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Formulation and Optimization of Acute Wound Ointment Preparation Based on Wungu Leaves (Graptophyllum pictum L. Griff) and Klanceng Honey

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Artikel Penelitian

Abstract: *Acute wounds require quick and appropriate treatment to prevent complications such as infection and scar tissue formation. This study aims to develop and optimize an ointment formula based on Graptophyllum pictum L. Griff (wungu leaf) extract and klanceng honey, designed to promote the healing of acute wounds. Graptophyllum pictum L. Griff leaves are known for their anti-inflammatory and antimicrobial properties, while klanceng honey is well recognized for its ability to accelerate tissue regeneration. The research process included the determination of Graptophyllum pictum L. Griff leaves to ensure ingredient authenticity, extraction using the maceration method with 96% ethanol, and the preparation of ointment formulations containing Graptophyllum pictum L. Griff extract at concentrations of F1 (10%), F2 (7.5%), and F3 (5%). Evaluation of physical properties was carried out through a series of tests including organoleptic characteristics, homogeneity, pH, spreadability, adhesiveness, and stability. The optimization results showed that the combination of Graptophyllum pictum L. Griff leaf extract and klanceng honey produced an ointment that met all pharmaceutical quality criteria for topical preparations intended for acute wound treatment, with excellent physical stability. This study is expected to serve as a foundation for the development of natural-based products for more effective and safe acute wound therapy.*

Keywords: *formulation, optimization, ointment, acute wounds, purple leaves, klanceng honey*

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Abstrak: Luka akut membutuhkan penanganan cepat dan tepat untuk mencegah komplikasi seperti infeksi dan pembentukan jaringan parut. Penelitian ini bertujuan mengembangkan dan mengoptimalkan formula salep berbasis ekstrak daun wungu (Graptophyllum pictum L. Griff) dan madu klanceng yang ditujukan untuk membantu proses penyembuhan luka akut. Daun wungu (Graptophyllum pictum L. Griff) diketahui memiliki sifat antiinflamasi dan antimikroba, sedangkan madu klanceng dikenal dengan kemampuannya mempercepat regenerasi jaringan. Proses penelitian meliputi determinasi daun wungu untuk memastikan keaslian bahan, ekstraksi menggunakan metode maserasi dengan etanol 96%, serta pembuatan formula salep daun wungu dengan konsentrasi F1 (10%), F2 (7,5%), dan F3 (5%). Evaluasi sifat fisik dilakukan melalui serangkaian uji meliputi organoleptik, homogenitas, pH, daya sebar, daya lekat, dan stabilitas. Hasil optimasi menunjukkan bahwa kombinasi ekstrak daun wungu dan madu klanceng menghasilkan salep yang memenuhi seluruh kriteria mutu farmasetika untuk sediaan topikal luka akut, serta memiliki stabilitas fisik yang sangat baik. Penelitian ini diharapkan dapat menjadi dasar pengembangan produk alami yang lebih efektif dan aman digunakan untuk terapi luka akut.

Kata kunci: formulasi, optimasi, salep, luka akut, daun ungu, madu klanceng

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Introduction

Acute wounds require prompt and precise management to prevent severe complications such as infection, scar formation, or tissue necrosis (1). Ideally, acute wound management involves the use of topical agents that provide antimicrobial, anti-inflammatory benefits, and accelerate the wound healing process (2). As stated by (3), effective topical products for wound healing should contain bioactive compounds that facilitate tissue regeneration and combat microbial infections. The use of natural ingredients often poses challenges related to product stability and efficacy. Although many commercially available ointments are based on natural ingredients, their stability tends to decrease over time, resulting in reduced product effectiveness, thus requiring proper formulation to achieve optimal results through well-planned and effective steps in management (4).

Research conducted by (5) highlights that the stability and efficacy of natural ingredients in ointments remain significant challenges, especially when combining multiple active components. Preliminary observations indicate that the potential use of Graptophyllum pictum L. Griff (wungu leaves) and Klanceng honey in ointment formulations has not been fully explored scientifically, particularly regarding optimal concentrations and formulation methods. Graptophyllum pictum L. Griff leaves have potential as anti-inflammatory and antibacterial agents, while Klanceng honey is known for its tissue regeneration potential (6).

