FORMULATION AND ANTIOXIDANT TEST OF PEEL-OFF GEL FACE MASK PREPARATION FROM PLANTAIN PEEL EXTRACT (Musa *paradisiaca* L.) WITH THE DPPH METHOD

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A B S T R A C T

Plantain peel (Musa paradisiaca L.) has the potential to be used as an active ingredient in peel-off gel mask preparations. The purpose of this study is to formulate a formula, evaluate physicochemical properties, and study the antioxidant activity of the gel mask preparation. This study uses a laboratory experimental approach, where plantain peel extract is obtained through the maceration method with a 96% ethanol solvent. The tests carried out include organoleptic, homogeneity, pH, dry time, and potential irritation. The peel-off gel mask formulation was developed in three variations of extract concentrations, namely F1 (5%), F2 (10%), and F3 (15%). The antioxidant activity test was carried out using the DPPH method by measuring the percentage of inhibition at concentrations of 20 ppm, 40 ppm, 60 ppm, and 80 ppm. The results of the study showed that peel-off gel mask preparations based on plantain peel extract met the criteria of organoleptic, homogeneity, pH, drying time, and were safe from potential irritation. In addition, the results of antioxidant activity tests at 5%, 10%, and 15% extract concentrations showed IC50 values of 115.22 ppm, 114.56 ppm, and 112.74 ppm, respectively, which were included in the category of moderate antioxidant activity. These findings suggest that plantain peel may be a potential active ingredient in skincare products that function as antioxidants.

INTRODUCTION

Indonesia is one of the largest producers of bananas in the world, making a significant contribution to global supply. Based on data from the Central Statistics Agency (BPS) and the Directorate General of Horticulture, banana production in Indonesia in 2020 reached 8,182,756 tons, an increase of 12.39% compared to the previous year. This increase reflects the development of the national horticultural sector, especially in the banana commodity, which has an important role in the country's economy. In addition to being a superior product in the domestic market, the increase in banana production also indicates export potential that can strengthen Indonesia's competitiveness in the international market (BPS and the Director General of Horticulture, 2020).

Domestic demand for bananas is expected to continue to increase along with the increase in population, increase in education levels, increase in income, and increasing public awareness of the importance of good nutritional intake (Sirappa, 2021). As one of the tropical horticultural commodities that is in great demand, bananas have great economic value and deserve to be developed intensively through an agribusiness approach. In the global food market, bananas occupy the fourth position as the most important food crop after wheat, rice, and corn, especially in regions with high banana consumption, such as Dubai. Bananas have a rich nutritional content and provide various health benefits, such as being a source of minerals, vitamins, fiber, and bioactive compounds that play a role in regulating blood pressure, improving digestive function, kidney health, and stamina (Sirappa, 2021).

The banana plant (Musa paradisiaca L.) is not only valuable from its fruit, but all parts of the plant, including the banana peel, can be used, for example as animal feed. Banana peels are known to contain bioactive compounds, such as antioxidants, as well as essential nutrients such as fats, proteins, calcium, iron, phosphorus, and vitamins B and C. In fact, the antioxidant content in plantain peels is reported to be higher than in the pulp, showing the great potential of banana peels as a raw material for health products and cosmetics (Saputri et al., 2022). These antioxidant compounds are essential in protecting cells from oxidative damage and supporting the prevention of degenerative diseases and premature aging, making them a potential ingredient for the pharmaceutical, cosmetic, and functional food industries.

The sustainable use of banana peels can provide significant added value, especially as a natural ingredient with high bioactive content (Saputri et al., 2022). Bananas play an important role in various sectors, ranging from food, health, socio-culture, to the economy. The harvest area and production of bananas in Indonesia continue to increase every year along with the increasing use of various plant parts. Although bananas are widely consumed in fresh and processed form, other parts such as banana stems and leaves have great potential to be developed. However, the utilization of banana waste in Indonesia is still not optimal compared to other countries that have utilized this part economically (Sirappa, 2021).

Banana peels contain high potassium, which is about 42%, which functions to strengthen plant stems, fight diseases, and help the flowering and ripening process of fruits. The use of banana peels as liquid fertilizer can also increase nutrients in the soil, accelerate root growth, and support the development of flowers and fruits (Novriyanti et al., 2022). In addition to its important role in the agricultural sector, banana-based products have also entered the cosmetics industry, especially for skincare. In this industry, banana-based cosmetic products have been used to address various skin problems, such as moisturizing dry skin, reducing acne, camouflaging dark spots, reducing wrinkles, and preventing premature aging (Ekayanti et al., 2023).

