ISSN 2548-6462 (online), ISSN 2088-8740 (print)

DOI: 10.30644/rik.v14i2.1026

Evaluation and testing of the antibacterial activity of Noni (*Morinda citrifolia L.)* Leaf Extract Cream on Acne-Prone Skin

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Accepted: 14 March 2025; Revision: 06 May 2025; Published: 31 May 2025

Abstract

Background: Acne is a prevalent skin condition often caused by the proliferation of bacteria, leading to inflammation and infection. *Morinda citrifolia* L. (Noni) has been traditionally used for its medicinal properties, particularly its antibacterial effects. This study aims to evaluate the antibacterial activity of Noni leaf extract cream and its potential as an acne treatment.
Method: Cream formulations were prepared using ethanol extracts of Noni leaves at concentrations of 1.25%, 2.50%, and 5.00%. The antibacterial activity was tested using the Kirby-Bauer disk diffusion method against *Streptococcus pyogenes*. Additionally, the creams underwent organoleptic, pH, viscosity, spreadability, and adhesion tests to assess quality and stability.
Results: The cream exhibited significant antibacterial activity, with inhibition zones ranging from 5.79 mm (1.25%) to 9.16 mm (5.00%). The 5.00% concentration demonstrated the highest efficacy. The pH remained within a stable and skin-compatible range (6.1–6.5), while viscosity was consistent (23,000–25,000 cps). Spreadability ranged from 5.2 to 6.5 cm, and adhesion exceeded 4 seconds, indicating favorable topical application properties. Throughout stability testing, the cream maintained uniform color, texture, and odor without notable degradation.
Conclusion: Noni leaf extract cream, particularly at 5.00%, shows potent antibacterial activity against *S. pyogenes* and meets quality standards for topical formulations. These findings support its potential development as an effective acne treatment product.

Keywords: Noni, Extract, Cream, Antibacterial Efficacy.

INTRODUCTION

The skin is the human body's largest organ, located on the outermost layer and covering the entire body surface. One of the most common skin infections experienced by almost everyone is acne (*Acne vulgaris*) (1).

Acne vulgaris is a medical term that refers to various types of acne. This condition affects the skin's pilosebaceous units, which consist of sebaceous glands and hair follicles. Acne develops due to the blockage of follicles by dead skin cells, sebum, and inflammation caused by *Propionibacterium acnes* in the sebaceous follicles (2).

There are two types of treatments commonly used to treat acne, namely topical treatments applied directly to the acne area to produce local effects and oral treatments by taking them to treat acne through the systemic route. Topical and oral antibiotics are routinely used to treat acne (21)

The prevalence of acne in developing countries varies between 40% and 80%. In Indonesia, acne affects approximately 80%–85% of adolescents, with cases increasing each year. This growing prevalence has driven a higher demand for traditional medicine derived from natural ingredients. Indonesia is home to around 30,000 medicinal plants, though only about 1,200 are effectively utilized by the population (3)

One plant known for its antibacterial properties is *Morinda citrifolia L.* (noni). A study by Aryadi found that an ethanolic extract of noni leaves at a 10% concentration could effectively inhibit the activity

of *Staphylococcus aureus*, with a strong inhibition zone of 16 mm. The antibacterial activity of the ethanolic extract is attributed to its active compounds, including saponins, triterpenoids, tannins, and essential oils, such as phenols (1)

Noni plants contain several active compound, nemely anthraquinones, alkaloids, flavonoids, acubin, alizarin, tannis, and triterpenes. Noni Leaves also contain antibacterial chemichel components such as anthraquinones, (20)

Noni leaves are believed to inhibit the growth of *Staphylococcus aureus* and *Streptococcus pyogenes*. Both *S. Aureus* and *S .pyogenes* are Gram-positive cocci bacteria that cause pharyngitis. These bacteria are non-motile, non-spore-forming, and classified as facultative anaerobes. Noni leaf Generally, the use of noni leaves is by crushing the noni leaves and applying them to the injured area or drinking the boiled water (4).

