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Research Article

Natural Anti-Dandruff Pomade: Exploring the Antifungal Potential of Cananga odorata Flower Extract Against Candida albicans

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Abstract

Scalp disorders are frequently perceived as minor conditions, although dandruff may interfere with scalp comfort, hair appearance, and personal hygiene. Dandruff is a mild scalp disorder characterized by visible white flakes and pruritus. Pomade, as a hair-styling and hair-care product, can be developed with natural active ingredients, including *Cananga odorata* flowers (*Cananga odorata* (Lam.) Hook. F. & Thomson), which have been reported to possess antimicrobial and antifungal properties. This study aimed to formulate a pomade containing ethanol extract of *Cananga odorata* flowers and evaluate its antifungal activity against *Candida albicans*, one of the fungi associated with dandruff formation. This experimental study comprised simplicia preparation, extraction, pomade formulation, physical evaluation, and antifungal activity testing against *Candida albicans*. The ethanol extract of *Cananga odorata* flowers was successfully incorporated into pomade formulations at concentrations of 5%, 10%, and 15%. All formulations demonstrated acceptable physical characteristics, including organoleptic properties, homogeneity, pH, spreadability, hair-retention capacity, irritation safety, hedonic acceptability, and stability. The formulation containing 15% extract produced the largest inhibition zone, with a mean diameter of 20.5 mm, indicating strong antifungal activity. These findings suggest that ethanol extract of *Cananga odorata* flowers has potential as a natural active ingredient in anti-dandruff pomade preparations.

Keywords: antifungal, *Cananga odorata (Lam.) Hook. F. & Thomson*, *Candida albicans*, dandruff, pomade.

INTRODUCTION

Scalp disorders, including sensitive scalp, excessive oiliness, and dandruff, are common hair and scalp problems frequently reported in previous studies. Previous study stated that *Candida sp.* is associated with the occurrence of dandruff on the scalp. In addition, the presence of Candida sp. on the scalp may contribute to hair loss, resulting in alopecia, scaling, and itching [1].

Hair, as an aesthetic feature of the human body, requires regular care. Consequently, many individuals devote considerable time to maintaining and improving hair appearance. Scalp conditions such as sensitivity, oiliness, and dandruff can disrupt normal hair growth, as reported. Hair undergoes a physiological cycle in which it grows, matures, becomes longer, sheds, and is replaced by new hair [2]. Physiological conditions, emotional and physical stress, nutrition, hormonal disturbances, and medication use may influence hair growth and may lead to thinning, fragility, reduced pigmentation, hair loss, and even baldness [3].

Dandruff is a common scalp disorder that affects nearly half of the post-pubertal population, regardless of ethnicity or sex, and is thought to involve both microbial and non-microbial factors, as described. This scalp problem is highly prevalent and may be experienced by individuals at some point in life irrespective of age, sex, or race [4]. One fungal species implicated in dandruff-related scalp problems is *Candida albicans*, as reported. Proper hair and scalp care is therefore required to maintain scalp health and prevent fungal-related skin disorders caused by Candida sp [4,5].

Candida albicans is a pathogenic fungal species belonging to Deuteromycota. This fungal species is known as an opportunistic pathogen that causes candidiasis of the skin, mucosa, and internal organs. Morphologically, *Candida albicans* is oval or spherical, with a diameter of approximately 3-5 µm, and is capable of producing pseudohyphae. *Candida albicans* exhibits two major morphological forms, namely a yeast-like form and a hyphal-like form [5,6].

Cananga odorata flower (*Cananga odorata*) is a medicinal plant widely recognized for its health-related benefits [7]. This plant is also known as a source of essential oil. The Cananga species found in Indonesia is *Cananga odorata*. *Cananga odorata* flowers are among the plants that can be used in traditional medicine [7,8]. Extracts of *Cananga odorata* flowers have been reported to exhibit antioxidant and antimicrobial activities. Previous research has examined *Cananga odorata* extract shampoo preparations. One study formulated and evaluated the physical properties of a shampoo combining rice straw (*Oryza sativa*) and *Cananga odorata* extract (*Cananga odorata*), using 20 g of rice straw and 10% *Cananga odorata* flower extract. That concentration was reported to provide favorable anti-dandruff properties [8,9].

