



Potency and Test Sun Protection Factor (SPF) Preparation of Yellow Beetle Meat Extract Lotion (*Cucurbita Moschata* Durch.) As a Sunscreen

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ABSTRACT

Excessive exposure to ultraviolet radiation can cause skin damage. Products that can reduce the negative impacts of exposure to ultraviolet radiation include sunscreen. Pumpkin fruit (*Cucurbita moschata* Durch.) is a fruit that contains secondary metabolite compounds in the form of flavonoids to protect against sunlight. The aim of this research was to determine the SPF value, physical properties, and stability of the pumpkin extract (*Cucurbita moschata* Durch.) lotion formula. This lotion product is made in three different extract concentrations: 15%, 17.5%, and 20%. The research method used is laboratory-experimental. The research results show that the highest to lowest SPF values were obtained at F3, namely 8.274 (maximum protection), F2 7.898 (extra protection), and F1 7.401 (extra protection). The results of the physical properties show that the resulting lotion is homogeneous, thick in texture, pH in the range 6.4-6.9, viscosity in the range 3,263.9-7,177.2 cP, spreadability in the range 6.18-6.78 cm, and adhesive power in the range of 5.38-7.48 seconds. The results of the stability test of the lotion preparation showed a stable pH, unstable viscosity, stable adhesion to F2, and stable spreadability. The 6th cycle SPF test obtained F1 4,955 (medium protection), F2 5,184 (medium protection), and F3 6,473 (extra protection). The conclusion is that the highest SPF lotion is F3, namely 8.274 (maximum protection), homogeneous physical properties, pH 6.5, viscosity 7,177.2 cP, adhesion power 7.48 seconds, and spreadability 6.78 cm. The most stable stability test is at F2. The SPF value test in the 6th cycle produced a lower SPF value compared to the SPF value before the stability test was carried out.

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INTRODUCTION

The human skin is a multilayered "molecular assembly" (Starr et al., 2022) made up of lipids, proteins, and cells as well as structural elements like sweat glands. (Kolarsick et al., 2011) Its structural features (Drakou et al., 2021; Kolarsick et al., 2011; Nguyen & Soulika, 2019; Stan et al., 2021) reflect its many functions, which include protection, hydration, thermoregulation, immunity, and sensation.

Skin is the outermost part of the body's surface that protects from ultraviolet rays. Excessive exposure to ultraviolet radiation can cause skin damage such as dryness,

burning, redness, irritation, aging, and increase the risk of skin cancer. (Blaustein et al., 2024).

Another method of protecting the skin from UV rays is topical antioxidant use. In order to prevent and treat photoaging, it is advised to develop nanoparticles for sunscreens and antioxidants. These can enhance the appearance, stability, penetration, and safety of unpleasant skin. (Lin et al., 2024). One product that can protect the skin or reduce the negative effects of exposure to ultraviolet light is sunscreen. The synthetic compounds used in sunscreen products are para-aminobenzoic acid (PABA), benzophenone and cinnamates derivative compounds which function as ultraviolet (UV) light absorbers. (Rifki Pratama et al., 2020). These compounds have the effect of absorbing light so they can quickly brown the skin or act as photosensitizers. (Tranggono & Latifah, 2007). Topical sunscreens are the most commonly used method to achieve this. However, traditional sunscreen formulations have limitations that hinder their widespread use. (Chavda et al., 2023). The right solution to overcome these negative effects is to use natural ingredients as sunscreen products. One natural ingredient that contains ingredients to protect the skin from the harmful effects of exposure to ultraviolet light is pumpkin (*Cucurbita moschata* Durh.).

Pumpkin (*Cucurbita maxima*), belonging to family *Cucurbitaceae*, is a well-known edible plant, cultivated and abundantly used as herbal medicine and functional food. (Hussain et al., 2022). Pumpkin fruit (*Cucurbita moschata* Durh.) contains metabolic compounds in the form of flavonoids which have chromophore groups so they have the potential to act as sunscreen. Flavonoid compounds also have a function as antioxidants. Pumpkin fruit extract has strong antioxidant activity with an IC₅₀ value of 30.75 ppm. (Lismawati et al., 2021). One of the sunscreen preparations that is widely marketed is lotion preparations. The lotion preparation in this study was used on the body's skin to protect against exposure to ultraviolet rays. Lotion is a cosmetic preparation that has the advantage of being easy to use on the skin because the formula is not too dense so it is more evenly distributed over a wide surface of the skin and the product dries quickly after use. (Putri et al., 2019)

Based on the background above and the absence of research regarding the potential and SPF test of lotion products derived from pumpkin extract, the author is interested in conducting a study regarding the potential and SPF test of cream products derived from pumpkin extract (*Cucurbita moschata* Durh.).

