object glasses to release. Good cream adhesion is in the range of 2-300 seconds.[20,24]

i. Stickiness
The spreadability test was conducted to determine the ability to spread the cream when used on the skin surface. Weighed 0.5 g of cream was placed on a scaled glass then covered with another scaled glass. Leave it for 1 minute and measure the diameter of the cream that spreads. Weights of 50 g, 100 g, 150 g, and 200 g were placed on the scaled glass for 1 minute and the diameter of spread was measured. The spreadability of a good cream is in the range of 5-7 cm.[24,29]

Data Analysis

Data analysis of organoleptic evaluation results, homogeneity, adhesion, spreadability, cycling test, storage stability, and centrifugation test were performed descriptively. Meanwhile, the measurement results of cream SPF value, viscosity and pH were analyzed using ANOVA (One-way Analysis of Variant) method, followed by LSD (least significant difference) test with a 95% confidence level.

3. RESULT AND DISSCUSION

The results of plant identification in accordance with letter number 234/UNI7.4.08/LL/2022 state that the plants used in this study are red shoot leaves with the species *Syzygium myrtifolium* Walp. The simplisia powder was extracted using maceration and remaceration methods. The maceration method was chosen because it is simple, fast, and can draw chemical compounds from the sample, besides not using high temperatures which risk damaging bioactive components that are not resistant to high temperatures. Remaceration (change of new solvent) is done so that the compounds contained in the sample can be extracted thoroughly.[30] Ethanol is used as a solvent because during immersion plasmolysis occurs which causes the breakdown of the cell wall due to the difference in pressure inside and outside the cell, the compounds contained in the cytoplasm will be dissolved in organic solvents and the compound extraction process will be perfect. This can produce compounds that are not resistant to heating and release more flavonoids.[31] The extraction yield was 25.98 g with a yield of 12.99%.

Phytochemical screening is carried out as a preliminary test carried out on simplisia powder and thick extract of red shoot leaves with the aim of identifying the content of secondary metabolite compounds qualitatively by observing the occurrence of color changes in the sample.[32] Based on the results in Table 3, the phytochemical screening of red shoot leaves contains flavonoids, tannins, saponins, phenols, alkaloids and triterpenoids.

Table 3. Phytochemical screening of red shoot

Test	Reagent	Result	
		Simplisia	Extracts
Alkaloids	HCl 2 N + *Dragendorff*	-	+
	HCl 2 N + *Bouchardart*	-	+
	HCl 2 N + *Mayer*	-	-
	FeCl 1 %	+	+
Flavonoids	Mg powder + HCl	+	+
Saponins	Aquadest + HCl 1 N	+	+
Phenol	NaCl 10 % + FeCl	-	+
Triterpenoids	HCl + H_2SO_4	-	+

Note: Contains secondary metabolite compounds (+), does not contain secondary metabolite compounds (-)

 DOI : 10.21111/pharmasipha.v9i2

Determination of SPF value

Determination of the SPF value of the red shoots leaves cream preparation was carried out using the UV-Vis Spectrophotometry method at a wavelength of 290-320 nm based on the Mansur equation.[21] Tests were carried out with seven formulas, each using an extract concentration of 125 mg and varying concentrations of sunflower oil and olive oil bases. Data on the SPF value of red shoots leaf extract cream preparation can be seen in Table 4.

Table 4. Results of SPF value of red shoot leaf extract cream preparation

Formula	SPF value	Protection category
F1	4,337	Medium
F2	3,822	Minimal
F3	4,713	Medium
F4	5,090	Medium
F5	6,523	Medium
F6	5,551	Medium
F7	5,271	Medium

