



Dosage Evaluation and Antioxidant Activity Test of Lotion of Ethanol Extract of Belimbing Wuluh Leaf (*Averrhoa Bilimbi L.*)

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<p>Track Record Article</p> <p>Accepted: 27 January 2024 Revised: 05 February 2024 Published: 21 March 2024</p> <p>How to cite : Ernoviya, & Afriadi. (2024). Dosage Evaluation and Antioxidant Activity Test of Lotion of Ethanol Extract of Belimbing Wuluh Leaf (<i>Averrhoa Bilimbi L.</i>). <i>Contagion: Scientific Periodical Journal of Public Health and Coastal Health</i>, 6(1), 408–420.</p>	<p style="text-align: center;">Abstract</p> <p><i>This study aims to make and evaluate the lotion formula from ethanol extract of star fruit leaves (<i>Averrhoa bilimbi L.</i>) and test the antioxidant activity of the lotion. The research method used is experimental, making lotions and testing antioxidant activity from July to October 2023 at the Semi-Solid Preparation Technology Laboratory, Department of Pharmacy, Poltekkes Kemenkes Medan, and Research Laboratory, University of North Sumatra. In the preparation stage, star fruit leaf simplisia was extracted by maceration using a 95% ethanol solvent. The lotion formula was made with ingredients such as PEG 4000, stearyl alcohol, glycerin, sodium lauryl sulfate, coconut oil, nipagin, and distillate water, with varying concentrations of ethanol extract of star fruit leaves. The formulation was evaluated through organoleptic, homogeneity, pH, spreadability, and viscosity tests. The results showed that the lotion produced had a homogeneous shape and aroma to the concentration of ethanol extract. In addition, the pH of the lotion is also within the safe range for human skin. The spreadability test showed the lotion's ability to spread on the skin, which met the requirements for lotions with spreadability values between 5 and 7 cm. The viscosity of the lotion was also by the set standards. Stability tests were conducted to monitor the physical and chemical changes of the lotion over four weeks. The results showed that lotions with 1% and 3% ethanol extract concentrations were stable during the study period. However, the 5% concentration experienced inhomogeneity changes in the third week. In conclusion, lotion with ethanol extract of star fruit leaves at 1% and 3% concentration can produce a good and stable formula. However, the antioxidant activity of the lotion is still in the weak to moderate category. This research contributes to developing plant-based natural cosmetic products for skin care.</i></p> <p>Keywords: <i>Antioxidant Activity, Belimbing Wuluh, Ethanol Extract, Evaluation, Lotion</i></p>
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INTRODUCTION

Skin is the outermost part of the body that lines the human body. The skin weighs an estimated 7% of the total body weight. The skin's outer surface has pores (small cavities) through which sweat is released. Skin is a part that has many functions, including as a body protector from various things that can harm, as a sense of touch, as a body temperature regulator, etc. (Sulastomo in Megasari, n.d., 2020).

Skin is the largest organ in humans that has a protective function. In adult humans weighing 70 kg, the skin weighs up to 5 kg and can coat the entire body surface of 2 cubic meters (A. Haerani in Muharyati, 2022). The skin has several important functions for the body, namely skin protection, sensation, communication, thermoregulation, metabolic synthesis and cosmetics (Carville in Muharyati, 2022).

Antioxidant activity of belimbing wuluh leaves can be classified based on the IC_{50} value obtained. If the IC_{50} value of an extract is below 50 ppm, then the antioxidant activity is very strong. The IC_{50} value between 50-100 ppm means the antioxidant activity is strong, the IC_{50} value between 101-150 ppm means the antioxidant activity is moderate, and the IC_{50} value between 151-200 ppm means the antioxidant activity is weak. In comparison, if the IC_{50} value is above 200 ppm, the antioxidant activity is weak (Salim in Hasim et al., 2019).

Ethanol extract of star fruit leaves has higher antioxidant activity than ether and water fractions of methanol extract of star fruit with IC_{50} values of 44.01 and 50.36 ppm, respectively. Ethanol extract from star fruit leaves also has higher antioxidant activity than ethanol extract from strawberry leaves (IC_{50} 363.55 ppm) according to Widyastuti et al., (2016), ethanol extract from bangun-bangun leaves (IC_{50} 59.26 ppm) according to Surya et al., (2013), and infusa of wungu leaves (IC_{50} 125.09 ppm) based on research conducted (Salim in Hasim et al., 2019).

