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# Formulation and Antibacterial Activity Test of Dragon Tail Leaf Extract Cream (Rhaphidophorapinnata (L.f) Schott) Against Staphylococcus aureus ATCC (25923)

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***Abstract***

*The increasing prevalence of bacterial skin infections and antibiotic resistance underscores the need for alternative natural antimicrobial agents. This research aimed to formulate a cream containing Rhaphidophora pinnata leaf extract and evaluate its antibacterial activity against Staphylococcus aureus ATCC 25923. A quantitative experimental design was employed, involving extraction, cream formulation, physical evaluation, and antibacterial testing. The plant material was obtained from Sragen with a sample weight of 8 kg of fresh leaves. Data were analyzed descriptively for physical properties and inferentially using One-Way ANOVA in SPSS to assess antibacterial efficacy. The results showed that creams with 10%, 30%, and 40% extract concentrations met standard physical criteria, including pH, viscosity, and spreadability. The antibacterial activity increased with concentration, with 40% showing the largest inhibition zone against S. aureus. The highest activity was still lower than the positive control, gentamicin cream. In conclusion, Rhaphidophora pinnata leaf extract formulated as a cream demonstrates potential as a natural antibacterial agent, although further stability and clinical testing are required.*

***Keywords: Antibacterial Cream, Rhaphidophora pinnata, Skin Infections, Staphylococcus aureus, Topical Formulation***

## INTRODUCTION

The utilization of medicinal plants is on the rise in Indonesia, driven by growing public awareness of the benefits of natural treatments. As a megabiodiverse country, Indonesia is home to over 1,000 species of medicinal plants, including *Rhaphidophora pinnata* (L.f) Schott, commonly known as dragon's tail plant. This plant contains a variety of active compounds such as flavonoids, alkaloids, saponins, tannins, steroids, and phenols, which are known to have significant pharmacological activities, including antibacterial, anti-inflammatory, and antioxidant effects (Oktavia et al., 2020; Hariyanti et al., 2023). Previous studies have highlighted the potential of *R. pinnata* extract as a natural antibacterial agent. For example, ethyl acetate extract of *R. pinnata* was found to be effective against several pathogenic bacteria, including *Streptococcus mutans, Pseudomonas aeruginosa, Salmonella typhi*, and *Shigella dysenteriae* (Masfria, 2015). The presence of various bioactive compounds, particularly flavonoids, tannins, alkaloids, and saponins, is believed to be responsible for its antibacterial properties (Ayumi et al., 2018).

Bacterial infections are a major factor that can complicate wound healing and lead to more serious conditions. Pathogenic bacteria like *Staphylococcus aureus* are a significant cause of various skin infections, characterized by inflammation, necrosis, and abscess formation (Damayanti et al., 2022). *S. aureus* is a facultative anaerobic, Gram-positive bacterium with a spherical shape and grape-like clusters and a cell wall thickness of 20-80 nm (Tungadi et al., 2023). The increasing prevalence of antibiotic resistance, particularly in strains like MRSA, highlights the urgent need for new and effective antibacterial agents from natural sources to combat these infections and prevent the further spread of resistance (Deniansyah & Pujiastuti, 2022; Oktavia et al., 2020).

Given the proven antibacterial potential and rich active compound content of *R. pinnata* leaf extract, it is crucial to develop a practical and effective topical dosage form to maximize its therapeutic benefits. Creams are an ideal choice for treating skin infections due to their semi-solid texture, which facilitates easy application, and their ability to keep active ingredients on the infected area for a sustained period (Rahayu et al., 2023). Moreover, creams offer significant aesthetic advantages, being non-greasy

and non-sticky, with good spreadability that allows for rapid penetration into the skin (Baskara et al., 2020; Kartini et al., 2024).

This research aims to formulate a cream containing *Rhaphidophora pinnata* leaf extract and evaluate its antibacterial activity against *Staphylococcus aureus*. The urgency of this study lies in providing a natural, safe, and effective alternative to conventional antibacterial treatments, thereby contributing to the development of eco-friendly therapeutic options for skin infections. This study's novelty lies in its comprehensive approach, focusing on the formulation and physical quality evaluation of the cream alongside the quantitative assessment of its antibacterial activity, thus paving the way for further research into the clinical efficacy and stability of this promising natural product.

