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Formulation of sheet mask utilizing Pometia pinnata Fruit Peel Waste as Anti-Aging and Anti-Bacterial Agent in Facial Skin Care

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Abstract: *Pometia pinnata* fruit peel extract contains secondary metabolites, such as tannins, saponins, and flavonoids, which demonstrate both antioxidant and antibacterial properties. Despite the potential identified in matoa fruit peel, its utilization remains constrained. Consequently, there is a necessity for innovative approaches to unlock its latent capabilities. Universal desires for skin health and beauty exist among individuals. Nonetheless, various factors contribute to facial skin issues, including exposure to free radicals during outdoor activities. Recently, sheet masks have gained popularity as a hygiene and efficient method for facial care. Therefore, this study aims to incorporate matoa fruit peel as an active component in sheet masks. These masks will be formulated and subjected to tests measuring antioxidant activity using the DPPH (1,1-diphenyl-2-picrylhydrazyl) method, as well as antibacterial activity through the disc diffusion method to assess inhibition zones against Propionibacterium acnes bacteria. The assessment encompasses organoleptic tests, pH measurement, homogeneity, and stability. Findings from the study reveal that the sheet mask formulation is slightly viscous, possessing a distinctive odor and a light brown color. The pH of the sheet mask formulation ranges between 5.3 and 5.15. The formulation exhibits homogeneity at both 3°C and room temperature. Stability is maintained with no observable changes in color, odor, or consistency at 3°C and room temperature. Additionally, no irritations were reported by the 12 volunteers during the skin irritation test. Antioxidant testing demonstrates high activity, with inhibition percentages of 74.47% (1:1) and 42.68% (0.5:1). In contrast, antibacterial testing indicates moderate efficacy, with an inhibition zone of 5.8667 mm. The research confirms that the matoa fruit peel extract formulated in the sheet mask exhibits both antioxidant and antibacterial properties, making it suitable for addressing acne in facial skincare.

Keywords: antibacterial, antioxidant, matoa fruit peel, sheet mask

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1. INTRODUCTION

The skin, constituting approximately 15% of the total body weight, is the outermost organ enveloping the human body. It encompasses pores or cavities on its outer layer that are channels for sweat release. The skin plays various roles, including serving as the body's primary shield, a sensory organ for communication, and a regulator of body temperature (Santi et al., 2019). Especially, facial skin requires special care as it reflects an individual's health and beauty aspirations. Healthy facial skin is characterized by uniform and radiant color, smooth texture, firmness, and freedom from acne. Factors such as outdoor activities, exposing facial skin to free radicals, sunlight, dust, cigarette smoke, and air pollution, can contribute to facial skin problems, including dullness and acne, leading to loss of skin elasticity, and clogged facial pores (Monica, 2019). Therefore, facial care is crucial in addressing potential issues that may arise in facial skin (Isfianati, 2018). The use of masks is a longstanding method of facial care, dating back to ancient times, aimed at cleansing pores and enhancing facial skin conditions. Types of facial masks vary based on their form, including powder masks, cream masks, paper masks, and gel masks (Monica, 2019). A currently popular type of mask, particularly in Asia, is the sheet mask, a dry film or sheet that is considered advantageous due to its ease of customization compared to paste masks. Sheet masks are made from non-woven fibers derived from plant cellulose,

typically cotton. The sheet mask operates through Occlusive Dressing Treatment (ODT), exhibiting superior absorption and penetration characteristics, along with hygienic and efficient packaging as it is a disposable product that is easy to apply without rinsing (Verawaty, 2020).

