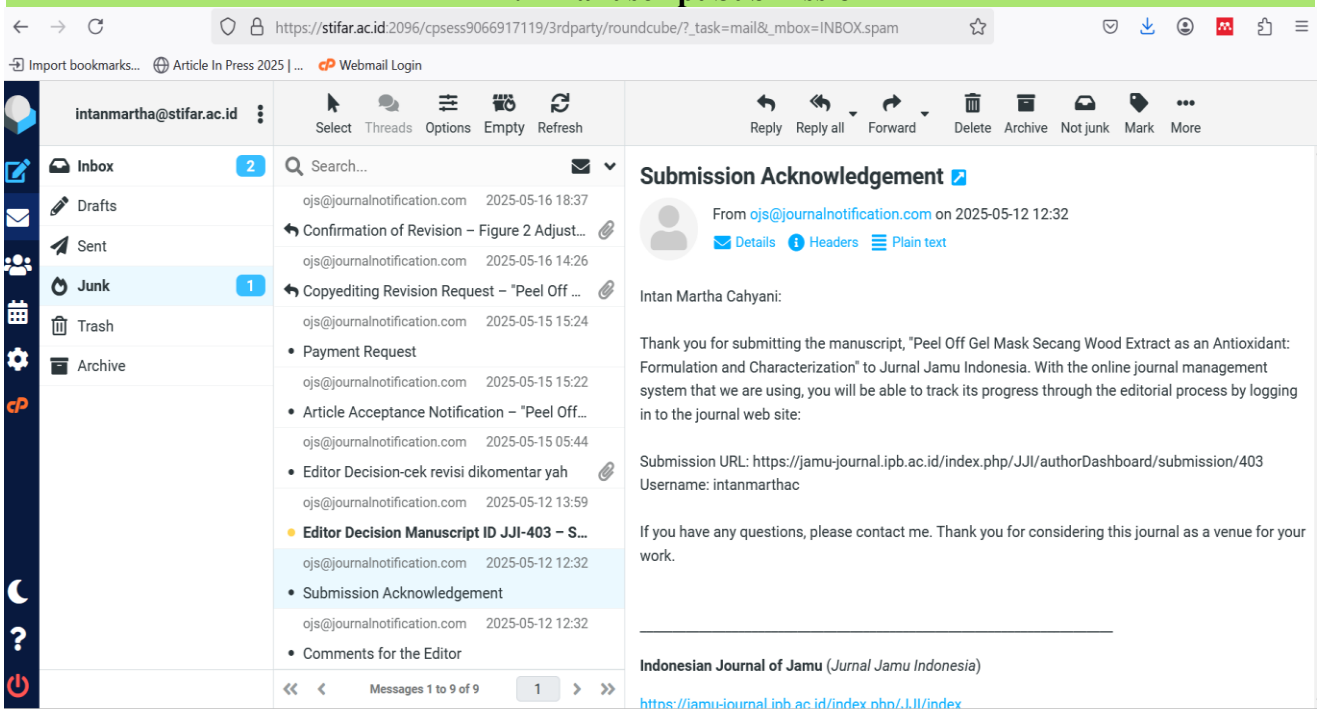
BUKTI KORESPONDENSI
JURNAL NASIONAL TERAKREDITASI KEMENRISTEKDIKTI PERINGKAT 2

Judul artikel	:	Formulation and Characterization of Peel-Off Gel Mask Containing Secang (*Caesalpinia sappan* L.) Wood Extract with Strong Antioxidant Activity
Jurnal	:	Jurnal Jamu Indonesia (JJI)
Edisi	:	Tahun 2025, Vol 10, No.2 Halaman 121-125
Penerbit	:	TropBRC IPB University
Penulis	:	Intan Martha Cahyani, Tan Tanando Tanzaq, Ruth Ditya Agustina, Kemala Endar Setiawati

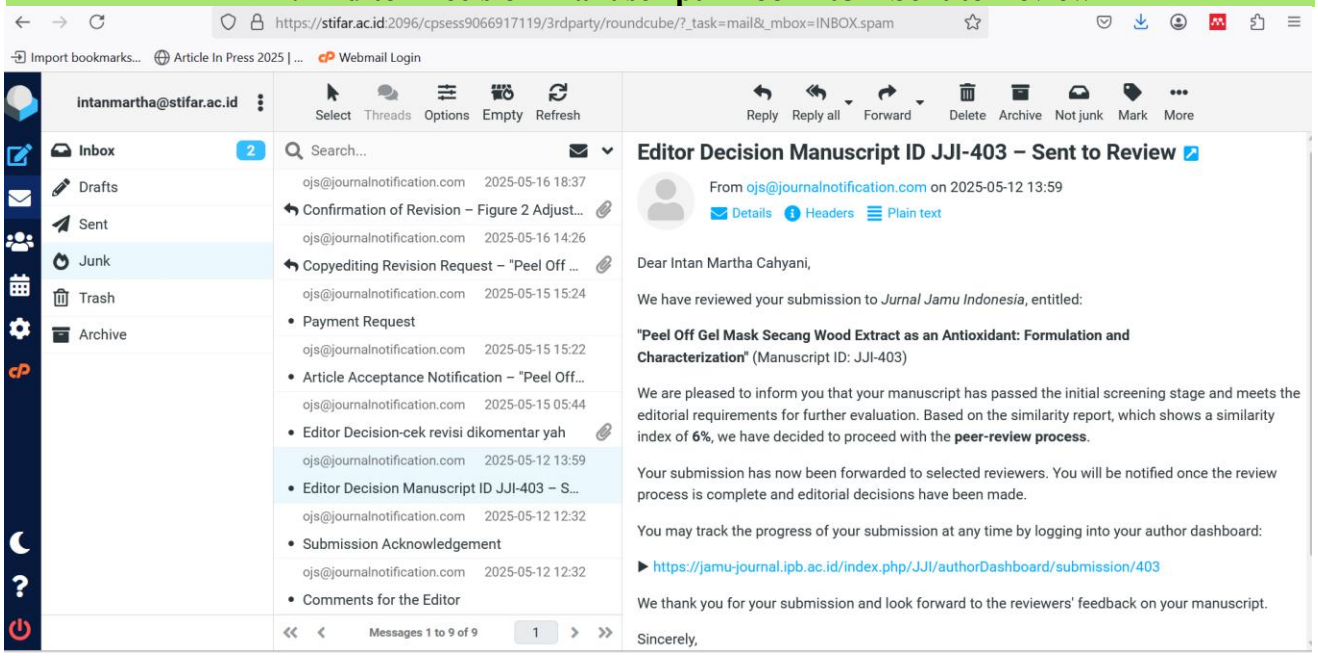
Tabel Tahapan Publikasi Artikel

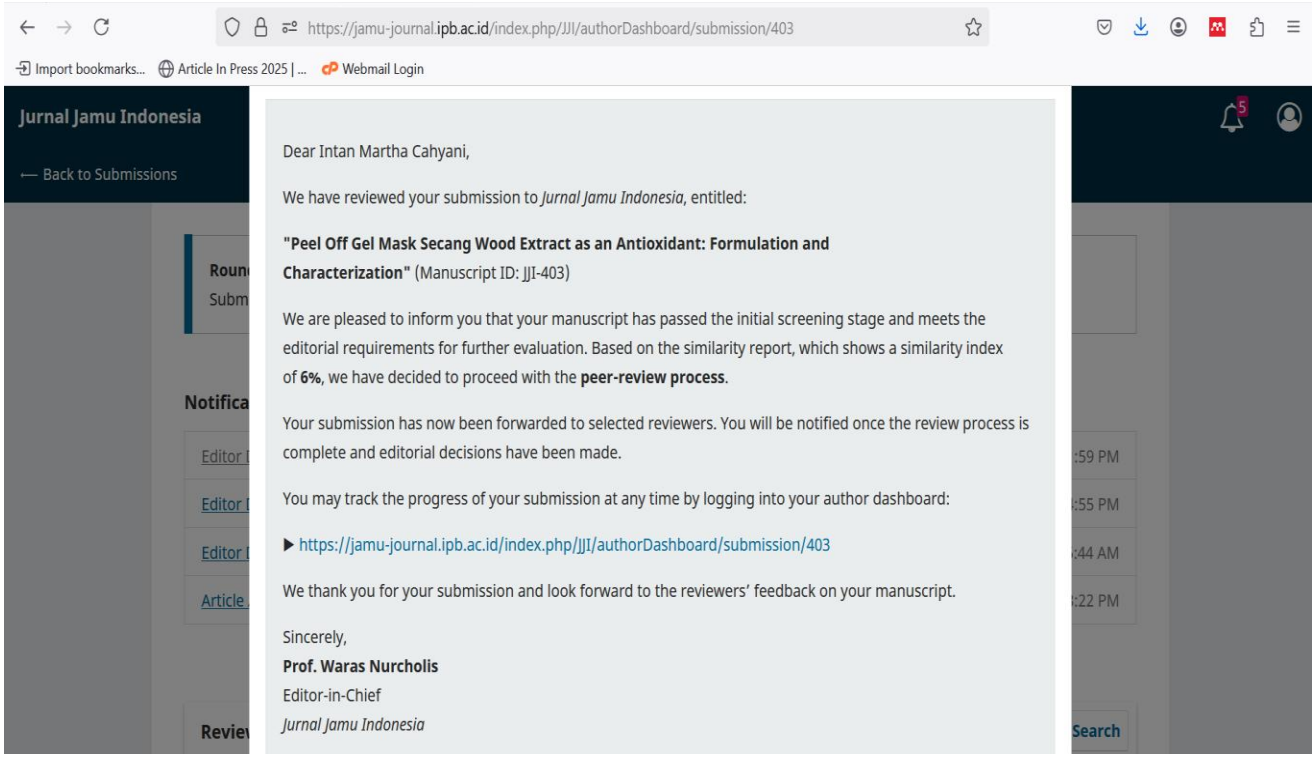
No	Tahapan Publikasi	Tanggal
1	Manuscript Submission	12 Mei 2025
2	Editor Decision Manuscript ID JJI-403 – Sent to Review	12 Mei 2025
3	Editor Decision: Revisions Required and reviewer comment	13 Mei 2025
4	Submit first revised manuscript	13 Mei 2025
5	Editor's comments on first revised manuscript	15 Mei 2025
6	Submit second revised manuscript	15 Mei 2025
7	Article Acceptance Notification	15 Mei 2025
8	APC Payment request from JJI editorial	15 Mei 2025
9	APC Payment Confirmation	15 Mei 2025
10	Copyediting Revision Request from editor JJI	16 Mei 2025
11	Minor revision request from the author on Copyediting results	16 Mei 2025
12	Confirmation of Revision – Figure 2 Adjustment and Unit Correction	16 Mei 2025
13	Response to Revision Confirmation	16 Mei 2025
14	Manuscript Proof for Correction	17 Mei 2025
15	Response to Proof of Manuscript for Correction	17 Mei 2025
16	Article Published Vol 10 issue 2 (19 Mei 2025) on website https://jamu-journal.ipb.ac.id/index.php/JJI/article/view/403 https://jamu-journal.ipb.ac.id/index.php/JJI/article/view/403/205	19 Mei 2025

1. Manuscript Submission

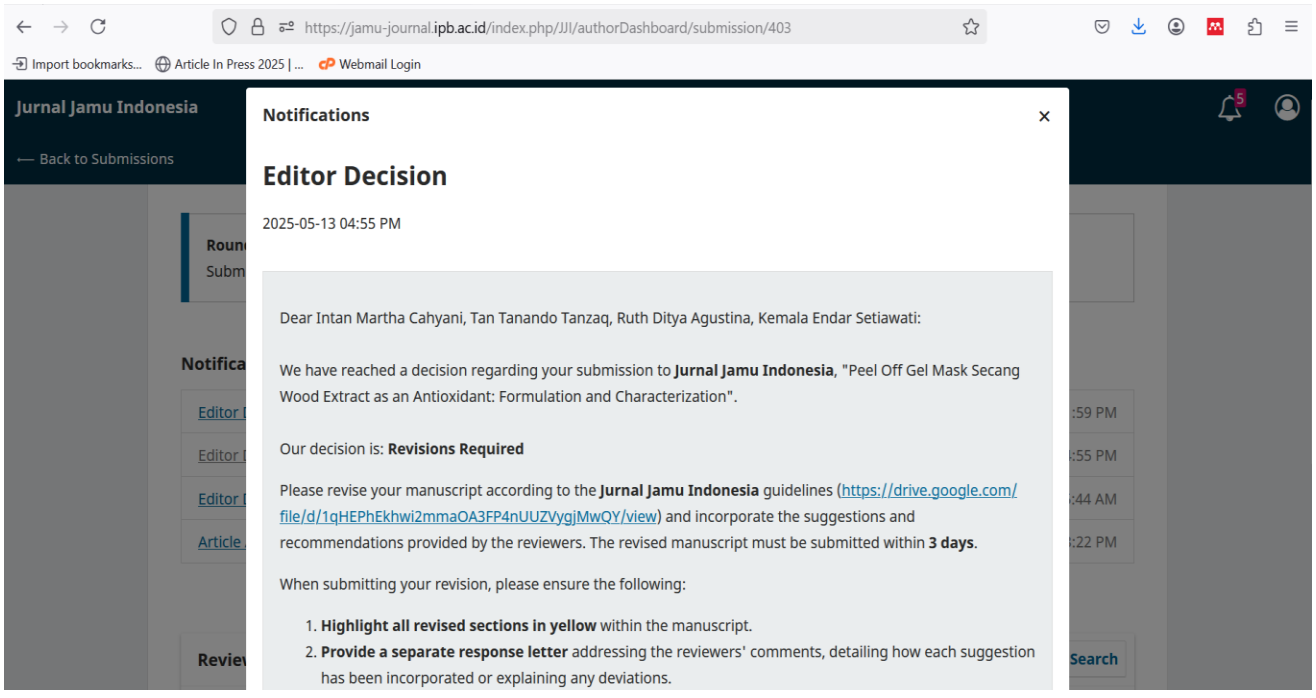


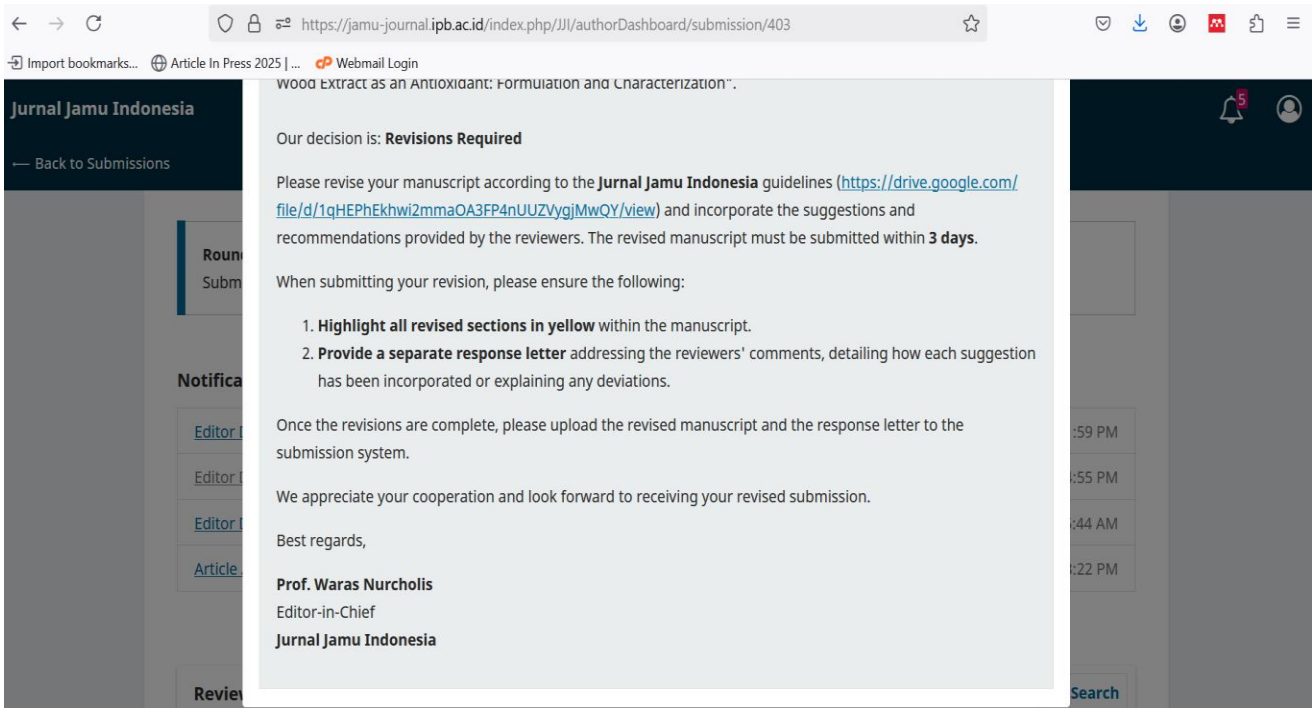
2. Editor Decision Manuscript ID JJI-403 – Sent to Review



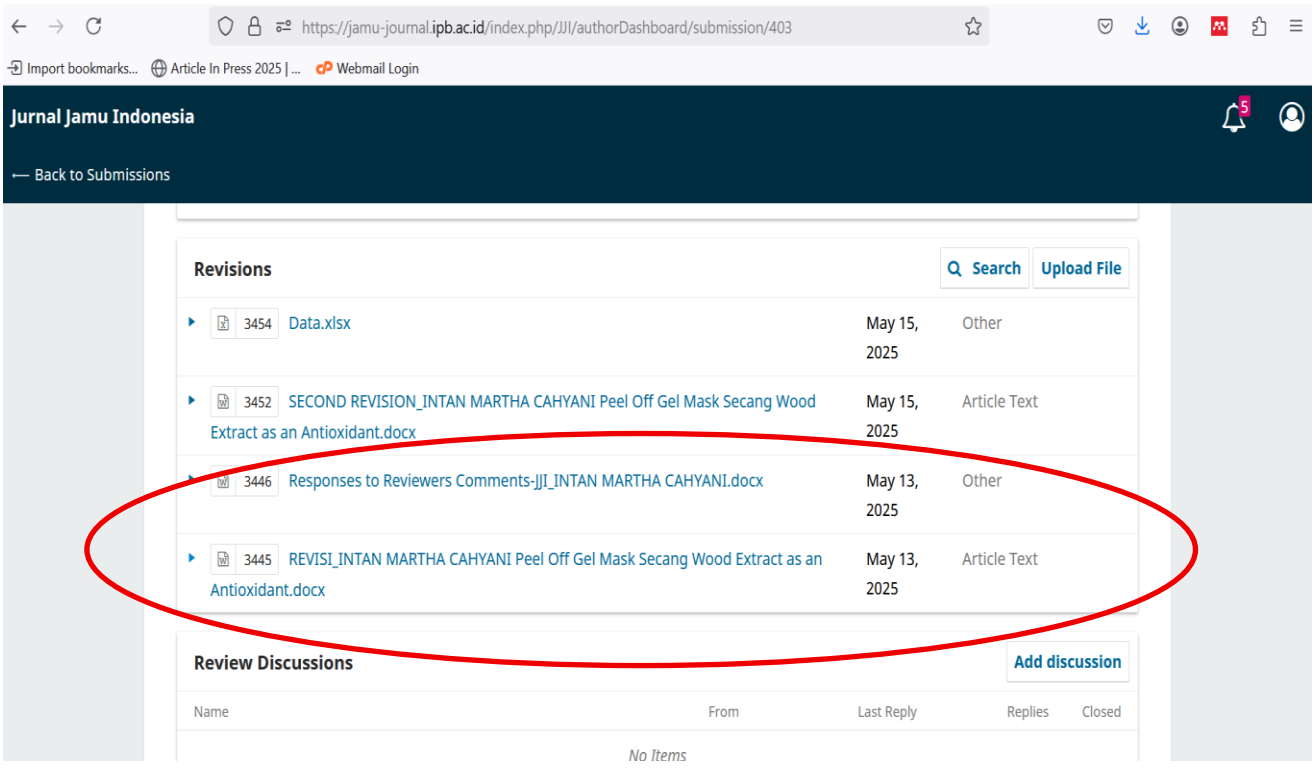


3. Editor Decision: Revisions Required and reviewer comment





4. Submit first revised manuscript



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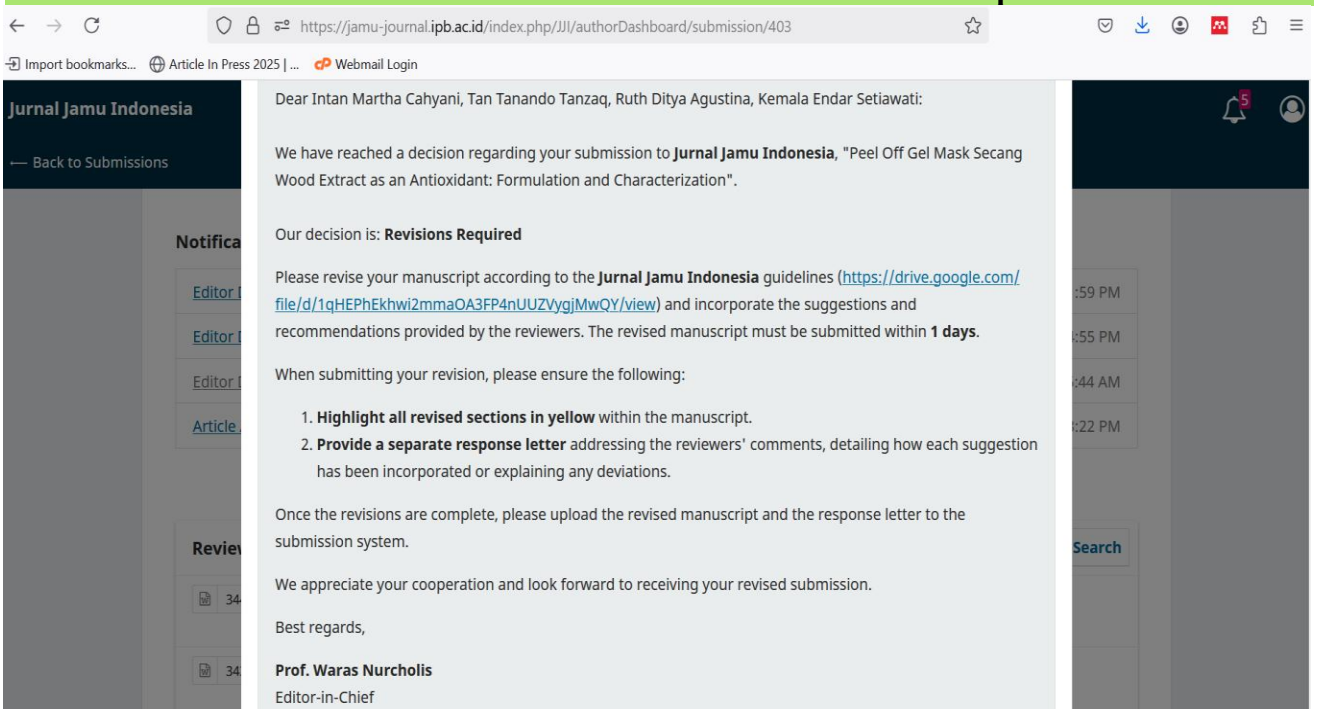

Jurnal Jamu Indonesia

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Once the revisions are complete, please upload the revised manuscript and the response letter to the submission system.

