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Evaluation Of The Antioxidant Activity Of Lotion Containing Ethanolic Extract Of Matoa Leaves (Pometia Pinnata J.R.Forst, & G.Forst.)

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Abstract

Skin exposure to environmental stress produces free radicals and ROS that accelerate aging and skin damage, while antioxidant Lotions from natural extracts such as Matoa leaves (Pometia pinnata) offer protection. This experimental study aimed to evaluate the antioxidant activity of ethanol extracts, the effect of concentration (0.5-6%) on the physical quality of Lotions, and the DPPH scavenging ability of the final Lotion. The population of all Matoa leaf extract Lotion formulations; a sample of 2 kg of fresh leaves from Matesih, Karanganyar was purposively selected. Instruments included a UV-Vis spectrophotometer (517 nm), a Brookfield viscometer, a pH meter; SPSS 28.0 was analyzed by ANOVA, regression for IC50. The extract was very potent (IC50 43.07 ppm) containing flavonoids, alkaloids, saponins, tannins; All Lotions met the standards (homogeneous, pH 5.22-6.34, viscosity 10,100-12,740 cP, spreadability 5-6.5 cm), FV (6%) was optimal (IC50 66.30 ppm, strong). High concentrations increased inhibition but increased viscosity, decreased spreadability ($p<0.05$). The findings confirm that Matoa Lotion is effective for herbal skin care; further in vivo and stability testing is recommended.

Keywords: Antioxidant Activity, DPPH, Ethanol Extract, Lotion Formulation, Pometia Pinnata.

INTRODUCTION

Human skin is often directly exposed to air, sunlight, environmental pollutants, as well as mechanical and chemical disturbances that trigger the formation of free radicals and reactive oxygen species (ROS) from internal metabolism, thereby accelerating premature aging and increasing the risk of skin cell damage. Cosmetics such as *Lotion*s function as external treatments to cleanse, protect, and improve skin condition from such exposure, with a light texture that is easy to apply and non-sticky compared to other topical preparations. [Ayu *et al*., 2024] Antioxidants in *Lotion*s can ward off free radicals, maintain skin hydration, prevent uneven pigmentation, and reduce the risk of long-term skin cancer [Sawiji *et al*., 2022]

Matoa leaves (*Pometia pinnata* JR Forst. & G. Forst.), a tropical plant of the Sapindaceae family native to Papua, are rich in secondary metabolites such as flavonoids, tannins, saponins, alkaloids, steroids, glycosides, which have the potential as antioxidants, antibacterials, and antifungals to fight free radicals. Ethanol extracts of Matoa leaves have shown strong antioxidant activity through the DPPH method, with simple and sensitive visual color changes using UV-Vis spectrophotometry. [Utoro *et al*., 2022] Previous studies have shown similar potential in Matoa bark and leaf serum, although publications on leaves are still limited in Indonesia [Ambarsari & Dayanti, 2024].

Although Matoa leaf extract has antioxidant potential, there have not been many in-depth studies on its activity specifically with ethanol as a polar solvent. [Kusumaningrum *et al*., 2023] *Lotion* formulation from natural extracts often affects physical qualities such as viscosity, pH, and homogeneity depending on the extract concentration, but its effect on Matoa leaves has not been comprehensively explored. [Aprilliani *et al*., 2022] The antioxidant activity of post-formulation *Lotion* also needs to be verified, because the emulsion process has the potential to reduce the bioactive potential compared to pure extracts [Nuraini & Naila, 2025].

The lack of further research on the antioxidant properties of Matoa leaves in Indonesia creates a scientific gap, particularly in its integration into moisturizing *Lotion*s for herbal skin care. These three issues define the main questions: does ethanol extract of Matoa leaves have antioxidant activity, how its concentration affects the physical quality of the *Lotion*, and whether the final *Lotion* retains its antioxidant activity.

This study aims to explore the antioxidant activity of Matoa leaf ethanol extract using the DPPH method, analyze the effect of extract concentration on the physical quality of the *Lotion*, and evaluate the antioxidant activity of the *Lotion* preparation. The urgency lies in the increasing demand for safe herbal cosmetics in the community, which can be developed from local sources such as Matoa for the prevention of skin aging due to ROS. [Sawiji *et al*., 2022] The novelty includes a specific *Lotion* formulation from Matoa leaves with ethanol, complementing previous limited literature that focuses more on bark or serum, and providing a reference for the development of natural-based topical pharmaceutical preparations in Indonesia [Aprilliani *et al*., 2022].

