Usadha: Journal of Pharmacy. Vol. 5, No. 3, (2026). ISSN 2827-9905
Available online at: https://jsr.lib.ums.ac.id/index.php/ujp

ANTIBACTERIAL ACTIVITY OF OINTMENT CONTAINING ETHANOLIC EXTRACT OF RED CORDYLINE LEAVES (*Cordyline fruticosa* (L.) A. Chev.) AGAINST *Cutibacterium acnes* AND *Staphylococcus aureus* BACTERIA

Afina Aninas Roihanah[1], Ratih Guswinda Lestari[2*], Adhi Wardhana Amrullah[3]
[1,2,3]Departement of Pharmacy, Faculty of Health Sciences, Universitas Kusuma Husada Surakarta, Surakarta, Indonesia
*E-mail correspondence : ratihguswinda@ukh.ac.id

Submitted: June 30, 2026; Accepted: August 13, 2026; Published: August 31, 2026.

Abstract

Skin infections caused by Cutibacterium acnes and Staphylococcus aureus remain a major public health concern with high prevalence in Indonesia. This issue is further compounded by the increasing emergence of antibiotic resistance, creating an urgent need for alternative antibacterial agents derived from natural sources. The present study aimed to evaluate the antibacterial activity of an ointment formulation containing ethanol extract of red cordyline (Cordyline fruticosa) leaves against Cutibacterium acnes and Staphylococcus aureus. This research employed an experimental laboratory design. The extract was obtained through maceration using 70% ethanol and subsequently formulated into hydrocarbon-based ointments at concentrations of 10% (Formula I), 15% (Formula II), and 20% (Formula III). Phytochemical screening revealed the presence of flavonoids, tannins, saponins, and polyphenolic compounds in the extract. All ointment formulations met the established requirements for physical quality, stability, and sensory acceptability, with overall preference scores ranging from 70.5% to 75%. Antibacterial testing against Cutibacterium acnes produced inhibition zones of 4.28 ± 0.3 mm, 9.38 ± 0.6 mm, and 11.03 ± 0.3 mm for Formulas I, II, and III, respectively. In contrast, antibacterial testing against Staphylococcus aureus produced inhibition zones of 4.16 ± 0.3 mm, 5.98 ± 0.4 mm, and 11.61 ± 0.5 mm for Formulas I, II, and III, respectively. It can be concluded that the ointment containing 20% red cordyline leaf extract exhibited the highest antibacterial activity against both Cutibacterium acnes and Staphylococcus aureus.

Keywords: *red cordilyne, ointment, Cutibacterium acnes, Staphylococcus aureus.*

INTRODUCTION

Skin infections of bacterial origin represent a widespread health problem across many countries worldwide. According to the Global Burden of Bacterial Skin Diseases study, approximately 169.72 million new cases of bacterial skin diseases were recorded globally in 2019 (Xue *et al*., 2022). Indonesia, characterized by its tropical climate and high humidity, also demonstrates a considerable prevalence of bacterial skin infections. Two bacterial species most frequently associated with human skin infections are *Cutibacterium acnes* and *Staphylococcus aureus*. *C. acnes* is recognized as the primary etiological agent of acne vulgaris (Tsuru *et al*., 2021), a condition affecting 48% to 52% of the general population in Indonesia (Wulandari *et al*., 2022). Meanwhile, *S. aureus* is responsible for a variety of skin infections including impetigo, folliculitis, furuncles, and abscesses, and accounts for approximately 45.3% of all skin and soft tissue infections reported in the country (Santosaningsih *et al*., 2018). Of growing concern is the increasing resistance of these two bacterial species to conventional antibiotics. Data from the Surveillance of Indonesian Network

for Antimicrobial Resistance indicates that the prevalence of Methicillin-Resistant *Staphylococcus aureus* (MRSA) in Indonesian hospitals reached 33% in 2023 (Osok *et al*., 2025). Furthermore, isolates of *C. acnes* obtained from patients in Indonesia have shown resistance rates of 61.3% against clindamycin, 45.2% against erythromycin, and 12.9% against tetracycline (Wahyuningsih *et al*., 2023). This situation highlights the necessity to develop and utilize alternative antimicrobial therapies derived from natural ingredients.

Red cordyline (*Cordyline fruticosa*) leaves contain various biologically active secondary metabolites, including tannins, saponins, flavonoids, fenol, and terpenoids as well as phenolic compounds (Wahyuningsih *et al*., 2023; Indiyen *et al*., 2020; La *et al*., 2026), which are known to inhibit bacterial growth. Previous studies have demonstrated that red cordyline leaf extract produces an inhibition zone of approximately 17.8 mm against *S. aureus* (Indiyen *et al*., 2020) and between 8.19 mm and 11.75 mm against *C. acnes* (Wahyuningsih *et al*., 2023). Other research has identified flavonoid compounds in the ethyl acetate fraction of the extract, which contribute to its antibacterial and antioxidant properties (Utami *et al*., 2023).

The ointment dosage form was selected for this study due to its superior adherence and protective properties compared to other topical preparations, allowing for longer contact time with the skin and enhanced therapeutic effect (Gold *et al*., 2023). This study aimed to evaluate the antibacterial efficacy of ointment formulations containing ethanol extract of red cordyline leaves against *Cutibacterium acnes* and *Staphylococcus aureus*. Although the antibacterial activity of Cordyline fruticosa extracts has been reported, evidence regarding their incorporation into a pharmaceutically acceptable semisolid dosage form and the relationship between extract concentration, formulation stability, and antibacterial performance remains limited. Furthermore, no previous study has simultaneously evaluated accelerated stability, sensory acceptability, and dual antibacterial activity against both Cutibacterium acnes and Staphylococcus aureus within a hydrocarbon ointment system. Therefore, this study addresses an important translational gap between ethnopharmacological evidence and the development of a stable topical antibacterial formulation suitable for potential therapeutic application.