One interesting finding is the high antioxidant content in plantain peels compared to the pulp, making it a potential source of bioactive compounds for a wide range of applications. However, the use of banana peels in Indonesia is still limited, especially only used as animal feed or compost. This shows that there are great opportunities that have not been utilized optimally, especially in the fields of health, food, and cosmetics, which are increasingly growing in the use of natural ingredients. The bioactive potential contained in plantain peels should be optimized to produce products with high added value, which not only have economic benefits but also support the sustainability of natural resources (Jami'ah et al., 2018).

Research on the potential of plants and natural ingredients containing antioxidant compounds continues to grow, including their use as active ingredients in cosmetic products, especially for skin care. Plantain peel, which is rich in nutrients and has high antioxidant activity, is one of the potential natural ingredients in product formulations such as peel-off gel masks. This mask is known for its transparent shape and easy application to the skin, as well as providing significant benefits in skin care (Pratiwi & Wahdaningsih, 2018). The use of these masks offers a variety of benefits, including reducing wrinkles, acne, and shrinking pores. This product is in demand by consumers from all walks of life because of its anti-aging properties.

As we age, human skin undergoes natural aging which is characterized by a decrease in elasticity, changes in texture, and the appearance of signs of aging such as dullness. This aging process is exacerbated by external factors such as exposure to UV rays, environmental pollution, and free radicals that accelerate the breakdown of skin cells. Therefore, the formulation of cosmetic products containing antioxidants is essential to protect the skin from oxidative damage. Antioxidants play an important role in neutralizing free radicals, preventing cell damage, and slowing down the skin aging process (Trisnaputri et al., 2023).

Plantain peel extract (Musa paradisiaca L.) contains bioactive compounds such as alkaloids, tannins, flavonoids, steroids, and triterpenoids, which contribute significantly to antioxidant activity. Research shows that extracts with a concentration of 15% have an antioxidant ability of 58.02% (Anisa et al., 2020), which is effective in inhibiting skin cell oxidation and preventing aging. In addition, plantain peels also have the potential to be used in cosmetics and as an organic fertilizer ingredient, offering economic and ecological benefits through sustainable waste management (Saputri et al., 2022; Trisnaputri et al., 2023).

Based on the results of previous research and in-depth literature studies, plantain peel (Musa paradisiaca L.) shows significant potential as an active ingredient in the formulation of skin care products, especially because of its high antioxidant content. The development of cosmetic product formulations based on natural ingredients is a strategic step, in line with the global trend that increasingly prioritizes the use of environmentally friendly ingredients in the beauty and health industry. Face masks that utilize plantain peel extract as its main component can be an innovation in skin care, especially to protect the skin from damage caused by free radicals and slow down the skin aging process.

Based on the description above, I am interested in researching the topic titled "Formulation and Antioxidant Test of Peel-Off Gel Face Mask Preparation from Plantain Peel Extract (Musa Paradisiaca L.) With the DPPH method."

METHODOLOGY

This study is a laboratory research with an experimental approach that aims to produce plantain peel extract (Musa paradisiaca L.) through maceration techniques. The extract obtained is used as an active component in the formulation of peel-off gel masks. Furthermore, an evaluation of the antioxidant activity of the resulting formulation is carried out to determine its bioactivity potential.

Type of Research

This study is a laboratory research with an experimental approach that aims to produce plantain peel extract (Musa paradisiaca L.) through maceration techniques. The extract obtained is used as an active component in the formulation of peel-off gel masks. Furthermore, an evaluation of the antioxidant activity of the resulting formulation is carried out to determine its bioactivity potential.

Time and Place of Research

This research was conducted in July 2024 at the Baubau Polytechnic Pharmacy Laboratory.

Tool

The tools used in the research include Thermometer (Digital Omron), pH-meter (Hanna Instruments HI 8424), Viscometer (Digital NDJ-5S), Blender, Stirring Rod, Horn Spoon, Spoon, Whatman Filter Paper, Glass Jar, Hot Plate (Thermo Scientific), Analytical Scale (Radwag), UV-Vis Spectrophotometer (Optizen 2120 UV+Mecusys), Rotary Evaporator (Scilogex), Lumpang and Pestle, Aluminum foil (Best Fresh), Stopwatch, Glass utensils commonly used in the laboratory.

