# FORMULATION AND PHYSICAL EVALUATION OF CREAM CONTAINING MENIRAN LEAVES (*Phyllanthus niruri* L.) USING VARIATIONS OF STEARIC ACID AND TRIETHANOLAMINE

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**Abstract**

Meniran leaves (*Phyllanthus niruri* L.) have antibacterial activity against *Cutibacterium acnes*. The aim of this study was to determine whether varying concentrations of stearic acid and triethanolamine as emulsifiers could affect the physical properties of meniran leaf extract cream formulations (*Phyllanthus niruri* L.) and to identify the optimal cream formulation. This was an experimental study. The cream formulation was prepared in three formulas with varying concentrations of stearic acid and triethanolamine, namely F1 (15% : 4%), F2 (16% : 3%), and F3 (17% : 2%). The evaluation of the cream formulations included organoleptic properties, pH, homogeneity, viscosity, spreadability, adhesion, irritation, and hedonic properties, as well as data analysis using the One-Way ANOVA method. The results of the analysis showed that variations in stearic acid and triethanolamine concentrations affected spreadability, adhesion, viscosity, and pH values. The best formula was F3 with stearic acid and triethanolamine concentrations of 17% : 2%.
**Keywords**: stearic acid, meniran leaves, triethanolamine

## INTRODUCTION

The skin is the largest and heaviest organ in the body, and skin health is crucial because it acts as a protective barrier against physical and chemical irritants. Everyone feels more confident when their facial skin is clear (Hidayaturrahmi, 2022). Acne is a common skin issue that can be addressed. It can cause feelings of depression, anxiety, and embarrassment for those affected, although it is not a serious infectious disease. Acne is triggered by various factors, such as skin condition, hygiene, lifestyle, hormones, and stress. One of the causes is an imbalance of microorganisms in the skin layer (Vitoria et al., 2018). The bacteria living on the skin's surface are diverse, one of which is *Cutibacterium acnes*, more commonly known as *Propionibacterium acnes*.

Cream is a semi-solid formulation containing one or more active ingredients dissolved in an appropriate base material. Traditionally used in semi-solid formulations with a sufficiently liquid consistency, it is formulated as an oil-in-water or water-in-oil emulsion (Kemenkes RI, 2020). Cream is a semi-solid emulsion containing at least 60% water and intended for external use. High-quality creams have several characteristics, including: a smooth texture, easy application, easy to wash off or rinse with water, odorless, free from harmful microorganisms, does not cause skin irritation, and leaves no residue (Kemenkes RI, 2020).

Meniran is a plant with properties that can address various issues, including acting as a natural antibiotic. In a study conducted by Denis & Mardiyanti, (2024), ethanol extract from meniran leaves was found to have antibacterial activity against Cutibacterium acnes bacteria at a 5% concentration, with an inhibition zone of 11.5 mm, classified as strong. Secondary metabolites in meniran, such as alkaloids, saponins, and flavonoids, have antibacterial activity that can inhibit the growth of *Cutibacterium acnes* bacteria (Fitri & Widiyawati, 2017), making meniran leaves an excellent option for acne treatment.

Based on the background described above, this study aims to determine whether varying concentrations of stearic acid and triethanolamine as emulsifiers can affect the physical properties of antibacterial cream formulations, and to identify the optimal concentration of stearic acid and triethanolamine as emulsifiers to achieve the best physical properties in antibacterial cream formulations.

## METHOD

### Instrumen

The equipment used in this study included a set of adhesion testing equipment, a set of spreading testing equipment, a rotary evaporator (Boeco®), a digital viscometer (Silvergreen), a maceration vessel, a moisture analyzer (MX-50 And Japan), an analytical balance (Ohaus), an electric stove, a set of glassware (Pyrex®), reaction tubes (Pyrex®), mortar and pestle (Pyrex®), thermometer, water bath (Memmert WTB-6), dropper pipette, wooden clamps, filter paper, flannel cloth, knife, scissors, cream pot, horn spoon, and pH meter (Smart Sensor AS218), vernier caliper.

