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Physical Quality and Antioxidant Test of Strawberry Leaf Fraction Lotion DPPH Method (1,1- Diphenyl-2- Picryhydrazyl)

Candra Asih Setyaningrum[1], Arif Wijayanto[2], Juvita Herdianty[3], Devita Riafinola Andaririt[4]
[1,2,3,4]Pharmaceutical Study Program, Universitas STRADA Indonesia, Indonesia
***Corresponding author** : candraasih17@gmail.com

ABSTRACT

Lotion is a cosmetic preparation that functions to moisturize and protect the skin by providing a soothing effect. This research utilizes natural ingredients in the form of strawberry leaf extract (Fragaria vesca) to create a lotion formulation with high antioxidant activity. The objective of this study is to determine the effect of varying concentrations of strawberry leaf extract on the physical quality and antioxidant activity of the lotion. This experimental study involved formulating lotions with different concentrations of strawberry leaf extract at 2%, 4%, and 6%. The antioxidant activity was evaluated using the DPPH (1,1-Diphenyl-2-Picrylhydrazyl) method to measure the extract's ability to scavenge free radicals. The main active component in strawberry leaf extract is polyphenol compounds, which act as natural antioxidants in cosmetic products. The results showed that the strawberry leaf fraction lotion had a soft texture, green color, and a characteristic strawberry leaf scent. The pH test had a significance value of 0.00. The viscosity test also had a significance value of 0.00. The adhesion test results showed a significance value of 0.00, and the spreadability test also had a significance value of 0.00. The DPPH antioxidant test showed regression values of 0.932 for the positive control, 0.854 for the negative control, 0.948 for F1, 0.985 for F2, and 0.967 for F3. This study provides strong evidence that strawberry leaf fraction is suitable as an active ingredient in antioxidant cosmetic products, with the potential to compete with conventional ingredients. The SPSS test results showed a significant effect of concentration on free radical inhibition, as well as significant differences in pH, spreadability, and adhesion tests among the formulations. However, some groups did not meet the assumptions of normality and homogeneity, indicating the need for alternative analytical methods for further validation.

Keywords : Lotion, Strawberry Leaf Fraction, Antioxidant, DPPH, Physical Quality

INTRODUCTION

Dry skin in tropical regions like Indonesia is often exacerbated by ultraviolet (UV) exposure, which can cause premature aging by damaging the skin through interactions with chromophores and increasing the production of Reactive Oxygen Species (ROS). Therefore, the use of antioxidants is crucial for protecting the skin from damage caused by UV-induced free radicals.

UV exposure can also damage collagen and elastin, leading to hyperpigmentation, inflammation, and dehydration that accelerate skin aging. This drives consumers to seek products like facial serums to combat the negative effects of pollution and UV rays. Both natural and synthetic antioxidants help neutralize free radicals and protect the skin.

Lotion, which maintains skin moisture, also contains antioxidants to combat skin damage. It is easier to apply evenly and provides better protection compared to other semi-solid products. Strawberry leaves have antioxidant activity and could potentially be used as an ingredient in lotion formulations. Further research is needed to develop lotions containing to strawberry leaf extract by evaluating its antioxidant activity using the DPPH method**.**

METHOD

Materials

The materials used include strawberry leaf fractions, TEA, cetyl alcohol, glycerin, nipagin, nipasol, DPPH indicator, 70% ethanol, ethyl acetate, n-hexane, distilled water, vitamin C, silica gel F254 plates, methanol, chloroform, and paper.

Tools

The equipment used in this study includes a maceration vessel, porcelain dish, mortar, water bath, analytical balance, UV-Vis spectrophotometer, thin-layer chromatography equipment, beakers, volumetric flasks, stirring rods, pestle, micropipette, pH meter, moisture analyzer, microscope, two sets of glass slides, and a weighing boat.

Preparation

This study is an experimental research aimed at developing lotion formulations with varying concentrations of strawberry leaf extract at 2%, 4%, and 6%. The antioxidant activity of these formulations is evaluated using the DPPH (1,1-diphenyl-2-picrylhydrazyl) method to measure the extract's ability to scavenge free radicals. Polyphenols, the primary active compounds in strawberry leaf extract, act as natural antioxidants in cosmetic products.

