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Research Article

Anti-acne Emulgel Formulation of Torbangun Leaf Essential Oil (*Plectranthus amboinicus* (Lour.) Spreng. and Antibacterial Test against *Staphylococcus aureus* and *Propionibacterium acne* bacteria

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ABSTRACT

Plectranthus amboinicus (Lour.) Spreng. It is a member of the Lamiaceae family that grows naturally throughout the tropics. This plant contains essential oils that have antimicrobial activity including inhibition against *Staphylococcus aureus* bacteria. Acne is an inflammation of the skin that can be caused by bacteria such as *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Propionibacterium acne*. For treatment, emulgel preparations are in great demand because they can be used as a better topical drug delivery system. The purpose of this study was to formulate torbangun essential oil emulgel and to determine its antibacterial activity against *Staphylococcus aureus* and *Propionibacterium acne* bacteria. Emulgel evaluation includes organoleptic testing, pH, viscosity, spreadability and stability. The results showed that Torbangun essential oil anti-acne emulgel concentrations of 4 and 8% gave strong antibacterial activity against *Staphylococcus aureus* and *Propionibacterium acne* bacteria. The emulgel formula that meets the stability test is an anti-acne emulgel formula with a carbomer base.

Keywords: Emulgel, Essential oil Torbangun, *Staphylococcus aureus*, *Propionibacterium acne*

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INTRODUCTION

Plectranthus amboinicus (Lour.) Spreng. It is a member of the Lamiaceae family that grows naturally throughout the tropical and warm regions of Africa, Asia and Australia. This plant is often known as the torbangun plant which contains phytochemicals which are associated with therapeutic and nutritional properties which are highly utilized in the pharmaceutical industry. Previous research reported that this plant contains volatile compounds and non-volatile compounds including monoterpenoids, diterpenoids, triterpenoids, sesquiterpenoids, phenolics, flavonoids, esters, alcohols and aldehydes. The results of pharmacological activity research show that torbangun leaves have antimicrobial, anti-inflammatory, antitumor, wound healing, anti-epileptic, larvicide, antioxidant and analgesic activities¹.

This plant has many pharmacological activities including antimicrobial, anti-inflammatory, antitumor activity, wound healing. Research reported by Bhatt², the polyphenol content shows antibacterial activity against pathogenic bacteria, namely *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli* and *Yersinia enterocolitica*. The essential oil from this plant has inhibitory power against the bacteria *E. coli*, *S. aureus* and *C. tropicalis*³. The hydroalcoholic extract shows activity against MRSA strains⁴. Torbangun essential oil has inhibitory power against bacteria and *Pseudomonas aeruginosa*⁵, *Staphylococcus aureus* and *Propionibacterium acne*^{6,7}.

Acne (acne vulgaris) is inflammation of the skin that occurs due to active oil glands under the skin which can be characterized by clogged pores. This inflammation is triggered by acne-causing bacteria such as *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Propionibacterium*

*acnes*⁸. Acne treatment can take up to months, depending on the severity of the acne experienced. Treatment of acne with antibiotics, such as erythromycin, clindamycin, tetracycline and benzoyl peroxide can cause side effects such as irritation and excessive use of antibiotics can cause previously sensitive bacteria to become resistant. Therefore, it is necessary to search for natural antibacterial compounds that do not have a negative impact on humans.

One of the topical dosage forms currently in demand is emulgel. Emulgel is a combination of gel and emulsion. So that hydrophobic compounds can be formulated with the advantages of the unique properties of the gel. Emulgel can be used as a better topical drug delivery system⁹. A good gel preparation is obtained by formulating a type of gelling agent. Gelling agents can influence the physical properties of the gel produced.

Given the importance of antibiotics to modern medicine, and the increasing concern of resistance. For this reason, it is necessary to develop research on the emulgel formula for torbangun leaf essential oil and test its antibacterial activity against the bacteria *Staphylococcus aureus* and *Propionibacterium acne*.