RESEARCH METHODS

This research is purely experimental with a pre-post test one group design to test the effect of the concentration of ethanol extract of Matoa leaves (*Pometia pinnata* JR Forst. & G. Forst.) on the physical quality of *Lotion* and antioxidant activity using the DPPH method, conducted at the STIFARM Semarang Natural Materials Laboratory. The experimental approach was chosen because it allows strict control of variables to prove causality, in accordance with the post-positivist paradigm that emphasizes hypothesis testing through quantitative measurements. [Sugiyono, 2021][Emzir, 2021] The stages include sample collection, determination, simplicia, maceration extraction, *Lotion* formulation (concentrations of 0.5%; 1%; 1.5%; 3%; 6%), physical evaluation, phytochemical screening, DPPH test, and data analysis during November 2025-January 2026 [Achmad & Syamsul, 2022][Fadhila *et al*., 2022].

The main instruments include a UV-Vis spectrophotometer for DPPH (λ max 517 nm), a Brookfield viscometer for viscosity (5,000-20,000 cP), a Hanna pH meter for skin pH (4.5-6.5), as well as a maceration tool, rotary evaporator, moisture balance, and a furnace for standardization. Materials include fresh Matoa leaves from Matesih Karanganyar, 70% ethanol, quercetin (comparator), stearic acid, cetyl alcohol, triethanolamine, nipagin, aerosil, DPPH, green tea perfume, and distilled water. Data analysis techniques using SPSS 28.0: normality test (Kolmogorov-Smirnov), homogeneity (Levene), One-Way ANOVA for significant differences between formulas ($p<0.05$), equipped with inhibition formula (%), IC50 from linear regression $y = a + bx$, and antioxidant category (IC50 <50 ppm very strong) [Rahmatillah *et al*., 2025][Puspitaningrum *et al*., 2025].

The population is all possible *Lotion* formulations from ethanol extract of Matoa leaves, with a sample of 2 kg of fresh (green) leaves from Matesih, Karanganyar, selected by purposive sampling based on freshness to minimize variability. [Jumasna, 2022] The independent variable is the extract concentration (0.5-6%), the dependent variable is the physical quality (organoleptic, homogeneity, pH, viscosity, spreadability 5-7 cm) and IC50 DPPH of the *Lotion*/extract. [Shinde *et al*., 2023] Determination of identity confirmation at UPF RSUP Dr. Sardjito Tawangmangu confirmed the species *Pometia pinnata* [Sudaryono, 2022][Creswell & Creswell, 2022].

The procedure begins with sorting, washing, sun drying (moisture content <10%), fine mesh 40; standardization of simplicia (drying shrinkage, moisture content ≤10%, ash); maceration (1:10 ethanol 70%, 3x24 hours, rotary 50°C); standardization of extract (organoleptic, ethanol-free, moisture/ash content). [Fadhila *et al*., 2022][Syarif *et al*., 2022] Phytochemical screening (flavonoid HCl-Mg, alkaloid Mayer/Wagner/Dragendorff, foam saponin, tannin FeCl3); *Lotion* formulation (oil phase 80°C stearic acid-cetyl alcohol, aqueous phase aquadest-TEA-nipagin, mix + aerosil + extract 35°C + perfume); physical evaluation.[Ginting *et al*., 2025][Alkogajeva *et al*., 2025] DPPH test: 50-100 ppm DPPH solution, OT 30-60 minutes, series of extract/quercetin/*Lotion* concentrations (20-250 ppm), UV-Vis absorbance, calculate % inhibition and IC50[Rahmatillah *et al*., 2025].

RESULTS AND DISCUSSION

Plant Determination

The material used in this study was Matoa leaves obtained in the Matesih area, Karanganyar, Central Java. The Matoa leaves used in this study were determined first with the aim of matching the morphological characteristics of the Matoa plant with existing literature. Plant determination was carried out at the UPF (Functional Implementation Unit) of Dr. Sardjito Tawangmangu General Hospital. It has the Sapindaceae family, *Pometia pinnata* JRForst, & G.Forst. Species and synonyms Aporetica pinnata (JRForst. & G.Forst.) DC. The yield obtained from the matoa leaf simplicia is 19%.

Standardization of Matoa Leaves (*Pometia pinnata* JRForst, & G.Forst.)