METHOD

This research is a laboratory experimental research which includes sampling, sample identification, simplification, extraction, phytochemical screening, emulsion making, SPF value testing before stability testing, physical properties, stability testing and SPF value testing before stability testing. The research results were then analyzed using the One Way ANOVA SPSS version 26 statistical program.

1. Tools and materials

The equipment used is analytical scales (Ohaus®), glassware, blender (Philips), mortar and stamper (Rofa), water bath (Mettler), pH meter (Hanna instrument), glass objects (Slides), 80 g load and 100 g stopwatch (Casio), rotary vacuum evaporator (IKA RV 10 digital), UV-Vis spectrophotometer (Biobase), filter paper, digital



viscometer (Atago), 60 mesh sieve, and oven (Memmert). The ingredients used are 70% ethanol, cetyl alcohol (Brataco), stearic acid (Brataco), glycerin (Brataco), triethanolamine (Brataco), nipagin (Brataco), nipasol (Brataco), liquid paraffin, oleum rosae, distilled water, buffer pH 4 and pH 7, and yellow pumpkin (*Cucurbita moschata* Durch.).

2. Determination and sample processing

Yellow pumpkin fruit is taken from plantations in Kaliwangi Village, Purwojati District, Banyumas Regency, Central Java. Plants and pumpkin fruit were identified at the Environmental Laboratory, Faculty of Biology, Jenderal Soedirman University. Wet sorting of pumpkin fruit (*Cucurbita moschata* Durch.) was carried out to select pumpkin fruit that was in good condition. The results of sorting the pumpkin are peeled, then washed and chopped. Then drying is carried out using an oven. After that, dry sorting and grinding were carried out using a blender, sifted using a 60 mesh sieve to obtain pumpkin fruit powder.

3. Screening process

The process of making pumpkin fruit extract in this research uses the remaceration method. This remaceration was carried out by dissolving 1.5 kg of pumpkin simplicia powder with 2 L of 70% ethanol and changing the solvent every 1 x 24 hours for 3 days and filtering through flannel cloth. The resulting filtrate was concentrated using a rotary evaporator at 40°C. The results of this process are then evaporated in a water bath at 70°C to produce a thick pumpkin seed extract. The resulting thick extract was weighed and the yield was calculated.

4. Qualitative test of flavonoids

Put 2 grams of pumpkin extract (*Cucurbita moschata* Durch.) into a beaker, add 10 ml of hot water, boil for 5 minutes and strain. Take 5 ml of the resulting filtrate, add enough magnesium powder, and add 1 ml of concentrated HCl and 2 ml of ethanol, then shake vigorously until the solution separates. The extract shows positive results for the presence of flavonoid compounds when it forms a red, yellow or orange color. (Oshadie et al., 2017)

5. Making lotion preparations from pumpkin fruit extract

Mass one ingredients include glycerin as a humectant, triethanolamine as an emulsifier (emulator) and methylparaben (nipagin) as a preservative. The ingredients for mass one are dissolved using sufficient distilled water accompanied by stirring. Mass two ingredients include cetyl alcohol as a thickener, liquid paraffin as an emullient, stearic acid as an emulsifier (emulgator) and propyl paraben (nipasol) as a preservative. Mass two of material is put into an evaporation cup and then heated to a temperature of 70°C. Mass one is then mixed with mass two ingredients, distilled water as a solvent, pumpkin fruit extract as the active substance and oleum rosae as a fragrance at a temperature of 70oC. The mixture was stirred until homogeneous until a lotion was formed.(Shobib et al., 2016)

6. Test the SPF value of pumpkin lotion using the in vitro method

The initial stage of this experiment was carried out by weighing 0.02 grams of the cream preparation, then dissolving it in a weighing bottle with 5 ml of 96% p.a. ethanol solution, then putting it in a measuring flask and adding ethanol to a volume of 10 ml.

The mixture was sonicated for 5 minutes, then filtered. The resulting filtrate was placed in a 3 ml test tube, and 3 ml of ethanol (96% p.a.) was added. The absorbance of the filtrate solution was measured at 290–320 nm for every 5 nm interval.