One of the most commonly used cosmetic formulations for skincare is cream. Creams are semi-solid topical preparations that are suitable for acne treatment. They are preferred because they are easy to apply, comfortable on the skin, non-sticky, and easily washed off with water, preventing excessive dryness and minimizing acne aggravation (5).

Conventional acne therapy usually involves the use of topical or systemic antibiotics, such as clindamycin, erythromycin, and tetracycline, as well as other chemical agents such as benzoyl peroxide and retinoids. However, the use of this conventional therapy has several limitations, Bacterial Resistance esistensi eritromisin ⁄ klindamisin from45% until 91% and tetrasiklin dari 5% to 26,4% (21),

So why the experiment based on the background above, the researcher conducted a study to evaluate the effectiveness of a cream formulation containing ethanolic extract using noni leaves (*Morinda citrifolia L.*) as an anti-acne agent by testing its antibacterial activity against *Streptococcus pyogenes*.

METHOD

1. Tools

The equipment used in this study includes a digital analytical balance (Fujitsu® and Osuka), Erlenmeyer flasks (Pyrex), a macerator, filter paper, a vacuum rotary evaporator (Buchi), beakers (Pyrex), a stirring rod, a water bath (B-One), measuring cylinders (Pyrex), Petri dishes (Pyrex and Herma), an autoclave (Lasser), an incubator (Memmert), a laminar airflow cabinet, a blender (Miyako), a refrigerator (Toshiba), a hot plate (Thermolyne), a porcelain evaporating dish, a Brookfield viscometer, a spatula, a spray bottle, an inoculation loop, aluminum foil, a mesh sieve, a funnel (Herma), a mortar and pestle, glass slides, a Bunsen burner, a pH meter (ATC), wooden clamps, test tubes (Pyrex), a test tube rack, an oven (Memmert), umbrella paper, and mattress thread.

2. Materials

The materials used in this study include noni leaves, 96% ethanol, distilled water, aluminum foil, acetic acid, KOH, chloroform, concentrated H_2SO_4, 10% NaCl, 1% gelatin solution, $FeCl_3$, BAP medium, crystal violet, iodine solution, ethanol, 0.9% physiological NaCl (Sanbe Farma), McFarland 0.5 solution, 5 mm disc paper (Whatman No.42), and amoxicillin 25 µg paper discs (Oxoid).

Plant determination

Noni leaves were sourced from plants growing in Pare District, Kediri Regency. To verify and confirm the plant species as *Morinda citrifolia L.*, a taxonomic determination was conducted at the Plant Taxonomy Laboratory of UPT Materia Medica Batu, Malang.

Simplicia Preparation

2.0 kg of noni leaves were cleaned to remove any attached dirt, washed under running clean water, and drained. Next, the leaves were dried under sunlight while covered with a black cloth. Once completely dry, the noni leaves were ground into a fine powder using a blender. The resulting powder was then sieved with a 60-mesh sieve to separate any coarse particles from the *Simplicia*.

Extract Preparation

150 g of powdered noni leaves (*Morinda citrifolia L.*) was weighed and placed in a container. Then, 1.5 liters of 96% ethanol was added at a 1:10 ratio, ensuring the *simplicia* was fully submerged and the container was sealed with aluminum foil. The maceration process was carried out for 3 × 24 hours, with 0.5 liters of solvent replaced daily and stirring performed every 8 hours. Afterward, the mixture was filtered to obtain the filtrate, which was then concentrated using a rotary evaporator. The remaining filtrate was evaporated further until a thick extract was obtained, which was then weighed to determine its final mass.

Table 1. Formulation

Ingredients	Concentration (grams)			
	F0	F1	F2	F3
Extract	-	0,625	1,25	2,5
Stearic acid	4	4	4	4
Liquid paraffin	1,5	1,5	1,5	1,5
Lanolin	1	1	1	1
Glyceryl monostearate	0,65	0,65	0,65	0,65
Propylene glycol	1,5	1,5	1,5	1,5
Glycerin	1,5	1,5	1,5	1,5
Triethanolamine (TEA)	0,25	0,25	0,25	0,25
Methylparaben	0,1	0,1	0,1	0,1
Distilled water ad	50	50	50	50

Description:
F1 noni leaf extract = 1.25%
F2 noni leaf extract = 2.5%
F3 noni leaf extract = 5.0%

Physical Quality Test

Organoleptic Evaluation Test

The organoleptic evaluation was carried out by visually observing the formulation's color, odor, and form (6).

