



UTILIZATION OF HIBISCUS LEAVES EXTRACT AS AN ENVIRONMENTALLY FRIENDLY DETERGENT ACTIVE INGREDIENTS

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ABSTRACT

Detergent is an ingredient used to maintain cleanliness. In the manufacture of detergents, an active ingredient in the form of LAS (Linear Alkylbenzene Sulfonate) surfactant is often added to kill bacteria. In addition to using synthetic materials, natural ingredients can also be used that can act as antibacterial. One of the natural ingredients with antibacterial activity is hibiscus leaves (Hibiscus tiliaceus L). The use of hibiscus leaf extract as a substitute for LAS surfactants aims to reduce the impact of environmental pollution. The purpose of this research was to find the right formula in the manufacture of liquid detergent made from hibiscus leaf extract and determine its quality based on SNI 06-0475-1996. The research method used is experimental research that produces qualitative and quantitative data. Qualitative data include phytochemical tests, organoleptic tests, hard water emulsion stability tests, and cleaning power tests. The resulting quantitative data includes the characteristics of the liquid detergent produced based on testing pH, specific gravity, antimicrobial test, phenol coefficient, and levels of active substances. Based on the study, results showed that hibiscus leaf extract contained secondary metabolites in the form of saponins, triterpenoid/steroidal saponins, flavonoids, and polyphenols. The antibacterial test showed that hibiscus leaf liquid detergent had antibacterial activity 1.67 times more effective than phenol. The product test results show that the liquid detergent of hibiscus leaves has the quality according to SNI 06-0475-1996.

INTRODUCTION

Cleanliness is a reflection for every individual in maintaining health which is important in life. The Millenium Development Goals (MDGs) program with the motto "Health is not everything, but without health everything is nothing" places cleanliness as the main factor in achieving health and well-being. Clean and Healthy Lifestyle is a program designed by the government and implemented in various main sectors. This is because personal and environmental hygiene is a must and priority for every community.

Detergent is one of the cleaning agents widely used by the community in households, industry, hotels, restaurants, and others. Based on the form, detergent can be in the form of powder detergent and liquid detergent. In general, both forms of detergent have the same function. Liquid detergents are widely used in cleaning kitchen utensils. However along with the times, liquid detergents are also widely applied for

industrial needs and cleaning cloths. This is because liquid detergent is easier than powder detergent to handle and more practical in its use.

Detergents are usually used to remove stains, while removing stains may not necessarily kill harmful bacteria. The active ingredients commonly used in detergents are Linear Alkylbenzene Sulfonate (LAS) surfactants. Surfactants are compounds that have two hydrophobic (lipophilic) and hydrophilic (lipophobic) groups, as foam-forming and detergency properties (Nurfarahin et al., 2018).

Surfactants are useful for removing dirt and fat (Cornwell, 2018). The negative impact of using LAS surfactants is the problem of biodegradation. During use, detergents are difficult to be degraded by bacteria in water, which results in detergent waste remaining in the water. This results in an accumulation of detergent in the water. The accumulation of detergent in water can be a source of water pollution. This can cause environmental damage, especially in aquatic habitats. Based on the data



obtained, it is proven that it takes 1-87 days to decompose LAS substances, and even worse, only 50% of the substances can be decomposed by microorganisms (Scott & Jones, 2000)

Detergents that are used on a large scale for a long period can contaminate groundwater due to the decomposition process of detergents that produce benzene, this causes drinking water consumed to cause cancer (Dominguez et al., 2018). This process can occur during the drinking water treatment process, precisely in the chlorination process using chlorine to kill germs. Chlorine contains elements of chlorine and when benzene is mixed with chlorine it can produce chlorobenzene which has proven to be very dangerous (Yuan et al., 2020). Therefore, the idea arose about the manufacture of liquid detergents that have antimicrobial properties. One of the ingredients found in nature and has the anti-microbial ability is hibiscus leaf (*Hibiscus tiliaceous* L).