Several studies have explored natural ingredients for facial care products, including a study by Verawaty (2020) that used a sheet mask with ethanol extract from red betel leaves as its active ingredient. The formulated extract from red betel leaves has been proven to enhance facial skin moisture, as evidenced by increased ethanol extract levels, leading to elevated facial skin water content. In addition to red betel leaves, the creation of sheet masks can also utilize waste from matoa fruit peel. Matoa (*Pometia pinnata*) belongs to the Sapindaceae family and is found in various tropical regions, including Indonesia. Although matoa is relatively well-known, its skin has not been effectively utilized. Matoa fruit peel contains compounds such as saponins, tannins, alkaloids (Pamangin et al., 2020), phenolics, flavonoids (Surya, 2018), terpenoids (Maryam et al., 2020), as well as vitamins A, C, E. According to Faustina and Santoso (2014) and Irawan et al (2017) found that matoa fruit peel exhibits high antioxidant activity compared to its seed and flesh fruit. The high antioxidant activity of ethanol extract from matoa fruit peel is attributed to the presence of alkaloids, saponins, and tannins (Noviatun, 2015). Based on the above description, it can be concluded that matoa fruit peel waste has not been extensively utilized and has the potential to be developed into an active ingredient for sheet mask formulations due to its high antioxidant content. Furthermore, the development of sheet mask formulations using matoa skin extract can contribute to the economic value of matoa fruit peel waste. Therefore, the current study will be formulated and evaluated sheet mask utilizing matoa fruit peel waste (Pometia pinnata) as facial skincare with anti-aging and antibacterial effect.

2. MATERIAL AND METHODS

2.1 Material

This study uses matoa fruit peel (*Pometia pinnata*) obtained from Pekanbaru in September 2022. PEG 40 Hydrogenated Castor Oil, xanthan gum, glycerin, butylene glycol, methylparaben, aquadest, ethanol 70% used for extraction was distilled first. The laboratory equipment is pH meter (Sartorius). A sheet mask was purchased from the market.

2.2 Methods

2.2.1 Extraction

The main sample for this study consisted of 500 grams of dried matoa fruit peel ground into a powder. The extraction method employed in this research was sonication. 500 g matoa fruit peel powder was extracted with 2L of 70% ethanol. Extraction was repeated three times.

2.2.2 Formulation

The following is a formulation design for sheet mask modification with matoa fruit peel extract that refers to Staniyah and Ika (2023).

Table 1. Formulation for the matoa fruit peel sheet mask (Staniyah and Ika, 2023).

Ingredient	Formula
Extract	1%
PEG 40	0,25%
Butylene Glycol	5%
Glycerin	5%
Xanthan Gum	0,5 %
Methylparaben	0,2 %
Ethanol	3%
Aquadest	Add 100%

2.2.3 Sheet Mask Preparation

The sheet mask preparation method followed the procedures conducted by Staniyah and Ika (2023). Xanthan gum was dispersed gradually with some distilled water in a mortar (Mass I). Methylparaben was dissolved in hot water at approximately 70ºC (Mass II). Mass II and Mass I were then slowly mixed in the mortar to obtain Mass III. Butylene glycol, glycerin, and PEG-40 Hydrogenated Castor Oil were mixed in an evaporating dish and homogenized (Mass IV). Mass IV was added to the mortar containing Mass III. After homogeneous mixing, the mixture was stirred with an overhead stirrer until further homogeneity was achieved.

2.2.4 Evaluation of the Formula

a. **Organoleptic:** Organoleptic testing of the serum formulation included observations of color, odor, and shape (Fitria and Padua Ratu, 2022).

b. **pH Measurement:** The acidity level (pH) of the formulation was measured using a pH meter (Verawaty, 2019).

c. **Homogenity:** A certain amount of the formula was applied to a glass slide, and the formula should exhibit a homogeneous composition without visible coarse particles (Verawaty, 2019).

d. **Stability Testing:** Stability assessment was conducted under room temperature and refrigeration conditions. Each prepared formulation was placed in vials, stored, and examined daily for several days. Physical testing on the mask included monitoring changes in aroma, color, and consistency following the guidelines of the Indonesian National Agency of Drug and Food Control (1985).

e. **Skin Irritation Test:** This experiment involved 12 volunteers to determine whether the prepared formulation could cause redness, itching, or roughness on the skin. The formulation was applied to the area behind the ear and left for 24 hours. Observations were made for changes such as redness, itching, and roughness on the skin (Surjanto et al., 2016).

