

SPF Activity Sunscreen Spray Gel Ethanol Extract of Cinnamon Bark (Cinnamomum burmanii Ness. Bl, Syn)

by Wulan Kartika Sari

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SPF Activity Sunscreen Spray Gel Ethanol Extract of Cinnamon Bark (*Cinnamomum burmanii* Ness. BI, Syn)

***Wulan Kartika Sari, Rika Sebtiana Kristantri, & Tris Harni Pebriani**

Pharmacy Study Program, Sekolah Tinggi Ilmu Farmasi Yayasan Pharmasi Semarang – Indonesia 94119

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Abstract

This cinnamon bark contains cinnamaldehyde, which is a secondary metabolite compound derived from aldehydes, including the polyphenolic group, which has activity as a sunscreen and antioxidant by absorbing UV rays, so it can protect the skin from direct sun exposure (sunscreen). The aim of the study was to determine whether there was an effect of the concentration of the ethanol extract of cinnamon bark (*Cinnamomum burmanii* Ness. BI, Syn) on the physical characteristics and SPF value of spray gel preparations and to determine the concentration of the ethanol extract of cinnamon bark that produced spray gel with physical characteristics and SPF value. best. The study was conducted by extracting cinnamon bark by the remaceration method using 96% ethanol for 3 days. The extract obtained was then subjected to phytochemical screening TLC and then applied to a spray gel preparation with concentrations of FI (10%), SII (15%), and FIII (20%), followed by testing the activity of sunscreen using the UV-Vis spectrophotometry method. The results of phytochemical screening and TLC on the ethanol extract of cinnamon bark showed positive results for containing flavonoids, alkaloids, tannins, steroids, and antioxidants. The statistical test results showed that there was a difference with a sig value of 0.05. It was concluded that the ethanol extract of cinnamon bark affected pH, viscosity, spreadability, stickiness, drying time, and SPF value. The formula that gave the best physical characteristics and SPF value was found in the concentration of sunscreen spray gel: the ethanol extract of cinnamon bark with a concentration of FIII (20%).

Keywords: Cinnamon Bark Ethanol Extract, Physical Characteristics, SPF, Spray Gel

*Correspondence:

Wulan Kartika Sari*

e-mail: wulankartika06@gmail.com

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Introduction

Cinnamon (*Cinnamomum burmanii* Ness. BI, Syn) is a plant that is cultivated for its skin to be used as an anti-diarrhea medicine, stomach cramps, and is able to reduce secretions in the intestine. Cinnamon also has antimicrobial, antifungal, antiviral, antioxidant, antitumor abilities, lowers blood pressure, cholesterol and has low-fat compounds (Bandara et al., 2012). Cinnamon (*Cinnamomum burmanii* Ness. BI, Syn) belongs to the family Lauraceae family of simplicia, which is widely available in Indonesia where part of the stem bark can be used as an additive by the community. Cinnamon, which has been further processed to obtain its essential oil, is used as a flavoring and aroma agent in the food, beverage, pharmaceutical, cigarette and cosmetic industries, often used as incense in traditional religious ceremonies (Justicia et al., 2017). Cinnamon bark essential oil obtained from the steam distillation process of leaves and twigs has a sharp taste, pungent odor, yellowish to brown in color and will turn darker in color due to the influence of storage or outside air. The main constituents of cinnamon bark essential oil are 80-95% aldehyde, 60-70% sinamaldehyde, 80-90% eugenol, terpenes (limonene, p-cementine, (-) linalool and β -caryophyllene, eugenol (Endarini, 2016). Components The chemistry of cinnamon bark contains cinnamic alcohol, coumarin, cinnamic acid, cinnamaldehyde, anthosinins and essential oils which contain sugars, proteins, simple fats, pectin and others (Al-Dhubiab, 2012). Cinnamon bark (*Cinnamomum burmanii* Ness. BI, Syn) besides that cinnamon bark also has antioxidant activity (Sari et al., 2015).