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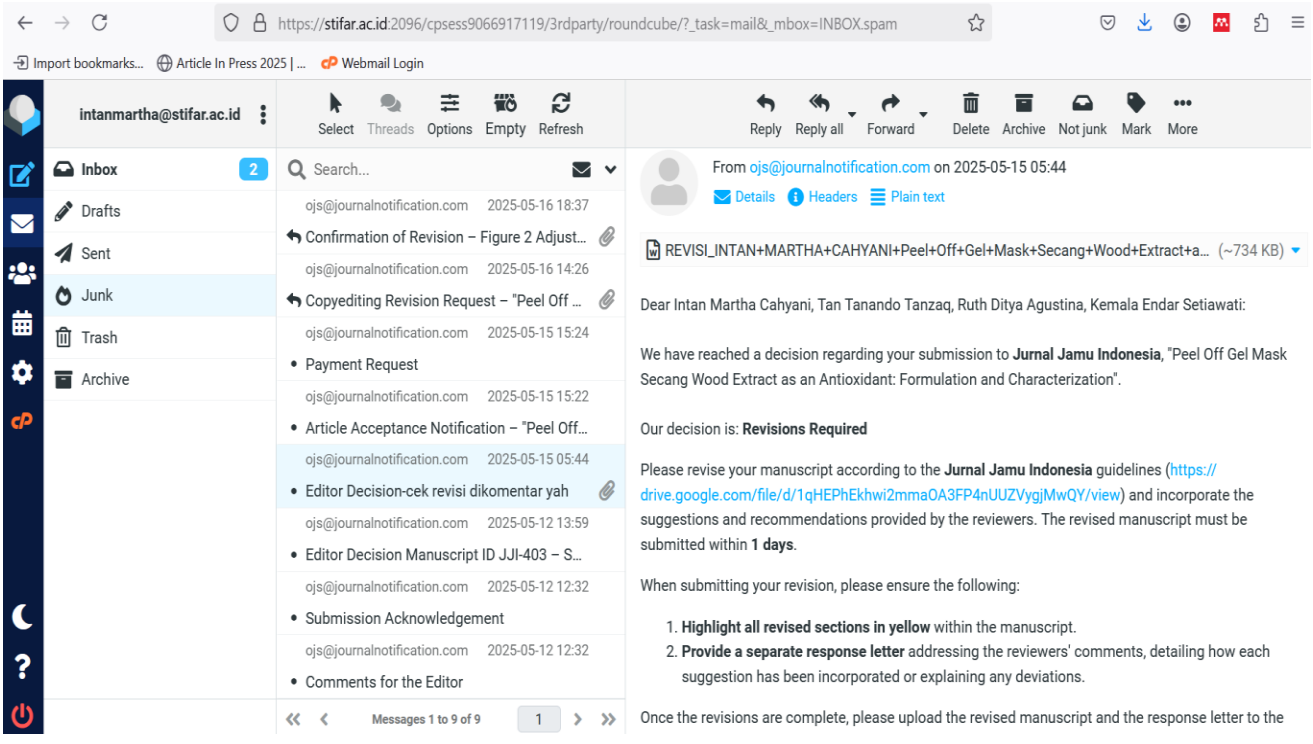
Best regards,

Prof. Waras Nurcholis
Editor-in-Chief



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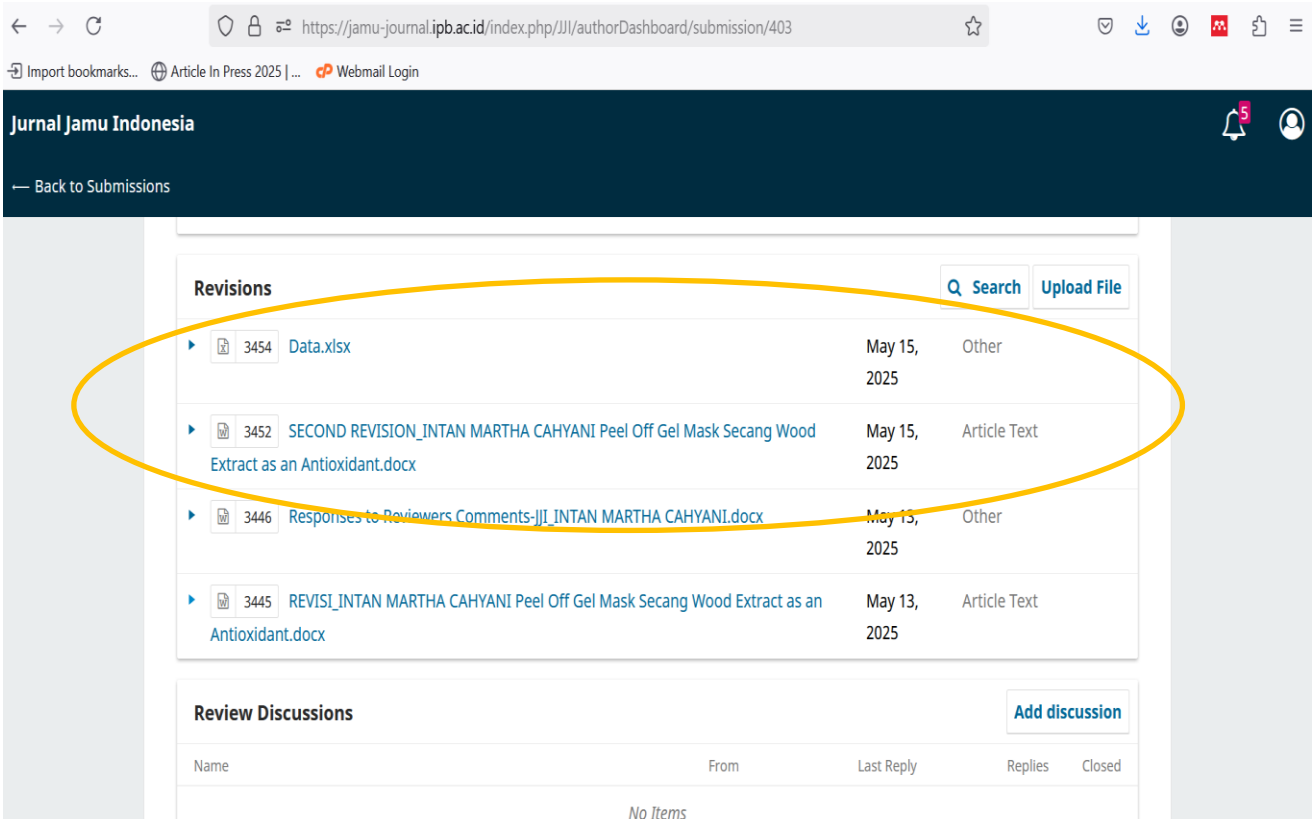
Once the revisions are complete, please upload the revised manuscript and the response letter to the

6. Submit second revised manuscript



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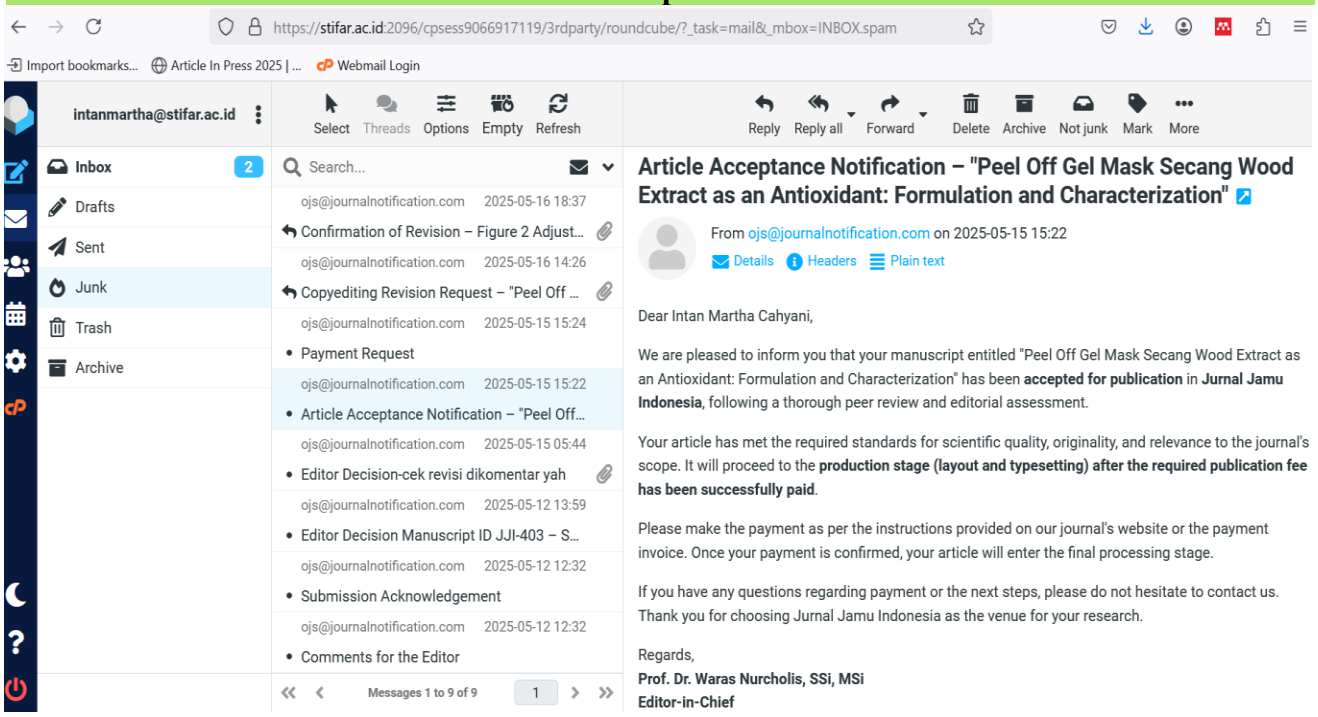

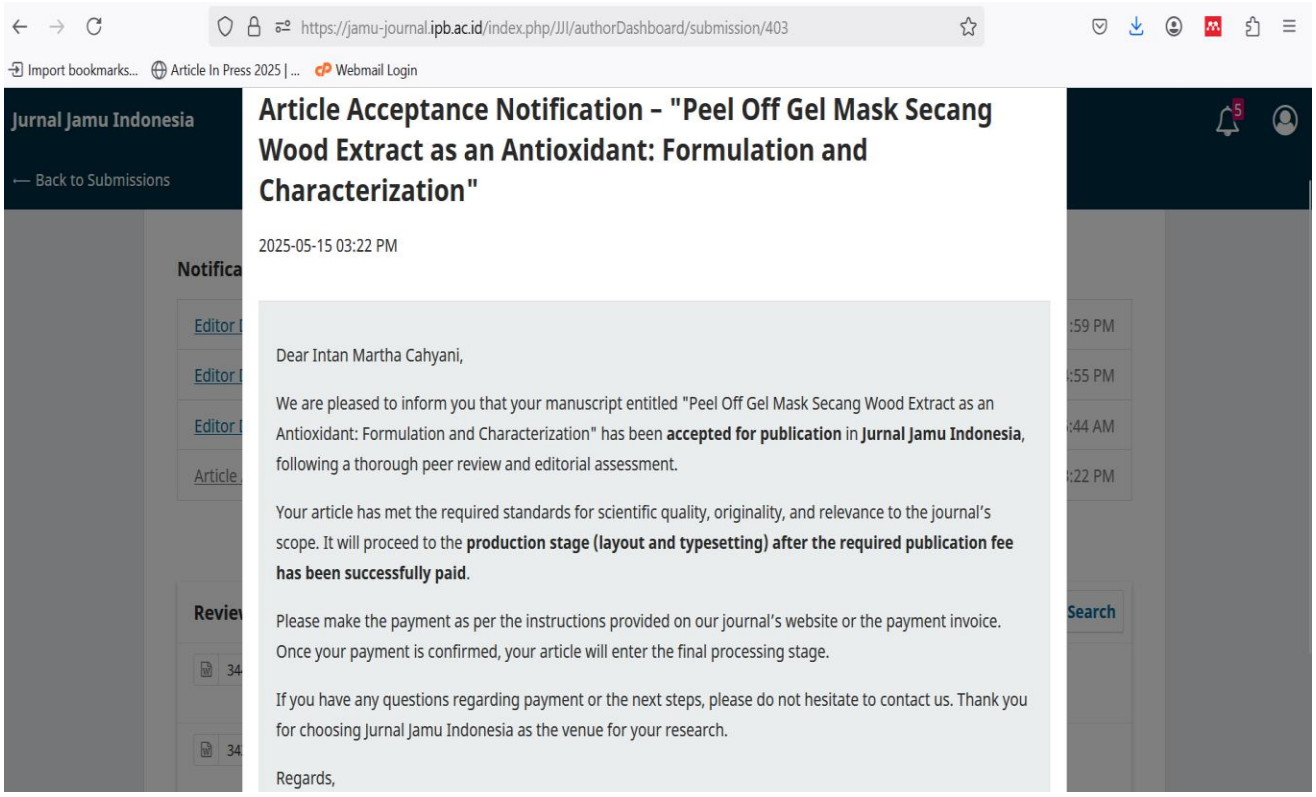

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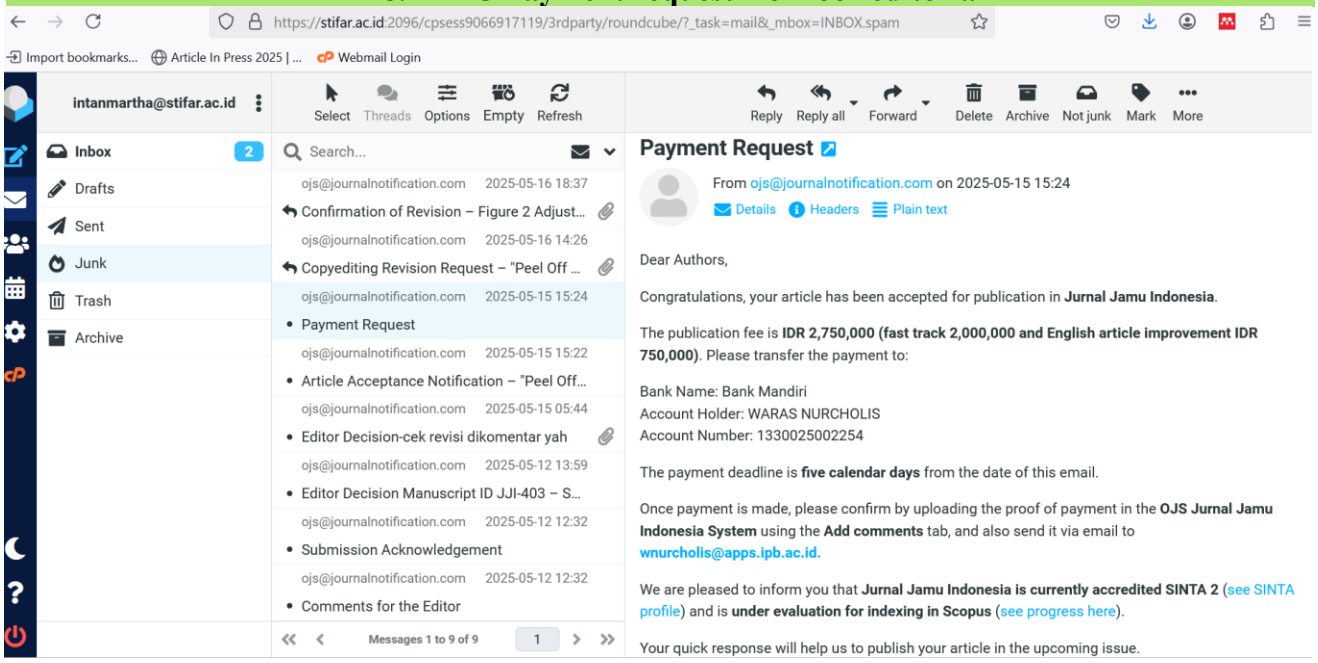

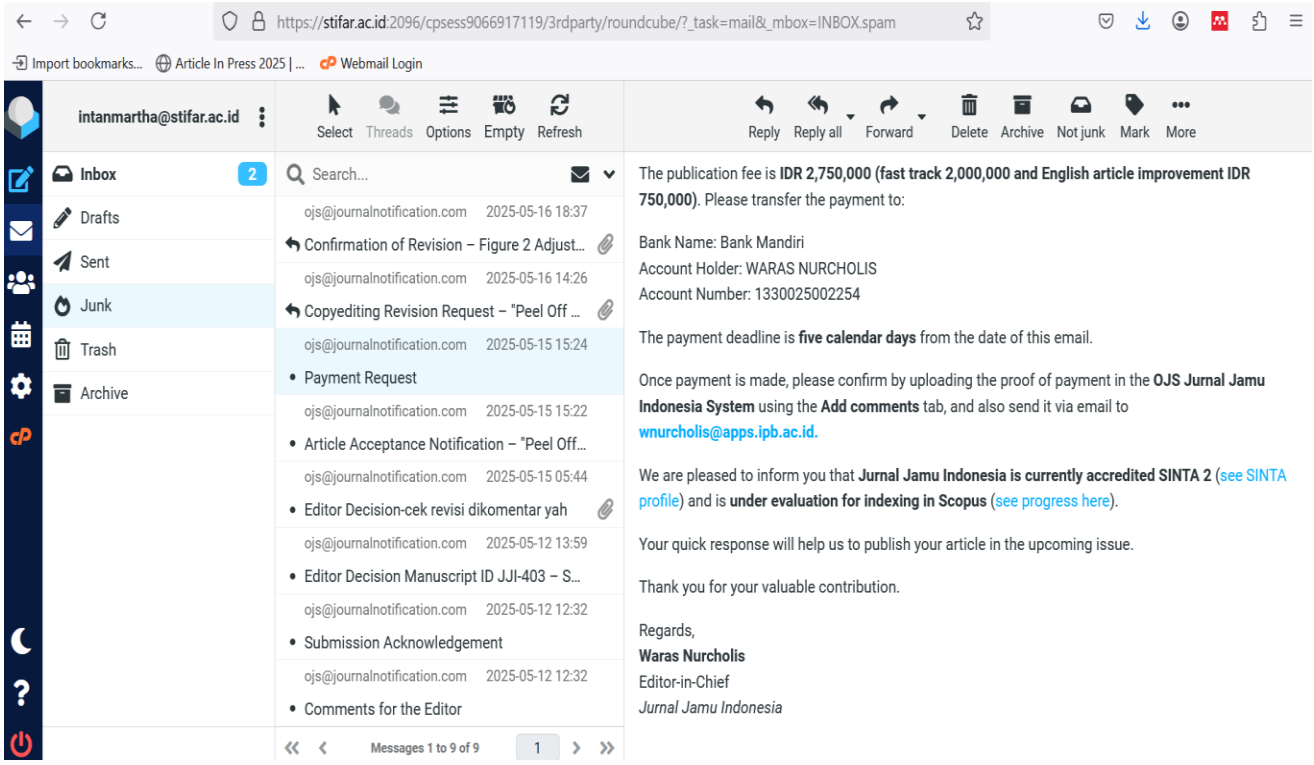
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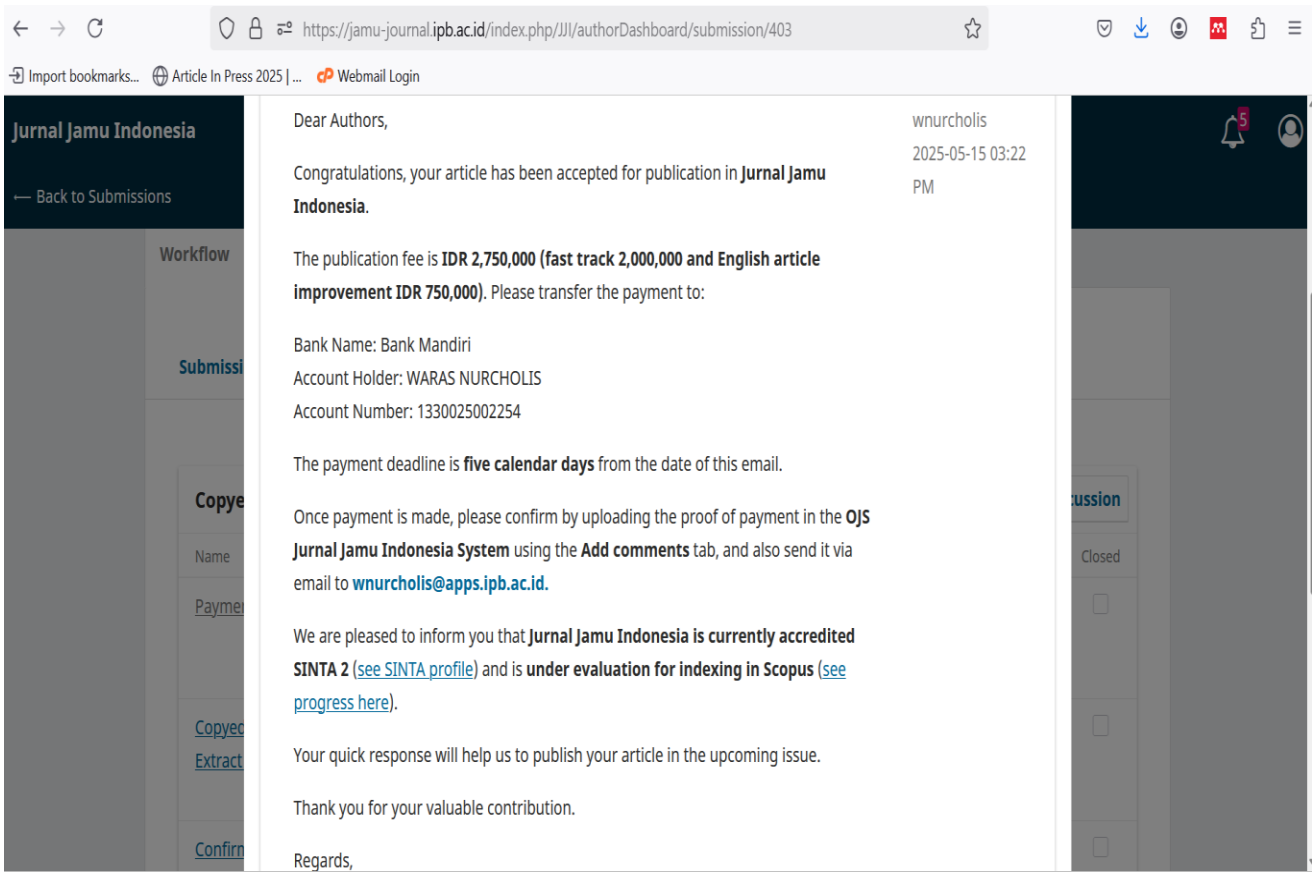
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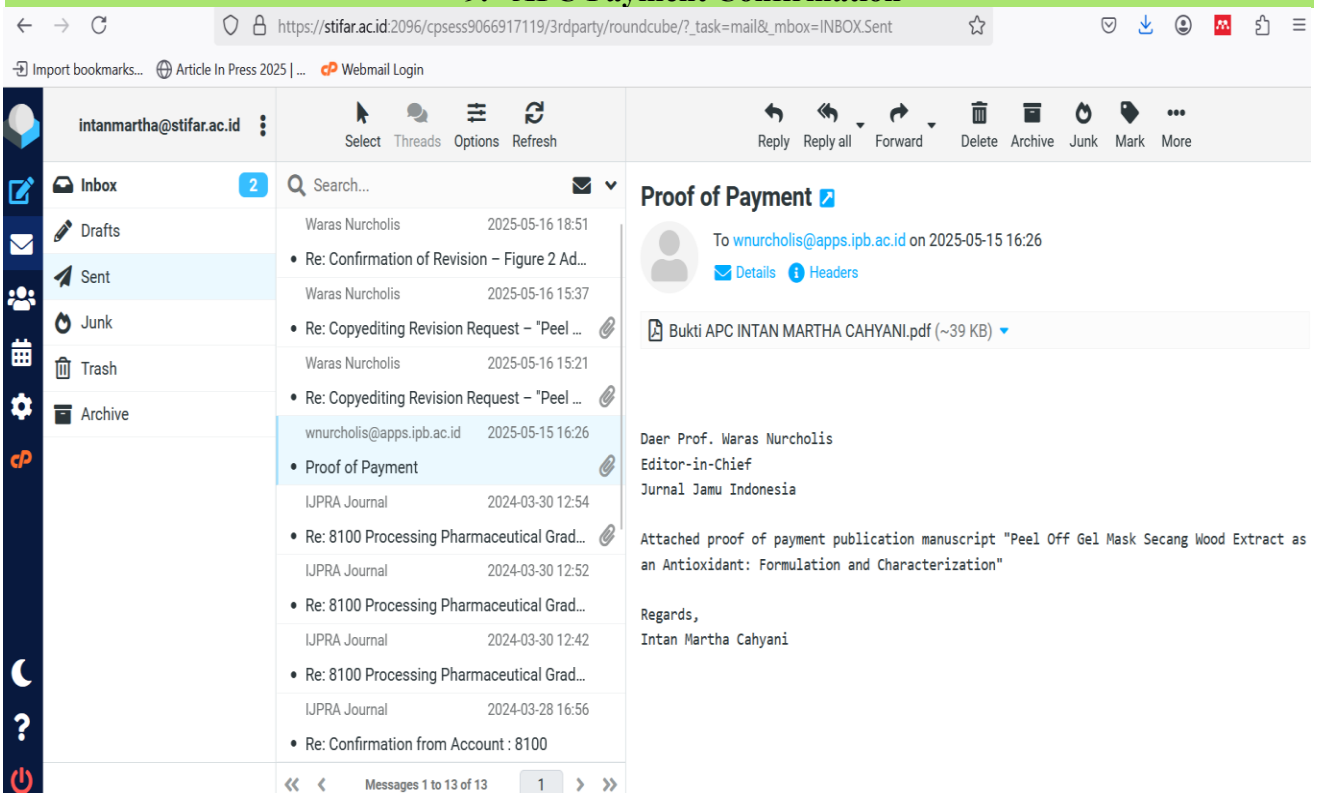