Homogeneity Test

The homogeneity test was conducted to assess the distribution of the active ingredient within the cream formulation. The test involved weighing 0.1 g of the cream, placing it at the center of an object glass, spreading it evenly, and covering it with another. The cream was then applied to a glass slide, ensuring a uniform consistency without coarse granules (7).

pH Test

A 1 g sample was weighed and dissolved in 100 mL of heated distilled water. After cooling, the electrode was immersed in the solution and left until the pH meter displayed a stable reading, which was recorded as the pH of the formulation. The pH test was conducted to determine the acidity of the formulation, ensuring that it does not cause skin irritation. The skin's pH ranges from 4.5 to 6.5. The test was repeated three times for each formula (7).

Viscosity Test

The viscosity test used a Brookfield viscometer (NDJ-5S Digital Rotary). The viscosity measurement aims to determine the thickness level of the cream. The measurement was performed using a Brookfield device with spindle No. 4 at a speed of 30 rpm (8).

Spreadability Test

A 0.5 g sample of the formulation is placed on a watch glass, then covered with another identical watch glass, and subjected to pressure for 60 seconds. Subsequently, weights of 50 g, 100 g, and 150 g are sequentially added and left for 60 seconds. The spreadability diameter is determined by measuring the average diameter from multiple directions (9).

Adhesion Test

A cream sample weighing 0.1 g is placed at the center of an object glass and covered with another object glass. A 50 g weight is placed on the cover glass for 5 minutes. The ends of the top and bottom object glasses are clamped onto the adhesion test apparatus, and then the weight support is released. The duration required for the two object glasses to detach from the apparatus is recorded as the formulation's adhesion time (10).

Stability Test

The stability test was conducted using the cycling test method. The cream was stored at approximately 4ºC for 24 hours, followed by storage at approximately 40ºC for another 24 hours. This process was repeated for six cycles, during which physical changes in the cream, including organoleptic

properties, homogeneity, and pH, were observed (9).

Antibacterial Activity Testing

The preparation of *S. pyogenes* bacteria was carried out by suspending the bacteria in 10 mL of 0.9% physiological NaCl solution until the turbidity matched that of a McFarland standard (equivalent to a concentration of 1.5 × 10^8 CFU/mL). The *S. pyogenes* suspension was then inoculated onto BAP medium by streaking it with a sterile cotton swab and left to stand for 5 minutes. Sterile discs were immersed in each test solution for 20 minutes and drained. The drained test discs were placed on the surface of the medium in their designated positions under aseptic conditions. The plates were then incubated at 37°C for 24 hours, after which the inhibition zones formed were observed and measured (1)

RESULTS

1. Extraction Results

The results of the quality parameter test for the ethanol extract of noni leaves are presented in Table 2.

Table 2. Quality Parameters of Noni Leaf Extract

Parameter	Test Result
Weight of simplicia	150 grams
Weight of extract	30.75 grams
Yield	20.5%
Organoleptic	Thick consistency, characteristic odor, bitter taste, dark greenish color

Table 3. The phytochemical screening results of the ethanolic extract of noni leaves

Golongan senyawa	Reagen	Ekstrak
Flavonoid	HCl pekat + Mg + amil alkohol	+
Saponin	*Aquadest*	+
Tanin	$FeCl_3$ +gelatin	+
Triterpenoid	Lieberma nn burchard	+

Based on the phytochemical screening results, it was found that both the powdered Simplicia and the ethanol extract of noni leaves contain flavonoids, saponins, triterpenoids, and tannins. The phytochemical screening results of the ethanolic extract of noni leaves are presented in Table 3.

2. Physical Quality Test Results

Organoleptic Evaluation Test

The organoleptic test was conducted to visually assess the quality of the cream formulation by observing its physical characteristics, including appearance, scent, and color, as shown in Table 4.