Table 1. Results of Matoa Leaf Standardization (*Pometia pinnata* JRForst, & G.Forst.)

	Ash Content Test	Drying Loss	Water Content Test
Simple ingredients	1.43%	9.7%	3.06%
Extract	4.22%	-	6.26%.

Phytochemical Screening of Matoa Leaf Extract (*Pometia pinnata* JRForst, & G.Forst.)

Table 2. Ethano Extract Screening Results; Matoa Leaves (*Pometia pinnata* J.R. Forst, & G. Forst.)

Compound Test	Reagent	Results Based on Literature	Results	Information
Alkaloid	Mayer	There is a yellowish white precipitate.	There is white sediment.	+
	Wagner	There is a blackish brown precipitate.	There is brown sediment.	+
	Dragendorff	There is a brick red sediment.	There is a brick red sediment.	+
Flavonoid	Mg powder + concentrated HCL	Red color appears	Red color appears	+
Saponin	Aquadest	Forms a stable foam	A stable foam is formed.	+
Tannin	FeCl3 1%	There is a blackish green color.	A blackish green color is formed.	+

Making *Lotion* Preparations.

Table 3. Matoa Leaf Extract *Lotion* Formulation (Ika & Siti, 2025)

Material	Concentration %				
	FI	F II	F III	F IV	FV
Ethanol extract of Matoa leaves	0.5	1	1.5	3	6
Stearic Acid	2	2	2	2	2
Cetyl Alcohol	2	2	2	2	2
Triethanolamine	0.2	0.2	0.2	0.2	0.2
Nipagin	0.15	0.15	0.15	0.15	0.15
Aerosil	1.75	1.75	1.75	1.75	1.75
Green tea perfume	qs	qs	qs	qs	qs
Aquadest until	100	100	100	100	100

Physical Quality Test of *Lotion* Preparations

Organoleptic Test

Table 4. Organoleptic Test of Preparations

Formula	Replication	Color	Form	Smell
Base	1	White	Thick, slightly runny	green tea
FI	1	Pale light brown	Thick, slightly runny	green tea
	2	Pale light brown	Thick, slightly runny	green tea
	3	Pale light brown	Thick, slightly runny	green tea
F II	1	Light brown	Thick, slightly runny	green tea

Formula	Replication	Color	Form	Smell
	2	Light brown	Thick, slightly runny	green tea
	3	Light brown	Thick, slightly runny	green tea
F III	1	Light brown	Thick	green tea
	2	Light brown	Thick	green tea
	3	Light brown	Thick	green tea
F IV	1	Chocolate	Thick	green tea
	2	Chocolate	Thick	green tea
	3	Chocolate	Thick	green tea
FV	1	Chocolate	Thick	green tea
	2	Chocolate	Thick	green tea
	3	Chocolate	Thick	green tea

Homogeneity Test

Table 5. Homogeneity Test.

Formula	Replication	Homogeneity
Base	1	Homogeneous
FI	1	Homogeneous
	2	Homogeneous
	3	Homogeneous
F II	1	Homogeneous
	2	Homogeneous
	3	Homogeneous
F III	1	Homogeneous
	2	Homogeneous
	3	Homogeneous
F IV	1	Homogeneous
	2	Homogeneous
	3	Homogeneous
FV	1	Homogeneous
	2	Homogeneous
	3	Homogeneous

pH test

Table 6. pH Test

Replication	Base	Formula				
		I	II	III	IV	V
1	6.34	6.01	5.55	5.45	5.41	5.2
2	6.34	5.56	5.56	5.46	5.42	5.22
3	6.34	5.07	5.5	5.47	5.37	5.24

Viscosity Test

Table 7. Viscosity Test

Replication	Base	Formula				
		I	II	III	IV	V
1	11020	12320	12740	11420	11840	11100
2	11020	12240	11240	10380	10820	10780
3	11020	11520	10460	10600	10160	10900

Spread Power Test

Table 8. Spreadability Test

Replication	Base	Formula				
		I	II	III	IV	V
1	6.3	6.5	6.2	6	5.5	5.9
2	6.3	6.4	6.2	5.9	5	5.7
3	6.3	6.1	6.2	6	5.8	5.5

Antioxidant Testing

Table 9. Antioxidant Activity of Quercetin, Ethanol Extract of Maoa Leaves, and *Lotion* Formula