Formulation

Table 1. Lotion Formula

Material Name	F1	F2	F3	K-
Fraksi strawberry leaf	2	4	6	-
TEA	2	2	2	2
Asam Stearat	2,5	2,5	2,5	2,5
Cetyl Alcohol	4	4	4	4
Glicerin	10	10	10	10
Nipagin	0,02	0,02	0,02	0,02
Nipasol	0,02	0,02	0,02	0,02
Aquadest	ad 100	ad 100	ad 100	ad 100

Lotion Evaluations

Antioksidant test

DPPH Solution Test (1,1-diphenyl-2-picrylhydrazyl) A quantity of 0.0019 g of DPPH powder (M.W. = 394.32) was dissolved in 15 mL of analytical grade ethanol. This solution was then transferred to a 50 mL volumetric flask, and the volume was adjusted to the mark with analytical grade methanol to achieve a DPPH concentration of 0.1 mM.

Determination of Maximum Wavelength for DPPH 2 mL of the DPPH 0.1 mM solution was mixed with 2 mL of analytical grade ethanol in a test tube. The mixture was then placed in a 3 mL cuvette and analyzed at a wavelength of 517 nm using a UV-Vis

spectrophotometer.

Preparation of 100 ppm Stock Solution Vitamin C was used as the standard control; 5 mg of Vitamin C was dissolved in analytical grade ethanol. This solution was placed in a 50 mL volumetric flask and the volume was adjusted to the mark.

Preparation of Test Solutions with Concentrations of 0.4, 0.8, 1.2, 1.6, and 2 ppm The 100 ppm Vitamin C stock solution was diluted to prepare test solutions with concentrations of 0.4, 0.8, 1.2, 1.6, and 2 ppm. From the stock solution, 40 µL, 80 µL, 120 µL, 160 µL, and 200 µL were transferred to a 10 mL volumetric flask, and the volume was adjusted to the mark with analytical grade ethanol.

Absorption Measurement Using UV-Vis Spectrophotometer 2 mL of the Vitamin C test solution was combined with 2 mL of DPPH 0.1 mM solution in a test tube and incubated for 30 minutes in darkness. Absorption was then measured at the optimal wavelength.

Preparation of Strawberry Leaf Fraction Body Lotion Solution - 100 ppm Stock Solution 1 g of strawberry leaf fraction body lotion was dissolved in analytical grade ethanol and transferred to a 10 mL volumetric flask, with the volume adjusted to the mark using analytical grade ethanol.

Preparation of Test Solutions with Concentrations of 0.4, 0.8, 1.2, 1.6, and 2 ppm The 100 ppm stock solution of strawberry leaf fraction body lotion was prepared for testing at concentrations of 0.4, 0.8, 1.2, 1.6, and 2 ppm. From this stock solution, 40 µL, 80 µL, 120 µL, 160 µL, and 200 µL were transferred to a 10 mL volumetric flask, and the volume was adjusted to the mark with analytical grade ethanol.

Absorption Measurement Using UV-Vis Spectrophotometer 2 mL of the strawberry leaf fraction body lotion solution was combined with 2 mL of DPPH 0.1 mM solution in a test tube and incubated for 30 minutes in darkness. Absorption was measured at the optimal wavelength.Moisture contents test

Prepared granules are measured 500 miligram, then heated wih 105^{o}C temperature for 10 minutes in Ohauss MoistureAnalyOrganoleptic test

Adhesion test

Adhesion was tested by weighing 0.25 grams of lotion, placing it on the marked center of a glass slide, and covering it with another slide. A 1 kg weight was applied for 5 minutes, and then the slides were separated. The test measures the lotion's ability to adhere to the skin, with the requirement being less than 4 seconds (Ulandari & Sugihartini, 2020). The adhered slides were placed on a testing device with an 80-gram load, and the time until the slides separated was recorded. Good adhesion for semi-solid preparations is considered if it lasts more than 1 second

Viscosity test

Viscosity was measured using a viscometer. The reading was noted from the viscosity scale for rotor number 1. Once the reading stabilized, the viscosity was recorded in cps. The required viscosity range is between 2000 and 50,000 cps (SNI 16-4399-1996)

RESULT

In this research, strawberry leaves (Fragaria vesca) were identified at Materia Medika Batu Malang to confirm their authenticity. The identification process was based on physical traits such as the shape, color, and aroma of the leaves. Strawberry leaves are characterized by their green color, wrinkled surface, serrated edges, and fresh scent.

Proper identification is essential to ensure that the materials conform to research specifications and to maintain consistency in extraction results.

Strawberry leaves were gathered from a selected garden to ensure their quality. The leaves were harvested in the morning to preserve optimal moisture levels and then washed to remove

any dirt. After washing, the leaves underwent wet sorting to discard any damaged or pest-infested ones. They were then dried in a shaded area to protect the active compounds from sunlight. The leaves were sorted again to confirm their quality before being ground and sifted through a 60-mesh sieve, producing uniform particles for a more effective extraction process.