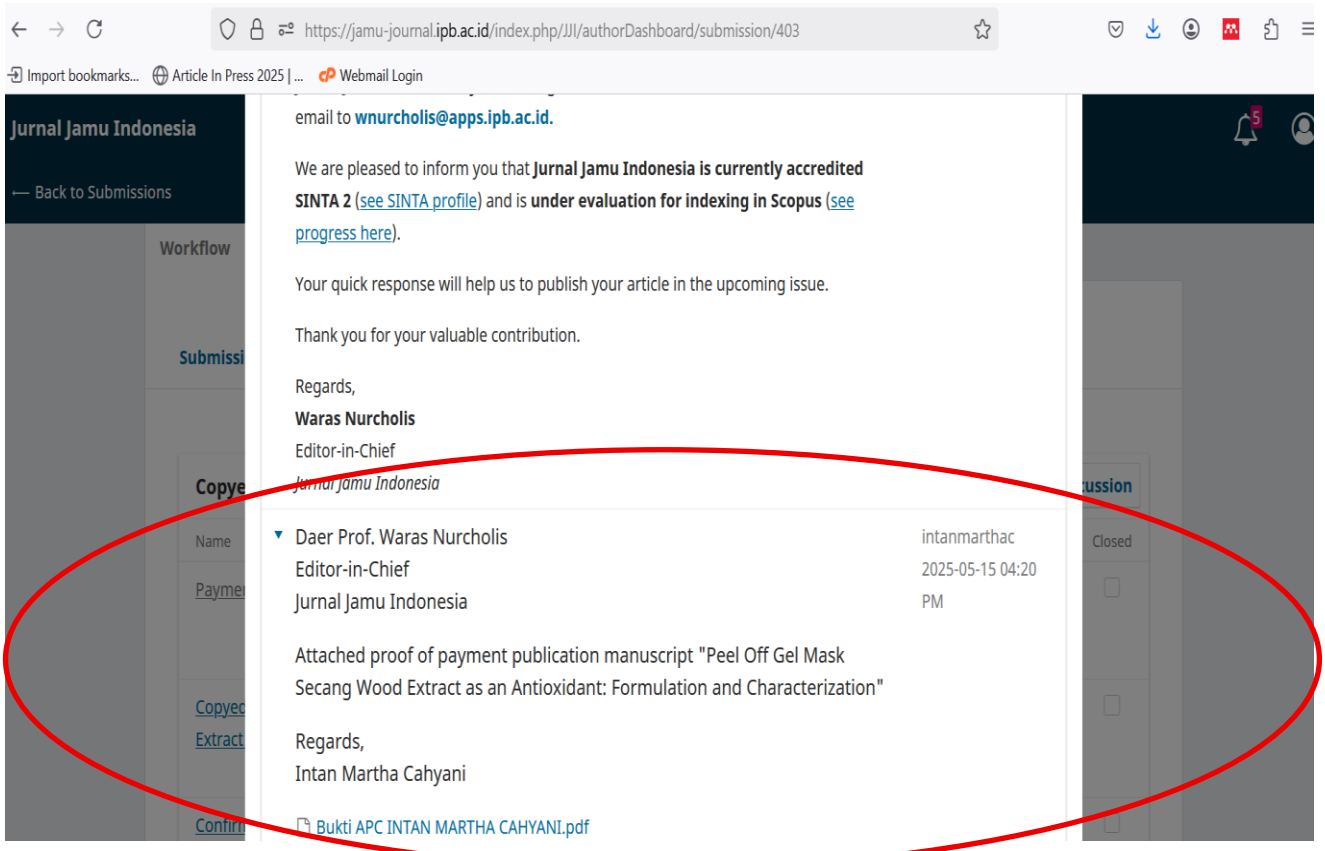

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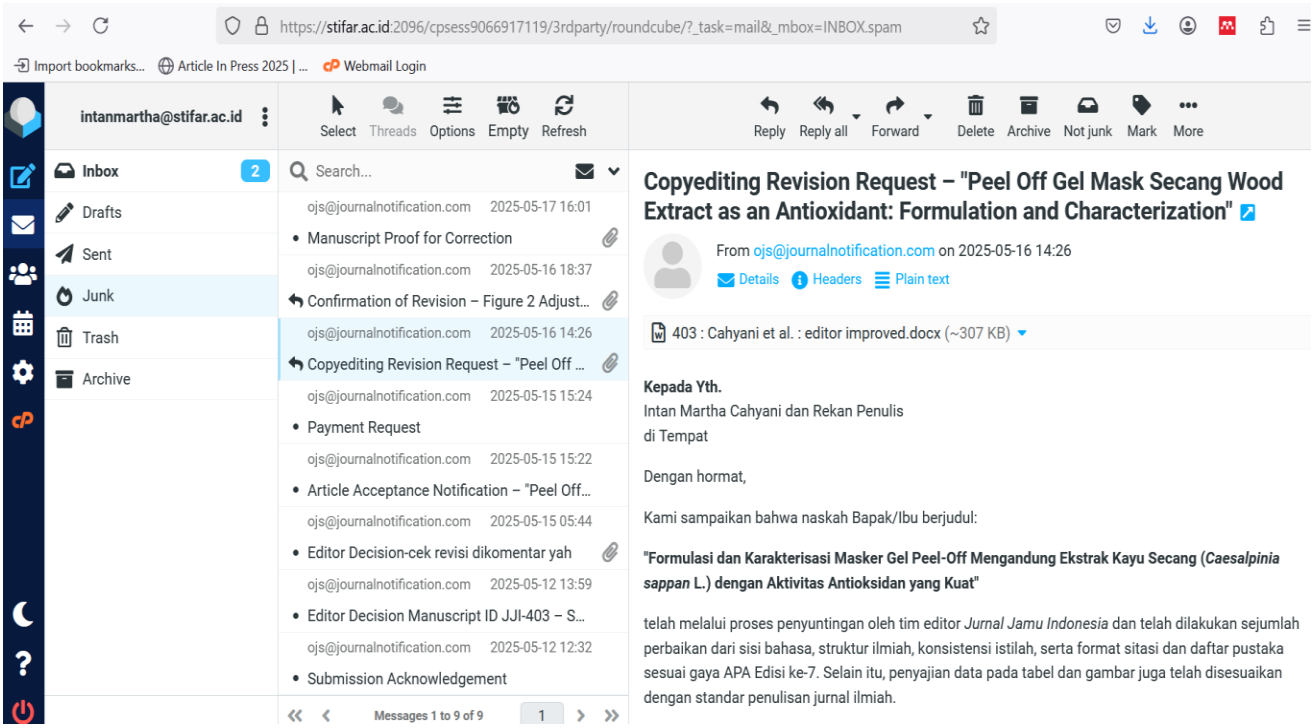