2.2.5 Determination of Antioxidant Activity with DPPH (1,1- diphenyl-2- picrylhydrazyl)

The antioxidant activity of QHPP extract was confirmed with a method performed by Hasanah et al. (2017).

a. **Preparation of DPPH Stock Solution :** DPPH (2 mg) was dissolved in 100 mL of ethanol p.a in a 100 mL volumetric flask to obtain a solution with a concentration of 0.05 mM (Hasanah et al., 2017).

b. **Determination of Maximum Wavelength and Absorbance of DPPH Solution :** Two mL of 0.05 mM DPPH were added to 1 mL of ethanol p.a, homogenized, and left for 30 minutes in the dark. The absorbance of the solution was measured using a UV-VIS spectrophotometer at a wavelength between 400 – 600 nm to determine the maximum wavelength. The measurement was conducted in triplicate (Hasanah et al., 2017).

c. **Determination Antioxidant Activity of Formulation:** The antioxidant activity of formula was confirmed with a method performed by Hasanah et al. (2017). Each formula was mixed with with DPPH solution to obtained concentration of 1:1; and 0.5:1. The absorbance of the samples were measured at the maximum wavelength after 30 minutes[23]. The IC_{50} was calculated using a regression equation, then the AAI (Antioxidant Activity Index) was calculated by dividing the DPPH concentration by the IC_{50} obtained.

2.2.6Antibacterial Activity Determination

a. **Sterilization of Equipment and Media** : Reagent tubes and petri dishes were sterilized in an oven at 170°C for 1 hour. The media were sterilized in an autoclave at 121°C for 15 minutes. Needles and forceps were sterilized under Bunsen lamp (Iskandar et al., 2021).

b. **Preparation of Nutrient Agar (NA) Media**: The media were dissolved in 100 mL of distilled water, heated using a hot plate, and covered with cotton. The media were sterilized by autoclaving at 121°C for 15 minutes.

c. **Preparation of Bacterial Suspension** : *P. acnes* bacteria were taken from the previously rejuvenated culture using a wire loop and suspended in an Erlenmeyer flask containing 10 mL of NaCl (0.9%) until the turbidity matched the McFarland standard (Arista et al., 2013).

d. **Antibacterial Activity Test of Sheet Mask Formulation** : Disc pads were prepared and 10 µL of sheet mask formulation was added at each concentration until the entire fluid was absorbed into the disc pad.

3. RESULTS AND DISCUSSION

The organoleptic evaluation of the sheet mask formulation shows that the consistency is slightly thick, has a distinctive odor, and is brown in color. As concentration increases, the color intensity of the formulation becomes stronger (Verawaty, 2019). This phenomenon is attributed to the higher concentration of ethanol extract from matoa fruit peel being added. In Table 2, the evaluation results of pH level measurements using a pH meter are presented. This process was repeated daily for six days. The measured pH values of the sheet mask formulation were recorded and evaluated against the skin pH standard, which is within the pH range of 4.5-6.5 (Verawaty et al., 2019).

Based on the research conducted by Elisnayanti and Sutriningsih (2019), the examination of the characteristics and standardization of matoa fruit peel extract revealed a pH level of 5.92, indicating that matoa fruit peel extract has acidic properties. Therefore, the pH increases with the concentration of matoa fruit peel extract. The stability of pH in topical formulations is very crucial as formulations that are too acidic can cause skin irritation, while those that are too alkaline can cause dry skin (xerosis cutis) (Surjanto et al., 2016).

The stability test was conducted continuously for six days with the formulation stored at 3°C and room temperature. Stability assessment was based on observations of changes in odor and color. The research results indicated that the formulation remains stable for six consecutive days when stored at 3°C and room temperature. This stability can be attributed to the addition of antioxidants and preservatives, particularly the use of methylparaben, which plays a role in maintaining formulation stability (Stephani, 2014). The stability results are presented in Table 3.

Table 2. Observation of pH Stability

Sample	Temperature	Observation Day (pH)						Average
		1	2	3	4	5	6	
1	Room	5.3	5.10	5.09	5.10	5.08	5.11	5.08
2	3°C	5.3	5.11	5.11	5.23	5.13	5.15	5.20

Table 3. Organoleptic Evaluation of Formula

Sample	Temperature	Observation day					
		1	2	3	4	5	6
1	Room	-	-	-	-	-	-
2	3°C	-	-	-	-	-	-

Noted: (-) : No Change (color, odor dan consistensy); (+) : Change (color, odor dan consistensy)

Table 4. Homogenity Test Result of the Formulation Base Sheet Mask at 30 C and Room Temperature

Sample	Temperature	Observation					
		1	2	3	4	5	6
1	Room	+	+	+	+	+	+
2	3°C	+	+	+	+	+	+

