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Formulation and Antioxidant Test of Soursop Leaf Lotion Preparation (Annona squamosa L.) Using the ABTS Method

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Abstract

Soursop leaves (Annona squamosa L.) are known to contain secondary metabolite compounds such as flavonoids, alkaloids, tannins, and polyphenols that have the potential as natural antioxidants. Antioxidants play an important role in warding off free radicals that can cause skin damage, premature aging, and degenerative diseases. This study aims to formulate a lotion preparation with soursop leaf extract and evaluate its antioxidant activity using the ABTS (2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid)) method. The extract was obtained through a maceration method using 96% ethanol. The lotion formula was prepared with various concentrations of soursop leaf extract, then tested for physical quality properties, as well as antioxidant activity by measuring the IC50 value of the ABTS radical solution. The results showed that soursop leaf extract has very strong antioxidant activity, indicated by a strong IC50 value. The resulting lotion preparation has good physical characteristics and antioxidant activity comparable to the comparator quercetin. Thus, soursop leaf extract lotion has the potential to be developed as a natural skin care product with moisturizing and antioxidant functions.

Keywords: ABTS, Antioxidants, Soursop Leaves, IC50, Lotion.

INTRODUCTION

Research Phenomenon

Free radicals produced by air pollution, cigarette smoke, and motor vehicles have been identified as major factors triggering cell damage and various degenerative diseases, such as cancer, infections, and heart disease. Active oxygen species (ROS) and reactive nitrogen species (RNS) can interact with DNA, causing mutations during replication, thus accelerating aging and skin damage (Werdiningsih et al., 2020; Handayani, 2025; Taslim, 2022). To overcome the negative impact of free radicals, the use of natural antioxidants is crucial due to their ability to break the chain of oxidation reactions and protect cells from damage (Putri et al., 2024; Barve, 2011).

Soursop leaves (Annona squamosa L.) are a rich source of natural antioxidants, rich in secondary metabolites such as flavonoids, alkaloids, tannins, and polyphenols. Various studies have shown that soursop leaf extract has potential as an antioxidant, antidiabetic, and hepatoprotective agent, and can be used as an herbal remedy to boost immunity (Kumar et al., 2019; Wibisono, 2020; Taslim, 2022). Furthermore, topical preparations such as lotions are the primary choice for delivering active antioxidants due to their ease of application and convenience (Haerani et al., 2018; Mardikasari, 2019).

Research Problems

Although the antioxidant potential of soursop leaves has been extensively studied, there are still limitations in developing topical preparations that meet physical quality standards and have optimal antioxidant activity. One of the main challenges is ensuring that soursop leaf extract can be formulated into a lotion that is stable, homogeneous, and has physical characteristics suitable for external use (Handayani, 2025; Rasyadi, 2024). Furthermore, testing antioxidant activity in lotion preparations requires a sensitive and accurate method, such as the ABTS method, which can measure antioxidant capacity at various pH ranges and solvents (Putri et al., 2024; Rantias, 2019).

Previous research on lotion preparations containing other plant extracts, such as soursop and celery leaves, has shown that formulation and physical quality testing significantly influence the effectiveness of the resulting antioxidants (Handayani, 2025; Taslim, 2022; Seledri, 2024). However,

data on the optimal concentration of soursop leaf extract in lotion that provides the best antioxidant activity is still limited and requires further study (Kumar et al., 2019; Wibisono, 2020).

Purpose, Urgency, and Novelty of the Research

This study aims to formulate a lotion preparation with soursop leaf extract (Annona squamosa L.), evaluate the physical quality of the lotion, and test its antioxidant activity using the ABTS method. The urgency of this research lies in the effort to develop natural skin care products that not only function as moisturizers, but also as effective antioxidants in warding off free radicals. The novelty of this study is the use of the ABTS method to evaluate the antioxidant activity of soursop leaf extract lotion preparations, as well as determining the optimal concentration of the extract that provides the best antioxidant activity, which has not been widely studied in previous studies (Putri et al., 2024; Handayani, 2025; Seledri, 2024).