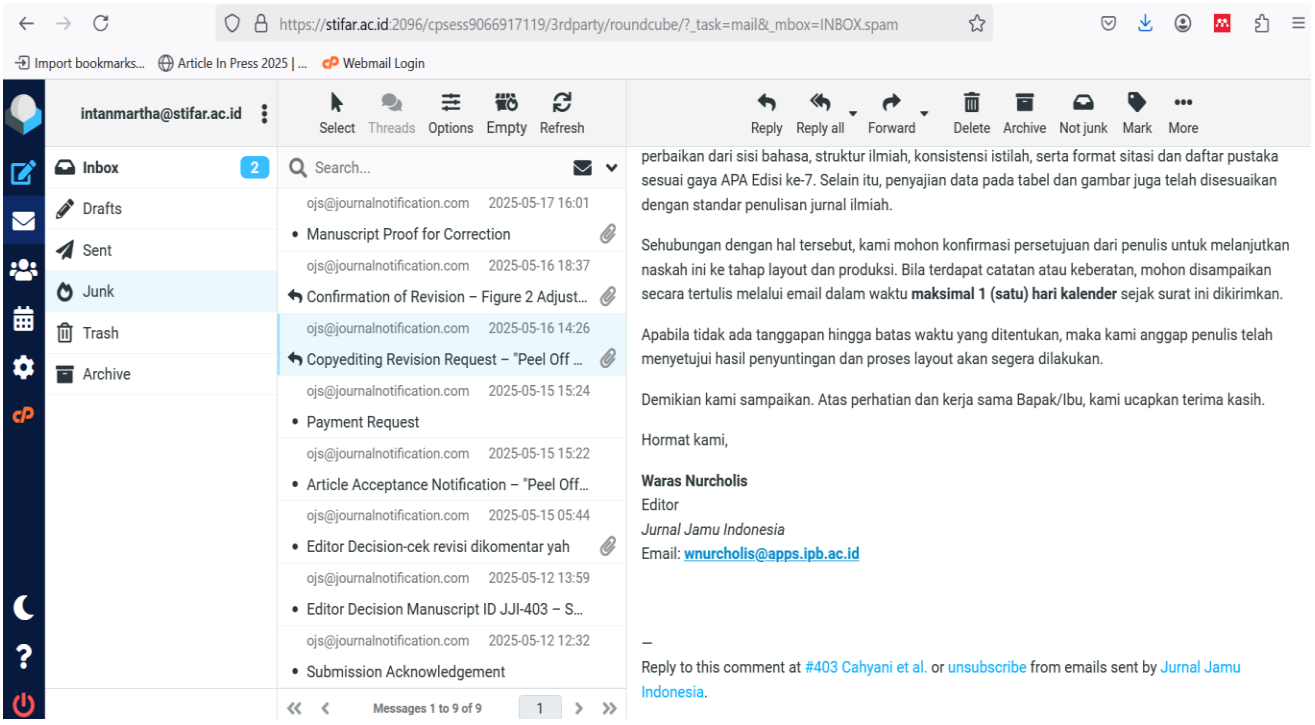

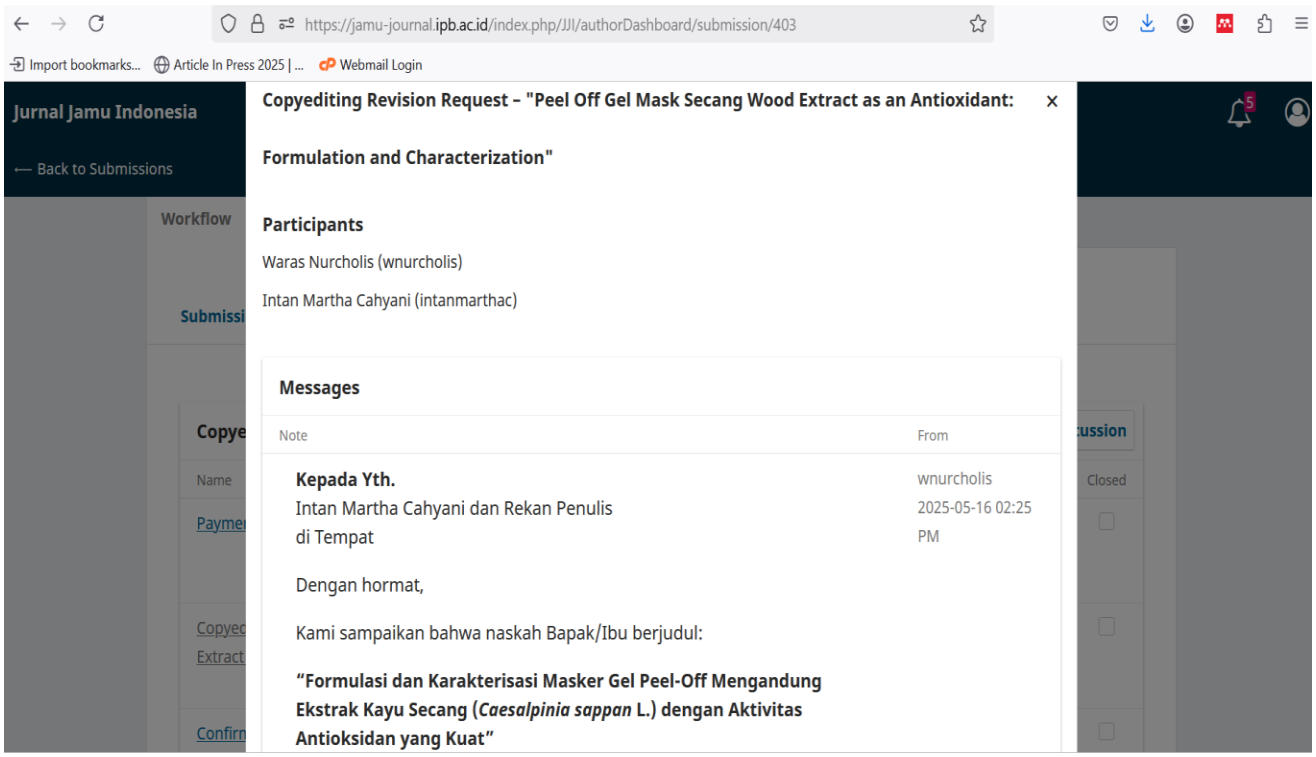
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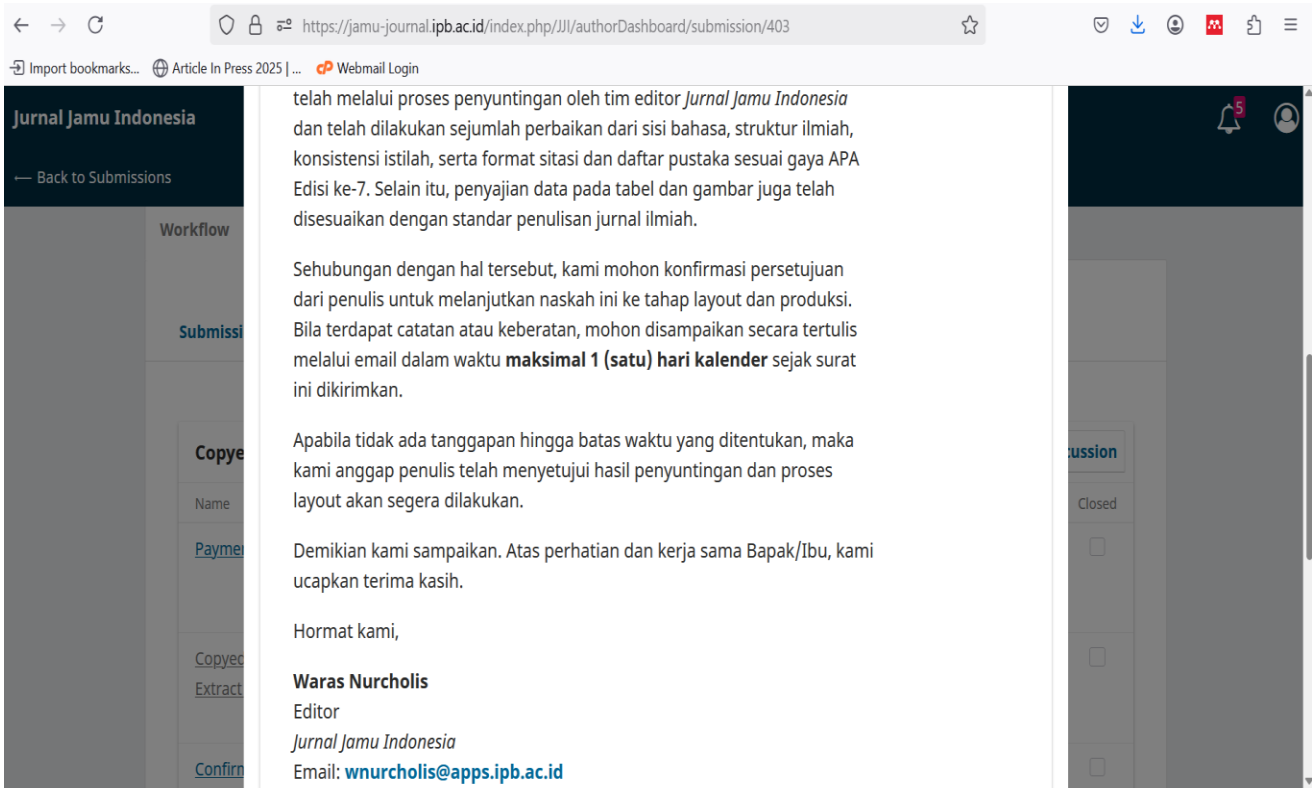
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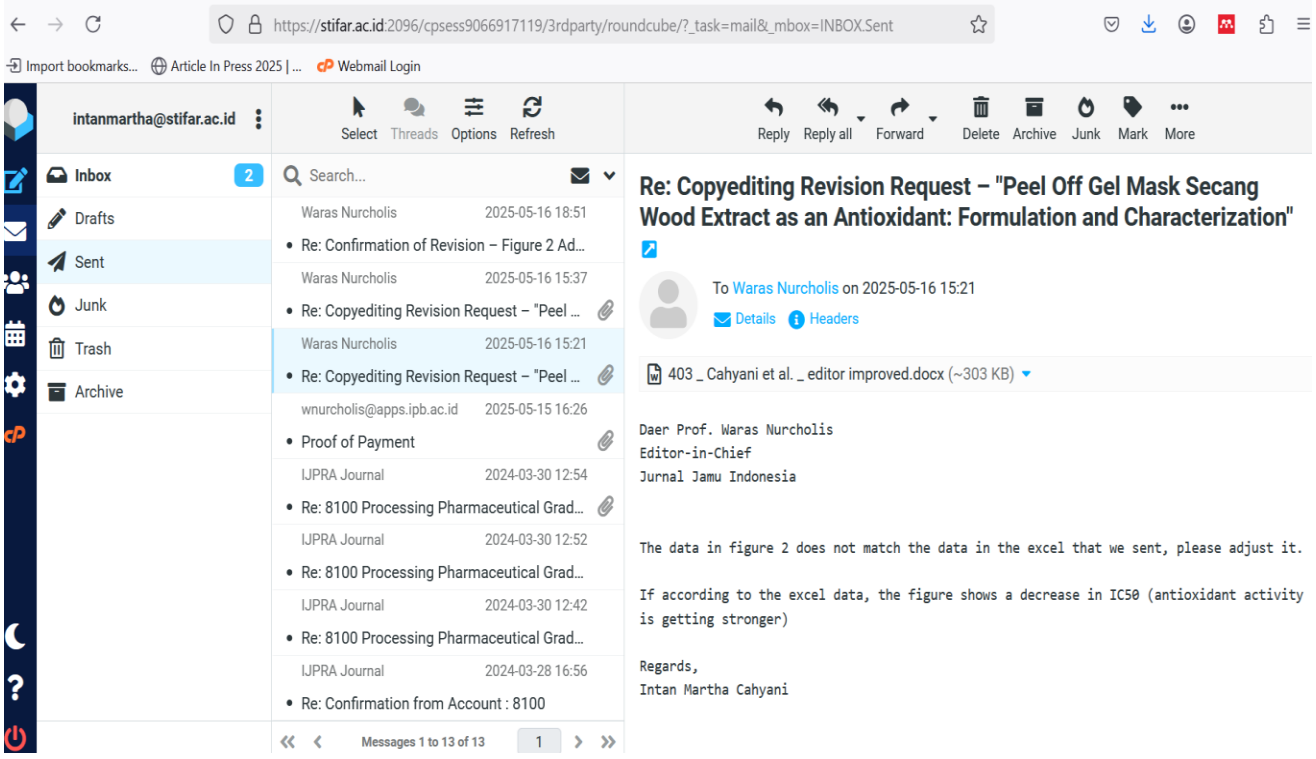
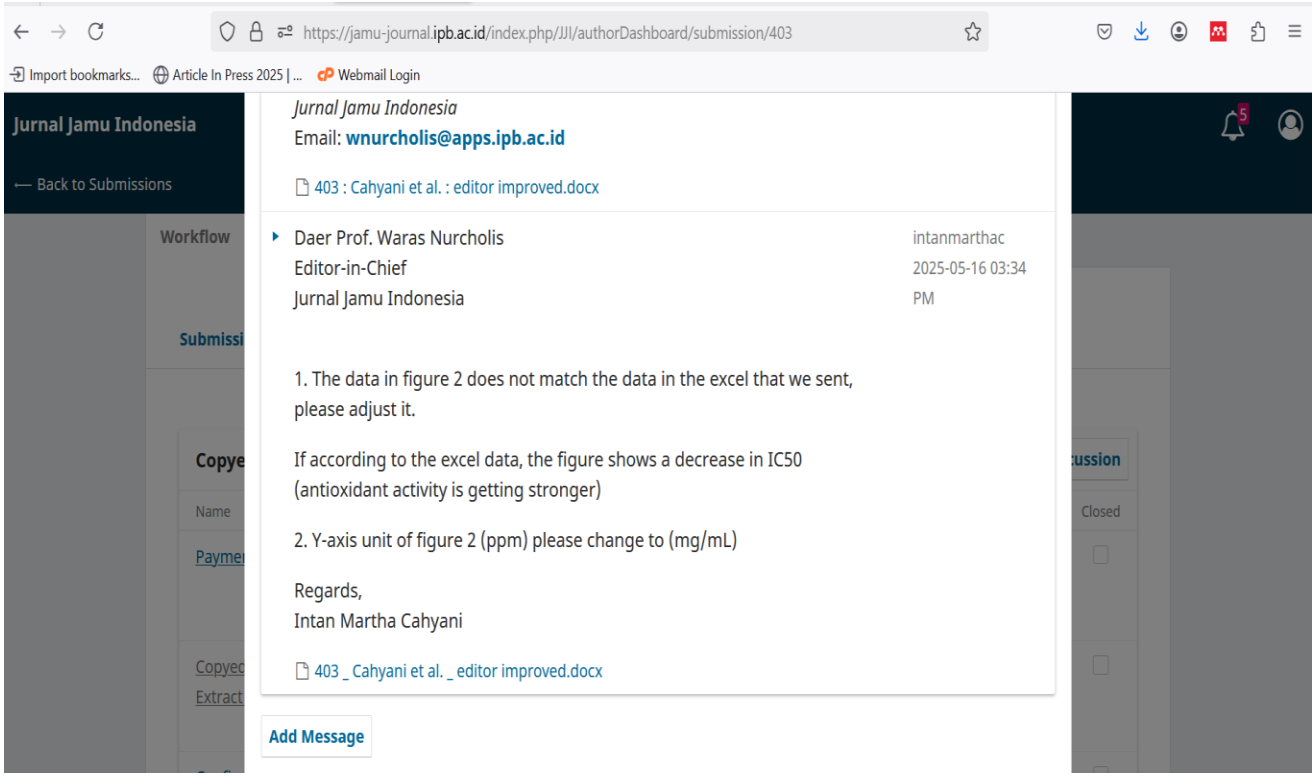
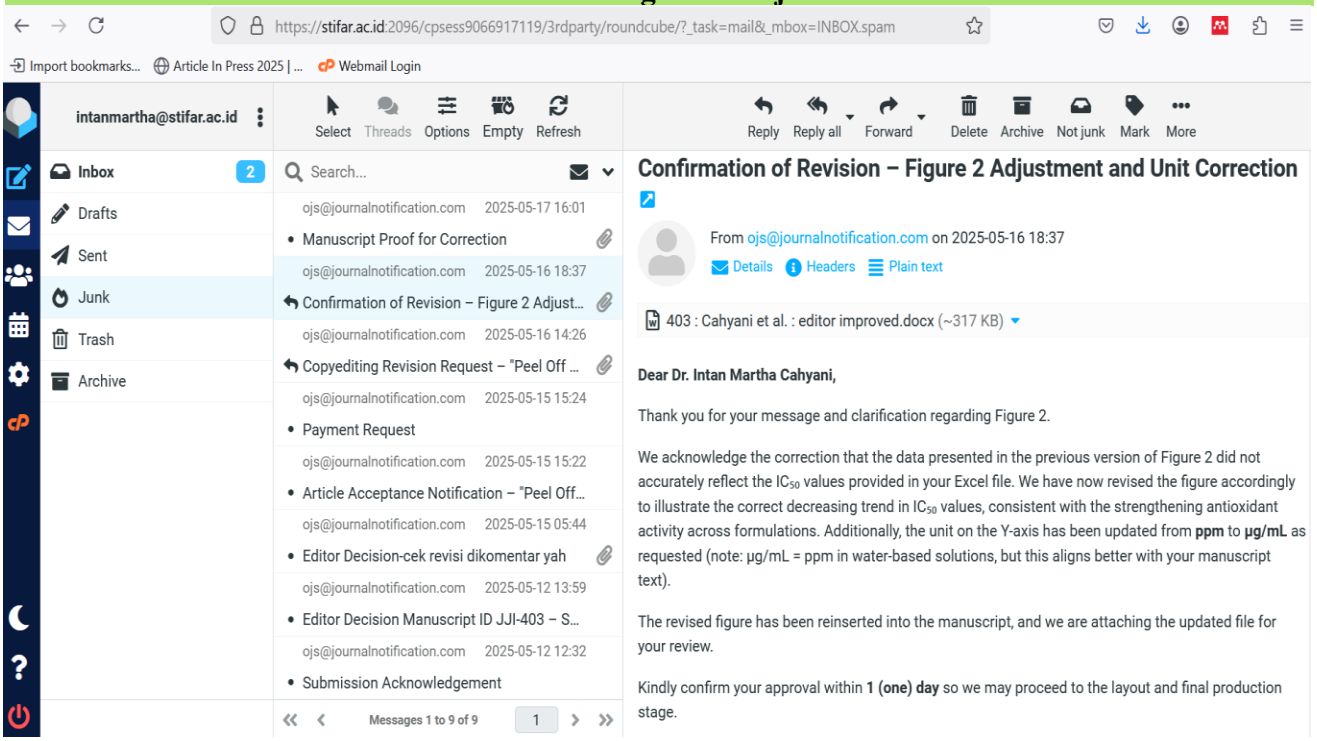
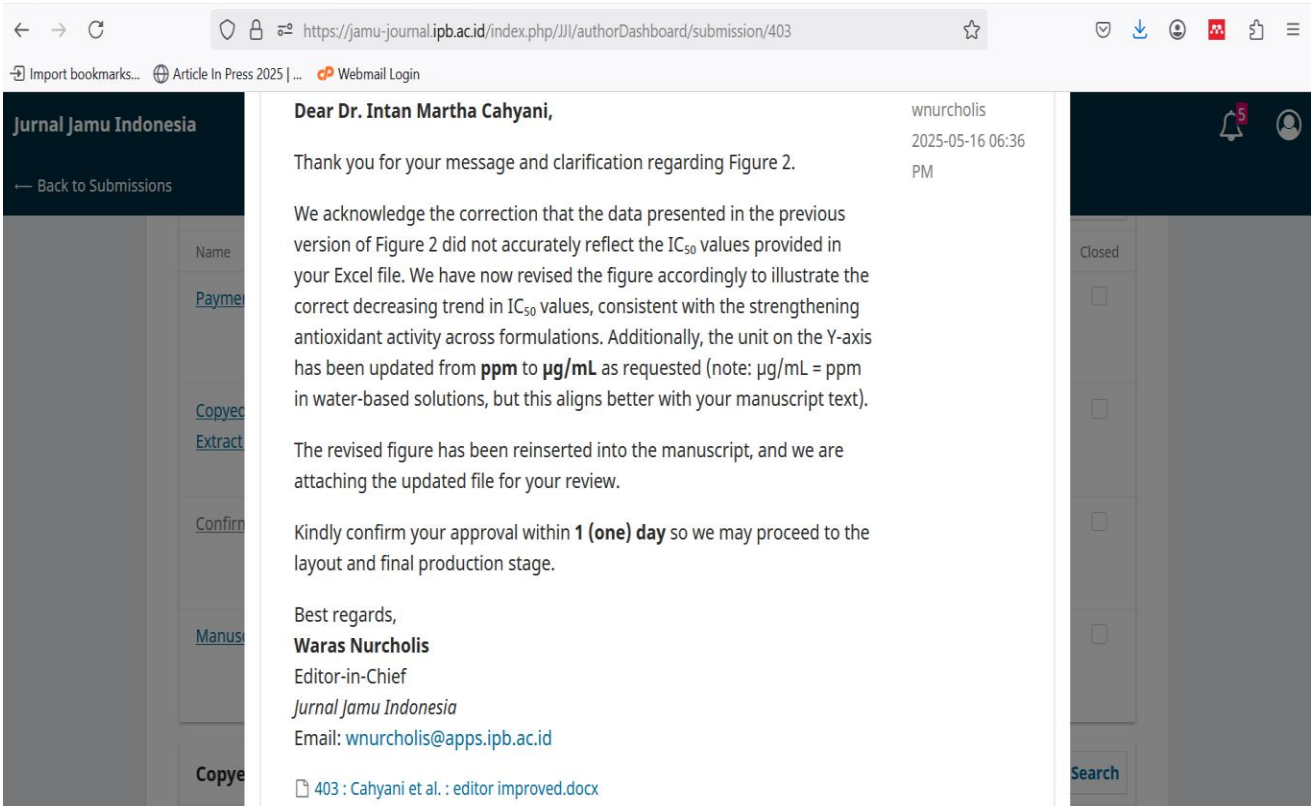




12. Confirmation of Revision – Figure 2 Adjustment and Unit Correction





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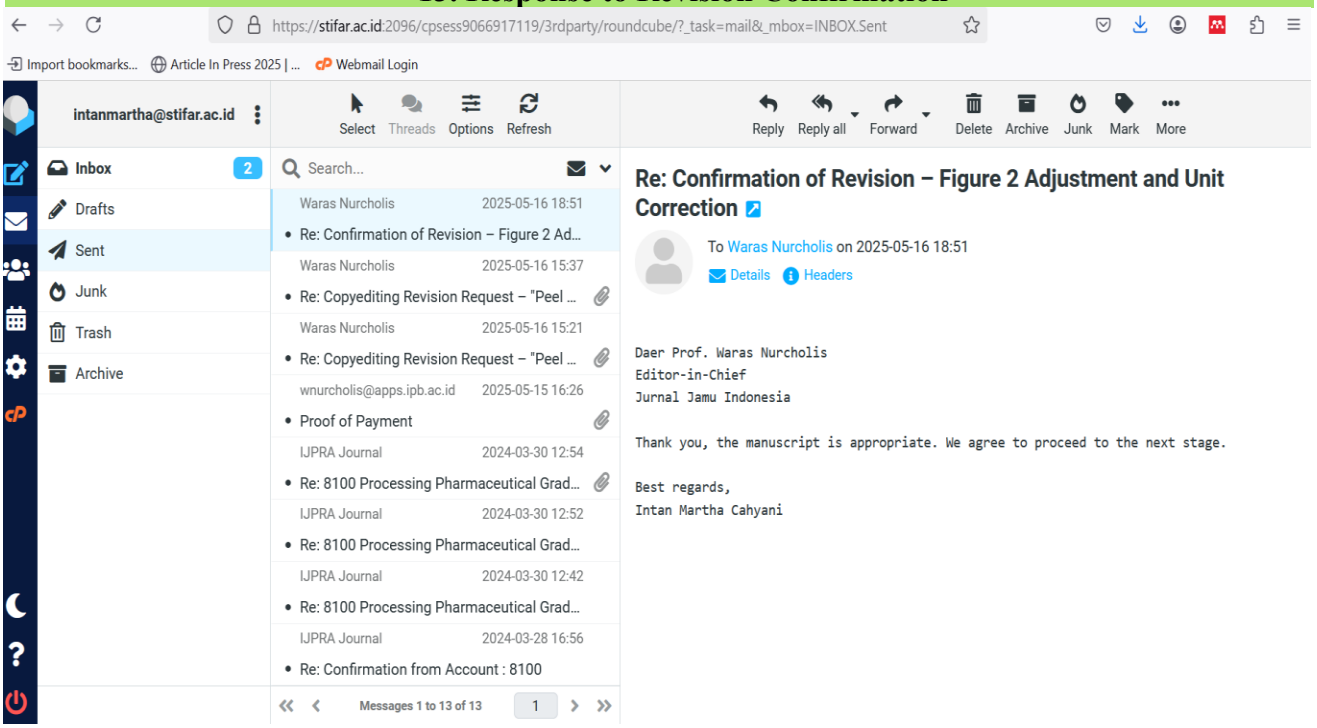

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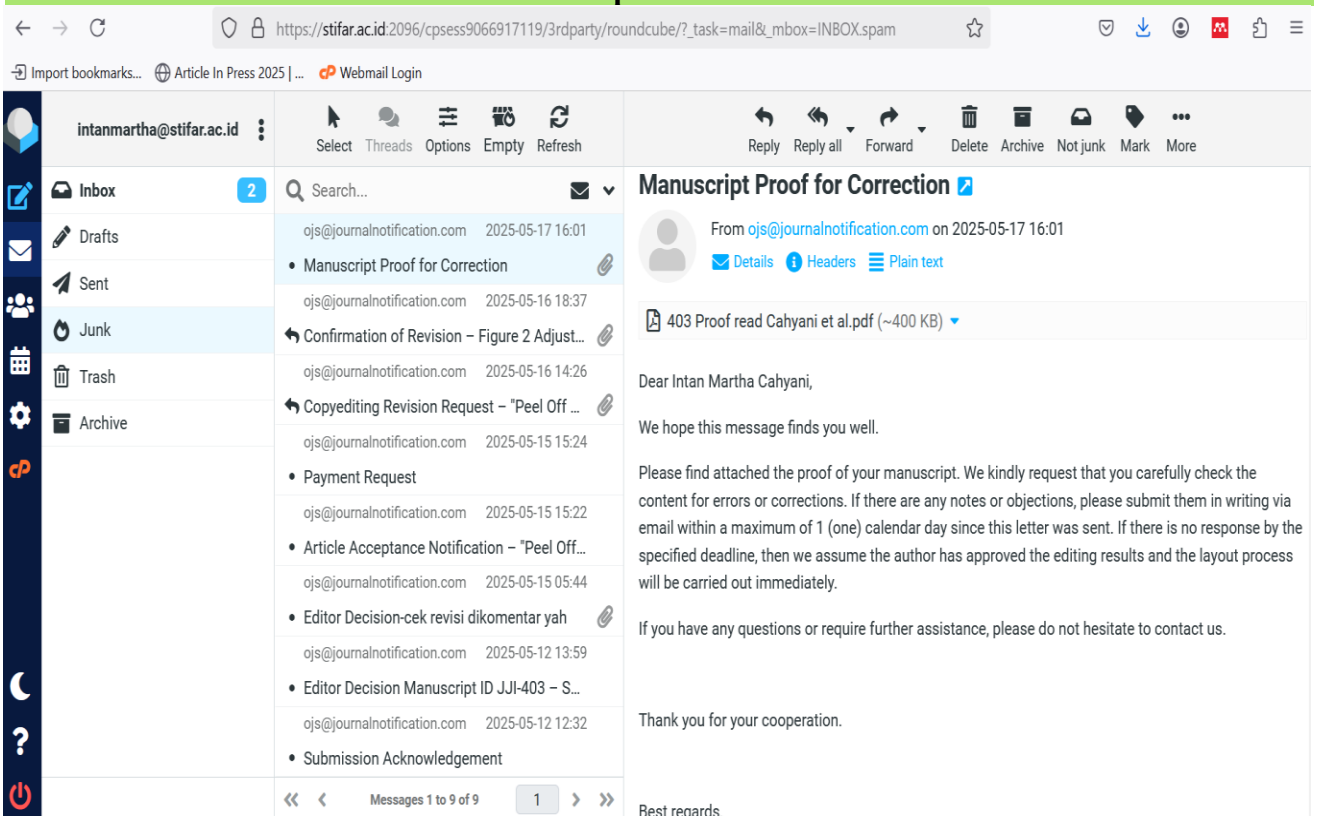

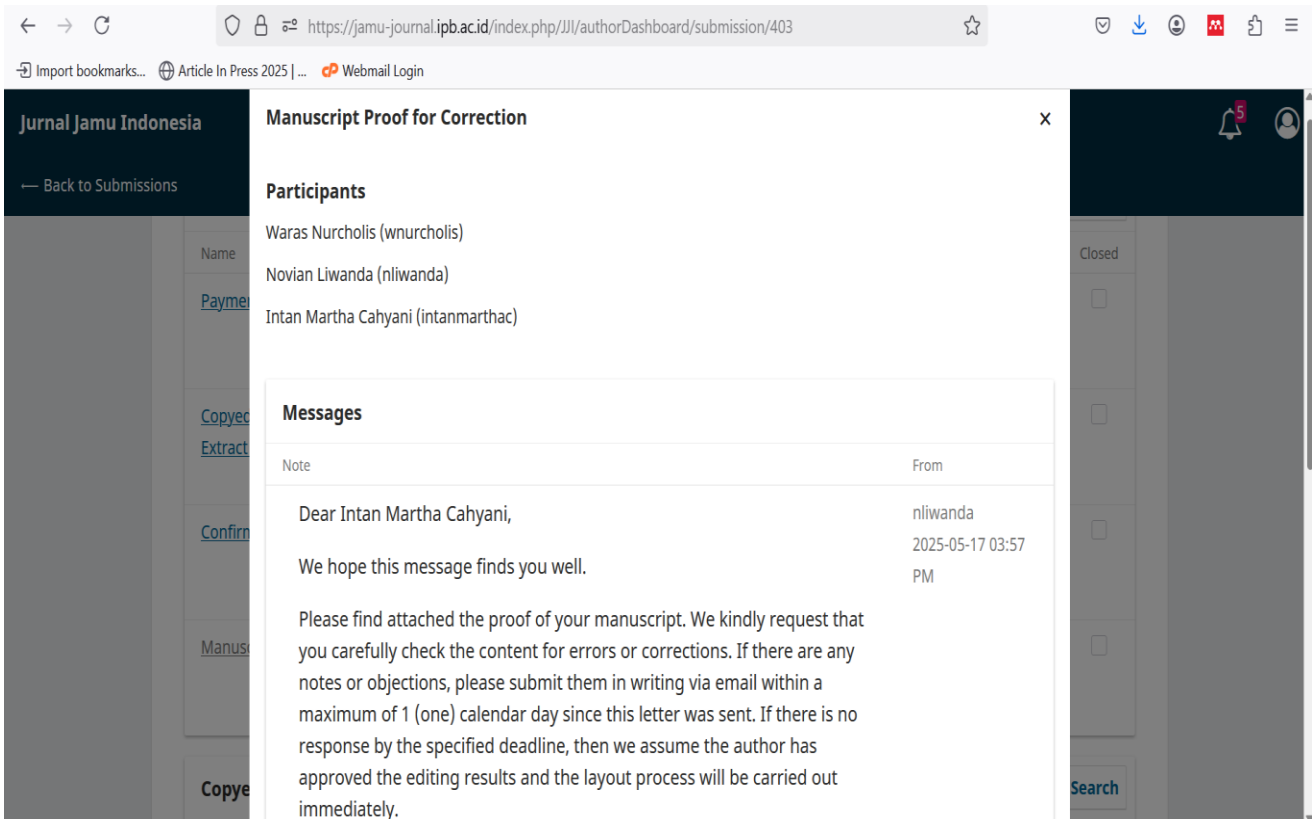
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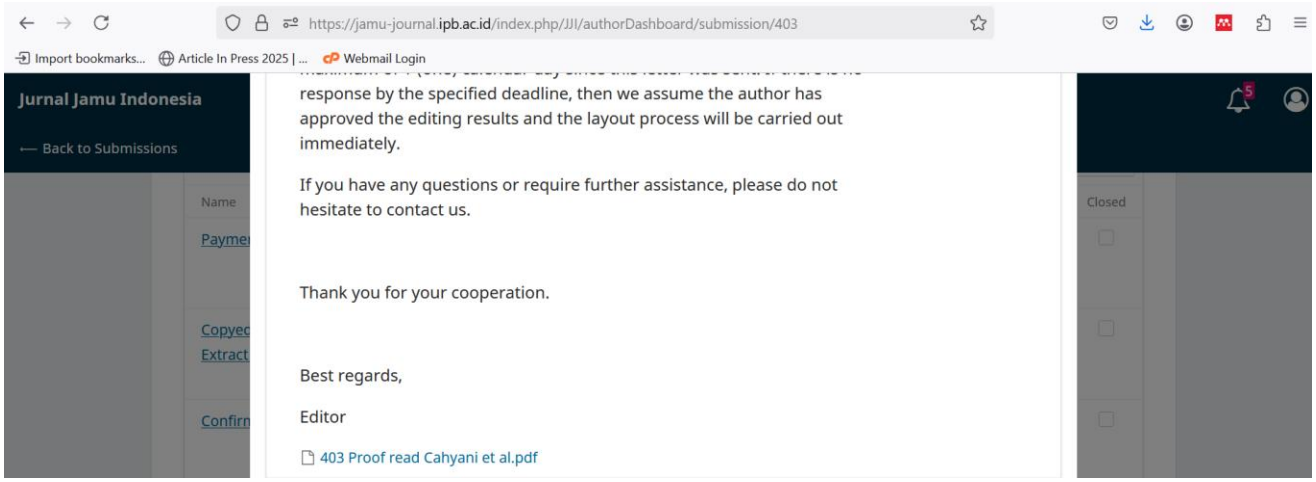
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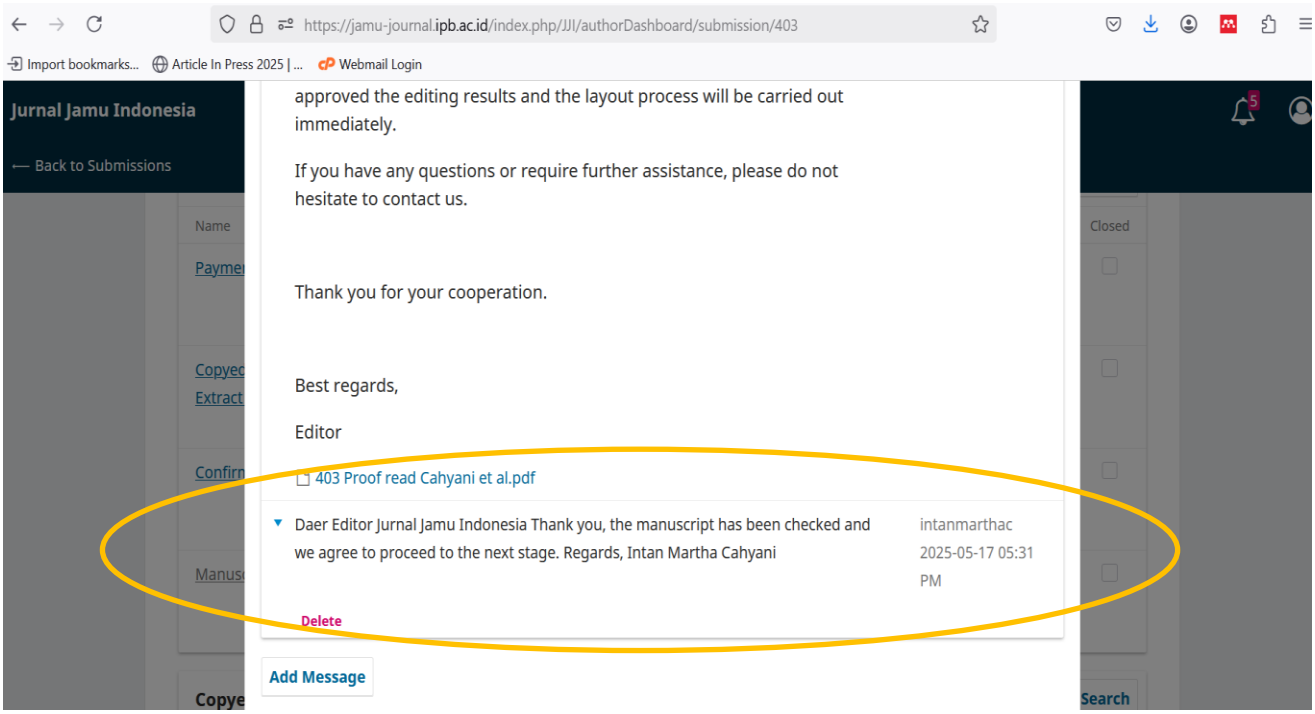