The process of making strawberry leaf extract involves maceration using 70% ethanol as the solvent. Maceration consists of soaking the dried material in the solvent for three 24-hour periods, with the solvent being replaced every 24 hours to achieve optimal extraction. After maceration, the extract solution is filtered to separate the liquid extract from the leaf residue, ensuring that the desired active components are maximally obtained.

Fig 1. Concentration Process

The figure above illustrates the concentration process of the extract. The liquid extract is then concentrated using a rotary evaporator to remove the ethanol solvent, resulting in a thick extract.

Fig 2. Fractionation Process

The thick strawberry leaf extract obtained from maceration undergoes fractionation using n-hexane and ethyl acetate as solvents to separate components based on polarity. The ethyl acetate fraction produced from this process is selected for use in lotion formulations, as it contains the desired active components that potentially offer antioxidant benefits in cosmetic products.

The identification of flavonoids in the ethyl acetate fraction of strawberry leaves was conducted using Thin Layer Chromatography (TLC) with a mobile phase of ethyl acetate: n-hexane in a 7:3 ratio. Flavonoids, known for their antioxidant properties, were successfully identified in this fraction. The presence of flavonoids is crucial as these compounds contribute to the antioxidant potential, which will impact the effectiveness of the formulated lotion.

The body lotion was prepared by incorporating the ethyl acetate fraction of strawberry leaves at three different concentrations (2%, 4%, and 6%) into the lotion base. The lotion base consisted of Triethanolamine (TEA) as an emulsifier, cetyl alcohol as an emollient, glycerin as a humectant, and preservatives Nipagin and Nipasol. The mixture was homogenized after heating to dissolve and blend all components. The ethyl acetate fraction of strawberry leaves was added gradually, resulting in three lotion formulations: F1 (2% strawberry leaf fraction), F2 (4%), and F3 (6%). Homogenization using a homogenizer ensured the even distribution of the strawberry leaf fraction in the final lotion.

The organoleptic test results indicated that the commercial product K+ (Marina), which contains antioxidants, has a smooth texture, white color, and a distinctive Kakadu aroma. Product K-, which lacks the strawberry leaf fraction, also has a smooth texture and white color but no aroma. Lotion F1 (with 2% strawberry leaf fraction) has a smooth texture, green color, and a characteristic strawberry leaf aroma. Lotion F2 (with 4% strawberry leaf fraction) showed similar results, with a smooth texture, green color, and strawberry leaf aroma. Lotion F3, containing 6% strawberry leaf fraction, has a smooth texture, deep green color, and a pronounced strawberry leaf aroma, indicating increased intensity of color and scent with higher concentrations of the strawberry leaf fraction.

Table 1. Organoleptic test

Formulation	Organoleptis		
	Textur	color	Aroma
K+	Soft	White	Kakadu-like
K-	Soft	White	No aroma
F1	Soft	Green	Strawberry leaf-like
F2	Soft	Green	Strawberry leaf-like
F3	Soft	Green	Strawberry leaf-like

The results of the homogeneity test indicate that only the K+ (Marina) lotion is homogeneous, with no bubbles or clumps, demonstrating good quality. In contrast, K- and all formulations containing strawberry leaf fractions (F1, F2, F3) are not homogeneous, characterized by the presence of bubbles which indicate unevenness in the mixture. This lack of uniformity may affect the stability and quality of the product, suggesting that formulations with strawberry leaf fractions require further optimization to achieve the desired homogeneity.

Table 2. homogeneity test

Information	Homogeneity
K+	Homogeneous
K-	Not homogeneous
F1	Not homogeneous
F2	Not homogeneous
F3	Not homogeneous

The pH test results show that K+ (Marina lotion) has an average pH 5.37, which meets the requirements requirements of SNI 16-4399-1996 for lotion preparations with an ideal pH between 4.5–8.0. However , K-, F1 (2% fraction strawberry leaves), F2 (4% fraction strawberry leaves), and F3 (6% fraction strawberry leaves) have a higher pH bases , respectively 8.5, 8.56, 8.48, and 8.31, which may need adjustment For close to natural pH skin . The results of the one-way ANOVA test showed p- value 0.000, which is more small from 0.05, indicating difference significant among formulations.

