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DEVELOPMENT AND EVALUATION OF PEPEROMIA PELLUCIDA L. PEEL-OFF GEL MASK AS ANTI-ACNE AGENT

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ABSTRACT

This study investigates the development of a peel-off gel mask formulated with *Peperomia pellucida* L. extract as a natural treatment for acne. *Peperomia pellucida* L., traditionally valued for its medicinal properties, was characterized microscopically and macroscopically to confirm the plant's identity and quality. Ethanol extraction yielded 16.54% bioactive compounds, including flavonoids, tannins, saponins, and triterpenoids, known for their antibacterial and anti-inflammatory activities. The research utilized a concentration-dependent approach, formulating three gel variants with 5% (F1), 10% (F2), and 15% (F3) extract concentrations. Antibacterial testing against *Propionibacterium acnes* showed that F3 exhibited the largest inhibition zone (10.72 mm), significantly outperforming the positive control (4.6 mm). Stability testing revealed that the formulations maintained consistent color, odor, and pH but faced challenges in viscosity and homogeneity at extreme temperatures. Hedonic testing indicated that participants favored F2 (10% extract) for its balanced aroma, color, and ease of application, although F1 and F3 were preferred for texture. Despite stability challenges, the formulations, mainly F3, demonstrated promising antibacterial efficacy. In conclusion, the peel-off gel mask containing *Peperomia pellucida* L. extract (F3) shows significant potential as a natural alternative to synthetic acne treatments. Further refinement is needed to enhance stability and user experience while maintaining its high antibacterial activity.

Keywords: Peperomia pellucida, acne, peel-off mask, antibacterial, formulation

INTRODUCTION

Acne vulgaris is a prevalent skin disorder, particularly common during adolescence, and is characterized by excessive sebum secretion from sebaceous glands. This overproduction can lead to blocked pores, triggering inflammation and the appearance of red lesions on the skin. The primary causative agent of acne is *Propionibacterium acnes*, a Gram-positive bacterium that contributes to irritation and acne formation (Gollnick et al., 2016). Due to the growing demand for natural treatment options, medicinal plants, such as *Peperomia pellucida* L., commonly known as suruhan in Indonesia, have gained

attention for their traditional use in treating skin conditions (Fitrianingsih et al., 2019).

Peperomia pellucida is a wild herb that thrives in moist, shaded environments, including rocky and damp areas. In Indonesia, it has a long history of use for various medicinal purposes, particularly for treating skin disorders. The plant contains bioactive compounds with potential antibacterial properties, making it a strong candidate for developing acne treatment formulations (Goodarzi et al., 2020). Herbal-based topical preparations are preferred due to their typically favorable safety profile and reduced side effects compared to synthetic alternatives (Kim et al., 2017). Among these formulations, peel-off gel masks are especially beneficial, as they create a transparent, elastic film on the skin that facilitates the absorption of active ingredients while also removing impurities and dead skin cells upon peeling (Sonyot et al., 2020).

Figure 1. Suruhan, *Peperomia pellucida*

This study uses an ethanol extract from *Peperomia pellucida* leaves to develop a peel-off gel mask for acne treatment. The objective is to determine the optimal concentration and formulation demonstrating effective antibacterial activity against *P. acnes*. This natural-based topical formulation offers a promising alternative to conventional synthetic acne treatments, potentially reducing skin irritation and enhancing comfort through its film-forming properties (Castillo et al., 2018).

METHODS

Materials

Peperomia pellucida L. leaves were sourced from local herbal suppliers in Indonesia. The leaves were extracted using 96% ethanol (Pharmaceutical Grade, PT. DPH) through maceration to isolate the active compounds. Polyvinyl alcohol (Pharmaceutical Grade, PT. DPH), hydroxypropyl methylcellulose (Pharmaceutical Grade, PT. DPH), propylene glycol (Pharmaceutical Grade, PT. DPH), DMDM hydantoin (Pharmaceutical Grade, PT. DPH), citric acid (Pharmaceutical Grade, PT. DPH), and distilled water (aquadest) were used in the formulation.

For antibacterial testing, pure cultures of *Propionibacterium acnes* (ATCC 11828),

0.9% NaCl solution, McFarland 0.5 standard, Mueller-Hinton Agar (MHA), and Nutrient Agar (NA) were utilized.