The development of pomade in the present study was not intended merely for styling, adding shine, or facilitating hair arrangement. Rather, this study formulated a pomade capable of inhibiting the growth of *Candida albicans*, a fungus associated with dandruff [10,11]. The product was developed as a potential hair-care preparation for men with dandruff-related scalp problems, using *Cananga odorata* extract (*Cananga odorata*) as the active ingredient.

MATERIALS AND METHODS

Research Design

This study employed an experimental research design. The procedures included the preparation of simplicia, extraction, formulation of pomade containing ethanol extract of *Cananga odorata* flowers (*Cananga odorata* (Lam.) Hook. F. & Thomson), and antifungal activity testing against *Candida albicans*.

Sample

The research population consisted of *Cananga odorata* (Lam.) Hook. F. & Thomson plants collected from Paya Dua, Bandar Baro District, North Aceh Regency. Sample used comprised 5 kg of fresh *Cananga odorata* flowers. The sample was determined at Herbarium Medanese (MEDA), Universitas Sumatera Utara.

Research Instruments

The study utilized a comprehensive set of research instruments and materials to conduct the experiments. The instruments included test tubes (Simax, China), analytical scales (AND, Japan), measuring cylinders (Simax, China), beakers and Erlenmeyer flasks (Simax, China), a laboratory blender (Panasonic, Japan), glass maceration vessels (Simax, China), stirring rods and L-shaped rods (Simax, China), Petri dishes (SPL Life Sciences, Korea), mortar and pestle (porcelain; Asahi, Japan), preparation containers and spatulas (Eisco, India), droppers (Eisco, India), filter paper (Advantec, Japan), rotary evaporator (Eyela, Japan), autoclave (Tomy, Japan), laboratory oven (Memmert-style, Korea OEM), incubator (Libra, India), colony counter (Eutech, Singapore), Bunsen burner (AIS, India), inoculating loops (HiMedia, India), tweezers (TAIYO, Japan), and sterile gauze (Welcron, Japan). The materials used in this study comprised *Cananga odorata* (Lam.) Hook. F. & Thomson flowers collected from Paya Dua, North Aceh, ethanol solvent (96% analytical, Changshu, China), *Candida albicans* ATCC 10231 (HiMedia, India), white petrolatum (Kaneka, Japan), beeswax (local Indonesian supplier), lanolin (Nikko Chemicals, Japan), Span 80 (Croda Asia Pacific, Singapore), nipagin (methylparaben; Wako, Japan), glycerin (Sime Darby, Malaysia), and potato dextrose agar (PDA) medium (HiMedia, India).

Sample Preparation

A total of 5 kg of *Cananga odorata* (Lam.) Hook. F. & Thomson flowers was collected from Paya Dua, North Aceh. Wet sorting was performed to remove impurities and dirt materials, followed by weighing. The flowers were then washed to remove soil and other contaminants attached to the simplicia material, weighed, and chopped. Drying was subsequently carried out in a drying cabinet at 50-60°C to obtain simplicia that were less susceptible to deterioration and could be stored for a longer period. The dried material was then blended and sieved using Mesh No. 65 to obtain powdered simplicia [12,13].

Extract Preparation

Extraction was performed by maceration. A total of 500 g of dried powdered simplicia was placed into a vessel, followed by the addition of 3250 mL of 96% ethanol. The vessel was closed and stored for 5 days protected from light, with occasional stirring [14]. The mixture was then pressed and filtered using filter paper to obtain filtrate I and marc. The marc was subsequently remacerated with 1750 mL of ethanol in a closed vessel and stored for 2 days in a cool place protected from light, with occasional stirring. The mixture was filtered again to obtain filtrate II and marc. Filtrates I and II were combined and concentrated using a rotary evaporator until a thick extract was obtained [13,15].