Ultraviolet light (UV) is the main component emitted by sunlight. UV light is oxidative because it can produce a free radical compound called a reactive oxygen species (ROS). ROS that accumulate on the skin have a negative effect on the skin because they can induce cell damage, premature aging, and skin cancer (Hassan et al., 2013). Sun radiation comes from infrared light, which has a wavelength of more than 760 nm; visible light, with a wavelength of 400-760 nm, and UV (ultraviolet) light, which consists of UV-A (320-400 nm), UV-B (290- 320 nm) and UV-C (200-290 nm). Sunlight that reaches the surface of the earth and has an impact on the skin is made up of UV-A and UV-B rays (Wang et al., 2008). The body's response to sun exposure to the skin can be in the form of sweating, melanin formation, and thickening of horn cells, but excessive sun exposure so that the body's protection system is insufficient or due to excessive environmental influences sooner or later can damage skin tissue (Putri et al., 2019).

Cinnamon bark extract has antioxidant activity with an IC₅₀ value of $0.398 \mu \pm 0.075$,

which means it has very strong antioxidant activity (Priani et al., 2014). Subsequent studies stated that the activity of sunscreen and the physical stability of the spray gel formula from the extracts of Intersection Giring (*Curcuma heyneana* Val) and Cinnamon Extract (*Cinnamomum burmanii* Ness) with a combination of Carbopol and HPMC showed that Formula I had an IC₅₀ value of 1.21 with an average SPF value, an average of 10.48 has a strong affinity; Formula II's IC₅₀ value of 1.23 with an average SPF value of 19.29 means it has a strong affinity; and Formula III's average IC₅₀ value of 1.18 with an average SPF value of 12.52 has a strong affinity (Rusita & A.S., 2017). Sunscreen activity and SPF value of the lotion combination of cinnamon bark extract and pomegranate peel extract belong to the ultra category, and there is no difference in sunscreen activity in sun exposure and in closed spaces (Rusita & A.S., 2017).

Research on dosage forms that are widely used as sunscreens circulating in the community shows they are in the form of creams, gels, or lotions. There are not many products that make sunscreen preparations in the form of a spray gel, especially those made from natural ingredients. The spray gel form was chosen because of its nature to provide a concentrated content, but at the same time it also has the ability to dry quickly, so it can provide a pleasant experience and is easy to apply. Spray gel preparations have advantages, including being safer because the level of microorganism contamination is lower, the drug contact time is relatively longer than other preparations, and they are more practical in their use. Based on this background, the researchers wanted to develop an ethanol extract of cinnamon bark into a spray gel preparation type. In addition, considering the important role of sunscreen in preventing adverse effects due to prolonged exposure to UV rays on the skin, it is necessary to test the activity of sunscreen gel spray ethanol extract of cinnamon bark by determining the SPF value.

Methods

Tools and materials

The tools used in this study were glassware (Pyrex), mortar and pestle porcelain OD 06 80 mm (Rofa), flannel cloth, porcelain cup (Iwaki), Analytical Balance (Shimadzu ATX224), Philips blender (HR-2222), Mesh Sieve 40/60 (ABM), Vacuum Rotary Evaporator (Heidolph), Digital waterbath DWB 6H (Maskot), chamber (Iwaki), Tube clamp (CNC), Oven (Binder BD 115®), pH meter (Hanna HI 2210-2 Benchtop pH meter with electrode and probe), Viscometer Brookfield (DV-1 Prime), and spectrophotometer UV-Vis (Shimadzu 1240).

The materials used were cinnamon bark powder, 96% technical ethanol, pa ethanol, standard sinamaldehyde, toluene, ethyl acetate, Molisch reagent, Biuret reagent, vanillin, sulfuric acid, TLC plate, carbopol, HPMC, TEA, methyl paraben, propyl parabens, propylene glycol, NaCl, and aqua destillata.

