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Antimicrobial Activity of Hand Lotion of Flower *Mimusops elengi*

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Keywords: *M. elengi*; *S. aureus*; *C. albicans*; Hand lotion; Antimicrobial

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Abstract

BACKGROUND: Aceh is a tropical region that is very many overgrown by various plants that have medicinal properties; one of them is *M. elengi. M. elengi* flower extract has the main content of triterpene and alcohol, that have antibacterial, antifungal, antioxidant and antineoplastic activity. Extraction of chemical compounds containing essential oils generally uses distillation, and get the small amounts of chemical compounds, while the maceration with *n*-hexane solvent, producing less active nonpolar compounds against *S. aureus* bacteria.

AIM: Isolating the methanol extract from *M. elengi* flowers and test its antibacterial and antifungal activity. Furthermore, extracts with active concentrations are made into a lotion.

METHODS: Methanol extract from *M. elengi* flower was characterised by gas chromatography-mass spectrometry, then tested for antibacterial and antifungal, then made into the lotion. The lotion was tested again for its antimicrobial activity, physical and organoleptic properties.

RESULTS: The most abundant chemical compounds in an extract of *M. elengi* based on characterisation with GC-MS is Borneol L; (Bicyclo [2.2.1] heptane-2-ol, 1,7,7-trimethyl, as much as 82%). The methanol extract of *M. elengi* flower can inhibit the growth of *S. aureus* bacteria and *C. albicans* fungi, and also the lotion from methanol extract can inhibit the growth of *S. aureus* bacteria, but the *M. elengi* flower extract lotion cannot inhibit the growth of *C. albicans* fungi. The lotion inhibits the growth of *S. aureus* bacteria, from a concentration of methanol extract of 8% and 16%. Lotion with 16% methanol extract has 81.33% in activity power compared with positive control. The results of physical and organoleptic properties test, with the concentration of methanol extract of *M. elengi* 1, 2, 8, and 16%, have pH in the range of 6.6-8 (still in a safe range, 4.5-9 according to SNI 16-4399-1997). The lotion type is m/a, the spreading capacity of the lotion is 18.8 - 39.5 cm2. The power of adhesive at skin ranges from 1 minute 27 seconds to 3 minutes 7 seconds. The viscosity of the lotion ranges from 23,670-24,400 cP, this range is in the range based on SNI 16-4399-1996 (2000-50,000 cP), so the lotion is in a good category. The preferred lotion is at a concentration of 2%, in fragrance.

CONCLUSION: Antibacterial activity of the lotion of methanol extract of *M. elengi* flower against *S. aureus* bacteria was the best at 16%, but could not inhibit the growth of *C. albicans* fungi. The most abundant compounds in methanol extract are Borneol L compounds; (Bicyclo [2.2.1] heptane-2-ol, 1,7,7-trimethyl. In general, the physical properties of this lotion meet the requirements of SNI16-4399-1996, SNI 16-4399-1997, and lotions which are preferred at a concentration of 2% in fragrance.

Introduction

Aceh is a tropical region that is very many overgrown by various plants that have medicinal properties, such as *Artocarpus camansi*, which is efficacious as an antidiabetic drug [1], [2], [3], [4] and also *Ficus racemosa* and *Morus alba* which can lose weight [5], [6]. *Mimusops elengi* plants were also found, which are very easy to find in various regions of Aceh.

Literature search, the plant of *M. elengi* (Indonesia: Tanjung) can function as Antimicrobial, Analgesic, Antibiotic, Antihyperlipidemic, Anti-inflammatory, Antioxidant, Antipyretic, Cytotoxic, Congestive enhancing, Gingival bleeding, Gastric ulcer, Hypotensive activity [7], [8]. Flower of *M. elengi* extract has the main content of triterpene and alcohol having antibacterial, antifungal, antioxidant and antineoplastic activity [9].

Extraction of chemical compounds containing essential oils generally uses distillation, and get the small amounts of chemical compounds, the maceration with n-hexane solvent, producing less

active nonpolar compounds against *S. aureus bacteria* [10].

Based on the above, this study aims to isolate the methanol extract from *M. elengi* flowers and test its antibacterial and antifungal activity. Furthermore, extracts with active concentrations are made into lotions. Media of lotion (cetyl alcohol, stearic acid, lanolin, glycerine, Methylparaben, triethanolamine, and Akua dest), with modification [11], and patchouli oil as aroma binder of methanol extract of *M. elengi*.