RESEARCH METHODS

Types and Methods of Research

This study used a descriptive experimental approach, which aims to describe and interpret the results of testing the antioxidant activity of soursop (Annona squamosa L.) leaf extract and lotion formulation using the ABTS method in the pharmacy laboratory of Duta Bangsa University, Surakarta. The descriptive experimental approach was chosen because it is able to provide an objective picture of the effect of independent variables on dependent variables under controlled laboratory conditions (Sugiyono, 2022; Yunitri, 2024; Werdiningsih et al., 2020; Putri et al., 2024). Experimental research is considered the gold standard in the development of health sciences because of its precision and objectivity in answering cause-and-effect hypotheses (Yunitri, 2024; Cresswell & Creswell, 2022).

Data Analysis Instruments and Techniques

The research instruments included laboratory equipment such as a rotary evaporator, Brookfield viscometer, water bath, UV-Vis spectrophotometer, moisture balance, pH meter, and other glassware. The materials used included soursop leaf extract, 96% ethanol, methanol, potassium persulfate, and additional ingredients for lotion formulation. Data analysis techniques were carried out quantitatively and qualitatively, including measuring the physical characteristics of the lotion, testing antioxidant activity using the ABTS method, and analyzing the physical quality of the preparation. The data obtained were analyzed descriptively to describe the test results and comparisons between formulas (Sugiyono, 2022; Emzir, 2021; Handayani, 2025; Barve, 2011).

Population and Sample

The population in this study was all lotion preparations formulated with soursop leaf extract at various concentrations. The study samples included lotions made with extract concentrations of 0%, 1%, 2%, and 3%, as well as soursop leaf extract that had undergone standardization and phytochemical testing. Sample selection was carried out using purposive sampling based on a modified formula from previous studies and adjusted to the research objectives (Sugiyono, 2022; Kumar et al., 2019; Wibisono, 2020).

Research Procedures

The research procedure began with the collection and identification of soursop leaves, followed by the preparation of simplicia, standardization of simplicia (drying shrinkage test, water content, and ash content), and extraction using the maceration method with 96% ethanol. The obtained extract was then tested for organoleptic characteristics, water content, and metal-free content, and phytochemical screening was carried out to detect active compounds. Next, the extract was formulated into lotions with various concentrations, and physical quality tests were carried out (organoleptic, pH, viscosity, spreadability, adhesion, hedonic test, and irritation test) according to SNI standards. The antioxidant activity test was carried out using the ABTS method, including the preparation of ABTS stock solutions, potassium persulfate, and PBS, and absorbance measurements using a UV-Vis

spectrophotometer. The test data were analyzed to determine the lotion formula with the best antioxidant activity (Sugiyono, 2022; Cresswell & Creswell, 2022; Putri et al., 2024; Handayani, 2025; Na'imah, 2024).

The writing of this research method refers to the principles of experimental and descriptive research that have been widely used in pharmaceutical and health research, and is supported by the latest and relevant references from the Google Scholar database (Sugiyono, 2022; Yunitri, 2024; Emzir, 2021; Cresswell & Creswell, 2022).

RESULTS AND DISCUSSION

Material Collection and Plant Determination

The soursop leaves used in this study were obtained from a resident's yard in Kedawung District, Sragen Regency, Central Java Province. The material was collected in the morning, yielding 5 kg.

Determination of the obtained soursop (Annona squamosa L.) leaf plants was carried out at the Functional Service Unit of Dr. Sardjito General Hospital under the name of UPF Yankestard on Jl. Raya No. 11, Tawangwangu, Kalisoro, Karanganyar, Central Java. The purpose of this determination was to determine the accuracy of the soursop (Annona squamosa L.) leaf samples by matching the morphology of the plants to be studied to avoid errors in the test plants. The results of the determination using the organoleptic method can be seen in Appendix 6.

Making Simple Powder

Drying of Soursop Leaf Simplicia

A total of 5 kg of fresh soursop leaves that have been obtained are then sorted from unfit stems and leaves, weighed, and wet sorted to clean from dust and dirt attached to the leaves, and cut into pieces, then dried in direct sunlight covered with black cloth to avoid dirt, dust, and reduce damage to color, taste, or chemical content. Drying of soursop leaves is done for 5 days, then after drying, the simplicia is stored in a closed container.

Table 1. Results of the Soursop Leaf Simplex

Wet Weight	Dry Weight	Yield Value
6100 grams	5000 grams	81%

Based on the table above, the yield of the wet simplicia powder to dry simplicia powder was 81%. The yield calculation for the simplicia was obtained by comparing the dry weight to the initial weight of the sample. If the percentage exceeds 10%, it has a good yield percentage value (Ministry of Health of the Republic of Indonesia, 2017).