Extraction Process

Dried cinnamon bark (*Cinnamomum burmanii* Ness. Bl, Syn) was then powdered and sieved using sieve no. 40. Extraction was carried out by the remaceration method using 96% ethanol solvent for 7 consecutive days with several stirrings. A total of 1000 grams of cinnamon powder were weighed, and 750 ml of solvent were added. The container was then closed tightly and soaked for 5 days. During the maceration process, occasional stirring is carried out every day. Then it was filtered and separated from the solvent with a "Heidolph" vacuum rotary evaporator until a thick extract was obtained.

Phytochemical Screening of Extracts and TLC Identification

A phytochemical screening was carried out to determine the bioactive components contained in the ethanol extract of cinnamon bark. The phytochemical screening carried out included examination of alkaloids, flavonoids, saponins, and tannins. Examination of the content in the extract was aimed at identifying the cinnamaldehyde compound, which was carried out by thin layer chromatography (TLC) using the mobile phase of toluene-ethyl acetate (93:7) and the stationary phase of silica gel GF254, vanillin-sulfuric acid spot reagent, and pure cinnamaldehyde as a comparison. Then the TLC plate was heated at 110°C for 2 minutes in the oven. Phytochemical screening was carried out, namely:

Examination of Alkaloids

Alkaloid test was carried out using 3 methods, namely the Meyer, Wagner and Dragendorff methods. Cinnamon bark ethanol extract samples were reacted with 5 mL of chloroform and 5 mL of ammonia, then heated, shaken and filtered. Added 5 drops of 2 N sulfuric acid to each filtrate, then shaken and allowed to stand. The top layer of each filtrate was taken and tested with Meyer, Wagner, and Dragendorff reagents. Positive alkaloid results, indicated by the formation of orange, brown and white precipitates (Mondong, 2015).

Examination of Flavonoids

The ethanol extract sample of cinnamon bark was heated with 10 mL of aqua destillata until it boiled for 5 minutes, then filtered, and an aqueous extract was obtained. Put 5 mL of the filtrate into a test tube, and then add sufficient magnesium powder, 2 mL of 2 N HCl, and 5 mL of amyl

alcohol. The sample in the test tube is shaken vigorously, indicating that it contains flavanoids if an orange color forms on the amyl alcohol layer (Handayani et al., 2017).

Saponin Examination

The ethanol extract sample of cinnamon bark was heated with 10 mL of distilled water until it boiled for 5 minutes, then filtered, and an aqueous extract was obtained. 10 mL of aqueous extract was shaken vertically for 10 minutes, then a few drops of 2N HCl were added if a steady foam formed, which indicated it contained saponins (Handayani et al., 2017).

Examination of tannins (FeCl₃ reagent)

The powder and ethanol extract of cinnamon bark were each added to 10 mL of distilled water, boiled for 15 minutes, and filtered. In the first filtrate test tube, add as much as 2 mL plus 2-3 drops of 1% FeCl₃ solution. Positive for tannins if the color is blue-black or green-brown (Handayani et al., 2017).

Sunscren Spray Gel Formulation Cinnamon Bark Extract

Sunscren spray gel ethanol extract of cinnamon bark in this study will be made with a composition based on Table 1.

Table 1. Formula Sunscren Spray Gel Cinnamon Bark Ethanol Extract

Ingredient Name	Concentration(%)
Cinnamon extract	10, 15; dan 20
Karbopol 940	0,5
HPMC	0,5
Trietanolamin	8 drop
Propylenglycol	15
Methyl paraben	0,18
Propyl paraben	0,2
Aethanolum	20
Natrii Chlorida	0,27
Aqua destillata	until 100

The formula for sunscren spray gel with ethanol extract of cinnamon bark was prepared by expanding Karbopol 940 with hot water until it dispersed homogeneously, then adding trietholamin and stirring until it became a transparent gel. The HPMC was dispersed with aqua destillata until all of it was homogeneously dispersed into a clear and quite viscous liquid. Then methyl paraben and propyl paraben are dissolved in glycerin. The carbopol 940 and HPMC gel masses were mixed until homogeneous in a beaker glass, then methyl paraben and propyl paraben, which had been dissolved with glycerin, were added and stirred until homogeneous. Cinnamon bark ethanol extract and aqua destillata were added little by little to the mixture and then stirred with a mortar until homogeneous. Put the preparation into the spray gel container. Preparation of spray gel ethanol extract of cinnamon bark and then tested the characteristics of the preparation, including:

Organoleptic Testing

Organoleptic testing of the cinnamon bark spray gel preparation was carried out by observing the physical appearance of the preparation, including shape, color, and smell (Depkes RI, 1995).