One of the plants used as medicine is the leaves of Belimbing Wuluh. Belimbing wuluh is a plant that belongs to the Oxalidaceae tribe. Belimbing wuluh (*Averrhoa bilimbi* Linn.) is a plant from the Americas and tropical climate, cultivated in several countries such as Malaysia, Argentina, Australia, Brazil, India, the Philippines, Singapore, Thailand, and Venezuela (Kurniawati, 2017). The star fruit plant (*Averrhoa bilimbi* L.) is one of the plants that has long been used as a traditional medicine. Belimbing wuluh (*Averrhoa bilimbi* L.) can be used as an anti-acne drug because of the flavonoid compounds in belimbing wuluh fruit, which have antibacterial activity (Andasari et al. in Amira, 2021).

Previously, belimbing wuluh leaves have been formulated as gel preparations and tested for antioxidant effectiveness. The antioxidant activity of the gel at concentrations of 5%, 10%, and 15% had IC_{50} values of 118.38 ppm, 94.16 ppm, and 89.12 ppm, respectively. The results showed that the antioxidant gel preparation of 70% ethanol extract from star fruit leaves had good physical properties in formula II, and formula III had the strongest antioxidant properties, namely 89.12 ppm (Zaky et al., 2021).

Other research conclusions include organoleptic testing results, spreadability, and homogeneity. Two formulas meet the requirements, namely Na. Lauryl sulfate 0.5% and Na. Lauryl sulfate 1%, and in testing the pH of the three Na. lauryl sulfate formulas 0.5%, 1%, and 2% do not meet the requirements (Arisanty & Anita, 2018).

Based on previous research, researchers are interested in making lotion preparations of ethanol extract from star fruit leaves (*Averrhoa Bilimbi* L.), then evaluating the formula and testing its antioxidant activity. The lotion is a skin moisturizing cosmetic preparation in the

form of a liquid emulsion used on the hands and body area to moisturize the skin in order to get a good antioxidant effect from the lotion preparation (Mayaranti Wilsya et al., 2022). The advantages of lotion over other preparations are its large water content so that it can be applied easily; the spread and penetration power are quite high; it does not give a greasy feeling; it gives a cool effect and is also easily washed with water.

METHODS

This research is included in experimental research, namely making lotion preparations of ethanol extract of star fruit leaves (*Averrhoa Bilimbi L.*), then evaluating the formula and testing its antioxidant activity. This research was conducted at the Semi-Solid Preparation Technology Laboratory, Department of Pharmacy, Poltekkes Kemenkes Medan and Research Laboratory, Universitas Sumatera Utara. This research was carried out from July to October 2023.

The sampling technique used in this study was purposive sampling. The sample tested in this study was belimbing wuluh leaves (*Averrhoa Bilimbi L.*).

1. Tools and Materials

Beaker glass, measuring cup, filter cloth, stirring rod, rubber, plastic, blender, digital scale, mortar, stamper, blades, napkin, tissue, pot, spoon stretcher, water bath, porcelain cup, watch glass, pH meter, tube clamp, and dropper pipette. Star fruit leaves (*Averrhoa Bilimbi L.*), 95% ethanol, PEG 4000, Stearyl alcohol, Glycerin, Na lauryl sulfate, Coconut oil, Nipagin, and Aquadest.

2. Preparation of Ethanol Extract of Belimbing Wuluh Leaf

a. Simplisia Preparation

Fresh star fruit leaves (*Averrhoa Bilimbi L.*) were collected and dried without direct sunlight. After drying, each was pulverized using a blender.

b. Calculation of Distillation Liquid

Simplisia of belimbing wuluh leaves were each extracted by maceration using a 95% ethanol solvent. The 75 parts of 95% ethanol used amounted to 1,845.24 ml. The 25 parts of 95% ethanol used amounted to 615.08 ml.

c. Lotion Formulation

The formula used in this study is based on the research design (Ningsih et al., 2021). The basic formula of the lotion preparation to be made is as follows:

R/ PEG 4000 8%, Stearyl alcohol 4%, Glycerin 20%, Na lauryl sulfate 1.2%, Coconut Oil 2.5%, Nipagin 0.1%, Vanilla fragrance q.s, Aquadest ad 100%. The lotion preparation formula of ethanol extract of star fruit leaves in this study is shown in the table below.