Table 1 Formula For Pumpkin Pulp Extract Lotion

Bahan	Fungsi	Rentang	Jumlah (%)			
			Blanko	F1	F2	F3
Ekstrak buah labu kuning	Zat aktif		0	15	17,5	20
Setil alkohol	Stiffening agent (pengental)	2-10 %	2	2	2	2
Paraffin cair	Emulien	1-32 %	7,0	7,0	7,0	7,0
Asam stearat	Pengemulsi (emulgator)	1-20 %	2	2	2	2
Gliserin	Humektan	≤ 30 %	5,0	5,0	5,0	5,0
TEA	Pengemulsi	2-4 %	2	2	2	2
Nipagin	Pengawet	0,02-0,3 %	0,1	0,1	0,1	0,1
Nipasol	Pengawet	0,01-0,6 %	0,1	0,1	0,1	0,1
<i>Ol. rosae</i>	Pewangi	0,05-0,10%	0,1	0,1	0,1	0,1
Akuades ad 100 mL	Pelarut		81,2	66,2	61,2	56,2
Total			100	100	100	100

7. Physical Evaluation Of Pumpkin Fruit Extract Lotion

- Organoleptic tests are carried out by examining the shape or composition of the product, odor and color of the finished lotion product.
- Homogeneity test using a glass object. The lotion preparation is applied to a glass object, after which coarse grains will be detected visually (Anon, 2016).
- The pH test was carried out using a pH meter calibrated with a buffer solution of pH 4 and pH 7. To carry out the test, the electrode was dipped in 0.5 grams of lotion diluted with 10 ml of distilled water. The standard requirement for the quality of skin moisturizers is to have a pH between 4.5-8.0. (Pendidikan et al., 2013)
- The viscosity test was carried out with an atago® viscometer. The lotion preparation is put into a beaker, then placed on the viscometer plate and mounted. The spindle is installed and then lowered until the core is submerged in the lotion preparation, driven at a speed of 30 rpm. Then read the scale and pay attention to when the moving red needle is stable. The required standard optimum viscosity value
- The adhesion test was carried out by applying 0.25 grams of cream to a glass object and covering it with another glass object. The glass panel was pressed with a load of 1 kg for 5 minutes. The load is lifted and the two attached glassware are removed and the time required to remove the glassware is recorded. The requirement for a good time is more than 4 seconds. (Ulaen et al., 2004)
- The spreadability test was carried out by placing 0.5 grams of cream on a round glass, then placing another round glass on top and leaving it for 1 minute. The distribution diameter of the lotion preparation is measured. Then a load weighing



- 50 grams is added and left for 1 minute, then the diameter is measured when the load has reached 500 grams. The diameter of a good spread is around 5-7 cm
- g. The stability test was carried out using the method. This is done in 6 cycles. The lotion is stored at $\pm 4^{\circ}\text{C}$ for 24 hours and then at $\pm 40^{\circ}\text{C}$ for 24 hours. This process is counted as one cycle. Each cycle monitors physical changes in the lotion, including organoleptics, homogeneity, pH, viscosity, spreadability and stickiness. (Sari and Hastuti, 2020). At the end of the sixth cycle, the SPF value of the pumpkin extract lotion formula was determined before and after the stability test to compare the resulting SPF values.

8. Data Analysis

The sample used in this research was a lotion preparation. The number tested was 4 formulas including blank formula, formula 1, formula 2 and formula 3

Determining the value in this research means that each formula is tested to evaluate its physical properties including pH test, viscosity test, spreadability test, and adhesiveness test. The values obtained will be analyzed using the SPSS statistical program version 26 One Way ANOVA test method. Before carrying out the One Way ANOVA test, the physical evaluation values of the preparations were first carried out with a normality test using Kolmogorov-Smirnov and a homogeneity test using Levene. After going through the normality and homogeneity tests, if the dependent variable values include pH, viscosity, spreadability and stickiness, a p-value > 0.05 is produced, meaning the data is normally distributed, then proceed with the One Way ANOVA test, whereas if the values obtained are not normally distributed with a p-value < 0.05 , the Kruskal Wallis statistical test was carried out. On days 0 and 12, a t test was carried out on the stability data to determine the stability of the formulation during storage