Homogeneity Testing

Homogeneity testing of cinnamon bark spray gel preparations was carried out visually with a slide glass, observing whether or not the distribution of particles formed visually or whether there were particles that were not mixed homogeneously (WOS Zubaydah WOS Zubaydah et al., 2022).

pH Testing

The pH of the preparation was measured using a pH meter that had previously been calibrated using a solution of pH 7 and pH 4. The pH meter electrode was inserted into the cinnamon bark gel spray preparation to be tested. The requirements for testing the pH of the preparation correspond to the pH of the skin, namely 4,5-6,5 (Sari WK, Kristantri RS, 2021).

Viscosity Testing

The viscosity test for the preparation of cinnamon bark spray gel was measured using a Brookfield LVT-RVT viscometer. The preparations were prepared in a 100 mL beaker glass, and then the viscometer was set using a spindle with the number R5 and a speed of 30 rpm. The tool is run until it shows a viscosity value (cPs), which is the viscosity value of the preparation (Sari WK, Kristantri RS, 2021).

Testing the Spraying Pattern

Testing the spray pattern of the cinnamon bark gel spray preparation is carried out using transparent plastic that has been weighed beforehand. The preparation is sprayed on the plastic, and the time it takes for the preparation to dry is recorded using a stopwatch. The pattern of spray formation was observed, then the diameter was measured, then the plastic was weighed, and the difference in weight was calculated as the number of preparations that came out of each spray. Tests were carried out in triplicate with different spraying distances, namely 3, 5, 10, 15, and 20 cm (WOS Zubaydah WOS Zubaydah et al., 2022).

Testing of Adhesion to the Skin

Testing the adhesion to the skin of spray gel cinnamon bark gel is carried out by spraying the preparation on the skin of the arm above from a distance of 3 cm, waiting for 10 seconds, and observing whether the preparation sticks to the skin or drips down. The longest and shortest diameters of the spray are measured, then tested on other formulas with the same working

procedure (Martono & Suharyani, 2018).

Stability Testing (Freeze-thaw cycling test)

Stability testing of the cinnamon bark gel spray preparation was carried out by the cycling method by storing the preparation at $4 \pm 2^\circ\text{C}$ for 48 hours and then storing it at $40 \pm 2^\circ\text{C}$ for 48 hours. This treatment is included in one cycle, and preparation testing is continued for up to three cycles. Organoleptic, homogeneity, viscosity, and pH observations were carried out on the preparations before and after treatment (Wardani et al., 2016).

Testing SPF

Testing sunscreen spray gel preparations of cinnamon bark gel in each formula dissolved in ethanol at 96% p.a. (2 mg/2 mL). The absorbance of each sample was determined with a UV-visible spectrophotometer, and readings of the absorbance values were taken every 5 nm interval from a wavelength of 290 nm to 320 nm. The determination of the SPF value was carried out in triplicate for each test sample (Sari MD, Priani EP, 2015).

Data Processing and Analysis

Data obtained from phytochemical screening in the form of color reactions and TLC were compared with standard standards to qualitatively determine the content contained in the extract. The SPF value test was carried out using the equation from the research results of Mansur et al. (1986) and the EE values in Table 2.

$$SPF_{\text{spectrophotometric}} = CF \times \sum EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Information:

CF = Correction factor

EE = Efficiency of erythema

I = Intensity spectrum of the sun

Abs = Absorbance

Table 2. EE value x I

Wavelength (nm)	EE x I
290	0,0150
295	0,0817
300	0,2874
305	0,3278
310	0,1864
315	0,0839
320	0,0180
Total	1

The SPF value of each preparation with different extract concentrations was analyzed by normality and homogeneity tests using Shapiro-Wilk statistical analysis. If the data is normally distributed and homogeneous, then proceed with the parametric test using one-way ANOVA statistical analysis, but if otherwise, proceed with the Mann-Whitney non-parametric test to determine the significance of the difference in

extract concentration to the SPF value of the preparation.