Table 4. Organoleptic Test of Cream Formulation

Formula	Color	Odor	Form
F0	White	Odorless	Semi-solid
F1	Light green	Characteristic extract odor	Semi-solid
F2	Dark green	Characteristic extract odor	Semi-solid
F3	Deep dark green	Characteristic extract odor	Semi-solid

Description:
F1 = ethanol extract concentration of 1.25%
F2 = ethanol extract concentration of 2.5%
F3 = ethanol extract concentration of 5.0%

Homogeneity Test

The results of the homogeneity test indicate that the cream formulation is uniformly mixed. The detailed results are presented in Table 5.

Table 5. Homogeneity Test of Ethanol Extract Cream

Formula	Homogenitas
F0	Homogen
F1	Homogen
F2	Homogen
F3	Homogen

pH Test

The pH measurements for the ethanol extract cream of noni leaves indicate that all concentration variations in Formulas 0, 1, 2, and 3 meet the standard pH range suitable for facial skin.

Table 6. pH Test Results of Ethanol Extract Cream Formulation

Trial	pH Value			
	F0	F1	F2	F3
1	4,79	4,92	5,28	5,43
2	4,70	4,85	5,10	5,25
3	4,73	4,95	5,16	5,48
Average SD	4,74 ± 0,04	4,90 ± 0,05	5,17 ± 0,07	5,38 ± 0,12

Viscosity Test

Viscosity in a cream formulation refers to the resistance of the cream to flow

or spread. The higher the resistance, the greater the viscosity. The viscosity test was carried out using a Brookfield viscometer equipped with spindle number 4 at a speed of 30 rpm.

Table 6. Viscosity Test Results of the Cream Formulation

Trial	Viscosity Test (cP)			
	F0	F1	F2	F3
1	4237	15015	16343	19662
2	4255	15105	16359	19670
3	4375	15020	16400	19660
Average	4289	15046	16367	19664
SD	±75,02	±50,57	±30,23	± 5,29

Spreadability Test

The spreadability of a cream refers to its ability to distribute evenly. The easier it is to apply, the wider the surface area of contact between the cream and the skin, thereby enhancing the absorption of the active substance at the site of application.

Table 7. Results of the Spreadability Test of Cream Formulations

Trial	Spreadability Diameter (cm)			
	F0	F1	F2	F3
1	6,2	5,2	5.1	5,3
2	6,3	5,3	5,2	5,5
3	6,4	5,1	5,3	5,3
Average SD	6,3 ± 0,1	5,2 ± 0, 1	5,2 ± 0,1	5,3 ± 0,1

Adhesion Test

The adhesiveness of a base is associated with the duration of contact between the base and the skin. An ideal base ensures adequate contact time with the skin to achieve the intended effect. A good cream formulation typically adheres for about 2 to 300 seconds. The longer the cream adheres to the skin, the more time the active compound penetrates, enhancing drug absorption.

Table 8. Result of the Adhesion Test

Trial	Adhesion test (second)			
	F0	F1	F2	F3
1	1,16	1,29	1,01	1,03
2	1,18	1,17	1,05	1,05
3	1,20	1,30	1,07	1,02
Average	1,18	1,25	1,06	1,03
SD	±0,02	±0,07	±0,03	± 0,1

Stability Test

Table 9. Results of Organoleptic Stability Test

Time	F1	F2	F3
Cycle 1	Light green color, characteristic extract odor, semi-solid form	Dark green color, characteristic extract odor, semi-solid form	Dark green to deep color, characteristic extract odor, semi-solid form
Cycle 2	Light green color, characteristic extract odor, semi-solid form	Dark green color, characteristic extract odor, semi-solid form	Deep dark green color, characteristic extract odor, semi-solid form
Cycle 3	Light green color, characteristic extract odor, semi-solid form	Dark green color, characteristic extract odor, semi-solid form	Deep dark green color, characteristic extract odor, semi-solid form
Cycle 4	Light green color, characteristic extract odor, semi-solid form	Dark green color, characteristic extract odor, semi-solid form	Deep dark green color, characteristic extract odor, semi-solid form
Cycle 5	Light green color, characteristic extract odor, semi-solid form	Dark green color, characteristic extract odor, semi-solid form	Deep dark green color, characteristic extract odor, semi-solid form
Cycle 6	Light green color, characteristic extract odor, semi-solid form	Dark green color, characteristic extract odor, semi-solid form	Deep dark green color, characteristic extract odor, semi-solid form

The stability test was carried out using the cycling test method, which involves exposing the cream to alternating hot and cold temperatures over six cycles (12 days).

