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Evaluation of Sunscreen Cream Combination of Kepok Banana Corm and Moringa Leaf Extracts

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ABSTRAK

Pemanfaatan bahan alam sebagai bahan aktif dalam sediaan kosmetik kombinasi dua bahan alam jarang ditemui. Krim kombinasi dari bahan alam perlu dilakukan evaluasi, baik kimia dan fisikanya. Penelitian ini bertujuan untuk mengevaluasi kandungan bahan aktif yang dapat diolah sebagai tabir surya dan mengevaluasi mutu fisik krim. Prosedur penelitian ini adalah pembuatan ekstrak formulasi krim, evaluasi mutu fisik, uji antioksidan, hingga uji SPF. Hasil dari uji mutu fisik dihasilkan krim M/A dan memenuhi syarat mutu fisik krim, uji antioksidan dengan nilai IC_{50} FI aktivitas sedang, FII aktivitas kuat, dan FIII aktivitas sangat kuat, uji SPF FI,FII, dan FIII proteksi maksimal. Kesimpulan pada penelitian ini evaluasi mutu fisik krim disimpulkan memenuhi syarat yang telah ditetapkan, uji antioksidan aktivitas kuat, dan uji SPF proteksi maksimal.
Kata Kunci: ekstrak, evaluasi, fisika-kimia, kombinasi, tabir surya

ABSTRACT

The utilization of natural materials as active ingredients in cosmetic formulations combining two natural substances is rare encountered. It is essential to conduct an evaluation of the combination cream derived from natural materials, both chemically and physically. This research aimed to evaluate the active ingredient content that could be processed as sunscreen and to assess the physical quality of the cream. The methods employed included extract preparation, cream formulation, physical quality evaluation, antioxidant testing, and SPF testing. The results of the physical quality tests indicate that the M/A cream meets the required physical quality standards. The antioxidant test results show that FI has moderate activity, FII has strong activity, and FIII has very strong activity, while the SPF test results for FI, FII, and FIII indicate maximum protection. The conclusion of this research is that the evaluation of the physical quality of the cream meets the established criteria, the antioxidant test demonstrates strong activity, and the SPF test indicates maximum protection.
Keywords: combination, extract, evaluation, sunscreen, psychochemical

INTRODUCTION

The skin is the outermost layer of the body, functioning as a protective barrier that safeguards the body from various harmful environmental factors, such as ultraviolet (UV) radiation, dehydration, and microorganisms (Sugihartini & Nuryanti, 2017). High exposure to ultraviolet (UV) radiation can result in adverse effects on the skin, including erythema, hyperpigmentation, sunburn, premature aging, and skin cancer. To protect the skin from these detrimental effects caused by UV exposure, it is essential to use sunscreen formulations (Azzahra et al., 2023).

Sunscreen is a substance or material that can protect the skin from ultraviolet (UV) radiation. The effectiveness of sunscreen is determined by its Sun Protection Factor (SPF) value, which indicates the level of protection it provides against UV radiation (Rusita Youstiana Dwi & S Indarto A., 2017). Sunscreens can use either synthetic compounds or natural substances as their active

ingredients, but synthetic compounds may carry risks of causing skin diseases (Pontoan, 2016). The use of natural compounds as sunscreens includes secondary metabolites that can protect the skin from UV radiation, thus serving as effective sunscreens. These secondary metabolites include flavonoids, phenols, and tannins (Lumantow et al., 2023).

Natural materials that can be utilized as active ingredients in sunscreens include the corm of the yellow Kepok banana. The corm of the Kepok banana contains secondary metabolites such as flavonoids, glycosides, terpenoids, and tannins (Wenas et al., 2020). The choice of the Kepok banana corm is due to the fact that the general public typically only utilizes the fruit, leaves, and heart of the banana plant, while the corm, which also has significant benefits, is seldom used (Andini, Maisa, et al., 2023). The Kepok banana corm contains flavonoids with antioxidant properties; these antioxidant properties can protect cells from damage caused by free radicals. Additionally, the photoprotective properties of flavonoids can shield the skin from ultraviolet radiation (Wimpy et al., 2020).

Another natural ingredient used in combination with the Kepok banana corm is moringa leaf. Moringa leaves are rich in flavonoids, which offer various benefits, including antioxidant, anti-inflammatory, and anticancer properties (Erwiyani et al., 2020). One of the flavonoids present in moringa leaves is quercetin. Moringa leaf extract has an SPF value of 5% (Azzahra et al., 2023). Research by Resti Rahayu et al. (2022) indicates that at concentrations of 3%, 6%, and 9%, moringa leaf extract can be formulated into a cream preparation.

