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Formulation and Antibacterial Activity of Binahong Leaf Face Mist Against *P. acnes*

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Abstract: *Acne is one of the common skin problems and is often caused by the bacteria P. acnes . Acne treatment with antibiotics can cause side effects, including bacterial resistance. Therefore, this study aims to formulate and evaluate the antibacterial activity of a face mist preparation containing binahong leaf extract (Anredera cordifolia), which is known to have natural antibacterial properties. The research method includes extraction of binahong leaves using the maceration method with 70% ethanol, face mist formulation with various extract concentrations (1%, 2%, and 3%), and evaluation of its physical properties and antibacterial activity using the disc diffusion method. The results of the physical property test showed that all formulations had a pH within a safe range for the skin (4.5-6.5), good homogeneity, and optimal spray spread. The antibacterial activity test showed that face mist with an extract concentration of 2% had the highest inhibitory power against P. acnes with an average inhibition zone of 19.83 mm, classified as strong. Therefore, binahong leaf extract has the potential as an active ingredient in face mist preparations to treat acne.*

Keywords: Acne, Antibacterial, Binahong Leaves, Face mist, P. acnes

INTRODUCTION

Acne, also known as acne vulgaris, is a widespread skin condition that affects both men and women. In 2005, acne vulgaris accounted for 48.06% of all patient visits to the cosmetic medical department of Dr. Soetomo General Hospital in Surabaya. This percentage kept rising in the following years. The Indonesian Dermatology Group (2018) documented a rise in the occurrence of acne vulgaris, reaching 80% in 2007 and exhibiting additional growth in 2009 (Asrianti et al., 2024; Ayudianti & Indramaya, 2014; Listiawan et al., 2022).

Acne can be treated through oral or topical methods with antibiotics like clindamycin, tetracycline, and erythromycin. Nonetheless, these treatments can lead to negative effects, such as skin irritation and the emergence of bacterial resistance if used incorrectly. At present, natural and effective treatment methods are being favored more and more. One significant advancement that has been extensively created is the development of face mist that includes plant extracts as key ingredients (Almeria, 2022; Ramsis et al., 2024; Widyasanti et al., 2024a).

Skincare products are advancing quickly as more people become aware of how crucial it is to keep skin healthy. One item that is presently very sought after is face mist, which serves to offer immediate moisture and rejuvenate the skin on the face. Besides its advantages for the skin, face mist is popular for its simplicity and convenience of use. In the cosmetics field, the shift towards incorporating natural ingredients is gaining more popularity because they generally pose fewer risks than synthetic chemicals, along with providing extra advantages like antioxidant properties, anti-inflammatory effects, and abilities to promote healing of wounds (Choi et al., 2024; Gălbău et al., 2024; Liu, 2022; Yao & Xu, 2022).

Face mist is categorized as a cosmetic product designed to refresh the skin. The main purpose of a skin freshener is to revitalize the facial skin, lower excess oil, and assist in tightening skin pores. With the progress in science and technology, the production of face mist products is growing, integrating natural extracts that include phytochemical compounds which offer extra advantages for the skin (Angelica et al., 2022; Lisyanti et al., 2022a; Rahman & Mehnaz, 2024; Sakka & Hasma, 2023).

Binahong leaves *(Anredera cordifolia L.)* are known to have various benefits in the fields of health and beauty. Leaf extract contains active compounds such as flavonoids, saponins, and ascorbic acid, which exhibit antioxidant, antibacterial, and anti-inflammatory properties. Due to its antibacterial activity, binahong leaf extract has strong potential to be incorporated into cosmetic formulations such as face mist. This antibacterial property may help prevent and minimize acne development. Therefore, the resulting face mist is expected to function not only as a facial skin freshener but also as a product that helps prevent and reduce acne formation (Anjani & Hanifah, 2022; Ni Luh Diah Tantri & Ni Kadek Warditiani, 2023; Tusilva et al., 2025).

Therefore, this research intends to create a face mist formula that includes binahong leaf extract, assess its physical characteristics, and investigate its antibacterial properties.

METHODS

This research was a laboratory experiment designed to create a face mist formulation that includes binahong (*Anredera cordifolia* L.) leaf extract, as well as to assess its physical characteristics and antibacterial effectiveness. The research was carried out in a controlled lab environment to gather precise and dependable information. A research method was utilized to assess the impact of incorporating binahong leaf extract on the quality and antibacterial properties of the formulation. The study examined face mist as a cosmetic product designed to refresh the skin. The research was conducted in multiple phases, encompassing extraction, formulation, physical assessment, and antibacterial evaluation (Felma Mosse et al., 2021; Tri Puji Lestari et al., 2022; Wahyuningsih et al., 2023).