Pollination of Soursop Leaf Simples

After the soursop leaf sample has completely dried, it is then ground and sieved with a 40-mesh sieve to obtain a fine powder, which is stored in a closed container. The purpose of powdering the simplex is to facilitate the maceration process (Srie, 2017).

Table 2. Yield of Soursop Leaf Simple Powder

Wet Weight	Dry Weight	Yield Value
5000 grams	590 grams	11%

Based on the table above, it can be explained that the results of pollination of soursop leaf simplicia obtained a yield of 590 grams, and then obtained a yield value of 11%.

Standardization of Simple Powder

Drying Loss

The purpose of the drying loss standardization test for soursop leaf (Annona squamosa L.) is to provide limits on the loss of compounds during the drying process (Wahyu Ningsih et al., 2023).

The drying loss test is one of the parameters for a simple substance to maintain quality and avoid fungal growth. In this experiment, the results obtained were with an average percentage of 9.2%, meeting the established standard of below 10% (Ministry of the Republic of Indonesia, 2017). The drying loss results can be seen in Table 8 as follows:

Table 3. Results of the Standardization Test for Drying Loss of Soursop Leaf Simples

Replication	Weight Initial (gram)	Weight End (gram)	Results (%)	Average	Reference
I	2	1.8	9.1	9.2%	Ministry of the Republic of Indonesia, 2017
II	2	1.8	9.2		
III	2	1.8	9.4		

The determination of drying loss of 2 grams of simplicia powder was carried out using an oven at a temperature of 105°C for 30 minutes with 3X replication until a constant value was obtained. Based on the table, this study obtained results of 9.1%, 9.2%, and 9.4%. This indicates that the simplicia powder has met the standard requirements for drying loss, which is below 10% (Ministry of the Republic of Indonesia, 2017).

Ash Content of Simple Drugs

The standardization test for determining the ash content of soursop leaf (Annona squamosa L.) simplicia was carried out with the aim of determining the total ash content and to determine whether it is good or not for use (Wahyu Ningsih et al., 2023).

Table 4. Results of the Ash Content Test of Simplex

Replication	Initial Weight (grams)	Final Weight (grams)	Results (%)	Average	Reference
I	2	1.4	9.9	8.5%	Indonesian Herbal Pharmacopoeia, 2008
II	2	1.7	8.1		
III	2	1.6	7.6		

Determination of the ash content of 2 grams of the simplicia sample with 3 replicates was carried out using an oven for 30 minutes, then cooled using a desiccator until cold, and then the sample was put into a furnace for 4 hours. Based on the table above, the results were 9.9%, 8.1%, and 7.6%.

According to the Indonesian Herbal Pharmacopoeia, the ash content of herbal medicines should not exceed 10.2%, and the results obtained in this study were 8.5%, demonstrating that the results meet standard requirements. The higher the ash content, the higher the mineral content of the plant.

The mineral content in organic materials can include organic salts of acetate, oxalate, pectate, malic acid, and organic salts of alkali metals, chlorides, carbonates, phosphates, and nitrate sulfates. Minerals can also come from complex organic salts (Ministry of the Republic of Indonesia, 2017).

Water Content of Simple Drugs

The purpose of the standardization test for determining the water content of soursop (Annona squamosa L.) leaf simplicia is to determine the limits regarding the range of water content contained in soursop leaf simplicia. This water content test on soursop leaf simplicia obtained the following results:

Table 4. Results of the Standardization Test of Water Content of Srikaya Simplex

Testing	Sample Weight	Replication			Average (%)	Reference
Water content simple ingredients soursop leaves	2 grams	I	II	III		Pharmacopoeia Indonesian Herbal, 2008
		9.34%	6.74%	4.03%	6.7%	

Water content is a parameter to determine the water residue after the drying process. In testing using a moisture balance tool for 15 minutes with 3 replications of 2 grams of sample, the water content obtained from the standardization test results of the water content of soursop leaf simplicia was 6.7%, these results have met the requirements for the water content test in the Indonesian Herbal Formakope (2008) for soursop leaf simplicia, which is not more than 10%. Determination of water content is also tied to the purity of the simplicia, because the greater the percentage of water content in a simplicia, the easier it is for a material to experience faster decay, which is caused by microbial growth. High water content can also cause decomposition of active compounds in the simplicia material due to enzymatic reaction activity. Therefore, testing water content is very important in determining the quality and stability of a natural material simplicia (Yulien, 2022).