Material

The ingredients used in the study include Aquadest, Plantain peel extract, Polyvinyl alcohol (Sigma), Methyl paraben (Sigma), Propylene glycol (Alkemi), DPPH (Sigma), Ethanol 70%, Hydroxypropyl methyl cellulose (Colorcom), Vit C.

Working Procedure

Sampling

A total of 500 grams of plantain peels in fresh and good condition were taken for this study. The banana peel is obtained from one of the Wameo markets located in the city of Baubau.

Sample preparation

The process of making simplicia began with the selection of samples obtained from the area in the city of Baubau, Southeast Sulawesi. The samples are then weighed and cleaned of impurities through a wet sorting process. After being washed with running water until clean, the leaves are cut into pieces to a size of about 1 cm to make the drying process easier. Next, the sample is dried in the sun that has been covered with a black cloth until dry or by air-conditioning and then weighed. The dried simplisia is then blended until smooth and then weighed and stored in a clean container, namely a glass jar.

Extraction

A total of 300 grams of dried simplicia powder derived from plantain peels (Musa paradisiaca L.) was extracted using the maceration method. The extraction process is carried out by placing the simplicia in a glass container, then adding 1200 mL of 95% ethanol. The selection of 95% ethanol as a solvent is based on its selective, non-toxic, optimal absorbency, and ability to extract compounds with various polarities, both polar, semi-polar, and non-polar.

The glass container is sealed tightly using black duct tape coated with aluminum foil to prevent exposure to light. The extraction is carried out at room temperature for three days with periodic stirring, ensuring that the process takes place optimally without exposure to direct light. Then it is filtered using filter paper and separated from the pulp using a flannel cloth. Then use a rotary evaporator to obtain a viscous extract (Suhaela *et al.*, 2023).

Making Peel-Off Gel Masks

Prepare the tools and materials used. Put 10 mL of PVA into a 100 mL measuring cup, then add aquadest and stir until the color is clear and homoen, add 2 mL of HPMC little by little, then add 0.2 mL of methyl paraben and 10 mL of propylene glycol into the mortar until dissolved and the rest of the aquadest into a chemical glass with a hot plate temperature of 80°C, Once the whole ingredients are homogeneously mixed, add the extract. The full composition of the formula used can be seen in Table 1.

Table 1. Design of Peel-Off Gel Mask Formulation for Plantain Peel (Trisnaputri et al., 2023).

No.	Bahan	Konsentrasi (%)			Fungsi
		F1	F2	F3	
1.	Ekstrak kulit pisang raja (*Musa paradisiaca* L)	5	10	15	Zat Aktif
2.	Etanol 96%	15	15	15	Pelarut dan penstabil
3.	PVA	10	10	10	Pembentuk lapisan film
4.	HPMC	2	2	2	Basis gel
5.	Metil Paraben	0,2	0,2	0,2	Pengawet
6.	Propilen Glikol	10	10	10	Humektan
7.	Aquadest	Ad100 mL	Ad100mL	Ad100mL	Pelarut

Information:

Formulation 1 (F1) : Formulation of gel mask preparations *peel-off* concentration of 5%.

Formulation 2 (F2) : Formulation of *peel-off gel mask preparations* with a concentration of 10%.

Formulation 3 (F3) : Formulation of *peel-off gel mask preparations* with a concentration of 15%.

Evaluation of Peel-Off *Gel Mask Preparations*

Organoleptic Test

Organoleptic testing was carried out to assess the visual characteristics of peel-off gel mask preparations, including shape, color, and aroma, through direct observation (Trisnaputri et al., 2023).

Homogeneity Test

Homogeneity testing is carried out by applying a sample of the formulation on the glass of the object, then flattened to ensure the absence of particles that look uneven. The formulation is declared homogeneous if, when applied to glass or other transparent media, there are no coarse particles or agglomerations that are visually detected (Trisnaputri et al., 2023).

pH Test

A total of 1 gram of plantain peel extract formulation was weighed and put into a test tube, then aquadest was added until the sample was completely submerged. The mixture is stirred until homogeneous, after which the universal pH paper is dipped for about 30 seconds. The color change that occurs on the pH paper is then compared with the pH color scale to determine the acidity or alkalinity level of the formulation (Trisnaputri et al., 2023).