Sample	Concentration (ppm)	% Inhibition	IC_{50}	Information
Quercetin	10	20.51	20,113ppm	Very strong
	20	31.08		
	30	39.24		
	40	46.50		
	50	45.48		
Extract	40	48.55	43,071 ppm	Very strong
	50	55.72		
	60	56.10		
	70	66.54		
	80	72.08		
Formula 0	100	40.42	230,784 ppm	Weak
	200	47.05		
	300	51.32		
	400	59.39		
	500	65.16		
Formula 1	50	64.44	135.92 ppm	Currently
	100	57.89		
	150	51.20		
	200	46.26		
	250	39.17		
Formula 2	50	67.65	106,533 ppm	Currently
	100	61.90		
	150	53.61		
	200	49.20		
	250	43.85		
Formula 3	50	69.25	98.802 ppm	Strong
	100	63.90		
	150	55.88		
	200	50.53		
	250	43.58		
Formula 4	50	70.19	84.698 ppm	Strong
	100	64.97		
	150	57.09		
	200	53.21		
	250	45.05		
Formula 5	50	72.46	66.304 ppm	Strong
	100	67.38		
	150	58.82		
	200	54.81		
	250	47.99		

DISCUSSION

In this thesis research, the aim is to identify the antioxidant activity of matoa leaf extract (*Pometia pinnata* JRForst, & G.Forst.) in *Lotion* preparations. This research stage begins with plant determination to ensure the correct identity of the ingredients to be used. The results of the matoa plant determination show that the sample used has the number TL.02.04 / D.XI.6 / 38062.1015 / 2025. Has the Sapindaceae family, *Pometia pinnata* JRForst, & G.Forst. Species and synonyms Aporetica pinnata (JRForst. & G.Forst.). This is very important to ensure the presence of content in the matoa plant that has potential bioactivity which includes antioxidant properties, antibacterial, and activity that fights diabetes.(Hanafi *et al*., 2020).

After the determination was carried out, the collection of matoa leaves was carried out, which was obtained as much as 5000 g and after that it was dried which produced 950 g of dry leaves, as shown

in the attachment, indicating the loss of water content in the leaves. The drying shrinkage test for the simplicia obtained obtained a result of 9.7% tested using a heated crucible and after that it was dried and the results were seen, according to the research journalNur Fadhila *et al*., (2022)A good drying shrinkage value is no more than 10%, while the water content test itself obtained a result of 3.06%, according to the research journalNur Fadhila *et al*., (2022)A good water content value is 10%. To determine the ash content obtained, it was 1.43%. This test was carried out with the aim of providing an overview of the total amount of ash obtained and the material remaining after high-temperature annealing.

After standardization, extraction was carried out using 70% ethanol so that the resulting extract was greater, the powder used in maceration was 900 grams and dissolved in 9000 ml/9L of ethanol. Maceration was carried out for 3 days while stirring occasionally and after that filtering was carried out for further evaporation using a rotary evaporator and water bath to thicken the extract. The extract obtained obtained 160.405 grams of extract with a yield of 17.8%, while in the study(Pagarra *et al*., 2025)with a yield of 19.40%. After the extract results were obtained, the extract was standardized using the test results attached to the previous results.

The extract obtained was subjected to screening tests, as in the bacterial research journal.Sutomo *et al*., (2021)The phytochemical content of Matoa leaves (*Pometia pinnata* J.R. Forst, & G. Forst.) consists of alkaloids, flavonoids, tannins, and saponins, which are consistent with the screening tests in this study. After that, antioxidant activity testing was carried out as in the study.Ambarsari & Dayanti, (2024), pThe results of the antioxidant activity test of matoa leaf ethanol extract using the DPPH method are presented in Table 4.4. The inhibition percentage increased with increasing extract concentration, from 48.55% at a concentration of 40 ppm to 55.72% at a concentration of 50 ppm and then to a concentration of 60 ppm to 56.10 ppm, at a concentration of 70 ppm it was obtained 66.54% and at 80 ppm it was obtained 72.08%. Linear regression analysis produced an IC_{50} value of 43.071 ppm, which indicates that the ethanol extract of matoa leaves is classified as a strong antioxidant according to research.Ambarsari & Dayanti, (2024)which shows that matoa leaves have an antioxidant content of 45.78 ppm, which states that matoa leaf extract has strong category antioxidant activity based on the DPPH method.