The effectiveness of sunscreen preparations is based on the determination of the SPF value which is a universal indicator that explains the effectiveness of a preparation or substance that is UV protector with the higher the SPF value, the more effective it is to protect the skin from the adverse effects of UV rays.[7] According to the Food Drug Administration (FDA), SPF value categories in the range of 1 - 4 fall into the minimal protection category, SPF values of 4 - 6 fall into the medium protection category, SPF values of 6 - 8 fall into the extra protection category, SPF values of 8 - 15 fall into the maximum protection category and SPF values >15 fall into the ultra protection category.[33] Based on the data from Table 4, F2 has an SPF value of 3.821 which is included in the minimal protection category, while formula F1 has an SPF value of 4.337, F3 has an SPF value of 4.713, F4 has an SPF value of 5.090, F5 has an SPF value of 6.526, F6 has an SPF value of 5.551 and F7 has an SPF value of 5.270. Formulas, namely F1, F3, F4, F5, F6, and F7 have SPF values in the medium protection category range.

Red shoot leaves contain flavonoid and tannin compounds that are thought to play a role in sunscreen activity. In accordance with the results of phytochemical screening on 96% ethanol thick extract of red shoot leaves which shows the presence of flavonoid content. Flavonoid and tannin compounds are known to have potential as sunscreens because they have chromophore groups (conjugated single double bonds) that are able to absorb UV rays, both UV-A and UV-B, thereby reducing the intensity of exposure to the skin.[34,35]

The protection category of the cream preparation is minimal and moderate, this can be influenced by excipients in the preparation that can affect the activity of the extract and although at the concentration of sunflower oil and olive oil base there is antioxidant activity, the concentration used in the preparation is too small so that it does not cause a significant increase in SPF value.

 DOI : 10.21111/pharmasipha.v9i2

Based on the results using the ANOVA method, a significance value of 0.000 <0.05 was obtained, this shows that there is a significant difference in the SPF value of the cream for each formula. The test was continued using the Post Hoc Test (LSD test) to find out which formula had the difference. Based on the test results obtained in F6 against F7 (significance value 0.011>0.05) and in F4 against F7 (significance value 0.079>0.05), this can be interpreted with a significance value>0.05 the results of the data obtained indicate that there is no significant difference in the SPF value of the concentration of the base variation. However, the results of the LSD test on formulas F1, F2, F3, F5, and F6 against each formulation obtained a significance value <0.05, which means that there is an effect of SPF value on variations in base concentration contained in the formulation of red shoots leaf extract cream preparations.

Evaluation of cream characteristics

In the evaluation of the characteristics of red shoot extract cream, three formulations were selected from the SPF value test of the cream with the best SPF value, namely red shoot extract cream formulations F5, F6, and F7 with SPF values of 6.526, 5.551, and 5.270, respectively.

Organoleptic and storage stability test

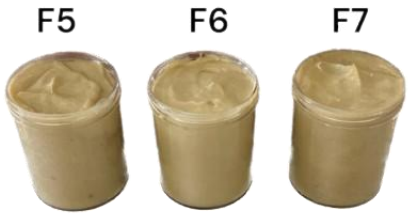

Figure 1. Red shoot leaf extract cream with the best SPF value

The results of organoleptic observations of the three red shoots leaf extract cream formulas have a solid shape, smell typical of extracts and in preparations F5 and F7 are brown, F6 is pale brown. In preparation F6, the color of the cream is paler than that of F5 and F7 because the concentration of sunflower oil and olive oil are both 1%. The results of observations of storage stability during 28 days of storage at room temperature (15-30 °C) of preparations F5, F6, and F7 have color, odor, and dosage form showing no difference.

Homogenity test

Homogeneity testing aims to determine the mixture of cream preparations with no visible coarse grains.[24] Homogeneity affects the effectiveness of therapy because it is related to the same drug levels at each use. the use of creams by applying, so that with the homogeneity of a preparation part of the active substance will have the same opportunity to occupy the therapeutic site.[36] The results of homogeneity testing carried out on days 0, 7, 14, 21 and 28 showed homogeneous preparation results (no coarse grains). This is in accordance with the requirements of cream homogeneity, namely homogeneous cream and no coarse grains are found in the cream and there is an even color equation.