Hibiscus leaves contain phytochemical compounds such as saponins, flavonoids, polyphenols, and tannins (Olivia et al., 2021). Derivatives of polyphenolic compounds are known to have antibacterial effects (Novitasari, 2017). The content of saponins in hibiscus leaves functions as a washing agent that has soap-like properties and acts as a surfactant. Saponins from a colloidal solution in water form a stable foam when shaken and do not disappear with the addition of acid (A. Harborne, 1998). The level of cleanliness of washing with hibiscus leaves is the same as with synthetic detergents, even hibiscus leaves do not fade clothes to maintain the quality of the fabric as before. In addition, detergent waste from hibiscus leaves can be decomposed by nature, and the pollution level is almost non-existent. Therefore, an environmentally friendly detergent from hibiscus leaves is a potential alternative and acts as an antibacterial. The liquid detergent made from hibiscus leaves is expected to be used by the community as a form of awareness of the environment and human life.

This research was conducted on the formulation of a detergent that utilizes hibiscus leaves as an antibacterial. The formulation is done to get the best detergent formula so that it can be produced for daily use. That way, this research can also be implemented to the community by providing socialization regarding the manufacture of detergents with antimicrobial capabilities from hibiscus leaf extract. Based on this description, several problem formulations

can be formulated, including what percentage of hibiscus leaf extract should be added to the detergent formula to obtain detergent with the best antimicrobial ability, the detergent produced has good quality based on the requirements of SNI 06-0475-1996. The purpose of this research was to find the right formula in the manufacture of liquid detergent made from hibiscus leaf extract and determine its quality based on SNI 06-0475-1996.

This research is expected to provide information about the use of hibiscus leaves in the manufacture of liquid detergent. In addition, this research is expected to be one of the considerations for cultivating hibiscus plants and can contribute to the development of science regarding anti-bacterial detergents.

MATERIALS AND METHODS

Materials and Tools

The ingredients used in liquid detergents include distilled water, citric acid, borax, CMC (Carboxymethyl Cellulose), hibiscus leaves, fragrance, food coloring, and STPP (Sodium Tripoly Phosphate), and texapon. In contrast, the materials for analysis include distilled water, glacial acetic acid, sulfuric acid, hibiscus leaf, FeCl₃, HCl, Chloroform, NaCl, MgCl₂, pH buffer solution, anhydrous CaCl₂, quaternary ammonium, methylene blue, pure culture, filter paper millipore, nutrient agar, phenol, and comparison product samples.

The tools used are bulb, incubator, loop wire, ruler, spray bottle, tweezers, pycnometer, pH meter, electric heater, spatula, analytical balance, rotary evaporator, and glassware.

Methods

This research was experimental research that produced qualitative and quantitative data. Qualitative data included phytochemical tests, organoleptic tests, hard water emulsion stability tests, and cleaning power tests. The resulting quantitative data contained the characteristics of the liquid detergent produced based on testing the pH value, specific gravity, anti-microbial test, phenol coefficient, and the active substance content.

Preliminary Analysis (Phytochemical Analysis)

Phytochemical analysis is an initial test method to determine the content of active compounds contained in plants (J. B. Harborne,

2013), phytochemical test was based on the identification of the color formed in hibiscus leaf extract using Liebermann Burchard reagent for terpenoids or steroids, FeCl_3 solution for testing polyphenolic compounds, gelatin for tannins and Mg, and 2% HCl for flavonoid compounds.

Saponin Test

15 mg of sample was added to 5 mL of hot water $\pm 70^\circ\text{C}$. Then, shaken vigorously and observed. If the foam is formed with a height of 1-10 cm, which lasts for 10 minutes, it is positive for saponins.