Noted**:** (-) : Not Homogeneus; (+) : Homogeneus

The homogeneity test results for the sheet mask formulation base can be seen in Table 4. The homogeneity test involved placing 1 mL of the sheet mask formulation on a glass slide, spreading it evenly, and observing the results. The results show that the sheet mask formulation is homogeneous because its appearance is consistent. Homogeneity is confirmed by the absence of coarse particles or separation in the formulation (Reveny et al., 2017; Nawawi, 2012). This outcome is likely due to the optimal stirring process, which expands the contact area with increased stirring speed, resulting in optimal homogeneity of the mixture. Stirring is a motion-induced process in a specific substance or mixture, creating a circulation pattern that impacts the homogenization process (Barkat et al., 2011).

Before applying for a pharmaceutical product, an irritation test on volunteers is necessary. If the formulation does not cause redness, itching, or roughness on the skin, it is considered safe for use (Surjanto et al., 2016). In this study, an irritation test was conducted on 12 volunteers by applying the formulation to the area behind the ear. The results showed no irritating reactions in all 12 volunteers involved in the study. The test results can be seen in Table 5.

Tables 5. Irritation Test of Formula on Volunteer

Statement	Volunteer											
	1	2	3	4	5	6	7	8	9	10	11	12
Redness	-	-	-	-	-	-	-	-	-	-	-	-
Itching	-	-	-	-	-	-	-	-	-	-	-	-
Skin Roughness	-	-	-	-	-	-	-	-	-	-	-	-

Tables 6. Antioxidant Activity Test Result of Matoa Fruit Peel Extract Sheet Mask Formulation

Blanc	Concentration of Formula : Blanc DPPH)	Samples Absorbance	Inhibition Percentage (%)
0.656	1:1	0.1675	74.47
	0.5:1	0.376	42.68

In this study, antioxidant activity testing was conducted on the base and solution of the sheet mask formulation with matoa fruit peel extract using a quantitative assay to determine the level of the serum formulation's activity as an antioxidant. DPPH test results were measured using a UV- Vis spectrophotometer with a maximum wavelength of 516.0 nm, and the % antioxidant values were obtained for each concentration.

The parameter used in the antioxidant test of the sheet mask formulation with matoa fruit peel extract solution was the % antioxidant value, representing the antioxidant activity of the sample. The measurement of the DPPH solution's maximum wavelength obtained at 516.0 nm with absorbance of 0.656. The results in Table 6 show that as the extract concentration increases, the absorbance value decreases, indicating a greater inhibition of free radical DPPH. The absorbance difference with the DPPH control was taken, and the percentage value was calculated. According to the calculations, the % antioxidant value at a concentration of 1:1 shows a value of 74.47%, and at a concentration of 1:0.5, it shows a value of 42.68%. The results indicated that the formula has antioxidant activity. Therefore, the formula has the potential to be a highly effective antioxidant in the sheet mask formula.

Table 7. Results of Antibacterial Activity Tes of Matoa Fruit peel Extract Shett Mask Formulation

Control	Inhibition Zone Diameter (mm)			Average
	I	II	III	
Formulation + Extract	5.7	5.8	6.1	5.87
Base Formulation (-)	na	na	na	na

*na: Not Active

Based on the results in Table 7, the antibacterial activity test of the extract sheet mask formula against *P. acnes* bacteria was conducted by comparing the base formulation as a negative control with the formulation and extract as a positive control. The results indicate that the formulation with matoa fruit peel extract has moderate antibacterial activity. The strength of antibacterial activity can be classified based on the diameter of the inhibition zone formed during the test. Antibacterial testing is categorized as weak if the inhibition zone diameter is 5 mm or less, moderate if the inhibition zone is 5-10 mm, strong if the inhibition zone is 10-20 mm, and very strong if the inhibition zone is more than 20 mm (Iskandar, 2022).

4. CONCLUSION

The study showed that matoa (Pometia pinnata) fruit pseel extract can be utilized as a potential source to be developed into an active ingredient for sheet mask formulations due to its significant antioxidant and antibacterial activity. Moreover, the development of sheet mask formulations using matoa fruit peel extract might contribute to increasing the economic value of matoa fruit peel waste.

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