Research Path

1. Preparation of Plant Materials

The *Peperomia pellucida* L. leaves were collected from Cikajang, Garut, West Java, Indonesia. After collecting, the leaves were subjected to wet sorting, washing, chopping, drying, and drying. Botanical determination was performed to confirm the authenticity of the plant material (Ibrahim & Yahaya, 2020).

2. Simplisia Characterization

The simplisia (dried plant material) was characterized using macroscopic and microscopic analyses, moisture content determination, and total ash content analysis (Widjayanti & Setiawan, 2022).

3. Extraction Process

Maceration was performed using a 1:10 ratio of 500 g of dried *Peperomia pellucida* leaves soaked in 5 L of 96% ethanol for 24 hours. This process was repeated thrice with ocscasional stirring to ensure thorough extraction (Alves et al., 2019).

4. Phytochemical Screening

Following standard procedures, phytochemical screening was performed to identify key bioactive compounds, including alkaloids, flavonoids, tannins, saponins, and triterpenoids (Rahma et al., 2023).

5. Antibacterial Testing

Antibacterial activity against *Propionibacterium acnes* was evaluated using the well diffusion method on Mueller-Hinton Agar (MHA). Clindamycin was the positive control, while DMSO was the negative control. Inhibition zones were measured after 24-hour incubation at 37°C (Zamri et al., 2020).

Table 1. Composition of peel-off gel mask formulations (% w/v)

Ingredient	F0	F1	F2	F3
Peperomia pellucida Extract	-	5	10	15
Polyvinyl Alcohol	10	10	10	10
HPMC	3	3	3	3
Propylene Glycol	15	15	15	15
Citric Acid	0,1	0,1	0,1	0,1
DMDM Hydantoin	0.25	0.25	0.25	0.25
Distilled Water	ad 100 mL	ad 100 mL	ad 100 mL	ad 100 mL

6. Gel Mask Formulation

To prepare the gel mask, polyvinyl alcohol (PVA) was first dissolved in hot water (>80°C) and mixed with hydroxypropyl methylcellulose (HPMC) in distilled water using an overhead stirrer. Propylene glycol, citric acid, DMDM hydantoin, and *Peperomia pellucida* extract were gradually added to complete the formulation (Table 1) (Silva et al., 2021).

7. Gel Evaluation

The peel-off mask was evaluated for its physical properties, including organoleptic characteristics (appearance, color, odor), pH, homogeneity, viscosity, rheology, drying time, and spreadability. All evaluations were conducted in triplicate to ensure accuracy and reproducibility (Arifin et al., 2022).

8. Stability Testing

Stability testing assessed the gel under various temperature conditions (4°C, 25°C, and 40°C) over six cycles. Parameters such as physical changes, pH, drying time, homogeneity, and spreadability were monitored throughout the test period (Rahmawatiani et al., 2020).

9. Hedonic Testing

A sensory evaluation was conducted with 30 participants who assessed the gel mask based on texture, color, smell, and ease of application. The results were statistically analyzed using SPSS software with the Friedman test to determine user preference and satisfaction.

This research involving human participants was conducted in accordance with ethical standards and approved by the Ethics Committee of BTH University, with ethical clearance No. 057/E.01/KEPK-BTH/IV/2023.

10. Antibacterial Testing of Gel Formulations

The antibacterial activity of the gel formulations (F1, F2, and F3) was evaluated using the well-diffusion method. The Ranee Acne Peel-off Mask was used as a positive control. Inhibition zones were measured after incubation at 37°C for 24 hours to assess the antibacterial efficacy of each formulation (Ahmad et al., 2022).

11. Data Analysis

Data from the organoleptic and homogeneity tests were analyzed descriptively. Statistical analysis of pH, viscosity, spreadability, and stability data was performed using Microsoft Excel. Antibacterial activity and hedonic testing results were analyzed using SPSS software. A One-Way ANOVA test was employed for antibacterial activity analysis, and the Friedman test was applied for hedonic testing. Post-hoc Duncan and LSD tests

were conducted when significant differences were observed.

RESULTS AND DISCUSSION

The plant species used in this study was confirmed as *Peperomia pellucida* L., also known as suruhan or sirih cina, by the Laboratory of Taxonomy and Botany, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (Specimen ID: No. 13/HB/12/2022).

