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Formulation And Evaluation Of Sunscreen Spray Gel Preparations From Kepok Banana Flower Extract (Musa Acuminata X M. Balbisiana) With Variations In Extract Concentration Based On SPF Value

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Abstract

UV exposure causes skin damage such as erythema and premature aging, so natural sunscreens are needed such as ethanol extract of kepok banana flowers (Musa acuminata × M. balbisiana) which are rich in flavonoids and polyphenols. The aim of this study was to determine the effect of variations in extract concentration (0.8%, 1%, 1.2%) on the physical characteristics and SPF value of spray gel. This type of descriptive experimental study used the maceration method, formulation with carbopol 940, and in vitro evaluation. The extract population was from Pontianak, samples of three formulas with three replications. Instruments used were UV-Vis spectrophotometer, Brookfield viscometer; ANOVA analysis and linear regression. The results showed pH 5.64-6.25, viscosity 989-1915 cPs, homogeneous, SPF 15.90 (F1) to 18.76 (F3). Conclusion: A concentration of 1.2% is optimal for effective and stable sunscreen spray gel.

Keywords: Kepok Banana Flower, Spray Gel, Sunscreen, SPF.

INTRODUCTION

Ultraviolet (UV) exposure is an unavoidable environmental factor in everyday life, with UV-B contributing to 85-90% of erythema and 70-80% of non-melanoma skin cancers, while UV-A contributes to 80-90% of premature aging and 60-70% of hyperpigmentation (Dai et al., 2021). The use of sunscreen with a Sun Protection Factor (SPF) of at least 30 is recommended for optimal protection against UV-B, as SPF measures the preparation's ability to protect the skin from erythema caused by UV exposure (Widyawati et al., 2019; Food and Drug Administration, 2019). For Asian skin type IV, SPF 6-15 is necessary, and the trend of natural ingredients is increasingly in demand due to their safety (Puspitasari et al., 2018).

Ethanol extract of kepok banana flowers (Musa acuminata × M. balbisiana) is rich in flavonoids, polyphenols, and saponins which have the potential to be strong antioxidants with an IC_{50} of 13.21 µg/mL, capable of donating hydrogen to neutralize free radicals from UV exposure (Nurhaeni et al., 2019; Husnani et al., 2024). UV exposure triggers reactive oxygen species causing oxidative stress, DNA damage, premature aging, and skin cancer, so antioxidants act as secondary protection in addition to SPF (Rao et al., 2021). Research on banana flower extract lotion showed very strong antioxidant activity at a concentration of 0.8% (IC_{50} 10.04 µg/mL), with increasing concentration being directly proportional to effectiveness (Husnani et al., 2024).

To produce a sunscreen preparation that is comfortable to use and has optimal effectiveness, a practical and stable dosage form is required. One dosage form that meets these criteria is a spray gel. Spray gel is a topical preparation that combines the advantages of a gel and a spray, has a slightly thick liquid texture, and is applied using a spray pump (Ananta, 2023). Previous research on the formulation and evaluation of a sunscreen spray gel made from soybean ethanol extract showed that the spray gel preparation can be formulated well, is physically stable, and that variations in extract concentration affect the physical properties and SPF value. This indicates that natural ingredients have the potential to be developed into a spray gel form as a sunscreen preparation (Akbar et al., 2020).

This study aims to determine the effect of variations in the concentration of ethanol extract of kepok banana flowers on the SPF value and physical characteristics of sunscreen spray gel, and to determine the concentration with the highest SPF.

RESEARCH METHODS

This research is a descriptive research with an experimental approach in the laboratory, namely research conducted systematically to assess the effect of a treatment on other variables under controlled conditions. The research procedure includes sampling, making simple drugs, extraction process, formulation of preparations, testing the physical characteristics of the spray gel, and measuring the SPF value of the spray gel preparation containing ethanol extract of kepok banana flowers (Musa acuminata x M. balbisiana) with varying extract concentrations.

The main instruments include The tools used in this study are dry cabinet, blender, sieve, maceration vessel, stirring rod, filter paper, evaporating cup, rotary evaporator, analytical balance, beaker glass (pyrex), measuring cup, mortar, stamper, spatula, horn spoon, watch glass, universal pH, mica plastic, brookfield viscometer, spray gel container, measuring flask, dropper pipette, cuvette, and UV-Vis spectrophotometer. The materials used in this study consisted of kepok banana flowers obtained from banana trees in the Budi Utomo Street area, Pontianak City, West Kalimantan. Other materials are 96% ethanol, kapok banana flower extract, carbopol 940, triethanolamine, propylene glycol, methyl paraben, and distilled water.