Result and Discussion

This study aims to determine the effect of the concentration of ethanol extract of cinnamon bark (*Cinnamomum burmanni* Ness. BI, Syn) on the physical characteristics and SPF value of the cinnamon bark gel spray preparation. The cinnamon bark used in this study was obtained from cinnamon bark plantations in the Sumowono area of Semarang Regency, Central Java. The plants to be used in this study were terminated at the STIFAR Pharmaceutical Biology Laboratory, Semarang Pharmaceutical Foundation. Determinations were made to ensure that the plants used in the study were indeed cinnamon bark plants and to avoid misuse of the plants during the research.

This research was started by carrying out wet sorting, washing, drying, dry sorting, pollination, and sieving using mesh number 44, and then the extraction of cinnamon stick powder was carried out by the maceration method using 96% ethanol solvent for 7 days. Drying aims to reduce the water content so as to ensure quality in storage, prevent mold growth, and prevent enzymatic processes that can reduce quality (Prasetyo & Inorah, 2013). The extraction method used in this research is the maceration method, based on immersing the sample in a solvent that penetrates the cell wall and enters the cell cavity containing the active compound. The active compound will dissolve in the appropriate solvent because of the difference in concentration between the active substance inside the cell and outside the cell, so that the high-concentration adjacent solution will be pushed out. This event occurs continuously until a concentration balance is reached between the solution outside and that inside the cell. Soaking the simplicia using solvent was carried out for 72 hours while stirring occasionally for the first 24 hours, and then the macerate was first filtered and collected. The extraction process was repeated several times for 3 days, and the extract obtained from the entire maceration process was evaporated using a rotary evaporator to separate the ethanol from the liquid extract to form a thick extract. The result of the extraction is a reddish-brown extract with a distinctive aromatic cinnamon odor. From 2,699 grams of simplicia powder, 877.1707 grams of viscous extract were produced, so the yield of the extract obtained was 32.5%. This fulfills the yield requirements according to the Indonesian Herbal Pharmacopoeia, where the percentage yield

obtained from the extraction process is not less than 25.4% (Kemenkes RI, 2017).

The results of the phytochemical screening of the viscous extract of cinnamon bark showed that the extract contained alkaloids, flavonoids, saponins, and tannins.

Table 3. Results of Phytochemical Screening of Ethanol Extract of Cinnamon Bark

Reactant	Compounds	Positive Result in the Research	Result Library
Alkaloid	Mayer's	Formed white or yellow precipitate	(-) No precipitate formed
	Dragendorff	Formed brick red precipitate	(+) Formed brick red precipitate
	Wagner	An orange precipitate forms (Abdurahman et al., 2021)	(+) An orange precipitate is formed
Flavonoid	Mg + HCl + amyl alcohol	The amyl alcohol layer is red, yellow, orange (Abdurahman et al., 2021)	(+) A red color is formed on the amyl alcohol layer
Saponin	Aqua destilata hot + HCl 2N	Formed froth after shaking for 10 seconds with a foam height of 1-10 cm and stable for not less than 10 minutes (Abdurahman et al., 2021)	(+) Formed stable foam
Tannin	FeCl ₃ 1%	A blue/green-black precipitate is formed	(+) A blue-black color is formed
	Gelatine 10%	A white precipitate formed (Abdurahman et al., 2021)	(+) A white precipitate is formed

Information:

(+): contains compounds

(-): does not contain compounds

Further analysis of the compounds using thin layer chromatography (TLC) was carried out to confirm the compounds contained in macerate and viscous extracts. The stationary phase used in this test was silica gel GF 254 nm, and observations were made under UV light at 254 nm with the addition of spot sight. Testing of chemical compounds by thin layer chromatography (TLC) was carried out with the aim of confirming that the phytochemical compounds contained in cinnamon bark extract contain alkaloids, flavonoids, saponins, and tannins. Based on the TLC results, both macerate and extract contained alkaloids, flavonoids, saponins, and tannins.