1. Microscopic and Macroscopic Characterization

1.1 Microscopic Examination

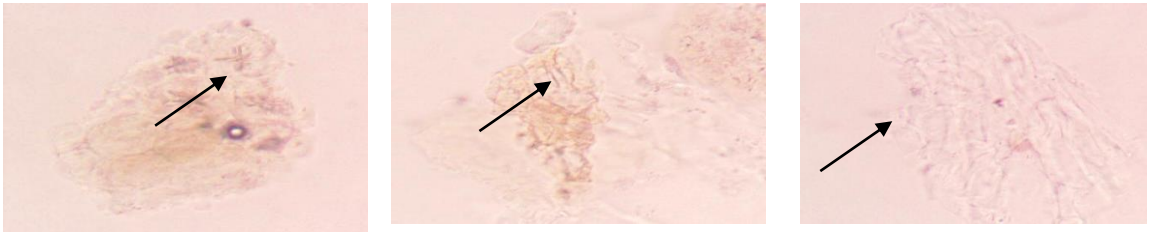
Microscopic analysis of *Peperomia pellucida* L. leaves was performed to confirm the identity and ensure the quality of the raw material. Several distinctive anatomical features were observed using a binocular microscope at 40x magnification, including calcium oxalate crystals in rosette formations, stomata, and cystoliths. These key microscopic characteristics are essential for authenticating the plant material, ensuring its suitability for medicinal purposes. Such anatomical traits confirm compliance with pharmacognostic standards, which is essential for its inclusion in herbal formulations.

1.2 Macroscopic Examination

The macroscopic evaluation provided insights into the physical properties of the fresh leaves, the dried powder (simplisia), and the ethanol extract of *Peperomia pellucida*. The fresh leaves were oval-shaped with green colouration, while the simplisia presented a greenish-brown hue and a characteristic bitter taste and herbal odour. The ethanol extract used in the gel mask formulation appeared as a thick, dark green-brown substance with a pronounced herbal scent. Consistency in the organoleptic properties of these materials across batches ensures reliability in the formulation process.

1.3 Water and Ash Content

The water content of the simplisia was measured at 2.67%, and the ethanol extract had a moisture content of 6%, both of which fall within acceptable limits for ensuring the stability of the material. The ash content was 18.79% for the simplisia and 9.72% for the extract, indicating a low level of contamination. These values confirm the purity and suitability of the plant material for formulating the peel-off gel mask.



Epidermis with calcium oxalate crystals in the form of rosettes | Upper epidermis with stomata and cystoliths | Lower epidermis

Figure 2. Microscopic analysis of *Peperomia pellucida* L. leaves

Table 2. Simplisia and *Peperomia pellucida* Leaf Extract Parameter Examination

Parameter	Mean ± SD	Standard
Moisture Content of Simplisia	2.67 ± 1.15	<10%
Moisture Content of Extract	6 ± 0	<15.2%
Total Ash Content of Simplisia	18.79 ± 0.13	<37.8%
Total Ash Content of Extract	9.72 ± 0.01	<20.8%

Table 3. Macroscopic analysis of *Peperomia pellucida* L. leaves

Examination	Fresh Leaves	Simplisia Powder	Extract
Shape	Oval	Powder	Thick Extract
Odor	Characteristic	Characteristic	Characteristic
Color	Green	Greenish-Brown	Dark Brown-Green
Taste	Bitter	Bitter	Bitter

Table 4. Extract yield of *Peperomia pellucida* leaves

Simplisia Weight (g)	Extract Weight (g)	Yield (%)	Standard (%)
500	82.72	16.54	>13.1

Table 5. Phytochemical screening of *Peperomia pellucida* leaves

Test	Reagent	Result
Alkaloid	Mayer & Dragendorff	-
Flavonoid	Magnesium Powder + Concentrated HCl	+
Triterpenoid	Liebermann-Burchard	+
Tannin	1% $FeCl_3$	+
Saponin	Shake + 2N HCl	+

Table 6. Evaluation of peel-off gel mask formulation

Formula	Organoleptic	pH	Spreadability (cm)	Drying Time (min)	Viscosity (cPs)	Homogeneity
F0	Clear, Odorless, Semi-Solid	5.07 ± 0.15	5.33 ± 0.15	22.65 ± 0.55	4606 ± 11.54	Homogeneous
F1	Brown, Characteristic Odor, Semi-Solid	4.99 ± 0.10	5.50 ± 0.10	23.91 ± 0.37	4253 ± 57.73	Homogeneous
F2	Brown, Characteristic Odor, Semi-Solid	4.97 ± 0.15	6.03 ± 0.15	24.33 ± 0.20	2900 ± 87.91	Homogeneous
F3	Brown, Characteristic Odor, Semi-Solid	4.86 ± 0.15	6.63 ± 0.15	25.32 ± 0.20	1113 ± 61.10	Homogeneous