Making Soursop Leaf Extract (Annona squamosa L.)

The preparation of soursop leaf extract was carried out using the maceration method with 96% ethanol solvent with a ratio of 1:10. 500 grams of soursop leaf powder was weighed, then put in a glass jar and added with 5000 mL of 96% ethanol solvent, then tightly closed and macerated for 5 x 24 hours. The first maceration was carried out for 3x24 hours with 3000 mL of 96% ethanol. Every 24 hours, stirring was carried out, and re-maceration was carried out once for 2x24 hours with 2000 mL of ethanol. The results of the yield values were as follows:

Table 5. Weight of Soursop Leaf Extract (Annona squamosa L.)

Sample weight	Extract Weight	Extract yield	Reference
500 grams	61.5 grams	12.3%	(Indonesian Herbal Pharmacopoeia, 2008)

The manufacture of soursop leaf extract uses the maceration method because it is a very simple extraction method, only with a soaking process, and the safest method in extracting compounds found in the plant (Wahyu Ningsih et al., 2023). The process of soaking the simplicia is carried out for 5 x 24 hours with a solvent ratio of 1:10, and stirring is carried out every 24 hours. The solvent used in this maceration method is 96% ethanol because ethanol solvents have been proven to be able to attract polar, semi-polar, and non-polar substances (Amina et al., 20116).

Furthermore, the macerate from the maceration process is then separated from the solvent using a rotary evaporator at a stable temperature of 40-50°C to obtain a thick extract, then continued with the concentration of the extract in a water bath to obtain a thick extract. Based on the table, the yield value is 12.3%. Therefore, the extract yield obtained is declared good because the extract yield is more than 10% and these results have met the requirements of the Indonesian Herbal Pharmacopoeia, which is more than 10%.

Standardization of Soursop Leaf Extract

Organoleptic Observation

Organoleptic observations of the extract were conducted using the five senses to determine the extract's characteristics, including shape, color, odor, and taste (Nasri, 2023). The results of this study showed that the extract was thick, dark green, and had a distinctive soursop leaf odor.

Determination of the water content of soursop leaf extract

The purpose of the standardization test for determining the water content of soursop (Annona squamosa L.) leaf extract was to determine the limits of the water content range contained in soursop leaf extracts. This test was conducted using a moisture balance, with 2 grams of extract heated at 105°C for 15 minutes. The water content results are shown in the following table:

Table 6. Results of the Standardization Test of the Water Content of Soursop Leaf Extract

Replication			Average	Reference
I	II	III		
2.37%	2.19%	1.73%	2.09%	Indonesian Herbal Pharmacopoeia

The standardization test results for the water content of soursop leaf extract were 2.09%, which meets the requirements for water content testing for soursop leaf simplicia, which is no more than 10%, as stipulated in the Indonesian Herbal Pharmacopoeia. Water content in extracts exceeding 10% is quite risky because excess water content can cause faster mold growth and the growth of other microorganisms (Ministry of the Republic of Indonesia, 2017).

Metal Free Test

The results of the calibration curve obtained from the measurement of lead (Pb) metal using atomic absorption spectrophotometry obtained a linearity equation, namely y = 0.02269x + 0.00050, with a correlation coefficient value of R2 = 0.99626. The correlation coefficient value that meets the requirements is more than 0.9770 (Tulandi et al., 2015), meaning that there is a linear relationship between the standard concentration of Pb metal and absorbance. The resulting absorbance will be directly proportional to the concentration, where the higher the concentration, the higher the absorbance value (Anggraini et al., 2025). Pb heavy metal testing was carried out at BPSMB Surakarta and can be seen in Appendix 25.

Phytochemical Screening

Phytochemical screening is performed by observing the color test reaction using color reagents. The results are shown in the following table:

Table 7. Phytochemical Screening

Compound	Reagent	Results	Reference
Alkaloid	HCl 2N + *Dragendorff*	brick red (+)	Formation of brick red color (Arshan et al., 2020)
	HCl 2N + *Mayer*	blackish green (-)	Formation of a blackish green color (Werdaningsih, 2020)
	HCl + *Wagner*	There is brown sediment (+)	Brown sediment occurs (Werdaningsih, 2020)
Saponin	2ml distilled water hot	No foam formed (+)	No foam is formed (Werdaningsih, 2020)