Dry Time Test

The dry time test was carried out by applying 1 gram of the formula to the skin of the upper arm with an application length of about 7 cm. The time required for the formation of a thin film layer of the mask was measured using a stopwatch to determine the drying duration (Trisnaputri et al., 2023).

Irritation Test

The irritation test is performed by applying each formulation to the wrist area and observing potential skin irritation reactions. Signs of irritation are noted based on the appearance of skin reactions, such as redness or itching, which usually appear immediately after application (Trisnaputri et al., 2023).

Antioxidant Activity Test

DPPH Solution Manufacturing

A total of 20 mg of DPPH is weighed with high accuracy, then dissolved in 96% ethanol until it reaches a volume of 100 mL in the flask, resulting in a solution with a concentration of 200 ppm. Next, 5 mL of a 200 ppm DPPH solution is taken and diluted with 25% ethanol until it reaches a final volume of 25 mL, resulting in a solution with a final concentration of 40 ppm.

Making Vitamin C Parent Solution

A total of 2.5 mg of vitamin C powder was accurately weighed, then dissolved in 96% ethanol until it reached a final volume of 25 mL, resulting in a parent solution with a concentration of 100 ppm that was ready for further analysis.

Solution Manufacturing

A total of 25 mg of peel-off gel mask preparations containing plantain peel extract are dissolved in ethanol until the volume reaches 25 mL, resulting in a solution with a concentration of 1000 ppm.
Measurement of Absorbance of Antioxidant Activity of Vitamin C Solution
A total of 0.25 mL, 0.5 mL, 1.0 mL, and 2.0 mL of vitamin C parent solution were pipetted into each measuring flask with a capacity of 25 mL, resulting in a test solution with final concentrations of 1 ppm, 2 ppm, 4 ppm, and 8 ppm. After that, as much as 5 mL of DPPH solution with a concentration of 200 ppm is added to each measuring flask, then the total volume of the solution is adjusted to the limit mark using 96% ethanol. This procedure is performed to obtain a sample that is ready to be used in testing antioxidant activity.
Absorbance Measurement
A total of 0.5 mL, 1.0 mL, 1.5 mL, and 2.0 mL of solution were pipetted with high precision into a measuring flask with a capacity of 25 mL. This procedure aims to produce a test solution with varying final concentrations, namely 20 ppm, 40 ppm, 60 ppm, and 80 ppm. After the addition of the parent solution, as much as 5 mL of DPPH solution with a concentration of 200 ppm is added to each flask. Furthermore, the final volume of each solution is adjusted with 96% ethanol until it reaches the limit mark on the flask. These steps are taken to ensure that the resulting solution is ready for further analysis in testing of antioxidant activity.
All solutions, including the control solution, test solution, and positive standard solution (vitamin C), were evenly shaken using vortex and then incubated at 37°C for 30 minutes in dark conditions, protected with aluminum foil to prevent radical degradation of DPPH due to light exposure. After the incubation process, the absorbance of the solution was measured using a UV-Vis spectrophotometer at a wavelength of 517 nm to determine antioxidant activity.

Data Analysis

The results of the formula optimization of the peel-off gel mask were evaluated through a series of physical quality tests, which included organoleptic observation, homogeneity analysis, pH measurement, drying time testing, and irritation evaluation. The data obtained from each test is presented in the form of a table to facilitate more systematic analysis and interpretation.

The antioxidant activity of plantain peel extract against DPPH free radicals was measured in the form of an inhibition percentage, which was then analyzed to determine the IC50 value. This IC50 value represents the concentration of the extract required to inhibit 50% of free radicals. The lower the IC50 value produced, the stronger the antioxidant potential of the extract.

In this study, the calculation of the IC50 value was carried out through linear regression analysis, by applying a mathematical equation in the form of y = ax + b. Here, y refers to the percentage of inhibition at the 50% point, whereas x is the concentration required to achieve that inhibition. This method ensures accuracy in determining the antioxidant potential and allows for a more in-depth evaluation of the effectiveness of plantain peel extract. The aaa constant shows the value of the y variable when x is zero, while the bbb constant shows the change of the y variable for every change of one unit on the x variable. The antioxidant activity against DPPH free radicals is calculated using the following formula:

$$\% \text{ Penghambat} = \frac{\text{absorbansi blanko - absorbansi sampel} \times 100\%}{\text{absorbansi blanko}}$$

RESULTS AND DISCUSSION (Times New Roman, point 11, Bold, Spasi 1& UPPERCASE)

Results of Plantain Peel Extract Yield

Table 2. Results of Yield of Plantain Peel Extract (*Musa paradisiaca* L.)