Pomade Formulation

Table 1: Pomade Formula

Ingredient	Concentration (% w/w)				Function
	F0	F1	F2	F3	
Cananga odorata flower extract	0%	5%	10%	15%	Active substance
White petrolatum	40	40	40	40	Base
Beeswax	6	6	6	6	Base
Lanolin	9	9	9	9	Moisturizer
Span 80	11	11	11	11	Emulsifier
Nipagin	0.1	0.1	0.1	0.1	Preservative
Glycerin	ad 100	ad 100	ad 100	ad 100	Thickening agent

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract

Preparation of *Cananga odorata* extract Pomade

All required materials were prepared and weighed. White petrolatum, lanolin, and beeswax were placed into a beaker glass and heated until melted. Nipagin and glycerin were then added while stirring. Span 80 and *Cananga odorata* extract were added gradually and stirred until homogeneous. The mixture was poured into containers and allowed to cool [14, 16]. The organoleptic test was conducted through visual observation of the form, color, and odor of the preparation. Organoleptic parameters influence the aesthetic acceptability of a product; therefore, the resulting preparation should have an attractive form, color, and odor [17].

pH of the preparation is determinedusing a pH meter. The instrument was first calibrated using a standard neutral pH buffer solution (pH 7.01) and an acid buffer solution (pH 4.01) until the instrument showed the pH value. Then the electrodes were washed with distilled water, then dried with a tissue. Samples were made with a concentration of 1%, namely weighing 1 g of the preparation and dissolved in distilled water up to 100 ml. Then the electrode is immersed in the solution [18].

The spreadability test was conducted using an object glass and caliper. The spreading method was used to determine the extent of spread formed by the pomade containing *Cananga odorata* flower extract [18]..

An ideal topical preparation should not irritate the skin. The irritation test was conducted on 12 volunteers who had completed informed consent forms. A positive irritation reaction was indicated by redness, itching, or swelling of the skin. The irritation test was conducted to evaluate safety of its usage [19].

The hedonic test showed differences in preference regarding texture, color, and odor, as well as differences in preference related to color and polishability. These differences were presumed to result from the variation in color generated by each formula. The test was conducted on 12 volunteers by giving a score 9 for extremely like; 8 = very much like; 7 = like; 6 = slightly like; 5 = neutral; 4 = slightly dislike; 3 = dislike; 2 = strongly dislike; 1 = extremely dislike[19].

Antifungal Testing

Sterilization of Instruments

All instruments used in the study were washed thoroughly and dried. Once dry, the instruments and materials were wrapped in parchment paper and sterilized in an autoclave at 121°C for 15 minutes.

Preparation of 0.5 McFarland Solution

A total of 0.05 mL of 1% barium chloride ($BaCl_2$) in distilled water was mixed with 9.95 mL of 1% sulfuric acid (H_2SO_4). The solution was then stored in a place protected from direct sunlight .

Fungal Rejuvenation

Candida albicans was rejuvenated by first sterilizing an inoculating loop over a Bunsen flame for 10 seconds, then streaking the loop onto a pure fungal culture until the cells adhered. The fungal cells were subsequently transferred to a sterilized PDA medium in a Petri dish, which was closed and incubated at 37°C for 24 hours to allow for fungal growth, with all procedures performed near a Bunsen flame to minimize contamination [20].

Fungal Activity Test

The antifungal activity test was performed using the well diffusion method. The fungal suspension was spread onto sterilized PDA medium. Wells were made in the PDA medium using a punch hole with a diameter equivalent to a paper disc, positioned 2 cm from the edge of the plate, 3 cm between wells, and 4 mm in depth. Pomade preparations at different concentrations, namely 5%, 10%, and 15%, were then placed into the wells. Gatsby pomade was used as the positive control, whereas the blank formula was used as the negative control. The preparations were introduced into the wells using a micropipette. The plates were incubated in an incubator at 37°C for 24 hours. After incubation, the inhibition zones were observed and measured using a caliper, and the inhibition zone diameters were calculated. The calculation was based on the following information: well diameter = 6 mm; measurement diameter = [(d1 + d2) / 2] - x, where d1 is the horizontal diameter, d2 is the vertical diameter, and x is the well diameter [21,22].

Data Analysis

The data were obtained descriptively by recording the results after application of pomade preparations containing *Cananga odorata* (Lam.) Hook. F. & Thomson flower extract against *Candida albicans*. Data were presented descriptively in tables and figures. Prior to statistical analysis, the data were tested for homogeneity and normality. When the data were normally distributed, two-way analysis of variance (ANOVA) was used to compare three or more means. ANOVA can be applied to separate variation caused by controlled factors from other sources of variation. The statistical software used for data analysis was the Statistical Program for Social Science (SPSS) [23].