**Materials**
The materials used in this study were meniran leaves obtained from the city of Pekalongan, Central Java, and other materials including 96% ethanol solvent (JK Care, technical grade), distilled water (Brataco, technical grade), magnesium powder (Merck, pro analyst), concentrated hydrochloric acid solution (Merck, pro analyst), quercetin (Sigma Aldrich, pro analytical grade), caffeine (Sigma Aldrich, pro analytical grade), diosgenin (Sigma Aldrich, pro analytical grade), gallic acid (Sigma Aldrich, pro analytical grade), $FeCl_3$ (Merck, pro analytical grade), Dragendorf reagent (Merck, pro analytical grade), and methylene blue (Laboratory Reagent). For the following materials: stearic acid (Wilfarin, pharmaceutical grade), cetyl alcohol (Ecogreen Oleochemicals, pharmaceutical grade), triethanolamine (Petronas, pharmaceutical grade), methyl paraben (Shree Chemicals, pharmaceutical grade), propyl paraben (Shree Chemicals, pharmaceutical grade), liquid paraffin (PT. Wilmar Nabati Indonesia), and glycerin (PT. Wilmar Nabati Indonesia) with pharmaceutical grade materials from CV. Kimia Jaya Labora.

**Research Procedure**
**Extraction**
Extraction of meniran leaf samples was performed using the maceration method. A total of 500 grams was placed in a maceration vessel and macerated using 96% ethanol solvent three times. The first maceration was performed using 3 liters of 96% ethanol solvent, then soaked for 3 x 24 hours with intermittent stirring. The residue obtained was re-extracted using 1 liter of 96% ethanol for 1 x 24 hours. The residue formed during the second maceration was then re-macerated using 1 liter of 96% ethanol for 1 x 24 hours and filtered. The resulting maceration filtrate was concentrated using a rotary evaporator at 50°C (Denis & Mardiyanti, 2024).

**Phytochemical Screening Test**

1. **Flavonoid Identification**
   A small amount of ethanol extract from meniran leaves was taken and dissolved in ethanol, then 0.05 mg of magnesium powder and hydrochloric acid (HCl) were added dropwise and shaken vigorously. The presence of flavonoids was indicated by the formation of red, yellow, or orange colors (Ulfah et al., 2021). The positive control test uses quercetin as the flavonoid reference standard, and the negative control test uses distilled water.
2. **Saponin Identification**
   A small amount of ethanol extract from meniran leaves is taken and added to 10 mL of hot distilled water, then cooled and shaken vigorously for approximately 1 minute. A positive result is indicated by the formation of foam for at least 10 minutes with a foam height of 1–10 cm (Denis & Mardiyanti, 2024). The positive control test used diosgenin as the saponin reference standard, and the negative control test used distilled water.
3. **Alkaloid Identification**
   A small amount of ethanol extract from meniran leaves is taken, then 10 drops of 2N $H_2SO_4$ are added and shaken vigorously. Dragendroff reagent is then added; a positive result is indicated by the presence of a brick-red precipitate (Muajana et al., 2017). The positive control test uses caffeine as the alkaloid reference standard, and the negative control test uses distilled water.
4. **Identification of Phenolics**
   One milliliter of concentrated extract is placed in a tube, then 2–3 drops of $FeCl_3$ are added. A positive result is indicated by the formation of an ink-blue or dark green color (Halimu et al., 2017). The positive control test uses gallic acid as the reference standard, and the negative control test uses distilled water.

**Formulation of Meniran Leaf Extract Cream**

In this study, a meniran leaf extract cream formulation was developed with 3 formulas and 3 replicates for each formula. The cream formulation formulas are presented in Table 1. The cream preparation procedure involved the following steps: First, the oil phase, consisting of stearic acid, cetyl alcohol, liquid paraffin, and methyl paraben, was melted at 50°C and stirred until homogeneous (Mixture A). Then, the aqueous phase, consisting of triethanolamine (TEA), glycerin, propyl paraben, and distilled water, was dissolved at 50°C and stirred until homogeneous (Mixture B). The melting of the aqueous phase and oil phase was performed on a water bath at 50°C. After that, the water phase (Mixture A) is added to the oil phase (Mixture B). Before mixing the two phases, the mortar is heated using boiling water, then the hot water is drained from the mortar. After that, the oil phase is added first to the mortar and stirred clockwise, then the water phase is added gradually while stirring constantly until a cream-like consistency is formed. Next, the concentrated meniran leaf extract was dissolved with a small amount of distilled water, then the meniran leaf extract was added to the mixture little by little while stirring quickly until the cream preparation was homogeneous and there were no lumps in the cream preparation (Suci et al., 2024).