Hand lotion is needed to protect hands from dryness, in addition to protecting the skin from infections caused by bacteria and fungi. Medical officers and medical professionals are vulnerable to these infections.

Extraction of methanol extract is intended to take all the chemical components of nonpolar, semipolar, and polar components, so it is expected that its antimicrobial ability is more effective. Antibacterial and antifungal tests, using Mueller Hinton agar (MHA), and dextrose subouraund agar (SDA), with *S. aureus* and *C. albicans* as the bioindicator.

Material and Methods

Plant materials and bioindicator

Flowers of *M. elengi* are taken around the Universitas Syiah Kuala Campus, Banda Aceh, Indonesia. Determination of *M. elengi* plant is done in the herbarium laboratory of the Biology Department of the Faculty of Mathematics and Natural Sciences of Universitas Syiah Kuala, by Dr Ir. Saida Rasnovi, M.Sc.

Bacteria of *S. aureus* was obtained from the Microbiology Department of the Faculty of Medicine UNSYIAH, while the fungus *C. albicans* was obtained from the Microbiology Section of the University of Indonesia (UI).

Spectrometry investigation

Gas Chromatography and Mass spectra were measured using a Shimadzu GC-MS QP 2010 Ultra. Column chromatography was performed on silica gel 60 (70-230 mesh Merck). TLC analysis was carried out by using precoated silica gel plates (Merck).

Testing phytochemicals

The method used for testing of phytochemicals can be found in: Phytochemical methods, Simplified Determination Method to Analyze plant [12].

Extraction of secondary metabolite compounds from the flower of M. elengi

Fresh flowers *M. elengi* as much as 3.24 kg was dried and obtained 796 g of dried *M. elengi.* Furthermore, *M. elengi* flower was mashed and macerated with methanol solvent for 2 x 24 hours, then filtered and evaporated using the rotary evaporator, and obtained methanol extract as much as 79.03 g (2.43%). The methanol extract obtained was characterised by GC-MS, and tested its activity on *S.aureus* and also fungal, *C. albicans* with concentrations: 1, 2, 4, 8, and 16%. The result of observation of antibacterial and antifungal activity showed that methanol extract of flower of *M. elengi* could be inhibited the growth of *S. aureus* bacteria and fungal *C. albicans* was at concentration 1, 2 (actively inhibited the fungus of *C. albicans*, and 8 and 16% actively inhibited the bacteria *S. aureus*), so the lotion of *M elengi* flower methanol extract was formulated with methanol extract concentration of 1, 2, 8, and 16%.

The making of the lotion M. elengi

Calculation of the lotion composition of *M. elengi* flower can be seen in Table 1.

Table 1: The formula of lotion preparation [11], with modification, [13]

No	Material	Composition (%)			
	Cetyl Alcohol	0.5	0.5	0.5	0.5
I	Stearic Acid	3	3	3	3
	Lanolin	1	1	1	1
	Patchouli Oil	1	1	1	1
II	Mimusopselengi flower extract	1	2	8	16
	Glycerin	2	2	2	2
III	Methylparaben	0.1	0.1	0.1	0.1
	Triethanolamine (TEA)	0.75	0.75	0.75	0.75
	Aquades	90.65	89.65	83.65	75.65
	Jumlah	100	100	100	100

Lotion-making procedure

Weighed all the necessary ingredients. Part (I), materials are inserted into a porcelain cup and is melted over a water bath to a temperature of 70°C. Part (III) is dissolved in hot Akua. Then part (III) is inserted in porcelain in a hot state, then added part (I) into section (III) with constant stirring until the temperature drops. At 45°C temperature added methanol extract that has been mixed with glycerin and patchouli oil (II) while stirring until homogeneous. It is then fed into the appropriate container [14].

The antibacterial activity test

Testing of inhibitory activity of methanol extract of the flower of *M. elengi* and lotion against *S. aureus* bacteria by agar diffusion method, using the paper disc as the container of measured material (sample). The discs that have been filled with *M. elengi* flower extract/ lotion with various concentration

(1, 2, 4, 8, 16% w/v), positive control, gentamicin 30 µg/mL, and negative control (methanol solvent), and patchouli oil 1% (v/v), are placed on the Mueller Hinton medium that has been inoculated with *S. aureus* bacteria, then incubated for 18-24 hours, at temperature 37°C. The presence of clear area indicates the inhibitory power [15].