RESULTS AND DISCUSSION

Based on the drying process of the *Cananga odorata* flower simplicia, 5 kg of fresh sample was used. The simplicia preparation included sample collection, weighing, wet sorting, chopping, drying, and dry sorting. The powdered simplicia obtained weighed 783 g, with a drying shrinkage of 84.34%. The solvent was evaporated using a rotary evaporator until 91.41 g of thick *Cananga odorata* extract was obtained, with an extract yield of 22.85%.

Evaluation Results of the Pomade Preparation

The evaluation of pomade containing *Cananga odorata* (Lam.) Hook. F. & Thomson flower extract included organoleptic testing, homogeneity testing, pH testing, spreadability testing, hedonic testing, irritation testing, and stability testing, as presented below.

Organoleptic Test Results

Table 2: Organoleptic Test Results of the Preparation

Observation	Formula			
	F0	F1	F2	F3
Form	Semi-solid	Semi-solid	Semi-solid	Semi-solid
Color	White	Light green	Green	Dark green
Aroma	No aroma	Flowery	Flowery	Flowery

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract

Based on the organoleptic evaluation, the pomade containing *Cananga odorata* (Lam.) Hook. F. & Thomson flower extract had a semi-solid form and characteristic odor. The colors of the preparations were white for F0, light green for F1, green for F2, and dark green for F3.

Homogeneity Test Results

The homogeneity test was conducted to ensure that no coarse particles were present on the object glass and that all ingredients had been properly mixed. The results showed that all formulations were homogeneous.

pH Measurement Results

Table 3: pH Measurement Results of the Preparation

Formula	Test I	Test II	Test III	Average pH
F0	6.3	6.6	6.5	6.4
F1	6.5	6.3	6.2	6.3
F2	6.4	6.3	6.4	6.3
F3	6.4	6.5	6.4	6.4

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract

The pH of the pomade preparation was measured using a pH meter. The pH values were measured three times when the preparation was first produced. The mean pH values were 6.4 for F0, 6.3 for F1, 6.3 for F2, and 6.4 for F3. These results indicate that the pH values of all formulations remained within the permitted range of 4.5-6.5 [24].

Spreadability Test Results

Table 4: Spreadability Test Results of the Preparation

Formula	Test I		Test II		Test III		Average
	Without load	With load	Without load	With load	Without load	With load	
F0	4.0	4.5	5.0	5.6	4.5	6.8	5.07
F1	3.6	4.3	5.5	6.4	5.0	7.0	5.30
F2	3.8	4.5	5.7	6.7	5.0	6.8	5.42
F3	4.0	4.5	5.6	7.0	5.0	7.0	5.52

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract

The spreadability test showed that the mean spreadability values of the pomade preparations containing *Cananga odorata* extract were 5.07 cm for F0, 5.30 cm for F1, 5.42 cm for F2, and 5.52 cm for F3. These values met the standard spreadability range for semisolid preparations, namely 5-7 cm.

Hair-Retention Test Results

Table 5: Hair-Retention Test Results

Formula	1 hour	2 hours	3 hours	4 hours
F0	+	+	+	+
F1	+	+	+	+
F2	+	+	+	+
F3	+	+	+	+

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract
(+) = hair appeared neat
(-) = hair did not appear neat

The pomade was applied to artificial hair to obtain more accurate observations. F0, F1, F2, and F3 all produced positive results, as the hair remained neat for four hours after application of the pomade preparation containing *Cananga odorata* flower extract