Triterpenoid or steroidal Test

0.5 mg of the sample was added to 5 mL of chloroform, then it was heated until remaining 1 mL. The filtrate was added with 1 mL of glacial acetic acid and a drop of concentrated sulfuric acid. After 30 minutes, if a brown or purple color forms on the barrier between the two layers, it means containing of triterpenoid saponins. If a bluish-green color is formed, it contains steroidal saponins.

polyphenols and Tannin Test

10 mL of hot water was added to extract, then five drops of 10% NaCl were added and divided into two test tubes. One test tubes was added three drops of FeCl_3 . If a blue-black color was formed, it was positive for polyphenols. In the second tube, three drops of gelatin were added. If a precipitate formed, it was positive for tannin.

Making hibiscus leaf extract

Hibiscus leaves were separated from the stalks, washed, and cut into tiny pieces. Then they were dried at room temperature for 24

hours. Dried hibiscus leaves were macerated with ethanol and methanol for 24 hours. The methanol extract was evaporated at 60°C to obtain a extractum spissum (thick extract). Then, the extract was put into a 100/250/500/1000 mL volumetric flask, added distilled water to the mark, and filtered. The filtrate was ready for further analysis.

Making liquid detergent

A total of 1 gram of CMC was added to 1 gram of Na_2SO_4 , 0.1 gram Na_2CO_3 , 0.1 gram $\text{Na}_2\text{B}_4\text{O}_7$, 0.1 grams of STPP, and 0.5 grams of texapon. All ingredients were dissolved in aquadest until there were no lumps in the mixture, then hibiscus leaf extract was added. Citric acid was added to achieve a pH of 6-8. Then, the mixture was added distilled water to a volume of 100 mL and added dye and fragrance.

Liquid detergent analysis

Cleaning power test

Liquid detergent was diluted by making comparisons 10:100, 5:100, and 1:100. The detergent solution was used to wash dirty clothes, and the ability to lift dirt was seen based on the level of cleanliness of the clothes and compared to detergents on the market.

Organoleptic test

The test was carried out on 20 panelists with the results of observations on a numerical scale that they liked, neutral, and disliked the parameters of aroma, color, and foam.

pH test

The pH meter was calibrated using pH buffers 4, 7, and 10. Then it was used to measure the pH value of the sample solution.

Table 1. Formulation of Liquid Detergent

Formula	Ingredients									
	citric acid (g)	CMC (g)	Hibiscus leaf (ml)	Na_2CO_3	Na_2SO_4	$\text{Na}_2\text{B}_4\text{O}_7$	Dye	Fragrance	STPP	Texapon
1	-	1,5	-	0,1	1,5	0,1	-	-	0,1	-
2	-	1,5	-	0,1	1,5	0,1	-	-	0,1	-
3	0,05	1	-	0,1	1	0,1	-	-	0,1	0,5
4	0,1	1	-	0,1	1	0,1	-	-	0,1	1
5	0,05	1	-	0,1	1	0,1	-	-	0,1	1
6	0,05	1	-	0,1	1	0,1	-	-	0,1	2
7	0,2	1	-	0,1	1	0,1	-	-	0,1	5
8	0,15	1,5	-	0,1	1	0,1	-	-	0,1	5
9	0,1	1,75	-	0,1	1	0,1	0,1	-	0,1	5
10	0,15	1,5	-	0,1	1	0,1	-	-	0,1	5
11	0,155	1,25	10	-	1	0,3	0,1	0,2	0,1	5

Specific gravity test

The pycnometer was washed and then rinsed with ethanol and dried. After letting it sit for 30 minutes, the lid was put on and weighed (W_0). The distilled water was put into the dry pycnometer, then closed (avoid bubbles) and weighed (W_1). The pycnometer was cleaned again, dried, and then filled with the sample without any bubbles. The pycnometer containing the sample was weighed (W_2). The formula calculated the density of the sample:

$$\text{density} = \frac{W}{V} = \frac{W_2 - W_0}{W_1 - W_0} \cdot \frac{W_1 - W_0}{V}$$

Hard water emulsion stability test

A total of 0.0304 grams of anhydrous CaCl_2 and 0.0319 grams of $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ were dissolved in aquadest in a 100 mL volumetric flask. 1 mL of the sample was put into 100 mL of hard water, then stirred and left for 6 hours. After 6 hours, it was observed whether there was a separation of layers or a precipitate formed.