Test the antifungal activity of C. albicans

Testing inhibitory activity of extract methanol and lotion, the flower of *M. elengi* against fungal *C. albicans* by agar diffusion method, using the paper disc as the container of measured material (sample). The discs that have been filled with the test material, *M. elengi* flower extract /lotion (1, 2, 4, 8, 16% w/v), positive control (nystatin 100 µg/mL), patchouli oil 1% (v/v), and negative control (methanol solvent), are placed on dextrose subouraund agar (SDA), which has been inoculated with *C. albicans* fungus, then incubated for 1-5 days at 37°C. The presence of clear media indicates inhibitory power [15].

The examination of the lotion

The examination of the lotion is carried out on the antimicrobial activity as well as the physical properties of the lotion ie: pH [16], the power of spreadability [17], type emulsion [18], a viscosity [19], and the power of adhesive [20]**.**

Results

Phytochemical test of M. elengi flower

Phytochemical tests of *M.elengi* flowers indicate secondary metabolites of, triterpenes, steroids, and saponins, both in fresh extracts, as well as in methanol extracts.

Characterisation of methanol extract, the flower of M. elengi Using GC-MS

The extract of *M. elengi* flower methanol obtained from the maceration results characterised using GC-MS, and results from Gas Chromatography can be seen in Figure 1.

Sample Information

Analysed	: 4/4/2018 8:35:27 AM
Sample Name	: the extract of Tanjung flower
Sample ID	: MS 3_18_3
Injection Volume	: 0.20
Method File	: D:\Metode\atsiri new.qgm
Tuning File	: C:\GCMSsolution\System\Tunel\6 november 2017 qgt

Chromatogram the extract of Tanjung flower D:\Measurement 2018\maret 2018\ms mar 5.qgd

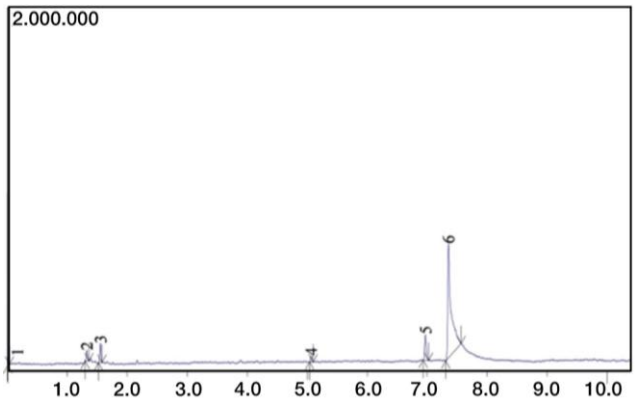
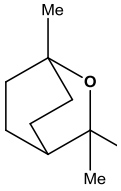
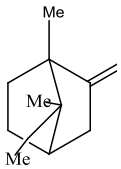
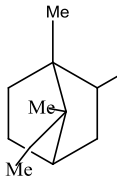


Figure 1: Chromatogram of methanol extract the flower of M. elengi

The results of the characterisation of the methanol extract the flower of *M. elengi* with gas chromatography (GC) yielded 6 chemical compounds after they were characterised by mass spectrometry (MS) and based on Library data on MS instruments, the six compounds are listed in Table 2.

Table 2: Chemical compounds contained in the methanol extract of M. elengi, characterisation with GC-MS

Peak	R. time	Area (%)	Name	Similarity (%)	Structure
1	0.22	1.21	3-Decyn-2-ol	81	Me (CH2)5CCCH(OH)Me
2.	1.325	2.68	Methane, sulfinylbis-(CAS) Dimethyl sulfoxida	82	MeS(O)Me
3.	1.552	4.52	Acetic acid, ethyl ester (CAS)	97	EtOAc
4.	5.067	1.57	1.8 cineole (2-Oxabicyclo [2.2.2]octane,1,3,3-trimethyl)	95	
5.	6.970	7.97	Camphor (Bicyclo[2.2.1]heptan-2-one,1,7,7-trimethyl)	96	
6.	7.356	82.04	Borneol L (Bicyclo[2.2.1]heptan-2-ol,1,7,7-trimethyl)	97	

Similarities of compounds with data library 275 L of Data Base existing on GC-MS instruments ranged between 81-97%. Compounds with a retention time of 7,356 min are Borneol L (Bicyclo [2.2.1] heptane-2-ol, 1,7,7-trimethyl) have 97% resemblance, and are the main compound in the methanol extract of *M. elengi*, with composition 82.04%. Borneol L compound has a melting point of 206-209°C, this compound borneol is also found in Dryobalanops

aromatic plant with the amount of 26.02%, and used as a chemical marker for the plants *Dryobalanops aromatica* [21].