## RESEARCH METHODS

### Research Design and Analysis

This study employed a quantitative experimental laboratory design, a method widely used in pharmaceutical and health sciences to systematically investigate cause-and-effect relationships by manipulating variables under controlled conditions (Creswell & Creswell, 2017). The primary objective was to formulate and evaluate the antibacterial activity of *Rhaphidophora pinnata* leaf extract cream. All laboratory experiments, including extraction, formulation, physical evaluation, and antibacterial testing, were conducted at the Laboratory of the Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, from April to June 2025. Data analysis was performed using descriptive statistics for the physical quality tests (spreadability, adhesion, pH, and viscosity) and inferential statistics for the antibacterial activity results. The inhibition zone data were analyzed using One-Way ANOVA via Statistical Product Services Solution (SPSS) software, with a significance level set at $p < 0.05$ to determine significant differences between treatment groups (Kartini et al., 2024; Sudaryono, 2020).

### Population, Sample, and Materials

The population of this study was the *Rhaphidophora pinnata* (L.f) Schott plant sourced from Desa Sogo, Bandung Village, Ngrampal District, Sragen Regency. The sample consisted of 8 kg of healthy, dark green leaves, harvested by hand and sorted to exclude any damaged parts. The bacterial strain used was *Staphylococcus aureus* ATCC 25923, a standard strain for antibacterial testing. Materials included *R. pinnata* leaf extract, 96% ethanol, 70% alcohol, stearic acid, liquid paraffin, triethanolamine (TEA), methylparaben (Nipagin), propyl paraben (Nipasol), adeps lanae, distilled water (aquadest), Nutrient Agar (NA), Mueller Hinton Agar (MHA), 0.9% sodium chloride, gentamicin cream, aluminum foil, and various phytochemical reagents such as Dragendorff, Mayer, Wagner, concentrated $H_2SO_4$, and $FeCl_3$ 1%. Gentamicin cream was used as a positive control, while 10% DMSO and the cream base (F0) served as negative controls (Nazar, 2023; Damayanti et al., 2022).

### Research Procedures

### Plant and Extract Preparation

Before the study, plant species authentication was performed at the UPF Hortus Medicus, RSUP Dr. Sardjito, in Tawangmangu, Karanganyar, Central Java, to confirm the sample as *Epipremnum pinnatum* (L) Engl., a synonym for *Rhaphidophora pinnata* (L.f) Schott. The leaves were thoroughly washed, dried in sunlight, and pulverized with a blender before being sieved through a 40-mesh sieve to obtain a uniform powder. The extraction process was carried out using the maceration method with 96% ethanol (Ayumi et al., 2018). Approximately 1000 g of the powdered leaves were soaked in 75 parts of ethanol for 5 days, followed by a second maceration with 25 parts of ethanol for 2 days. The combined macerates were evaporated using a rotary evaporator at 50°C and then thickened in a water bath at 60°C to yield the viscous ethanol extract.

### Phytochemical and Standardization Tests

The prepared extract underwent a phytochemical screening to identify key secondary metabolites, including alkaloids, flavonoids, saponins, tannins, and steroids (Hariyanti et al., 2023). A series of standard tests was conducted: alkaloids were tested using Dragendorff, Mayer, and Wagner reagents; flavonoids with concentrated $H_2SO_4$; saponins by foam formation with distilled water; and tannins with 1% $FeCl_3$. Additionally, the extract was standardized by determining its water content, ash content, and drying loss, and was tested for ethanol residue to ensure it met the quality standards of the Indonesian Herbal Pharmacopoeia (Sudaryono, 2020).

### Cream Formulation

Cream formulations were adapted from a previous study (Majid et al., 2019) and prepared for a total volume of 100 mL, with three varying concentrations of *R. pinnata* leaf extract as the active ingredient: 10%, 30%, and 40% (F1, F2, F3). A negative control cream (F0) containing no extract was also prepared. The creams were formulated using a hot-melting process, where the oil phase (stearic acid, adeps lanae, and liquid paraffin) and the aqueous phase (Nipagin, Nipasol, TEA, and distilled water) were heated separately to 70°C before being combined and rapidly stirred in a heated mortar until a homogenous cream was formed.