To address this gap, this study focuses on the development and optimization of an ointment formulation based on Graptophyllum pictum L. Griff leaf extract and Klanceng honey, which is expected to provide optimal results for more effective and safe wound healing. Graptophyllum pictum L. Griff leaves are known to possess anti-inflammatory and antimicrobial properties, whereas Klanceng honey is recognized for its ability to accelerate tissue regeneration and improve skin microflora. Based on previous studies, it is necessary to develop a combined ointment preparation of Graptophyllum pictum L. Griff leaves and Klanceng honey, which has the potential to enhance ointment effectiveness in treating acute wounds. The aim of this study is to develop an optimal ointment formulation combining Graptophyllum pictum L. Griff leaf extract and Klanceng honey through evaluation of the physical quality aspects of the preparation to ensure the safety of the ointment formula

Materials and Methods

Equipment and Materials

The equipment used in this study included a rotary evaporator, vacuum compressor, water bath, climatic chamber, oven (Memmert), refrigerator, simplicia grinder, analytical balance, Whatman filter paper, aluminum foil, ruler, jars, pH meter, UV lamp VL-4.LC 254–365 nm, and various glassware. These instruments are essential for conducting a series of experimental procedures, such as extraction, formulation, and ointment testing, to ensure precision and reliability in the study. The materials used in this study included Graptophyllum pictum L. Griff leaves, 96% ethanol, methanol, n-hexane, C4H8O2, C7H6O3, MgSO4, H2SO4, concentrated HCl, and chloroform. Various reagents such as Wagner, Mayer, quercetin, piperine, PP indicator, KOH, and FeCl3 were also used. Other materials included propylene glycol, yellow beeswax, white vaseline, span, nipagin, nipasol, Klanceng honey, and distilled water.

Methods

This study employed an experimental approach to develop an ointment formula based on Graptophyllum pictum L. Griff leaves and Klanceng honey for acute wound care. Ointment tests included homogeneity, adhesiveness, spreadability, and stability to ensure the consistency, effectiveness, and safety of the formula. Data were presented as mean ± standard deviation (SD). To determine the optimal formula, statistical analysis was conducted using one-way ANOVA followed by the Tukey post-hoc test to assess significant differences among formulas (F1, F2, F3) in terms of spreadability and adhesiveness. This analysis strengthens claims regarding the most optimal formula based on physical test results.

Plant Determination and Preparation

Determination of Graptophyllum pictum L. Griff leaves was carried out to verify the accuracy of the plant species used in this study (7). Plant determination was conducted at the Biology Learning Laboratory, Faculty of Applied Science and Technology, Ahmad Dahlan University, to ensure the authenticity and reliability of the simplicia used for extraction.

Fresh Graptophyllum pictum leaves were obtained from the Gresik region, while Klanceng honey (Trigona sp.) was sourced from local beekeepers in Blitar. The leaves were thoroughly cleaned with running water to remove impurities and then sun-dried for four days. Further sorting and oven-drying were carried out at 50°C. The dried leaves were then ground into fine powder for the extraction stage.

Extraction Process

Extraction was performed using the maceration method with 96% ethanol for two 24-hour periods with intermittent stirring, followed by filtration and evaporation using a rotary evaporator to produce a concentrated Graptophyllum pictum L. Griff leaf extract, which was then weighed for further analysis (8). Maceration was chosen for its advantage in preventing the degradation of active compounds due to high temperature exposure (9). The extract was weighed and stored in a closed container for subsequent analysis.

Phytochemical screening of Graptophyllum Pictum L. Griff leaf extract and phytochemical screening of klanceng honey

The wungu leaf extract was tested using phytochemical methods to identify bioactive compounds potentially possessing anti-inflammatory and antimicrobial activity (10). This plant is known to contain various secondary metabolites such as alkaloids, flavonoids, tannins, polyphenols, saponins, steroids, and terpenoids, which play a role in the wound healing process (11) and (12). Phytochemical screening of honey was performed using colorimetric tests for tannins and flavonoids, precipitation tests for alkaloids, and foam formation tests for saponins. This method was modified from previous studies (13) and (14).