Table 3. pH Test Results

Formulation	Replication 1	Replication 2	Replication 3
K+	5.37	5.39	5.37
K-	8.53	8.50	8.47
F1	8.56	8.53	8.59
F2	8.51	8.48	8.47
F3	8.30	8.31	8.34

Viscosity Test

Viscosity test show that K+ has viscosity of 7967.3 mPa.s , while K- has viscosity of 2968.0 mPa.s. F1 has viscosity 3103.1 mPa.s , F2 has viscosity of 1326.1 mPa.s , and F3 has viscosity 1908.3 mPa.s . Based on requirements of SNI 16-4399-1996, which set range viscosity between 2000–50,000 mPa.s , compliant formulations criteria the are K+, K-, and F1. The results of the one-way ANOVA test show p- value 0.000, which is more small from 0.05, indicating existence difference significant among formulations.

Table 4. Viscosity Test Results

Formulation	Viscosity (mPa.s)
K+	7967.3
K-	2968.0
F1	3103.1
F2	1326.1
F3	1908.3

Spread Power Test

Power test results spread to a number of body lotion formulation shows variation in ability spread . Formulation F2 (4% fraction strawberry leaves) and F3 (6% fraction strawberry leaves) have an average power spreads of 5.70 cm and 5.37 cm, respectively, which are located in ideal range 5-7 cm, so both of them show appropriate consistency For body lotion preparation . Formulation F1 (2% fraction) leaf

strawberry), with an average power of spread 8.53 cm, indicating too much consistency dilute , exceed limit on ideal standard . Control positive (K+) also indicates Power spread more tall from standard , while control negative (K-) is in expected range . With Thus , F2 and F3 are the most appropriate formulation For produce lotion with ability optimal distribution . The results of the one-way ANOVA test show p- value 0.000, which is more small from 0.05, indicating existence difference significant among formulations the .

Table 5. Spreadability Test Results

Formulation	Replication 1	Replication 2	Replication 3
K+	7.4	7.6	7.7
K-	6.6	6.3	6.5
F1	8.7	8.4	8.5
F2	5.9	5.7	5.5
F3	5.5	5.2	5.4

Adhesion Test

Power test sticky show that Formulation F2 (4% fraction) strawberry leaves) have an average power 41 seconds close , approaching the ideal standard is 40 seconds and shows Power optimal adhesion . Formulation F3 (6% fraction strawberry leaves) and control positive (K+) also approaches ideal value , with an average of 41.33 seconds each . In contrast ,

formulation F1 (2% fraction strawberry leaves) have an average of slightly more high , namely 42.67 seconds , which is still can accepted but approach limit above . Control negative (K-) indicates the average power sticky the highest , which is 49 seconds , indicates more consistency Good compared to with formulation others . With Thus , F2 is the most appropriate formulation with standard Power expected stickiness For lotion preparation . The results of the one-way ANOVA test showed p- value 0.000, which is more small from 0.05, indicating existence difference significant formulations the .

Table 6. Adhesion Test Results

Formulation	Replication 1	Replication 2	Replication 3
K+	00:00:41	00:00:43	00:00:40
K-	00:00:51	00:00:49	00:00:47
F1	00:00:42	00:00:41	00:00:45
F2	00:00:41	00:00:42	00:00:40
F3	00:00:41	00:00:41	00:00:42

Activity Test Antioxidants

Wavelength Determination Results Maximum DPPH

Determination long wave maximum done For ensure point absorbance highest from DPPH, which was found at 517 nm. according to with literature , which confirms that measurement in length wave This accurate For test activity antioxidants , especially in DPPH interaction with compound tested .

Operation Time Determination Results

optimal incubation time is 30 minutes For ensure that reaction between DPPH and compounds antioxidant reach equilibrium . This allows accurate measurement to ability faction ethyl acetate strawberry leaves in catch radical free , ensure valid results in activity test antioxidants .

Test Results Activity Free Radical Scavenging

Testing with DPPH method shows that faction ethyl acetate strawberry leaves in significant capable catch radical free . Formulations F2 (4% fraction) and F3 (6% fraction) showed decline higher DPPH absorbance big compared to with F1 (2% fraction), which shows improvement activity antioxidant along with increasing concentration fraction .

Regression value for F1, F2, and F3 were 0.998, 0.984, and 0.956 respectively, indicating strong linear relationship between concentration and decline absorbance . Compared with control positive , activity antioxidant faction strawberry leaves approach , but still below, Vitamin C (value regression 0.962). This result show potential faction strawberry leaves as source antioxidant natural that can used in product For oppose stress oxidative .

DISCUSSION

Plants used in study This is strawberry leaves (Fragaria vesca), which have been identified at Materia Medika Batu, Malang, based on characteristic features physique like shape , color , and aroma of the leaves . Accurate identification is essential . For ensure materials used in accordance with specification research and for guard consistency results extraction .