2. Extract Yield and Phytochemical Screening

Peperomia pellucida L. leaves were extracted using the maceration method with 96% ethanol, yielding 82.7 grams of a thick, green-brown extract from 500 grams of dried *Peperomia pellucida* simplisia. This equated to a yield of 16.54% (Table 5), which exceeds the acceptable standard of 13.1%, indicating high extraction efficiency (Ibe-Diala & Igwe, 2022). Ethanol, a polar solvent, effectively extracts both polar and non-polar bioactive compounds, including flavonoids, tannins, and phenolics, ensuring the retention of therapeutic potency. The high yield suggests minimal loss during the extraction process, preserving the plant's bioactive properties for use in the gel mask formulation.

Phytochemical screening (Table 6) confirmed the presence of key secondary metabolites such as flavonoids, tannins, saponins, and triterpenoids (Rahma et al., 2023). Flavonoids were detected using the magnesium and hydrochloric acid test, and these compounds are well-known for their antioxidant and anti-inflammatory effects. Their ability to reduce skin inflammation and oxidative stress makes them valuable in acne treatment. Saponins, identified via foam tests, enhance skin permeability and possess antibacterial properties, which are particularly effective against Propionibacterium acnes. With their astringent properties, Tannins help reduce

sebum production and tighten skin pores, thereby supporting acne management (Ibrahim & Yahaya, 2020).

The absence of alkaloids suggests that the antibacterial efficacy of the extract is primarily derived from flavonoids and saponins. This diverse phytochemical profile underscores the potential of *Peperomia pellucida* as a natural ingredient in anti-acne formulations, confirming its suitability for topical treatments.

3. Gel Mask Formulation and Evaluation

3.1 Gel Mask Formulation

The peel-off gel mask was formulated using *Peperomia pellucida* L. extract. Polyvinyl alcohol (PVA) served as the film-forming agent, and hydroxypropyl methylcellulose (HPMC) functioned as a thickener to ensure an optimal gel consistency. Propylene glycol was included as a humectant to help retain skin moisture, while DMDM hydantoin acted as a preservative to enhance product stability. Citric acid was used to adjust the pH to a level suitable for facial skin, minimizing the risk of irritation.

The formulation process involved dissolving PVA in water at a temperature exceeding 80°C, followed by the gradual addition of HPMC to achieve a uniform consistency using an overhead stirrer. The *Peperomia pellucida* extract was then incorporated gradually to ensure an even distribution of the active compounds. The final gel exhibited a smooth, semi-solid texture with a consistent green-brown color, resulting from the natural pigments in the plant extract.

3.2 Organoleptic Properties

The organoleptic evaluation of the gel formulations (F0-F3) revealed semi-solid textures, with differences in color and odor corresponding to the concentration of the extract. The control formulation (F0) was clear and odorless, while formulations F1-F3, which contained increasing amounts of the extract, had a brown hue and an herbal scent. All gels demonstrated a smooth consistency, with no visible phase separation, indicating stable formulations.

3.3 pH, Viscosity, and Spreadability

The pH ranged from 4.86 to 5.07, aligning with the ideal range for skin care products. Viscosity testing revealed F0 had the highest viscosity (4606 cPs), while F3, containing the most extract, had the lowest (1113 cPs). This drop in viscosity for F3 could be attributed to the interaction between the extract and PVA. Spreadability was within the acceptable range (5-7 cm), with F3 showing the best spreadability (6.63 cm), ensuring easy application.

3.4 Film Formation and Drying Time

All formulations were able to form films and dried within 15 to 30 minutes. The control formulation (F0) dried the fastest, at 22.65 minutes, while F3 took slightly longer, at 25.47 minutes. The increased drying time for F3 can likely be attributed to its higher water content and lower viscosity. Despite the variations, all formulations successfully formed a smooth, elastic film that could be easily peeled off, confirming the effective film-forming capabilities of PVA and HPMC, even in plant extracts.