Based on the homogeneity test results conducted both before the cycling test (cycle 0) and throughout the cycling test (cycles 1 to 6), the cream formulation consistently displayed a uniform structure.

Table 10. Results of Homogeneity Stability Test

	F0	F1	F2	F3
cycle 1	Homogen	Homogen	Homogen	Homogen
cycle 2	Homogen	Homogen	Homogen	Homogen
cycle 3	Homogen	Homogen	Homogen	Homogen
cycle 4	Homogen	Homogen	Homogen	Homogen
cycle 5	Homogen	Homogen	Homogen	Homogen
cycle 6	Homogen	Homogen	Homogen	Homogen

Throughout the cycling test process (cycle 1 to cycle 6), fluctuations in pH values—both decreases and increases—were observed, likely due to the influence of temperature variations.

Tabel 11. Results of pH Stability Test

Time	F0	F1	F2	F3
cycle 1	5,19	5,39	5,11	5,10
cycle 2	5,36	5,51	5,15	5,26
cycle 3	5,18	5,51	5,25	5,24
cycle 4	5,14	5,48	5,35	5,18
cycle 5	5,05	5,4	5,21	6,01
cycle 6	5,16	5,46	5,25	5,97

Table 12. Results of the Inhibition Zone Diameter of the Cream

Treatment	Inhibition Zone Diameter (mm)			Average
	1	**2**	**3**	
Negative control (sterile distilled water)	-	-	-	-
Noni leaf extract cream 1.25%	-	-	-	-
Noni leaf extract cream 2.50%	5,50	5,70	6,05	5,79
Noni leaf extract cream 5.00%	7,70	9,80	10,0	9,16
Positive control (Amoxicillin 25 µg)	33,00	33,00	33,00	33.0

Antibacterial Activity Testing

The antibacterial activity test is conducted using the Kirby-Bauer method, which measures the extract's ability to inhibit microorganism growth by observing the formation of inhibition zones. This method is chosen because it allows for easy adjustment of extract concentration, uses simple equipment, provides results in a short amount of time, and facilitates the isolation process on culture media.

DISCUSSION

The extraction method employed was maceration, which aims to diffuse the active constituents of the simplicia into a solvent. In this process, 96% ethanol was used as the solvent. This ethanol concentration serves as an effective extractor of bioactive compounds and acts as an antiseptic, helping to prevent microbial contamination during extraction. Ethanol can extract antibacterial compounds such as alkaloids, flavonoids, polyphenols, and steroids. The maceration was carried out for 3 x 24 hours using a solvent-to-sample ratio of 1:10, or approximately 1.5 liters of solvent, to ensure optimal extraction results.

A phytochemical screening test was conducted once the dry extract (macerate) was obtained. The screening results revealed that the powdered Simplicia and the ethanol extract of noni (Morinda citrifolia) leaves contain secondary metabolites such as flavonoids, saponins, triterpenoids, and tannins. These compounds are known for their antibacterial properties, making them effective in inhibiting the growth of acne-causing bacteria (11).

Organoleptic testing was carried out through sensory observation, focusing on the cream formulation's appearance, aroma, and color (12). The results indicated that the cream had a semisolid consistency and exhibited the characteristic scent of noni leaf extract in all three concentration variations, while the control formula (F0) was odorless. The physical form of all samples was consistently semisolid. In terms of color, noticeable differences were observed among the formulations. The control (F0), which contained no extract, appeared white, whereas F1, F2, and F3 showed varying shades of green depending on the concentration of the added extract. F1 produced a light green hue, F2 a darker green, and F3 a deep dark green. These differences in color intensity are attributed to the increasing concentration of noni leaf extract used in each formulation—the higher the extract content, the more intense the green color.