Tabel 1. Formulation of Belimbing Wuluh (*Averrhoa bilimbi L.*) Leaf Extract Lotion

Preparation				
Materials	F0	F1	FII	FIII
Ethanol Extract of Belimbing Wuluh Leaf	0%	1%	3%	5%
PEG 4000	8%	8%	8%	8%
Stearyl Alcohol	4%	4%	4%	4%
Glycerin	20%	20%	20%	20%
Na Lauryl Sulfate	1,2%	1,2%	1,2%	1,2%
Coconut Oil	2,5%	2,5%	2,5%	2,5%
Nipagin	0,1%	0,1%	0,1%	0,1%
Vanilla Fragrance	q.s	q.s	q.s	q.s
Aquadest	ad 100%	ad 100%	ad 100%	ad 100%

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control),

F1 : Formula I with 1% concentration of ethanol extract of star fruit leaves,

FII : Formula II with 3% concentration of ethanol extract of star fruit leaves.

FIII : Formula III with 5% concentration of ethanol extract of star fruit leaves.

3. Preparation Evaluation Test

a. Organoleptical Test

Organoleptical test is done by direct observation which includes the shape, color, and smell of the lotion (Mayaranti et al., 2020).

b. Homogeneity Test

Homogeneity testing is done using two glass objects, where the sample is placed on one of the objects and placed evenly. The lotion preparation should show a homogeneous composition (evenly mixed) and no visible coarse particles (Mulyani in Mayaranti et al., 2020).

c. pH test

The pH test on the preparation was carried out using a pH meter. The tool is first calibrated using a neutral standard (pH 7.01), then rinsed with distilled water and inserted into an acidic pH solution (pH 4.01) until the tool shows the pH value. Then, the pH device is washed/rinsed with distilled water and dried with a tissue. It weighed 0.5 grams of preparation and dissolved with 50 ml of distilled water. Then, the pH device is dipped in the solution. Let the tool show the pH value until it is constant (Putri in Nara, 2019).

d. Spreadability Test

The purpose of evaluating the spreadability is to determine the ability of the lotion to spread on the skin to meet the requirements for lotion spreadability when the spreadability

is 5 - 7 cm. Good spreadability will make it easier when applied to the skin. The amount of extract used in each formula affects the diameter of the spreadability of the preparation (Dominica, 2019).

The spreadability test was carried out by weighing 0.5 grams of star fruit leaf lotion preparation and placing it in the centre of a Petri dish. Above the preparation is placed another Petri dish that has been weighed and then allowed to stand for 1 minute, and the diameter of the spread is. Add 50 grams of weight on top of the Petri dish, let it stand for 1 minute, and record the diameter of the spread. Weights are added in multiples of 50 grams until they reach 200 grams, then the diameter and the spread area are measured (Pujiastuti in Mayaranti et al., 2020).

e. Viscosity Test

Determination of viscosity aims to determine the difference in viscosity in each formula of Lotion ethanol extract of star fruit leaves. The tool used is Brookfield Viscometer. The spindle is first heated at 75°C then attached to the Brookfield Viscometer measuring instrument. The position of the spindle in the hot solution is set until it is right, the viscometer is turned on, and the temperature of the solution is measured; when the temperature of the solution reaches 75°C, the viscosity value can be known by reading the viscometer on a scale of 1 to 100. Readings are taken after one minute of full rotation twice using spindle No.7 with a value/determination, namely 400. The speed of the tool used is 50 rpm (Naiu, 2018).

RESULTS

1. Physical Evaluation Test

a. Organoleptical Test

The results of organoleptical observations of the lotion preparation of ethanol extract of star fruit leaves can be seen in the following table

Table 2. Organoleptic Test Results of Lotion Preparations

Formula	Organoleptical Observation		
	Color	Shape	Aroma
F0	White	Semi solid	Lavender scent
FI	Light green	Semi solid	Lavender scent and extract signature
FII	Dark green	Semi solid	Lavender and extract characteristic aroma
FIII	Dark green	Semi solid	Aroma typical of the extract

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with 3% concentration of ethanol extract of star fruit leaves.