MATERIALS AND METHODS

Equipment and Materials

The equipment used included a blender (Philips®), sieve, maceration vessel, water bath (Memmert®), rotary evaporator (IKA RV10®), anaerob jar (Oxoid®), (analytical balance (OHAUS®), hot plate (Thermo Scientific®), autoclave (GEA®), Laminar Air Flow cabinet (BioBase®), incubator (Memmert®), oven (Memmert®), petri dishes (OneMed®), micropipettes (D-Lab®), sterile cork borer, vernier caliper, beakers (IWAKI®), volumetric flasks (Pyrex®), and Erlenmeyer flasks (IWAKI®).

The materials comprised red cordyline leaves from the Tawangmangu region, Karanganyar Regency, Central Java, Indonesia, 70% ethanol (Liquid Pharma®), white petrolatum, white wax, stearyl alcohol, methylparaben, bacterial strains of *Cutibacterium acnes* and *Staphylococcus aureus*, Brain Heart Infusion Broth (BHIB), anaerogen (Thermo®), 0.5 McFarland standard, chloramphenicol, clindamycin, Mayer's reagent, Dragendorff's reagent,

hydrochloric acid (HCl), magnesium powder (Mg), iron(III) chloride ($FeCl_3$), concentrated sulfuric acid (H_2SO_4), potassium hydroxide (KOH), and phenolphthalein indicator.

Sample Preparation

Red cordyline leaves were collected from the Tawangmangu region, Karanganyar Regency, Central Java, Indonesia. Botanical identification was performed at the Laboratory of the Ministry of Health, Dr. Sardjito General Hospital, under reference number TL.02.04/D.XI/793.060/2026, confirming the plant as *Cordyline fruticosa* (L.) A. Chev., belonging to the Asparagaceae family. The collected leaves were washed, air-dried, and further dried in an oven at 40 °C until reaching a constant weight.

Extraction

The dried leaf material was extracted using the maceration method with 70% ethanol as the solvent, at a ratio of plant material to solvent of 1:5 (w/v). The mixture was allowed to stand for three consecutive periods of 24 hours each, followed by a remaceration process for an additional 48 hours. The resulting liquid extract was filtered and concentrated using a rotary evaporator and water bath until a thick, semi-solid extract was obtained (Wahyuningsih *et al*., 2023).

Phytochemical Screening

Preliminary phytochemical analysis was conducted on the ethanolic extract of red cordyline (*Cordyline fruticosa*) leaves to identify the presence of secondary metabolites. Alkaloids were detected using Mayer's and Dragendorff's reagents; formation of a white precipitate with Mayer's reagent and an orange precipitate with Dragendorff's reagent indicated a positive result (Firmansyah & Jawa La, 2024). Flavonoids were identified via the magnesium-hydrochloric acid reduction test; the appearance of red, orange, or yellow coloration confirmed their presence (Firman *et al*., 2024). Tannins were detected using iron(III) chloride solution, where a dark green to black color indicated a positive reaction (Sugiarti & Fitrianingsih, 2018). Saponins were analyzed using the foam test: 1 g of extract was mixed with warm water, shaken vigorously, and observed for stable foam formation of 1–10 cm height persisting for at least 10 minutes (Cahyanta *et al*., 2023). Polyphenolic compounds were identified by adding hot water and iron(III) chloride; development of green, red, purple, blue, or black coloration indicated a positive result (Indiyen *et al*., 2020).

Ointment Formulation

The extract was incorporated into a hydrocarbon ointment base at three concentrations: 10% (Formula I), 15% (Formula II), and 20% (Formula III). The base was prepared by heating 2% white wax and 5% stearyl alcohol in a water bath at 65 ± 5 °C. Subsequently, 0.3% methylparaben and sufficient white petrolatum to reach 100% total weight were added, with continuous stirring until homogeneity was achieved. The extract was then mixed into the base at a temperature of 50 ± 5 °C and stirred until uniformly distributed.

Evaluation of Physical Characteristics

Organoleptic and Homogeneity Tests

The preparations were visually inspected for consistency, color, odor, and uniformity (Lasut *et al*., 2019; Cahyanta *et al*., 2023).

pH Measurement

The pH of each formulation was determined using a calibrated pH meter (Cahyanta *et al*., 2023).

Spreadability Test

A fixed amount of ointment was placed between two glass plates, and increasing weights from 0 g to 1,000 g were applied for one minute. The diameter of the spread ointment was measured (Kurniawan *et al*., 2025; Retnowati *et al*., 2023).

Adhesion Test

The sample was placed between two glass slides, compressed under a 1 kg weight for five minutes, and the time required for separation was recorded. A minimum adhesion time of 4 seconds was considered acceptable (Kurniawan *et al*., 2025).

Protective Capacity Test

One filter paper was impregnated with 1% phenolphthalein solution, and another was coated with wax. The ointment was applied between the two papers, followed by the addition of 1 N potassium hydroxide solution. The absence of red coloration for at least one minute indicated good protective capacity (Cahyanta *et al*., 2023).

Stability Testing (Freeze-Thaw Cycle)

Stability was assessed by subjecting the formulations to alternating temperature cycles: storage at 4 °C for 24 hours, followed by 40 °C for 24 hours, repeated for three complete cycles. Physical properties were evaluated before and after the cycles (Lasut *et al*., 2019).