Formulation is homogeneous when no coarse granules or visible separate components are present. The homogeneity test results on the ethanol extract cream of noni leaves demonstrated a uniform structure, as the applied cream showed

evenly distributed particles and consistent coloration. A homogeneous cream formulation is characterized by the absence of coarse granules or visible particles within the preparation. Semisolid preparations intended for topical application must have a pH that aligns with the skin's natural pH, typically between 4.5 and 8.0 (13). If the pH falls outside this range, an overly alkaline preparation may cause skin dryness, while one that is too acidic could lead to irritation. The pH measurement results of the ethanol extract cream from noni leaves indicate that all concentration variations in Formulas 0, 1, 2, and 3 meet the acceptable pH standards for facial skin.

Viscosity refers to the resistance of a liquid formulation to flow; the higher the viscosity, the greater the resistance to movement. According to relevant studies and the SNI 16-4399-1996 standard, an ideal viscosity for cream formulations is 2,000 to 50,000 cPs. The viscosity measurements for formulas F1, F2, and F3 were 15,046 ± 50.57; 16,367 ± 30.23; and 19,664 ± 5.29 cPs, respectively. Adding noni leaf extract influences the viscosity level, where higher extract concentrations result in increased viscosity. F3 demonstrated the highest viscosity among the three, indicating better consistency than F1 and F2. Ideally, the cream's viscosity should strike a balance—not too thick and not too runny (14).

The spreadability test is essential in evaluating cream formulations, as it indicates the softness and ease with which the cream can be applied to the skin. Spreadability also affects absorption at the application site—the better the spreadability, the more effectively the cream can be absorbed. An ideal spreadability value ranges between 5–7 cm (15). Based on the results, the formulations F0, F1, F2, and F3 showed spread diameters of 6.3 ± 0.1; 5.2 ± 0.1; 5.2 ± 0.1; and 5.3 ± 0.1 cm, respectively. These results indicate that all formulations meet the standard for good spreadability. However, it was observed that increasing the concentration of noni leaf extract led to a decrease in spread diameter. This change in diameter is also influenced by the pressure applied during testing.

Adhesiveness of a cream base refers to the duration it remains in contact with the skin. A good base ensures prolonged and effective contact with the skin to achieve its intended therapeutic effect. A cream should have an adhesion time between 2 and 300 seconds(16). The longer the cream adheres to the skin, the more time it allows the active substance to penetrate, enhancing drug absorption. In this study, the average adhesion times observed were 1.18 seconds for F0 (without extract), 1.25 seconds for F1, 1.04 seconds for F2, and 1.03 seconds for F3. These values indicate that the creams did not meet the required adhesion time based on literature standards. Therefore, the formulations do not exhibit optimal adhesion properties for effective drug delivery.

Based on the organoleptic evaluation conducted before the cycling test (cycle 0) and throughout cycles 1 to 6, no changes were observed in the cream's color, odor, or form during the 12-day storage period (17). This indicates that the formulated cream met the stability test standards. The homogeneity test results for formulations F0, F1, F2, and F3 during cycles 1 to 6 also showed no texture changes, coarse particles, and no separation between the oil and water phases. These findings suggest that the ethanol extract cream maintained good physical stability, remaining homogeneous throughout the 12-day storage period. Meanwhile, the pH test results exhibited some fluctuations due to temperature changes; however, the pH values remained within the acceptable range for cream formulations and skin pH. This indicates that the pH of the formulation was stable and met the required standards for topical products (18).