Chemical compounds present in methanol extract of *M. elengi* flower, there are 3 compounds with straight-chain (aliphatic), and there are 3 with bridging compounds, bicyclo namely: 1.8 cineole (2-Oxabicyclo [2.2.2] octane, 1,3,3 -trimethyl); Camphor (Bicyclo [2.2.1] heptane-2-one, 1,7,7-trimethyl); and Borneol L (Bicyclo [2.2.1] heptane-2-ol, 1,7,7-trimethyl). The three bicyclo compounds is a component of essential oil; the results of the literature study known the compound has antibacterial activity [22]. The usefulness of borneol in research Borneol Depresses P-Glycoprotein Function by an NF-κB Signaling Mediated Mechanism in a Blood-Brain Barrier in Vitro Model [23].

Test Result of Antibacterial Activity Methanol Extract Flower M. elengi against S. aureus

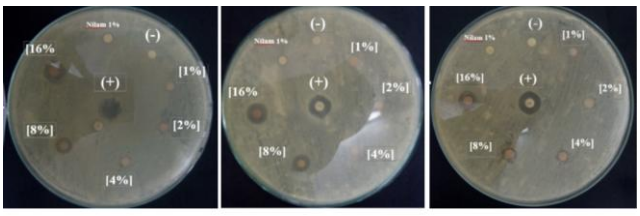
The result of the antibacterial activity of methanol extract of *M. elengi* on *S. aureus* bacteria is shown in Table 3, which shows the average yield of the inhibition zone in millimetres.

Table 3: Average inhibition zone of methanol extract, the flower of *M. elengi* on *S. aureus*.

No.	The concentration of extract (w/v)	Average inhibitory zone (mm)
1	1%	0
2	2%	7.3 ± 0,5
3	4%	7.6 ± 0.3
4	8%	11.1 ± 1.57
5	16%	16 ± 2
6	Patchouli	7.3 ± 0.5
7	Control (+)	18.8 ± 0,5
8	Control (-)	0

Control (+): gentamicin 30 µg/mL; Control (-): methanol solvent; Patchouli 1%; Diameter of discs: 6 mm.

Observation of the inhibition zone of the growth of *S aureus* bacteria in Petri dishes, with repetitions 3 times, showed quite clear results, which can be seen in Figure 2 (yield in Table 3)



(a = test 1) (b = repeat 2) (c = repeat 3)

Figure 2: Inhibition zone of M. elengi methanol extract on S. aureus

Based on Figure 2 (Table 3), it can be seen that *M. elengi* flower methanol extract can inhibit the growth of *S. aureus* bacteria, except at 1% concentration. At concentrations of 2 and 4% had 7.3 and 7.6 mm inhibition zone, when compared with positive controls, the inhibitory activity power was 38.82% and 40.25%. Both of these concentrations are inactive since their activity is below 50%. At concentrations of 8 and 16%, having good activity, with an average inhibition zone of 11.1 mm and 16 mm, compared to positive controls, the inhibitory power activity was 59.04%; and 85.10%. Based on this calculation, the greater the concentration of methanol extract of *M. elengi* flower, the greater the inhibitory power (when compared with the positive control). Based on the observations made, it can be said that the most active is methanol extract of flower *M. elengi* is at 16%.

Antimicrobial activity was categorised as strong with a diameter of inhibitory zone > 20 mm, medium (16-20 mm), weak (10-15 mm), very weak < 10 mm. So that in this study, *M.elengi* flower methanol extract concentration of 8%-16% has a weak to moderate inhibition zone category [24].

In a previous study, the extract *n*-hexane of *M. elengi* flowers with a concentration of 4% (b / v) had an activity of 39.81% [10]. When compared with this study using methanol solvent, *M. elengi* flower extract at the same concentration was able to inhibit the activity of *S. aureus* bacteria with the inhibitory power of 40.04%. This shows that methanol extract of *M. elengi* flower is more active than *n*-hexane extract in inhibiting the growth of *S. aureus* bacteria. This is because methanol solvents can attract more secondary metabolites than *n*-hexane solvents [25].

Patchouli oil activity as anti-bacteria in 1% concentration, with 3 times observations obtained average inhibitory zone to *S.aureus* bacteria of 7.3 ± 0.5 mm, compared to the positive control, its inhibitory power activity is 38.28%.

The methanol extract of M. elengi flower grown in India tested against S. aureus has good activity [26].