Table 5. Evaluation result of red shoot leaf extract cream preparation

Parameters	Formulation	Day 1	Day 28	Before	After
Organoleptic	F5	Brown in color, characteristic odor, semi solid in shape	Brown in color, characteristic odor, semi solid in shape		
	F6	Brown in color, characteristic odor, semi solid in shape	Brown in color, characteristic odor, semi solid in shape		
	F7	Brown in color, characteristic odor, semi solid in shape	Brown in color, characteristic odor, semi solid in shape		
Homogenity	F5, F6, F7	Homogeneous	Homogeneous		
Cycling test (6 cycles)	F5, F6, F7			No phase separation occurs	No phase separation occurs
Centrifuge test	F5, F6, F7			No phase separation occurs	No phase separation occurs

Cycling test

The cycling test is carried out by observing the red shoots leaf extract cream preparation against several possibilities of crystallization or cloudiness (evaporation).[37] The test was conducted for 6 cycles. Based on the observation of the cycling test carried out on red shoots leaf extract cream F5, F6, and F7, the results showed stable results as indicated by no phase separation and no crystallization.

Centrifuge test

The purpose of testing is to see the stability of the cream preparation. The results of observations of preparations F5, F6, and F7 of red shoot extract cream did not occur phase separation and based on this, the preparation was stable against gravity for one year of storage.[38]

pH test

The results of the pH test on days 0, 7, 14, 21 and 28 showed stable results, namely in the pH range of 6 where according to the SNI 16-4399-1996 standard the pH value of skin products ranges from 4.5-7.5. According to Saputra et al. (2021) the cream can irritate the skin if the pH is below 4.5 and if the pH is above 6.5 it can cause dry and scaly skin.[39] The pH test results of F5, F6, and F7 meet the pH test requirements.

Based on the results using the ANOVA method, the significance value in the three formulas was 0.020>0.05. The test was continued using the Post Hoc Test (LSD test) results in F5 against F6 (significance value 0.08>0.05). In F5 against F7 (significance value 0.037>0.05) and F6 against F7 (significance value 0.0,407>0.05). Based on the One Way Anova test and Post Hoc Test, namely with significance> 0.05 the results of the data obtained indicate that there is no significant difference in the concentration of the base on the pH value.

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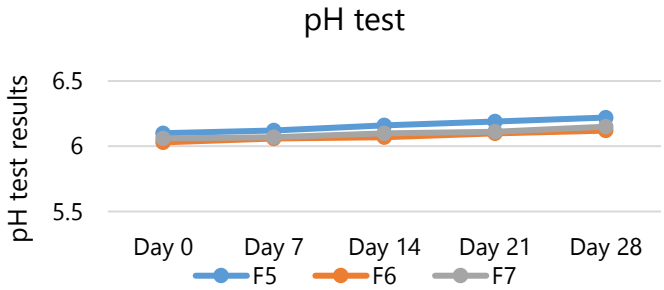

Figure 2. pH test results of red shoot leaf extract cream

Viscosity test

Viscosity testing aims to determine the level of viscosity of the preparation and is a statement of the resistance of a liquid to flow.[40] According to Mudhana & Pujiastuti. (2021) Good cream viscosity is indicated by the concentration of cream that is not too thin and not too thick.[41] Based on Figure 2, the results of viscosity measurements taken on days 0, 7, 14, 21 and 28 in preparations F5, F6, and F7 have increased. The highest viscosity was found in formula F6 with 1% sunflower oil and olive oil base respectively. Then, F5 with 0.25% sunflower oil base and 0.75% olive oil and F7 which did not use a base obtained the lowest value. The difference in base concentration variation affects the viscosity of red shoots leaf extract cream, the higher the base concentration, the higher the viscosity. Viscosity of the preparation can occur due to the influence of additional ingredients used in the cream preparation. According to Murdiana et al. (2022) The increase in cream viscosity can be influenced by the presence of fatty acids contained in the formulation of cream preparations.[42] Red shoot extract cream uses sunflower oil and olive oil bases which contain many fatty acids, one of which is stearic acid, which is 1.3% and 0.5-5.0%, respectively. According to Saryanti et al. (2019) Stearic acid can increase the viscosity of the preparation.[43] According to SNI 16-4399-1996, a good cream viscosity requirement is between 2000 cPs-50,000 cPs.[24] Based on the test results, preparations F5, F6, and F7 meet the required viscosity range for cream preparations.