Table 4. TLC Test Results for Cinnamon Bark Ethanol Extract

Reactan Compounds	Positive Result in Research (Harbone, 1987)	Result Library	Value Rf		
			Condensed	Extract Macerate	Description
Alkaloids	Formed	Formed	0.87	0.90	(+)

	greenish-brown stains on a yellow background	greenish-brown stains on a yellow			
Flavonoids	Formed pale yellow, green-yellow, orange, brown and blue stains	Formed light yellow to orange stains	0.80	0.75	(+)
Saponin	Formed pink, mauve and bluish green stains	Formed brownish red stains	-	0.74	(+)
Tanin	Formed yellow-brown stains	Formed brownish yellow stains	0.75	0.75	(+)

Information:

(+): contains compounds

(-): does not contain compounds

Cinnamon bark ethanol extract is formulated in a spray gel preparation for sunscreen with a combination of carbopol 940 and HPMC as gelling agents, triethanolamine as a base, glycerin as a humectant, and methylparaben and propylparaben as preservatives. The choice of base for the manufacture of spray gel can affect the characteristics of the spray gel that is formed. The use of a single spray gel base is less effective for forming a spray gel. At a small concentration, carbopol 940 can produce a high viscosity value but has a small adhesive power, while HPMC can increase the adhesive power. Variations in the use of HPMC and carbopol simultaneously will affect the physical properties of the gel; HPMC can affect spreadability, and adhesion, while carbopol affects viscosity (Tambunan & Sulaiman, 2018). The results of the physical characteristic test of spray gel with concentrations of cinnamon bark extract of 10% (F1), 15% (F2), and 20% (F3) included organoleptic, homogeneity, pH, viscosity, spray pattern, spreadability, stickiness, and time to dry on the skin.

Table 5. Organoleptic Results and Homogeneity of Spray Gel Preparations

Test the Physical Characteristics of the Preparation	Test Result		
	F1	F2	F3
Organoleptic	Form : Semi thick gel Colour : Brick red Smell : Typical of cinnamon form	Form : Semi thick gel Colour : Brick red Smell : Typical of cinnamon form	Form : Semi thick gel Colour : Brick red Smell : Typical of cinnamon form
Homogeneity on 0, 7, and 14 days	Homogeneous	Homogeneous	Homogeneous

Based on organoleptic testing of the three formulas, the preparations were obtained in the

form of a gel with a slightly thick consistency. The preparation has a characteristic aromatic odor of cinnamon sticks and a brick red color due to the addition of cinnamon bark extract, which has a characteristic odor and brick red color. Organoleptic testing and homogeneity of the preparations were carried out using visual observations (five senses). Observation of homogeneity is carried out by spraying the preparation to be tested on a glass object and observing whether or not there are particles or other substances that have not been dispersed homogeneously in the preparation. Homogeneous preparations will facilitate the penetration of active substances evenly on the surface of the skin so that the expected effect can be achieved. An observation of homogeneity in the preparations was carried out on days 0, 7, and 14 to determine the possibility of damage to the preparations after storage. In the resulting cinnamon bark spray gel preparation, the higher the concentration of cinnamon bark extract used, the more concentrated the color of the spray gel. From the results of the observations, it was shown that the preparation was homogeneous on days 0, 7, and 14, which showed that the extract was evenly distributed on a gel base, no lumps were formed, and there was no water coming out on the surface of the preparation.