3.5 Homogeneity

All formulations exhibited excellent homogeneity, with no visible particles or signs of phase separation. This indicates that the active ingredients, including the *Peperomia pellucida* extract, were well-dispersed throughout the gel matrix, ensuring consistency in application and product effectiveness.

4. Stability Testing

4.1 Organoleptic Stability

The organoleptic properties of the *Peperomia pellucida* L. peel-off gel masks, including color, odor, and consistency, were evaluated under cycling conditions (4°C, 25°C, and 40°C) over 9 days. No significant color, odor, or texture changes were observed in the formulations. The extract-based formulations (F1–F3) retained their characteristic brown color and herbal scent, while the control formulation (F0) remained clear and odorless. These results suggest that the formulations are organoleptically stable, a crucial factor for consumer acceptance. A consistent appearance and scent are essential to ensure product appeal and user satisfaction.

4.2 pH Stability

The initial pH of the formulations ranged from 4.86 to 5.07, which falls within the ideal pH range for skincare products (4.5–6.5), ensuring suitability for sensitive skin. After the cycling tests, a slight increase in pH was observed, particularly in F3, which rose to 6.3. Despite this increase, all formulations remained within the acceptable range for sensitive skin, with a pH below 6.5. The rise in pH can be attributed to the sensitivity of PVA to temperature fluctuations, leading to mild hydrolysis at elevated temperatures (40°C), which increases the alkalinity. Proper storage conditions—such as avoiding extreme temperatures—are recommended to maintain optimal pH stability.

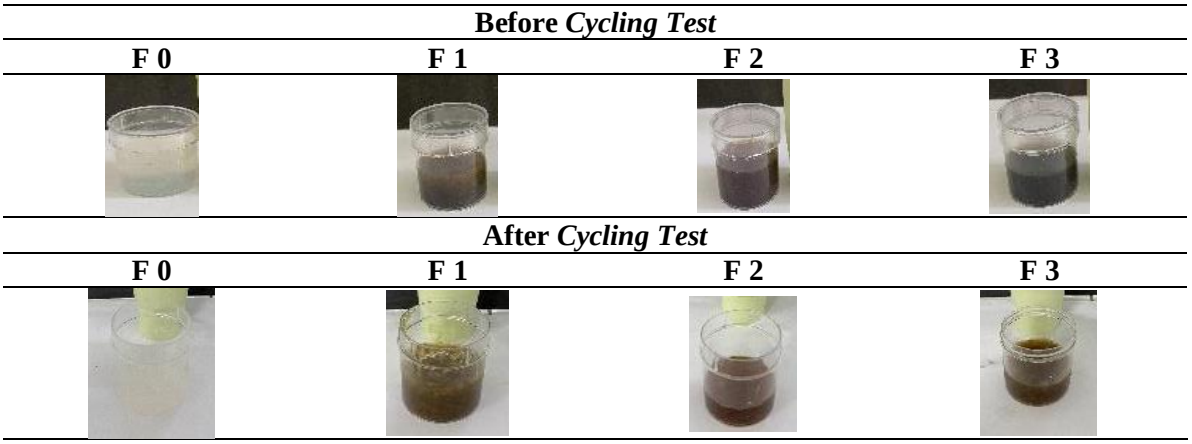


Figure 3. Stability test before and after cycling test

Table 7. Antimicrobial activity of formulations measured by inhibition zone diameter (mm)

Formula	Inhibition Zone Diameter (mm)								
	I	II	III	IV	V	VI	VII	VIII	Mean±SD
F 0	0	0	0	0	0	0	0	0	0 ± 0
F 1	4.28	5.08	3.23	2.53	2,38	3.03	3.78	3.23	3.44± 0.90
F 2	5.28	6.23	4.73	5.63	5.13	6.08	5.88	5.43	5.54± 0.50
F 3	13,03	10.13	11.28	10.08	9.78	11.88	9.83	9.93	10.72± 1.19
Control +	6.6	4.15	5.7	5.5	3.4	2.05	7.2	4.15	4.6 ± 1.74

4.3 Homogeneity and Separation

All formulations initially demonstrated good homogeneity; however, F3, which contained the highest *Peperomia pellucida* extract, exhibited signs of phase separation and visible particles by the end of the stability test. This suggests that the gel matrix, primarily formed by PVA, may become unstable at higher extract concentrations under extreme temperature conditions. The results indicate that higher extract loads can interfere with the integrity of the polymer network, potentially requiring additional stabilizing agents to prevent phase separation during prolonged or high-stress conditions.