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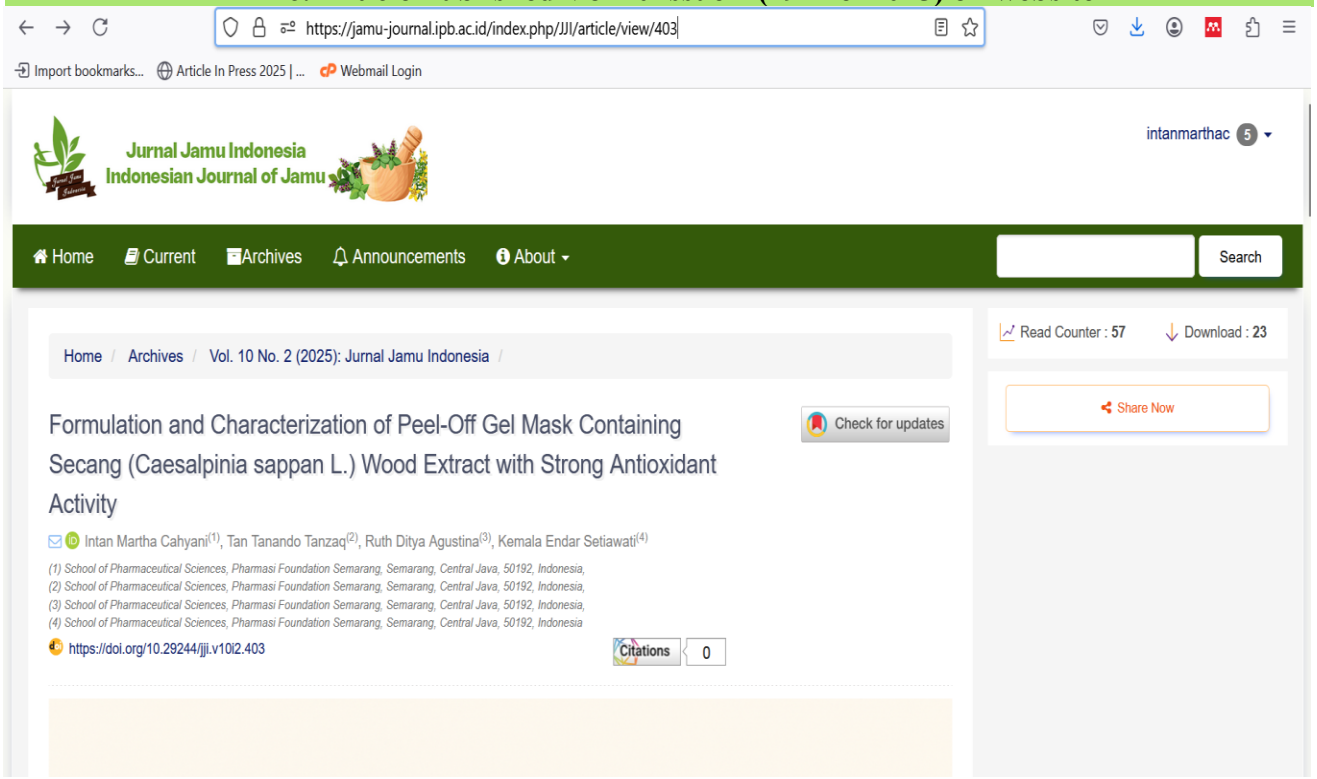

BUKTI KORESPONDENSI MANUSCRIPT SUBMISSION

Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

Intan Martha Cahyani[1*], Tan Tanando Tanzaq[1], Ruth Ditya Agustina[1], Kemala Endar Setiawati[1]
[1]Stifar Yayasan Pharmasi, Letjend Sarwo Edie Wibowo KM 1, Semarang, 50192, Indonesia
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Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} value of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3’-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat

menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dengan nilai IC_{50} ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

Secang wood contains active compounds of the flavonoid group which can be used as primary antioxidants or secondary antioxidants. The presence of brazilin components in secang wood has the effect of protecting the body from poisoning due to free radicals (Rina et al., 2012). Has reliable antioxidant power with a higher antioxidant index than commercial antioxidants (BHT and BHA) so it has the potential as a free radical scavenging agent (Sugiyanto et al., 2013). Secang wood extract has been proven effective as an antioxidant with an IC_{50} value of 74,44 μg/mL (Tanzaq et al., 2019).

Mask is one of the cosmetics for facial skin care. However, the use of masks is generally less efficient. The demands of market needs with today's lifestyle are not only effective but easy, comfortable and flexible in their use. Peel off gel mask is the result of the development of facial skin care products that can answer these challenges (Ningsih et al., 2016). Peel off gel mask is a type of facial mask that has the advantage of being easy to remove or lift like an elastic membrane (Rahmawanty et al., 2015). Several studies have proven that peel off gel mask preparations can increase the effectiveness of antioxidants, including Paedaria fotida extract (Eka et al., 2022), areca seed extract (Dwi Mulyani et al., 2023), red spinach leaves extract (Welly et al., 2022) and mangrove leaves extract (Hasibuan et al., 2024).

2. Methods

2.1 Materials and Tools

The materials used in this study were secang wood, ethanol 96% (Merck), Sodium Carboxymethyl Cellulose (CMC Na), Polyvinil Alcohol (PVA), propilenglicol, vitamin C dan 1,1-difenil-2-pikrilhidrazil (DPPH) .

The tools used in this study were rotary evaporator (Heidolph), alat-alat gelas (Pyrex), pH meter (Hanna Instrument pH 210 Microprocessor), viskometer (Brookfield DV-I Prime), and spektrofotometer UV-Vis mini 1240 (Shimadzu).

2.2 Sengon Wood Extraction

The extraction method used is maceration by soaking secang wood powder using 96% ethanol solvent with a ratio of 1:10. Extraction is carried out for 3x24 hours. The filtrate obtained is then evaporated with a rotary evaporator until a thick extract is obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel Off Gel Masker Secang Wood Extract

Peel-off gel mask of secang wood extract was made by developing PVA and CMC Na (Table 1) in hot distilled water until fully expanded. PVA mass plus expanded propylene glycol and CMC Na was stirred until homogeneous. Ethanol extract of secang wood was added little by little into the peel-off gel mask base, distilled water was added until the weight of the preparation was 100% and stirred until homogeneous (Cahyani et al., 2025).

2.4 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Organoleptic

Observations were made on the color, odor, and dosage form of the Peel Off Gel Mask Secang Wood Extract (Syam et al., 2021).

Homogeneity

Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results

of determining the operating time. The same stage was also carried out on vitamin C solutions with concentrations of 2.4,6,8,10 μg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure 1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e) (Cahyani et al., 2025).

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value (Table 2) so it can be said that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of sengon wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008)

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous
pH	6.4 ± 0.16	5.85 ± 0.43	5.09 ± 0.35
Viscosity (cPs)	11986.4 ± 6.02	13992.6 ± 5.13	15993.2 ± 5.36
Spreadability (cm)	5.6 ± 0.19	5.18 ± 0.33	4.52 ± 0.33
Adhesion (secon)	3.5 ± 0.13	4.2 ± 0.16	4.85 ± 0.04
Drying Time (minute)	16.06 ± 0.39	17.88 ± 0.38	19.45 ± 0.40
IC_{50} (µg/mL)	88.71 ± 2.06	81.58 ± 3.60	79.04 ± 1.84

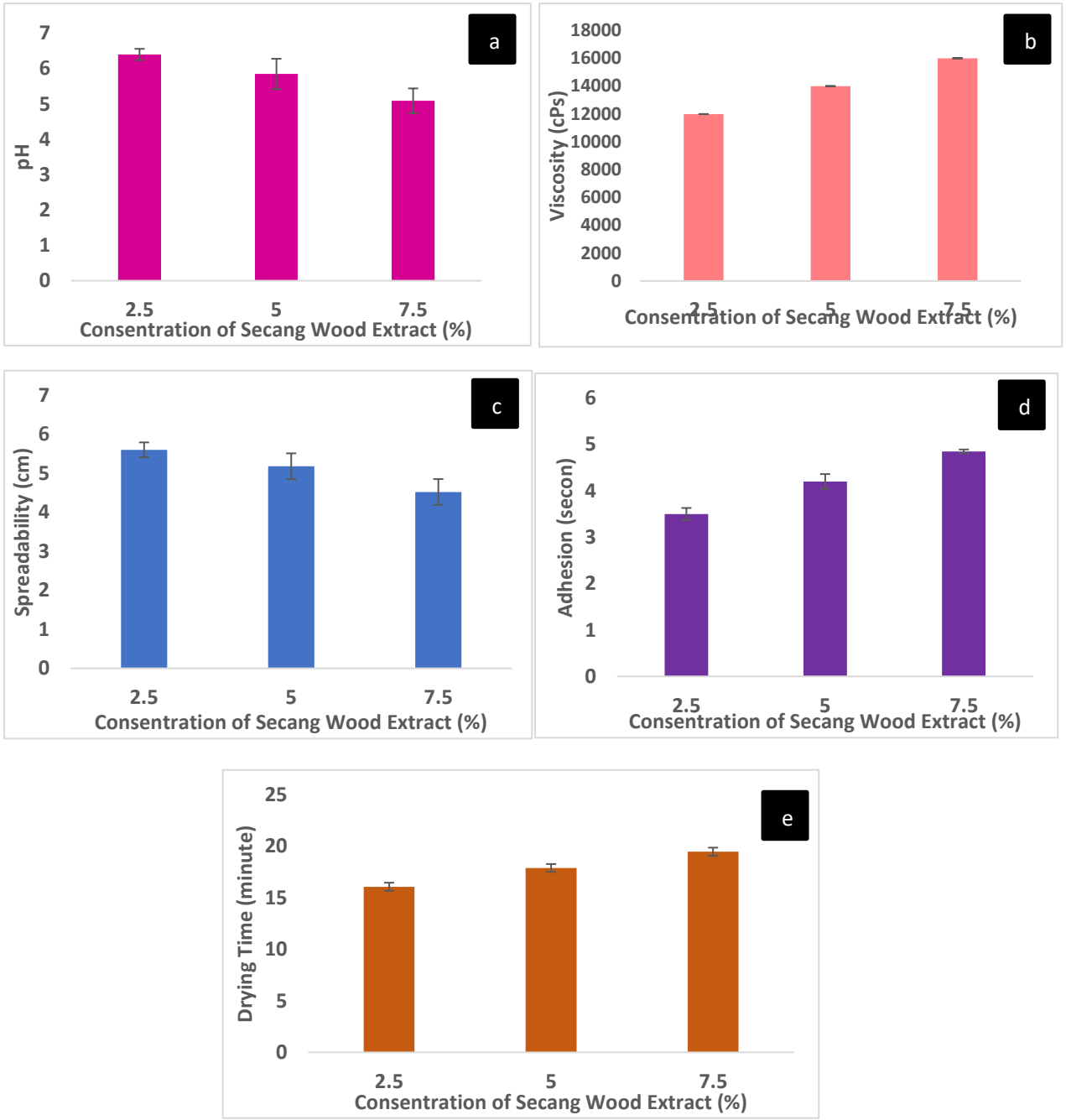

Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

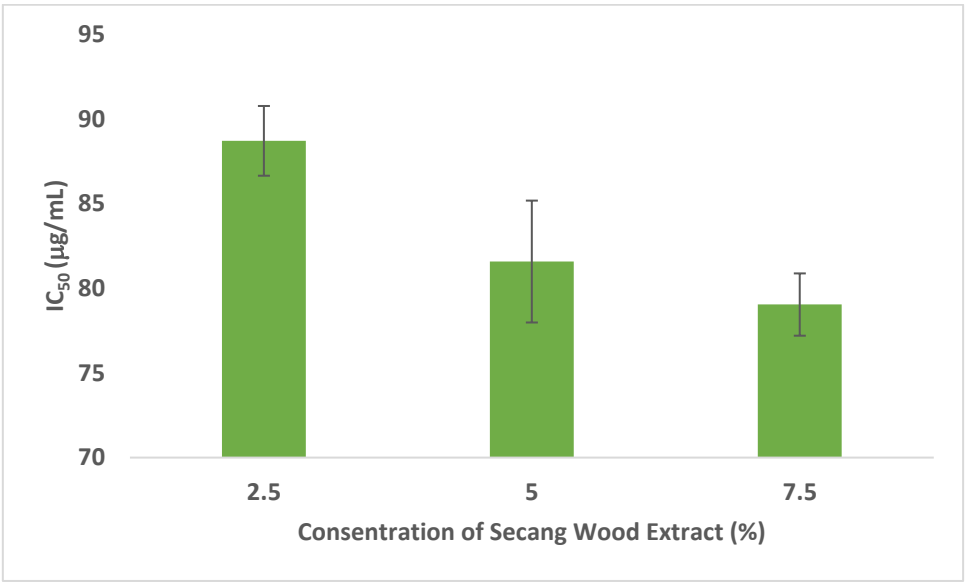

Figure 2. Antioxidant activity (IC_{50})of Peel Off Gel Mask Secang Wood Extract

BUKTI KORESPONDENSI CATATAN REVIEWER 1

Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} value of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3’-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dengan nilai IC_{50} ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

Commented [AS1]: It has not been stated what the vulnerable value is if it is classified as a strong category.

BUKTI KORESPONDENSI CATATAN REVIEWER 1

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

Secang wood contains active compounds of the flavonoid group which can be used as primary antioxidants or secondary antioxidants. The presence of brazilin components in secang wood has the effect of protecting the body from poisoning due to free radicals (Rina et al., 2012). Has reliable antioxidant power with a higher antioxidant index than commercial antioxidants (BHT and BHA) so it has the potential as a free radical scavenging agent (Sugiyanto et al., 2013). Secang wood extract has been proven effective as an antioxidant with an IC_{50} value of 74,44 µg/mL (Tanzaq et al., 2019).

Mask is one of the cosmetics for facial skin care. However, the use of masks is generally less efficient. The demands of market needs with today's lifestyle are not only effective but easy, comfortable and flexible in their use. Peel off gel mask is the result of the development of facial skin care products that can answer these challenges (Ningsih et al., 2016). Peel off gel mask is a type of facial mask that has the advantage of being easy to remove or lift like an elastic membrane (Rahmawanty et al., 2015). Several studies have proven that peel off gel mask preparations can increase the effectiveness of antioxidants, including Paedaria fotida extract (Eka et al., 2022), areca seed extract (Dwi Mulyani et al., 2023), red spinach leaves extract (Welly et al., 2022) and mangrove leaves extract (Hasibuan et al., 2024).

Commented [AS2]: Write down the novelty of this research that distinguishes it from previous studies that used secang wood as a peel off gel marker.

2. Methods

2.1 Materials and Tools

BUKTI KORESPONDENSI CATATAN REVIEWER 1

The materials used in this study were secang wood, ethanol 96% (Merck), Sodium Carboxymethyl Cellulose (CMC Na), Polyvinil Alcohol (PVA), propilenglicol, vitamin C dan 1,1-difenil-2-pikrilhidrazil (DPPH) .

The tools used in this study were rotary evaporator (Heidolph), alat-alat gelas (Pyrex), pH meter (Hanna Instrument pH 210 Microprocessor), viskometer (Brookfield DV-I Prime), and spektrofotometer UV-Vis mini 1240 (Shimadzu).

2.2 Sengon Wood Extraction

The extraction method used is maceration by soaking secang wood powder using 96% ethanol solvent with a ratio of 1:10. Extraction is carried out for 3x24 hours. The filtrate obtained is then evaporated with a rotary evaporator until a thick extract is obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel Off Gel Masker Secang Wood Extract

Peel-off gel mask of secang wood extract was made by developing PVA and CMC Na (Table 1) in hot distilled water until fully expanded. PVA mass plus expanded propylene glycol and CMC Na was stirred until homogeneous. Ethanol extract of secang wood was added little by little into the peel-off gel mask base, distilled water was added until the weight of the preparation was 100% and stirred until homogeneous (Cahyani et al., 2025).

2.4 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Organoleptic

Observations were made on the color, odor, and dosage form of the Peel Off Gel Mask Secang Wood Extract (Syam et al., 2021).

Homogeneity

Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results of determining the operating time. The same stage was also carried out on vitamin C solutions

with concentrations of 2.4,6,8,10 µg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure

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1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e) (Cahyani et al., 2025).

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value (Table 2) so it can be said that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of sengon wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008)

Commented [AS4]: It has not been explained on what basis the antioxidants obtained are categorized as strong, medium, or weak.