Anti-microbial test

The test was carried out by inhibiting the growth of microorganisms. Namely, the inhibition zone will be seen as a clear area around the area containing antibacterial substances. Suspended 1-2 ose of pure culture for 24 hours. The suspension was pipetted 1 mL into a petri dish, and then the liquefied NA medium was poured into a petri dish that already contained bacteria—mixed to form a figure 8 and allowed to freeze. The millipore paper chips that had been extracted with various concentrations were put into a petri dish aseptically—and then incubated at 35°C for 48 hours. Microbial growth was recorded, and the transparent area (zone) was measured around the millipore paper plate.

Phenol coefficient test

Preparation of phenol standard solution. A standard stock of 5% phenol was made in 50 mL of sterile distilled water. Then, sterile distilled water was prepared with a ratio of 1:90 and 1:100 in an Erlenmeyer flask. Each 1 mL of 5% phenol standard solution was added and then homogenized, and 5 ml of each ratio was pipetted into different test tubes.

Making a disinfectant solution. Sterile distilled water was prepared in a ratio of 1:100, 1:150, 1:200, and 1:250 (water: liquid detergent

oh hibiscus leaves and comparison product) in different Erlenmeyer flasks. Into each Erlenmeyer flask was added 1 mL of product sample and homogenized.

Phenol coefficient test. The NA medium was made and then poured into a petri dish and waited for it to freeze. 0.5 L of pure culture was added into a 1:90 phenol tube and waited 5 minutes (5 minutes contact time). Ose that has been incandescent was dipped into the tube, then streaked on the first frozen NA medium. Waited 5 minutes, then dipped the ose into the tube and inscribed on the second frozen NA medium (10 minutes contact time). The ose was dipped into the tube and streaked five minutes later on the third frozen NA medium (contact time 15 minutes). The same method was also carried out for 1:100 phenol and both samples for each comparison and then incubated at 35°C for 24 hours. Bacterial growth was observed.

RESULTS AND DISCUSSION

The raw material for this research was hibiscus leaf originating from the Bogor district to be used as an additional ingredient in antibacterial liquid detergent. Hibiscus leaves were taken at random, and the best leaves were selected and separated from the stems. The leaves were cut into small pieces to speed up the drying process. Drying was carried out in the sunray to reduce the water content in the leaves and make it easier for the solvent to attract bioactive components in the sample during maceration (Chairunnisa et al., 2019). The solvents used were methanol and ethanol because these two solvents are suitable solvents for dissolving secondary metabolite compounds. %yield generated in the extraction process is shown in Table 2.

Table 2. % Yield in Each Solvent

Solvent: Ethanol

Sample Type	Sample Weight	Extract Weight	%Yield
Wet	20 g	16,9380 g	84,69%
Dry	20 g	14,7285 g	73,64%

Solvent: Methanol

Sample Type	Sample Weight	Extract Weight	%Yield
Wet	40 g	19,5629 g	48,91%
Dry	40 g	23,4491 g	58,62%

Table 3. Phytochemical Test Results of Hibiscus leaf Extract

No	Sample	Solvent	Compound Type			
			Saponins	Saponins triterpenoids/steroids	Flavonoids	Polyphenol
1.	Wet Sample	-	-	++ (steroids)	+++ (red)	-
2.	Dry Sample	-	-	+++ (steroids)	+ (orange)	+
3.	Wet Sample	Ethanol	+++	-	++ (red)	+++
4.	Dry Sample	Ethanol	++	+++ (triterpenoids)	+ (orange)	++
5.	Wet Sample	Methanol	++	-	+ (orange)	++
6.	Dry Sample	Methanol	+	++ (triterpenoids)	+++ (red)	+++

Phytochemical Analysis

Based on phytochemical analysis (Table 3), it showed that hibiscus leaf extract contains secondary metabolites in the form of saponins, triterpenoid/steroidal saponins, flavonoids, and polyphenols. These metabolites indicated that hibiscus leaf extract has the potential as an antibacterial.