MATERIAL AND METHODS

Table.1: Torbangun leaf essential oil emulgel formula

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Essensial oil of torbangun	-	0.5	1	2	4	8	-	0,5	1	2	4	8
Carbomer	0.75	0.75	0.75	0.75	0.75	0.75	-	-	-	-	-	-
HPMC	-	-	-	-	-	-	4	4	4	4	4	4
TEA	qs	qs	qs	qs	qs	qs	-	-	-	-	-	-
Parafin liquid	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Propilenglikol	10	10	10	10	10	10	10	10	10	10	10	10
Tween 20	2,93	2,93	2,93	2,93	2,93	2,93	2,93	2,93	2,93	2,93	2,93	2,93
Span 20	4,07	4,07	4,07	4,07	4,07	4,07	4,07	4,07	4,07	4,07	4,07	4,07
Methylparaben	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03
Propylparaben	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Jojoba oil	2	2	2	2	2	2	2	2	2	2	2	2
BHT	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Na EDTA	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Aqua dest	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100

Emulgel Preparations

The oil phase is mixed into the water phase little by little until an emulsion is formed, add the torbangun leaf essential oil then add it to the gel base that has been developed first, then stir until the emulgel is formed¹¹.

Evaluation of Emulgel

1. Organoleptic and homogeneity observations

Organoleptic observations include shape, color, odor of the emulgel preparation. Meanwhile, the homogeneity of the

Intrument

Mortar, stamper, glassware, pH meter, digital analytical balance, viscometer, set of distillation tools, rotary evaporator, hand blender, incubator, petri dish, micro pipette, vernier caliper, spatula, tweezers, vortex, cupboard aseptic, autoclave, spirit lamp, aluminum foil.

Materials

Torbangun leaf, Torbangun essential oil, Carbomer, HPMC, as test bacteria used are *Staphylococcus aureus*, *Propionibacterium acne*, Muller Hinton media, anaerobic oxoid, 70% alcohol and aqua destillata

Sample collection

Torbangun leaf samples were cultivated in Bukittinggi, West Sumatra and identified in the Andalas University Herbarium.

Sample preparation

Essential oil extraction

The torbangun leaves were cleaned, dried to remove water from washing the samples, weighed, then chopped and put into a flask, 500 mL of distilled water was added, then distilled. Distillation was stopped when the volume of essential oil obtained was seen to be constant¹⁰.

emulgel was carried out by weighing 0.1 gram of the preparation and then smearing it on a glass object, observing the arrangement¹².

2. pH measurement

The pH of the emulgel was measured using a pHmeter. Determination of the pH of the preparation is carried out by dipping the pH meter electrode into the diluted sample

3. Viscosity measurement

Performed using a Brookfield NDJ 8S viscometer with Rotor No. 4 at a speed of 6 rpm

4. Measurement of Spreadability

The preparation is weighed as much as 0.5 grams, placed between two glasses and left for 1 minute. The diameter of the spread emulgel is measured by taking the average length of the diameter of several sides. Add a load of 50 grams to it, let it soak for 1 minute and measure the diameter of the spread.

5. Freeze-Thaw Test

The Freeze-Thaw method is carried out at two different temperatures, namely 4°C and 40°C. The first step is to weigh 4 grams of emulgel and put it in a 10 mL vial. The vials were put into the freezer (4°C) and kept for 48 hours, then moved to the climate room (40°C) and kept for 48 hours, this is the first cycle¹³.

Antibacterial Activity Test

1. Media creation

1. A total of 34 grams of Muller Hinton Agar (MHA) powder was dissolved in 1 liter of distilled water, heated to boiling while stirring until completely dissolved. Sterilized in an autoclave at 121°C, 15 lbs pressure, for 15 minutes.
2. Bacterial inoculation
3. The test bacteria were taken using a sterile tube needle, then planted on agar media by streaking with the quadrant scratching technique¹⁴.
4. Making a suspension of *Staphylococcus aureus* and *Propionibacterium acne* bacteria
5. The bacteria are taken with a loop needle, then suspended in 5 ml of 0.9% physiological NaCl solution, until turbidity is obtained, stir until homogeneous.
6. 4. The antibacterial activity test was carried out on *Staphylococcus aureus* and *Propionibacterium acnes* bacteria by first making wells in the media, then inserting ± 1 mg of the preparation into the wells using a previously sterilized spatula, incubating at 37°C for 24 hours. Then observe the growth of the test bacteria and measure the diameter of the obstacle area with a caliper.

RESULT

DISCUSSION

From 4 kg of fresh Torbangun leaves, 0.5 mL of essential oil was obtained using the water vapor distillation method. Meanwhile, using the distillation method, 0.7 mL of essential oil is obtained from 4 kg of fresh Torbangun leaves. The essential oil obtained has a liquid form, pale yellow color, smell and taste typical of Torbangun. The results of the phytochemical screening of Torbangun leaves contain alkaloids, flavonoids, tannins, steroids and phenolic compounds.