Hedonic Evaluation

Sensory acceptability was assessed by 10 panelists using a 5-point Likert scale: 5 = strongly like, 4 = like, 3 = neutral, 2 = dislike, and 1 = strongly dislike. Assessments covered texture, aroma, and color. Acceptance percentage was calculated using the formula 1.

$$\text{Acceptance Percentage} = \frac{Total\ Score\ Obtained}{Maximum\ Possible\ Score} \times 100\% \quad (1)$$

Antibacterial Activity Assay

Antibacterial activity was determined using the agar well diffusion method. Bacterial suspensions of *C. acnes* was anaerob condition and *S.aureus* with aerob condition adjusted to match the turbidity of a 0.5 McFarland standard (approximately 1×10^8 CFU/mL). The suspensions were evenly spread onto Nutrient Agar plates using sterile swabs. Wells were punched into the agar and filled with the test formulations, the ointment base (negative control), and 1% clindamycin gel or 2% chloramphenicol ointment (positive control). The plates were incubated at 37 °C for 24 hours, after which the diameter of the inhibition zones was measured using a vernier calliper (Wahyuningsih *et al*., 2023). Inhibition zone measurements were performed after completion of the incubation period. The Petri dishes were examined for the presence of a clear zone surrounding each well. This clear zone indicated the area in which microbial growth was inhibited by the tested sample or control. The diameter of the inhibition zone around each well was measured in both the vertical and horizontal directions using a vernier caliper, and the results were expressed in millimeters (mm) (Rawung *et al*., 2020).

Each treatment was performed in triplicate to obtain more accurate results and to enable statistical analysis. The diameter of the inhibition zone was measured using a vernier caliper

or a ruler. Measurements were taken from the edge of the well to the diameter of the clear zone. The resulting data were recorded and analyzed to determine the level of antibacterial activity (Andani *et al*., 2022). Based on the measured inhibition zone diameter, antibacterial activity was classified into four categories refers to The Davis and Stout Classification Scale (1971).

Data Analysis

All experiments were conducted in triplicate, and the results were expressed as mean ± standard deviation (SD). Descriptive analysis was used to evaluate the physical characteristics of the ointment formulations, including organoleptic properties, homogeneity, pH, spreadability, adhesiveness, protective ability, and cycling-test stability. Antibacterial activity was assessed by measuring the diameter of the inhibition zones against *Cutibacterium acnes* and *Staphylococcus aureus*. Statistical analysis was performed using IBM SPSS Statistics software. Data obtained from pH, spreadability, adhesiveness, and antibacterial activity tests were first evaluated for normality and homogeneity. Differences among formulations (FI, FII, and FIII), positive control and negative control were analyzed using One-Way Analysis of Variance (ANOVA). When significant differences were observed ($p < 0.05$), Tukey's Honestly Significant Difference (HSD) post hoc test was applied to identify differences between individual formulations. Statistical significance was established at a confidence level of 95% ($p < 0.05$).

RESULTS AND DISCUSSION

The yield of the thick red cordyline leaf extract was 26.6% (w/w), which meets the standard requirement of a minimum yield of 10% (Anggaini *et al*., 2024). Phytochemical screening confirmed the presence of flavonoids, tannins, saponins, and polyphenols that shows in Table 1. These compounds exhibit distinct antibacterial mechanisms: flavonoids disrupt bacterial cell membranes and inhibit nucleic acid synthesis (Sriarumtias *et al*., 2020); tannins precipitate bacterial proteins and alter membrane permeability; saponins increase membrane porosity leading to leakage of cellular contents (Rahardjo *et al*., 2017); and polyphenols inhibit essential bacterial enzymes (Indiyen *et al*., 2020).

The increase in the concentration of ethanolic extract of red cordyline leaves (Cordyline fruticosa) from 10% (FI) to 15% (FII) and 20% (FIII) significantly affected several physical quality parameters of the ointment, including pH, spreadability, adhesiveness, stability, and protective properties that shows in Table 2. These changes can be explained based on the principles of semisolid formulation science, particularly the relationship between extract solids content, system viscosity, and interactions between the active constituents and the hydrocarbon base.

All formulations maintained a semi-solid consistency, purple in color (Figure 1), the standard characteristic of a suitable ointment. The pH values decreased progressively with increasing extract concentration, from 4.94 in FI, 4.75 in FII and 4.66 in FIII. All formulations remained within the physiological skin pH range (4.5–6.5), indicating their suitability for topical application. Statistical analysis confirmed significant differences in pH across formulations ($p < 0.05$).

Table 1. Phytochemical screening of Red Cordyline Extract

Phytochemicak compound	Result Test	Result Figure	Inference
Flavonoid	Orange color		+
Alkaloid	no sediment		-
Saponin	Foaming		+
Tannin	Dark-green		+
Polyphenols	Dark-red color		+

Table 2. Physical Properties of Red Cordyline Leaf Extract Ointment

Formulation	Consistency	Color	Odor	pH	Spreadability (cm)	Adhesion Time (s)	Acceptance (%)
Formula I (10%)	Semi-solid	Purple	Distinctive	4.94 ± 0.05*	4.7 ± 0.1*	5.72 ± 0.08*	72.7
Formula II (15%)	Semi-solid	Purple	Distinctive	4.75 ± 0.03*	4.4 ± 0.1*	7.04 ± 0.08*	70.7
Formula III (20%)	Semi-solid	Purple	Distinctive	4.66 ± 0.03*	4.1 ± 0.1*	8,89 ± 0,1*	74.7
Negative Control (Base)	Semi-solid	White	Odorless	6.45 ± 0.02	5.3 ± 0.1	4.72 ± 0.2	-

* Significantly different from the negative control ($p < 0.05$)

The reduction in pH is associated with the higher content of phenolic compounds, flavonoids, and tannins present in the red cordyline extract. Phenolic compounds contain hydroxyl groups capable of donating protons, thereby increasing the acidity of the formulation system. A similar phenomenon was reported by Thomas *et al*. (2022), who demonstrated that increasing the concentration of polyphenol-rich plant extracts in semisolid formulations resulted in lower pH values due to the greater contribution of acidic constituents. From a

pharmaceutical perspective, a slightly acidic pH is advantageous because it helps maintain the skin acid mantle and may contribute to the inhibition of pathogenic skin bacteria (Cahyanta *et al*., 2023).