Irritation Test Results

Table 6: Irritation Test Results of the Preparation

Formula	Observation						Volunteer						
		A	B	C	D	E	F	G	H	I	J	K	L
F0	Redness	-	-	-	-	-	-	-	-	-	-	-	-
	Swelling	-	-	-	-	-	-	-	-	-	-	-	-
	Itching	-	-	-	-	-	-	-	-	-	-	-	-
F1	Redness	-	-	-	-	-	-	-	-	-	-	-	-
	Swelling	-	-	-	-	-	-	-	-	-	-	-	-
	Itching	-	-	-	-	-	-	-	-	-	-	-	-
F2	Redness	-	-	-	-	-	-	-	-	-	-	-	-
	Swelling	-	-	-	-	-	-	-	-	-	-	-	-
	Itching	-	-	-	-	-	-	-	-	-	-	-	-
F3	Redness	-	-	-	-	-	-	-	-	-	-	-	-
	Swelling	-	-	-	-	-	-	-	-	-	-	-	-
	Itching	-	-	-	-	-	-	-	-	-	-	-	-
K+	Redness	-	-	-	-	-	-	-	-	-	-	-	-
	Swelling	-	-	-	-	-	-	-	-	-	-	-	-
	Itching	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract
(-) = no irritation
(+) = redness
(++) = itching
(+++) = swelling

The irritation test was conducted on 12 volunteers who had completed informed consent forms. A positive irritation reaction was indicated by redness, itching, or swelling of the skin. The results showed that all pomade formulas produced negative irritation responses in volunteers and were therefore considered safe for use. These findings indicate that each pomade formulation did not cause irritation in the volunteers [25].

Hedonic Test Results

Table 7: Hedonic Test Results of the Preparation

Panelist	Texture				Odor				Color			
	F0	F1	F2	F3	F0	F1	F2	F3	F0	F1	F2	F3
A	7	9	9	9	8	9	9	9	7	9	9	9
B	7	9	9	9	8	9	9	8	8	9	9	9
C	8	9	9	9	7	9	8	9	7	8	8	9
D	7	8	9	8	9	9	9	9	7	9	9	9
E	8	9	9	8	9	8	9	7	7	8	9	9
F	8	9	9	8	9	9	9	9	7	9	9	9
G	8	9	9	9	8	7	8	9	7	8	8	9
H	8	8	9	9	8	9	8	9	7	9	9	9
I	7	8	9	9	8	9	7	7	8	9	9	9
J	8	9	9	9	9	9	9	9	7	9	8	9
K	7	8	8	9	8	8	8	9	7	9	9	8
L	7	9	9	9	9	8	8	9	8	9	9	9
Total	90	104	107	105	100	103	101	103	87	105	105	107

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract
9 = extremely like; 8 = very much like; 7 = like; 6 = slightly like; 5 = neutral; 4 = slightly dislike; 3 = dislike; 2 = stro ngly dislike; 1 = extremely dislike.

The hedonic test assessed panelists' preferences regarding texture, odor, and color of the pomade containing *Cananga odorata* flower extract. For texture, F0 scored 8.0 (very much like), F1 scored 8.0 (very much like), F2 scored 9.0 (extremely like), and F3 scored 8.0 (very much like). For odor, F0 scored 7.0 (like), F1 scored 8.0 (very much like), F2 scored 9.0 (extremely like), and F3 scored 8.5 (very much like). For color, F0 scored 7.0 (like), F1 scored 8.0 (very much like), F2 scored 8.0 (very much like), and F3 scored 9.0 (extremely like).

Stability Test Results

For the stability test, results showed that F0 remain the same from week 1 until week 12. F0 preparation has a semi solid form, white in color, homogen and has no aroma. F1 has a semi solid and homogen form since week 1 until week 12, has a light green color and stable during storage. While F2, has a homogen and semisolid form with darker color compare to F1. It has a green color and stable during storage observation [26]. F3 has dark green color, semi solid form and homogenous since week 1 until the end of evaluation on week 12.

Effectiveness Test Results as an Anti-Dandruff Preparation

Table 8: Inhibition Zone Results Against *Candida albicans*

Formula	Inhibition Zone Diameter (mm)			Average (mm)
	Test I	Test II	Test III	
F0	0	0	0	0
F1	8.6	8.2	8.9	8.6
F2	12.4	12.5	12.7	12.5
F3	20.4	20.1	21	20.5
C+	0	0	0	0

Notes:
F0 = pomade without extract (blank formula)
F1 = pomade containing 5% *Cananga odorata* flower extract
F2 = pomade containing 10% *Cananga odorata* flower extract
F3 = pomade containing 15% *Cananga odorata* flower extract
C+ = positive control (Gatsby® pomade)

Based on the effectiveness test as an anti-dandruff preparation against *Candida albicans*, the mean inhibition zone diameters were 0 mm for F0 (blank), 0 mm for the positive control, 8.6 mm for F1 (5%), 12.5 mm for F2 (10%), and 20.5 mm for F3 (15%).