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 µg/mL; 81.58 µg/mL and 79.04 µg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous
pH	6.4 ± 0.16	5.85 ± 0.43	5.09 ± 0.35
Viscosity (cPs)	11986.4 ± 6.02	13992.6 ± 5.13	15993.2 ± 5.36
Spreadability (cm)	5.6 ± 0.19	5.18 ± 0.33	4.52 ± 0.33
Adhesion (secon)	3.5 ± 0.13	4.2 ± 0.16	4.85 ± 0.04
Drying Time (minute)	16.06 ± 0.39	17.88 ± 0.38	19.45 ± 0.40
IC_{50} (µg/mL)	88.71 ± 2.06	81.58 ± 3.60	79.04 ± 1.84

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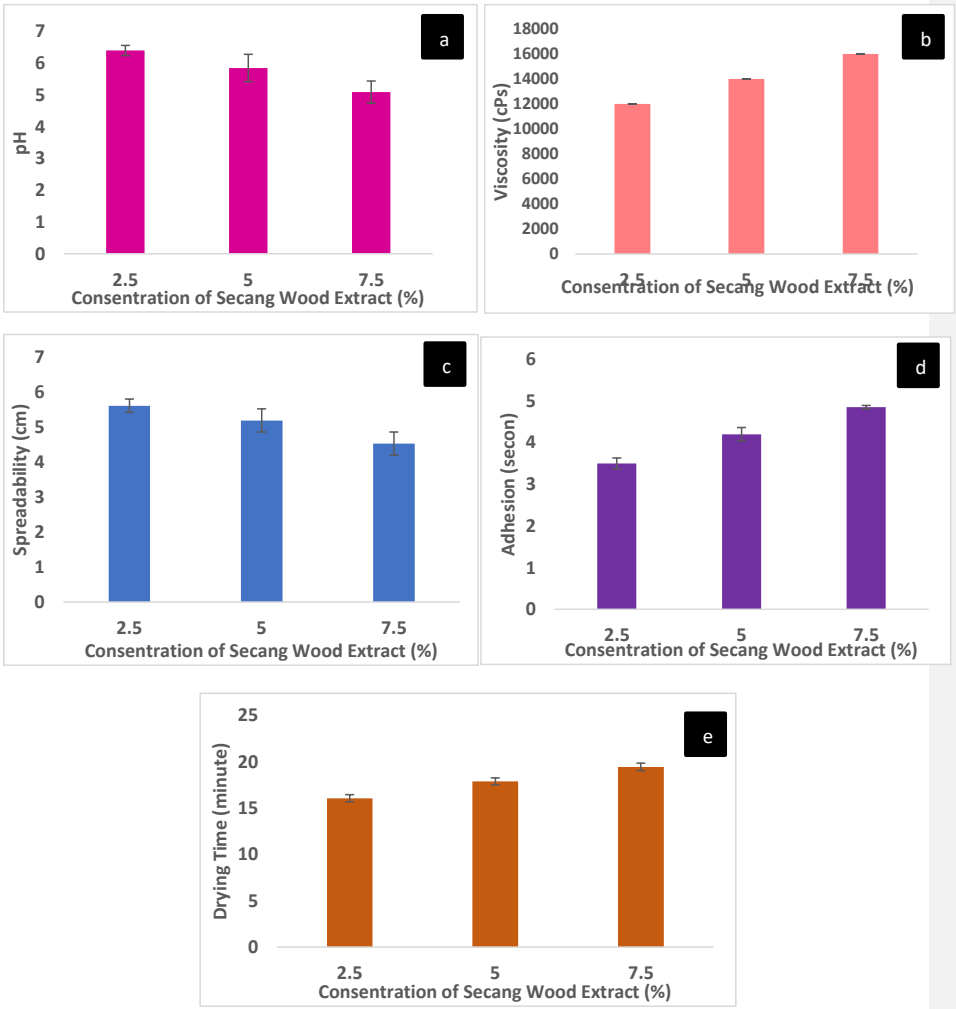

Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

BUKTI KORESPONDENSI CATATAN REVIEWER 1

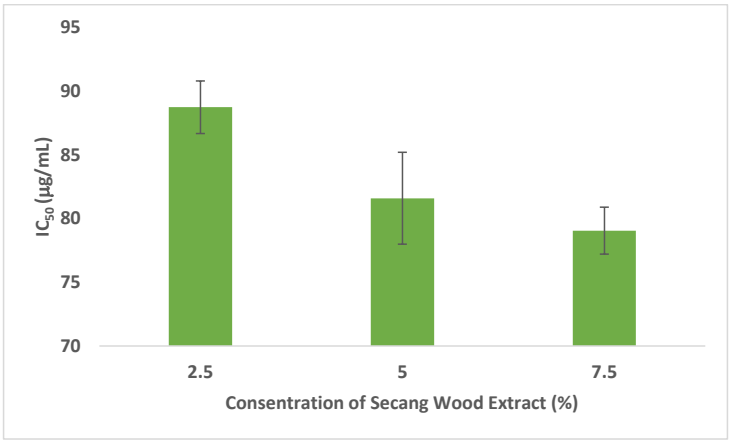

Figure 2. Antioxidant activity (IC_{50})of Peel Off Gel Mask Secang Wood Extract

BUKTI KORESPONDENSI CATATAN REVIEWER 2

Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} value of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3’-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dengan nilai IC_{50} ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

BUKTI KORESPONDENSI CATATAN REVIEWER 2

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

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2. Methods

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BUKTI KORESPONDENSI CATATAN REVIEWER 2

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Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results of determining the operating time. The same stage was also carried out on vitamin C solutions

with concentrations of 2.4,6,8,10 μg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure

1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e) (Cahyani et al., 2025).

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Commented [da1]: How is the analysis of vitamin C as a standard against the three formulas?

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value (Table 2) so it can be said that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of sengon wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008)

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 µg/mL; 81.58 µg/mL and 79.04 µg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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BUKTI KORESPONDENSI CATATAN REVIEWER 2

Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous
pH	6.4 ± 0.16	5.85 ± 0.43	5.09 ± 0.35
Viscosity (cPs)	11986.4 ± 6.02	13992.6 ± 5.13	15993.2 ± 5.36
Spreadability (cm)	5.6 ± 0.19	5.18 ± 0.33	4.52 ± 0.33
Adhesion (secon)	3.5 ± 0.13	4.2 ± 0.16	4.85 ± 0.04
Drying Time (minute)	16.06 ± 0.39	17.88 ± 0.38	19.45 ± 0.40
IC_{50} (µg/mL)	88.71 ± 2.06	81.58 ± 3.60	79.04 ± 1.84

BUKTI KORESPONDENSI CATATAN REVIEWER 2

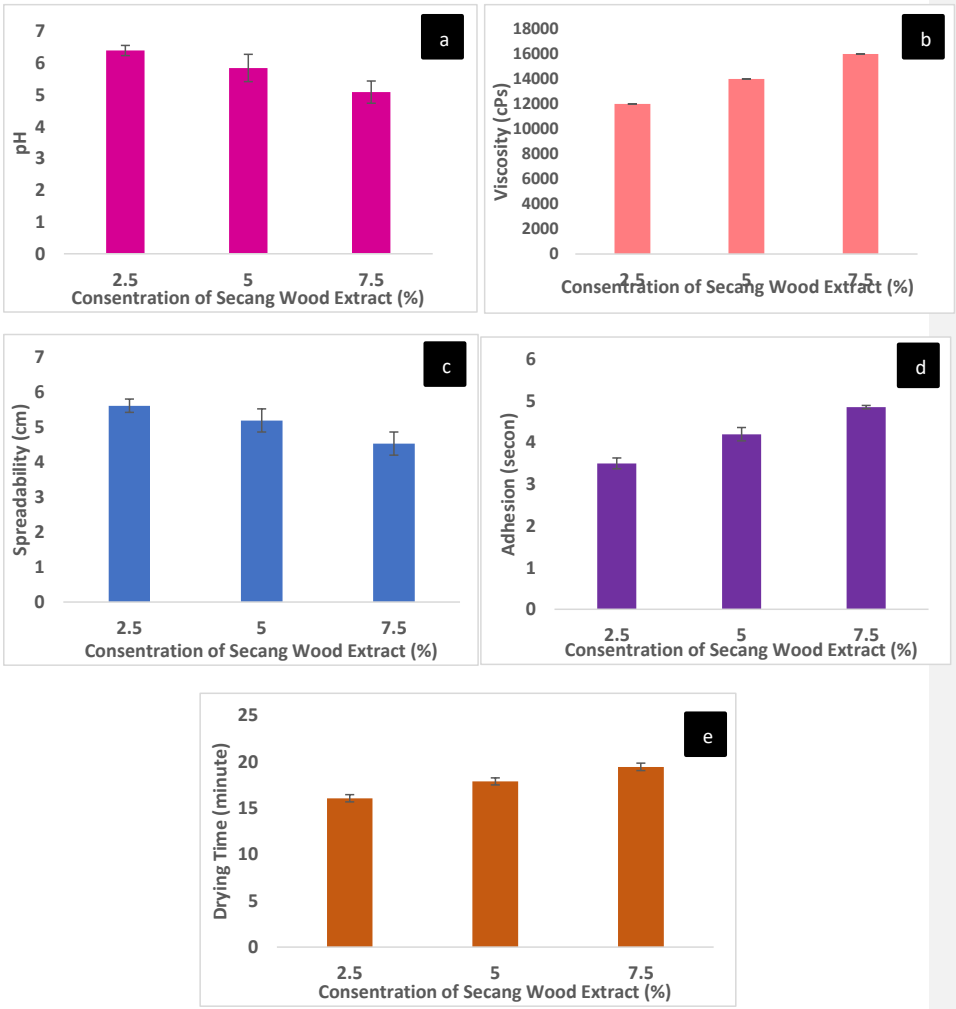

Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

BUKTI KORESPONDENSI CATATAN REVIEWER 2

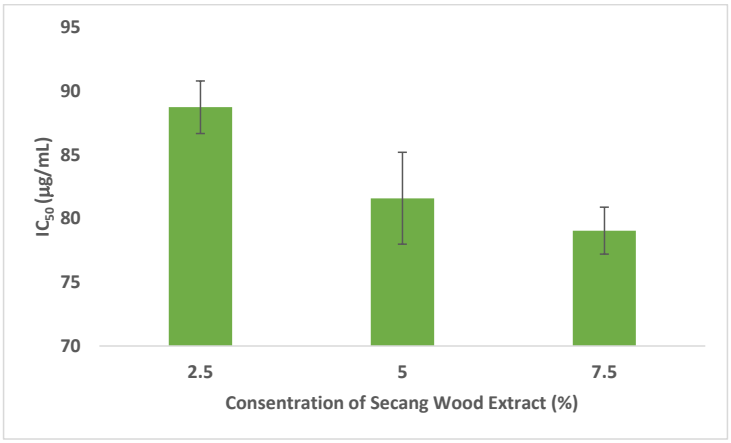

Figure 2. Antioxidant activity (IC_{50})of Peel Off Gel Mask Secang Wood Extract

BUKTI KORESPONDENSI CATATAN REVIEWER 3

Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} value of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3’-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dengan nilai IC_{50} ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

BUKTI KORESPONDENSI CATATAN REVIEWER 3

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

Secang wood contains active compounds of the flavonoid group which can be used as primary antioxidants or secondary antioxidants. The presence of brazilin components in secang wood has the effect of protecting the body from poisoning due to free radicals (Rina et al., 2012). Has reliable antioxidant power with a higher antioxidant index than commercial antioxidants (BHT and BHA) so it has the potential as a free radical scavenging agent (Sugiyanto et al., 2013). Secang wood extract has been proven effective as an antioxidant with an IC_{50} value of 74,44 µg/mL (Tanzaq et al., 2019).

Mask is one of the cosmetics for facial skin care. However, the use of masks is generally less efficient. The demands of market needs with today's lifestyle are not only effective but easy, comfortable and flexible in their use. Peel off gel mask is the result of the development of facial skin care products that can answer these challenges (Ningsih et al., 2016). Peel off gel mask is a type of facial mask that has the advantage of being easy to remove or lift like an elastic membrane (Rahmawanty et al., 2015). Several studies have proven that peel off gel mask preparations can increase the effectiveness of antioxidants, including Paedaria fotida extract (Eka et al., 2022), areca seed extract (Dwi Mulyani et al., 2023), red spinach leaves extract (Welly et al., 2022) and mangrove leaves extract (Hasibuan et al., 2024).

2. Methods

2.1 Materials and Tools

BUKTI KORESPONDENSI CATATAN REVIEWER 3

The materials used in this study were secang wood, ethanol 96% (Merck), Sodium Carboxymethyl Cellulose (CMC Na), Polyvinil Alcohol (PVA), propilenglicol, vitamin C dan 1,1-difenil-2-pikrilhidrazil (DPPH) .

The tools used in this study were rotary evaporator (Heidolph), alat-alat gelas (Pyrex), pH meter (Hanna Instrument pH 210 Microprocessor), viskometer (Brookfield DV-I Prime), and spektrofotometer UV-Vis mini 1240 (Shimadzu).

2.2 Sengon Wood Extraction

Commented [L1]: Sengon wood or secang wood?

The extraction method used is maceration by soaking secang wood powder using 96% ethanol solvent with a ratio of 1:10. Extraction is carried out for 3x24 hours. The filtrate obtained is then evaporated with a rotary evaporator until a thick extract is obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel Off Gel Masker Secang Wood Extract

Peel-off gel mask of secang wood extract was made by developing PVA and CMC Na (Table 1) in hot distilled water until fully expanded. PVA mass plus expanded propylene glycol and CMC Na was stirred until homogeneous. Ethanol extract of secang wood was added little by little into the peel-off gel mask base, distilled water was added until the weight of the preparation was 100% and stirred until homogeneous (Cahyani et al., 2025).

Commented [L2]: What about the comparative formula?both negative and positive. Should be included in table 1 and discussion

2.4 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Organoleptic

Observations were made on the color, odor, and dosage form of the Peel Off Gel Mask Secang Wood Extract (Syam et al., 2021).

Homogeneity

Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results of determining the operating time. The same stage was also carried out on vitamin C solutions

with concentrations of 2.4,6,8,10 μg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Commented [L3]: Need to be compared with previous research

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure

1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e) (Cahyani et al., 2025).

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Commented [L4]: Need to be compared with previous research

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value (Table 2) so it can be said that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of sengon wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008)

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 µg/mL; 81.58 µg/mL and 79.04 µg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous
pH	6.4 ± 0.16	5.85 ± 0.43	5.09 ± 0.35
Viscosity (cPs)	11986.4 ± 6.02	13992.6 ± 5.13	15993.2 ± 5.36
Spreadability (cm)	5.6 ± 0.19	5.18 ± 0.33	4.52 ± 0.33
Adhesion (secon)	3.5 ± 0.13	4.2 ± 0.16	4.85 ± 0.04
Drying Time (minute)	16.06 ± 0.39	17.88 ± 0.38	19.45 ± 0.40
IC_{50} (µg/mL)	88.71 ± 2.06	81.58 ± 3.60	79.04 ± 1.84

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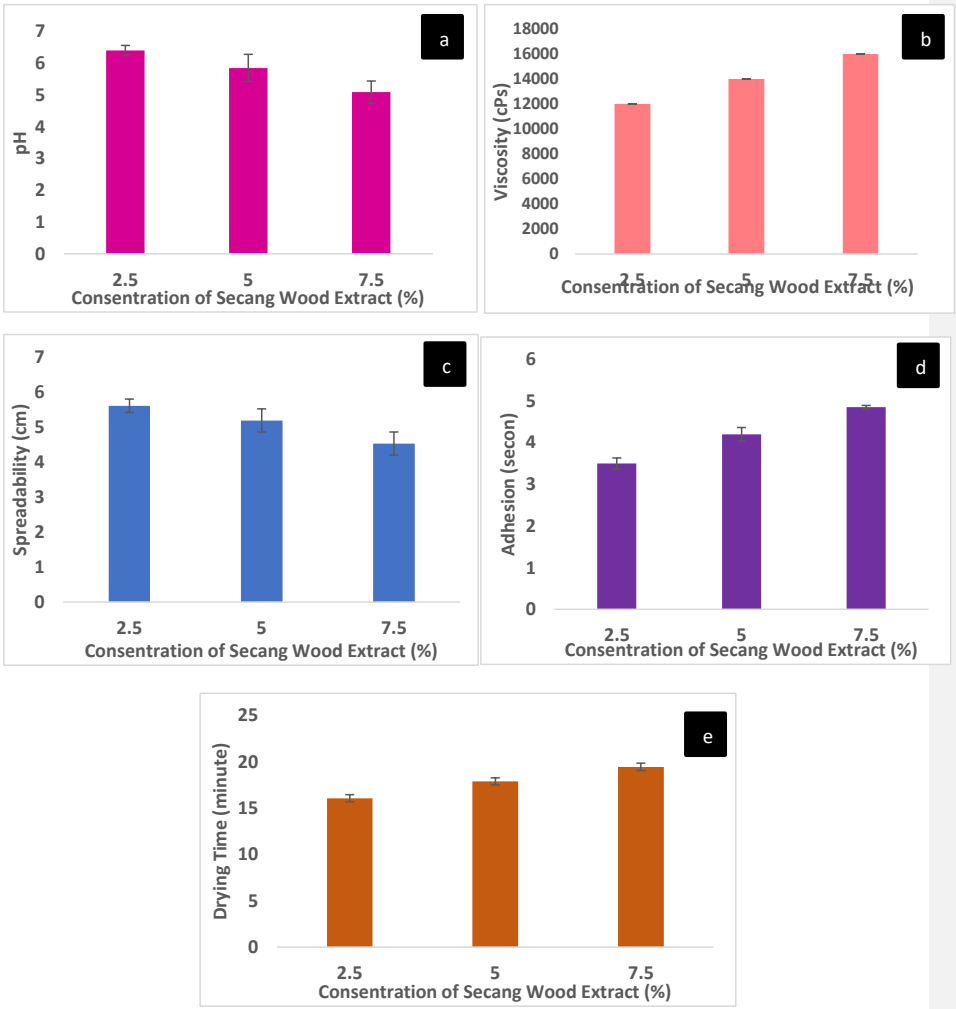

Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

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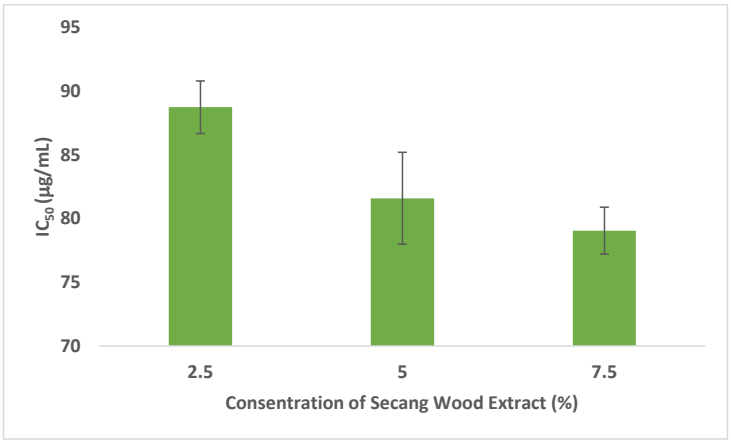

Figure 2. Antioxidant activity (IC_{50})of Peel Off Gel Mask Secang Wood Extract

Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

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Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category were the IC_{50} value (50-100 μg/mL) and the third formula respectively are 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3’-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat

menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dimana nilai IC_{50} (50-100 μg/mL) dan pada ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

Secang wood contains active compounds of the flavonoid group which can be used as primary antioxidants or secondary antioxidants. The presence of brazilin components in secang wood has the effect of protecting the body from poisoning due to free radicals (Rina et al., 2012). Has reliable antioxidant power with a higher antioxidant index than commercial antioxidants (BHT and BHA) so it has the potential as a free radical scavenging agent (Sugiyanto et al., 2013). Secang wood extract has been proven effective as an antioxidant with an IC_{50} value of 74,44 μg/mL (Tanzaq et al., 2019).

Mask is one of the cosmetics for facial skin care. However, the use of masks is generally less efficient. The demands of market needs with today's lifestyle are not only effective but easy, comfortable and flexible in their use. Peel off gel mask is the result of the development of facial skin care products that can answer these challenges (Ningsih et al., 2016). Peel off gel mask is a type of facial mask that has the advantage of being easy to remove or lift like an elastic membrane (Rahmawanty et al., 2015). Several studies have proven that peel off gel mask preparations can increase the effectiveness of antioxidants, including Paedaria fotida extract (Eka et al., 2022), areca seed extract (Dwi Mulyani et al., 2023), red spinach leaves extract (Welly et al., 2022) and mangrove leaves extract (Hasibuan et al., 2024).

2. Methods

2.1 Materials and Tools

The materials used in this study were secang wood, ethanol 96% (Merck), Sodium Carboxymethyl Cellulose (CMC Na), Polyvinil Alcohol (PVA), propilenglicol, vitamin C dan 1,1-difenil-2-pikrilhidrazil (DPPH) .

The tools used in this study were rotary evaporator (Heidolph), alat-alat gelas (Pyrex), pH meter (Hanna Instrument pH 210 Microprocessor), viskometer (Brookfield DV-I Prime), and spektrofotometer UV-Vis mini 1240 (Shimadzu).

2.2 Secang Wood Extraction

The extraction method used is maceration by soaking secang wood powder using 96% ethanol solvent with a ratio of 1:10. Extraction is carried out for 3x24 hours. The filtrate obtained is then evaporated with a rotary evaporator until a thick extract is obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel Off Gel Masker Secang Wood Extract

Peel-off gel mask of secang wood extract was made by developing PVA and CMC Na (Table 1) in distilled water (80°C) until fully expanded. PVA mass plus expanded propylene glycol and CMC Na was stirred until homogeneous. Ethanol extract of secang wood was added little by little into the peel-off gel mask base, distilled water was added until the weight of the preparation was 100% and stirred until homogeneous (Cahyani et al., 2025).

2.4 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Organoleptic

Observations were made on the color, odor, and dosage form of the Peel Off Gel Mask Secang Wood Extract (Syam et al., 2021).

Homogeneity

Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results of determining the operating time. The same stage was also carried out on vitamin C solutions with concentrations of 2.4,6,8,10 μg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Gelling agents used in the peel-off gel mask formulation are PVA and CMC Na (Table 1). PVA is a hydrophilic polymer with adhesive properties that are easy to peel off when dry and provide a film layer effect called the peel-off effect (Anindhita et al., 2023). However, the film layer formed tends to be stiff and easily broken (Sinambela & Telaumbanua, 2022). Carboxymethyl Cellulose Sodium (CMC Na) is a hydrophilic polymer with a more stable viscosity in the long term (Eryani et al., 2023) so that it can increase the elasticity of the PVA layer formed as reported in previous studies (Cahyani et al., 2025) .

Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure 1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e) (Cahyani et al., 2025).

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value. The determination of the antioxidant activity category is based on IC_{50} where it is very strong (<50 μg/mL), strong (50-100 μg/mL), moderate (100-150 μg/mL) and weak (151-200μg/mL) (Puspitasari & Wulandari, 2017). IC_{50} value of the three formulas in Table 2. indicated that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of secang wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with

the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008). Several previous studies were limited to characterization of the preparation and did not determine the antioxidant activity in the formulation peel off gel mask (Ermawati & Adi, 2023). The formulation of sappanwood extract in the peel-off gel mask preparation was considered appropriate because the IC_{50} value of the preparation was close to the IC_{50} of the extract (74.44μg/mL). However, when compared, vitamin C is still stronger as a comparative standard in the very strong category 3.04 μg/mL (Tanzaq et al., 2019).