FIII : Formula III with 5% concentration of star fruit leaf ethanol extract.

b. Homogeneity Test

The homogeneity test of the lotion preparation of ethanol extract of star fruit leaves was carried out to see whether there were coarse grains and colors in the preparation that made the preparation inhomogeneous. The observation results of the homogeneity test can be seen in the following table

Table 3. Homogeneity Test Results of Lotion Preparations

Formula	Homogeneity Testing
F0	Homogeneous
FI	Homogeneous
FII	Homogeneous
FIII	Homogeneous

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with 5% concentration of ethanol extract of star fruit leaves

c. pH test

pH testing is done using a pH metter tool. The results of pH testing of lotion preparations of ethanol extract of star fruit leaves can be seen in the following table

Table 4. Results of pH Test of Lotion Preparations

Formula	pH testing
F0	6,3
FI	6,4
FII	6,4
FIII	6,3

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

d. Spreadability Test

The observation results of the spreadability test on lotion preparations of ethanol extract of star fruit leaves can be seen in the table below.

Table 5. Data on the Spreadability Test Results of Lotion Preparations

Formula	Spreadability Testing
F0	5,5 cm
FI	5,4 cm
FII	5,2 cm
FIII	5,5 cm

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

e. Viscosity Test

The results of the viscosity test observations on the lotion preparation of ethanol extract of star fruit leaves can be seen in the table below.

Table 6. Viscosity Test Result Data of Lotion Preparations

Formula	Viscosity Testing
F0	3.204 cP
FI	3.146 cP
FII	3.342cP
FIII	2.860 cP

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

2. Stability Test

Stability tests carried out on star fruit leaf lotion preparations include organoleptic tests shown in table 7, homogeneity tests shown in table 8, pH tests shown in table 9, and viscosity tests shown in table 10.

Table 7. Organoleptical Test Results Organoleptical Test Results on First Week and Second Week Lotion Preparation Stability Tests

Formula	Organoleptical Observation					
	Week 1			Week 2		
	Color	Shape	Aroma	Color	Shape	Aroma
F0	White	Semi solid	Lavender	White	Semi solid	Lavender
FI	Light green	Semi solid	Lavender, khas extract	Light green	Semi solid	Lavender, khas extract
FII	Darj green	Semi solid	Lavender, khas extract	Dark green	Semi solid	Lavender, khas extract
FIII	Dark green	Semi solid	khas extract	Dark green	Semi solid	Lavender, khas extract

Table 8. Organoleptical Test Results Organoleptical Test Results on the Third Week and Fourth Week Lotion Preparation Stability Tests

Formula	Organoleptical Observation					
	Week 3			Week 4		
	Color	Shape	Aroma	Warna	Bentuk	Aroma
F0	White	Semi solid	Lavender	White	Semi solid	Lavender
FI	Light green	Semi solid	Lavender, khas extract	Light green	Semi solid	Lavender, khas extract
FII	Dark green	Semi solid	Lavender, khas extract	Dark green	Semi solid	Lavender, khas extract
FIII	Dark green	Semi solid	khas extract	Dark green	Semi solid	khas extract

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

Table 9. Homogeneity Test Results on the Lotion Preparation Stability Test

Formula	Homogeneity Observation			
	Week 1	Week 2	Week 3	Week 4
F0	Homogeneous	Homogeneous	Homogeneous	Homogeneous
FI	Homogeneous	Homogeneous	Homogeneous	Homogeneous
FII	Homogeneous	Homogeneous	Homogeneous	Homogeneous
FIII	Homogeneous	Homogeneous	Not Homogeneous	Not Homogeneous

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

Table 10. Results of the pH Test in the Lotion Preparation Stability Test

Formula	pH observation			
	Week 1	Week 2	Week 3	Week 4
F0	6,1	5,6	5,0	4,9
FI	6,0	5,9	4,6	4,6
FII	6,3	5,4	4,9	4,8
FIII	5,3	5,4	4,8	4,7