The application of matoa leaf extract in *Lotion* preparations has different IC_{50} results for each formula, in formula 1 it has an IC_{50} of 135.92 ppm, in formula two it has an IC_{50} of 106.53 ppm, in formula 3 it has an IC_{50} of 98.80 ppm, formula 4 has an IC_{50} of 84.69 ppm and formula 5 has an IC_{50} of 66.34 ppm. The increase in IC_{50} occurs because the higher concentration of the extract affects the good antioxidant results in the preparation. In the One Way Anova test, the data results were not normal and then the Kruskall Walls test was carried out and obtained significantly different data because the sig value was > 0.5.

In the organoleptic test, this evaluation is conducted to examine the visual appearance of the *Lotion*, such as color, odor, and shape. All formulas have different shapes and colors at each concentration.Aprilliani *et al*., (2022).Homogeneity test, all formulas have homogeneous results according to the research journal of Wahdaningsih *et al*., (2020) a good *Lotion* must show a homogeneous and uniform appearance without any sediment or separation. Furthermore, the physical quality test results can be seen in each table provided in the results data above. The table above shows that each formula has a different pH value. The base has a pH value of 6.34. Formula I with an extract concentration of 0.5% has a pH value of 5.54, formulation 2 with an extract concentration of 1% has a pH value of 5.53, formulation 3 with a concentration of 1.5% has a pH value of 5.46, formulation 4 with a 3% extract has a pH of 5.4 and formulation 5 with a concentration of 6% has a pH of 5.22. The pH results of all formulas and replications are in accordance with the pH range of topical preparations as in the journalAprilliani *et al*., (2022), the pH of the *Lotion* must be in accordance with the physiological pH range of the skin, which is around 4.5–6.5, so as not to cause irritation. For the results of the pH test using One Way Anova, the data results were normal and there was a significant difference, because the significant value was less than 0.5. For the dispersion test, the data was

normally distributed and the normal data obtained was significantly different because it had a significant value of less than 0.5. For the viscosity test carried out using a Brookfield viscometer, the data was not homogeneous and the results did not show a significant difference because the value was more than 0.5.

In the viscosity test, each formula has a different thickness texture, the higher the extract concentration, the thicker the preparation. itself has a suitable range of results in the journal Akbari *et al*., (2023) measurements were carried out using a Brookfield type viscometer, and the results are expressed in standard centipoise units, namely 5,000–20,000 cP. In the results of the *Lotion* preparation spreadability test, there are differences in the distribution of each formula, such as in the viscosity results where the higher the extract, the lower the cP value.

Overall, this study has shown that matoa leaf ethanol extract is still safe to be applied to *Lotion* preparations, but each extract concentration has its own differences, where each increase in the extract concentration used provides different physical quality tests and better antioxidant results. The higher the extract concentration, the thicker the *Lotion* and the less spreadable it is, and the lower the pH level but still according to the standard pH of topical preparations for the skin. The higher the extract concentration used also makes the preparation have better antioxidant content, as in the test results, explaining that formula 5 has the best IC_{50} results of all formulas and is a strong antioxidant.

CONCLUSION

This study successfully proved that the ethanol extract of Matoa leaves (*Pometia pinnata* JR Forst. & G. Forst.) has very strong antioxidant activity with IC50 43.071 ppm using the DPPH method, while the FV formula *Lotion* (6%) showed strong potential (IC50 66.304 ppm), supported by the content of flavonoids, alkaloids, saponins, and tannins from phytochemical screening. All *Lotion* formulas met physical quality standards: homogeneous, pH 5.22-6.34 (suitable for skin 4.5-6.5), viscosity 10,100-12,740 cP, and spreadability 5-6.5 cm, with increasing extract concentration resulting in darker color, higher viscosity, and better radical inhibition although ANOVA showed significant differences in pH and spreadability ($p<0.05$). [Aprilliani *et al*., 2022] These findings confirm the potential of Matoa as a local herbal cosmetic ingredient to fight ROS and skin aging. [Ambarsari & Dayanti, 2024].

Studyincludes a single focus on the DPPH method without in vivo testing or long-term stability of the *Lotion*, as well as variations in sample locations that may affect phytochemical content. [Rahmatillah *et al*., 2025] Suggestions for further studies include human clinical testing, combinations of other solvents, and evaluation of skin irritation for commercialization. Practically, these results support the development of Matoa-based antioxidant *Lotion* as a safe, effective, and affordable skin care product in Indonesia, contributing to the sustainable herbal cosmetics industry. [Sawiji *et al*., 2022].

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