Natural-based sunscreens can be formulated into pharmaceutical preparations, one of which is cream. Cream is a semisolid formulation that contains various ingredients easily dispersed within a suitable base (Noviardi et al, 2019). In the development of a cream formulation combining Kepok banana corm extract and moringa leaf extract, variations in the concentration of active ingredients can be a determining factor in achieving optimal product quality concerning physical characteristics. A cream preparation is considered good if it meets the standards and parameters for physical characteristics and does not undergo physical changes during storage (Wahyuningsih & Sumaryono, 2021). The addition of natural ingredients, such as Kepok banana corm extract and moringa leaf extract, in the formulation of creams can affect the physical quality of the cream (Cahyati et al., 2016). In the study by (Andini et al., 2024) the cream containing Kepok banana corm extract at a concentration of 30% was not well received in terms of color aspects. According to (Diah Ningsih & Nur Atiqah, 2020) moringa leaf extract at a concentration of 3% was categorized as providing moderate protection. This study involves the formulation of a cream using Kepok banana corm extract in combination with moringa leaf extract. Previous research indicated that the cream with Kepok banana corm extract provided maximal protection at a concentration of 30%.

METHODS

Preparation of Kepok Banana Corm Extract and Moringa Leaf Extract.

The preparation of the Kepok banana corm and moringa leaf simplicia is followed by the extraction of these materials using a maceration method with 70% ethanol as the solvent. This process involves 200.02 grams of Kepok banana corm powder and 500.9714 grams of moringa leaf powder. The mixture is then filtered using a Buchner funnel, and the resulting liquid extract is concentrated using a rotary evaporator (Andini, Sari, et al., 2023).

Cream Formulation

The formulation of the cream involves two phases: the oil phase (stearic acid, cetyl alcohol, beeswax, liquid paraffin, and nipasol) and the water phase (TEA, nipagin, and glycerin). The oil phase is melted at 70°C, while the water phase is prepared in a beaker by adding warm water and mixing until homogeneous. Subsequently, the water phase is incorporated into the oil phase in a

warm mortar and stirred continuously, maintaining the temperature for 5-10 minutes to prevent crystallization of the oil phase. The cream is allowed to cool to 40°C or a lukewarm temperature, after which 30% Kepok banana corm extract and 3%, 6%, and 9% moringa leaf extract are added, modified by the research of (Andini et al. 2024; Syarifah et al. 2022).

Table 1. Cream Formulation

Bahan	Formula I (%)	Formula II (%)	Formula III (%)
Kepok Banana Corm extract	30	30	30
Moringa leaf extract	3	6	9
Setil Alcohol	0.2	0.2	0.2
Stearat Acid	0.5	0.5	0.5
Gliserin	2	2	2
TEA	0.2	0.2	0.2
Nipasol	0.02	0.02	0.02
Nipagin	0.1	0.1	0.1
Parafin Liquid	0.5	0.5	0.5
Cera Alba	2	2	2
Aquadest	Ad 100	Ad 100	Ad 100

Evaluation of Cream

Organoleptic Testing

The cream preparation has organoleptic standards, which include being odorless and having a semisolid consistency. Organoleptic testing encompasses the evaluation of color, odor, and texture (Devin Suwandi et al., 2023).

Homogenity Testing

The test is conducted visually by applying 500 mg of the cream onto a microscope slide, which is then covered with another slide. The cream is considered homogeneous if, upon observation, it exhibits a uniform texture and does not exhibit clumping (Sari & Susiloningrum, 2022).

Cream Type Testing

Cream type testing is employed to determine the emulsion type present in the cream. There are two types of cream: the first is oil-in-water (O/W), where the oil phase is dispersed in the water phase; the second is water-in-oil (W/O), where the water phase is dispersed in the oil phase. To perform the test, 1 gram of cream is applied to a glass slide, then methylene blue is added on top of the cream and mixed. If the blue color appears uniformly, the cream is classified as O/W; if the blue color does not distribute evenly, the cream is classified as W/O (Devin Suwandi et al., 2023).

pH Testing

pH testing measures the acidity or alkalinity of a cream preparation. An acceptable pH range for a good cream formulation is aligned with the skin's natural pH, which is between 4.5 and 6.5, to prevent irritation upon application. The test is performed by taking 1 gram of the cream, diluting it with 10 ml of distilled water, and measuring the pH using a pH meter (Noviardi et al., 2019).