Strawberry leaves are picked in the morning day from the garden that has been determined For guard quality and consistency ingredients . After picking , the leaves washed , sorted and dried with method winded -
air it out shady . After dry , leaves ground and sieved using mesh 60 for facilitate the extraction process .Extract strawberry leaves made with method maceration use solvent 70% ethanol for 3x24 hours. Extract liquid Then concentrated using rotary evaporator and fractionated use n-

hexane and ethyl solvents acetate . Fraction ethyl acetate used in lotion formulation because contain component desired active .

identification test on fractions ethyl acetate done use method Thin Layer Chromatography (TLC). The test results show the presence of flavonoids, which have potential as antioxidant important in formulated lotion activity .

Body lotion is made with mix faction ethyl acetate strawberry leaves in a lotion base consisting of Triethanolamine (TEA), cetyl alcohol , glycerin , nipagin, and nipasol . Formulation made in three concentration different (2%, 4%, and 6%) and homogenized using a homogenizer.

Only K+ formulation (control) positive) which shows homogeneity perfect , while formulation other show non-uniformity . K+ formulation has a pH close to neutral , ideal for skin , while formulation other has a higher pH language .

K+ has viscosity highest , F2 has viscosity lowest , and F1 and F3 have medium viscosity . F1 has Power spread highest , while F2 and F3 show Power spread more low .

Formulations F2 and F3 show Power sticky approaching the ideal, with consistent results in various testing Vitamin C, which is used as standard comparator , shows correlation positive between improvement concentration and level inhibition radical free . At concentration lowest (0.4 ppm), Vitamin C is already capable inhibit radical free by 84.513%, with very low IC_{50} value which is 0.010 ppm. This shows that Vitamin C has potential Very strong antioxidant .

Control positive , namely the commercial body lotion Marina, showed activity more antioxidants low compared to with Vitamin C. At a concentration of 0.4 ppm, the control positive inhibit radical free by 79.425%, with IC_{50} value is not calculated (IC_{50} = 0.000). Activity more antioxidants low This Possible caused by the content antioxidant experience in Marina's formulation is not as strong as potential from pure Vitamin C.

Control negative , which is not contain material active antioxidants , indicating activity inhibition lowest . At the concentration lowest (0.4 ppm), inhibition radical free only reached 78.872%, with IC_{50} value = 0.000. This result show that without existence component antioxidant active , the body lotion's ability to ward off radical very limited and almost free No effective in protect from effect oxidative. Formulation 1, which contains 2% fraction leaf strawberry,show improvement activity antioxidant compared to with control positive . At a concentration of 0.4 ppm, inhibition radical free reached 83.075%, with IC_{50} value of 0.004 ppm. Activity This show that although faction strawberry leaves used relatively low (2%), formulation This own potential sufficient antioxidants good , approaching the effectiveness of Vitamin C, so that effective in ward off radical free on concentration low .

Formulation 2, which contains 4% fraction strawberry leaves , showing activity more antioxidants tall compared to with Formulation 1. At a concentration of 0.4 ppm, inhibition radical free reached 95.907%, with IC_{50} value is not calculated (IC_{50} = 0.000). Activity This approach potential antioxidant Vitamin C, shows that addition faction strawberry leaves in formulation in a way significant increase effectiveness of body lotion in ward off radical free. Formulation 3, which contains 6% fraction strawberry leaves , on showing activity antioxidant the highest among all tested formulations . At a concentration of 0.4 ppm, inhibition radical free reached 94.912%, with IC_{50} value is not calculated (IC_{50} = 0.000). This result show that improvement concentration faction strawberry leaves in significant increase potential antioxidants in cream , with very close activity potential antioxidant Vitamin C.

CONCLUSIONS

Although test results show difference significant , some assumption analysis statistics No fully fulfilled . Normality test disclose that distribution on several groups , especially for pH and power sticky , abnormal , and variance in pH test is not homogeneous (Sig. = 0.016). This result show that although there is difference significant , necessary be noticed that some data is not fulfil assumption base analysis statistics . DPPH IC_{50} Antioxidant Test on control positive , Sig. value 0.008, value regression is 0.932. Control negative Sig. value 0.025, but with mark regression 0.854, indicating that the effect No as strong as sample others . Formulation 1 (2%) Sig. value 0.005 and value regression 0.948. Formulation 2 (4%) Sig. value 0.001 and value regression 0.985. Formulation 3 (6%) Sig. value 0.003 and value regression 0.967. In overall , results This show that improvement concentration faction strawberry leaves in significant increase ability inhibition radical free to all samples tested .

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