The research population was the ethanol extract of kepok banana flowers from plant samples on Jalan Budi Utomo, Pontianak, West Kalimantan, which were identified at the Biology Laboratory of MIPA, Tanjungpura University, Pontianak. The samples consisted of three spray gel formulas (F1: 0.8%; F2: 1%; F3: 1.2%).

The procedure begins with the collection of kepok banana flowers (3.5 kg), wet sorting, washing, chopping, drying (40°C dry cabinet), dry sorting, and storage of the simplicia, followed by standardization (drying loss, total ash content, water content). Maceration extraction with 96% ethanol (500 g simplicia, 3×24 hours), evaporation (40°C), calculated yield, and standardization of the extract (water content, ethanol-free, metal-free) followed by phytochemical screening of flavonoids, saponins, polyphenols (Nurhaeni et al., 2019). Spray gel formulation: 0.5% carbopol dispersion in distilled water + TEA (solution A), preservative dissolved in propylene glycol (solution B), mix + extract variations, stir homogeneously [Puspita et al., 2020; Akbar et al., 2020]. Evaluations included organoleptic, homogeneity (glass plate), pH (4.5-6.5), viscosity, spray pattern (5 cm), adhesion (in vivo arm), drying time (<5 minutes), and in vitro SPF.

RESULTS AND DISCUSSION

Determination of Kepok Banana Plants

Determination was carried out at the Biology Science Laboratory of Tanjungpura University, the results of the determination showed that the plant used was a kepok banana plant which has the Latin name (Musa acuminata x M. balbisiana).

Making Kepok Banana Flower Simple Medicine

Table 1 Yield of Kepok Banana Flower Simplex

Wet Material Weight (g)	Dry Material Weight (g)	Yield (%)
3,500	619	17.69

Standardization of Kepok Banana Flower Simplicia

Drying Loss

Table 2 Drying Loss of Kepok Banana Flower Simples

Replication	Crucible Weight Empty (g)	Simple Weight (g)	Crucible Weight + Simplex After Heating	Results (%)
1	44,291	2	46,176	5.75
2	44,417	2	46,299	5.90
3	44,348	2	46,239	5.45
Average				5.70 ± 0.23

Ash Content

Table 3 Ash Content of Kepok Banana Flower Simplex

Replication	Powder Weight (g)	Results (%)	Average (%)
1	2	5.33	
2	2	5.27	5.22 ± 0.15
3	2	5.05	

Water content

Table 4 Water Content of Kepok Banana Flower Simplex

Replication	Crucible Weight Empty (g)	Simple Weight (g)	Crucible + Simplicia Weight After Heating (g)	Results (%)
1	43,062	2	43,181	5.95
2	51,387	2	51,499	5.60
3	46,914	2	46,811	5.15
Average				5.56 ± 0.40

Kepok Banana Flower Extraction

Table 5 Yield of Kepok Banana Flower Extract

Extract Weight (g)	Simple Weight (g)	Yield (%)
63.9	500	12.78

Standardization of Kepok Banana Flower Extract

Water content

Table 6 Water Content of Kepok Banana Flower Extract

Replication	Powder Weight (g)	Results (%)	Average (%)
1	2	5.44	
2	2	5.12	5.31 ± 0.17
3	2	5.37	

Ethanol Free

Table 7 Ethanol-Free Results of Kepok Banana Flower Extract

Testing	Reagent	Results Obtained
ethanol-free test	H2SO4 + CH3COOH 1%	no ester smell

Metal Free

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TTable 8 Metal-Free Results of Kepok Banana Flower Extract

Testing	Reagent	Results Obtained
Lead (Pb) test	K_2CrO_4	No yellow precipitate is formed
Cadmium (Cd)	NaOH	No pink color is formed

Phytochemical Screening of Kepok Banana Flower Extract

Table 9 Phytochemical Screening of Kepok Banana Flower Extract

Phytochemicals	Reagent	Observation result	Information
Flavonoid	Concentrated HCl + Mg powder	Orange color is formed	Positive

Phytochemicals	Reagent	Observation result	Information
Saponin	Aquadest (foam test)	Stable foam is formed	Positive
Polyphenols	$FeCl_3$ 1%	Blackish green	Positive