The materials utilized in this research comprised binahong (Anredera cordifolia) leaf simplicia, 70% ethanol as the solvent for extraction, distilled water, and supplementary excipients necessary for the formulation of face mist. *P. acnes* served as the test organism in the antibacterial activity evaluation. All materials used in this research were of laboratory-grade quality. The purpose of using high-quality materials was to guarantee the accuracy and reliability of the research findings. Each material was created in accordance with the specifications of the different phases of the research (Ojoboh & Igben, 2024; Ren et al., 2024).

The tools utilized in this research included laboratory glassware, an analytical scale, a maceration vessel, a rotary evaporator, a pH meter, an autoclave, an incubator, a spray bottle, and microbiological apparatus for testing antibacterial properties. All instruments were verified to be clean and appropriate for use before the experimentation began. Calibration of instruments was conducted to ensure the precision of measurements throughout the study. The utilization of suitable tools was crucial to assist every phase of the research procedure. All procedures were carried out following the established protocols for laboratory operations.

The process of obtaining binahong leaves was carried out utilizing the maceration technique, employing 70% ethanol as the solvent. The dried binahong leaf was soaked in the solvent while being stirred occasionally to help extract the active compounds. Once the maceration process was finished, the mixture was filtered to distinguish the solid residue from the liquid filtrate. The filtrate obtained was subsequently concentrated utilizing a rotary evaporator until a thick extract was formed. This concentrated extract was then utilized as the main component in the face mist formulation. The process of extraction was conducted meticulously to preserve the stability of the active ingredients (Noviani et al., 2025; Sakka & Hasma, 2023).

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The face mist formulations were prepared by incorporating binahong leaf extract into the base at concentrations of 1%, 2%, and 3%. The extract was slowly incorporated while stirring steadily until a uniform mixture was achieved. The process of creating the formulation took place in a controlled lab environment to avoid contamination. The completed preparation was subsequently placed into spray bottles for additional assessment. The composition was created to yield a reliable and easy-to-use cosmetic item. Every formulation was examined to guarantee uniformity and consistency.

The physical assessment of the face mist consisted of sensory testing, pH testing, spray distribution evaluation, drying time assessment, and uniformity test. The organoleptic assessment was performed by examining the color, smell, and transparency of the preparation. The pH level was assessed using a pH meter to guarantee it is suitable for skin pH. Tests on spray dispersion and drying time were carried out to evaluate the effectiveness and comfort of the product during its application. A test for uniformity was conducted to confirm that there are no large particles or sediment present in the formulation (Lisyanti et al., 2022a; Noviani et al., 2025; Ojoboh & Igben, 2024; Ren et al., 2024).

The antibacterial effectiveness was evaluated against *P. acnes* utilizing the disc diffusion technique. The bacterial suspension was created and set to the McFarland 0. 5 standard, after which it was applied to Mueller Hinton Agar (MHA). Discs that held the face mist formulation were positioned on the surface of the inoculated media. The media were .incubated at 37°C for 24 hours. The size of the area surrounding the discs, where bacteria growth was prevented, was measured as a sign of antibacterial effectiveness. Measurements were taken meticulously to ensure precise results (Indriastuti et al., 2025; Mustaanah et al., 2025; Noviani et al., 2025).

RESULTS AND DISCUSSION

Result

Organoleptic Test Results

The sensory assessment revealed that the face mist formulations with binahong leaf extract demonstrated differences in color, scent, and clarity, which were affected by the concentration of the extract used. The formulations' color grew more vibrant as the concentration of binahong leaf extract increased. The distinct scent of binahong leaves was more evident in preparations with greater concentrations of the extract. All formulations showed excellent clarity, without any coarse particles or sediment. The findings are shown in Table 1.

Table 1. Organoleptic Test Results

Formula	Replication	Appearance	Odor
F0	1	Clear and transparent	Odorless
	2	Clear and transparent	Odorless
	3	Clear and transparent	Odorless
F1	1	Clear and transparent	with a slight characteristic extract odor
	2	Clear and transparent	with a slight characteristic extract odor
	3	Clear and transparent	with a slight characteristic extract odor
F2	1	Clear and transparent	with a characteristic extract odor
	2	Clear and transparent	with a characteristic extract odor
	3	Clear and transparent	with a characteristic extract odor
F3	1	Clear and transparent	with a characteristic extract odor
	2	Clear and transparent	with a characteristic extract odor
	3	Clear and transparent	with a characteristic extract odor

F0 : extract 0%
F1 : extract 1%
F2 : extract 2%

F3 : extract 3%

pH Test Results

The reduction in pH values as concentrations of binahong leaf extract rise is thought to be due to the presence of acidic substances, including ascorbic acid, found in the extract. The pH levels, which are within the normal range for skin (4.5-6.5), suggest that the formulation is safe to use and is not likely to cause any irritation. Proper pH levels play a crucial role in keeping the skin microflora balanced. The results of the pH test are shown in Table 2.