The antibacterial activity was tested using the Kirby-Bauer method, which involves inhibiting microorganism growth by observing the formation of inhibition zones. The Kirby-Bauer method was chosen due to its ease of adjusting extract concentrations, the simplicity of the equipment used, quick results, and the ease of isolating on the

medium (19). Blood Agar Plate (BAP) is a solid and differential medium. The bacterium *S. pyogenes* on the BAP medium shows hemolysis, creating a clear zone around the bacterial colonies, classifying it as *Streptococcus β hemolyticus*. In the antibacterial activity test, the ethanol extract cream of *Morinda citrifolia* leaf was tested at concentrations of 1.25%, 2.50%, and 5.00% (w/w). The results showed inhibition zones for the cream extract at concentrations of 1.25%, 2.50%, and 5.00%, with distilled water as a negative control and amoxicillin as a positive control. At a concentration of 2.50%, a moderate inhibition zone of 5.79 mm was observed. At 5.00%, a large inhibition zone of 9.16 mm was formed. However, at 1.25%, no inhibition zone appeared. This indicates that the Minimum Inhibitory Concentration (MIC) of *Morinda citrifolia* leaf extract against *S. pyogenes* is 2.50%. The negative control (sterile distilled water) did not produce an inhibition zone, showing no antibacterial activity. The positive control in this study used amoxicillin paper disks (25 µg), with inhibition between 5-10 mm considered moderate and weak if the average diameter of the inhibition zone is ≤ 5 mm (19).

Based on the results of this study, noni leaf extract (Morinda citrifolia) shows promising potential as an active ingredient in topical preparations for acne treatment. Phytochemical screening revealed the presence of secondary metabolites such as flavonoids, saponins, triterpenoids, and tannins, which are known to possess antibacterial, anti-inflammatory, and antioxidant activities. The antibacterial activity was confirmed through the Kirby-Bauer method, where at concentrations of 2.5% and 5%, inhibition zones against Streptococcus pyogenes were observed with diameters of 5.79 mm and 9.16 mm, respectively, indicating the extract's effectiveness against acne-causing bacteria. Furthermore, the cream formulations containing the extract demonstrated good physical stability during 12 days of testing, with no changes in color, aroma, or texture, and maintained a pH range suitable for skin (4.5–8.0). However, the formulation also has some limitations. The cream's adhesiveness was below the minimum standard, with adhesion times of less than 2 seconds, which could affect the contact time of the active ingredient with the skin and its absorption effectiveness. Additionally, the noni extract has a strong characteristic odor that may affect the product's aesthetic appeal, and the cream changes to a dark green color at higher concentrations, which may be less preferred by consumers. From a methodological perspective, the maceration technique using 96% ethanol solvent was effective in extracting the active compounds, and the antibacterial test method used provided representative results of the extract's inhibitory capacity. Nevertheless, this study has not yet included toxicity tests, skin irritation tests, or in vivo efficacy evaluations, nor has it performed further formulation optimization to improve adhesiveness. Therefore, although these preliminary results support the development of noni leaf extract cream as a natural alternative acne medication, further comprehensive research is needed to ensure the safety, efficacy, and suitability of the product for clinical applications.

CONCLUSIONS

Based on the study's results, it can be concluded that the cream formulation of ethanol extract of morinda citrifolia leaves can be made into a cream preparation. However, it does not meet the quality standards for adhesive strength testing. The ethanol extract cream of morinda citrifolia leaves exhibits antibacterial activity against *Streptococcus pyogenes* bacteria. The Minimum Inhibitory Concentration (MIC) of the ethanol extract cream against *Streptococcus pyogenes* was found at a concentration of 5.00%. The average inhibition zone diameter was 9.16 mm, with formula I showing 7.70 mm, formula II showing 9.80 mm, and formula III showing 10.00 mm. This demonstrates that formula III is the most effective in inhibiting the activity of *S. pyogenes*. The morinda citrifolia leaf

extract can be formulated into a good cream preparation.

The initial test results show that this extract is able to provide a positive effect on acne skin conditions, so it has the potential to be an alternative natural treatment is safer and more environmentally friendly compared to synthetic chemical drugs.

The Importance of Further Research

Although the initial results show promising prospects, further research is needed to strengthen scientific evidence regarding the effectiveness and safety of noni leaf extract. Further research is important to determine the right dosage, optimal formulation method, and potential long-term side effects. In addition, clinical trials in humans are also needed to ensure that the results obtained in vitro or in test animals can be applied effectively and safely in humans.

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