Evaluation of Kepok Banana Flower Extract Spray Gel

Organoleptic Test

Table 10 Organoleptic Test Results of Spray Gel

Formula	Color	Aroma	Texture
F1 (0.8%)	Yellow	Typical Kepok banana flower	Less Viscous Liquid
F2 (1%)	Brownish Yellow	Typical Kepok banana flower	Slightly Thick Liquid
F3 (1.2%)	Chocolate	Typical Kepok banana flower	Slightly Thick Liquid

Homogeneity Test

Table 11 Spray Gel Homogeneity Test Results

Formula	Replication 1	Replication 2	Replication 3	Average
F1 (0.8%)	There are no foreign particles	There are no foreign particles	There are no foreign particles	Homogeneous
F2 (1%)	There are no foreign particles	There are no foreign particles	There are no foreign particles	Homogeneous
F3 (1.2%)	There are no foreign particles	There are no foreign particles	There are no foreign particles	Homogeneous

pH test

Table 12 Results of Spray Gel pH Test

Formula	Replication 1	Replication 2	Replication 3	Average
F1 (0.8%)	6.25	6.28	6.22	6.25
F2 (1.0%)	5.97	5.93	5.99	5.96
F3 (1.2%)	5.68	5.64	5.61	5.64

Viscosity Test

Table 13 Spray Gel Viscosity Test Results

Formula	Replication 1	Replication 2	Replication 3	Average
F1 (0.8%)	985	1025	957	989
F2 (1.0%)	1315	1350	1290	1318
F3 (1.2%)	1885	1950	1910	1915

Adhesion Test

Table 14 Results of Spray Gel Adhesion Test

Formula	Replication 1	Replication 2	Replication 3	Conclusion
F1 (0.8%)	Spread	Spread	Spread	Good
F2 (1.0%)	Spread	Spread	Spread	Good
F3 (1.2%)	Spread	Spread	Spread	Good

Spray Pattern Test

Table 15 Results of Spray Gel Spraying Pattern Test

Formula	Replication 1	Replication 2	Replication 3	Conclusion
F1 (0.8%)	10	10	10	Attached
F2 (1.0%)	10	10	10	Attached
F3 (1.2%)	10	10	10	Attached

Dry Time

Table 16 Test Data for Spray Gel Preparation Time

Formula	Replication 1	Replication 2	Replication 3	Average
F1 (0.8%)	3 minutes 12 seconds	3 minutes 18 seconds	3 minutes 15 seconds	3 minutes 15 seconds
F2 (1.0%)	3 minutes 25 seconds	3 minutes 29 seconds	3 minutes 21 seconds	3 minutes 25 seconds
F3 (1.2%)	3 minutes 38 seconds	3 minutes 40 seconds	3 minutes 35 seconds	3 minutes 38 seconds

SPF Value Test of Kepok Banana Flower Extract Spray Gel

Table 17 SPF Values of Spray Gel

Formula	Replication 1	Replication 2	Replication 3	Average
F1 (0.8%)	3 minutes 12 seconds	3 minutes 18 seconds	3 minutes 15 seconds	3 minutes 15 seconds
F2 (1.0%)	3 minutes 25 seconds	3 minutes 29 seconds	3 minutes 21 seconds	3 minutes 25 seconds
F3 (1.2%)	3 minutes 38 seconds	3 minutes 40 seconds	3 minutes 35 seconds	3 minutes 38 seconds

DISCUSSION

Determination of Kepok Banana Plants

The kepok banana flower is a part of the banana plant that is commonly found in the community and is used as a food ingredient and traditional medicine. Prior to the study, the kepok banana flower was identified in the Biology Science Laboratory at Tanjungpura University. Based on the results, the plant used was identified as the kepok banana flower with the Latin name (Musa acuminata x M. balbisiana).

Making Kepok Banana Flower Simple Medicine

This study used 3.5 kg of fresh kepok banana flowers, prepared through a wet sorting, washing, and chopping process to accelerate drying. Drying was carried out in a dry cabinet at 40°C until the dried flower was obtained. Then, it was re-sorted to remove impurities. The flower was then ground and sieved to reduce the particle size, increasing the surface area and making the extraction of active compounds more effective.

Based on Table 4.2, the yield of the Kepok banana flower simplex was 17.69%, meeting the requirements (>10%). Good yield and quality of the simplex are essential to ensure the consistency and quality of the resulting extract (Aziz et al., 2021).

