

Formulation of Seaweed (*Sargassum polycystum*) and Mangrove (*Rhizophora apiculata*) Leaf as Antimosquito Lotion

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Abstract. Mosquito repellent lotions generally use ingredients such as diethyltoluamide (DEET). DEET has been mixed by the manufacture of commercial mosquito repellent lotions and used by consumers without regard to the consequences if it is continuing used. Though many natural plants, especially marine plants can also provide the same benefits as a mosquito repellent. Therefore, in this study the aim was to make a lotion based on seaweed (*Sargassum polycystum*) and mangrove leaves (*Rhizophora apiculata*) as a mosquito repellent. The treatments in this study were 30% seaweed (L1), 30% mangrove leaf (L2), 15% seaweed, and 15% mangrove leaf (L3), and control (L0). The results showed that the effectiveness of the protective cover of anti-mosquito lotion *S. polycystum* (L1) was able to protect for 2 hours, (L2) mangrove leaf lotion was able to protect for 4 hours and *S. polycystum* lotion and mangrove leaf *R. apiculata* (L3) were able to protect for 3 hours.

1 Introduction

The potential of seaweed in Indonesia is immense because Indonesian waters have three types of seaweed, namely Rhodophyta, Chlorophyta, and Phaeophyta. One type of seaweed that has a reasonably high economic value is the brown algae *S. polycystum*. The seaweed contains bioactive compounds of alkaloids, saponins, and tannins [1].

In addition to seaweed, Indonesia also has marine plants that have high potential, such as mangroves. Mangroves are plants that form a form of marine forest ecosystem, which is the residence of various marine biota around the coast. The most common type of mangrove found in *R. apiculata*. It contains bioactive compounds, such as alkaloids, steroids, tannins, saponins, terpenoids [2].

The utilization of marine plants that have high potential can be used as an innovation. One of the innovations in processing aquatic plants is the manufacture of mosquito repellent lotions by utilizing the compounds contained in seaweed and mangrove leaves. The content that can be used as an active substance of insecticides from *S. polycystum* and *R. apiculata* is the content of saponins and alkaloids. In the manufacture of mosquito repellent lotions, saponin compounds can be used as mosquito repellents because the properties of saponins have toxic properties for cold-blooded animals, which can inhibit the work of enzymes in the digestive process of insects [3]. In addition to

saponins, compounds commonly used as pesticides are alkaloids

Anti-mosquito or repellent is a compound that can prevent mosquitoes from flying, landing or piercing the skin surface at a certain distance [4]. Repellent is a substance that makes insects unattractive to humans so they can avoid getting bitten. Repellent does not function as an insect killer but only serves as a deterrent to contact between humans and insects [5]. When mosquito repellent lotion had been applied to human skin, the cream will be absorbed into the skin pores and will evaporate due to body heat so that mosquito chemical receptors will be detected [6,7]. Currently, the mosquito repellent on the market contains diethyltoluamide (DEET). The problem that often occurs in diethyltoluamide (DEET) is skin irritation [8]. Therefore, this study has been made to make a safe mosquito repellent lotion by utilizing marine products.

2 Methods

2.1 Time and Place

The studies will be carried out from April to July 2021. This research was performed at the Marine Chemistry Laboratory and the Marine Biotechnology Laboratory Faculty of Marine and Fisheries Sciences, Raja Ali Haji Maritime University (UMRAH).

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2.2 Tools and Materials

The tools used in the manufacture of lotions are a Hotplate stirrer, analytical scales, blender, beaker, stirrer, bottle lotion. The tools used in the study of power testing reject mosquito that box and mosquito nets. The analysis of the physical tests, which include testing the pH, homogeneity, coverage, viscosity, and irritation, use the tool in a row such as pH meter, glass objects, glass watch, ruler, paper green millimeters, weights, viscometer Ostwald. The main ingredient is seaweed (*Sargassum polycystum*) and leaves of mangrove (*Rhizophora apiculata*). Other materials used are stearic acid, cetyl alcohol, emulgade, propylene glycol, glycerin, TEA, distilled water and methyl paraben.

2.3 Research Methods

This research includes two stages, namely the firststage of sample preparation and the second stage of mosquito lotion formulation.

2.4 Antimosquito Lotion Formulation with Modifications

Making seaweed slurry starts from weighing 88 grams of seaweed and soaking it for 2-3 days. After 2-3 days, the seaweed is then drained and blended until smooth and homogeneous. After homogeneous, the seaweed slurry has been put into the container. The manufacture of mangrove leaf slurry begins by separating the leaves from the leaf bones, and then the mangrove leaves are weighed 156 grams, and put in a blender and then put into a container.