Spreadability decreased from 4.7 cm in FI to 4.4 cm in FII and 4.1 cm in FIII. This reduction reflects an increase in the viscosity of the system caused by the higher concentration of the thick extract. In semisolid dosage forms, spreadability is inversely related to viscosity, as viscosity increases, flow resistance becomes greater and the ointment spreads less readily under an applied force. The red cordyline extract contains solid components and polyphenolic compounds that enhance the internal cohesion of the ointment mass and strengthen the semisolid structure formed by white petrolatum, white wax, and stearyl alcohol. Retnowati *et al*. (2023) similarly reported that increasing herbal extract concentration in ointments increased viscosity and reduced spreadability. Although the spreadability of FIII was slightly below the ideal range of 5–7 cm, the hydrocarbon base possesses occlusive properties that may compensate for the reduced spreadability by improving drug retention on the skin surface (Nurdianti & Setiawan, 2022). This is likely due to the addition of the thick extract, which increased the formulation's viscosity, thereby enhancing the ointment's ability to adhere to the skin surface (Putri & Paramita, 2023). One-Way ANOVA results indicated significant differences among the formulas ($p < 0.001$; $p < 0.05$), and the Tukey HSD post-hoc test confirmed that every pair of formulas exhibited a significant difference in spreadability ($p < 0.05$).

Adhesiveness increased markedly with increasing extract concentration, from 5.72 s in FI to 7.04 s in FII and 8.89 s in FIII. Following the freeze–thaw test, these values further increased to 6.92, 8.83, and 9.91 s, respectively. The increase in adhesiveness is attributable to the higher viscosity and stronger internal cohesion of the ointment resulting from the incorporation of the thick extract. The greater the amount of solids and natural polymeric constituents, the stronger the adhesive forces between the ointment and the skin surface. Kurniawan *et al*. (2025) stated that ointments with higher viscosity generally exhibit longer adhesion times because greater energy is required to separate the two surfaces. From a biopharmaceutical standpoint, increased adhesiveness is beneficial because it prolongs the residence time of the formulation on the skin, enhances the opportunity for drug penetration, and may reduce the frequency of application.

Protection test results for the red cordyline leaf extract ointments (FI, FII, FIII) showed no color change on the filter paper during the testing period. This indicates that all formulas were capable of preventing the penetration of the 1 N KOH solution and possessed good protective properties. The effective protection observed across all formulas is attributed to the use of a hydrocarbon ointment base (white petrolatum and white beeswax), which is occlusive and water-insoluble. The hydrocarbon base forms a dense lipid layer on the skin surface, effectively preventing the entry of external irritants (Nurdianti & Setiawan, 2022).

All formulations (FI, FII, and FIII) remained stable after three cycling-test cycles (4 °C – 40 °C), with no changes in appearance, color, or odor (Figure 1). The pH values did not change significantly, whereas spreadability decreased and adhesiveness increased after stability testing.

a b c d

Figure 1. Red Cordyline Leaf Extract Ointment: Formula I (a), Formula II (b), Formula III (c), and Ointment Base (d)

The good stability is mainly attributed to the hydrocarbon base, which is hydrophobic and resistant to phase separation during temperature fluctuations. White petrolatum and white wax form a lipophilic system that is relatively stable under varying storage temperatures. In addition, the flavonoids and polyphenols present in the red cordyline extract possess antioxidant activity that may help prevent oxidative degradation, as evidenced by the absence of browning or rancid odor during storage (Utami *et al*., 2023). Lasut *et al*. (2019) reported that hydrocarbon-based ointments generally exhibit superior physical stability in freeze–thaw testing compared with emulsion-based systems because their lipophilic structure undergoes minimal phase changes. The observed decrease in spreadability and increase in adhesiveness after storage (Table 3) suggest a slight restructuring of the semisolid network, however these changes remained within acceptable quality limits.

Table 3. Stability results of Red Cordyline Leaf Extract Ointment

Formulation	pH	Adhesion Time (s)	Spreadability (cm)
Formula I (10%)	4.90 ± 0.04	6.92 ± 0.08*	4.2 ± 0.05*
Formula II (15%)	4.71 ± 0.02	8.83 ± 0.05*	3.9 ± 0.05*
Formula III (20%)	4.62 ± 0.02	9.91 ± 0.06*	3.6 ± 0.1*
Formula IV (Base)	6.41 ± 0.01	5.85 ± 0.08*	4.8 ± 0.1*

*significantly different compared to the parameters of the red cordyline leaf extract ointment formulation prior to the stability test ($p<0,05$).

A hedonic test was conducted with 10 panelists using a 5-point Likert scale to assess preference regarding texture, aroma, and color. The red cordyline leaf extract ointment formulations were well-received by the panelists. Formula III (20% extract) achieved the highest hedonic score (74.7%), indicating it was the panelists' overall favorite. Statistical analysis revealed no significant differences between the formulations across any of the hedonic parameters. This indicates that the variations in extract concentration (10%, 15%, and 20%) did not result in statistically significant differences in the panelists' organoleptic assessments. The results of the hedonic test are presented in Figure 2.