The saponin test performed showed positive results on ethanol and methanol extracts. The most substantial test results were on samples of wet leaves with ethanol as a solvent. This result was the basis for making hibiscus leaf extract which would be used as an ingredient for making detergents.

The triterpenoid or steroid test results were positive for triterpenoids in the ethanol and methanol extract samples from the dry leaf samples. In contrast, the wet leaf samples were negative for triterpenoids or steroids, and the non-extracted leaf samples were positive for steroids.

The results of the flavonoid test from various wet and dry leaf extracts and non-extraction showed positive results. This is because flavonoid compounds are polar, which can dissolve in polar and semipolar solvents. The polarity of these compounds is because flavonoids are polyhydroxy compounds (having more than one hydroxyl group) (Arifin & Ibrahim, 2018).

Polyhydroxy flavanones will be reduced by magnesium metal and react with hydrochloric acid to form benzo pyrylium salts (flavylium salts) red or orange (Ghorbani, 2017). The polyphenol test gave positive results in all samples except for samples of wet leaves without being extracted. The hallmark of phenolics was to form a blue-black complex with iron (III) chloride. The complex formed was detected to be iron (III) Hexa phenolic (J. B. Harborne, 2013).

Product Results

Liquid detergent products were made by adding hibiscus leaf extract. In the process of making the product, 11 experiments were carried out without hibiscus leaf extract by considering several factors such as viscosity, pH, emulsion, color, and aroma. The ingredients used as a constituent of liquid detergent products include distilled water, CMC, STPP, Na_2SO_4 , Na_2CO_3 , $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, texapon, citric acid, hibiscus leaf extract, fragrances, and dyes. The distilled water contains almost no minerals as a solvent. In addition, citric acid serves as acidity setting agent. Borax ($\text{Na}_2\text{B}_4\text{O}_7$), a highly concentrated salt solution, was used to brighten the color of clothes. CMC (Carboxy Methyl Cellulose) functions to prevent dirt from returning to clothes and as a thickener. Hibiscus leaf extract functioned as a surfactant and antibacterial. The fragrance is an aromatic mixture that can be in the form of natural oils, a mixture of natural perfumes, and synthetic perfumes. Adding fragrance to detergent was intended to provide a pleasant aroma and cover odors that arise during washing. The fragrance used in the product was Tahity fragrance. Dyes function as a colorant in liquid soap. STTP (Sodium Tripoly Phosphate) increased washing efficiency by surfactants by deactivating minerals that cause water hardness. Texapon was used as a foam producer in detergents and Na_2SO_4 to prevent clumping in the product. The formula for making liquid detergent can be seen in the Appendix.

The first formula experiment found that the product did not contain foam, and the detergent was too thick. In the second experiment, a little texapon was added, and a little foam was obtained. The third experiment added more texapon than the previous one, obtained a product with the appropriate viscosity, and the foam was still small and unstable. In the fourth experiment, the composition of the material was

the same as in the previous experiment, and the results obtained were an appropriate viscosity and an inappropriate and unstable foam. The fifth experiment found a formula with a pH of 9, a little foam, and poor viscosity. In the sixth experiment, more texapon was added than in the previous experiment, and the results were pH 10 with less foam and poor viscosity. In the seventh experiment, more CMC, texapon, and citric acid were added than in the previous experiment, which resulted in pH 4, moderate foam, and less viscosity. In the eighth experiment, to increase the pH to get a pH of 6-8, it was done by reducing the amount of citric acid and adding the amount. A formula with an appropriate pH was obtained, namely pH 8, but very thick and moderately foamy.