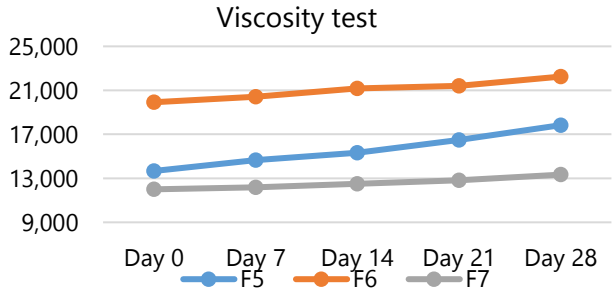

Figure 3. Viscosity test results of red shoot leaf extract cream

Based on the results using the ANOVA method, the significance value in the three formulas is 0.000 <0.05. This shows that there is a significant difference in the viscosity value of the cream in formulas F5, F6, and F7. The test continued by using the LSD test obtained significance <0.05 found in all formulas. This means that the difference in base concentration variations in all formulas affects the viscosity of the

red shoots leaf extract cream preparation where the highest viscosity value is in formula F6 with a concentration of sunflower oil and olive oil of 1% each and the lowest viscosity value in formula F7 which does not use a base. Based on the data of the spreadability results, it shows that there is an influence on the viscosity of the preparation, the higher the viscosity, the lower the diameter of the spreadability.

Spreadability test

Spreadability testing is done to determine the ability of the cream when used and how wide the cream can spread on the skin.[44] Good spreadability means that the cream will be easily applied to the skin surface so that the contact area between the cream and the skin becomes wider, and the absorption of active ingredients into the skin is maximized.[45] The spreadability test requirement for topical preparations is about 5-7 cm.[24] Based on Figure 5, the results of measurements taken on days 0, 7, 14, 21 and 28, the spreadability of the red shoot extract cream produced by preparations F5, F6, and F7 met the criteria for good spreadability requirements. Preparations F5 and F7 have the greatest spreadability, while F6 has the smallest spreadability. In the image results of preparations F5, F6, and F7, the effect of load and storage duration will have a significant effect on the diameter of the spreadability. Increasing the load will affect the increase in spreadability, and the longer the storage time, the spreadability will decrease. According to Ratnapuri et al. (2019) spreadability and viscosity are interconnected with the greater the viscosity, the smaller the diameter of the spreadability of the preparation.[46]