Solvent	Heavy Simplisia	Heavy Extract	Result Resin
Ethanol 96%	500 grams	50 grams	10%

The extraction process is carried out using a solvent of 96% ethanol and 500 grams of simplicia to produce a deep yellow extract. From the extraction process, the weight of the extract is 50 grams, so the percentage of yield obtained is 10%.

Organoleptic Test

Table 3. Organoeptic Test Results

Parameters	F1	F2	F3	Standard
Color	Yellow color	Yellow color	Yellow color	Distinctive color and smell of banana peel extract
Aroma	The characteristic smell of sweet aroma is very sharp	The characteristic smell of sweet aroma is very sharp	The characteristic smell of sweet aroma is very sharp	
Texture	Semi-dense shape, smooth with no coarse particles and easy to apply	Semi-dense shape, smooth with no coarse particles and easy to apply	Semi-dense shape, smooth with no coarse particles and easy to apply	

Description:

Formulation 1 (F1) : Plantain peel extract 5%.

Formulation 2 (F2) : Plantain peel extract 10%.

Formulation 3 (F3) : Plantain peel extract 15%.

Based on the results of the organoleptic test in this study (Table 3.) seen from the color, aroma, texture shows that all colors show the same parameters, namely F1, F2 and F3 are yellow, the characteristic smell of sweet aroma is very sharp, semi-solid shape, smooth without coarse particles and easy to apply.

Homogeneity Test

Table 4. Results of Homogeneity Test of Peel Off Gel Mask Formulation of Plantain Peel Peel Extract (*Musa paradisiaca* L.)

Formula	Homogeneity	Standard
F1	Homogeneous	Homogeneous
F2	Homogeneous	
F3	Homogeneous	

Based on the observation results presented in Table 4, the preparations show a good level of homogeneity during the storage period. This is evidenced by the absence of coarse particles and a smooth and even surface. Therefore, it can be concluded that the mask preparation has good stability in terms of homogeneity, with an even distribution of components throughout the storage time.

pH Test

The results of the formulation pH test on plantain peel extract (*Musa paradisiaca* L.) are as follows.

Table 5. pH Test Results

Formula	Ph	Standard
F1	7	6-7
F2	7	
F3	7	

Based on the observations in (Table 5.) obtained the results for , F1, F2 and F3 are all eligible. The pH value of all preparations of 7 is always considered normal for the skin. If the preparation is too acidic, it will irritate the skin, and if the preparation is too alkaline, it will cause desquamation/exfoliation.

Dry Time Test

Table 6. Formulation Dry Time Test Results

Formula	Dry Time	Standard

F1	15 minutes	
F2	15 minutes	15-30 minutes
F3	15 minutes	

Based on the results of the observation of the drying time in (Table 6), it shows that the drying time of all formulas is still included in the standard range, namely within 15-30 minutes.

Irritation Test

Table 7. Irritation Test Results

Formula	Time of Contact with Skin	Result
F1	15-20 minutes	
F2	15-20 minutes	No irritation
F3	15-20 minutes	

Based on the results of the formulation test listed in Table 7, the application of formulas 1, 2, and 3 on the skin during a contact duration of 15-20 minutes does not cause irritation symptoms, such as the appearance of redness, pain sensations, or cuts on the skin. This shows that the three formulations are safe to use under the test conditions carried out.

Antioxidant Test

Tabel 8. Results of % inhibition from *peel-off gel mask preparations* and Vit C comparator

Formula	Concentration (ppm)	Average absorbance	% Inhibition
F1	20	0,6283	0,555
	40	0,5688	9,925
	60	0,4920	22,102
	80	0,4341	31,283
F2	20	0,6218	1,506
	40	0,5530	12,446
	60	0,4906	22,324
	80	0,4284	32,171
F3	20	0,6207	1,712
	40	0,5402	14,413
	60	0,4819	23,704
	80	0,4259	32,519
C Screw	1	0,4622	26,827
	2	0,3917	37,974
	4	0,2986	52,814
	8	0,1118	82,432