RESULT

1. Determination Results

After the pumpkin plants were identified at the Environmental Laboratory, Faculty of Biology, Jenderal Soedirman University, the results showed that the pumpkin plants whose fruit were used as research samples in the form of lotions were in accordance with the type of plant desired, with the scientific name of the pumpkin fruit plant (*Cucurbita moschata* Durh.) and the *Cucurbitaceae* family.

a. Extract Soak

Table 1 Calculation results for soaking pumpkin flesh extract

Sample	Simplistic Weight	Ekstrak weight	Rendement
Yellow Pumpkin (<i>Cucurbita moschata</i> Durh.)	1.500 gram	320,85 gram	21,39%

Based on Table 1, in this study the resulting yield value was 21.39% and is classified as good, because the yield value was more than 10%. (Paongan & Vifta, 2022)

b. Qualitative Test Of Flavonoids

Table 2 Qualitative Test Results For Flavonoid Compounds

Compound Class	Result	Information
Flavonoid	+	Shown in orange on the sample, there is no precipitate

Based on Table 2, the test results show that pumpkin extract gives positive results where the sample produces an orange color (Appriliani & Oktaviannoor, 2021a) The orange color formed is caused by the reaction between the addition of Mg sulfate and concentrated HCl which causes the reduction of flavonoid compounds (Robinson, 1995).

c. Test the 0th Cycle SPF Value

Table 3 Results Of SPF Values For Lotion Preparations

Formula	SPF Value	SPF Protection
Blanko	1,944	Has no potensial SPF
F1	7,401	Exstra Protection
F2	7,898	Exstra Protection
F3	8,274	Maxsimal Protection

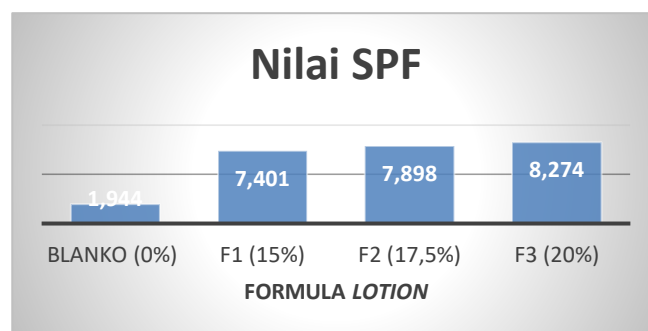


Figure 1. Graph of the SPF value of lotion preparations on day 0

Based on Table 3, the SPF value test shows that the resulting blank formula has no potential as a sunscreen with an SPF of 1.944 because pumpkin pulp extract was not added to the preparation. The SPF value for F1 is 7.401 in the extra protection category, F2 is 7.898 in the extra protection category, and F3 is 8.274 in the maximum protection category. The results obtained from determining the SPF value can be concluded that for each formula, the concentration of pumpkin extract affects the SPF value, because the higher the concentration of the extract used, the higher the SPF value will be. (Syaputri et al., 2023)



d. Evaluation Of The Physical Properties Of The Pumpkin Pulp Extract Lotion Preparation.

1) Organoleptic Test

Table 4 Organoleptic Physical Properties Test Results

Formula	Result Organoleptik Test		
	Colour	Tekstur	Smell Information
Blanko	putih	+	<i>oleum rosae</i>
F1	coklat muda	+	khas labu kuning
F2	coklat	++	khas labu kuning
F3	coklat tua	++	khas labu kuning

Information :

+ = slightly thick

++ = thick

Based on Table 4, the results of organoleptic observations show that lotion preparations with blank formulas, formulas 1, 2 and 3 have different colors for each formulation. This is because the extract concentration in each formula is different, the higher the extract concentration in the mixture, the stronger the color the product produces.

2) Homogenitas Test

Tabel 5 Homogenitas Phsysical Properties test Results

Replikasi	Formula			
	Blanko	F1	F2	F3
R1	Homogen	Homogen	Homogen	Homogen
R2	Homogen	Homogen	Homogen	Homogen
R3	Homogen	Homogen	Homogen	Homogen

Based on Table 5, the results of homogeneity test observations show that all blank preparations, F1, F2 and F3 have a good and homogeneous particle arrangement on the glass without coarse grains. This shows that the process of mixing the ingredients for each formulation has gone well or evenly. (Rifki Pratama et al., 2020)

Table 6 Physical properties test results: pH, viscosity, adhesive power, spreadability