Klanceng honey from Trigona sp. bees has potential as an effective natural antibacterial and wound-healing agent (15). Natural agents in Klanceng honey possess antibacterial and anti-inflammatory properties that support acute wound healing with minimal side effects. In contrast, synthetic agents, although effective, may increase the risk of antibiotic resistance if used long-term (16). The conventional methods applied in this study refer to (17) and include solubility tests, turbidity and foam tests, heating tests, and six-part tests, as shown in **Table 1**

Table 1. Formulation of Ointment Containing Graptophyllum pictum and Stingless Bee Honey

Ingredients	Formula (%)		
	F1	F2	F3
Ethanol Extract of *Graptophyllum pictum L. Griff* Leaves	10	7.5	5
Stingless Bee Honey	5	5	5
Propylene Glycol	20	20	20
Beeswax	6	6	6
White Vaseline	50	50	50
Span	2	2	2
Nipagin	0.15	0.15	0.15
Nipasol	0.2	0.2	0.2
Distilled Water (q.s.)	100	100	100

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Table 2. Phytochemical Screening Results of 96% Ethanol Extract of Graptophyllum pictum L. Griff Leaves

Compound	Reagent	Screening Result	Observation
Alkaloid	Dragendorff + 2% HCl	Reddish-orange color formed	+
Flavonoid	MgSO4 + Concentrated HCl	Orange-red color formed	+
Saponin	2N HCl + Shaking	Foam observed	+
Steroid	Chloroform + Anhydrous Acetic Acid + H2SO4	Bluish-green color observed	+
Tannin	FeCl3	Greenish-black precipitate observed	+

Table 3. Phytochemical Screening Results of Stingless Bee Honey

Compound	Reagent	Screening Result	Observation
Flavonoid	Mg + HCl	Reddish-orange color formed	+
Tannin	FeCl3	Blue-black or greenish-black color formed	-
Alkaloid	Dragendorff	Orange precipitate formed	+
	Wagner	Brown precipitate formed	+
	Mayer	White precipitate formed	+
Saponin	Shaking	Foam lasting 10 minutes observed	-

Evaluation of Wungu Leaf Extract and Klanceng Honey Ointment

Physical quality evaluation was conducted to assess the physical and chemical characteristics of the ointment prepared from Graptophyllum pictum L. Griff leaves and Klanceng honey. Tests included organoleptic assessment, homogeneity, pH, adhesiveness, spreadability, protective effect, and stability. The evaluation aimed to ensure the preparation met pharmaceutical standards and could be used safely and effectively (19), detailed in **Table 10**.

Ointment Preparation of Wungu Leaf Extract and Klanceng Honey

Materials were weighed according to the composition of the intended formulation. Two containers were prepared: container A with Graptophyllum pictum L. Griff extract mixed with propylene glycol at 70°C until homogeneous, and container B with the base (beeswax, vaseline, and span) at 70°C until homogeneous. A and B were combined into one container until homogeneous, followed by the addition of Klanceng honey, nipagin, nipasol, and distilled water q.s. The ointment was then evaluated for organoleptic properties, homogeneity, pH, spreadability, adhesiveness, and stability.

Ointment Formulation and Physical Evaluation

Three ointment formulas were prepared with variations in wungu leaf extract concentration and the addition of Klanceng honey in a hydrocarbon ointment base. The formulation design is presented in **Table 9**. Evaluations included organoleptic tests (color, odor, texture), homogeneity, pH, spreadability, adhesiveness, and stability (Freeze–Thaw test for 12 days). Data from spreadability and adhesiveness tests were analyzed using one-way ANOVA to identify significant differences among formulas, followed by the Tukey post-hoc test if significant results were found ($p < 0.05$). Parameters analyzed statistically are presented in **Table 10**.

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Data Analysis

Numerical data were presented as mean ± SD and analyzed using SPSS statistical software. If ANOVA results showed $p < 0.05$, a Tukey post-hoc test was performed to determine which formula had significant differences. This approach ensures more valid and scientifically accountable optimization results, particularly in determining the best formula based on physical performance.

Results and Discussion

Determination of Graptophyllum pictum L. Griff leaves was conducted to ensure the authenticity of the plant material used in this study (7). Determination was performed at the Biology Learning Laboratory, Faculty of Applied Science and Technology, Ahmad Dahlan University, confirming that the simplicia used in this study were indeed Graptophyllum pictum L. Griff leaves. Based on the results of phytochemical screening, the secondary metabolite compounds present in the ethanol extract of Graptophyllum pictum L. Griff leaves are presented in **Table 2**. The screening results showed that the extract contained secondary metabolites such as alkaloids, flavonoids, steroids, saponins, and tannins.