**Table 1.** Formulation Design of Meniran Leaf Extract Cream Preparation

| Ingredient Name | Formulation (%) | | | Function |
|---|---|---|---|---|
| | F1 | F2 | F3 | |
| Meniran leaf ethanol extract | 5 | 5 | 5 | Active Ingredient |
| **Stearic acid** | **15** | **16** | **17** | **Emulsifier** |
| **Triethanolamine** | **4** | **3** | **2** | **Emulsifier** |
| Cetyl alcohol | 4 | 4 | 4 | Thickener |
| Glycerin | 10 | 10 | 10 | Humectant |
| Liquid paraffin | 6 | 6 | 6 | Emollient |
| Methyl paraben | 0.2 | 0.2 | 0.2 | Preservative |
| Prophyl paraben | 0.05 | 0.05 | 0.05 | Preservative |
| Destilled water | Ad 100 | Ad 100 | Ad 100 | Solvent |

**Evaluation of the Physical Properties of Cream**

1. **Organoleptic Test**
   This organoleptic test was conducted by observing various aspects, including smell, color, and texture of the cream preparation using the five senses (Suci et al., 2024).
2. **Homogenity Test**
   The homogeneity test was performed by placing an adequate amount of cream between two watch glasses, then observing whether there were any coarse particles and whether the surface was smooth and even (Majid et al., 2019). The criteria for a good homogeneity test are that the cream preparation does not contain clumped particles or mixed M/A phase compositions.
3. **pH Test**
   The pH test uses a pH meter, which is first calibrated with standard buffer solutions at pH 4.01 and pH 7.01 until the pH meter reads those values. The sample to be tested for pH is prepared by dissolving 1 gram of meniran leaf extract cream in 25 ml of distilled water. The electrode is then immersed in the container containing the sample to be tested (Karim Zulkarnain et al., 2023). The ideal pH value is 4.5–6.5 (Majid et al., 2019).
4. **Viscosity Test**
   The viscosity test was conducted using a digital viscometer (bdv-9s). The procedure involved attaching the rotor to the viscometer and locking it in place in a clockwise direction. The cup was filled with the cream sample to be tested, and the rotor was placed in the center of the cup containing the sample. The “on” button was then pressed. Rotor number 2 (for measuring preparations with a viscosity of 100–4000 dPas) will begin to rotate, and once the viscosity reaches stability, the measurement results can be read on the display in dPas units (Pratasik et al., 2019). The viscosity requirement for a good semi-solid formulation is in the range of 400–4000 dPas (Milanda et al., 2021).
5. **Spreadability Test**

Weigh 1 gram of cream and place it in the center of an inverted Petri dish. Place another transparent glass slide over the cream and let it sit for 1 minute. Then, a 50-gram weight is added and left for 1 minute. Subsequently, weights of 50, 100, 150, 200, and 250 grams are added for 1 minute each with the same procedure. The diameter of the spread cream is recorded for each tested weight. Good spreading power is 5–7 cm (Majid et al., 2019).