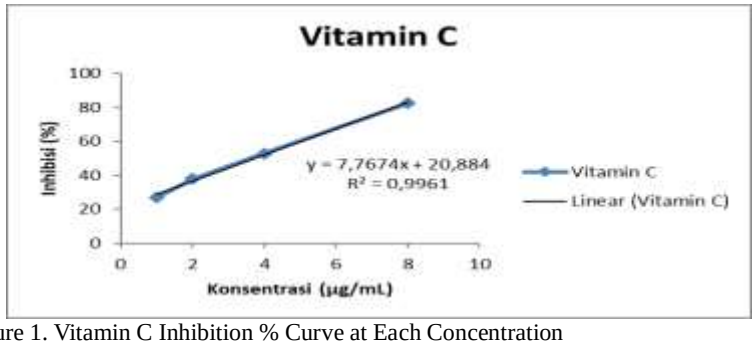

Figure 1. Vitamin C Inhibition % Curve at Each Concentration

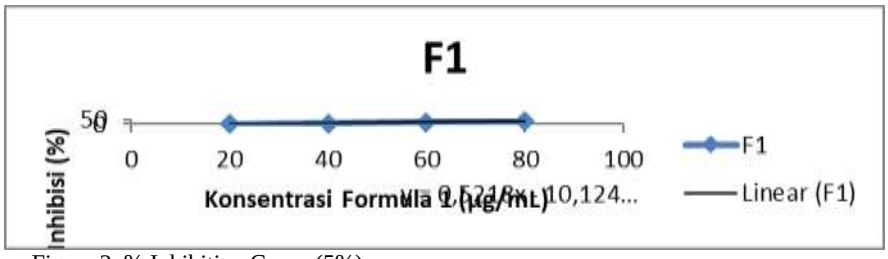

Figure 2. % Inhibition Curve (5%)

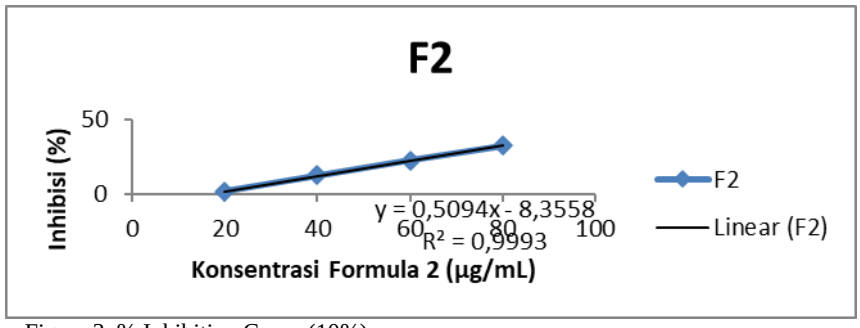

Figure 3. % Inhibition Curve (10%)

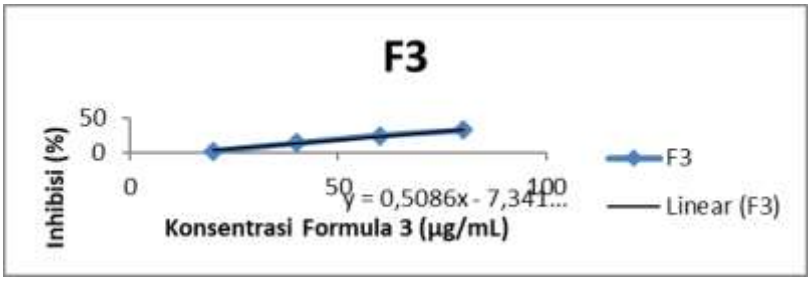

Figure 4. Mask Inhibition % Curve (15%)

Table 9. Antioxidant and Vitamin C Test Results

Formula	IC50 value (ppm)	Antioxidant
F1	115,22	Keep
F2	114,56	Keep
F3	112,74	Keep
C Screw	3,75	Very Strong

Discussion

This study aims to design an optimal and effective formula in the manufacture of mask preparations that are applied as face masks. Plantain peel was chosen as the active ingredient in the formulation of peel-off gel masks because it is known to have high antioxidant activity. This activity makes it a potential candidate to increase the effectiveness of cosmetic products that aim to provide protection against oxidative damage to the skin.