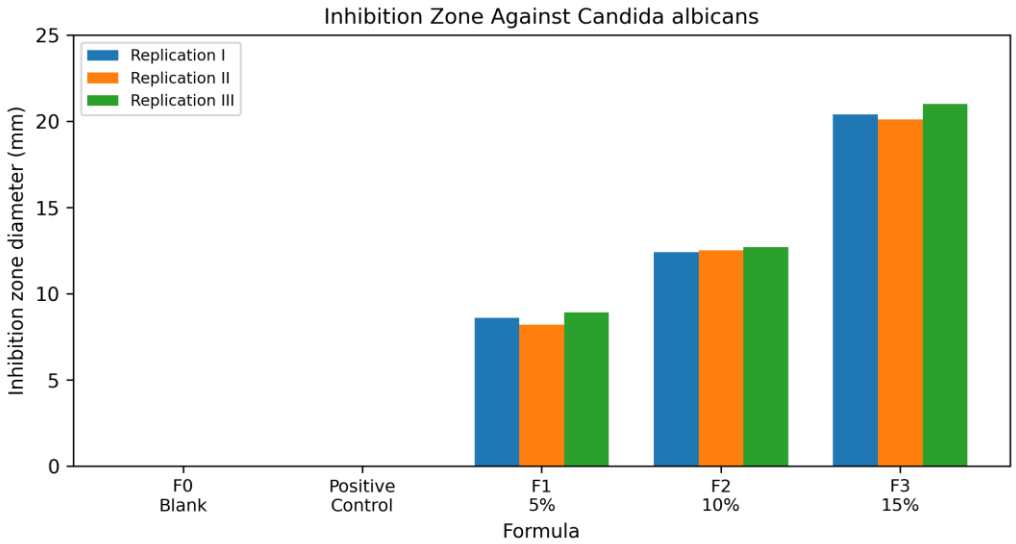

Figure 1: Inhibition Zone Diagram

Table 9: Statistical Test Results

Formula	Normality	Homogeneity	ANOVA
F1	0.843	>0.05	0.00
F2	0.637	>0.05	0.00
F3	0.637	>0.05	0.00

Based on the inhibition zone data, the statistical results indicated that each concentration produced different effects. The data were normally distributed and homogeneous, as shown by p-values greater than 0.05. The ANOVA test showed a significant result, with a p-value less than 0.05. Therefore, the data indicated significant differences between the positive and negative controls and the treatment formulas F1, F2, and F3. The highest inhibition zone was obtained from the 15% concentration, with a mean diameter of 20.5 mm, which was classified as strong category [27].

Discussion of Antifungal Activity Against Dandruff-Causing Fungi

Plant-derived antifungal compounds are largely secondary metabolites, particularly phenolic compounds and terpenes present in essential oils. Other compounds that may contribute to antifungal activity include alkaloids, saponins, tannins, phenolics, flavonoids, and triterpenoids [28]. Based on the compound-group test, the active compounds present in the pomade extract included flavonoids containing hydroxyl (OH) functional groups, which can more readily enter cells and form complexes with cell membrane proteins. This interaction may cause irreversible protein denaturation in the cell membrane [27]. Flavonoids may act as antifungal agents because their phenolic structure is capable of denaturing proteins and damaging microbial cell membranes irreversibly. The more lipophilic a flavonoid is, the greater its potential to disrupt microbial membranes [16].

CONCLUSION

Ethanol extract of *Cananga odorata* flowers can be successfully formulated into pomade preparations with acceptable physical quality, including suitable organoleptic properties, homogeneity, pH, spreadability, hair-retention capacity, stability, user acceptability, and no irritation response in volunteers. The formulated pomade also demonstrated antifungal activity against *Candida albicans*, with the inhibition zone increasing along with extract concentration. Among all formulations, the pomade containing 15% *Cananga odorata* flower extract produced the highest inhibition zone diameter of 20.5 mm and was categorized as having strong antifungal activity. Therefore, *Cananga odorata* flower extract has promising potential as a natural active ingredient in anti-dandruff pomade preparations.

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