Table 6. Test Results for pH and Viscosity of Spray Gel Preparations

Day	F1		F2		F3	
	pH	Viscosity	pH	Viscosity	pH	Viscosity
0	5.43 ± 0.07	2086.67 ± 126.01	5.32 ± 0.02	2246.67 ± 45.46	5.15 ± 0.03	1899.33 ± 165.26
7	5.38 ± 0.07	1979 ± 64.82	5.19 ± 0.02	1898.67 ± 103.65	5.13 ± 0.09	1757.00 ± 80.29
14	5.24 ± 0.05	1937 ± 54.08	5.12 ± 0.02	1865.00 ± 82.94	5.05 ± 0.01	1758.00 ± 48.54

Information:

- Centipoise viscosity units

- Results are the mean of 3 replicates ± SD

pH testing is needed to ensure the safety of the preparation and the degree of acidity of the preparation when applied to the skin surface, and because topical preparations that have a pH that is too acidic or alkaline can cause irritation. Spray gel preparations that are too acidic can cause irritation to the skin, whereas if the pH of the preparation is alkaline, it can cause the skin to become dry [24]. Good topical preparations have a pH similar to the pH of the skin surface, which is between 4.5-6.5 (Sari WK, Kristantri RS, 2021). The results of tests carried out on the three formulas found that all preparations met the safe pH range for use, namely the pH range of 4.5-6.5. The pH test showed that the higher the concentration of the extract in the spray gel preparation, the lower the pH value

would be. This is because the ethanol extract of cinnamon bark contains compounds belonging to the class of flavonoids, which are phenolic compounds. Phenolic compounds that decompose into polyphenolic compounds are found in the ethanol extract of cinnamon bark.

Decomposition causes the amount of H⁺ to increase as the concentration of the ethanol extract of cinnamon bark increases, causing a decrease in the pH of the spray gel. However, the pH of the spray gel can be said to be good because it still meets the skin's pH requirements, namely 4.5–6.5. The addition of triethanolamine can also affect the pH value of the spray gel. This is because triethanolamine is an alkalizing agent that can neutralize the acidity of carbopol 940. The combination of HPMC and carbopol 940 can be used to cover the deficiencies of carbopol 940. The 0.5% will form a gel at a pH of 6–11, but the viscosity will decrease at a pH of less than 3 or more than 12 (Rowe et al., 2009). If the concentration of carbopol 940 is increased, the pH will also be more acidic. So a combination of HPMC and carbopol 940 is needed to reduce the concentration of carbopol 940 so that the gel that is formed is not too acidic (Deshpande & Shah, 2012).

Measurement of the viscosity of the preparation was carried out using a Brookfield viscometer with spindle number 63 and a stirring speed of 50 rpm. Viscosity is one of the most important parameters in the manufacture of spray gel preparations. A viscosity that is too high will reduce the comfort level of use because it will be difficult to spray. Low viscosity is also not expected; this is because if the preparation is too runny, it will drip when applied to the skin, so that the preparation does not stay completely on the skin surface.

Based on the results obtained, it shows that the higher the extract added to the preparation, the resulting viscosity decreases. This is because the extract has a pH that tends to be acidic, as evidenced by the fact that the higher the concentration of the extract, the lower the pH of the preparation. This decrease in pH results in a decrease in the consistency of the carbopol gel, where carbopol will form a gel under alkaline conditions (Khaerunnisa et al., 2015). The viscosity of this preparation will later affect the ability of the preparation to be sprayed from the container and the spreadability of the preparation when applied to the skin surface.