4.4 Spreadability and Viscosity Changes

Before stability testing, all formulations demonstrated acceptable spreadability, with values ranging between 5 and 7 cm. After the cycling test, F3 experienced a significant reduction in spreadability, likely due to increased viscosity caused by water evaporation during the high-temperature phase. This thickening effect made the gel more difficult to apply. F0 (control) maintained stable viscosity throughout the testing period, while F1 and F2 showed moderate increases. Notably, F3, which initially had a viscosity of 1113 cPs, experienced a

dramatic rise after cycling, further compromising its spreadability. These findings suggest that higher extract concentrations can lead to viscosity instability, particularly when exposed to fluctuating temperatures, making the formulation less suitable for practical use.

4.5 Rheology and Film Formation

Rheological testing showed that all formulations initially exhibited dilatant (shear-thickening) flow behavior, which is desirable for peel-off masks. This behavior allows the gel to spread easily upon application, forming a solid film once dried. However, the rheological properties of F3 deteriorated after cycling, resulting in poor film formation and a brittle texture. This suggests that high concentrations of *Peperomia pellucida* extract can disrupt the PVA network, reducing the mask's elasticity and performance. Formulations F1 and F2, with lower extract concentrations, maintained their desirable film-forming properties and elasticity. These findings highlight the importance of balancing extract content with the gel matrix to ensure formulation stability and performance as an effective peel-off mask.

5. Antibacterial Activity

5.1 Antibacterial Activity of the Extract

The well diffusion method evaluated the antibacterial activity of *Peperomia pellucida* L. ethanol extract against Propionibacterium acnes. Concentration-dependent inhibition of bacterial growth was observed, with inhibition zones increasing from 6.44 mm at 5% extract concentration to 9.63 mm at 15%. These results demonstrate the potent antibacterial properties of *Peperomia pellucida*, particularly against *P. acnes*, a key pathogen in acne development (Rahmawatiani et al., 2020). The antibacterial efficacy is likely due to bioactive compounds such as flavonoids, tannins, saponins, and triterpenoids, all known for their antimicrobial effects (Ibe-Diala & Igwe, 2022).

Flavonoids act by disrupting bacterial cell membranes, leading to the leakage of intracellular contents and subsequent cell death. Tannins bind to bacterial proteins, inhibiting their enzymatic activity and suppressing bacterial growth. Together, these mechanisms contribute to the extract has strong antibacterial effects, making *Peperomia pellucida* a promising natural alternative for acne treatment (Asiyah, 2019).

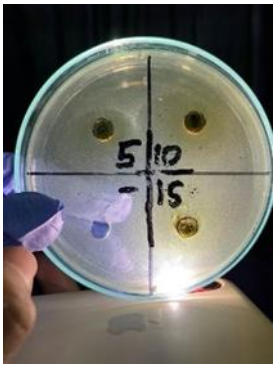


Figure 4. Antibacterial activity of *Peperomia pellucida* extract at varying concentrations (5%, 10%, 15%) against *Propionibacterium acne.*

5.2 Antibacterial Activity of the Gel Formulations

The peel-off gel formulations (F1–F3), containing increasing concentrations of *Peperomia pellucida* extract, were tested for antibacterial activity against *P. acnes*. The highest concentration (15% extract) in F3 produced the largest inhibition zone (10.72 mm), significantly outperforming the positive control (4.6 mm) and even some commercial acne masks.

Figure 5. Antibacterial activity of peel-off gel formulations against *Propionibacterium acnes*

The superior antibacterial activity of the gel formulations compared to the positive control can be attributed to the synergistic effect of the bioactive compounds in the *Peperomia pellucida* extract. Unlike the positive control, which likely contains a single active agent, the extract comprises multiple bioactive components, including flavonoids, alkaloids, and terpenoids, known for their antibacterial properties. These compounds may act on multiple bacterial targets, thereby enhancing efficacy.

Additionally, the gel's film-forming properties likely contributed to its superior performance. The prolonged contact between the gel and the skin facilitates the sustained release of bioactive compounds, ensuring higher local concentrations of the active substances than the positive control, which may diffuse away more quickly.