Maceration was chosen as the extraction method because it is a simple technique, in which the plantain peel simplicia material is soaked in a suitable solvent. The working principle of maceration is based on the ability of a solvent to penetrate the cell wall and flow into the cell cavity containing the active component. These active components are then diffused into the solvent, driven by the difference in concentration between the solvent inside and outside the cell, until an equilibrium point is reached. This process continues repeatedly until the distribution of active components reaches a balance between the inside and outside of the cell.

After completing the maceration process, the resulting mixture is filtered to separate the filtrate from the residue. The filtrate is then further processed using a rotary evaporator to obtain a viscous extract from the plantain peel, which will be used in subsequent formulation and testing.

The extraction results using 96% ethanol and a simplicia mass of 500 grams produced a thick yellow extract with a final weight of 50 grams, so the yield obtained was 10%. In comparison,

previous studies reported that the yield value of plantain peel extract reached 14.2% (Saputri et al., 2022). The higher yield in the study showed a greater concentration of active compounds, reflecting the effectiveness of extraction against the bioactive components of plantain peels.

In addition, the difference in the levels of active compounds produced from the peel of a plantain (Musa paradisiaca Sapientum) can be influenced by the environmental factors in which the plant grows, which contributes to variations in the content of bioactive compounds. An understanding of these factors is essential to explore the potential applications of plantain peel in health and cosmetics. This environmental influence is closely related to the plant metabolic process, namely the biochemical process and the synthesis of secondary metabolite compounds. Environmental factors such as the altitude of a place with high environmental stress, such as high temperature, high humidity and low sunlight intensity can affect the production of secondary metabolites such as flavonoid and antioxidant levels in plant extracts (Sarni et al., 2020).

The organoleptic test is a visual observation test, especially observing the changes that occur during preparation. The observed composition should have a consistent aroma and color as well as the consistency of a semi-dense composition (Suryono *et al*., 2018). Based on (Table 3.), the results of the observation of the three organoleptis formulations before the test showed that F1, F2 and F3 were yellow. with a distinctive aroma of plantain peel extract and medium consistency.

The results of the organoleptic test of peel off gel face mask preparations meet the requirements of the organoleptic test. *Peel-off* gel face mask preparations that have a semi-dense texture produce an even yellowish color of F1 (5 %), F2 (10%) and F3 (15%) and a distinctive sweet aroma that is very sharp.

A homogeneity test is performed to ensure that all ingredients in the formulation have been evenly mixed. In the context of peel-off gel mask preparations, homogeneity tests are carried out by applying the preparation to objective glass (Sinala et al., 2019). Based on the observation results presented in Table 4, the formulas F1, F2, and F3 show a good level of homogeneity during the storage period. The stability of this homogeneity can be seen from the absence of coarse grains and a smooth and even surface. Therefore, it can be concluded that the manufactured preparations show an even and stable distribution of components, which is very important for maintaining the quality and effectiveness of the product in cosmetic applications. This homogeneity assessment is an important parameter in the evaluation of formulations, given its influence on performance and user satisfaction. According to Titaley et al. (2014), a gel is said to be homogeneous if there is an even color uniformity and no different particles are found. Thus, the formula in this study is stated to have good homogeneity stability.

The safety of a preparation, especially topical preparations, needs to be evaluated through pH analysis. Ensuring that the pH value of the preparation matches the natural pH of human skin is an essential requirement for topical products (Satria et al., 2022). The pH testing of *peel-off* gel mask preparations was carried out using a pH meter. Based on the test results in (Table 5). It can be seen that F1, F2 and F3 are all qualified all showing pH 7 which is the normal pH that is qualified for masks applied to human skin The results of the pH test show that the plantain peel ethanol extract mask has a pH of around 7.

Expected drying time of gel mask preparations *peel-off* The result is between 15-30 minutes (Syarifah *et al.*, 2015). Based on the observations presented in Table 6, the drying time of the preparations of all formulas is within the standard range, which is within 15 minutes.

Based on the results of the irritation test in (Table 7.), the irritation test examination *of peel-off gel mask preparations* was carried out on the skin of the face. Symptoms that arise are observed, generally irritation will be immediately indicated by the presence of itchy, reddened and injured skin reactions after adhesion or touching of the skin. In the tests carried out, the three formulas, F1 (5%), F2 (10%), and (F3) 15% did not cause irritation to the skin of the face. This is shown by the absence of a reaction on the skin of the face and meeting the requirements of the preparation.