Compound	Reagent	Results	Reference
Flavonoid	Mg powder + 5 drops of HCl concentrated	There is an orange layer (+)	Formation of an orange layer (Werdaningsih, 2020)
Tannin	3 drops of FeCl3 1%	No foam is formed, and changes occur blackish green (+)	There is a blackish green change (Werdaningsih, 2020)

Alkaloid

The alkaloid test is carried out by adding 2N HCl, then extracting it into an acidic environment. The alkaloid will re-form its salt, which is more attracted to the aqueous phase because it is more soluble in water. The acidic phase is added with Mayer's reagent, which will produce a blackish green color. This is because the Hg2+ metal ion in the Mayer's reagent binds to the nitrogen in the alkaloid ring, forming a complex between the alkaloid and Mayer's reagent. On the addition of Dragendorff's reagent, the color changes to red. This is because the alkaloid with Dragendorff appears due to the formation of a complex between the alkaloid salt and the bismuth ion from Dragendorff's reagent. On the addition of Wagner, there is a brown precipitate; this is due to the formation of an insoluble complex between the alkaloid salt and the iodine ion from Wagner's reagent (Arshan et al., 2020).

Saponin

Saponin test: Aquades added with soursop leaf extract is heated for 10 minutes, then shaken. Positive results are indicated if foam appears because saponin acts as a natural surfactant compound, and in this study, it did not show negative results because there was no foam (Werdaningsih, 2020).

Flavonoid. Flavonoid testing is carried out by adding concentrated Mg and HCl which are useful for reducing the benzeproyron core in the flavonoid structure so that a dark red or orange color change occurs because a complex reaction occurs between the flavonoid compound and the reagent causing a shift in the absorption spectrum to the visible light region, this is what causes the color to become orange or red. Flavonoids themselves function as anti-viruses, anti-inflammatories, anti-aging, and antioxidants. Based on the table above, the results obtained are an orange color change, indicating a positive flavonoid (Werdaningsih, 2020).

Tannin

A positive tannin test is characterized by a color change that occurs upon addition of $FeCl_3$ solution, a blackish-green color due to the condensation of one of the hydroxyl groups in the tannin compound. The results in this study showed no foam and a color change to blackish-green (Werdaningsih, 2020).

Antioxidant Test of Soursop Leaf Extract

Before measuring antioxidant activity, the maximum wavelength of the ABTS+ solution was first determined. The goal was to determine the wavelength with the highest absorbance so that the measurement was under optimum conditions and the results were maximized. Wavelength determination was carried out by scanning in the range of 700–750 nm (Na'imah, 2024), and the maximum wavelength was obtained at 730 nm with an absorbance value of 0.531. The results of the ABTS Wavelength Measurement can be seen in Figure 16.

Figure 1. ABTS Wavelength

Determining the operating time aims to determine the appropriate measurement time, namely when the reaction between the sample and the reagent has occurred completely and formed a stable complex compound (Aderiyanti, 2022). The test was conducted using a 15 ppm quercetin standard solution with a 1-minute interval for 30 minutes. Based on the measurement results, the absorbance value showed a decrease from the 0th to the 6th minute, then stabilized from the 7th to the 20th minute in the range of 0.514–0.518. This indicates that the quercetin solution began to reach stability after 6 minutes of reaction with the ABTS solution. The results of the ABTS operating time measurement can be seen in Figure 2.

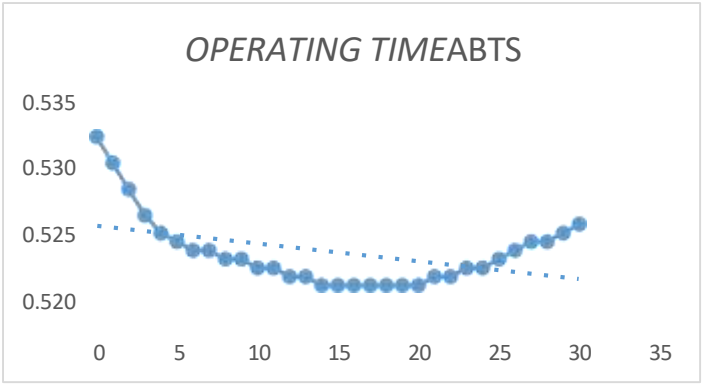

Figure 2. ABTS Operating Time

Measurement of antioxidant activity of test samples using the ABTS method from soursop leaf extract (Annona squamosa L.) with concentration variations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm, and quercetin as a comparison with concentration variations of 5 ppm, 10 ppm, 15 ppm, 20 ppm, and 25 ppm. A test solution was made, then from each concentration of quercetin sample, 2 ml was taken and added to 1 ml of ABTS solution, and then measured using UV-Vis spectrophotometry at a wavelength of 531 nm, with the operating time that was obtained. The percent ABTS reduction value in soursop leaf extract (Annona squamosa L.) and quercetin can be seen in the following table:

Table 8 Antioxidant Activity of Soursop Leaf Extract (Annona squamosa L.) and Quercetin (Comparator) Using the ABTS Method

Sample	Concentration (ppm)	Absorbance	% Inhibition	IC50	Conclusion
Quercetin	5 ppm	0.498	40,000	17,958	Very strong
	10 ppm	0.470	43,373		
	15 ppm	0.441	46,827		
	20 ppm	0.394	52,490		
	25 ppm	0.370	55,462		
Soursop Leaf Extract	10 ppm	0.490	40,964	26,170	Very strong
	20 ppm	0.456	45,020		
	30 ppm	0.388	53,293		
	40 ppm	0.354	58,394		
	50 ppm	0.303	63,534		

Making Lotion Preparations

The preparation of soursop leaf extract lotion (Annona squamosa L.) is carried out by weighing the ingredients according to the measurements, then dividing them into oil phases (stearic acid, cetyl alcohol, propyl paraben, and liquid paraffin) and water phases (triethanolamine, glycerin, methyl paraben, and distilled water). Then heat using an electric stove and mix the oil phase ingredients into a porcelain cup and heat until the ingredients dissolve, then make the water phase by mixing all the ingredients into a beaker glass and then heating to a temperature of 70°C. After heating, the water phase is mixed into the oil phase slowly using a mortar and pestle that has been heated beforehand. Stirring is carried out until a homogeneous lotion mass is formed, then add the extract and oleum jasmine as a lotion fragrance and stir until evenly distributed. The finished lotion is then put into a pump bottle. The method of making the lotion is in line with research (Auliasari et al., 2017).

Evaluation of Lotion Preparations

Organoleptic

Organoleptic testing of lotion preparations is conducted through direct observation of physical characteristics such as color, aroma, and texture. The results of this organoleptic test can be seen in the following table:

Table 9. Organoleptic Test Results of Lotion

Formula	Color	Aroma	Texture	Reference
F0	White	Essential features jasmine	Thick	(Auliasari et al., (2017)
F1	Green	Essential features jasmine	Thick	
F2	Green	Essential features jasmine	Thick	
F3	Green	Essential features jasmine	Thick	

Based on the table above, organoleptic tests of f0, f1, f2, and f3 showed a distinctive jasmine aroma and a thick texture, thus aligning with research by Auliasari et al. (2027. The results of this study can be seen in Appendix 18.

Homogeneity Test

A sufficient amount of lotion from each formula was taken and applied to a glass plate. The cream mass was rubbed, and the consistency was homogeneous, meaning no solids were felt on the glass. A homogeneous lotion is one in which all ingredients are well mixed and no coarse particles are present. The results of the homogeneity test can be seen in the following table:

Table 10. Lotion Homogeneity Test Results

Formula	Results	Reference
0	Homogeneous	(Hamida et al., 2024)
1	Homogeneous	
2	Homogeneous	
3	Homogeneous	

Homogeneity observation aims to determine the mixing of lotion ingredients, both active ingredients and other mixed ingredients. The results of homogeneity observations for F0, F1, F2, and F3 are homogeneous. This proves that this study is in line with research (Hamida 2024), namely, the ingredients contained in the lotion preparation are well mixed because there are no coarse particles. The results of this study can be seen in Appendix 18.

pH test

The pH test was performed using a pH meter to increase accuracy. The results of the lotion pH test can be seen in the following table:

Table 11. pH Test Results.

Replication	F0	F1	F2	F3	Reference
1	6.8	6.92	7.14	6.40	
2	6.83	6.97	7.34	6.44	(Hamida et al., 2024)
3	6.74	6.99	7.16	6.42	
Average	6.79	6.96	7.21	6.42	

The pH measurements were performed using a pH meter to determine the acidity level of the product. The results from the table above indicate that the lotion's pH is within the range of 6.79–6.42, which is considered safe for skin. The pH measurement results indicate that the value is within the range of 4.5–8.0, which corresponds to the skin pH standard according to SNI 16-4399-1996, making it considered safe and comfortable to use. The results of this study can be seen in Appendix 18.