The oil phase material consists of stearic acid, cetyl alcohol, and Se-PF emulsifier, and the water phase material consists of glycerin, propylene glycol, TEA (triethanolamine), and distilled water were each weighted according to the formulation made, then heated using a hotplate. Stirrer with a temperature of 70-75° C until melted. Once available, the oil phase material, and water phase are mixed little by little at a constant speed. Then, seaweed pulp, mangrove leaf pulp and methylparaben has added to the lotion preparation [9][10].

2.5 Analysis Procedure

Test the protection power of mosquito repellent lotion [11]. The physical parameter tested in this study was analyzing the physical test of mosquito repellent lotion, such as pH [12], homogeneity test [13], dispersion test [13], viscosity test (Purnamasari et al., 2016). Irritation test [14]. The mosquito repulsion test was analyzed using a Completely Randomized Design (CRD) consisting of four treatments L0 (control), L1, L2, and L3, with six repetitions, totaling 24 experimental units.

3 Results and Discussion

3.1 Mosquito Repellent Test

To test the protective power of mosquitoes, it must be carried out directly on human hands to know its effectiveness so that in this study, it was tested on the hands of 4 volunteers. The skin was smeared with 0.5 grams of lotion evenly up to the elbows, then the volunteers' arms were put in a box containing 25 *Aedes aegypti* mosquitoes and observed for five mins every hour for 6 hours. This mosquito repellent test followed how many mosquitoes perched and a bit on the volunteers' skin. The results of mosquito repulsion can be seen in Figure 1, which shows the curve decreasing downwards as the test time increases. This is caused by the evaporation of the compounds contained in the lotion over time so that the smell of the lotion disappears and there is a decrease in the protective power of the cream, and the activity of mosquitoes decreases so that fewer mosquitoes perch on the skin [15].

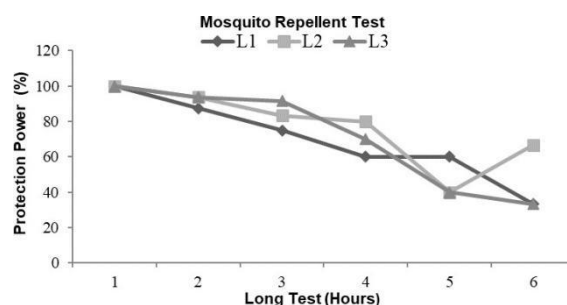


Fig 1. Mosquito Repellent Test Results For 6 Hours

The mosquito repellent test of the three formulations of anti-mosquito lotion, seaweed and mangrove leaves, provided mosquito repellent on the skin. The protection provided by this seaweed and mangrove leaf lotion is caused by the smell and also the bioactive components it contains. The average results in the mosquito repellent test with a ratio of L0 (control) showed that the L1 formulation had a small mosquito repellent, followed by the L3 formulation. The highest mosquito repellent power is the L2 formulation with the manufacture of lotion with *Rhizophora apiculata* mangrove leaves as an additive by 30% [16]. This mangrove leaf lotion also has a long mosquito repellent capacity in the test of up to 4 hours because it can protect by 80%, in contrast to the L1 formulation, which is only able to protect up to the second hour, and the L3 formulation, which protects up to the third hour only [8].

This shows that the lotion with the addition of mangrove leaves has a more excellent mosquito repellency than the lotion formulation with *Sargassum polycystum* seaweed or cream with a mixture of seaweed and mangrove leaves. This may be due to the non-optimal compounds from seaweed and mangrove leaves when mixed into one formulation. This mangrove leaf lotion can be displayed to be effective as an anti-mosquito, this is because it has a protection power of > 80%. The results of the study can be said to be effective if it has repulsion power against mosquito bites > 80%, and declared ineffective if the mosquito repels energy is < 80% [17].

The results of the mosquito repulsion test were then processed using statistical tests with the ANOVA hypothesis test. From the results of the ANOVA test, it has found that the value of $F_{count} > F_{table} (0.05)$ so that it can be concluded that the addition of mangrove leaf extract and seaweed has a significant effect as an anti- mosquito in the lotion formulation in this study.

3.2 Anti-mosquito Lotion Physical Test Analysis

The lotion preparation was visually observed to see its physical characteristics, which included pH, homogeneity, spreadability, and viscosity. Then it has done to see if the lotion meets the lotion standard or not.

3.2.1 pH

The pH standard of lotion according to SNI 16-4399-1996 is around 4.5-8. The pH test results showed that the control lotion, and formulation lotion both had a pH value of 7.3 and there was a slight difference in the pH value of the lotion formulation L1 with a pH value of 7.4 and L2 with a pH value of 7.2. The pH values of the four lotion formulations met the lotion standards based on SNI 16-4399-1996, which ranged from 4.5-8, and also, the pH value of this lotion was following the skin's pH value, which was neutral. The results of the pH analysis were shown in Table 1.

Table 1. Results of The pH Test

Formulation	pH	Standard
L0	7.3	4.5-8
L1	7.4	
L2	7.2	
L3	7.3	

3.2.2 Homogeneity

The homogeneity test was completed to decide the diversity of creams so that the quality of the creams that had been mixed evenly and did not leave stable particles that still clumped or did not mix well during the cream-making process.