Spreadability Testing

Spreadability testing evaluates the ability of a cream to spread on the skin. This test is conducted to ensure that the cream is easy to apply and effective in providing the desired effects. The procedure involves weighing 0.05 grams of the cream and placing it in the center of an inverted Petri dish. The

sample is then allowed to stand for 1 minute, after which sequential weights of 50 g, 100 g, and 250 g are applied every 60 seconds. The standard spreadability for a cream preparation is 5-7 cm (Devin Suwandi et al., 2023).

Adhesion Testing

Weigh 0.5 grams of the cream and apply it to a glass plate, then place a 250-gram weight on top. Allow it to rest for 5 minutes. After removing the weight, separate the two glass plates and record the time until they are completely detached. The criterion for good adhesion in topical formulations is a detachment time of no less than 4 seconds (Devin Suwandi et al., 2023) .

Viscosity Testing

The cream preparation is placed in a cylindrical container. Attach Rotor 1 and ensure that it is fully submerged in the cream. Activate the viscometer and observe the needle's position on the viscosity scale for Rotor 1. The physical quality standard for the cream preparation is a viscosity range between 2000 and 50,000 cP (Arifin et al., 2022).

Antioxidant Activity Testing

A stock solution is prepared by weighing 10 mg of DPPH, then dissolving it in 96% analytical-grade ethanol in a 100 ml flask, and placing it in a dark bottle. A blank solution is prepared by pipetting 30 ml of the stock solution and diluting it with 96% analytical-grade ethanol in a 100 ml flask. The solution is then observed at a wavelength of 517 nm. For sample testing, 12.5 mg of cream from each formulation is weighed and dissolved in 25 ml of 96% analytical-grade ethanol. Sample solutions are prepared at concentrations of 50, 100, 150, 200, and 250 ppm, each diluted to the mark in a 10 ml volumetric flask with 96% analytical-grade ethanol. For each concentration series, 2 ml is pipetted and mixed with 2 ml of DPPH solution. The mixture is vortexed and allowed to stand in the dark for 30 minutes, after which absorbance is measured at 517 nm using UV-Vis spectrophotometry (Pogaga et al., 2020).

Sun Protection Factor Testing

Weigh 0.1 g of cream from each formulation with 3 replicates. Dissolve the samples in 96% analytical-grade ethanol. Measure absorbance using a spectrophotometer with a wavelength range of 290-320 nm, using 96% analytical-grade ethanol as the blank (Andini et al., 2024; Erwiyani et al., 2021). Mathematical equations, reaction formulas, and similar notations are numbered without distinguishing between types of equations. The SPF is calculated using the formula:

$$SPF = CF \times \sum EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Data Analysis

The results of organoleptic testing, homogeneity, and cream type are analyzed descriptively. Meanwhile, spreadability, adhesion, pH, viscosity, antioxidant activity, and SPF values are analyzed using ANOVA with a confidence level of 95%.

RESULTS AND DISCUSSION

1. Organoleptic Testing

Table 2. Organoleptic Testing

Organoleptic	Formulation		
	FI	FII	FIII
Form	Semi Solid	Semi Solid	Semi Solid
Color	Light Brown	Brownish Yellow	Brownish Yellow
Odor	Characteristic Moringa Leaf	Characteristic Moringa Leaf	Characteristic Moringa Leaf

The results of the organoleptic testing as shown in table 2, indicate that all three formulations exhibit a semisolid form. The colors produced by the three formulations differ: FI yields a light brown color, FII produces a brownish-yellow color, and FIII also yields a brownish-yellow color. The odor varies as well, with FI having a characteristic smell, while FII and FIII both have a distinct moringa leaf odor. The intensity of the moringa leaf odor increases with the concentration of moringa leaf extract. Researchly (Syarifah et al., 2022) suggests that higher concentrations of natural extract result in a more intense color and stronger smell.

2. Homogenity Testing

Table 3. Homogenity Testing

Organoleptic	Formulation			Description
	FI	FII	FIII	
Homogeneity	Uniformly Mixed	Uniformly Mixed	Uniformly Mixed	Homogeneneous

The results of the homogeneity testing (table 3) indicate that all three formulations are homogeneous. The testing and observation of homogeneity were conducted on the three creams combining Kepok banana corm extract and moringa leaf extract to ensure that all components, including the water phase, oil phase, and extracts, are uniformly mixed. This test is crucial to verify that the active ingredients in the cream are evenly distributed when the cream is applied to the skin (Amini et al., 2020).