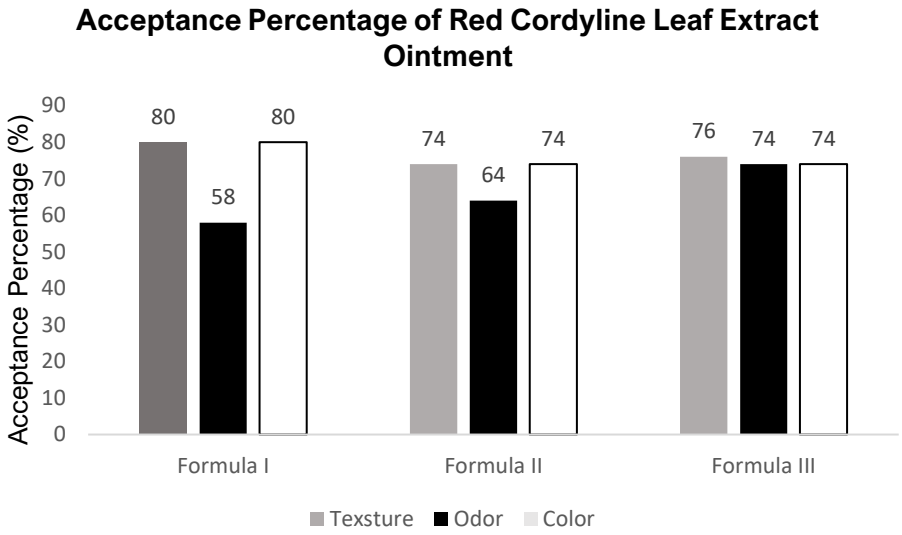


Figure 2. Diagram of Acceptance Percentage of Red Cordyline Leaf Extract Ointment

Antibacterial Activity

The hydrocarbon base (white petrolatum, white wax, and stearyl alcohol) forms a lipophilic and occlusive matrix that tends to retain flavonoids, tannins, and polyphenols within the ointment, thereby limiting their diffusion into the aqueous agar medium (Allen, 2022). This may explain why the inhibition zones of the ointment formulations were lower than those previously reported for the crude ethanolic extract of Cordyline fruticosa (Indiyen *et al*., 2020). Increasing extract concentration from 10% to 20% enhanced antibacterial activity because the higher drug loading increased the concentration gradient and partially overcame the diffusion resistance of the hydrocarbon matrix. In addition, white wax and stearyl alcohol increase the structural rigidity and viscosity of the ointment, which slows drug release but prolongs retention on the skin surface (Aulton & Taylor, 2018). The hydrocarbon base also protects phenolic compounds from moisture and oxidation, contributing to the good freeze–thaw stability observed in this study. Therefore, the hydrocarbon base in this formulation appears to function as a retentive and protective vehicle rather than a rapid-release vehicle. Although diffusion in agar may be slower, the prolonged residence time on the skin may improve the local antibacterial effect against Cutibacterium acnes and Staphylococcus aureus. Similar release-limiting effects of viscous hydrocarbon ointments have been reported in previous herbal ointment formulations (Retnowati *et al*., 2023).

Antibacterial activity testing was conducted using the well-diffusion method to determine the ability of the red cordyline leaf extract ointment to inhibit the growth of *Cutibacterium acnes* and *Staphylococcus aureus*. Inhibition strength categories were established based on The Davis and Stout Classification (1971) (Andani *et al*., 2022). The results demonstrated that the red cordyline leaf extract ointment possesses antibacterial activity. Formula III, containing 20% extract, exhibited strong antibacterial activity against both *Cutibacterium acnes* and *Staphylococcus aureus*. A clear dose-response relationship was observed, wherein higher extract concentrations resulted in larger inhibition zone diameters. One-way ANOVA results

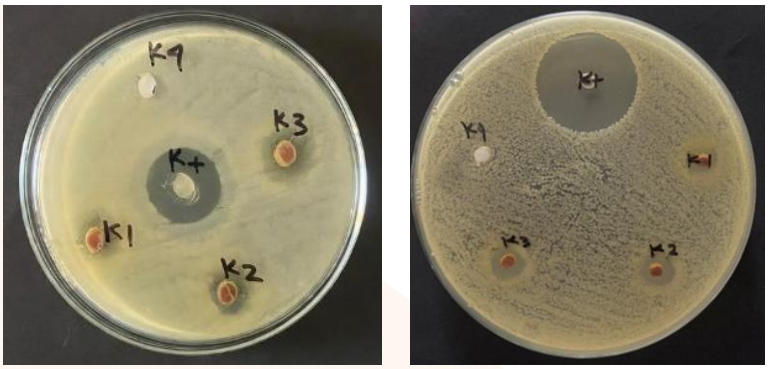
indicated highly significant differences among treatment groups for both test bacteria (*C. acnes*: p<0.001; *S. aureus*: p<0.001). Post-hoc Tukey HSD testing confirmed significant differences between all pairs of groups (p<0.05). This antibacterial activity is closely linked to the presence of active compounds flavonoids, tannins, saponins, and polyphenols which act synergistically to inhibit bacterial growth (Wahyuningsih *et al*., 2023). Formula III (20%) was identified as the optimal formulation, as it demonstrated strong antibacterial activity against both test bacteria, met all physical quality parameters, and was the most preferred by panelists in the hedonic test.

Although Formula III (20% extract) exhibited the highest antibacterial activity among the tested ointment formulations, its inhibition zones against *Cutibacterium acnes* (11.03 ± 0.3 mm) and *Staphylococcus aureus* (11.61 ± 0.5 mm) were substantially lower than those of the positive controls, namely 1% clindamycin gel (16.53 ± 0.4 mm) and 2% chloramphenicol ointment (30.48 ± 0.5 mm) that shows in Table 4 and Figure 3. This result is expected because the positive controls contain purified antibiotics with well-established potency and optimized release characteristics, whereas the red cordyline ointment contains a complex mixture of phytochemicals whose release is modulated by the hydrocarbon base.