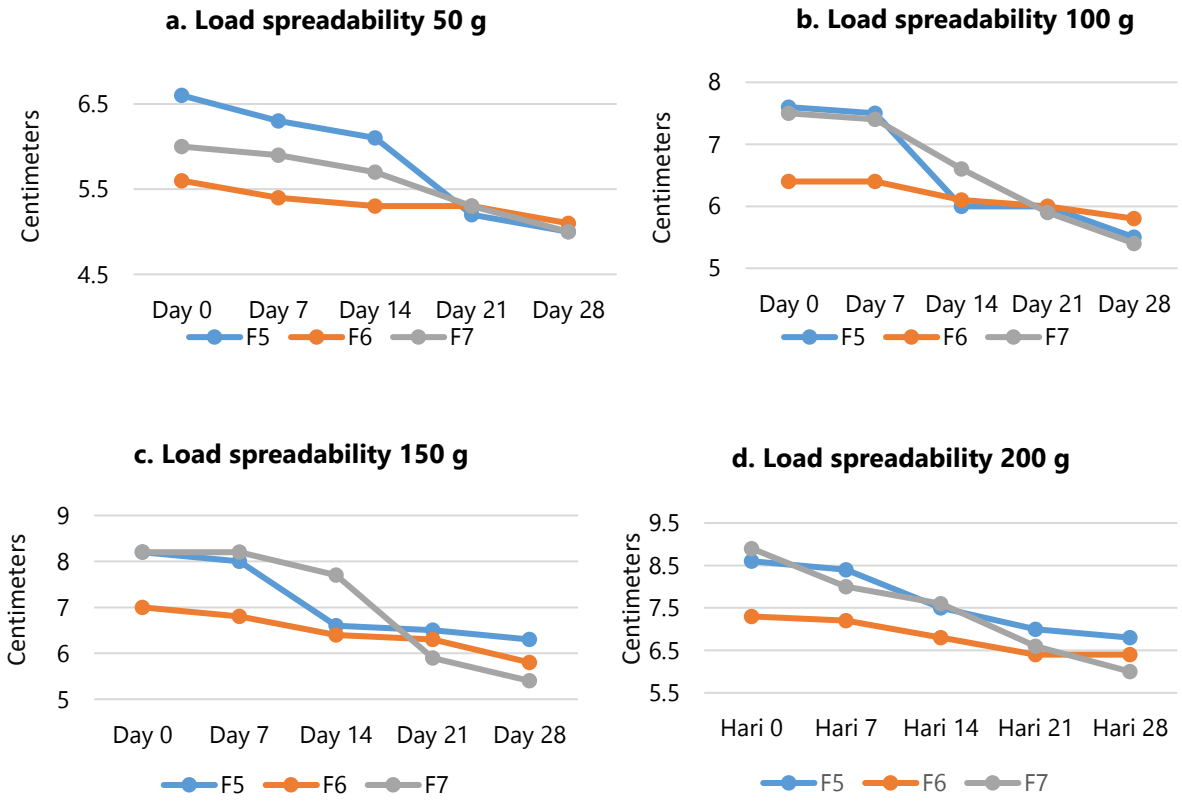

Figure 4. Spreadability test results of red shoot leaf extract cream (a) 50 g load, (b) 100 g load, (c) 150 g load, (d) 200 g load

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Stickiness test

Adhesion testing aims to determine the ability of the cream to adhere to the skin. The adhesion ability of the cream affects the penetration of active substances into the skin.[47] Based on Figure 5, the results of the adhesion test of red shoots leaf extract cream in formulas F5, F6, and F7 from day 0 to day 28 are known to be not good because they are not in accordance with the requirements, which are 2-300 seconds which causes not the maximum adhesion of the cream to the skin.[24]

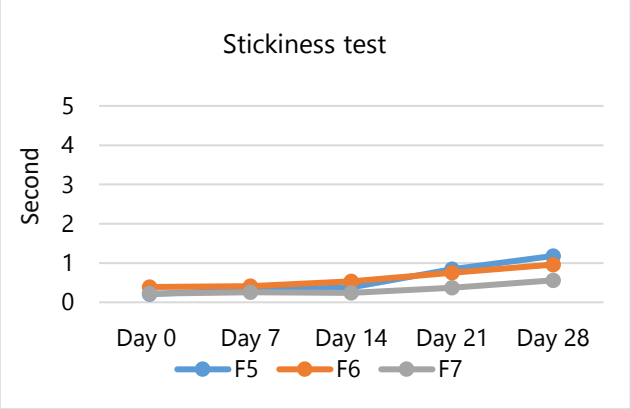

Figure 5. Red shoot leaf extract cream adhesion test results

4. CONCLUSION

Based on the results of the study, it can be concluded that the cream preparation formula with the best SPF value evaluated physical characteristics, namely, F5 with SPF values of 6.526 respectively, have organoleptical physical quality, homogeneity, pH, spreadability, and viscosity that meet the requirements of good cream preparation parameters. The stability of cream preparations F5 at room temperature storage, cycling test and centrifuge test obtained stable results with no phase separation.

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