3. Cream Type Testing

Table 4. Cream Type Testing

Testing	Formulation			Description
	FI	FII	FIII	
Cream Type	O/W	O/W	O/W	Oil in Water

The formulated cream is classified as an oil-in-water (O/W) as shown in table 4, as research Devin Suwandi et al. (2023) indicates that creams of this type provide superior spreadability compared to water-in-oil (W/O) creams. The cream type testing was conducted using a staining method with methylene blue. Methylene blue is water-soluble and disperses evenly. Thus, if the blue color appears uniformly, the cream is identified as an oil-in-water type (Lumantow et al., 2023).

4. pH Testing

The measurement of pH aims to determine whether the formulated cream is acidic or basic, according to the research Amini et al. (2020) The skin's pH requirement is 4.5 – 6.5. The pH test

results for the cream combining Kepok banana corm extract and moringa leaf extract as shown in table 5 showed a value of 5.85 ± 0.03 for FI, 5.73 ± 0.005 for FII, and 5.6 ± 0.03 for FIII. It can be concluded that the pH test results for FI, FII, and FIII fall within the acceptable pH range for the skin. The pH of the three formulations progressively decreases (Rikadyanti et al., 2021) which is consistent with research stating that the active compounds in the ethanol extract of moringa leaves exhibit a more acidic pH. Statistical analysis was conducted using one-way ANOVA on the pH measurements of the cream formulations combining Kepok banana corm extract and moringa leaf extract. ANOVA testing was performed on the three formulations to determine if there were any significant differences in pH values with the addition of different extract combinations.

Table 5. pH Testing

Formulation			Reference
FI	FII	FIII	
5,85 ± 0,03	5,73 ± 0,005	5,6 ± 0,03	Complies the pH for cream which range from 5,6 to 5,8

The statistical analysis results indicated a p-value <0.05, signifying no significant differences in pH values among the formulations. The addition of extract combinations did not produce a significant effect on the resulting pH values. In the statistical analysis using post hoc testing on the pH measurements of the cream formulations combining Kepok banana corm extract and moringa leaf extract, it can be concluded that significant differences were observed between Formula 1 and Formula 2, as well as between Formula 1 and Formula 3. However, no significant difference was found between Formula 2 and Formula 3.

5. Spreadability Testing

Table 6. Spreadability Testing

Formulation			Reference
FI	FII	FIII	
5,05 ± 0,23	5,78 ± 0,18	6,39 ± 0,33	Complies with the cream spreadability standard, which ranges from 5.05 cm to 6.39 cm

The spreadability test is conducted to determine how easily the cream can be applied to the skin. A cream with good spreadability will be easy to apply without requiring excessive pressure, thereby providing a comfortable sensation when applied to the skin (Lumantow et al., 2023). The test results from the three formulations (table 6) indicate that the spreadability of the formulated creams ranges from 5 to 6.39 cm, thus falling within the established cream spreadability requirement range of 5 to 7 cm (Dwi fitrah wahyuni wiwi, 2022). Statistical analysis using one-way ANOVA was conducted on the spreadability measurements of the cream formulations combining Kepok banana corm extract and moringa leaf extract.

The ANOVA test was performed on the three formulations to determine if there were any significant differences in spreadability values with the addition of various extract combinations. The statistical test results indicated a p-value <0.05, signifying no significant differences in spreadability values among the formulations. The addition of extract combinations did not produce a significant

effect on the resulting spreadability values. In the statistical analysis using post hoc testing on the spreadability measurements of the cream formulations combining Kepok banana corm extract and moringa leaf extract, it can be concluded that significant differences were observed between Formula 1 and Formula 2, as well as between Formula 1 and Formula 3. However, no significant difference was found between Formula 2 and Formula 3.

6. Adhesion Testing

Table 7. Adhesion Testing

Formulation			Reference
FI	FII	FIII	
9,25 ± 0,11	7,88 ± 0,01	6,70 ± 0,06	Complies with the cream adhesion standard, which is not less than 4 seconds

The adhesion test is conducted to determine the cream's ability to adhere to the skin (Puspitasari et al., 2019). The test results from the three formulations as shown in table 7, indicate that the adhesion time of the formulated creams ranges from 6 to 9 seconds, thereby meeting the cream adhesion requirement of not less than 4 seconds (Devin Suwandi et al., 2023).

Statistical analysis using one-way ANOVA was conducted on the adhesion measurements of the cream formulations combining Kepok banana corm extract and moringa leaf extract. The ANOVA test was performed on the three formulations to determine if there were any significant differences in adhesion values with the addition of various extract combinations. The statistical analysis results indicated a p-value <0.05, signifying no significant differences in adhesion values among the formulations. The addition of extract combinations did not produce a significant effect on the resulting adhesion values.