Plantain peel contains flavonoid compounds that have the potential as antioxidant agents, so it is very suitable for formulation into peel-off gel face mask preparations (Sumiyati & Ginting, 2019). Therefore, testing for antioxidant activity is important to evaluate the antioxidant capacity in sample preparations. There are various methods that can be used in testing antioxidant activity but in this study using DPPH, because this method has proven to be accurate and practical in determining the ability of antioxidants using diphenyl-1-picrylhydrazyl free radicals. So that the mechanism of action of each antioxidant can be known. Antioxidants can be useful to protect the skin against oxidants from the outside that are detrimental to skin health such as smoke, pollution, UV rays, the influence of

synthetic compounds, so a product is needed that can maintain cell damage or cell buildup from the skin and provide other nutrients. Antioxidant measurements are needed because of the large amount of oxygen-oxygen from the outside, so products are needed that can maintain skin health and cell damage that can be obtained from the peel off gel mask formula.

The DPPH method is based on the principle of oxidation-reduction reaction, where DPPH is a synthetic free radical that is soluble in polar solvents such as ethanol and methanol. Antioxidant compounds interact with DPPH through the hydrogen atom donation mechanism, which functions to neutralize free radicals by forming electron pairs.

The antioxidant activity of a compound is measured by an IC50 value, which indicates the concentration required to inhibit 50% of free radicals. The lower the IC50 value, the higher the antioxidant activity (Cahyani & Putri, 2017). The classification of antioxidant activity is carried out with the following criteria: very strong if the IC50 < 50 ppm, strong if the IC50 value is in the range of 50–100 ppm, medium if the IC50 is in the range of 100–150 ppm, and weak if the IC50 is between 150–200 ppm.

The results of the antioxidant activity test can be seen in Table 4.7, where the three mask formulas are based on ethanol extract of plantain peel showing moderate antioxidant activity. In contrast, an IC50 value of vitamin C of 24.49 ppm indicates very strong antioxidant activity. Previous research by Rodina et al. (2016) revealed that the higher the concentration of plantain peel extract used in the formulation, the greater the ability of the compound to neutralize DPPH free radicals. In this study, the antioxidant activity of the peel-off gel mask formulation showed a significant difference when compared to pure plantain peel extract, which has an IC50 value of 46.82 ppm, which is in the strong categoryThis is in line with research conducted by Jami'ah et al. (2018), which reported that plantain peel extract has an IC50 value of 46.82 ppm, which confirms the existence of strong antioxidant activity. According to Molyneux (2004), antioxidant compounds are categorized as very strong if the IC50 value is less than 50 mg/L, while the compound is categorized as strong if the IC50 value is in the range of 50–100 mg/L.

Research conducted by Rose (2013) in-depth evaluated the antioxidant activity of methanol extract of plantain peel (Musa paradisiaca Sapientum), which was obtained through maceration method with methanol solvent. The results showed that the methanol fraction and ethyl acetate fraction from plantain peels had significantly higher antioxidant activity compared to whole methanol extract and n-hexane fraction. These findings provide an indication that fractional separation can increase the potential bioactive activity of the extract. In addition, research conducted by Jami'ah et al. (2018) supports these results by showing that methanol extract from plantain leaves has very strong antioxidant activity, characterized by an IC50 value of 46.82 ppm. These results confirm the importance of further research on the potential of bioactive compounds in plantain peels and leaves as a natural source of antioxidants that can be used in a variety of applications, including in the health and cosmetic fields.

CONCLUSION

Plantain peel extract (Musa paradisiaca L.) has been successfully formulated into peel-off gel mask preparations. The physical characteristics of the peel-off gel mask formulation, which consists of F1 (containing 5% plantain peel extract), F2 (containing 10% plantain peel extract), and F3 (containing 15% plantain peel extract), indicate that all three formulas meet the standard criteria for a quality cosmetic preparation. Furthermore, the evaluation of antioxidant activity showed that all formulations had moderate antioxidant strength, which could be indicated by IC50 values respectively: 115.22 μg/mL for F1, 114.56 μg/mL for F2, and 112.74 μg/mL for F3. These findings confirm the potential use of plantain peel extract as an active ingredient in cosmetic products, especially in the development of preparations that are not only safe, but also effective in providing protective benefits against oxidative damage to the skin

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