6. **Adhesion Test**
   The adhesion test is performed by taking 1 gram of cream and applying it to the surface of a glass plate. Next, the two glass plates are pressed together until they adhere and are pressed with a 1 kg weight for 5 minutes. After that, the weight is removed and a release weight of 80 grams is applied to test the adhesion strength. Then, record the time when the two plates separate (Pratasik et al., 2019). A good adhesion strength test requirement for cream formulations is more than 4 seconds (Natalia, 2020).
7. **Irritation Test**
   The irritation test was conducted using the open patch test technique, applied to the forearm area of 12 panelists. Each panelist was tested with 9 creams. The open patch test was conducted by applying the test formulation to the forearm area and leaving it exposed, observing any reactions. The cream was applied to the skin area similar to the facial skin, specifically the forearm, for 30 minutes. The irritation test was conducted on 12 panelists consisting of men and women aged 20 to 35 years. Irritation was observed if skin reactions such as erythema and edema occurred, as the criteria for a safe cream formulation are that it does not cause erythema or edema (Kristiani and Filadelfian, 2024).
8. **Cream Type Test**
   The cream type test used the color dispersion method. The prepared cream was placed on a watch glass and then a few drops of methylen blue solution were added. If the cream did not mix with the methylen blue, the emulsion type was A/M; if it mixed with the methylen blue, the emulsion type was M/A (Zam Zam & Musdalifah, 2022).

## RESULT AND DISCUSSION

### Extraction

A sample of 6 kg of *Phyllanthus niruri* L. leaves yielded 970 grams of crude drug powder. 500 grams of the crude drug powder were used and extracted using the maceration method with 96% ethanol as the solvent. The extracted powder produced 81.78 grams of concentrated extract after maceration and evaporation using a rotary evaporator. The extract yield was calculated based on the ratio of the final weight (weight of the extract produced) to the initial weight (weight of the powder used) multiplied by 100%, resulting in an extract yield of 16.35%.

**Table 2. Results of Phytochemical Screening of Meniran Leaf Extract (Phyllanthus niruri L.)**

| Phytocemical Test | Reagent | Color Standard | Result |
|---|---|---|---|
| Flavonoid | Concentrated HCl, Mg powder | Red/Orange | + |
| Saponin | Added hot water | Foam formation | + |
| Alkaloid | $H_2SO_4$, Reagen dragendorff's reagent | Brick red | + |
| Phenolic | $FeCl_3$ | Green to blue-green | + |

Keterangan : (+) positive : Detected containing compounds
(-) negative : Detected not containing compounds

### Formulation of Meniran Leaf Extract Cream

In the preparation of the formulation, the concentrations of stearic acid and triethanolamine used differed from one another, namely F1 (15%:4%), F2 (16%:3%), and F3 (17%:2%). The purpose of varying the concentrations is to determine the effect of stearic acid and triethanolamine concentrations on the physical properties of the cream formulation. The formulation results are shown in figure 1.


**Figure 1.** Formulation Results of Meniran Leaf Extract Cream Formulations

**Evaluation of the Physical Properties of Cream**

The evaluation of the preparation was carried out to determine the results of the preparation of meniran leaf extract cream with variations in the concentration of stearic acid and triethanolamine in accordance with certain criteria, including physical property tests. The physical property evaluations conducted include organoleptic testing, homogeneity testing, pH testing, viscosity testing, spreadability testing, adhesion testing, irritation testing, and cream type testing. The evaluation has specific criteria that a formulation must meet to be considered successful. The results of the physical property evaluation of the meniran leaf extract cream formulation are presented in table 3.