Formula	pH*	Viscosity*	Adhesive Power*	Spreadability*
Blanko	6,9 ± 0,10	3.263,9 ± 3,72	5,38 ± 0,27	6,78 ± 0,15
F1	6,8 ± 0,10	5.409,8 ± 98,72	6,49 ± 0,27	6,39 ± 0,12
F2	6,5 ± 0,32	6.346,6 ± 106,76	6,77 ± 0,30	6,26 ± 0,07
F3	6,4 ± 0,36	7.177,2 ± 79,76	7,48 ± 0,23	6,21 ± 0,20

*Average ± SD

3) pH Test

Based on Table 6, the concentration of pumpkin extract affects the pH value because pumpkin extract contains acidic compounds such as vitamin C. Pumpkin flesh contains a lot of vitamin C, namely 123.72 mg/100 grams (Nurrohman & Astuti, 2022). The higher the concentration of the extract, the more acidic the pH of the cream. The pH value of each formula is in accordance with the pH range of topical formulations that are safe for the skin, namely 4.5-7 (Ratnapuri, 2020). Statistical data analysis of the pH values obtained was tested statistically. The results of the normality test using the Shapiro-Wilk test are a significance value of >0.05 , meaning the data is normally distributed, and the homogeneity test using the Levene test gives a significance value of >0.05 , the data is homogeneous. Because the data was normally distributed and homogeneous, the one-way ANOVA test was continued which gave a significance value of $0.141 > 0.05$, indicating that there were no real differences in the pH parameters F1, F2 and F3.

4) Viscosity Test

Based on Table 6, the concentration of the extract used affects the viscosity value, where the higher the concentration of pumpkin extract added to the lotion preparation, the amount of water in the lotion decreases so that the lotion becomes thicker (Wuryandari et al., 2019) Statistical data analysis from the one-way ANOVA test with a significance value of $0.000 < 0.05$ means that each formula due to variations in the concentration of pumpkin fruit extract in the lotion preparation has a significant effect on viscosity. If there were significant differences between each formula, post hoc testing was continued. The results of the Tukey HSD test show that all formulas have significant differences.

5) Test adhesion

Based on Table 6, the results of this adhesion test show the highest adhesion value of 7.48 seconds for F3 and the lowest adhesion value of 5.38 seconds for the blank formula. The results of this adhesion test meet the requirements for good adhesion, namely > 4 seconds (Yati et al., 2018) Based on the one way ANOVA test, a significance value of $0.000 < 0.05$ was obtained, this shows that each formulation that varied the concentration of pumpkin extract, such as lotion, had a significant difference in adhesive strength. To detect differences between formulas, the Tukey HSD test was continued with the zero sample results showing significant differences with all formulas, with formulas 1 and 3 there was a significant difference in the values obtained (0.009).

6) Spreadability test

Based on Table 6, the results of measuring the spreadability of each lotion dosage formula show that the highest spreadability value is 6.78 cm for the blank formula and the lowest value is 6.21 cm for F3. The values obtained are in accordance with the range of good lotion preparations, namely 5-7 cm. (Rantika et al., 2020). Based on the one way ANOVA test, a significant value of $0.001 < 0.05$ was obtained, indicating that there was a significant difference in the spreadability of each formulation. To see the difference in the formula, continue



with the Tukey HSD test. Tukey's HSD test results show that there are significant differences in the blank samples with all significance values < 0.05 .

7) Test The Stability Of The Lotion Preparation

The purpose of stability testing of lotion preparations is to ensure the stability of the preparation during long-term storage. In this research, the cyclone test method was used to test the stability of lotion preparations, namely. The cream is stored in the refrigerator at 4°C for 24 hours and then at 40°C for 24 hours. This process is counted as one cycle. The stability test has 6 cycles or a continuous duration of 12 days (Zam and Musdalifah, 2022). Tests in each cycle include organoleptic, homogeneity, pH, viscosity, stickiness and spreadability. The results of the stability test can be seen in Table.