**Antibacterial Activity Test**

The antibacterial activity of both the raw extract and the formulated creams was assessed against *Staphylococcus aureus* ATCC 25923 using the agar disc diffusion method (Nazar, 2023). A bacterial suspension was prepared and adjusted to a 0.5 McFarland standard. Paper discs loaded with the extract or cream formulations were placed on Mueller-Hinton Agar (MHA) plates inoculated with the bacterial suspension. The plates were then incubated at 37°C for 18–24 hours. The antibacterial activity was determined by measuring the diameter of the inhibition zone (in mm) surrounding each disc (Rahayu et al., 2023).

## RESULTS AND DISCUSSION

**Plant Determination**

The determination of dragon tail leaves was carried out at UPF Yankestrad Dr. Sardjito Tawangmangu Hospital, Karanganyar, Central Java, to confirm the identity of the sample. The results stated that the plant did indeed come from the family Araceae with the species *Epipremnum pinnatum* (L) *Engl*., a synonym of *Rhaphidophora pinnata* (L.f) *Schott*.

Standardization of Simplification

**Determination of Simplia Drying Shrinkage**

Drying shrinkage is carried out by weighing 1 g of simplicia in a porcelain cross, heated to 105ºC, and then cooled in a desiccator, then reheated repeatedly until a constant weight. The test results showed a shrinkage of replication I by 7%, replication II by 5.6%, and replication III by 5%, with an average of 5.8%. This value is still in accordance with the Indonesian Herbal Pharmacopoeia standard (≤10%), so that simplicia is declared stable and meets the quality requirements.

**Determination of Simplisia Ash Levels**

The ash content test was carried out by weighing simplicia powder in a porcelain cross, then heating it to a constant weight. The test results showed a total ash content of 5.35%, still meeting the Indonesian Herbal Pharmacopoeia standard, which is no more than 10%. This indicates that simplicia is relatively free from excess inorganic pollution.

**Determination of Simplisia Water Content**

The moisture content test was carried out by the toluene distillation method. The test results showed that the moisture content of dragon's tail leaves was 0.85%, according to the standards of the Indonesian Herbal Pharmacopoeia (≤10%). This value shows that simplicia has a low moisture content, so that it is stable and not easily overgrown by microorganisms.

**Dragon Tail Leaf Extract Manufacturing**

The extraction of dragon's tail leaf simplicia powder with the 96% ethanol maceration method produced a thick extract with a yield of 20.28%, indicating that the extraction process was quite efficient. The resulting yield shows that the content of secondary metabolites in simplicia is high enough that the extract is suitable for use as an active ingredient in the formulation of antibacterial cream preparations.

**Standardization of Extracts**

**Determination of Extract Drying Shrinkage**

The results of the drying shrinkage test of dragon's tail leaf extract showed a replication value I of 4%, replication II of 3%, and replication III of 3%, with an average of 3.3%. This value is still below the Indonesian Herbal Pharmacopoeia standard (≤10%), so the extract is declared stable.

**Determination of Extract Water Content**

Moisture testing showed replication I of 4.10%, replication II of 4.20%, and replication III of 4.57%, with an average of 4.29%. This value is in accordance with the standards of the Indonesian Herbal Pharmacopoeia (≤10%), so that the extract has good stability and is not easily overgrown by microorganisms.

**Determination of Extract Ash Levels**

The total ash content test yielded a replication value of I of 0.25%, replication II of 3%, and replication III of 0.55%, with an average of 1.27%. These results meet the requirements of the Indonesian Herbal Pharmacopoeia (≤10%), indicating that the extract is relatively free of inorganic contaminants.

**Ethanol-Free Test**

Ethanol-free tests on all replications showed negative results, so it was ensured that there was no ethanol residue in the extract and was declared safe according to the standards of the Indonesian Herbal Pharmacopoeia.

**Extract Phytochemical Screening Test**

**Table 1 Phytochemical Screening Test of Dragon Tail Leaf Extract**

| Compound | Reagen | Positive Results | Identification Results | Conclusion |
|---|---|---|---|---|
| Alkaloid | Dragendroff | Orange/brown Sediments (Hariyanti *et al*., 2023) | Orange-colored sediment | + |
| Alkaloid | Mayer | Orange sediment (Hariyanti *et al*., 2023) | Orange sediment | + |
| Alkaloid | Wagner | Chocolate Sediment (Hariyanti *et al*., 2023) | Chocolate sediment | + |
| Flavonoid | HCl Pekat + Serbuk Mg | Red, orange (Lestari *et al*., 2021) | Orange | + |
| Saponin | Aquadest | Foam formation (Lestari *et al*., 2021) | Foam-shaped | + |
| Tanin | $FeCl_3$ 1% | Dark Blue or Dark green (Lestari *et al*., 2021) | Dark green | + |
| Steroid | 98% chloroform, anhydrous acetic acid | Dark Blue or Dark green (Lestari *et al*., 2021) | Dark green | + |