Antifungal Activity the Extract Methanol of Flower of M. elengi against C. albicans

The results of the observation of the inhibitory zone of methanol extract on *C. albicans* fungus in Table 4, which shows the average yield of the inhibitory zone in millimetres

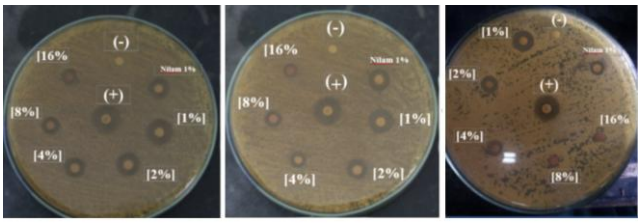
Table 4: The average inhibition zone of *M. elengi* methanol extract on the fungus of *C. albicans*

No	Concentration of extract (w / v)	Average inhibition zone (mm)
1	1%	17.5 ± 3,1
2	2%	15 ± 4.3
3	4%	11.6 ± 2.5
4	8%	10.16 ± 2.3
5	16%	8.5 ± 1.3
6	Patchouli	11.83 ± 3.3
7	Control (+)	21.83 ± 1.5
8	Control (-)	0

Positive control: nystatin 100 µg/mL; Negative Control: methanol solvent; Diameter of discs: 6 mm.

Observation of the inhibition zone of the growth of *C. albicans* fungus in Petri dishes, with

repetitions 3 times, showed quite clear results, which can be seen in Figure 3 (yield in Table 4)



(a = test 1) (b = repeat 2) (c = repeat 3)

Figure 3: Inhibitory power of methanol extract of M. elengi to fungus C. albicans

Based on Figure 3 (Table 4), it can be seen that the smallest concentration of methanol extract, which is 1%, most actively inhibits the growth of *C. albicans* fungi. The observation result of 3 repetitions (Figure 3A, B, and C) shows the average inhibitory zone of 1% methanol extract is 17.5 ± 3,1 mm (inhibitory power activity is 80.23%, compared with positive control), at 2% methanol extract concentration (an average inhibitory zone is 15 mm). Inhibitory power to *C. albicans* also decreased at a concentration of 8 and 16%, this can be due to the presence of organic compounds contained in the extract that can affect the work of antimicrobial substances, this compound does not inhibit the growth of fungus, but instead, it protects microorganisms from antimicrobial agents [27]. Other suspicions of this result are also influenced by the process of diffusion of the active substance through the cell wall of the fungus, the greater the concentration of the extract is thought to complicate the process of diffusion of the substance into the cell wall of the fungus, so there is no direct contact between the active compound with the mushroom cell[28].

Saponins contained in *M. elengi* flower methanol extract can be antifungal with a mechanism to disrupt the permeability of the fungal cell membrane because saponins have surfactant properties that are polar in shape so that when saponins diffuse into the cell membrane, it interferes with the substances needed by the fungus disrupted, and eventually the cell membrane becomes lysis and rupture [29].

Making the lotion of the flower of M. elengi

Making the lotion is based on the activity of the extract against microbes. Based on the tests had been done, the lotions made with methanol extract with concentrations 1, 2, 8 and 16%, (1 and 2%, active concentrations for fungi of *C. albicans*, while 8 and 16% active concentrations for *S. aureus*).

Lotion with 1% concentration of methanol extract is whitish, lotion with 2% methanol extract concentration is brown younger than 8% and 16%, and dark brown colour is the lotion with 16% methanol extract concentration.

The activity of the lotion of the flower of M. elengi against S. aureus bacteria

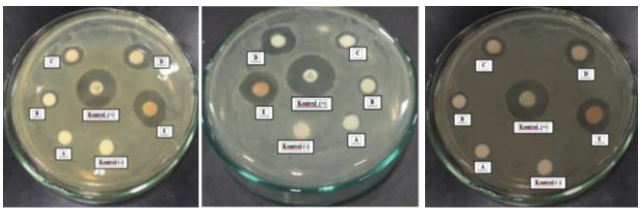
The antibacterial activity of the lotion of methanol extract from M. elengi on S. aureus bacteria is shown in table 5, which shows the average yield of the inhibition zone in millimetres.

Table 5: The average inhibition zone of the methanol extract of *M. elengi* flowers against *S. aureus*

No	Hand lotion extract methanol flower *M. elengi*	The average inhibition zone (mm)
1	(A) Blank + patchouli oil	7.3 ± 0.33
2	(B) lotion with extract 1%	9.8 ± 0.58
3	(C) lotion with extract 2%	11.3 ± 0.48
4	(D) lotion with extract 8%	15.1 ± 1.58
5	(E) lotion with extract 16%	18.3 ± 2.33
6	Control (+)	22.5 ± 0.25
7	Control (-)	6.8 ± 0.08

Control (+): Gentamicin 30 µg/mL; Control (-): Blank = Basis Lotion.