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

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Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous
pH	6.4 ± 0.16	5.85 ± 0.43	5.09 ± 0.35
Viscosity (cPs)	11986.4 ± 6.02	13992.6 ± 5.13	15993.2 ± 5.36
Spreadability (cm)	5.6 ± 0.19	5.18 ± 0.33	4.52 ± 0.33
Adhesion (secon)	3.5 ± 0.13	4.2 ± 0.16	4.85 ± 0.04
Drying Time (minute)	16.06 ± 0.39	17.88 ± 0.38	19.45 ± 0.40
IC_{50} (µg/mL)	88.71 ± 2.06	81.58 ± 3.60	79.04 ± 1.84

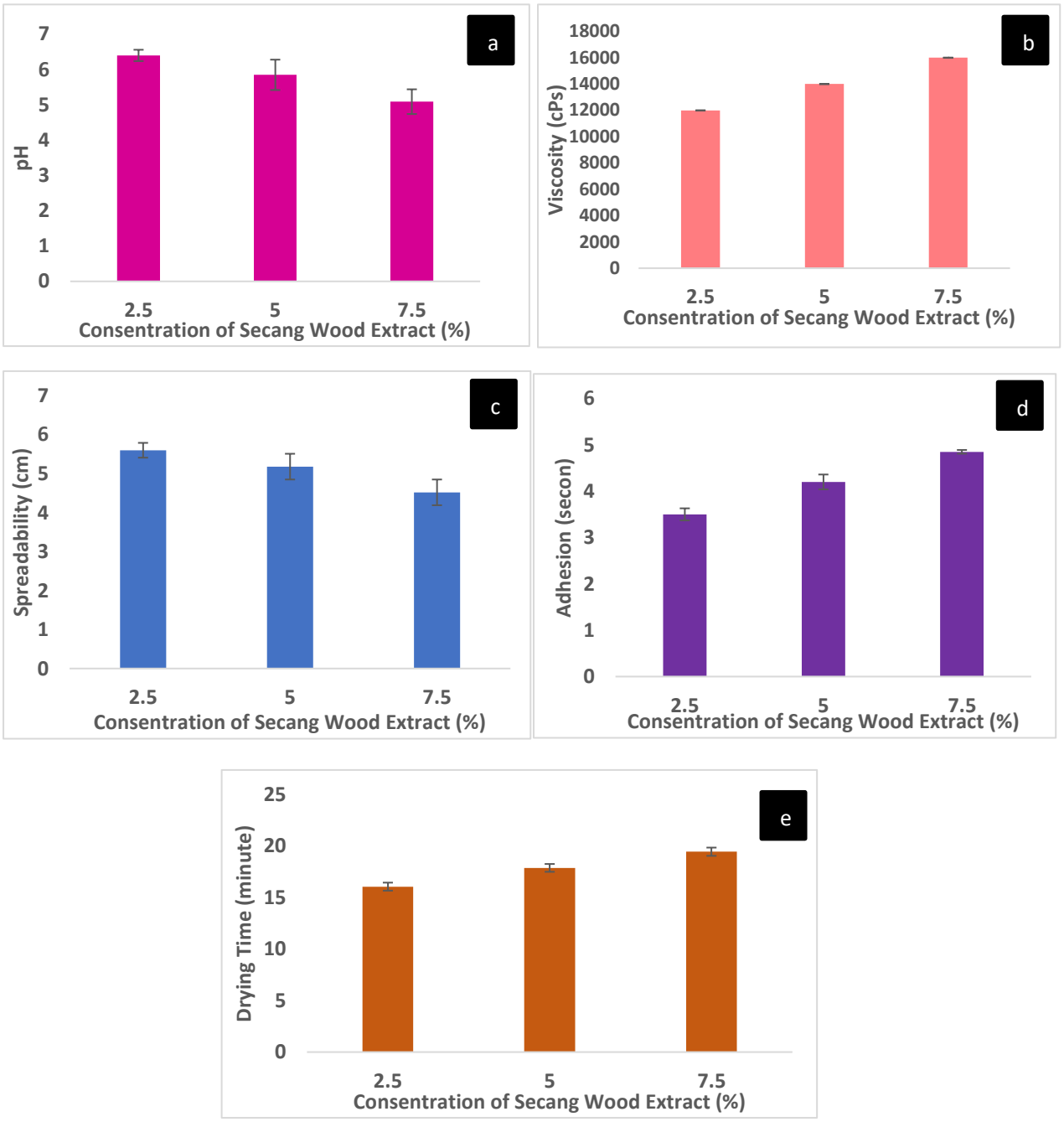

Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

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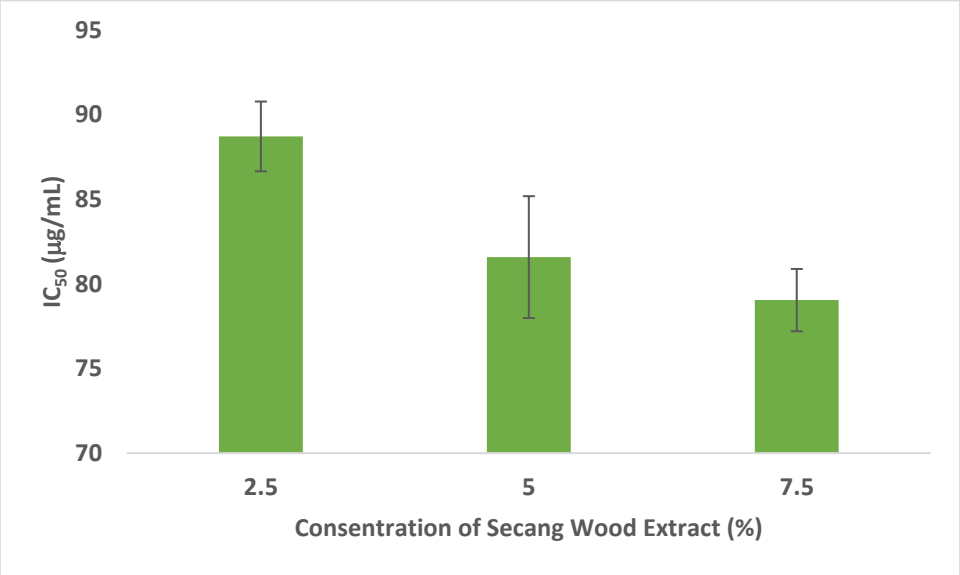

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377 **Figure 2**. Antioxidant activity (IC_{50})of Peel Off Gel Mask Secang Wood Extract

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BUKTI KORESPONDENSI RESPONSES TO REVIEWERS' AND EDITORIAL COMMENTS

Responses to Reviewers' and Editorial Comments

Journal name : Journal Jamu Indonesia

Manuscript Title : Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Manuscript No : 403

Type of paper : Original Article

Authors Name : Intan Martha Cahyani, Tan Tanando Tanzaq, Ruth Ditya Agustina, Kemala Endar Setiawati

Reviewer Code	Original comments of the reviewer	Reply by the author(s)	Changes done on page number and line number
3437	Remove "Sengon" and change with "Secang"	we rewrite as suggested	Line 86
3437	What about the comparative formula?both negative and positive. Should be included in table 1 and discussion	we added to the result and discussion as suggested	Line 160-166
3437	Need to be compared with previous research in the section discussion " Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract"	we added to the result and discussion as suggested	Line 165-166
3437	Need to be compared with previous research in the section discussion " Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract"	we added to the result and discussion as suggested	Line 199-204
3438	Remove "Sengon" and change with "Secang"	we rewrite as suggested	Line 86
3438	How is the analysis of vitamin C as a standard against the three formulas?	we added to the result and discussion as suggested	Line 203-204
3438	Remove "Sengon" and change with "Secang"	we rewrite as suggested	Line 194

BUKTI KORESPONDENSI RESPONSES TO REVIEWERS' AND EDITORIAL COMMENTS

3440	It has not been stated what the vulnerable value is if it is classified as a strong category in the abstract	we added to the abstract as suggested	Line 25 dan 46
3440	Write down the novelty of this research that distinguishes it from previous studies that used secang wood as a peel off gel mask	we added to the result and discussion as suggested	Line 199-204
3440	explanation for table 1 has not been included in the research results	we added to the result and discussion as suggested	Line 160-166
3440	It has not been explained on what basis the antioxidants obtained are categorized as strong, medium, or weak.	we added to the result and discussion as suggested	Line 188-190

Note : Highlighted yellow for changes to response reviewer.

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Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

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Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category were the IC_{50} value (50-100 μg/mL) and the third formula respectively are 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3'-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat

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menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dimana nilai IC_{50} (50-100 μg/mL) dan pada ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

Secang wood contains active compounds of the flavonoid group which can be used as primary antioxidants or secondary antioxidants. The presence of brazilin components in secang wood has the effect of protecting the body from poisoning due to free radicals (Rina et al., 2012). Has reliable antioxidant power with a higher antioxidant index than commercial antioxidants (BHT and BHA) so it has the potential as a free radical scavenging agent (Sugiyanto et al., 2013). Secang wood extract has been proven effective as an antioxidant with an IC_{50} value of 74,44 μg/mL (Tanzaq et al., 2019).

Mask is one of the cosmetics for facial skin care. However, the use of masks is generally less efficient. The demands of market needs with today's lifestyle are not only effective but easy, comfortable and flexible in their use. Peel off gel mask is the result of the development of facial skin care products that can answer these challenges (Ningsih et al., 2016). Peel off gel mask is a type of facial mask that has the advantage of being easy to remove or lift like an elastic membrane (Rahmawanty et al., 2015). Several studies have proven that peel off gel mask preparations can increase the effectiveness of antioxidants, including Paedaria fotida extract (Eka et al., 2022), areca seed extract (Dwi Mulyani et al., 2023), red spinach leaves extract (Welly et al., 2022) and mangrove leaves extract (Hasibuan et al., 2024).

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2. Methods

Commented [WN1]: Tambahkan analisis data bu, misal uji Tukey untuk data-data kuantitatif?

2.1 Materials and Tools

The materials used in this study were secang wood, ethanol 96% (Merck), Sodium Carboxymethyl Cellulose (CMC Na), Polyvinil Alcohol (PVA), propilenglicol, vitamin C dan 1,1-difenil-2-pikrilhidrazil (DPPH) .

The tools used in this study were rotary evaporator (Heidolph), alat-alat gelas (Pyrex), pH meter (Hanna Instrument pH 210 Microprocessor), viskometer (Brookfield DV-I Prime), and spektrofotometer UV-Vis mini 1240 (Shimadzu).

2.2 Secang Wood Extraction

The extraction method used is maceration by soaking secang wood powder using 96% ethanol solvent with a ratio of 1:10. Extraction is carried out for 3x24 hours. The filtrate obtained is then evaporated with a rotary evaporator until a thick extract is obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel Off Gel Masker Secang Wood Extract

Peel-off gel mask of secang wood extract was made by developing PVA and CMC Na (Table 1) in distilled water (80°C) until fully expanded. PVA mass plus expanded propylene glycol and CMC Na was stirred until homogeneous. Ethanol extract of secang wood was added little by little into the peel-off gel mask base, distilled water was added until the weight of the preparation was 100% and stirred until homogeneous (Cahyani et al., 2025).

2.4 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Organoleptic

Observations were made on the color, odor, and dosage form of the Peel Off Gel Mask Secang Wood Extract (Syam et al., 2021).

Homogeneity

Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

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An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results of determining the operating time. The same stage was also carried out on vitamin C solutions with concentrations of 2.4,6,8,10 μg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Gelling agents used in the peel-off gel mask formulation are PVA and CMC Na (Table 1). PVA is a hydrophilic polymer with adhesive properties that are easy to peel off when dry and provide a film layer effect called the peel-off effect (Anindhita et al., 2023). However, the film layer formed tends to be stiff and easily broken (Sinambela & Telaumbanua, 2022). Carboxymethyl Cellulose Sodium (CMC Na) is a hydrophilic polymer with a more stable viscosity in the long term (Eryani et al., 2023) so that it can increase the elasticity of the PVA layer formed as reported in previous studies (Cahyani et al., 2025) .

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Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure 1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e) (Cahyani et al., 2025).

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value. The determination of the antioxidant activity category is based on IC_{50} where it is very strong (<50 μg/mL), strong (50-100 μg/mL), moderate (100-150 μg/mL) and weak (151-200μg/mL) (Puspitasari & Wulandari, 2017). IC_{50} value of the three formulas in Table 2. indicated that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of secang wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with

the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008). Several previous studies were limited to characterization of the preparation and did not determine the antioxidant activity in the formulation peel off gel mask (Ermawati & Adi, 2023). The formulation of sappanwood extract in the peel-off gel mask preparation was considered appropriate because the IC_{50} value of the preparation was close to the IC_{50} of the extract (74.44μg/mL). However, when compared, vitamin C is still stronger as a comparative standard in the very strong category 3.04 μg/mL (Tanzaq et al., 2019).

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous
pH	6.4 ± 0.16	5.85 ± 0.43	5.09 ± 0.35
Viscosity (cPs)	11986.4 ± 6.02	13992.6 ± 5.13	15993.2 ± 5.36
Spreadability (cm)	5.6 ± 0.19	5.18 ± 0.33	4.52 ± 0.33
Adhesion (secon)	3.5 ± 0.13	4.2 ± 0.16	4.85 ± 0.04
Drying Time (minute)	16.06 ± 0.39	17.88 ± 0.38	19.45 ± 0.40
IC_{50} (µg/mL)	88.71 ± 2.06	81.58 ± 3.60	79.04 ± 1.84

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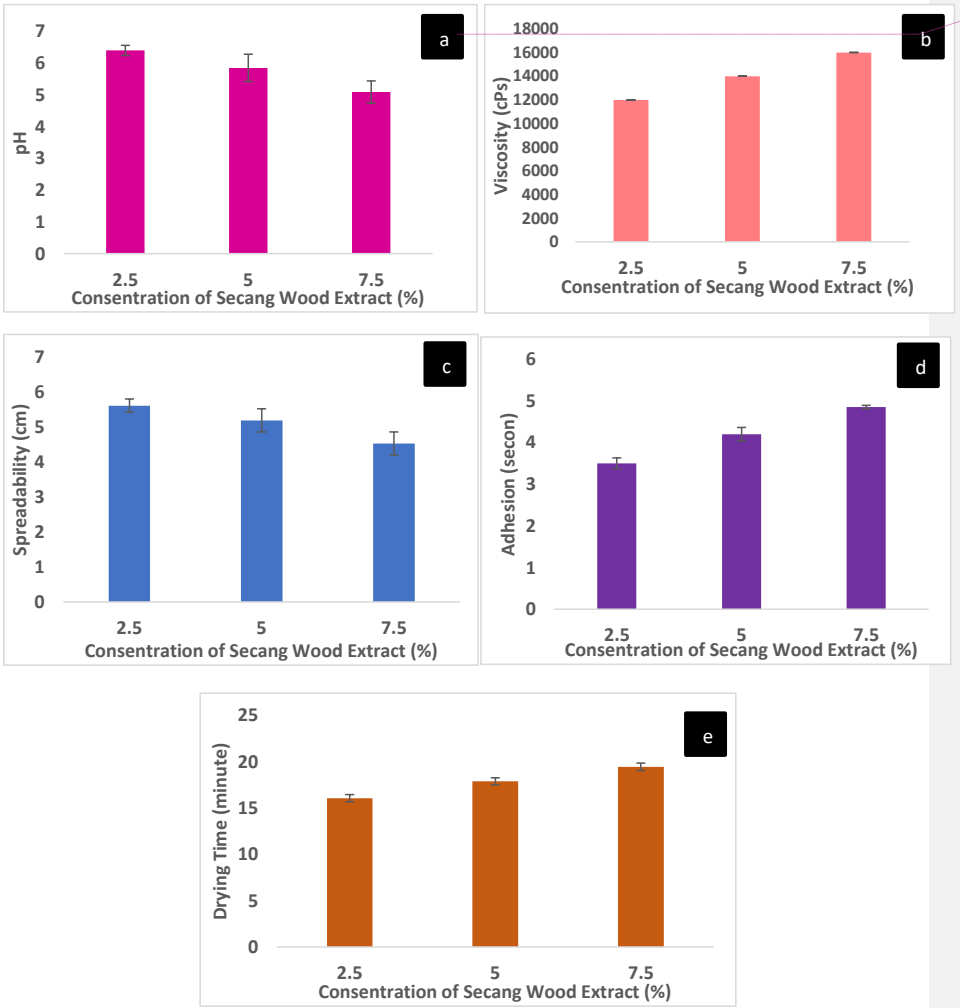

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Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

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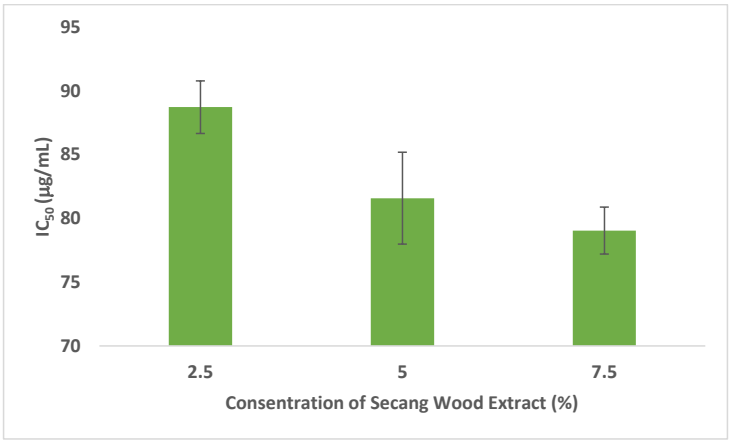

Figure 2. Antioxidant activity (IC_{50})of Peel Off Gel Mask Secang Wood Extract

Peel Off Gel Mask Secang Wood Extract as an Antioxidant: Formulation and Characterization

Masker Gel Peel Off Ekstrak Kayu Secang sebagai Antioksidan : Formulasi dan Karakterisasi

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Abstract

Secang wood contains active compounds of the flavonoid group, namely brazilin, brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan calchone which can be used as primary antioxidants or secondary antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding reactive free radicals. Increasing the value of the benefits of secang wood as an antioxidant can be done by developing a topical preparation formulation. Peel-off gel mask is the right topical preparation because in addition to maintaining skin health, it can also increase effectiveness and comfort during use. The study aims to determine the formula of a peel-off gel mask with secang wood extract as an antioxidant with good characteristics. The formulation of the peel-off gel mask was made with a concentration of secang wood extract of 2.5%; 5% and 7.5% using sodium carboxymethyl cellulose, polyvinyl alcohol and propylene glycol as a base. The preparation of the peel-off gel mask with secang wood extract produced was then tested with several parameters to determine the physical characteristics and antioxidant activity. The results showed that the higher the concentration of secang wood extract, the more significant the effect (p-value <0.05) on increasing viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category were the IC_{50} value (50-100 μg/mL) and the third formula respectively are 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL.

Keywords: Secang wood, Formulation, Peel off gel mask, Antioxidants, Physical characteristics

Abstrak

Kayu secang mengandung senyawa aktif golongan flavonoid yaitu brazilin, brazilin, 3’-O-metilbrazilin, sappanin chalcone, dan sappan calchone yang dapat digunakan sebagai antioksidan primer maupun antioksidan sekunder. Antioksidan merupakan senyawa yang dapat menghambat reaksi oksidadi dengan mengikat radikal bebas yang reaktif. Peningkatan nilai manfaat kayu secang sebagai antioksidan dapat dilakukan dengan pengembangan formulasi sediaan topikal. Masker gel peel-off merupakan sediaan topikal yang tepat karena selain dapat menjaga kesehatan kulit juga dapat meningkatkan efektivitas dan kenyamanan saat penggunaan. Penelitian bertujuan untuk mengetahui formula masker gel peel off ekstrak kayu secang sebagai antioksidan dengan karakteristik yang baik. Formulasi masker gel peel off dibuat dengan konsentrasi ekstrak kayu secang 2.5%; 5% dan 7.5% menggunakan natrium karboksimetil selulosa, polivinil alkohol dan propilen glikol sebagai basis. Sediaan masker gel peel off ekstrak kayu secang yang dihasilkan selanjutnya dilakukan pengujian dengan beberapa parameter untuk mengetahui karakteristik fisik dan aktivitas antioksidan. Hasil menunjukkan semakin tinggi konsentrasi ekstak kayu secang berpengaruh signifikan (p-value < 0,05) pada peningkatan viskosistas, daya lekat dan waktu mengering serta dapat

menurunkan pH, daya sebar dan nilai IC_{50}. Aktivitas antioksidan semua formula termasuk dalam kategori kuat dimana nilai IC_{50} (50-100 μg/mL) dan pada ketiga formula berturut-turut adalah 88.71 μg/mL; 81.58 μg/mL dan 79.04 μg/mL.

Kata Kunci: Kayu secang, Formulasi, Masker gel peel off, antioksidan, karakteristik fisik

1. Introduction

Air pollution is currently experiencing a significant increase, reaching 20%. Low air quality can have a negative impact because long-term exposure can cause health problems (Wahdaningsih et al., 2015). One of the mechanisms is the occurrence of oxidative stress in the body. The high level of air pollution today can cause the formation of free radicals so it needs to be balanced with natural antioxidant intake to prevent oxidative damage which is a trigger for various diseases, especially skin disorders (Widowati, 2011). Flavonoids are natural compounds that have the ability as antioxidants by inhibiting the formation of free radicals hydroxyl, peroxide, alkoxyl, superoxide anions, oxygen singkets and hydrogen peroxide (Utari, 2017).

Secang wood contains active compounds of the flavonoid group which can be used as primary antioxidants or secondary antioxidants. The presence of brazilin components in secang wood has the effect of protecting the body from poisoning due to free radicals (Rina et al., 2012). Has reliable antioxidant power with a higher antioxidant index than commercial antioxidants (BHT and BHA) so it has the potential as a free radical scavenging agent (Sugiyanto et al., 2013). Secang wood extract has been proven effective as an antioxidant with an IC_{50} value of 74,44 μg/mL (Tanzaq et al., 2019).

Mask is one of the cosmetics for facial skin care. However, the use of masks is generally less efficient. The demands of market needs with today's lifestyle are not only effective but easy, comfortable and flexible in their use. Peel off gel mask is the result of the development of facial skin care products that can answer these challenges (Ningsih et al., 2016). Peel off gel mask is a type of facial mask that has the advantage of being easy to remove or lift like an elastic membrane (Rahmawanty et al., 2015). Several studies have proven that peel off gel mask preparations can increase the effectiveness of antioxidants, including Paedaria fotida extract (Eka et al., 2022), areca seed extract (Dwi Mulyani et al., 2023), red spinach leaves extract (Welly et al., 2022) and mangrove leaves extract (Hasibuan et al., 2024).

2. Methods

2.1 Materials and Tools

The materials used in this study were secang wood, ethanol 96% (Merck), Sodium Carboxymethyl Cellulose (CMC Na), Polyvinil Alcohol (PVA), propilenglicol, vitamin C dan 1,1-difenil-2-pikrilhidrazil (DPPH) .

The tools used in this study were rotary evaporator (Heidolph), alat-alat gelas (Pyrex), pH meter (Hanna Instrument pH 210 Microprocessor), viskometer (Brookfield DV-I Prime), and spektrofotometer UV-Vis mini 1240 (Shimadzu).