Table 7. Test Results of Spraying Patterns and Spreadability of Spray

Spray Distance (cm)	Gel Preparations					
	Spray Pattern (mg)			Spread Power (cm)		
	F1	F2	F3	F1	F2	F3
3	132.13 ± 2.40	132.97 ± 1.72	128.13 ± 6.29	3.38 ± 0.06	4.10 ± 0.09	3.62 ± 0.19
5	124.70 ± 0.26	131.60 ± 1.22	130.67 ± 0.68	6.82 ± 0.06	6.33 ± 0.25	7.57 ± 0.76
10	125.80 ± 2.43	130.00 ± 0.95	129.07 ± 0.57	9.50 ± 0.25	10.53 ± 0.26	8.60 ± 0.51
15	126.00 ± 3.21	128.77 ± 1.79	126.33 ± 0.42	12.40 ± 0.23	12.38 ± 0.13	12.38 ± 0.32

20	125.10 ± 1.65	129.10 ± 0.61	127.97 ± 0.60	14.40 ± 0.13	14.95 ± 0.75	14.62 ± 0.32
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Note: Results are the mean of 3 replicates ± SD

This spreadability test aims to determine the ability of the preparation to spread when applied to the skin surface, as well as the appropriate spray distance, so that the spreadability of the preparation meets the requirements. Spreadability is the relationship between the softness of the preparation and its ease of use. The lower the viscosity, the wider the diameter spread.

Spreadability is one of the characteristics that can be responsible for the effectiveness of releasing active substances. Factors that can affect the spreadability are the viscosity of the preparation, the duration of pressure, and the temperature of the action. Good spreadability will guarantee a satisfactory release of the drug substance (Voigt, 1994).

Good spreadability of topical preparations is between 5–7 cm (Wasitaatmadja, 1997). Based on the test results, it shows that the appropriate spraying distance is 5 cm to obtain good coverage. In addition to the spreadability, observations were also made on the spraying pattern, which was intended to find out how much of the preparation was able to be removed from the container in one spray at a certain distance. The test results show that Formula 1 has a smaller average when compared to other formulas. This is because Formula 1 preparations have a higher viscosity, and the thicker the preparation, the more difficult it is for the preparation to be sprayed out of the container.

Table 8. Test Results for Sticking Resistance and Drying Time of Spray Gel Preparations on Respondent's Skin Surface

Spray Distance (cm)	Sticky Resistance			Drying Time		
	F1	F2	F3	F1	F2	F3
3	Attached	Attached	Attached	8 minutes 23 second	8 minutes 47 second	8 minutes 31 second
5	Attached	Attached	Attached	7 minutes 29 second	7 minutes 31 second	7 minutes 31 second
10	Attached	Attached	Attached	7 minutes 3 second	6 minutes 56 second	7 minutes 1 second
15	Attached	Attached	Attached	5 minutes 29 second	5 minutes 32 second	5 minutes 27 second
20	Attached	Attached	Attached	2 minutes 40 second	3 minutes 40 second	2 minutes 25 second

The next test was to determine the adherence resistance of the preparation, which was tested on the surface of the forearm skin of a number of respondents. The preparation is sprayed at a certain distance, and if the preparation drips after 10 seconds, it is said not to stick to the skin surface, whereas if it does not drip after 10 seconds, the preparation is said to be able to adhere to the skin surface (Kamishita et al., 1992). Based on the test results, it was found that all formulations had good adhesion resistance on the skin surface because they did not drip after 10 seconds. The adherence of the drug to the skin surface will, of course, affect the duration of the

pharmacological effects provided by the compounds contained in the drug.

The drying ability of the preparations was also tested on the skin surface of the forearms of a number of respondents. Good topical preparations have a drying time of less than 5 minutes (Shafira et al., 2015). The test results showed that the three formulas met the test requirements if sprayed at a minimum distance of 15 cm from the skin surface. The long distance of spraying causes the spread of the preparation to be wider, and the evaporation process, which is affected by body temperature, becomes faster.

Conflict of Interest

There is no conflict of interest in this Research

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Conclusions

Phytochemical screening and thin layer chromatography on the ethanol extract of cinnamon bark showed positive results for containing flavonoids, alkaloids, tannins, steroids, and antioxidants. The statistical test results showed that there was a significant difference of <0.05, so it could be concluded that there was an effect of kaffir lime leaf ethanol extract on pH, viscosity, spreadability, stickiness, drying time, and SPF value. The formula that provides the best physical characteristics and SPF value is at a concentration of 20%.

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