Observation of the inhibition zone of lotion on the growth of *S aureus* bacteria in Petri dishes, with repetitions 3 times, showed quite clear results, which can be seen in Figure 4 (yield in Table 5)



(test 1) (repeat 2) (repeat 3)

Figure 4: Inhibitory zone lotion of methanol extract of M. elengi on S. aureus

Based on Figure 4, it is known that the active *M. elengi* flower lotion inhibits the growth of *S. aureus* bacteria, from concentrations of 1% to 16%. Inhibitory of the lotion with 16% methanol extract has an inhibitory power activity of 81.33%, but if reduced by negative control of activeness only 51.24%, but the use of lotion is together with the media, so the combination of methanol extract of *M. elengi* flowers with the medium is good inhibiting the growth of *S. aureus* bacteria. At 8% concentration, the inhibitory power is 67.11%.

Comparison between the activity of extract and lotion, *M. elengi* in inhibiting the growth of *S. aureus* bacteria can be seen in Figure 5.

Based on Figure 5, it can be seen that the activities of lotion of methanol extract of *M. elengi* flowers in inhibiting the growth of *S. aureus* bacteria are bigger than the extract, at concentrations of 1, 2 and 8%, but smaller at 16%. This may be due to the dispersion of the active compound extract in the lotion medium.

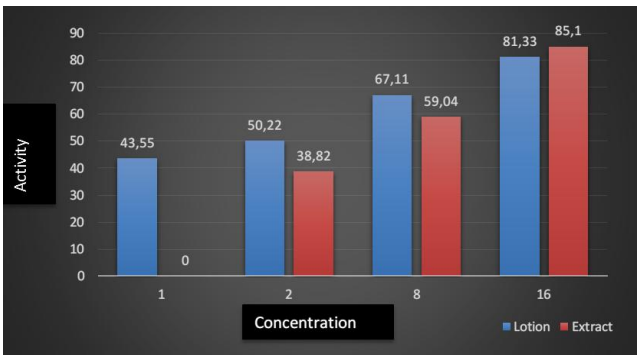


Figure 5: Comparison between the activity of lotion and methanol extract of the flower of M. elengi in inhibiting the growth of S. aureus bacteria

Antifungal activity of lotion containing methanol extract of M. elengi on C. albicans

The results of the testing of antifungal of lotion of methanol extract of *M elengi* flower against *C. albicans* can be seen in Figure 6.

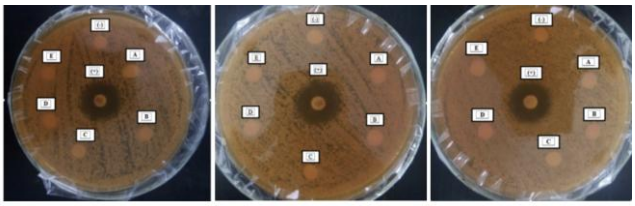


Figure 6: Inhibitory zone of lotion of methanol extract with concentrations of 1%, 2%, 8%, and 16% against C. albicans

Based on the observations in Figure 6 above, the observations A) Blanko + patchouli oil; B) lotion with extract 1%; C) lotion with extract 2%; D) lotion with extract 8%; E) lotion with extract 16%, showed no inhibitory zone. it can be said that the lotion of inactive methanol extract inhibits the growth of *C. albicans* fungus. These observations indicate that the positive control (nystatin can inhibit the growth of *C. albicans* fungus, with 23 ± 0.25 mm inhibitory zone) which indicates the inactivity of methanol extract 1, 2, 8, and 16% inhibits the growth of *C. albicans* fungus.

Physical and Organoleptic Properties

Measurement of physical and organoleptic properties is carried out every week, in 4 weeks.

Measurement of the type of lotion

Blank formulations were hand lotions which consisted of lotion base, while patchouli formulation, lotion base which added with 1% patchouli oil, then lotion base which was added with M.elengi methanol extract, with a concentration of 1% (b / v), 2% (b / v), 8% (b / v) and 16% (b / v). Hand lotions are made with lotion ingredients based on Indonesian Pharmacopoeia guidelines [13]. Which has been modified? The results showed that the type of lotion was type m/a, which was caused by the type of emulgator used in the formulation preparation. The emulgator used is Triethanolamine (TEA) and stearic acid. TEA and stearic acid are hydrophilic or ingredients that can dissolve in water so that it can strengthen the formulation of lotion formations which are classified as m/a the use of water beside as a solvent in the process of making hand lotions can also cause the emulsion type to be m/a [30].