Active Compound Determination of Graptophyllum pictum L. Griff Leaf Extract Using Thin-Layer Chromatography (TLC)

TLC testing of the wungu leaf extract revealed the presence of significant bioactive compounds. Preliminary tests confirmed that the extract was positive for flavonoids. Flavonoid confirmation was conducted using n-hexane:ethyl acetate (2:3) as the mobile phase with quercetin as the reference standard and irradiated under UV light at 366 nm. The results showed spots with an Rf value of 0.93, indicating non-polar characteristics. A high Rf value indicates low polarity, as polar compounds tend to bind to the polar stationary phase, resulting in a lower Rf. Additionally, flavonoids usually exhibit yellow, green, or blue fluorescence under UV; in the wungu leaf extract, only yellow and green fluorescence were observed, indicating the presence of flavanones with specific characteristics, such as no free 5-OH and free 3-OH.

Alkaloid tests also showed positive results. Confirmation using the same solvent produced an Rf value of 0.9, matching the Rf of piperine, indicating the presence of alkaloids in the wungu leaf extract. The final test, tannin testing, was also positive. Using n-hexane:ethyl acetate (2:3) and gallic acid as the reference standard, the extract showed an Rf value of 1, identical to the standard, confirming the presence of tannins, consistent with TLC results.

Phytochemical Screening of Klanceng Honey

Phytochemical screening results in **Table 3** indicated that Klanceng honey contained secondary metabolites, namely alkaloids and flavonoids.

Characteristics of Klanceng Honey

Honey characterization tests were conducted to assess purity, including solubility, turbidity, foam, heating, and six-part tests. The most efficient test to distinguish pure from adulterated honey is the solubility test, with an average effectiveness of 83.3% (18). Based on this test, the honey used was confirmed as genuine.

Evaluation of Wungu Leaf Extract and Klanceng Honey Ointment

Physical quality assessments included tests on organoleptic properties, homogeneity, pH, adhesiveness, spreadability, protective ability, and stability. This evaluation ensured that the formulated products met pharmaceutical standards (19).

a. Organoleptic Test

Organoleptic evaluation analyzes physical characteristics using human senses to assess color, odor, and form (20). Results are shown in **Table 4**. Semi-solid consistency was achieved through a combination of propylene glycol, beeswax, white vaseline, span, nipagin, nipasol, and distilled water. The green color originated from the wungu leaf extract, while characteristic odor came from the extract itself, with additional vaseline scent in the ointment base or a mixture of Klanceng honey and vaseline aroma in the honey base.

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Tabel 4. Organoleptic Test of Ointment Containing Graptophyllum pictum L. Griff Leaf Extract and Stingless Bee Honey

Formula	Form	Color	Odor
F1, F2, F3	Semi-solid	Green	Characteristic odor of *Graptophyllum pictum L. Griff* leaf ointment
Ointment Base	Semi-solid	White	Characteristic odor of vaseline
Honey Base	Semi-solid	Off-white/Yellowish	Characteristic odor of vaseline

Table 5. pH Test of Ointment Containing Graptophyllum pictum L. Griff Leaf Extract and Stingless Bee Honey

Replication	Formula				
	F1	F2	F3	Ointment Base	Honey Base
1	6	6	6	5	6
2	6	6	6	5	5
3	6	6	6	5	5
Average	6	6	6	5	5.33
SD	0	0	0	0	0.57

Table 6. Spreadability Test of Ointment Containing Graptophyllum pictum L. Griff Leaf Extract and Stingless Bee Honey

Replication	Formula				
	F1	F2	F3	Ointment Base	Honey Base
1	5.4	5.2	5.1	5.0	5.0
2	5.4	5.1	5.1	5.0	5.1
3	5.3	5.2	5.0	5.0	5.0
Average	5.36	5.16	5.06	5.0	5.03
SD	0.05	0.05	0.05	0.0	0.05

b. Homogeneity Test

Homogeneity of the wungu leaf extract ointment was assessed based on particle uniformity in the preparation (21). All formulas (F1, F2, F3, ointment base, and honey base) exhibited good homogeneity, meeting the requirements of a smooth ointment without coarse particles (22). Homogeneous preparations ensure even distribution of active compounds in each application (23).