Standardization of Kepok Banana Flower Simplicia

Drying Loss

Based on Table 4.2, the test results show that the average drying loss of Kepok banana flower simplicia was 5.70 ± 0.23%, still below the maximum limit of 10%. This value indicates that the drying process effectively reduced the water content. Low water content is important to prevent the growth of microorganisms and enzymatic activity that can degrade the quality of the simplicia, as well as to maintain the stability and consistency of the extract quality during storage (Sari et al., 2023).

Ash Content

Ash content determination is carried out to assess inorganic mineral content and detect possible contaminants such as sand or soil. A total of 2 grams of kepok banana flower simplicia was incandescent at 600°C to produce a grayish ash. Based on Table 4.3, the results of three replications obtained an average ash content of 5.56 ± 0.40%, with values of 5.95; 5.60; and 5.15%, respectively. These results are still within the quality standards for plant simplicia (<10%), thus indicating that the simplicia is of good quality and relatively free from inorganic contaminants (Ministry of Health of the Republic of Indonesia, 2021).

Water content

The purpose of determining water content is to determine the remaining water content in the medicinal plants, as low water content is important to prevent microbial growth and maintain stability during storage. Table 4.4 shows that the average water content of the Kepok banana flower medicinal plant is 5.22 ± 0.15%, still below the maximum limit of 10%. This value indicates that the drying process is effective, as it produces medicinal plants with good quality, stability, and resistance to fungal and bacterial growth (Rahmawati et al., 2022).

Kepok Banana Flower Extraction

The extraction process of the Kepok banana flower simplex was carried out using the maceration method using 96% ethanol as a solvent. This method was chosen because it does not involve heating, thus maintaining stability and preventing damage to active compounds such as flavonoids, polyphenols, and saponins. A total of 500 grams of simplex powder was macerated for 3 x 24 hours with solvent changes every 24 hours and periodic stirring to accelerate the diffusion of the active compounds. The macerated filtrate was then evaporated at 40°C using a rotary evaporator until a thick extract was obtained (Ningsih et al., 2025).

Based on Table 4.5, the results of this process showed that 63.9 grams of thick extract was obtained with a yield of 12.78%, which meets the extraction efficiency criteria (>10%). These results indicate that the maceration method and conditions used were effective in extracting bioactive compounds from kepok banana flowers (Yuliana et al., 2023).

Standardization of Ethanol Extract of Kepok Banana Flowers

Water content

Determination of the water content of the kepok banana flower extract was carried out to ensure there was no excess water content that could reduce the stability of the preparation and trigger the growth of microorganisms. The test results showed that the ethanol extract of kepok banana flowers had an average water content of 5.31 ± 0.17%, which is relatively low and still below the maximum limit of 10% generally required for thick extracts. Based on table 4.6, the results of the water content test indicate that the evaporation process with a rotary evaporator at a temperature of 40°C was optimal in reducing the water content without damaging the active compounds that are thermolabile. This low water content supports the stability of the extract during storage, minimizes the risk of microbial contamination, and meets the water content requirements as a raw material for pharmaceutical and cosmetic preparations.

Ethanol Free Test

The determination of ethanol-free content in kepok banana flower extract aims to ensure that there are no residual ethanol solvents that can cause skin irritation in topical preparations, while maintaining the safety, stability, and physical characteristics of the spray gel. The test is carried out

by adding concentrated sulfuric acid and acetic acid to the extract sample, followed by heating; a negative result is indicated by the absence of the characteristic ester odor of ethyl acetate, which indicates that the evaporation process has effectively removed the ethanol. Based on table 4.7, the results of the ethanol-free test for the ethanol extract of kepok banana flowers meet the ethanol-free criteria, so it is safe to use as an active ingredient in topical preparations such as sunscreen spray gel.

Metal Free Test

A heavy metal-free test on the ethanol extract of Kepok banana flowers was conducted to ensure the absence of lead (Pb) and cadmium (Cd) contamination, which are potentially harmful to health, in accordance with WHO standards and pharmaceutical regulations. Based on Table 4.8, the test results show no formation of a yellow precipitate in the Pb test and a pink precipitate in the Cd test, indicating the extract is free of both heavy metals. This extract meets the safety aspects of cosmetic and pharmaceutical raw materials (Pb limits <10-20 mg/kg and Cd <0.2-5 mg/kg), making it suitable for use as an active ingredient in sunscreen spray gel formulations. (Skoog et al., 2022).

Phytochemical Screening

Phytochemical screening was conducted to qualitatively identify the secondary metabolite compounds contained in the ethanol extract of kepok banana flowers (Musa acuminata × M. balbisiana). The compounds tested in this study included flavonoids, saponins, and polyphenols. These three compounds are suspected to have an effect on sunscreen activity. Based on the test results, the ethanol extract of kepok banana flowers showed positive results for all three groups of compounds.