Table 4. Results of Antibacterial Activity Test of Red Cordyline Extract Ointment

Sample	Inhibition Zone (mm)		Category
	Cutibacterium acnes	***Staphylococcus aureus***	
K1 (FI)	4,28 ± 0,3*	4,16 ± 0,3*	Weak
K2 (FII)	9,38 ± 0,6*	5,98 ± 0,4*	Moderate
K3 (FIII)	11,03 ± 0,3*	11,61 ± 0,5*	Strong
K4 (Base)	0 ± 0	0 ± 0	No Inhibiton
K+ (Positive Control)	16,53 ± 0,4	30,48 ± 0,5	Very Strong

Note: K1, K2, K3 = red Cordyline leaf extract ointments (10%, 15%, and 20%); K4 = ointment without extract (negative control); K(+) = 1% clindamycin gel (positive control) for C.acnes and 2% chloramphenicol ointment for S.aureus.
**Significantly different from the positive and negative controls.*



a b

Figure 3. Antibacterial Activity of Cordyline red ointment against the bacterial strain: *C. acnes* (a) and *S. aureus* (b). K+ represent 1% clyndamicin gel (a) 2% chloramphenizol gel (b); K1, K2, K3, K4 represents FI, FII, FIII, and ointment base.

The antibacterial activity observed in the red cordyline (*Cordyline fruticosa*) ointment is likely associated with the combined action of several secondary metabolites identified in the phytochemical screening, namely flavonoids, tannins, saponins, and polyphenols. These compounds may act synergistically against both *Cutibacterium acnes* and *Staphylococcus aureus*. Flavonoids are known to disrupt bacterial cell membranes, increase membrane permeability, and interfere with nucleic acid synthesis, leading to leakage of intracellular components and inhibition of bacterial growth (Sriarumtias *et al*., 2020). Tannins can precipitate bacterial proteins and inhibit membrane-associated enzymes, thereby impairing essential metabolic processes (Sugiarti & Fitrianingsih, 2018). Saponins possess surfactant-like properties that destabilize the lipid bilayer of bacterial membranes and promote cell lysis (Rahardjo *et al*., 2017). Polyphenolic compounds may further contribute by inhibiting oxidative enzymes and other proteins involved in bacterial energy metabolism (Indiyen *et al*., 2020).

Compared with previous studies, the inhibition zone of the 20% ointment against *S. aureus* (11.61 ± 0.5 mm) was lower than that reported for the crude ethanolic extract of *C. fruticosa* (approximately 17.8 mm) (Indiyen *et al*., 2020). Likewise, the activity against *C. acnes* (11.03 ± 0.3 mm) was within the upper range of values reported for other topical preparations containing red cordyline extract, such as face mist formulations (8.19–11.75 mm) (Wahyuningsih *et al*., 2023). The lower activity compared with the crude extract may be explained by the hydrocarbon ointment base, which can retain part of the phenolic and flavonoid constituents and reduce their diffusion into the aqueous agar medium. Nevertheless, such a base may prolong the residence time of the active compounds on the skin surface, which could be advantageous for localized topical therapy (Aulton & Taylor, 2018).

The antibacterial effect observed in this study is also comparable to several plant-based ointment formulations reported in the literature. Cahyanta *et al*. (2023) demonstrated that papaya leaf extract ointment exhibited moderate activity against *Propionibacterium acnes*, while Kurnia *et al*. (2024) reported that mangrove leaf extract ointment showed inhibitory activity against *S. aureus*. The inhibition zones obtained in the present study indicate that red cordyline ointment has antibacterial potency comparable to other Indonesian medicinal plant formulations, while additionally providing acceptable physical stability and sensory properties.

Based on the inhibition-zone classification applied in this study, the activity of Formula III can still be categorized as strong antibacterial activity, indicating that the formulation possesses genuine antibacterial potential. However, the lower potency compared with conventional topical antibiotics suggests that the formulation should not be interpreted as a direct substitute for standard antibiotic therapy in moderate to severe bacterial skin infections. In vitro agar diffusion tests primarily evaluate the ability of antibacterial compounds to diffuse through an aqueous medium and do not fully represent the conditions on the skin surface. The hydrocarbon base used in this formulation may prolong the residence time of flavonoids, tannins, saponins, and polyphenols on the skin, thereby supporting sustained local antibacterial and anti-inflammatory effects despite relatively slower diffusion in agar (Aulton & Taylor, 2018). For acne associated and superficial skin infections, complete bactericidal activity equivalent to clindamycin may not always be required. Reduction of bacterial load, suppression of inflammation, and prevention of lesion progression may still provide clinically meaningful benefits. Similar conclusions have been reported for several plant-based topical

formulations that exhibited moderate in vitro inhibition yet showed potential as adjunctive or alternative topical therapies, particularly in the context of increasing antibiotic resistance and concerns regarding prolonged antibiotic exposure (Kurnia *et al*., 2024).

CONCLUSION

Ointment formulations containing ethanol extract of red cordyline leaves possess significant antibacterial activity against *Cutibacterium acnes* and *Staphylococcus aureus*. The formulation with 20% extract was identified as the most effective, producing strong inhibition zones of 11.03 ± 0.3 mm against *C. acnes* and 11.61 ± 0.5 mm against *S. aureus*.

REFERENCES

Allen, L. V. Jr. & McPherson, T. B. 2021. *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*. 12th ed. Wolters Kluwer.

Andani, L., Sari, N. M., Salusu, H. D., Yusdiansyah, Wartomo, Prayitno, J. & Aryani, F. 2022. Phytochemical analysis, antioxidant and antibacterial activities of red andong leaves (*Cordyline fruticosa*). *Perennial* 18(2):39–44. doi:10.24259/perennial.v18i2.22466.