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

Table 11. Viscosity test results in the lotion preparation stability test

Formula	Viscosity Observation			
	Week 1 30 rpm	Week 2 30 rpm	Week 3 30 rpm	Week 4 30 rpm
F0	3.204 cP	3.585 cP	3.664 cP	3.367 cP
FI	3.146 cP	3.437 cP	3.722 cP	3.725 cP
FII	3.342 cP	3.554 cP	3.740 cP	3.755 cP
FIII	2.860 cP	3.672 cP	3.797 cP	3.785 cP

Description:

F0 : Formula 0 without ethanol extract of star fruit leaves (Negative Control)

FI : Formula I with 1% concentration of ethanol extract of star fruit leaves.

FII : Formula II with a concentration of 3% ethanol extract of star fruit leaves.

FIII : Formula III with a concentration of 5% ethanol extract of star fruit leaves.

DISCUSSION

Evaluation of Ethanol Extract Lotion Formula of Starfruit Wuluh Leaf (*Averrhoa Bilimbi L.*)

Based on the results obtained in the research on the formulation of lotion preparations of ethanol extract of star fruit leaves, it shows that in the organoleptic test, the lotion preparations produced have a homogeneous shape, white in F0, and light green in FI, and dark green in FII, FIII which are produced from ethanol extract of star fruit leaves. In addition, the lotion preparation has a lavender aroma in F0, caused by lavender fragrance to give a soft aroma to the hands. In FI and FII, the aroma produced is a combination of lavender aroma with

typical extracts, while in FIII, the aroma produced is a typical aroma of extracts obtained from ethanol extract of star fruit leaves.

The homogeneity test was carried out by applying each preparation formula on transparent glass. A good preparation shows a homogeneous composition and no visible coarse particles (Mayaranti Wilsya et al., 2020). After the homogeneity test was carried out on each preparation, it was found that the results were homogeneous in all preparations after the manufacturing process.

The pH test is carried out to avoid a pH that is too acidic, which can cause skin irritation and a pH that is too alkaline, which can cause dry skin. In the observation test, the pH obtained from F0, FI, FII, and FIII were 6.3, 6.4, 6.4, and 6.3. Differences in the concentration of active substances and temperature can affect the pH of the preparation. pH preparations that meet the criteria for skin pH are in preparations F0, FI, FII, and FIII. The pH value of lotions that meet the criteria must be by the pH of the skin, which is between 4.5 and 6.5. This indicates a lotion preparation that is safe to use on the skin because it is included in a safe pH range, cannot irritate the skin, and does not make the skin dry (Nara, Ayu, 2019).

In the spreadability test, F0, FI, FII, and FIII results are 5.5cm, 5.4cm, 5.2cm, and 5.5cm. The ability to spread lotion on the skin meets the requirements for lotion spreadability when the spreadability is 5 - 7 cm. Good spreadability will make it easier when applied to the skin. The amount of extract used in each formula affects the diameter of the spreadability of a preparation (Dominica & Handayani, 2019). This shows that the lotion preparation is good because it is included in the spreadability test range.

In the viscosity test of F0, FI, FII, and FIII, different results were obtained using a speed of 30 rpm. The viscosity value of lotion preparations on the skin has met the requirements for viscosity tests of 2,000-50,000 cP, and good viscosity will make it easier for the preparation to be applied to the skin. Factors that affect the viscosity of the preparation due to the provision of different extracts in each preparation have a different viscosity. The longer the storage of the preparation, the greater the viscosity value due to the provision of the largest glycerin in lotion preparations (Vinaeni et al., 2022).

The presence of fatty acids influences the viscosity of the lotion. The fatty acid in this formula is glycerin. So, the more glycerin, the more fatty acid content, the thicker the lotion and the higher the viscosity value (Riyanti et al., 2022). In the stability test, the organoleptic test showed a change in the shape of the FIII preparation, which changed its shape inhomogeneously in the third week because the oil used was not evenly mixed into the lotion preparation, so the preparation was unstable; in FI and FII it did not change shape until the

fourth week and was included in the stable preparation. During the homogeneity test, the FIII preparation experienced a change in inhomogeneity in the third week. In contrast, F0, F1, and FII did not experience homogeneity from the first to the fourth week. In the pH test table during the stability test, there was a slight change in pH in preparations F1, FII, and FIII in the first week. In the second and third weeks, the pH value of the preparation decreased from the first week; this is because the storage temperature of the preparation influences the pH value due to the recent weather rising slightly; the pH of the lotion preparation decreased from the first week.