Torbangun essential oil formulation with concentrations of 0.5%, 1%, 2%, 4% and 8% with HPMC and carbomer base. From the base that has been determined, proceed to the formulation of essential oil emulgel. The base formula chosen

was HPMC base with a concentration of 4% and Carbomer base with a concentration of 0.75%. Previous research reported that a gel preparation of Torbangun leaf ethanol extract based on carbopol-940 with a concentration of 0.75% met the evaluation of the physical characteristics of the gel preparation including organoleptic examination, homogeneity examination, spreadability test, pH measurement and irritation test¹⁵.

Evaluation of the Torbangun essential oil anti-acne emulgel was carried out for 4 weeks including organoleptic tests, homogeneity tests, pH and skin irritation tests, spreadability tests, viscosity, microbiological tests and stability tests. The organoleptic results of the essential oil emulgel on day 0 showed that the emulgel preparation with a Carbomer base with a concentration of 0.75% had a soft texture and was easy to spread, was white in color, had a characteristic smell of torbangun oil and was homogeneous, whereas the HPMC based emulgel all had a soft texture and easy to spread, yellowish white in color, has the characteristic smell of Torbangun oil and is homogeneous. The stability test showed that, of the 12 basic formulas carried out, there was phase separation in F8 and F12 in the 2nd and 3rd cycles (Table 7).

The stability test was carried out using the Freeze-Thaw test method. From the results of stability testing, it is known that the emulgel formula with an HPMC base shows separation of oil from the base. The results of this test are different from research conducted by Nur Mita et al (2020), where the research showed that the emulgel that met the physical characteristics and stability parameters was a formula with HPMC as a gel former. Gelling agents commonly used in topical formulations are cellulose derivatives, namely hydroxypropyl methylcellulose and other polymers, namely Carbopol. These two gelling agents have been proven to have many advantages for maintaining the emulgel dosage form¹⁶.

pH checks were carried out at Weeks 1, 2, 3 and 4. The test results showed that Torbangun essential oil emulsion with a 4% HPMC base with essential oil concentrations of 0.5, 1, 2.4 and 8% had a pH ranging from 5.8 - 6.6. Meanwhile, Torbangun essential oil emulsion with a 0.75% Carbomer base has a pH ranging from 7.2 to 7.5 (Figures 5 and 6). All formulas do not show skin irritation. The ideal gel preparation for topical preparation according to British Pharmacopeia, is between pH 6-8.

The spreadability examination that has been carried out shows that the spreadability of the Torbangun essential oil emulgel formula based on HPMC with a load of 50 g is around 5 - 7 cm, while for the Torbangun oil emulgel formula with a Carbomer base with a load of 50 g it is around 2.9 - 3.7 cm. The spreadability of emulgel base is related to viscosity. Where lower viscosity is related to greater spreading power and vice versa¹⁷.

The results of viscosity testing carried out at weeks 1, 2, 3, 4 for the HPMC based Torbangun oil emulsion formula ranged from 2200 - 15677 cP. And the viscosity of the carbomer-based torbangun essential oil emulgel formula carried out at weeks 1, 2, 3 and 4 showed a viscosity ranging from 10450 - 61300 cP (Figures 7 and 8). The viscosity of the gel base was measured at 6 rpm for 30 seconds. According to Standart National of Indonesia, the standard viscosity value for gel

preparations is 6000-50000 cP or 6-50 Pa.S. The results of viscosity measurements for all HPMC base formulas show values that are in accordance with the standard range, while for the Carbomer base they show viscosity values that exceed the standard range.

The physical viscosity of the topical formulation must provide rheology for ease of handling and distribution, as well as ease

the filling process during production. Despite this requirement, no specific viscosity values for topical preparations have been established. Gelling agents have different viscosities. This is due to the structure of each gel base. In this viscosity test, a relationship between decreasing viscosity and increasing concentration of added Torbangun essential oil can be seen.