Anggriani, M. S., Lestari, N. K. D., Deswiniyanti, N. W. & Sari, N. K. Y. 2024. Standardization of non-specific parameters of cumin (*Plectranthus amboinicus*) leaf ethanol extract. *Jurnal Kesehatan, Sains, dan Teknologi* 3(1). doi:10.36002/js.v3i1.2934.

Aulton, M. E. & Taylor, K. M. G. 2018. *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*. 5th ed. Elsevier.

Cahyanta, A. N., Istriningsih, E., Hidayah, A. A. & Wulandari, P. S. 2023. Formulation and antibacterial activity evaluation of papaya leaf (*Carica papaya* L.) extract ointment against *Propionibacterium acnes*. *Kunir: Jurnal Farmasi Indonesia* 1(1). doi:10.36308/kjfi.v1i1.524.

Davis, S. E., Tulandi, S. S., Datu, O. S., Sangande, F. & Pareta, D. N. 2021. Formulation and evaluation of ointment preparation containing ethanol extract of hibiscus leaves (*Hibiscus rosa-sinensis* L.) with various ointment bases. *Biofarmasetikal Tropis* 4(2):66–73. doi:10.55724/j.biofar.trop.v4i2.362.

Fahdi, F., Sari, H., Maria, K. et al. 2024. Antibacterial activity of a combination of mint leaves (*Mentha piperita*) and castor bean leaves (*Ricinus communis*) extracts against acne-causing *Propionibacterium acnes*. *BEST Journal (Biology Education, Sains and Technology)* 7(1). DOI: https://doi.org/10.30743/best.v7i1.9264

Fauzia, R. R., Karsidin, B. & Tristianti, D. 2025. Hedonic test of lipstick combination of red dragon fruit peel extract (*Hylocereus polyrhizus*) and beetroot tuber extract (*Beta vulgaris* L.) as natural colorant. *Media Farmasi Indonesia* 20(1):44–54. doi:10.53359/mfi.v20i1.303.

Firman, I., Kalsum, U. & Kamran, N. F. 2024. Formulation and antibacterial activity evaluation of anti-acne gel containing ethanol extract of water hyacinth (*Eichhornia crassipes*) leaves from Jeneberang River, Makassar, against acne-causing bacteria. *Jurnal Penelitian Farmasi Indonesia* 13(2):107–117. doi:10.51887/jpfi.v13i2.1971.

Firmansyah, T. & La, E. O. J. 2024. Phytochemical screening of ethanol extract of white turmeric rhizome, *Curcuma zedoaria* (Christm.) Roscoe. *Acta Holistica Pharmaciana* 4(1). DOI: 10.62857/ahp.v4i1.49

Gold, L. S., Kwong, P., Draelos, Z., Arekapudi, K. L., Levy-Hacham, O., Erlich, M. & Desai, S. R. 2023. Impact of topical vehicles and cutaneous delivery technologies on patient adherence and treatment outcomes in acne and rosacea. *Journal of Clinical and Aesthetic Dermatology* 16(5):26–34. PMID: 37288283; PMCID: PMC10243731.

Indiyen, R., Aryati, F. & Narsa, A. C. 2020. Antibacterial activity of ethanol extract of red andong leaves against *Escherichia coli* and *Staphylococcus aureus*. *Proceeding of Mulawarman Pharmaceuticals Conferences* 11:22–27. doi:10.25026/mpc.v11i1.388.

Indrayati, S., Siti, D. & Akma, F. 2018. The role of monosodium glutamate as an alternative enrichment medium to replace brain-heart infusion broth (BHIB) for the growth of *Escherichia coli*. *Prosiding Seminar Kesehatan Perintis E* 1(1).

Kurnia, A. R., Rochmah, N. N. & Pangesti, I. 2024. Formulation of mangrove leaf (*Rhizophora mucronata* Lamk.) extract ointment as an antibacterial agent against *Staphylococcus aureus*. *Pharmaqueous: Jurnal Ilmiah Kefarmasian* 6(1):11–21. doi:10.36760/jp.v6i1.2.

Kurniawan, I., Purnama, R. C. & Octonariz, V. Z. 2025. Evaluation of the formulation of salve preparations of kenikir leaf extract (*Cosmos caudatus* Kunth) with variations of salve base. *Jurnal Analis Farmasi* 10(2). DOI:10.33024/jaf.v10i2.23203

La, E. O. J., Salma, C. A. B. M., Esati, N. K. & Sawiji, R. T. 2026. Antipyretic activity of 70% ethanol extract of red andong leaves in male Wistar rats. *Jurnal Farmasimed (JFM)* 8(2):948–957.

Lasut, T. M., Tiwow, G., Tumbel, S. & Karundeng, E. 2019. Physical stability test of ointment containing ethanol extract of jackfruit leaves (*Artocarpus heterophyllus* Lamk.). *Biofarmasetikal Tropis* 2(1):63–70. doi:10.55724/jbiofartrop.v2i1.40.

Putri, N. L. P. T. & Paramita, N. L. P. V. 2023. Review of the antibacterial activity of green betel leaf (*Piper betle* L.) extract using diffusion and microdilution methods. *Journal Scientific of Mandalika (JSM)* 4(2):6–18. doi:10.36312/10.36312/vol4iss2pp6-18.

Nikmah, U. H. & Samodra, G. 2022. Effect of PEG 400 and PEG 4000 on ointment containing ethanol extract of mahogany seeds (*Swietenia mahagoni* (L.) Jacq.) as an antibacterial agent against *Propionibacterium acnes*. *Pharma Xplore: Jurnal Sains dan Ilmu Farmasi* 7(2). DOI:10.36805/jpx.v7i2.2955

Nurdianti, L. & Setiawan, F. 2022. *Teknologi Sediaan Farmasi Semisolid dan Likuid*. Perkumpulan Rumah Cemerlang Indonesia.