Tabel 10 pH Stability Test Results

Siklus	Formula			
	Blanko	F1	F2	F3
1	6,73 ± 0,05	6,83 ± 0,05	6,56 ± 0,32	6,4 ± 0,36
2	6,63 ± 0,11	6,83 ± 0,05	6,56 ± 0,32	6,4 ± 0,36
3	6,8 ± 0,1	6,8 ± 0,1	6,53 ± 0,28	6,4 ± 0,36
4	6,9 ± 0,1	6,86 ± 0,05	6,56 ± 0,32	6,46 ± 0,40
5	6,96 ± 0,05	6,8 ± 0	6,56 ± 0,32	6,46 ± 0,40
6	6,9 ± 0,1	6,8 ± 0,1	6,56 ± 0,32	6,4 ± 0,36

Tabel 11 Viskositas (cps) Stability Test Results

Siklus	Formula			
	Blanko	F1	F2	F3
1	3.255,9 ± 2,93	5.488,3 ± 259,0	6.312 ± 243,7	7.151,9 ± 3,88
2	3.249,4 ± 6,17	5.267,1 ± 53,2	6.244,5 ± 40,4	7.132,1 ± 11,7
3	3.243,5 ± 5,26	5.256,7 ± 49,7	6.237,2 ± 30,2	7.059,6 ± 25,9
4	2.242,7 ± 8,29	4.477,6 ± 81,9	5.448,7 ± 22,6	6.508,8 ± 261,5
5	2.234,1 ± 5,56	4.438,4 ± 29,2	5.344,6 ± 39,5	6.420,3 ± 28,7
6	2.229,8 ± 11,06	4.350,4 ± 34,5	5.264 ± 23,1	6.251,9 ± 23,3

Tabel 12 Adhesion stability test results (seconds)

Siklus	Formula			
	Blanko	F1	F2	F3
1	5,36 ± 0,27	6,47 ± 0,24	6,60 ± 0,28	7,46 ± 0,29
2	5,3 ± 0,24	6,38 ± 0,27	6,51 ± 0,27	7,28 ± 0,10
3	5,11 ± 0,08	6,35 ± 0,09	6,48 ± 0,35	7,27 ± 0,35
4	4,88 ± 0,09	5,82 ± 0,06	5,61 ± 0,31	6,72 ± 0,33
5	4,54 ± 0,25	5,64 ± 0,19	5,33 ± 0,12	6,61 ± 0,35
6	4,38 ± 0,07	5,42 ± 0,12	5,29 ± 0,33	6,45 ± 0,11

Tabel 13 Spreading stability test results (cm)

Siklus	Formula			
	Blanko	FI	FII	FIII
1	6,63 ± 0,27	6,33 ± 0,22	6,26 ± 0,37	6,21 ± 0,10
2	6,56 ± 0,33	6,33 ± 0,05	6,25 ± 0,43	6,21 ± 0,37
3	6,51 ± 0,20	6,3 ± 0,18	6,25 ± 0,25	6,2 ± 0,26
4	6,3 ± 0,26	6,3 ± 0,43	6,23 ± 0,11	6,15 ± 0,13
5	6,3 ± 0,18	6,21 ± 0,16	6,23 ± 0,20	6,13 ± 0,15
6	6,28 ± 0,10	6,18 ± 0,16	6,21 ± 0,20	6,1 ± 0,17

Based on Table 10, it is known that testing the pH of lotion preparations produces a pH value from the beginning of the cycle to the end of the cycle that is still relatively the same, namely pH 6, meaning that from the beginning of the cycle to the end of the cycle the pH of the preparation is relatively stable. Based on the paired sample test, the results from F1, F2 and F3 obtained a significance value (2-tailed) > 0.05, which shows that all lotion preparation formulas for pumpkin pulp extract are stable with respect to pH parameters

Based on Table 11, the viscosity of the lotion was measured using an Attago viscometer with rotor spindle number A2L at a speed of 30 rpm. Based on the results of this test, the blank formula produces values ranging from 2,229.8 to 3,255.9, F1 ranges from 5,256.7 to 5,488.3, F2 ranges from 5,264 to 6,312 and F3 ranges from 6,251.9 to 7,151.9. The resulting viscosity value is said to be good because it meets the requirements of Indonesian National Standard No. 16-4399-1996, between 2,000-50,000 cps. Based on the paired sample test, the results of F1, F2 and F3 obtained a significance value (2-tailed) < 0.05, which shows that all lotion preparation formulas for pumpkin pulp extract are unstable with respect to viscosity parameters

Based on Table 12, the tests in this study show that the adhesion results during six storage periods provide adhesion in the range of 4.38–7.46 seconds and are recognized as a good emulsion composition because they meet the adhesion requirements for lotion compositions, namely >1 second. (Forestryana and Rahman, 2020). The paired sample test on F1 and F3 obtained significance values (2-tailed) of 0.007<0.05 and 0.030<0.05, which indicated that the F1 and F3 lotion formulations were unstable in terms of adhesion parameters. while for F2, the significance value (2-tailed) was 0.055>0.05, indicating that pumpkin extract lotion was stable against F2. However, the average bond strength results for each cycle meet good bond strength standards for topical preparations.