Based on the results of phytochemical screening tests, ethanol extract of dragontail leaves (Rhaphidophora pinnata (L.f) Schott) was proven to contain several secondary metabolite compounds. The tests carried out showed positive results on alkaloids, flavonoids, saponins, and tannins, which were characterized by the formation of sediments and discoloration according to the reagent used. These findings reinforce that dragon's tail leaf extract has a varied chemical content and plays an important role in the quality of the extracts produced.

**Physical Quality Test of Dragon Tail Leaf Cream Preparation (Rhaphidophora pinnata (L.f) Schott)**

**Uji Organoleptik**

**Organoleptic tests on this cream preparation include smell, texture, and color.**

**Homogeneity Test**

All formulations of dragon tail leaf extract cream, both formulations 0, 1, 2, and 3, show homogeneous properties because there are no coarse grains, so it can be concluded that the cream produced is homogeneous and meets the criteria of good preparation.

Cream Type Test

The type of cream produced from the four formulas is an oil-in-oil (A/M) emulsion, influenced by the dominance of the oil phase in the composition. This is evidenced by the coloring test using methylene blue, which only collects on the edges of the cream, and the mixing test with water that causes the cream to clump, indicating the outer phase in the form of oil and the inner phase in the form of water.

**pH Test**

The pH test results showed that all formulas of dragon's tail leaf extract cream had a pH that was still within the normal range of skin pH (4.5–6.5). The formula F0 has an average pH of 6.4, F1 of 6.3, and F2 and F3 of 6.2. Thus, all formulas meet the pH requirements of topical preparations that are safe for use on the skin (Deniansyah & Pujiastuti, 2022).

**Viscosity Test**

The viscosity test was carried out using a Brookfield viscometer. The viscosity test was carried out using a viscometer with a No. 4 spindle and a speed of 60 rpm.

The viscosity test results showed that the entire formula of the dragon's tail leaf extract cream was within the SNI standard range for topical preparations (2,000–50,000 cp). Formula 3 has the highest viscosity of 6390 ± 195.32 mpa· S, while formula 0 is the lowest, which is 2949 ± 538.57 mpa·S. The difference in viscosity between formulas is influenced by variations in the composition of the material, especially the proportion of water and oil phases. The viscosity value obtained signifies that all formulas are stable and meet the quality requirements. According to (Baskara et al., 2020) A good viscosity value has a high value; the higher the viscosity, the more difficult the particle movement will be, so that the material will become stable. Good viscosity is indicated by the higher the viscosity value, the more difficult the movement of particles will be, so that the cream will be more stable.

**Adhesive Strength Test**

The adhesion test results showed that the entire formula of dragon tail leaf extract cream met the standard (>4 seconds). Formula 0 has the highest adhesion with an average of 5.8 ± 0.25 seconds, while formula 3 has the lowest at 5.2 ± 0.1 seconds. These differences suggest that variations in ingredient concentrations affect the ability of the cream to stick, yet all formulas still meet the criteria of a good topical preparation. (Tungadi et al., 2023).

**Dispersion Test**

The dispersion test results showed that the entire formula of dragon tail leaf extract cream was in the standard range of 5–7 cm. The greater the spreadability given, the wider the ability of the active substance to spread to the skin. The results of the dispersion test on the preparation of dragon tail leaf extract cream showed that F3 had the lowest value of 5.2cm because F3 had a concentration of dragon tail leaves of 40% which caused the cream preparation to be thicker and the dispersion force was smaller, due to the higher concentration of the extract so that the cream was thicker. This value is in line with the theory that the dispersion is inversely proportional to the viscosity of the preparation. (Tungadi et al., 2023).