Viscosity

The lotion preparation was placed into a 100 mL beaker, and its viscosity was measured using an NDJ-8S Viscometer, using spindle no. 4 at a speed of 30 rpm. The lotion viscosity requirement according to SNI 16-4399-1996 is between 2000 and 50000 cP. The viscosity results can be seen in the following table:

Table 12. Viscosity Test Results.

Replication	F0	F1	F2	F3	Reference
1	2,942	3.108	3,628	2,183	
2	2,977	2,962	3,543	2,220	(Hamida et al., 2024)
3	3,050	2,934	3,414	2,209	
Average	2.9 cP	3.0 cP	3.5 cP	2.2 cP	

Based on the table above, this study obtained results of 2,183-3,628, which meet the lotion viscosity requirements according to SNI 16-4399-1996, which is between 2,000-50,000 cP, making the lotion easy to apply to the skin surface. The results of this study can be seen in Appendix 18.

Spread power

As much as 0.5 g of lotion preparation is placed in the middle of the glass, then another glass is placed on top of the lotion preparation, and a load of 100 grams were applied over a period of 1-2 minutes, and the spread diameter was then measured. The lotion met the criteria if the spread was within the range of 5-7 cm. The results of this test can be seen in the following table:

Table 13. Results of the Spreadability Test.

Replication	F0 (cm)	F1 (cm)	F2 (cm)	F3 (cm)	Reference
1	1.1	3.6	9.9	9.9	(Hamida et al., 2024)
2	7.7	4.3	6.5	2.1	
3	2.4	6.9	7.0	8.9	
Average	7.7 cm	5.6 cm	4.8 cm	3.6 cm	

Observations showed that the lotion distribution diameter was within the range of 5–7 cm, thus concluding that the results of this study align with Hamida's study, which demonstrated good spreadability and easy spreadability during application (Hamida et al., 2024). The results of this study can be seen in Appendix 18.

Adhesive power

A 0.1 g sample of lotion was placed on a glass slide and then pressed with a 1 kg weight for 5 minutes. The weight was then removed from the slide, and the time the cream released from the slide was recorded. The required adhesion strength is greater than 4 seconds. The results of this adhesion test are shown in the following table:

Table 14. Results of the adhesion test

Replication	F0	F1	F2	F3	Reference
1	4.68	4.92	4.94	4.76	(Hamida et al., 2024)
2	4.41	4.35	4.88	4.15	
3	4.47	4.41	4.88	4.35	
Average	4.52 seconds	4.56 seconds	4.9 seconds	4.42 seconds	

The results of the observations showed that the lotion preparation had an adhesive power of > 4 seconds, so this study is in line with Hamida's research, which has met the criteria for good adhesive power and can stick to the skin surface for quite a long time (Hamida et al., 2024).

Hedonic

Organoleptic testing was conducted to evaluate the color, aroma, and texture of the soursop leaf extract lotion. Twenty panelists evaluated four coded samples and then assigned scores on an assessment form. The results of the hedonic testing for the lotion preparation can be seen in Appendix 16.

Irritation Test

Irritation testing was conducted using the open test method on the inner forearms of 20 panelists, with an application area of 2.5 × 2.5 cm. The preparation was applied uncovered, and the reaction was observed three times daily for one day. The results of the irritation test observations for the lotion preparation can be seen in Appendix 17.

Results of Antioxidant Activity Measurement of Soursop Leaf Extract Lotion (Annona squamosa L.)

Measurement of the antioxidant activity of the test sample using the ABTS method from the soursop leaf extract lotion sample (Annona squamosa L.) was measured after the test solution was made. The antioxidant activity test of the soursop leaf extract lotion preparation contained four formulas, with each formula made with concentration variations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm, and the PBZ brand lotion preparation with concentration variations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm was used as a comparison. Each concentration was taken 2 ml and put into a vial, and each vial was added with 1 ml of ABTS stock solution, then measured using UV-Vis spectrophotometry at a wavelength of 730 nm with the operating time that had been obtained. The ABTS reduction percentage value in the soursop leaf extract lotion sample (Annona squamosa L.) can be seen in the following table:

Table 15. Antioxidant Activity of Soursop Leaf Extract Lotion (Annona squamosa L.) Using the ABTS Method