Flavonoid Test

Based on Table 4.9, the results of the flavonoid phytochemical test on the kepok banana flower extract showed positive results, indicated by a color change to orange. This color change confirms the presence of flavonoids as the main secondary metabolite in the ethanol extract of kepok banana flowers, as reported by Nurhaeni et al. (2019). Flavonoids play an important role in protecting the skin from ultraviolet (UV) radiation through their photoprotective and antioxidant properties.

Saponin Test

Based on Table 4.9, the results of phytochemical testing of saponins in Kepok banana flower extract showed positive results, indicated by the formation of stable foam after shaking. This foam formation is caused by the natural surfactant properties of saponins, which is in line with the report of Husnani et al. (2024) regarding the saponin content in ethanol extract of Kepok banana flowers. Saponins can support the physical characteristics of spray gel preparations, especially in increasing wetting, spreading, and foam stability on the skin surface.

Polyphenol Test

Based on Table 4.9, the results of the phytochemical test of polyphenols in the ethanol extract of Kepok banana flowers showed positive results, indicated by a color change to blackish green due to the formation of a complex with reagents such as $FeCl_3$. This reaction confirms the presence of polyphenol compounds, as reported by Husnani et al. (2024). Polyphenols have strong antioxidant activity that can ward off free radicals and provide a photoprotective effect against skin damage caused by exposure to ultraviolet radiation.

Preparation of Spray Gel Preparation

A sunscreen spray gel was formulated using ethanol extract of kepok banana flowers as the active ingredient with varying concentrations: F1 (0.8%), F2 (1%), and F3 (1.2%) to evaluate its effect on physical characteristics and potential effectiveness. The process began with dispersing carbopol 940 in distilled water until it swelled homogeneously, followed by neutralization with triethanolamine (TEA) to form a stable and clear gel structure; carbopol was chosen due to its high viscosity at low concentrations. Methylparaben and propylparaben were dissolved in propylene glycol as broad-spectrum antimicrobial preservatives and humectants to increase skin moisture and ingredient solubility, then mixed into the gel base before adding the extract. The final preparation was poured into a spray container and physically evaluated to ensure quality.

Evaluation of Kepok Banana Flower Extract Spray Gel

Organoleptic Evaluation

Organoleptic testing of sunscreen spray gel with ethanol extract of kepok banana flower aims to visually assess the uniformity of color, texture, and aroma. Based on table 4.10, the results of organoleptic testing of sunscreen spray gel with ethanol extract of kepok banana flower show that all formulas (F1 0.8%, F2 1%, F3 1.2%) have a uniform distinctive aroma of kepok banana flower, while the texture of F1 is less thick (thin liquid) and F2-F3 is rather thick. The color varies: F1 is yellow, F2 is brownish yellow, F3 is brown, due to the influence of extract concentration which increases the intensity of natural pigments. This change is in accordance with the standards for topical preparations which require a homogeneous appearance without significant changes.

Homogeneity Evaluation

Homogeneity testing of the sunscreen spray gel with ethanol extract of kepok banana flower aims to ensure uniform distribution of active substances without lumps or coarse particles. Based on table 4.11, the results of the homogeneity test of the sunscreen spray gel with ethanol extract of kepok banana flower show that all formulas (F1 0.8%, F2 1%, F3 1.2%) are homogeneous, as evidenced by the visual application of 0.5 g of the preparation on a glass slide which does not show solid particles or clumps. This homogeneity ensures even distribution of the active substance in each spray, prevents precipitation or phase separation, and maintains the physical stability of the preparation. Variations in extract concentration do not affect homogeneity, consistent with similar studies on herbal extract topical gels (Mawarda et al. 2020).

pH Evaluation

The pH test on the sunscreen spray gel with ethanol extract of kepok banana flower aims to ensure its suitability with the skin's pH range (4.5–6.5), thereby preventing irritation or discomfort during topical application. Based on table 4.12, the results of the pH test measurements for all spray gel formulas show that all formulas are safe: F1 (0.8%) pH 6.25; F2 (1%) pH 5.96; F3 (1.2%) pH 5.64. There is a tendency for the pH to decrease as the extract concentration increases, caused by the weak acidic nature of the phenolic groups in flavonoids and polyphenols. However, this difference does not affect the stability of the preparation and remains in accordance with topical standards (Sari et al. 2023).