The variation in inhibition zones among F1 (3.44 mm), F2 (5.54 mm), and F3 (10.72 mm) highlights the direct correlation between extract concentration and antibacterial efficacy (Fitrya et al., 2023). These findings demonstrate that incorporating higher concentrations of the extract into the gel matrix not only retains but enhances the antibacterial activity of the active compounds (Rahma et al., 2023).

5.3 Mechanism of Action

The antibacterial properties of *Peperomia pellucida* can be attributed to multiple mechanisms. Flavonoids bind to bacterial proteins, disrupting their function and inhibiting replication, while tannins deactivate bacterial enzymes, disrupting their metabolism. Saponins increase bacterial membrane permeability, accelerating cell death (Arifin et al., 2022). These mechanisms are particularly effective against Gram-positive bacteria like *P. acnes*, making *Peperomia pellucida* a promising candidate for anti-acne formulations.

5.4 Statistical Analysis

The antibacterial activity data were analyzed using one-way ANOVA, which revealed statistically significant differences ($p < 0.05$) between the formulations. Post-hoc LSD analysis confirmed that F3, containing 15% extract, had significantly higher antibacterial activity compared to F1, F2, and commercial control. This supports the conclusion that higher concentrations of *Peperomia pellucida* extract enhance antibacterial efficacy, validating its potential as a natural anti-acne treatment (Widjayanti & Setiawan, 2022).

The antibacterial tests confirmed that *Peperomia pellucida* extract exhibits strong antibacterial properties, particularly at higher concentrations. Incorporating the extract into peel-off gel formulations preserved its antibacterial efficacy, with F3 (15% extract) showing the greatest inhibition of *P. acnes*. These findings suggest that *Peperomia pellucida* has significant potential as a natural alternative to synthetic acne treatments. Further formulation optimization could develop highly effective, user-friendly anti-acne products based on this medicinal plant (Amarathunga & Kankanamge, 2017).

6. Hedonic Test

The hedonic test evaluated consumer preferences for the peel-off gel masks containing Peperomia pellucida L. extract. Thirty participants assessed four formulations (F0–F3) based on aroma, color, texture, and ease of application. Statistical analysis using the Friedman test revealed significant differences in preferences for aroma ($p = 0.038$) and texture ($p = 0.072$).

Regarding aroma, participants favored F2, which had a moderate herbal scent, over F3, which was perceived to have a stronger, less appealing scent. F2 has light brown color, associated with natural ingredients, was also preferred, while F3's darker shade was less popular (Susanti & Ayun, 2022). Regarding texture, F1 and F3 received the highest ratings, with participants noting their smooth, even consistency. Although F0

was the easiest to apply due to its thinner consistency, it lacked the beneficial properties of extract-containing formulations (Puji et al., 2022).

Overall, F2 emerged as the most balanced formulation, offering a pleasant aroma and color, good ease of application, and a smooth texture, making it the most consumer-friendly. The results indicate that consumer preferences for the peel-off gel masks were influenced by the concentration of *Peperomia pellucida* extract, with F2 being the most preferred formulation due to its balanced sensory attributes and ease of application (Indah et al., 2021). While F1 and F3 were appreciated for their texture, F3's higher extract concentration made its aroma and ease of application less appealing.

These findings suggest that a moderate concentration of *Peperomia pellucida* extract, as found in F2, offers the best balance between efficacy and consumer-friendly sensory attributes. Further refinement of the formulation, particularly in enhancing the ease of application and texture, could improve marketability without compromising the therapeutic benefits of the extract (Chandra et al., 2021).

CONCLUSIONS

The development of *Peperomia pellucida* L. peel-off gel masks show strong potential as a natural treatment for acne. Microscopic and macroscopic evaluations confirmed the quality of the plant material, and the extract yielded bioactive compounds such as flavonoids and tannins, which demonstrated significant antibacterial and anti-inflammatory properties, particularly against *Propionibacterium acnes*. While the 15% extract formulation (F3) exhibited the highest antibacterial activity, challenges with viscosity and spreadability suggest that further refinement is needed. Stability testing indicated good pH and organoleptic stability, though improvements in inhomogeneity under extreme temperature conditions are necessary.

F2 emerged as the most consumer-friendly formulation, offering a favorable balance of sensory attributes and efficacy. Future formulation adjustments could enhance ease of application and texture while maintaining the extract's therapeutic properties, increasing the product’s overall market appeal

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