Table 2. pH Test Results

Formula	Replication	Uji pH	Standard
F0	1	6,82	4,5-8,0 (SNI 16-4399-1996)
	2	6,87	
	3	6,79	
F1	1	5,22	
	2	5,16	
	3	5,10	
F2	1	4,98	
	2	5,02	
	3	5,04	
F3	1	4,96	
	2	4,97	
	3	5,03	

Spray distribution evaluationTest Results

The results of the spray pattern tests indicated that every face mist formulation demonstrated even and steady spray patterns. No blockage of the nozzle was noted throughout the testing process. Changes in the amount of binahong leaf extract did not have a notable impact on how well the formulations performed when sprayed. The findings are displayed in Table 3.

Table 3. Spray Pattern Test Results

Formula	Replication	Result	Standard
F0	1	6 cm	5-7 cm
	2	7 cm	
	3	6 cm	
F1	1	5 cm	
	2	6 cm	
	3	6 cm	
F2	1	6 cm	
	2	5 cm	
	3	6 cm	
F3	1	6 cm	
	2	5 cm	
	3	5 cm	

Drying Time Test Results

The brief drying time suggests that the face mist formulations are lightweight and convenient for use. The lack of notable differences in drying time across the formulations indicates that incorporating

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binahong leaf extract did not significantly influence the evaporation characteristics of the formulations. The findings are displayed in Table 4.

Table 4. Drying Time Test Results

Formula	Replication	Driying Time (Minute)
F0	1	2,03
	2	2,06
	3	1,55
F1	1	2,35
	2	2,20
	3	2,25
F2	1	2,45
	2	2,29
	3	2,43
F3	1	2,47
	2	2,37
	3	2,10

Homogeneity Test Results

Good uniformity suggests that the binahong leaf extract was consistently distributed throughout the face mist base. It is crucial to guarantee an even spread of the active components with every application. These findings also suggest that the method used for formulation was suitable. The findings are displayed in Table 5.

Table 5. Drying Time Test Results

Formula	Homogeneity test	Standard
F0	Homogenous	SNI 16-4951-1998 (No clumps and particles)
F1	Homogenous	
F2	Homogenous	
F3	Homogenous	

Antibacterial Activity Test Results

The results of the antibacterial activity tests indicated that the face mist formulations with binahong leaf extract effectively prevented the growth of *P. acnes* . The size of the inhibition zones appeared to grow larger as the concentrations of binahong leaf extract increased. The findings are displayed in Table 6.

Table 6. Antibacterial Activity Test Results

Formula	Replication	Inhibition zone (mm)	Average inhibition zone	Category
Control (-)	1	0	0	None
	2	0		
	3	0		
F1	1	10,82	11,59	Weak
	2	7,49		
	3	16,45		
F2	1	13,10	19,83	Strong
	2	6,92		
	3	39,46		
F3	1	13,48	9,25	Weak
	2	5,66		
	3	8,62		

Discussion

Organoleptic Test

The organoleptic evaluation, which included observations of color, odor, and clarity, indicated that all face mist formulations remained stable and consistent throughout the study. As shown in Table 1, all preparations exhibited a clear appearance without any visible particles or precipitation, satisfying the aesthetic requirements for a topical spray. Conversely, formulations F1, F2, and F3 exhibited a progressive intensification in both color and aroma; hues shifted from light yellowish-brown to dark brown, accompanied by a more pronounced characteristic herbal scent as extract concentrations increased from 1% to 3%. This color transition is attributed to the presence of phytochemical constituents such as flavonoids and tannins within the extract, which naturally impart pigmentation to liquid preparations. Despite these aesthetic shifts, all formulations maintained excellent clarity and homogeneity without the presence of coarse particles or sediment (Angelica et al., 2022; Asrianti et al., 2024; Ferreira et al., 2021; Leanpolchareanchai & Teeranachaideekul, 2023; Ngoc et al., 2023).