Results of measurement of viscosity test

The viscosity value will influence the spread of the formulation preparations on the skin [31]. The viscosity of hand lotions was measured by using R1-2-H2 Rheology International viscometer spindle using spindle 3 at a speed of 100 rpm. The lowest viscosity was obtained in the first week with a formulation of 1% and a viscosity value of 24.030 cP. Whereas the highest viscosity value was produced from 16% formulation of 33.083 cP. Viscosity test results showed that the difference in the concentration of methanol extract of *M. elengi* flowers added to the formulation preparation could affect the value of the hand lotion viscosity. The observation of viscosity value for 4 weeks did not change significantly, which suggested that the storage period of hand lotion for 1 month did not affect the viscosity of the formulation**.**

The measurement results of the viscosity values of the formulations 1% to 16% have met the semi-solid preparation standard based on SNI 16-4399-1996 [32], which is in the range of values between 2.000-50.000 cP.

Measurement PH of lotions

Testing of pH of hand lotion is carried out every week for a 1-month storage period. Measurement of pH of hand lotion was carried out using thermo electron corporation Orion pH meter. The pH of the blank formulation having a pH value ranging from 7.2-7.7 showed that the hand lotion preparations made were somewhat an alkaline because the emulsifying agent used in this study was an alkaline emulsifier, triethanolamine, and stearic acid which resulted in the preparation having a slightly alkaline property [33]. The pH value of the 1% formulation to the 16% formulation ranged from 6.9 to 8.0, this pH value in the range of SNI 16-4399-1997 where the lotion that can be used for the skin is a lotion that has a pH range of 4.5-8.0. If the formulation preparation has a pH value that is too acidic, it can cause the skin to become irritated and if the formulation preparation has a pH value too alkaline it can cause the skin to become dry and irritated [34].

Spreadability of the lotion

The test of the spreadability power of the formulation was carried out by using two glass to spread semi-solid preparations. The addition of 1% extract increased the hand lotion distribution value by 80.2% compared to blank formulations, but with the addition of the hand lotion dispersion extract concentration decreased. This shows that the addition of 1% extract causes the emulsion in the formulation to become thinner while the addition of a greater concentration of extract emulsion becomes thicker [35].

Semi-solid preparations that are comfortable when used in the skin are formulation preparations that have a spreading power diameter ranging from 5-7 cm or equivalent to 19.6-38.46 cm^2. The dosage formulation which is not included in the range of comfortable dispersion in its use on the skin is a 16% hand lotion formulation with a value of 18.8 cm^2. It is assumed that the 16% formulation, which has very low dispersion, can cause discomfort when used on the skin because it causes stickiness.

The power adhesion the lotion

Adhesion test of hand lotion formulation is done to see the time needed for the formulation to stick to the skin. Good formulations are those that have not too fast and not too long adhesion, adhesion form blank formulations during storage process has increased sticking time, this can be caused by reduced water content during the storage process so that the formulation is thicker during the storage process, but the difference in sticky power values is not too large, which ranges from 28 seconds to 34 seconds. The hand lotion formulation, after being added with methanol extract of *M. elengi* flower has a longer adhesion value compared to the adhesion of the hand lotion blank. The formulation of the hand lotions which have been added with extracts which have the longest sticking power is 16% formulations with adhesion values ranging from 34 seconds to 53 seconds, and formulations that have the fastest adhesion are 1% formulations ranging from 30 seconds to 34 seconds.

Physical properties of all the lotion in from the first week till the fourth of weeks can be seen in Table 6.