7. Viscosity Testing

Table 8. Viscosity Testing

Formulation			Reference
FI	FII	FIII	
5530 ± 0,05	3870 ± 0,25	2160 ± 0,15	Complies with the viscosity standards for topical formulations, which range from 2000 to 50,000 cP

The viscosity test was conducted to determine the resistance generated by the cream (Pratasik et al., 2019). The viscosity values of the three formulations (table 8) fall within the acceptable viscosity range for topical formulations, which is between 2000 and 50,000 cP (Arifin et al., 2022). According to research by Rikadyanti et al. (2021) the addition of moringa leaf extract can significantly reduce the cream's viscosity. Statistical analysis using one-way ANOVA was conducted on the viscosity measurements of cream formulations combining Kepok banana corm extract and moringa leaf extract.

The ANOVA test was performed on the three formulations to determine if there were significant differences in viscosity values with the addition of various extract combinations. The statistical analysis results indicated a p-value >0.05, signifying significant differences in viscosity values among the formulations. The addition of extract combinations produced a notable effect on the resulting viscosity values. In the statistical analysis using post hoc testing on the viscosity measurements of the cream formulations combining Kepok banana corm extract and moringa leaf

extract, it can be concluded that significant differences were observed between Formula 1 and Formula 2, as well as between Formula 1 and Formula 3. Additionally, significant differences were also found between Formula 2 and Formula 3.

8. Antioxidant

Table 9. Antioxidan Activity

Formulation	IC_{50} Value	Antioksidant Activity
FI	115.96	Moderate
FII	56.39	Strong
FII	25.27	Very Strong

The antioxidant activity test of the cream formulations combining Kepok banana corm and moringa leaf extracts against DPPH revealed an IC_{50} value of 153.64 ppm. FI, with the addition of 3% moringa leaf extract, had an IC_{50} value of 115.96 ppm; FII, with 6% moringa leaf extract, had an IC_{50} value of 56.39 ppm; and FIII, with 9% extract concentration, had an IC_{50} value of 25.27 ppm (table 9). The results indicate that as the concentration of moringa leaf extract in the cream formulation increases, the antioxidant activity of the cream also enhances. The values obtained suggest that FI exhibits moderate antioxidant activity, FII exhibits strong antioxidant activity, and FIII exhibits very strong antioxidant activity. This is consistent with the categorization of antioxidant activity strength (Wimpy et al., 2020).

The IC_{50} values of FI, FII, and FIII were analyzed using the one-way ANOVA method. From the results presented in Appendix 3, the normality test indicated that the data were normally distributed, allowing for the continuation of the analysis with a one-way ANOVA followed by a post Hoc test. The results yielded a p-value of 0.00 (<0.05), indicating a significant difference among the three formulations.

9. SPF Value

Table 10. *Sun Protection Factor* Value

Formulation	SPF Value	Protection Category
FI	8.5	Maximum protection
FII	10.93	Maximum protection
FIII	11.65	Maximum protection

On the absorbance measurements at a wavelength range of 290 nm–320 nm, the results obtained were 8.5025 at a 3% concentration, 10.9369 at a 6% concentration, and 11.6501 at a 9% concentration as shown in table 10. The normality test for one-way ANOVA revealed a Sig value greater than 0.05 for each formulation. The statistical analysis results indicated a significant difference, with a Sig value less than 0.05. According to the determination of the Sun Protection Factor category, it can be concluded that all three formulations fall within the maximum protection category.

CONCLUSION

The organoleptic tests revealed that the cream formulations are semisolid, with a light brown color in FI and a yellowish-brown hue in FII and FIII. The creams emitted a characteristic scent of moringa leaves. The cream type test concluded that the formulations are oil-in-water (O/W) emulsions. Homogeneity testing indicated that the creams are uniform in consistency. The pH tests for FI, FII, and FIII yielded values within the range of 5.6–5.8, meeting the required standards. The

spreadability tests produced results within the range of 5.05–6.39 cm for all three formulations, indicating compliance with the spreadability standards. The adhesion test results met the required standard with a duration of 4 seconds.

In the viscosity test, all three formulations met the standard requirements for topical application. The antioxidant activity evaluation, based on IC50 values, showed that FI had a value of 115.96 ppm with moderate activity, FII had a value of 56.39 ppm with strong activity, and FIII had a value of 25.27 ppm with very strong activity. The SPF evaluation revealed that FI, FII, and FIII achieved values of 8.5, 10.93, and 11.65, respectively, indicating maximum protection across all three formulations.

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