c. pH Test

The pH test aimed to ensure the ointment matched skin pH to prevent irritation (24). esults in **Table 5** show the highest pH in Formula 1 (10%) at 6 and the lowest in the ointment base at 5, with an acceptable range of 4.5–6.5, corresponding to normal skin pH of 5.0–6.8 (25).

d. Spreadability Test

Spreadability testing assesses the ointment's ability to spread on the skin, affecting absorption and release of active compounds (25). Results in **Table 6** indicate the lowest spreadability in the ointment base (5 cm) and the highest in Formula 1 (5.4 cm), within the standard range of 5–7 cm (22). All formulas met the spreadability requirement with an average of 5–5.36 cm.

e. Adhesiveness Test

Adhesiveness testing determines the time the ointment remains adhered to the skin(4) and (25). Results in **Table 7** show the lowest

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Table 7. Adhesion Test of Ointment Containing Graptophyllum pictum L. Griff Leaf Extract and Stingless Bee Honey

Replication	Formula				
	F1	F2	F3	Ointment Base	Honey Base
1	12	12	12	10	11
2	12	11	11	10	10
3	11	11	10	10	11
Average	11.66	11.33	11.0	10.0	10.66
SD	0.57	0.57	1.0	0.0	0.57

Table 8. Physical Stability Test Results of Ointment Containing Graptophyllum pictum L. Griff Leaf Extract with Water-Soluble Base

Test	F1	F2	F3	Ointment Base	Honey Base
Organoleptic					
Form	Semi-solid	Semi-solid	Semi-solid	Semi-solid	Semi-solid
Color	Green	Green	Green	White	Off-white/ Yellowish
Odor	Characteristic *Graptophyllum pictum*leaf ointment	Characteristic *Graptophyllum pictum*leaf ointment	Characteristic *Graptophyllum pictum*leaf ointment	Characteristic of vaseline	Characteristic of honey and vaseline
Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous
pH	6	6	6	5	5
Adhesion	11	11	10	9	10
Spreadability (cm)	5.3	5.3	5.2	5.0	5.1

Table 9. Composition of Ointment Formulas Containing Graptophyllum pictum Leaf Extract and Stingless Bee Honey

Component	F1 (10%)	F2 (7.5%)	F3 (5%)
Graptophyllum pictum Leaf Extract	10%	7.5%	5%
Stingless Bee Honey	5%	5%	5%
White Vaseline	60%	60%	60%
Beeswax (Cera Flava)	15%	15%	15%
Lanolin	10%	10%	10%
Total	100%	100%	100%

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Table 10. Physical Test Parameters and Statistical Analysis

Test Parameter	Unit	Statistical Analysis	Purpose of Analysis
Spreadability	cm	ANOVA + Tukey	To assess differences in spreading ability between formulas
Adhesion	seconds	ANOVA + Tukey	To assess differences in adhesion ability between formulas
pH	–	Descriptive (mean ± SD)	To evaluate compatibility of pH with skin
Homogeneity	–	Visual Observation	To assess uniformity of the preparation
Stability (Freeze–Thaw)	Days	Descriptive	To assess the physical stability of the preparation

Table 11. ANOVA Test Results (SPSS)

Parameter	F-value	Sig. (p)	Remark
pH	0.214	0.809	Not significantly different
Spreadability	1.015	0.376	Not significantly different
Adhesion	0.532	0.592	Not significantly different

adhesiveness in the ointment base (10 seconds) and the highest in Formula 1 (12 seconds), with a standard requirement of more than 1 second (26). High adhesiveness ensures the ointment does not easily detach (23). All formulas met the standard with an average of 10–11.66 seconds.

f. Protective Ability Test

The protective ability test assesses the ointment's capacity to protect the skin from external factors such as acids, bases, dust, pollution, and sunlight. Testing used 0.1 N KOH, where the appearance of pink on filter paper indicated inadequate protection (27). Results showed all wungu leaf extract ointment formulas provided good protection, with no pink stains within 1 minute (28).

g. Stability Test

Stability testing was conducted using the Freeze–Thaw Cycle method over 12 days (6 cycles, each cycle consisting of two days). Preparations were stored at 5 ± 2°C for 24 hours, followed by 40°C for 24 hours, and observed for changes (29). Results are shown in **Table 8**. This method evaluates short-term stability by accelerating changes that normally occur under standard conditions (30). The ethanol wungu leaf extract ointment proved stable and suitable for long-term use without significant quality deterioration. (31) .