Table 4. Liquid Detergent Formula (100 ml volume)

No.	Material Name	Quantity
1	Distilled Water	81,9 mL
2	CMC	1,25 g
3	STPP	0,1 g
4	Na ₂ SO ₄	1,0 g
5	Na ₂ B ₄ O ₇ · 10H ₂ O	0,3 g
6	Texapon	5,0 g
7	Citric Acid	0,155 g
8	Fragrance	0,2 mL
9	Dye	0,1 mL
10	Hibiscus leaf extract	10 mL

In the ninth experiment, a formula with a pH of 7 was obtained by reducing the amount of CMC, but it was still very thick and had moderate foam. In the tenth experiment, it was carried out by reducing the amount of CMC to get the appropriate viscosity, and with the addition of champerlain, which aimed to produce an excellent and stable foam, the results were obtained with a pH of 7, suitable viscosity, and excellent stable foam, but two phases occurred at formulas. This is due to the addition of champerlain because champerlain and texapon cannot be dissolved when mixed. In the eleventh experiment, to get a good and stable foam, it was done by not adding Na₂CO₃ and champerlain, but a formula with a pH of 5.6 - 8 that was obtained pH 7, which was measured by universal pH, the obtained viscosity was appropriate, and the

resulting foam was good and stable. In the eleventh experiment, the ingredients for the product have met the requirements according to SNI 06-0475-1996 (BSN, 1996).

After obtaining a good formula without hibiscus leaf extract, detergent was then made with the addition of hibiscus leaf extract with various concentrations (0 mL; 2.5 mL; 5 mL; 10 mL; 15 mL; and 20 mL). The addition of this extract reduced the amount of solvent added. Based on the experimental results, the best formula was obtained, as shown in Table 4. The detergent product made was named Friend Clean

Analysis Based on SNI 06-0475-1996

The detergent produced was analyzed and compared with the requirements in SNI 06-0475-1996. The results of the analysis can be seen in Table 5.

Table 5. Analysis Result Based on SNI 06-0475-1996

No.	Criteria	Unit	Standard	Results
Conditions:				
1	Shape	-	Homogenous	Homogenous
			Liquid	Liquid
	Smell	-	Typical	Typical
2	Color	-	Typical	Typical
	pH (25°C)	-	6-8	6,97
3	Active materials	%	Min. 10	Not Tested
4	Density	g/mL	1,0-1,2	1,01
5	Total Plate Count	CFU/g	Max. 1 x 10 ⁵	-

pH Test

The pH value in SNI 06-0475-1996 is 6-8, based on Friend clean liquid detergent analysis, which was 6.97. The pH value in detergents on the market more or less ranges from 10-to 12. The pH value tolerated by human skin was 6-8. This was because, in the process of washing by hand, the detergent will experience direct contact with the skin, so the detergent must be able to prevent irritation of human skin. If the pH is acid, it will affect the structure of the acid coat that protects the skin from bacterial and fungal infections. At the same time, if the pH is too alkaline, then the acidic mantle on the skin will lose its acidic properties and can even be damaged. If this happens, the skin of the hands

will tend to be more easily irritated and infectious (McNichol et al., 2018). Based on this pH test, the Friend Clean detergent produced was safe for the skin and worthy to be marketed.

Density Test

Density is a physicochemical property of liquid detergents that is important to be reported (Bratovic et al., 2018). The value of the typical density of the liquid detergent produced appropriated to the quality requirements of SNI 06-0475-1996, which ranges from 1.0-1.2 g/mL. The density value of the detergent obtained was 1.01 g/mL. The density of liquid detergent will affect the ability of the detergent to dissolve in water and the stability of the emulsion of the liquid detergent. The density of the type of liquid detergent is greatly influenced by the density of the type of constituent components. The further the difference in the type of density of the constituent components of the detergent will cause a decrease in the stability of the emulsion of the detergent (Liu et al., 2020).

Antimicrobial activity Test

Antibacterial activity is seen through the results of anti-microbial tests (Karimi et al., 2019) and phenol coefficients (Yamasaki et al., 2017). Anti-microbial tests used *S.aureus* bacteria. Testing was done to determine the antibacterial power at each concentration of hibiscus leaves added to the product. Observations were made 1x24 hours in expediency at a temperature of 37°C. The resulting clear area is the sensitivity of bacteria to antibacterial materials used for test materials expressed with a width of transparent zone diameter and measured by millimeters (mm). The diameter of the bland zone ibis is categorized as its antibacterial power strength. The results of anti-microbial tests at various concentrations can be seen in Table 6.