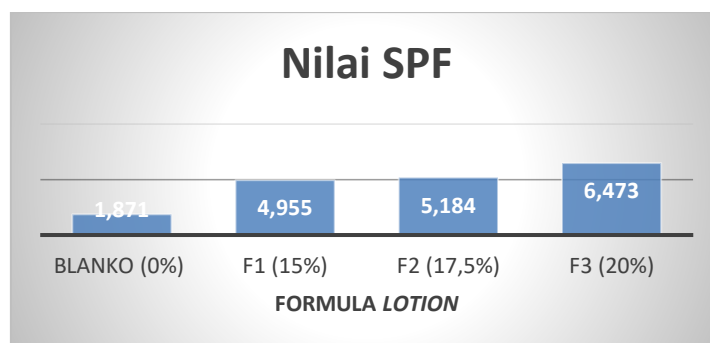
Based on Table 13, the spreadability stability test shows that the average stability of the spreadability of pumpkin pulp extract lotion on blanks is around 6.3-6.63 cm, F1 is around 6.3-6.33, F2 is around 6.21- 6.26 and F3 ranges from 6.1 to 6.21. This shows that during 12 days of storage, the lotion meets the requirements for good spreadability, namely 5-7cm. The spreadability of the product affects the comfort level of the product when applied to the skin (Mappa, 2013). Based on the paired sample test, the results of F1, F2 and F3 in sequence are 0.120>0.05; 0.580>0.05 and 0.707>0.05 indicate that all lotion formulations containing pumpkin extract are stable in spreadability parameters.



8) Uji nilai SPF sediaan *lotion* pada stabilitas siklus ke 6

Tabel 14 Hasil nilai SPF sediaan *lotion* siklus ke 6

Formula	Nilai SPF	Proteksi SPF
Blanko	1,871	Tidak berpotensi sebagai SPF
F1	4,955	Proteksi sedang
F2	5,184	Proteksi sedang
F3	6,473	Proteksi ekstra



Gambar 2 Grafik nilai SPF sediaan *lotion* stabilitas siklus ke 6

Based on this SPF value test, it shows that the highest SPF value was produced by F3, namely 6.473 and the lowest SPF value was produced by the blank formula, namely 1.871. Based on the test results, the blank formula with a value of 1.871 does not contain SPF because there is no addition of pumpkin pulp extract, F1 with an average SPF of 4.955 is in the medium protection category, F2 with an average SPF of 5.184 is in the medium protection category, and F3 with an average SPF of 6,473 in the extra protection category. A comparison between the SPF value before stabilization and the SPF value in the 6th cycle experienced a decrease in the SPF value, which indicates that the preparation experienced a decrease in its effectiveness as a sunscreen. The decrease in the SPF value in this test was caused by the storage temperature for 12 days, where this flavonoid compound is an unstable compound and breaks easily. Decomposition occurs under the influence of temperature, oxygen content and light.

Flavonoid degradation is caused by the breaking of molecular chains and oxygen reactions, which cause oxidation of hydroxyl groups and the formation of other volatile compounds (Rifkia, 2020). In addition, the degradation of flavonoid compounds is not only influenced by temperature and drying time. Flavonoid degradation also depends on other parameters such as material structure, phytochemistry, pH and oxygen availability.

DISCUSSION

The Qualitative test of flavonoids show that pumpkin extract gives positive results where the sample produces an orange color.(Appriliani & Oktaviannoor, 2021b) The orange colour formed is caused by the reaction between the addition of Mg sulfate and concentrated HCl which causes the reduction of Flavonoid compounds