Sample	Concentration (ppm)	Absorbance	% Inhibition	IC50	Category
Quercetin	5 ppm	0.498	40,000	14,381	Very strong
	10 ppm	0.470	43,373		
	15 ppm	0.441	46,827		
	20 ppm	0.393	52,490		
	25 ppm	0.370	55,462		
Lotion PBZ	10 ppm	0.516	37,831	44.52	Very strong
	20 ppm	0.489	41,084		
	30 ppm	0.458	44,819		
	40 ppm	0.429	48,313		
	50 ppm	0.398	52,048		
Formula 0	10 ppm	0.751	9,518	220.31	Very weak
	20 ppm	0.732	11,807		
	30 ppm	0.718	13,494		
	40 ppm	0.699	15,783		
	50 ppm	0.688	17,108		
Formula 1	10 ppm	0.699	15,783	132.62	Currently
	20 ppm	0.671	19,157		
	30 ppm	0.648	21,928		
	40 ppm	0.624	24,819		
	50 ppm	0.608	26,747		
Formula 2	10 ppm	0.558	32,771	85.30	Strong
	20 ppm	0.538	35,221		
	30 ppm	0.516	37,791		
	40 ppm	0.504	39,237		
	50 ppm	0.480	42,129		
Formula 3	10 ppm	0.560	32,530	72.20	Strong
	20 ppm	0.541	34,819		
	30 ppm	0.518	37,590		
	40 ppm	0.488	41,205		

50 ppm	0.488	43,614

The table above shows the results of antioxidant testing with the ABTS method, namely that the greater the extract concentration value of the sample, the smaller the absorbance value will be, and inversely proportional to the greater inhibition value. In the comparison sample of the pbz lotion preparation, the IC50 value was obtained at 44.52 ppm with a strong category in Formula 0 or Formula without extract, the IC50 value was obtained at 220.31 ppm with a very weak category in Formula 1, the IC50 value was obtained at 132.62 ppm with a medium category in Formula 2, the IC50 value was obtained at 85.30 ppm with a strong category, in Formula 3 the IC50 value was obtained at 72.20 ppm with a strong category.

From these results, it shows that the formula 3 lotion preparation has the best IC50 value compared to formulas 0, 1, 2, and 3. From the results obtained above in the results of the antioxidant activity test carried out on Formula 0, Formula 1, Formula 2, and Formula 3 lotion preparations, as well as with the comparison lotion preparation of the PBZ brand, that the higher the concentration of an extract contained in each lotion preparation formula greatly affects the antioxidant content, so the more the concentration of the extract used, the higher the antioxidant activity. This is in line with research conducted by (Setiawan et al., 2022) with an antioxidant activity test on soursop leaves formulated as a lotion with the ABTS method which was made into three formulas, that formula 3 obtained the best IC50 value compared to formulas 1 and 2, so the more soursop leaves used, the better the IC50 value will be (Setiawan et al., 2022).

CONCLUSIONS

The main results of this study indicate that soursop leaf extract (Annona squamosa L.) formulated into a lotion preparation has very strong antioxidant activity based on the IC50 value obtained using the ABTS method. The lotion formula with the highest extract concentration (Formula 3) showed the lowest IC50 value, indicating optimal antioxidant effectiveness and comparable to the quercetin comparator. In addition, all lotion formulas met physical quality standards, such as homogeneity, pH, viscosity, spreadability, and adhesion, and were deemed safe based on irritation tests and organoleptically acceptable by panelists. These findings strengthen the potential of soursop leaves as a natural active ingredient in skin care products that function as both a moisturizer and an antioxidant, and support the results of previous studies on the effectiveness of herbal plant antioxidants using the ABTS method.

However, this study has several limitations, including the lack of long-term stability testing of the lotion preparation and the lack of evaluation of antioxidant activity in vivo or on a human skin model. Furthermore, this study only compared antioxidant activity with one comparator (quercetin) and did not test for synergistic effects with other active ingredients. For further research, it is recommended to conduct stability testing of the preparation under various storage conditions, safety and effectiveness testing on human subjects, and exploration of combinations of soursop leaf extract with other active ingredients to enhance the functional benefits of the lotion. The practical implication of this study is the opportunity to develop natural cosmetic products based on soursop leaf extract that are not only safe and effective, but also can be an innovative alternative in the environmentally friendly and locally sourced skincare industry.

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