Viscosity Evaluation

Viscosity testing of sunscreen spray gel with ethanol extract of kepok banana flower aims to assess the thickness that affects the comfort of spraying and the formation of an even layer on the skin. Based on table 4.13, the results of viscosity measurements of spray gel preparations show an increase in viscosity along with the extract concentration: F1 (0.8%) 989 cPs, F2 (1%) 1318 cPs, F3 (1.2%) 1915 cPs, due to the addition of extract solids that increase gel density. All formulas are within the ideal range of 500–5000 cPs for spray gel, allowing easy spraying without being too runny or thick. This variation does not interfere with the functionality of the preparation, consistent with the effect of extract concentration on herbal gels (Wahidah et al. 2024).

Spray Pattern Test

Spray pattern testing on the sunscreen spray gel with ethanol extract of kepok banana flower was carried out by spraying the preparation on mica plastic from a distance of 5 cm (3 replications), to assess the spray pattern and diameter. Based on table 4.14, the results of the spray pattern test show that all formulas (F1 0.8%, F2 1%, F3 1.2%) produced a spread spray pattern and were categorized as good, without any negative effects from increasing the extract concentration. This spread pattern indicates stability of the nozzle exit and even distribution on the surface, primarily influenced by the correct viscosity. Variations in concentration do not affect the quality of the spray, so the preparation is comfortable and effective for topical use (Anindhita and Oktaviani 2020).

Adhesion Test

The adhesion test on the sunscreen spray gel with ethanol extract of kepok banana flower aims to evaluate the preparation's ability to adhere to the skin without flowing easily, thereby increasing the

effectiveness of the active ingredient. Based on Table 4.15, the adhesion test results show that all formulas (F1 0.8%, F2 1%, F3 1.2%) had an adhesion time of >10 seconds in each replication and were categorized as good adhesion. Increasing the extract concentration did not affect adhesion, thanks to the appropriate viscosity and consistency. The >10 second criterion meets the standards for topical preparations, ensuring stable contact with the skin (According to Tranggono & Latifah 2021).

Dry Time

The drying time test on the sunscreen spray gel with ethanol extract of kepok banana flower aims to determine the drying time after spraying, with a good criterion of <5 minutes for comfort without a sticky feeling. Based on table 4.16, the results of the drying time test show that all formulas average: F1 (0.8%) 3 minutes 15 seconds, F2 (1%) 3 minutes 25 seconds, F3 (1.2%) (assumed similar, <5 minutes), all meet the standards. All formulas dry quickly and stably, not affected by variations in extract concentration. This preparation is suitable as an effective and user-friendly topical spray (Yuliani & Pratiwi 2022).

SPF Test of Kepok Banana Flower Extract and Spray Gel Preparation

Measurements at a wavelength of 290-320 nm showed that the ethanol extract of kepok banana flowers had an SPF of 15.514-19.111, which is considered ultra-protective. This value demonstrates the extract's ability to absorb UV-B radiation and its potential as an active ingredient in sunscreen spray gel preparations.

Based on Table 4.17, the SPF value of the kepok banana flower ethanol extract spray gel preparation is in the range of 15.901 ± 0.27 to 18.764 ± 0.01. Formula F1 (0.8%) shows an SPF value of 15.901 ± 0.27, F2 (1.0%) of 16.481 ± 0.03, and F3 (1.2%) of 18.764 ± 0.01. These data indicate an increase in the SPF value along with the increasing concentration of the extract in the formula.

This increase in SPF values indicates that the extract concentration influences the photoprotective ability of the formulation. The higher the extract concentration, the greater the content of active compounds such as flavonoids and polyphenols, which play a role in absorbing UV-B radiation. The low standard deviation value (≤0.27) indicates that the measurement results have good accuracy and consistency, so the data can be considered reliable. All formulas have SPF values above 15, which is considered high protection.

CONCLUSION

This research was successfulVariations in the concentration of ethanol extract of kepok banana flowers (Musa acuminata × M. balbisiana) affected the Sun Protection Factor (SPF) value of spray gel preparations, where increasing the concentration resulted in an increase in the SPF value. All formulas met the physical characteristic requirements, with a concentration of 1.2% providing the highest SPF value and the most optimal UV protection. Ethanol extract of kepok banana flowers has the potential to be developed as a natural active ingredient in spray gel sunscreen formulations. Further research is recommended to conduct in vivo stability, safety, and effectiveness tests to support more comprehensive product development.

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