The consistency in the liquid dosage form across all variations suggests that the concentration of the base ingredients was sufficient to incorporate the extract without compromising the physical stability of the preparation. Among the tested variants, Formula F2 (2% extract) was identified as the optimal formulation, as it provided a balanced sensory profile—exhibiting consistent and satisfactory qualities in appearance and aroma that are desirable for cosmetic applications. These results align with contemporary cosmetic trends where natural plant extracts are increasingly favored for providing additional benefits like antioxidant and anti-inflammatory effects, provided they maintain the refreshing and non-irritating sensory characteristics expected of a face mist. The absence of clumps or undispersed particles across all concentrations further validates that the maceration and formulation protocols employed were effective in achieving a uniform distribution of the active botanical ingredients (Lisyanti et al., 2022a; Noviani et al., 2025; Sakka & Hasma, 2023; Widyasanti et al., 2024a).

pH Test

The pH evaluation of the face mist formulations (Table 2.) was conducted using a calibrated pH meter to ensure compatibility with the physiological pH of facial skin. The results indicated that the incorporation of binahong (*Anredera cordifolia*) leaf extract significantly influenced the acidity of the preparation. Specifically, as the concentration of the extract increased from 0% (F0) to 3% (F3), there was a notable reduction in pH values, ranging from approximately 6.8 down to 4.9. This increase in acidity is attributed to the presence of naturally occurring acidic phytochemicals within the binahong extract, such as ascorbic acid (Vitamin C) (Salim et al., 2021; Souhoka et al., 2021; Trisnawati et al., 2024).

From a dermatological perspective, all formulations (F0, F1, F2, and F3) remained within the safe and acceptable range for topical application, which typically spans from 4.5 to 6.5 or up to 8.0 according to Indonesian National Standards (SNI) (Nealma & Nurkholis, 2020; Yun et al., 2021). Maintaining a pH that aligns with the skin's natural "acid mantle" is critical in pharmaceutical analysis to prevent adverse reactions; solutions that are too acidic may cause localized irritation, while those that are excessively alkaline can lead to skin dryness, flaking, and a disruption of the skin's microbial balance. Therefore, the formulated face mist is considered safe for facial use as it supports skin homeostasis (Hawkins et al., 2021; Lukić et al., 2021).

Spray Pattern Test

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According to the collected data, it can be concluded that each of the four formulations of binahong leaf extract face mist displayed appropriate spray diameters, as the measured values fulfilled the standard spray coverage criteria of 5–7 cm (table 3.). A larger spray coverage means that the active substances are more evenly spread out and have greater contact with the skin area. The spray distribution test was performed by applying the face mist onto a mica plastic surface from a distance of 5 cm, and then measuring the area covered by the spray (Angelica et al., 2022; Lisyanti et al., 2022b). According to the findings, Formula F0 showed the most extensive spray coverage when compared to Formulas F1, F2, and F3.

Drying Time Test

According to the information provided in Table 4, the results of the drying time tests for the binahong leaf extract face mist formulations indicated that the drying times for formulations F0, F1, F2, and F3 satisfied the established standards, specifically not surpassing 5 minutes. Formula F0 showed the quickest drying time compared to the other formulas, which is due to the lack of binahong leaf extract. In comparison, formulations F1, F2, and F3 needed a bit more time to dry because of the presence and higher concentration of the extract, whereas F0 included only glycerin, PVP, and distilled water, lacking any binahong leaf extract (Ismayanti et al., 2021; Theedens et al., 2024; Tri Puji Lestari et al., 2022).

Homogeneity Test

The organoleptic evaluation of the face mist formulations (table 5.) revealed distinct physical variations that were directly correlated with the concentration of *Anredera cordifolia* L. (binahong) leaf extract. Formula F0, serving as the negative control, maintained a transparent, colorless, and odorless liquid state, reflecting the inherent properties of its base components, including glycerin, PVP, and distilled water. Conversely, formulations F1, F2, and F3 exhibited a progressive intensification in both color and aroma; the hues shifted from light yellowish-brown to dark brown, accompanied by a more pronounced characteristic herbal scent as extract concentrations increased from 1% to 3%. This color transition is primarily attributed to the presence of phytochemical constituents such as flavonoids and tannins within the extract, which naturally impart pigmentation to liquid preparations (Surendra et al., 2025).