Table 2: The observation results of emulgel base physical characteristics

Formula	Color	Homogeneity	Consistency
F1	White	Homogeneous	Viscous, easy to smear
F2	White	Homogeneous	Viscous, easy to smear
F3	White	Homogeneous	Viscous, easy to smear
F4	White	Homogeneous	Viscous, easy to smear
F5	White	Homogeneous	Viscous, easy to smear
F6	White	Homogeneous	Viscous, easy to smear
F7	White	Homogeneous	Viscous, easy to smear
F8	White	Homogeneous	Viscous, easy to smear
F9	White	Homogeneous	Viscous, easy to smear
F10	White	Homogeneous	Viscous, easy to smear
F11	White	Homogeneous	Viscous, easy to smear
F12	White	Homogeneous	Viscous, easy to smear

Table 3: Results of testing the stability of Torbangun essential oil emulgel

Formula	Physical Stability Test per-Week		
	1	2	3
F1	-	-	-
F2	-	-	-
F3	-	-	-
F4	-	-	-
F5	-	-	-
F6	-	-	-
F7	-	-	-
F8	-	+	+
F9	-	+	+
F10	-	+	+
F11	-	+	+
F12	-	+	+

(-) no separation of phases and consistency

(+) separation of phases

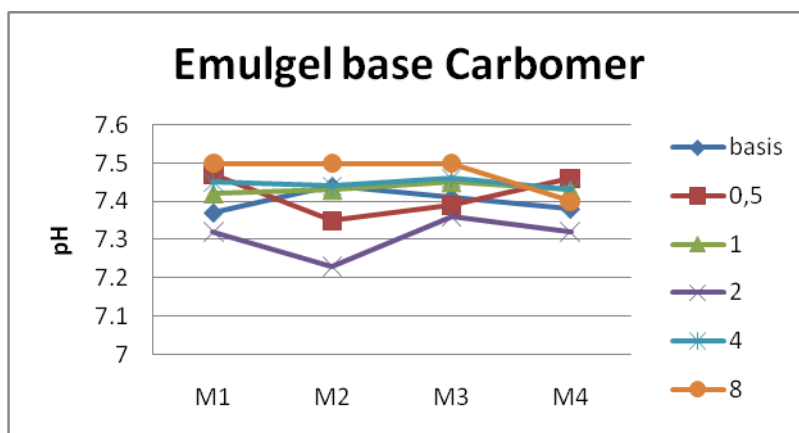


Figure 1: pH measurement of Torbangun essential oil emulgel based on Carbomer at weeks 1, 2, 3 and 4

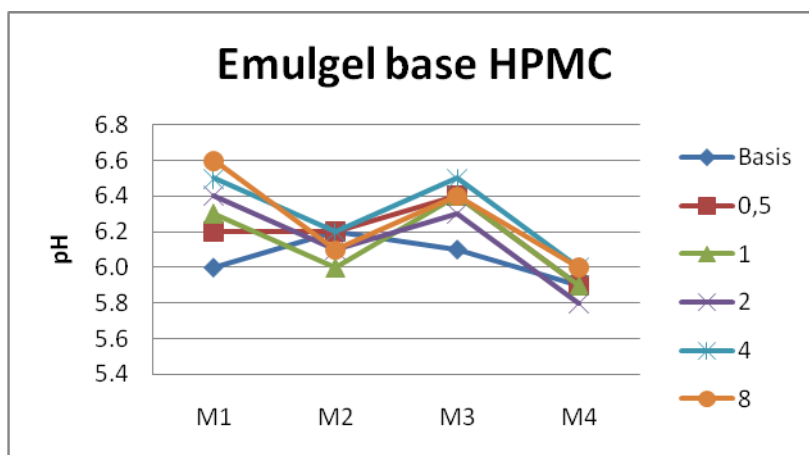


Figure 2: pH measurement of Torbangun essential oil emulgel based on HPMC at weeks 1, 2, 3 and 4

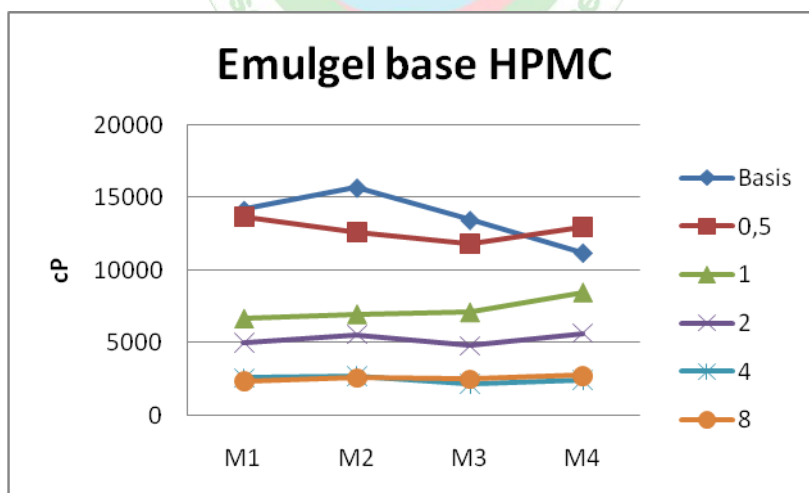


Figure 3: Measurement of the viscosity of Torbangun essential oil emulgel based on HPMC at weeks 1, 2, 3 and 4