Osok, T. M. Z., Waworuntu, O. A., Homenta, H. et al. 2025. Identification of methicillin-resistant *Staphylococcus aureus* among healthcare workers in the emergency department and inpatient wards of Sitti Maryam Islamic Hospital, Manado. *Syntax Admiration* 6(1). https://doi.org/10.46799/jsa.v6i6

Rahardjo, M., Koendhori, E. B. & Setiawati, Y. 2017. Antibacterial activity of aloe vera (*Aloe vera*) ethanol extract against *Staphylococcus aureus*. *Jurnal Kedokteran Syiah Kuala* 17(2):65–70. DOI:10.24815/jks.v17i2.8975

Rawung, F. T., Karauwan, F. A., Pareta, D. N. & Palandi, R. R. 2020. Antibacterial activity of ointment containing chrysanthemum leaf (*Chrysanthemum morifolium*) extract against *Staphylococcus aureus*. *Biofarmasetikal Tropis (The Tropical Journal of Biopharmaceutical)* 3(2):8–16. doi:10.55724/j.biofar.trop.v3i2.279.

Retnowati, E., Hasanatin, S. & Setyaningsih, D. 2023. Ointment formulation of ethanol extract of cocor bebek leaves (*Kalanchoe pinnata* Lamk.) using cera and vaselin album bases. *Pharmasipha: Pharmaceutical Journal of Islamic Pharmacy* 7(2):100–107. doi:10.21111/pharmasipha.v7i2.9567.

Santosaningsih, D., Santoso, S., Setijowati, N., Rasyid, H. A., Budayanti, N. S., Suata, K., Widhyatmoko, D. B., Purwono, P. B., Kuntaman, K., Damayanti, D., Prakoeswa, C. R. S., Laurens, M., van Nierop, J. W. I., Nanninga, G. L., Oudenes, N., de Regt, M., Snijders, S. V., Verbrugh, H. A. & Severin, J. A. 2018. Prevalence and characterisation of *Staphylococcus aureus* causing community-acquired skin and soft tissue infections on Java and Bali, Indonesia. *Tropical Medicine & International Health* 23(1):34–44. doi:10.1111/tmi.13000.

Sriarumtias, F. F., Najihudin, A., Rantika, N. & Nengsih, R. 2020. Antibacterial activity of tangerine powder (*Citrus reticulata* Blanco.) against caries-causing bacteria (*Streptococcus mutans*). *FITOFARMAKA: Jurnal Ilmiah Farmasi* 10(2):148–157.

Sugiarti, L. & Fitrianingsih, S. 2018. Antibacterial activity of ethanol extract of parijoto leaves (*Medinilla speciosa* Blume) against *Propionibacterium acnes* and *Staphylococcus aureus*. *Cendekia Journal of Pharmacy*. 2(1):60-67. https://doi.org/10.31596/cjp.v2i1.18

Sugiyono. 2023. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Tari, M. & Indriani, O. 2023. Formulation and physical stability test of cream containing sembung rambat extract (*Mikania micrantha* Kunth). *Babul Ilmi: Jurnal Ilmiah Multi Science Kesehatan* 15(1):126.

Thomas, N. A., Tungadi, R., Papeo, D. R. P., Makkulawu, A. & Manoppo, Y. S. 2022. Effect of variation in mahkota dewa fruit (*Phaleria macrocarpa*) extract concentration on the physical stability of cream preparations. *Indonesian Journal of Pharmaceutical Education* 2(2):143–152. doi:10.37311/ijpe.v2i2.13532.

Tsuru, A., Hamazaki, Y., Tomida, S., Ali, M. S., Komura, T., Nishikawa, Y. & Kage-Nakadai, E. 2021. Nonpathogenic *Cutibacterium acnes* confers host resistance against *Staphylococcus aureus*. *Microbiology Spectrum* 9(2):1–12. https://doi.org/10.1128/Spectrum.00562-21

Utami, Y. P., Maryam, F., Mus, S. & Agustin, N. A. 2023. Fractionation and characterization of antioxidant compounds from ethanol extract of red andong leaves (*Cordyline fruticosa* (L.) A. Chev.) using UV-Vis and FT-IR. *Jurnal Mandala Pharmacon Indonesia* 9(2):273–281. https://doi.org/10.35311/jmpi.v9i2.362

Wahyuningsih, E. S., Puspitasari, M., Gunarti, N. S. & Alkandahri, M. Y. 2023. Antibacterial activity of *face mist* containing ethanol extract of red andong leaves (*Cordyline fruticosa* (L.) A. Chev.) against *Propionibacterium acnes*. *Pharma Xplore: Jurnal Sains dan Ilmu Farmasi* 8(2). doi:10.36805/jpx.v8i2.pr.

Wulandari, R., Pravitasari, D. N., Indradi, R., & Putri, A. N. (2022). Risk factors for acne vulgaris among students. *CoMPHI Journal: Community Medicine and Public Health of Indonesia Journal, 3*(2), 122–129. https://doi.org/10.37148/comphijournal.v3i2.110

Xue, Y., Zhou, J., Xu, B. N., Li, Y., Bao, W., Cheng, X. L., He, Y., Xu, C. P., Ren, J., Zheng, Y. R. & Jia, C. Y. 2022. Global burden of bacterial skin diseases: a systematic analysis combined with sociodemographic index, 1990–2019. *Frontiers in Medicine* 9. https://doi.org/10.3389/fmed.2022.861115