The 0th Cycle SPF Value shows that the resulting blank formula has no potential as a sunscreen with a SPF of 1.944 because pumpkin pulp extract was not added to the preparation. The SPF value for F1 is 7.401 in the extra protection category, F2 is 7.898 in the Extra Protection category, and F3 is 8.274 in the maximum protection category. Evaluation Of The Physical Properties Of The Pumpkin Pulp Extract Lotion Preparation show that for organoleptic tests resulting on preparation of lotions with blanko formula, formula 1, 2 and 3 have different colors for each formulation. This is because the concentration of extracts in each formula is different, the higher the extractive concentration in the mixture the stronger the color of the resulting product. Then for the homogeneity test obtained the result that all preparations blanko have a homogeneous arrangement of particles. It indicates that the process of mixing the ingredients of each formulation has gone well or evenly. Then for Ph test results were obtained yellow pumpkin extract containing acid compounds like vitamin C. Yellow pumpkins meat contains a lot of vitamin C is 123.72 mg/100 gram (Astuti, 2022). The higher the concentration of the extract, the more acidic the pH of the cream. The pH value of each formula corresponds to the pH range of the topical formulation that is safe for the skin, i.e. 4.5-7 (Ratnapuri, 2020).

In addition to the pH test, the viscosity test and the concentration of the extracts used influenced the values of viscosity, where the higher the addition of the yellow pumpkin extract concentration to the lotion preparation then the amount of water in the lotions decreased so that the cream became thicker. Analysis of statistical data from oneway ANOVA test with a significance value of $0,000 < 0.05$ means that any formula due to the presence of variations in the concentration of yellow turmeric extract in the lotion preparation has a significant influence on the viscosity. With significant differences of each formula proceeded post hoc testing. The results of Tukey's HSD test showed that all formulas had significant differences. The adhesive test was also performed to determine the adhesion value produced, resulting in the highest adhesiveness value of 7.48 seconds for F3 and the lowest adhesivity value of 5.38 seconds for the blanko formula. This adhesivity test qualified for a good adhesives of > 4 seconds (Yati et al., 2018). The bar test showed a highest bar value of 6.78 cm for the Blanko formula and a lowest value of 6,21 cm for F3. The value obtained in the good lotion supply range was 5-7 cm. (Rantika et al. 2020). The result of HSD Tukey showed that there was a significant difference in the blanco sample with a total significant value of $< 0,05$.

In this study, the cyclone test method is used to test the stability of the lotion supply, i.e. the cream is stored in a refrigerator at a temperature of 4oC for 24 hours and then at 40oC during 24 hours. The process is counted as one cycle. The stability test has 6 cycles or continuous duration for 12 days. Test the SPF value of the lotion preparation on the stability of the sixth cycle. Based on the SPF test, this indicates that the highest SPF value produced by F3 is 6,473 and the lowest SPH value producing by the blanko formula is 1,871. Based upon the test results, the blanco formula with a value of 1,871 does not contain SPF because there is no addition of yellow turmeric meat extract, F1 with an average SPF of 4,955 falls into the category of moderate protection, F2 with a mean SPF Of 5,184 falls in the class of moderated protection, and F3 with an averaged SPF 6473 falls within the additional protection category. The comparison between the SPF values before the stabilization with the spf values in the sixth cycle experienced a decrease in the SPΦ values, indicating that the preparation experienced a reduction in its effectiveness as a sunscreen. The decrease in the SPF value in this test is due to the storage



temperature for 12 days, where the flavonoid compound is an unstable and fragile compounds. Decomposition occurs under the influence of temperature, oxygen and light. (Vatai et al., 2009).

CONCLUSION

Based on the results of the research carried out, it can be concluded that the pumpkin (*Cucurbita moschata* Durh.) flesh extract lotion formulated with different concentrations achieved SPF values before stability, namely the blank formulation provided SPF 1,944 (without SPF), F1 7,401 (extra protection) , F2 7,898 (extra protection) and F3 8,274 (maximum protection). Meanwhile, the SPF value in the sixth cycle after stability produced a blank formula of SPF 1,871 (without SPF), F1 4,955 (medium protection), F2 5,184 (medium protection) and F3 6,473 (extra protection), which indicates that after stabilization the SPF value of the preparation experienced decline.

Physical evaluation of lotion preparations includes organoleptic tests, homogeneity tests, pH tests, viscosity tests, adhesion tests and spreadability tests. The resulting values meet the specified standards. Organoleptic stability testing showed changes in the texture of the 4th cycle lotion preparation in formulas 3 and 4, resulting in a homogeneous preparation during 12 days of storage, stable pH, unstable viscosity, stable spreadability, and adhesive power in F1 and F3 was unstable while in F2 stable.

SUGGESTION

Further research is needed to vary the extract concentration to achieve maximum results, namely a very protective SPF value and needs to be developed into different SPF formulations and different active ingredients.

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