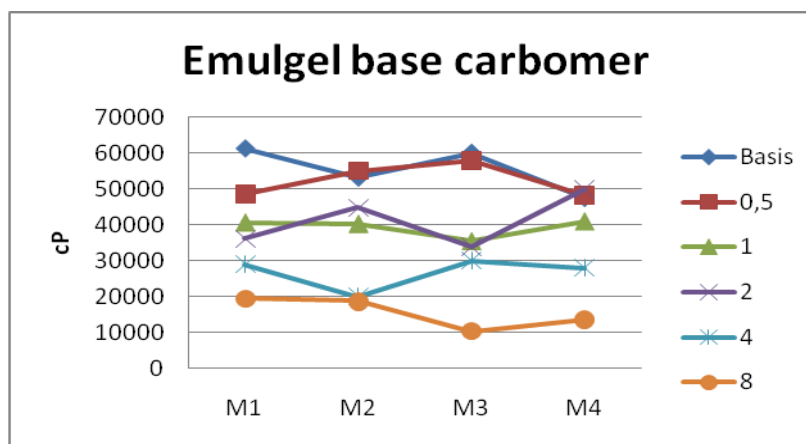


Figure 4: Measurement of the viscosity of Torbangun essential oil emulgel based on carbomer at weeks 1, 2, 3 and 4

Based on the physical evaluation of the basic emulgel formula as a whole, it can be concluded that the basic emulgel formula that meets all the criteria including physical characteristics, determining pH, viscosity, spreadability, and stability testing are formulas F2 and F6.

The results of testing the antibacterial activity of Torbangun essential oil emulgel using the agar diffusion method showed that the HPMC-based formula at concentrations of 4% and 8% could inhibit the growth of *Staphylococcus aureus* bacteria with inhibitory diameters of 9.92 mm and 14.85 mm respectively, emulgel on concentrations of 0.5%, 1% and 2% did not provide a diameter of the inhibitory area. Formulas based on Carbomer at concentrations of 4% and 8% can inhibit the growth of *Staphylococcus aureus* bacteria with inhibitory diameters of 9.6 mm and 11.17 mm respectively, emulgel at concentrations of 0.5%, 1% and 2% does not provide the diameter of the inhibition area. The results showed that the essential oil base and emulsifier with concentrations of 0.5%, 1% and 2% had no inhibitory diameter, while at concentrations of 4 and 8% there was an

inhibitory diameter. This decrease in the inhibitory power value can be caused by a relationship between the concentration of the essential oil used and the antibacterial activity, where it appears that the higher the concentration, the more visible the antibacterial activity of the preparation.

According to Davis and Stout (1971) antibacterial power based on the diameter of the inhibition zone is divided into very strong (inhibition zone more than 20 mm), strong (inhibition zone 10-20 mm), medium (inhibition zone 5-10 mm) and weak (inhibition zone less than 5 mm). The absence of a clear area at several concentrations (0.5%, 1%, 2%), is caused by the low concentration of essential oils. The low level of active compounds can cause inhibition of the growth of each test bacteria to occur in a small portion of the total number of bacterial cells, so that bacteria that are not disturbed by the active compounds can grow. Factors that influence bacterial growth are the availability of nutrients, water, temperature, pH, oxygen, and oxidation-reduction potential and the presence of inhibitory substances¹⁸.

Table 4: Test results of Torbangun essential oil anti-acne emulgel against *Staphylococcus aureus* bacteria

Formula	Area of inhibition zone (mm) HPMC base	Area of inhibition zone (mm) Carbomer base
Klindamisin gel (Positive control)	28,03 ± 1,68	26,81 ± 0,87
Emulgel base (Negatif control)	-	-
Emulgel 0,5%	-	-
Emulgel 1%	-	-
Emulgel 2%	-	-
Emulgel 4%	9,92 ± 1,42	9,60 ± 1,19
Emulgel 8%	14,85 ± 0,89	11,17 ± 1,89

The results of testing the antibacterial activity of Torbangun essential oil emulgel using the agar diffusion method showed that the HPMC-based formula at concentrations of 4% and 8% could inhibit the growth of *Propinibacterium acne* bacteria with inhibitory diameters of 10.58 mm and 14.92 mm respectively, emulgel on concentrations of 0.5%, 1% and 2% did not provide a diameter of the inhibitory area. Formulas based on Carbomer at concentrations of 2%, 4% and 8% can

inhibit the growth of *Propionibacterium acne* bacteria with inhibitory diameters of 8.63 respectively; 11.71 mm and 13.26 mm, while emulgel at concentrations of 0.5% and 1% did not provide the diameter of the inhibitory area (Table 5). The results show that the essential oil base and emulsifier with concentrations of 0.5%, 1% and 2% do not have inhibitory diameters, while at concentrations of 4 and 8% there are inhibitory areas.