Data on the diameter of the inhibition zone on *S. aureus* (Table 6) showed promising results at a concentration of 10%, 34 mm. There was a decrease in inhibition at a concentration of 15%, 18 mm, and at a concentration of 20%, 22 mm, while at concentrations of 2.5% and 5%, there

was no inhibition zone. A concentration of 10% put the largest inhibition zone compared to other concentrations of hibiscus leaves. According to Ramanathan et al. (2018), the criteria for the strength of antibacterial power based on the zone of inhibition were as follows: 5-10 mm is categorized as very weak, 10-20 mm is categorized as moderate, the zone of inhibition 20 mm or more is categorized as very strong. Therefore, the concentration of hibiscus leaf with 2.5%-5% hibiscus leaf extract was categorized as very weak. In contrast, the concentration of 15% was categorized as moderate, and the concentrations of 10% and 20% were categorized as very strong. The antibacterial ability of hibiscus leaf extract is supported by the results of the phenol coefficient test, as shown in Table 6.

Determination of the phenol coefficient value with the test bacteria *S. aureus* showed no bacteria in the phenol 1:90 dilution. Based on the observation table above, the highest bacterial killing effectiveness in sample R was found at a dilution of 1:250 with a value of 2.78 at a contact time of 15 minutes. In comparison, the highest effectiveness of killing bacteria in sample X was found at a dilution of 1:150 with a phenol coefficient value of 1.67 at a contact time of 15 minutes. So it could be seen that the two samples used have a phenol coefficient value above 1 (> 1) which means it had antibacterial power that was more effective and more potent than the phenol tested on *S. aureus* (Chavhan, 2017). So, in sample R, the antibacterial activity was 2.78 times more effective than phenol, and in sample X, the antibacterial activity was 1.67 times more effective than phenol.

Hard Water Emulsion Stability Test

A hard water emulsion stability test was carried out by leaving the sample in hard water for 6 hours and observing whether a precipitate formed in the detergent solution. The hard water used was CaCl₂ and MgCl₂. The results obtained in the liquid detergent soap product were that there was no emulsion because it did not produce a precipitate. This analysis aimed to determine whether liquid detergent can still foam in hard water (Pinheiro Da Silva Pinto, 2022).

Table 6. Antimicrobial Activity Test

	Concentrations (%)					
	0	2.5	5	10	10	20
Clear Zone (mm)	-	-	-	34	18	22

Table 7. Phenol Coefficient Test Result

Sample	Dilution	5 Minute	10 Minute	15 Minute	Phenol Coefficient Value
Phenol Standard	1: 90	-	-	-	1
	1: 100	+	+	+	
	1: 100	+	+	+	
	1: 150	+	+	+	
Sample R	1: 200	+	+	+	2.78
	1: 250	+	+	-	
	1: 100	+	+	+	
	1: 150	+	+	-	
Sample X	1: 200	+	+	+	1.67
	1: 250	+	+	+	

Description : Sample R = Comparison Sample (Rinso Cair), Sample X = Product (Friend Clean)

Cleaning Power Test

The cleaning power test was carried out by comparing it with comparable products on the market. Experiments were carried out three times with various comparisons, namely 10:100, 5:100, and 1:100. The three comparisons had the same cleaning power. However, the ratio used was 1:100 because less detergent used will be more effective.

Organoleptic Test

The organoleptic test was carried out by testing the consumer's preference for Friend Clean liquid detergent products. The tests carried out included look, smell, texture, and foam. This test was conducted on 20 untested panelists. Panelists gave a score for the aroma, foam, and color of the Friend Clean products with a score of 1 for very less, 2 for less, 3 for good, and 4 for very good.