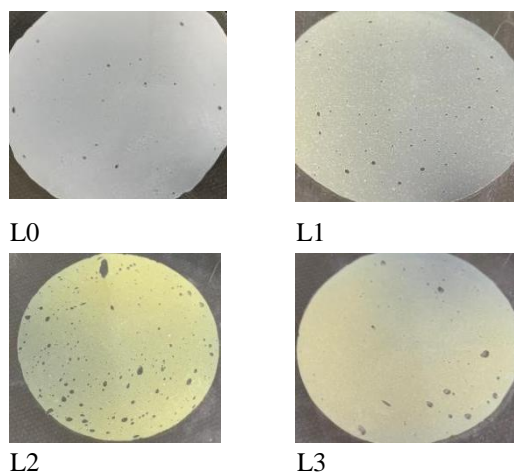


Fig 2. Homogeneity Test

Based on the results of the homogeneity test carried out on the four lotion formulations, it showed that the lotion formulations L0, L1, L2, and L3 had homogeneous lotion preparations, which has been characterized by the absence of lumps or solids that were visible when the lotion was applied and overwritten by clear glass. The good homogeneity of this lotion is due to the presence of emulsifier ingredients such as TEA, cetyl alcohol, and stearic acid, which make an emulsion between the oil phase and the liquid phase to blend well [14]. The air bubbles in the lotion were caused by glycerin during the cream-making process

3.2.3 Spreadability

A spreadability test has completed to decide the capability of the base to unfold at the skin surface while applied. The wider the spread, the faster the release of the therapeutic effect on the skin. Spreading power is done by measuring the spreadability of the lotion as much as 0.5 g of the lotion sample, which is given a weight of 50gr, and the diameter of the spread of the cream is measured using millimeter paper green. Based on the results of the dispersion test, the test results has found in Table 2 below.

Table 2. Results of The Spreadability Test

Formulation	Spread (cm)	Standard (cm)
L0	5.3	5-7
L1	5.2	
L2	5.3	
L3	5	

From the measurement results of the spreadability of lotion formulations L0 and L2 have the same spreadability of 5.3 cm, lotion formulation L1 has a spreadability value of 5.2 cm, and L3 has a spreadability value of 5 cm. Of the four lotions that has been tested for dispersibility, it shows that the lotion formulations L0, L1, L2, and L3 meet the standards ranging from 5-7cm. Good spreadability will make it easier when applied to the skin, as for what can affect the diameter of the spreadability of a reserve, namely the extract used in each lotion formulation [18]. In addition to the section used, the addition of TEA can also affect the spreadability, and this is because the more TEA will be able to increase the spreadability of the lotion [19].

3.2.4 Viscosity

The standard viscosity or viscosity according to SNI 16-4399-1996 ranges from 2000-50000 cP, so the viscosity of the four lotion formulations meets the requirements. The results of the viscosity test showed that L2 had a smaller viscosity value of 3.228 cP, then followed by lotion formulations L1, L0, and L3, which had the more immense viscosity value of 7.173 cP. This is thought to be the result of the addition of both samples of seaweed and mangrove leaves to L3 cream, which has believed to affect the viscosity of the cream. The viscosity value produced by the L1 and L2 mosquito repellent formulations is the same as the study[20], which ranges from 3000-4900cP.

The consistency value of preparation is an important parameter when consumers choose a product because it affects of using lotion preparations. The higher the viscosity value, the better the product stability but challenging to apply to the skin. The results of the viscosity test were shown in Table 3.

Table 3. Viscosity Test Results

Formulation	Viscosity (cP)	Standard(cP)
L0	6,170	2000-50000
L1	4,419	
L2	3,228	
L3	7,173	

3.3 Irritation Test

An irritation test is a test of preparation or substance in contact with the skin to see and identify whether the practice can cause skin inflammation after using the substance has being tested.

Table 4. Observation Results of Irritation Test

Treatment	Irritation Test Observation	Information
Panelists I	0%	-
Panelists II	0%	-
Panelists III	0%	-
Panelists IV	0%	-

Note : (-) : No irritation

From the results of the irritation test conducted on four volunteers who had used the lotion for 15 minutes, it showed that the lotion formulations L0, L1, L2, and L3 did not cause an irritation reaction or cause irritation of 0%, this has been indicated by the absence of rashes or red bumps on the skin. From volunteers skin, it can be concluded that the lotion is safe to use because it does not cause irritation and redness when used by volunteers.

4 Conclusion

Primarily based on the research conducted, it may be concluded that the lotion formula of Sargassum polycystum seaweed and Rizophora apiculata mangrove leaves can be used as a mosquito repellent. The best formulation is the L2 treatment with 30% mangrove leaf composition seen from several test parameters.

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