Table 6. Physical properties of the lotion from the first week till the fourth of weeks

Physical properties	Lotion type: Formulasi 1% (Average of measurements (week) 1)	Formulasi 1% (2)	Formulasi 1% (3)	Formulasi 1% (4)	Formulasi 2% (1)	Formulasi 2% (2)	Formulasi 2% (3)	Formulasi 2% (4)	Formulasi 8% (1)	Formulasi 8% (2)	Formulasi 8% (3)	Formulasi 8% (4)	Formulasi 16% (1)	Formulasi 16% (2)	Formulasi 16% (3)	Formulasi 16% (4)
PH	8.0	7.5	7.2	7.4	7.4	7.3	7.1	7.6	6.9	6.9	7.0	6.6	7.2	7.3	7.0	7.5
Adhesive Power of (Second)	31	33	34	30	34	38	37	32	37	37	36	34	45	49	53	34
Viscosity of (cP)	24,030	24,380	23,879	23,536	24,360	24,280	24,333	23,823	24,100	24,120	23,186	23,468	33,830	33,930	33,541	33,449
Spreadability of (cm)	28.4	29.5	28.4	28.4	24.6	24.6	24.6	30.1	21.2	21.2	22.4	23.5	18.8	18.8	18.0	21.2

Organoleptic test results

The testing the fragrance, colour, and texture of the hand lotion. Panelists as many as 30 people, and with measurements of, very like = 5, likes = 4, little likes = 3, dislike = 2, and very dislike = 1.

Table 7. ANOVA statistical analysis results with 95% confidence level (p < 0.05)

No	Level of preference	F	P-value
1	Fragrance	2.659	0.051
2	Color	2.758	0.047
3	Texture	2.881	0.033

Based on Table 7, the level of preference for fragrance, colour, and texture using hypotheses:H0: There is no difference in the level of preference for hand lotions based on fragrance, colour, and texture.H1: There is a different level of preference for hand lotions based on fragrance, colour, and texture. Shows that there are differences in the level of preference for fragrance, colour, and texture of hand lotions as evidenced by the value F calculated smaller than Ftable, and *p*-value which is greater than 0.05 so that H0 can be rejected, which means there are differences in the level of preference for the colour and texture of hand lotion.

To see the level of respondents preference for each formula, a comparison of the average values obtained in each formulation was carried out. Following the results of the average level of preference for fragrance, colour, and texture of the hand, lotion formulation can be seen in Table 8.

Table 8: Average values of the analysis of respondents preference level for fragrance, colour and texture of hand lotion formulations

No.	Hand lotion of	The average level of preference		
		Fragrance	Colour	Texture
1	Commercial Formulation	4.80	4.77	4.73
2	Formulation blank	3.03	4.03	3.90
3	Patchouli formulation	2.67	3.80	3.73
4	Formulation 1%	3.10	3.17	3.23
5	Formulation 2%	3.23	2.97	2.77
6	Formulation 8%	2.93	2.63	2.27
7	Formulation 16%	2.77	1.80	1.87

Control (+): commercial lotion; Control (-): Blank formulation.

Discussion

Hand lotion of methanol extract that the most optimal in inhibiting the growth of *S. aureus* bacteria at a concentration of 16% with an inhibition zone of 18.3 ± 2.33 mm and inhibitory power of 81.3%, as compared with the positive control of gentamicin (30 µg/mL)

The methanol extract of *M. elengi* flower can inhibit the growth of *S. aureus* and *C.albicans* microbe. At a concentration of 16%, inhibitory power

to *S. aureus* is 85.1%, as compared with the positive control of gentamicin (30 µg/mL), while the highest inhibitory power on *C. albicans* was 1%, with 80.1% inhibitory power (compared with nystatin positive control, 100 µg/mL).

The presence of terpenoid compounds in the form of a straight-chain and bridge {bicyclo namely: 1.8 cineole (2-Oxabicyclo [2.2.2] octane, 1,3,3-trimethyl); Camphor (Bicyclo [2.2.1] heptane-2-one, 1,7,7-trimethyl); and Borneol L (Bicyclo [2.2.1] heptane-2-ol, 1,7,7-trimethyl)} causes the power of inhibitory of methanol extract of *M. elengi* flower, while the lotion beside having the activity of the extract, also having activity from the media of lotion, is like cetyl alcohol, methylparaben, and triethanolamine. In addition to the presence of patchouli oil as a fragrant binder of methanol extract, it also acts as an anti-fungal [36]. So, the activity is highest than extract. The three bicyclo compounds is a component of essential oil; the results of the literature study known the compound has antibacterial activity [22].

The lotion of methanol extract 1, 2, 8, and 16% is inactive inhibits the growth of *C. albicans* fungus, because possible properties of the outer skin of the fungus *C. albicans* which cannot absorb lotion, so the lotion cannot inhibit its growth.

The formulation of *M. elengi* flower methanol extract hand lotion at concentrations of 1%, 2%, and 8%, and 16%, fulfilling the testing quality requirements for the physical properties of lotion formulations. The most preferred of *M. elengi* flower lotion is 2% formulation, in fragrance, colour, and texture.

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