The scent of the Friend Clean liquid detergent used was Tahiti. The color of Friend Clean liquid detergent was turquoise green, which was a mixture of the original green extract with the blue color of clothes dye. The level of preference for foam produced by Friend Clean liquid detergent in each wash was observed, and the results are obtained according to the supplementary data.

The product testing results showed that the liquid detergent product of hibiscus leaf extract was qualified appropriate to the requirements in SNI 06-0475-1996. All test parameters required by SNI 06-0475-1996 were tested except for the content of the active ingredients. This test was not carried out but was replaced with a cleaning power test compared to the product comparison.

CONCLUSION

Based on the phytochemical analysis results, hibiscus leaf extract contained secondary metabolites in the form of saponins, flavonoids, triterpenoid/steroidal saponins, and polyphenols. Friend Clean liquid detergent had the best antibacterial ability by adding 10 mL of hibiscus leaf extract to 100 mL of detergent. The product test results indicate that the liquid detergent of hibiscus leaves has the quality according to the requirements in SNI 06-0475-1996. So it is safe to use for everyday purposes.

It was necessary to analyze the content of the active substance to fulfill all the requirements specified in SNI 06-0475-1996.

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SUPPLEMENTARY

Table 8. Organoleptic Test Result

Aspect	Indicator	Panelist Assessment																								Total Score	Average Score of each Indicator	Average Score of each Aspect	Actual Score of each aspect
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XII	XIV	XV	XVI	XVII	XVIII	XIX	XX								
Look	1	3	3	4	3	3	3	3	3	3	3	4	3	4	4	4	3	4	2	3	4	4	65	3.25	10.30				
	2	4	3	3	4	3	3	4	3	3	4	3	4	3	4	4	4	3	3	3	3	3	67	3.35					
	3	4	4	4	4	3	3	4	4	4	4	3	3	3	4	4	4	3	4	4	4	4	74	3.70					
Smell	4	3	4	3	2	2	3	4	3	3	3	3	3	3	3	3	2	4	3	4	4	4	62	3.10	3.10				
	5	3	3	3	3	3	3	3	4	2	3	4	3	3	3	4	4	4	3	4	4	3	65	3.25	3.30				
Texture	6	4	3	3	4	3	3	4	3	3	4	3	4	3	3	4	4	4	3	3	3	3	67	3.35	6.60				
	7	3	3	3	3	3	3	3	4	2	3	4	3	4	3	4	4	4	3	4	4	3	65	3.25	3.25				
Total		24	23	23	23	20	21	23	24	24	20	22	26	21	22	27	25	27	21	25	24	24	465	23.25	13.083333				
Average overall score		3.32																											
Overall actual score		23.25																											

Indicator:

- 1 Attractive of packaging design
- 2 Color selection
- 3 Storage practicality
- 4 Selection of fragrance essence
- 5 Viscosity
- 6 Presence of residu
- 7 The amount of foam produced

$$\text{Ideal maximum score} = 7 \times 4 = 28$$

$$\text{Ideal minimum score} = 7 \times 1 = 7$$

$$X_i = \frac{1}{2}(28+7) = 17.5$$

$$Sb_i = \frac{1}{6}(28-7) = 3.5$$

$$X_i + 1, Sb_i = 17.5 + 1 \times 3.5 = 21$$

$$X_i + 1, Sb_i = 17.5 - 1 \times 3.5 = 14$$

$$\% \text{Ideal} = \frac{23.25}{28} \times 100\%$$

$$\% \text{Ideal} = 83.03\%$$

Table 9. Final result of organoleptic test

Score Range	Qualitative category
$X > 21$	Very Good
$21 > X \geq 17.5$	Good
$17.5 > X \geq 14$	Less
$X < 14$	Very Less
Final Result	
$23.25 > 21$	Very Good

The overall assessment results from the panellists showed that the actual score obtained was 23.25 from a maximum score of 28, with the ideal percentage reaching 83.03%. The actual score was in the range of $X > 21$, so the quality of Friend Clean detergent was included in the Very Good (VG) category