**Table 3.** Results of Physical Property Evaluation of Meniran Leaf Extract Cream

| Physical Evaluation | F1 | F2 | F3 |
|---|---|---|---|
| Organoleptic | Color : dark green<br>Aroma : characteristic of meniran leaves<br>Texture : Thick | Color : creamy green<br>Aroma : characteristic of meniran leaves<br>Texture : Slightly Thick | Color : light green<br>Aroma : characteristic of meniran leaves<br>Texture : Very Thick |
| Homogenity | Homogeneous | Homogeneous | Homogeneous |
| pH | 6.4 ± 0.03 | 6.22 ± 0.11 | 5.99 ± 0.06 |
| Viscosity | 394 ± 0.13 dPas | 788 ± 0.10 dPas | 992 ± 0.30 dPas |
| Spreadability | 0 g : 5.22 ± 0.17 cm<br>50 g : 5.79 ± 0.12 cm<br>100 g : 6.16 ± 0.20 cm<br>150 g : 6.47 ± 0.18 cm<br>200 g : 6.66 ± 0.04 cm<br>250 g : 6.85 ± 0.10 cm | 0 g : 4.55 ± 0.2 cm<br>50 g : 4.78 ± 0.22 cm<br>100 g : 5.18 ± 0.24 cm<br>150 g : 5.45 ± 0.22 cm<br>200 g : 5.7 ± 0.2 cm<br>250 g : 5.97 ± 0.18 cm | 0 g : 3.48 ± 0.12 cm<br>50 g : 3.77 ± 0.11 cm<br>100 g : 4.02 ± 0.20 cm<br>150 g : 4.28 ± 0.18 cm<br>200 g : 4.5 ± 0.25 cm<br>250 g : 4.87 ± 0.15 cm |
| Organoleptic | Color : dark green<br>Aroma : characteristic of meniran leaves<br>Texture : Thick | Color : creamy green<br>Aroma : characteristic of meniran leaves<br>Texture : Slightly Thick | Color : light green<br>Aroma : characteristic of meniran leaves<br>Texture : Very Thick |
| Adhesiveness | 2.38 ± 0.06 detik | 3.99 ± 0.15 detik | 4.86 ± 0.23 detik |
| Irritation | Non-irritating | Non-irritating | Non-irritating |
| Cream Type | O/W | O/W | O/W |

1. **Organoleptic Test**
   The organoleptic test aims to determine the physical appearance of the meniran leaf extract cream, including its color, shape, and aroma. The organoleptic results of the preparations can be seen in Table 3. F1, F2, and F3 have the same aroma characteristics,

while there are differences in texture and color among the formulas. From F1 to F3, the meniran leaf extract cream preparations produced have a thick to very thick texture with a dark green to light green color. According to Syamsuni, (2006), as cited by Saryanti et al., (2019), the quality parameters of a cream formulation that meet the requirements are a semi-solid texture, and the characteristic color and aroma of the plant extract used in the formulation. According to (Daniar et al., 2022), in organoleptic testing of cream, the concentration of stearic acid and triethanolamine emulsifiers can affect the color and form of the cream formulation. Therefore, it can be concluded that differences in the form and color of the cream formulation are caused by variations in the concentration of stearic acid and triethanolamine.

2. **Homogenity Test**
   The homogeneity test was conducted to determine whether all components of the *Phyllanthus niruri* L. leaf cream were well mixed, ensuring no small particles were visible under a watch glass. The results of the homogeneity test are presented in Table 3. The cream formulation was homogeneous due to mixing during ingredient blending, ensuring even distribution of components. The homogeneity of the cream formulation is crucial as it affects its efficacy during use. If a formulation is homogeneous, the concentration of active ingredients during use is assumed to remain consistent. The results meet the requirements, as the cream formulation contains no clumping particles, has a uniform structure, and exhibits color uniformity (Saryanti et al., 2019).
3. **pH Test**
   The pH test aims to ensure that the cream extract of *Phyllanthus niruri* L. leaves has a pH level safe for the skin, preventing irritation during use. If the cream's pH is too alkaline, it can cause skin flaking or irritation. The pH test results are shown in Table 3. The results indicate that the cream formulation of *Phyllanthus niruri* L. leaf extract meets the pH requirements for skin, as the pH value obtained is within the range of 4.2–6.5 (Majid et al., 2019). The pH test results of the three formulas obtained from this study showed an increasing pH value, as the concentration of stearic acid was higher than triethanolamine, and the interaction between the stearic acid emulsifier and triethanolamine increased the pH. This occurs because stearic acid is acidic and contains $H^+$ groups, so an increase in stearic acid causes the pH of the meniran leaf cream to become more acidic (Mudhana & Pujiastuti, 2021).
4. **Viscosity Test**
   The viscosity test aims to determine the thickness of the cream formulation by measuring the viscosity value of the cream formulation. The viscosity requirement for a good meniran leaf cream formulation is within the range of 50–1000 dPas (Pratasik et al., 2019). The results of the spreadability test of the formulation can be seen in Table 3. Based on the test results, the viscosity of the meniran leaf extract cream formulation (*Phyllanthus niruri* L.) showed that the average viscosity values of the three formulations met the requirements. The viscosity test results in this study indicated an increase in viscosity across all three formulations, as the stearic acid concentration was higher than the triethanolamine concentration. Variations in stearic acid and triethanolamine concentrations affect the viscosity of the cream formulation. Viscosity is directly proportional to adhesion but inversely proportional to spreadability (Endriyatno & Aida, 2023). As viscosity increases, the ability of the *Phyllanthus niruri* L. leaf extract cream to adhere to the skin surface increases.
5. **Spreadability Test**
   The spreadability test aims to assess the cream formulation's ability to spread on the skin surface. The results of the spreadability test for the formulations are presented in Table 3. Based on the spreadability test results, the cream formulations of *Phyllanthus niruri* L. leaf extract obtained from each formula meet the spreadability criteria for cream, which is within the range of 5–7 cm (Majid et al., 2019). The spreadability test results in this study showed a decrease in spreadability for all three meniran leaf extract cream formulations. This decrease is attributed to higher viscosity, which increases flowability and consequently enhances spreadability. According to Mansauda et al., (2022), the decrease in spreadability is due to the cream's increasing thickness.
6. **Adhesion Test**