Table 5: Test results of Torbangun essential oil anti-acne emulgel against *Propionibacterium acne* bacteria

Formula	Area of inhibition zone (mm) HPMC base	Area of inhibition zone (mm) Carbomer base
Klindamisin gel (Positive control)	21,71 ± 0,57	21,86 ± 0,75
Emulgel base (negatif control)	-	-
Emulgel 0,5%	-	-
Emulgel 1%	-	-
Emulgel 2%	-	8,63 ± 0,35
Emulgel 4%	10,58 ± 0,58	11,71 ± 0,7
Emulgel 8%	14,92 ± 0,99	13,26 ± 0,6

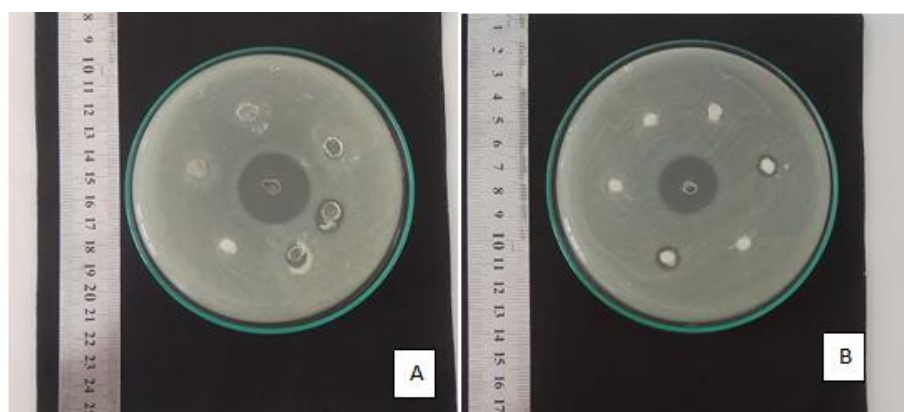
**Figure 5:** Inhibitory area for the growth of *Staphylococcus aureus* bacteria on Torbangun essential oil emulgel.

Image caption A: HPMC based emulgel

B : Carbopol based emulgel

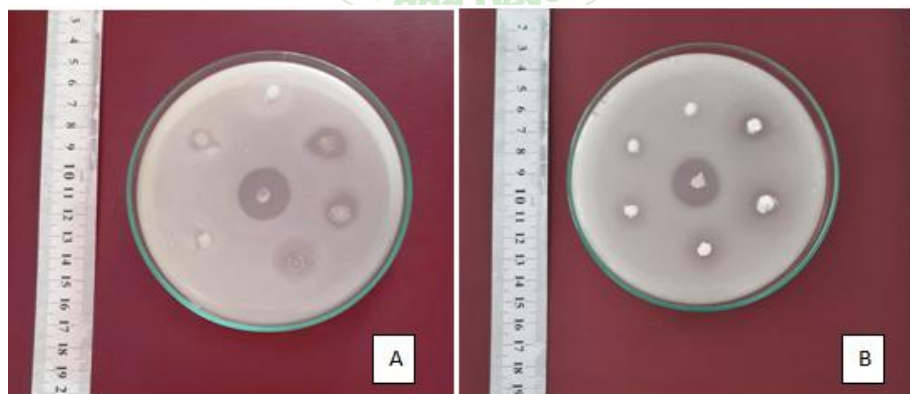
**Figure 6:** Inhibitory area for the growth of *Propionibacterium acne* bacteria in Torbangun essential oil emulgel.

Image caption A: HPMC based emulgel

B : Carbopol based emulgel

CONCLUSION

The Torbangun essential oil anti-acne emulgel formula has strong antibacterial activity against *Staphylococcus aureus* and *Propionibacterium acne* at concentrations of 4 and 8%. A preparation that meets stability testing is an anti-acne emulgel with a carbomer base.

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