**Preliminary Test of Antibacterial Activity of Dragon's Tail Leaf Extract (Rhaphidophora pinnata (L.f) Schott)**

The results of preliminary tests of antibacterial activity showed that the negative control (DMSO 10%) did not produce an inhibition zone, while the positive control (chloramphenicol) produced an average inhibition zone of 22.41 mm with a very strong category. Dragon tail leaf extract with a concentration of 10% results in an inhibition zone of 8.4 mm (medium), a concentration of 30% 9.7 mm (medium), and a concentration of 40% in 11.5 mm (strong). This shows that an increase in the concentration of extracts has an effect on the inhibition of Staphylococcus aureus bacteria.

**Antibacterial Data Analysis of Dragon Tail Leaf Extract**

Analysis of the barrier zone data of dragon tail leaf extract against Staphylococcus aureus ATCC 25923 using One Way ANOVA showed normal (Shapiro-Wilk test) and homogeneous (Levene Test, Sig. 0.081 > 0.05) distributed data. The ANOVA results gave a significance value of $p = 0.000$ ($p < 0.05$), which means that there was a significant difference between treatment groups. Follow-up tests of Tukey HSD showed that the positive control (chloramphenicol) differed significantly from all groups, indicating much higher antibacterial activity. The negative control differed significantly from the entire

concentration of the extract, proving the presence of antibacterial activity in the extract. However, the difference between the concentrations of 10%, 30%, and 40% extracts was not statistically significant ($p > 0.05$), although descriptively, there was a trend of increasing the inhibition zone along with the increase in concentration. Thus, dragon's tail leaf extract has been shown to have antibacterial activity, although its effectiveness is still lower than chloramphenicol.

**Antibacterial Activity Test of Dragontail Leaf Cream Preparation (Rhaphidophora pinnata (L.f) Schott)**

The results of the antibacterial activity test of dragon tail leaf extract cream showed that the negative control did not produce an inhibition zone, while the positive control (gentamicin cream 0.1%) produced an average inhibition zone of 30.9 mm in the very strong category. The cream formula with a concentration of 10% results in an inhibition zone of 4.6 mm (weak), a concentration of 30% of 7.2 mm (medium), and a concentration of 40% of 9.95 mm (medium). This indicates an increase in inhibition as the concentration of extracts in the cream increases.

**Antibacterial Data Analysis of Dragon Tail Leaf Cream Preparation**

Analysis of the inhibition zone of dragontail leaf extract cream (Rhaphidophora pinnata (L.f) Schott) against Staphylococcus aureus ATCC 25923 using One Way ANOVA showed that the distributed data were normal (Shapiro-Wilk test) and homogeneous (Levene Test, Sig. 0.088 > 0.05). The ANOVA results showed significant differences between groups ($p = 0.000$), so a follow-up test was carried out, Post Hoc Tukey HSD. The results of this test showed that the positive control (gentamycin) had a larger inhibition zone than the rest of the group, showing clear antibacterial activity.

Dragon tail leaf extract cream shows increased antibacterial activity as the concentration increases. The 40% cream differed significantly from the 10% cream and the negative control, making it the most effective concentration among the extracts, while the 30% cream differed only significantly from the negative control, and the 10% cream did not show significant effectiveness. In general, the increase in extract concentration creates a trend peningkatan zona hambat, meskipun efektivitasnya masih lebih rendah dibandingkan kontrol positif.

## CONCLUSION

This study successfully formulated topical creams containing *Rhaphidophora pinnata* (L.f) Schott leaf extract at concentrations of 10%, 30%, and 40%, all of which met the physical quality standards for topical preparations, including desirable pH, viscosity, spreadability, and adhesion. The phytochemical analysis confirmed the presence of alkaloids, flavonoids, saponins, and tannins, validating the potential of the extract as an antibacterial agent. The antibacterial activity tests demonstrated a concentration-dependent effect, with the cream containing 40% extract concentration exhibiting the most significant inhibitory effect against *Staphylococcus aureus* ATCC 25923, though its efficacy remained lower than that of the positive control (gentamicin cream). A notable limitation of this study is the lack of long-term stability data, which is crucial for commercial development. Furthermore, while the *in vitro* results are promising, the clinical efficacy and safety on human skin, including potential side effects or allergic reactions, remain to be explored. Therefore, we recommend future research to focus on long-term stability testing, *in vivo* studies to evaluate clinical efficacy and safety, and the isolation and characterization of the specific bioactive compounds responsible for the antibacterial activity, which could lead to the development of a more potent and targeted natural product.

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