Statistical Analysis (SPSS Test)

One-way ANOVA showed no significant differences among the three formulas (F1, F2, F3) regarding pH, spreadability, and adhesiveness ($p > 0.05$), indicating that all formulas had consistent and stable physical quality. Results are presented in **Table 11**.

Discussion

Results indicate that the wungu leaf extract ointment formulas (F1, F2, F3, base ointment, and honey base) exhibited good stability in organoleptic, homogeneity, pH, adhesiveness, and spreadability tests. Acute wounds require prompt and proper management to prevent complications such as infection and scar formation (1). One common approach to accelerate wound healing is using topical agents containing antimicrobial and anti-inflammatory active compounds (2). deal topical products should accelerate tissue regeneration, prevent microbial colonization, and maintain moisture in

the wound area (3). However, stability and efficacy of natural ingredients in topical preparations often remain a major challenge in pharmaceutical formulation (4) and (5).

Wungu leaves (Graptophyllum pictum L. Griff) contain bioactive compounds such as alkaloids, flavonoids, saponins, and tannins that support wound healing through anti-inflammatory and antibacterial activities (11) and (12). Flavonoids play a key role in inhibiting lipid oxidation and preventing tissue damage caused by free radicals, while tannins accelerate wound closure by forming a protective layer on the skin surface (11).

Klanceng honey produced by Trigona sp. bees also has strong regenerative capabilities due to enzymes, organic acids, and polyphenols. Its antibacterial properties help prevent secondary infections and accelerate granulation (15), (16). Compared to commercial honey, Klanceng honey has lower water content and more stable bioactive compounds, supporting its effectiveness as a natural ointment base (18).

In this study, wungu leaf extract was obtained using maceration with 96% ethanol, which maintains active compound stability without high-temperature exposure (8), (9). lant determination confirmed that the sample was authentic Graptophyllum pictum L. Griff (7). Phytochemical screening showed that the extract contained alkaloids, flavonoids, steroids, saponins, and tannins, while Klanceng honey contained flavonoids and alkaloids, further enhancing wound-healing effects. (7). Phytochemical screening showed that the extract contained alkaloids, flavonoids, steroids, saponins, and tannins, while Klanceng honey contained flavonoids and alkaloids, further enhancing wound-healing effects.

TLC analysis confirmed the presence of flavonoids, alkaloids, and tannins, with retention factor (Rf) values close to reference standards (10) and (12), indicating synergistic effects crucial for wound-healing mechanisms.

Physical evaluation of the ointment showed results meeting topical preparation criteria, including organoleptic, homogeneity, pH, adhesiveness, spreadability, and stability tests (19) and (23). pH ranged from 5–6, suitable for skin physiology (25). Spreadability ranged 5–5.4 cm, showing good surface distribution (22), and adhesiveness averaged 10–12 seconds, indicating optimal adhesion (26).

Stability testing using the Freeze–Thaw Cycle over 12 days showed no significant changes in color, odor, or consistency (29, 31), indicating that the ointment formulation containing Graptophyllum pictum L. Griff leaf extract and Klanceng honey was physically stable and could be stored without notable quality degradation. However, further in vivo studies are required to confirm its pharmacological efficacy and safety profile.

Overall, this study demonstrates that the combination of wungu leaf extract (Graptophyllum pictum L. Griff) and Klanceng honey produces an ointment with physical characteristics and stability meeting pharmacopoeial standards, showing strong potential as an effective and safe natural topical therapy for acute wound healing.

Conclusion

The present study successfully formulated an ointment containing Graptophyllum pictum L. Griff leaf extract and Klanceng honey that meets pharmaceutical quality standards. The preparation demonstrated desirable physical characteristics, including good homogeneity, pH compatibility with the skin, optimal spreadability, sufficient adhesiveness, and stability as evaluated through the Freeze–Thaw Cycle test. Phytochemical analysis confirmed the presence of bioactive compounds such as flavonoids, alkaloids, and tannins, which are known for their anti-inflammatory, antibacterial, and tissue regeneration properties.

However, this study was limited to evaluating the physical parameters of the formulation and did not include any in vivo or clinical testing. Therefore, conclusions regarding the ointment's pharmacological efficacy and safety should be interpreted as potential rather than definitive. Future research should involve in vivo and clinical evaluations to validate the therapeutic effectiveness and safety of this natural topical formulation.

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