According to Wintariani's et al., (2021) research, vanishing cream formulations include a 96% ethanol extract of star fruit leaves (*Averrhoa bilimbi* L.) F0 is a vanishing cream base serving as the negative control. F1 contains 10% ethanol extract of 96% star fruit leaves, F2 contains 15% ethanol extract of 96% star fruit leaves, and F3 contains 25% ethanol extract of 96% star fruit leaves. These formulations exhibit favourable physical characteristics as determined by various cream evaluation tests, such as organoleptic, homogeneity, spreadability, viscosity, adhesion, and pH tests. The results of Ismail's, (2022) research found that 96% ethanol extract of star fruit leaves formulated in the form of gel preparations had antibacterial properties against *Staphylococcus epidermidis* and provided the largest inhibition zone at a concentration of 40% (7.53 mm) compared to gel concentrations of 30% (3.17 mm) and 35% (4.37 mm).

Ariem et al., (2020) reports that the cream preparation was created in the shape of a semi-solid based on the findings of the organoleptic test. The cream preparation of Belimbing Wuluh leaf ethanol extract at concentrations of 5% and 7% has a significantly thinner form than the thicker concentration of 3%. This demonstrates that a thinner cream preparation is created at greater Belimbing Wuluh leaf ethanol extract concentrations. The results of Yuliana's research et al., (2023) found that the cream preparation of ethanol extract of star fruit leaves (*Averrhoa bilimbi* L.) through the test results is physically stable and has an IC_{50} value of less than 50, namely 5.19 $\mu\text{g/mL}$ which indicates a very strong antioxidant activity where the smaller the IC_{50} value, the higher the antioxidant activity.

A study by Verawaty et al., (2020) showed that the concentration of star fruit leaf infuse gel yielded effective results in various bacterial tests. The antibacterial activity against *S. epidermidis* bacteria showed inhibition zone diameters of 10.6 mm, 12.3 mm, and 29.1 mm at concentrations of 10%, 20%, and 30%, correspondingly. The higher the belimbing wuluh leaf infusa concentration, the stronger the inhibition. This is seen at a concentration of 30%, which effectively inhibits the growth of *S. epidermidis* bacteria.

Febriyanti's et al., (2024) research results indicated that the cream containing star fruit leaf extract at concentrations of 20%, 30%, 40%, and 50% exhibited inhibitory effects on *S. epidermidis* bacteria, as evidenced by clear zones around the wells measuring 6.27 mm, 8.05 mm, 8.49 mm, and 9.59 mm, respectively. The results of the bacterial inhibition zone fall within the moderate range. The anti-acne cream from star fruit leaf extract (*Averrhoa bilimbi* L.) did not exhibit potent antibacterial action against *S. epidermidis* bacteria. Based on Jamil et al., (2023) findings, star fruit leaf extract can be used as a transparent solid soap formulation in various concentrations with a distinctive extract aroma. Transparent solid soap preparations of star fruit leaf extract have antibacterial activity with the strongest inhibition at a concentration of 7.5% with an inhibition diameter of 29.5 mm, including the sensitive category.

The decrease in the pH value of the preparation is due to the addition of different levels of extract of star fruit leaves, which affects the stability of the pH value (Hosni et al., 2023). However, the change in pH value is still included in the pH range, which is good for the skin. The viscosity of the preparation also increased due to the thixotropic effect of the preparation, which tends to thicken when kept at room temperature. Therefore, the viscosity value of the lotion preparation increased from the first week to the fourth week (Hosni et al., 2023).

CONCLUSIONS

Based on the results and discussion in this study, the conclusions are that ethanol extract of star fruit leaves (*Averrhoa bilimbi* L.) can produce a good and stable lotion preparation formula at concentrations of 1% and 3%, respectively. The lotion preparation formula with a concentration of ethanol extract from star fruit leaves (*Averrhoa bilimbi* L.) 1% does not have antioxidant activity, 3% has a weak category, and 5% has a moderate category.

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