Despite these aesthetic shifts, all formulations maintained excellent clarity and homogeneity without the presence of coarse particles or sediment. The consistency of the liquid dosage form across all variations suggests that the concentration of the base ingredients was sufficient to incorporate the extract without compromising the physical stability of the preparation. Among the tested variants, Formula F2 (2% extract) was identified as the optimal formulation, as it provided a balanced sensory profile—exhibiting consistent and satisfactory qualities in appearance and aroma that are desirable for cosmetic applications. The absence of clumping or undispersed particles further validates that the maceration and formulation protocols employed were effective in achieving a uniform distribution of the active botanical ingredients (Selvi Mutia et al., 2023; Silvy Aldila et al., 2024; Universitas Islam Makassar et al., 2022).

Antibacterial Activity Test

The antibacterial activity of Formula 2 (F2) showed an average inhibition zone of 19.83 ± 17.27 mm. The notably high standard deviation observed in this group was attributed to a significant variance in one of the replicates. While the results generally indicate 'strong' antibacterial activity, this high variability suggests a need for further optimization of the diffusion process or a broader sample size to

ensure data homogeneity. Despite the outlier, the overall trend consistently demonstrates that the inclusion of binahong leaf extract enhances the inhibitory effect against *C. acnes* compared to the negative control.

While standard references such as the Indonesian Pharmacopoeia (2014; 2020) and the Clinical and Laboratory Standards Institute (CLSI) establish specific inhibition zone thresholds for pure clinical antibiotics, these categories are not directly applicable to complex natural extracts. Therefore, rather than strictly classifying the formulations into clinical resistance or susceptibility categories, the observed inhibition zones in this study were utilized to evaluate their relative antibacterial potential against *C. acnes*. Based on the experimental data, Formulation F0 exhibited no antibacterial activity, confirming that the face mist base alone lacks an inhibitory effect. Formulations F1 and F3 produced average inhibition zones of 11.59 mm and 9.26 mm, respectively, demonstrating an observable antibacterial response. Notably, Formulation F2 yielded the highest inhibitory effect with an average diameter of 19.83 mm. Overall, these findings confirm that the incorporation of binahong leaf extract significantly imparts antibacterial properties to the face mist preparations (Kementerian Kesehatan Republik Indonesia, 2014, 2020).

As stated in the Fifth Edition (2014) and Sixth Edition (2020) of the Indonesian Pharmacopoeia, an antibacterial product is deemed effective if it results in an inhibition zone that measures around 14–16 mm in diameter (Kementerian Kesehatan Republik Indonesia, 2014, 2020). At the same time, the Clinical and Laboratory Standards Institute (CLSI) categorizes antibacterial inhibitory activity into three groups: resistant or weak (19 mm). Manoppo (2021) additionally stated that inhibition zones measuring 21 mm signify exceptionally strong activity. According to the data shown in the table, formulations F1 and F3 resulted in inhibition zone diameters classified as weak by CLSI, with average measurements of 11.591 mm and 9. 256 mm, respectively. Formulation F2 achieved an average inhibition zone diameter of 19. 831 mm, categorizing it as strong. In contrast, F0 exhibited no antibacterial activity, as it lacked binahong leaf extract.

The diameter of the inhibition zone created by formulation F2 against *P. acnes* was categorized as strong based on CLSI standards; however, it was deemed ineffective according to the Indonesian Pharmacopoeia Fifth and Sixth Editions, as it surpassed the acceptable range of 14–16 mm. This difference may be due to variations in assessment standards, since the Pharmacopoeia criteria rely on antibiotics given at uniform doses (S3), while the precise concentration of active ingredients in plant extracts cannot be accurately measured. The antibacterial properties of the binahong leaf extract face mist are linked to its chemical components, which include flavonoids, saponins, tannins, and alkaloids. These constituents have been documented to hinder the proliferation of several harmful bacteria, including Escherichia coli, Shigella flexneri, Staphylococcus aureus, and *P. acnes* .

CONCLUSIONS

According to the findings of the formulation study on Binahong (Anredera cordifolia) leaf extract face mist, it can be concluded that Binahong leaf extract is suitable for use as an active component in face mist formulations intended for facial use. The test for antibacterial activity indicated that formulation F2 demonstrated the highest effectiveness, as it resulted in the greatest diameter of the inhibition zone.

CONFLICT OF INTEREST STATEMENT

The authors state that there are no conflicts of interest related to this research or the publication of this paper. This research was carried out independently, without any engagement, influence, or assistance from businesses, drug companies, or other groups that might compromise the objectivity or honesty of the research process. The materials, methods, data analysis, and the interpretation of the results were

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conducted exclusively on the basis of scientific principles. Additionally, the authors affirm that there are no personal, financial, or professional connections that could be seen as affecting the results or conclusions of this research.

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