The adhesion test aims to determine and observe the ability of the cream formulation to adhere to the skin surface. The results of the adhesion test for the formulation can be seen in Table 3. Based on the adhesion test, the cream formulation of *Phyllanthus niruri* L. leaf extract, obtained from the average of each formulation, meets the criteria for good adhesion for cream formulations, which is more than 1 second (Lumentut et al., 2020). The adhesion test results in this study showed an increase in adhesion for all three meniran leaf extract cream formulations, as higher concentrations of stearic acid and triethanolamine resulted in longer-lasting cream adhesion. Variations in stearic acid and triethanolamine concentrations influence the adhesion of the cream formulation.

7. **Irritation Test**
The irritation test aims to determine whether there are any skin-irritating effects from each cream formula, whether the composition of ingredients used in the formula is safe for use and does not cause skin irritation, including redness, itching, and a burning sensation in the skin area where the cream formulation is applied (Syamsuni, 2006). The results of the irritation test are shown in Table 3. The results obtained are consistent with the findings of Hasniar et al., (2015), who reported that the cream formulation combining stearic acid and triethanolamine emulsifiers does not irritate the skin. This is because nonionic emulsifiers do not have toxic properties, making the combination of stearic acid and triethanolamine safe for the skin, especially sensitive skin, and does not cause irritation.
8. **Cream Type Test**
The cream type test aims to determine the type of cream in the formulation and to determine whether the meniran leaf extract cream produced is in accordance with the planned cream type (Zam Zam & Musdalifah, 2022). The results of the cream type test are shown in Table 3. The results obtained are consistent with Zam Zam & Musdalifah, (2022), who state that a cream is classified as type M/A if it can be evenly mixed with methylen blue. Increasing the levels of stearic acid and triethanolamine does not affect the cream type of meniran leaf extract.

**Selection of the Best Formula**

Based on the results obtained, F3 is the best formula, as evidenced by the evaluation of the physical properties of the formulation, which showed the highest adhesion strength. This is related to the use of the cream formulation, which can adhere to the skin for an extended period and is effective when applied, allowing the active ingredients to be absorbed properly. The longer the cream adheres to the skin, the more active ingredients are absorbed, thereby killing bacteria and reducing inflammation. Therefore, it can be concluded that F3 is selected as the best formula with emulsifier concentrations of stearic acid and triethanolamine at (17%; 2%).

## CONCLUSION

From the research conducted, it can be concluded that variations in the concentrations of stearic acid and triethanolamine as emulsifiers affect the physical properties of the meniran leaf extract cream formulation, including pH, viscosity, spreadability, and adhesion. The best formula for the meniran leaf extract cream preparation with variations in stearic acid and triethanolamine is F3, with a concentration of stearic acid : triethanolamine (17% : 2%), as F3 yields the highest adhesion properties.

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