2.2 Secang Wood Extraction

The extraction method used is maceration by soaking secang wood powder using 96% ethanol solvent with a ratio of 1:10. Extraction is carried out for 3x24 hours. The filtrate obtained is then evaporated with a rotary evaporator until a thick extract is obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel Off Gel Masker Secang Wood Extract

Peel-off gel mask of secang wood extract was made by developing PVA and CMC Na (Table 1) in distilled water (80°C) until fully expanded. PVA mass plus expanded propylene glycol and CMC Na was stirred until homogeneous. Ethanol extract of secang wood was added little by little into the peel-off gel mask base, distilled water was added until the weight of the preparation was 100% and stirred until homogeneous (Cahyani et al., 2025).

2.4 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Organoleptic

Observations were made on the color, odor, and dosage form of the Peel Off Gel Mask Secang Wood Extract (Syam et al., 2021).

Homogeneity

Observations are made by preparing a number of preparations on object glass (Cahyani & Putri, 2017). All particles are evenly dispersed on the object glass indicating a homogeneous preparation (Syam et al., 2021)

pH

The pH meter electrode is dipped into the preparation until the display on the device shows a constant pH value (Andini et al., 2017). Results that match the skin pH (4.5-6.5) can increase acceptability when used (Silvia et al., 2021).

Viscosity

The viscosity of the preparation was measured using a Brookfield spindle 64 viscometer at a speed of 1.0 rpm (Cahyani & Putri, 2017). At a viscosity of 2000-50000 cps indicates a good peel-off gel mask (SNI 16-4399-1996: 1).

Spreadability

Observations were made on the spreading ability of 0.5 grams of the preparation placed in the middle of the spreading power tester, then covered with a glass plate that had previously been weighed and its weight recorded, left for one minute. The spreading ability is indicated by measuring the diameter of the four sides of the spread. Do the same steps for each additional 50 grams of load above it until the diameter of the spread is constant(Cahyani & Putri, 2017). The ideal spread of the peel off gel mask is 5-7 cm (Silvia et al., 2021).

Adhesion

0.25 g preparation on a glass object is given a load pressure of 100 grams for 5 minutes and then placed on the adhesive strength tester. The adhesive strength is measured by recording the time when the two glass objects are released. A time of more than 1 second indicates good adhesive strength of the peel off gel mask (Syam et al., 2021).

Drying Time

0.1 g of the preparation is applied to the arm with an area of 2.5 x 2.5 cm, then the time is observed until the preparation dries (Andini et al., 2017). standard drying time for a peel-off gel mask is 15-30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity with DPPH (2,2-difenyl-1-picrylhydrazyl) Method

The test was carried out in several stages. First, determine the maximum wavelength of the DPPH 30 solution μg/mL with a UV-Vis spectrophotometer in the 400-800 nm region. Determination of operating time is done by measuring the absorption at the maximum wavelength obtained using a standard solution (vitamin C) and DPPH 30 solution μg/mL at a 1:1 ratio for 60 minutes.

An amount of 0.05 grams of the preparation was dissolved in methanol up to 50 mL and diluted to obtain sample solution concentrations of 60,70,80,100 and 120 μg/mL. For each concentration, DPPH 30 solution was added μg/mL at a ratio of 1:1 and absorbance measurements were carried out using a UV-Vis spectrophotometer at a maximum wavelength after being incubated at room temperature for the time obtained from the results of determining the operating time. The same stage was also carried out on vitamin C solutions with concentrations of 2.4,6,8,10 μg/mL as a reference standard. Determine the IC_{50} value from the results of measuring the absorbance of the sample solution and the reference standard obtained (Maharani et al., 2022).

2.3 Data Analysis

The results of the physical characteristics of the secang extract peel-off gel mask (pH, viscosity, spreadability, adhesiveness, drying time) and IC_{50} were analyzed quantitatively using SPSS 23.0 with the one-way ANOVA method and the Kruskall Wallis test at a significance level of 95%. Descriptive analysis was carried out on the results of organoleptic and homogeneity tests.

3. Results and Discussion

3.1 Physical Characterization Evaluation of Peel Off Gel Mask Secang Wood Extract

Traditionally, secang wood has many health benefits, including antibacterial, anti-inflammatory, anti-diabetic, tuberculosis, malaria and tetanus (Setyowati et al., 2023). In addition, it is also widely used in food and cosmetics as an antioxidant (Rajput et al., 2022). Secang wood contains active compounds that are included in the flavonoid group, namely brazilin, brazilin, 3'-o-methylbrazilin, sappanin, chalcone, and sappan chalcone. Brazilin in secang wood has an antioxidant effect (Ngamwonglumlert & Devahastin, 2023). For the manufacture of secang wood extract, the maceration method using 96% ethanol (1:1) was used. The peel-off gel mask has unique characteristics with the formation of a transparent, elastic and easily removable film layer without rinsing which can increase the comfort of use and the effectiveness of active compounds. Therefore, this study was designed to make a peel-off gel mask of secang wood extract as an antioxidant F1 (2.5%) F2 (5%0 and F3 (7.5%) with the results of the physical characteristics test presented in Table 2.

Gelling agents used in the peel-off gel mask formulation are PVA and CMC Na (Table 1). PVA is a hydrophilic polymer with adhesive properties that are easy to peel off when dry and provide a film layer effect called the peel-off effect (Anindhita et al., 2023). However, the film layer formed tends to be stiff and easily broken (Sinambela & Telaumbanua, 2022). Carboxymethyl Cellulose Sodium (CMC Na) is a hydrophilic polymer with a more stable viscosity in the long term (Eryani et al., 2023) so that it can increase the elasticity of the PVA layer formed as reported in previous studies (Cahyani et al., 2025) .

Organoleptic and homogeneity testing aims to see the physical appearance and distribution of each component of a preparation. Based on table 2, the results show that the three formulas give the same results. The level of comfort of using a preparation is also influenced by the pH of the preparation. The higher the concentration of secang wood extract, the lower the pH of the preparation as seen in Figure 1a. This occurs because the ethanol extract of secang wood has a pH that tends to be acidic (2-6) (Muslimin et al., 2024), so that by adding the amount of secang wood extract, the pH of the preparation will decrease. The pH value of secang wood extract can affect the color of the peel-off gel mask preparation produced. This effect is caused because the stability of brazilin is greatly influenced by its acidity level where at pH 2-5 (yellow-orange), pH 6-7 (pink) and pH> 7 (red-violet) where the degradation results of brazilin into brazilein which is red in color (Rina et al., 2017).

The results of the viscosity test showed an increase that was proportional to the increase in the concentration of secang wood extract in the peel-off gel mask formula (Figure 1b). The thick concentration of secang wood extract showed high resistance so that it would affect the resistance of the preparation to flow. The viscosity of the preparation is closely related to the spreadability, adhesion and drying time. The higher the viscosity, the lower the spreadability (Figure 1c) and the higher the adhesion (Figure 1d) of the preparation because high resistance indicates a stronger bond between particles which causes water to be trapped and dry longer (Figure 1e). The same results were also obtained with the kolang kaling peel off gel mask (Cahyani et al., 2025). Increasing the concentration of sappanwood extract has a significant effect (p-value <0.05) on the physical characteristics including pH, viscosity, spreadability, adhesion and drying time of the secang extract peel-off gel mask.

3.2 Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Test results all formulas showed antioxidant activity included in the strong category as indicated by the IC_{50} value. The determination of the antioxidant activity category is based

on IC_{50} where it is very strong (<50 μg/mL), strong (50-100 μg/mL), moderate (100-150 μg/mL) and weak (151-200μg/mL) (Puspitasari & Wulandari, 2017). IC_{50} value of the three formulas in Table 2. indicated that the selection of the peel off gel mask preparation is right and the resulting formula can maintain the stability of the active compound. The increase in antioxidant activity is indicated by a decrease in the IC_{50} value along with the increase in extract concentration (Figure 2). This is because the higher the concentration of secang wood extract, the higher the brazilin content in the peel off gel mask preparation. Brazilin, in addition to playing a role in the color produced, is also a flavonoid with high antioxidant activity and is widely used in natural skin care (Faizah et al., 2023). Brazilin is a flavonoid with the ability to ward off free radicals and can inhibit enzymes responsible for the production of free radicals (Hu et al., 2008). Several previous studies were limited to characterization of the preparation and did not determine the antioxidant activity in the formulation peel off gel mask (Ermawati & Adi, 2023). The formulation of secang wood extract in the peel-off gel mask preparation was considered appropriate because the IC_{50} value of the preparation was close to the IC_{50} of the extract (74.44μg/mL) with significant (p-value <0.05) results between formulas. However, when compared, vitamin C is still stronger as a comparative standard in the very strong category 3.04 μg/mL (Tanzaq et al., 2019).

4. Conclusion

Increasing the concentration of secang wood extract has a significant effect (p-value <0.05) on increasing the viscosity, adhesiveness and drying time and can reduce pH, spreadability and IC_{50} value. The antioxidant activity of all formulas is included in the strong category with the IC_{50} values of the three formulas respectively being 88, 71 μg/mL; 81.58 μg/mL and 79.04 μg/mL. Peel off gel mask preparation formula with good characteristics and strong antioxidant activity at a concentration of 7.5% secang wood extract.

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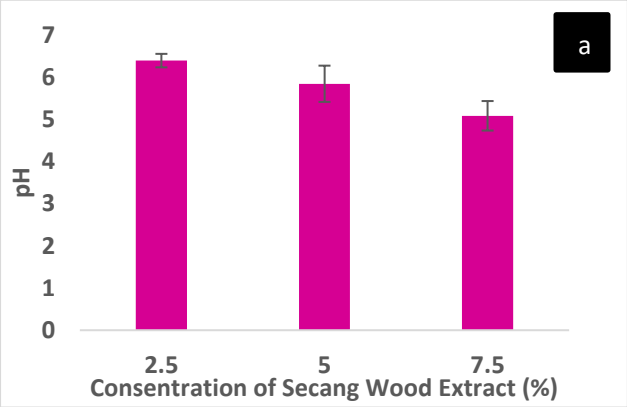
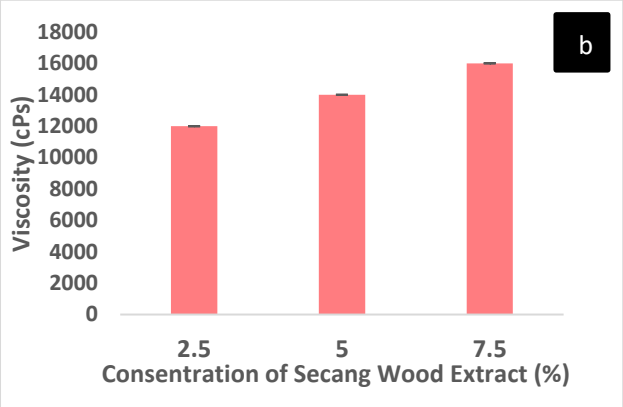
Table 1. Formulation of Peel Off Gel Masker Secang Wood Extract

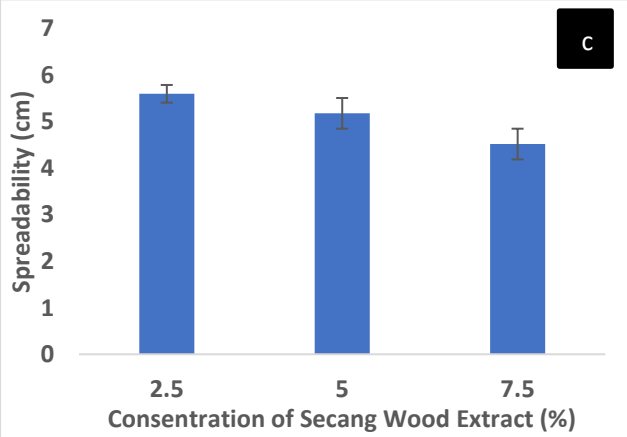
Material	Formula (%)		
	I	II	III
Secang Wood Extract	2,5	5	7,5
CMC Na	1,26	1,26	1,26
PVA	6,74	6,74	6,74
Propilenglikol	4	4	4
Aqua destilata ad	100	100	100

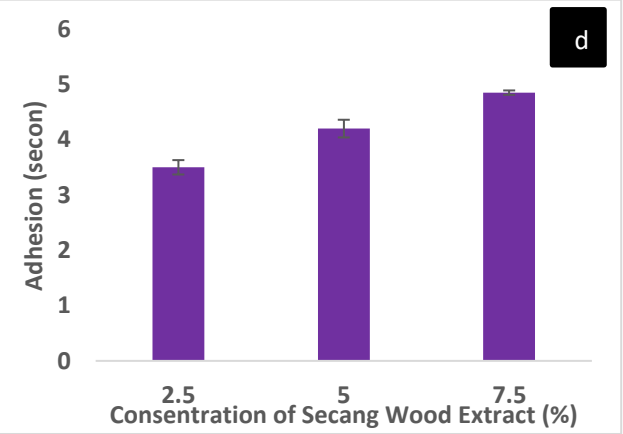
Table 2. Characterization and Antioxidant Activity of Peel Off Gel Mask Secang Wood Extract

Evaluation	Formula		
	I	II	III
Organoleptic	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell	Consistency thick and soft, colour orange, odor secang smell
Homogeneity	Homogeneous	Homogeneous	Homogeneous


a
pH
7
6
5
4
3
2
1
0
2.5
5
7.5
Consentration of Secang Wood Extract (%)


b
Viscosity (cPs)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
2.5
5
7.5
Consentration of Secang Wood Extract (%)


c
Spreadability (cm)
7
6
5
4
3
2
1
0
2.5
5
7.5
Consentration of Secang Wood Extract (%)


d
Adhesion (secon)
6
5
4
3
2
1
0
2.5
5
7.5
Consentration of Secang Wood Extract (%)

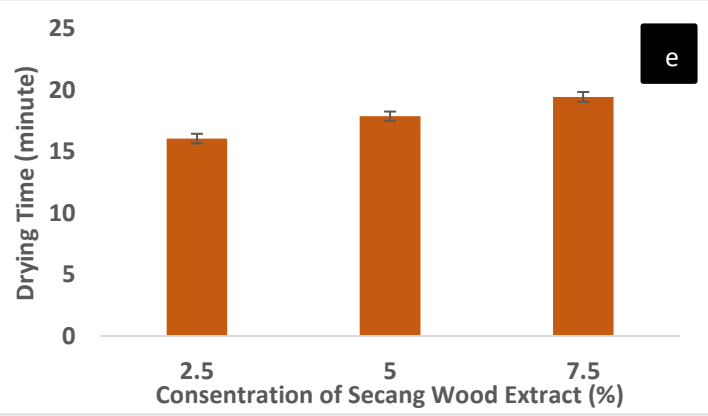

e
Drying Time (minute)
25
20
15
10
5
0
2.5
5
7.5
Consentration of Secang Wood Extract (%)

Figure 1. Characterizationof Peel Off Gel Mask Secang Wood Extract: (a) pH, (b) Viscosity, (c) Spreadability, (d) Adhesion and (e) Drying Time

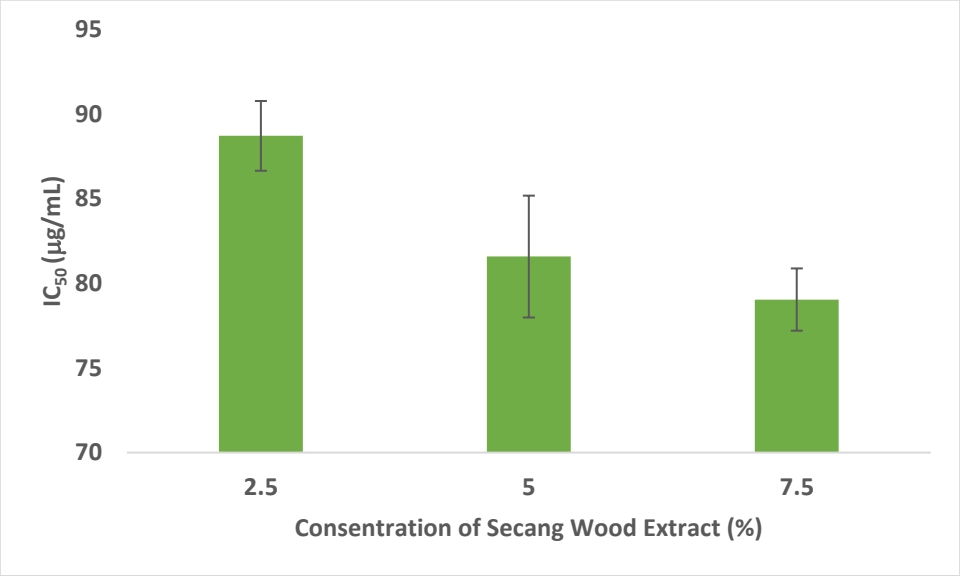


Figure 2. Antioxidant activity (IC_{50}) of Peel Off Gel Mask Secang Wood Extract

BUKTI KORESPONDENSI
DATA HASIL

Evaluation	Consentration of Secang Wood Extract (%)					
	Formula I		Formula II		Formula III	
	average	SD	average	SD	average	SD
pH	6.4	0.16	5.85	0.48	5.09	0.35
Viscosity (cPs)	11986.4	6.02	13992.6	5.13	15993.2	5.36
Spreadability (cm)	5.6	0.19	5.18	0.33	4.52	0.33
Adhesion (secon)	3.5	0.13	4.2	0.16	4.85	0.04
Drying Time (minute)	16.06	0.39	17.88	0.38	19.45	0.4
IC50 (mg/mL)	88.71	2.06	81.58	3.6	79.04	1.84

BUKTI KORESPONDENSI MINOR REVISION REQUEST FROM THE AUTHOR ON COPYEDITING RESULTS

Formulation and Characterization of Peel-Off Gel Mask Containing Secang (*Caesalpinia sappan* L.) Wood Extract with Strong Antioxidant Activity
Formulasi dan Karakterisasi Masker Gel Peel-Off Mengandung Ekstrak Kayu Secang (*Caesalpinia sappan* L.) dengan Aktivitas Antioksidan yang Kuat

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Abstract

Secang (*Caesalpinia sappan* L.) wood contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan chalcone, which act as primary and secondary antioxidants. Antioxidants are substances that can inhibit oxidation reactions by neutralizing free radicals. Enhancing the antioxidant potential of *C. sappan* wood can be achieved by developing a topical dosage form. Peel-off gel masks are an ideal form due to their ability to improve skin health and provide ease and comfort in application. This study aimed to formulate a peel-off gel mask containing *C. sappan* extract and evaluate its physical properties and antioxidant activity. The formulations were prepared using 2.5%, 5%, and 7.5% extract with sodium carboxymethyl cellulose, polyvinyl alcohol, and propylene glycol as the base. The resulting masks were assessed for physical characteristics (pH, viscosity, spreadability, adhesiveness, and drying time) and antioxidant activity using the DPPH method. The results indicated that increasing the extract concentration significantly ($p < 0.05$) increased viscosity, adhesiveness, and drying time, while decreasing pH, spreadability, and IC_{50} value. All formulations demonstrated strong antioxidant activity (IC_{50} between 50–100 µg/mL), with IC_{50} values of 88.71 µg/mL, 81.58 µg/mL, and 79.04 µg/mL, respectively.

Keywords: *Caesalpinia sappan*, peel-off gel mask, formulation, antioxidant, physical characterization

Abstrak

Kayu secang (*Caesalpinia sappan* L.) mengandung senyawa flavonoid seperti brazilin, 3'-O-metilbrazilin, sappanin chalcone, dan sappan chalcone yang berfungsi sebagai antioksidan primer maupun sekunder. Antioksidan merupakan senyawa yang mampu menghambat reaksi oksidasi dengan menetralkan radikal bebas. Upaya peningkatan potensi antioksidan kayu *C. sappan* dapat dilakukan melalui pengembangan sediaan topikal. Masker gel peel-off merupakan bentuk sediaan yang sesuai karena dapat menjaga kesehatan kulit sekaligus memberikan kenyamanan dan kemudahan saat pemakaian. Penelitian ini bertujuan untuk merumuskan dan mengevaluasi masker gel peel-off yang mengandung ekstrak kayu *C. sappan* berdasarkan karakteristik fisik dan aktivitas antioksidannya. Formulasi dibuat dengan konsentrasi ekstrak 2,5%, 5%, dan 7,5% menggunakan natrium karboksimetil selulosa, polivinil alkohol, dan propilen glikol sebagai basis gel. Evaluasi dilakukan terhadap parameter fisik (pH, viskositas, daya sebar, daya lekat, dan waktu kering) serta aktivitas antioksidan menggunakan metode DPPH. Hasil menunjukkan bahwa peningkatan konsentrasi ekstrak secara signifikan ($p < 0,05$) meningkatkan viskositas, daya lekat, dan waktu kering serta menurunkan pH, daya sebar, dan nilai IC_{50}. Seluruh formula menunjukkan aktivitas

antioksidan yang kuat (IC_{50} antara 50–100 µg/mL), dengan nilai IC_{50} berturut-turut sebesar 88,71 µg/mL, 81,58 µg/mL, dan 79,04 µg/mL.

Kata Kunci: *Caesalpinia sappan*, masker gel peel-off, formulasi, antioksidan, karakteristik fisik

1. Introduction

Air pollution has increased significantly in recent years, with levels rising by up to 20%, and has been identified as a major contributor to various health problems due to prolonged exposure (Wahdaningsih et al., 2015). One of the primary mechanisms through which pollution causes harm is oxidative stress, a condition arising from an overproduction of free radicals in the body. These reactive species can damage biological molecules, highlighting the importance of antioxidants in neutralizing free radicals and preventing oxidative damage, particularly in the skin (Widowati, 2011).

Flavonoids are natural compounds widely recognized for their antioxidant properties. They are capable of scavenging a variety of free radicals, including hydroxyl, peroxide, alkoxyl, superoxide anions, singlet oxygen, and hydrogen peroxide (Utari, 2017). One promising source of flavonoids is the wood of secang (*Caesalpinia sappan* L.), which contains active constituents such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone. These compounds act as both primary and secondary antioxidants. Among them, brazilin has shown particularly strong antioxidant activity, reportedly exceeding that of synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) (Sugiyanto et al., 2013). In previous studies, the extract of *C. sappan* demonstrated strong antioxidant potential with an IC_{50} value of 74.44 µg/mL (Tanzaq et al., 2019).

Facial masks are among the most popular cosmetic products for skin care. However, traditional mask types are often considered less practical due to lengthy application and removal processes. Peel-off gel masks have emerged as a more efficient alternative, offering ease of use, user comfort, and the ability to deliver active ingredients effectively without requiring rinsing (Rahmawanty et al., 2015). Furthermore, peel-off gel formulations have been shown to enhance antioxidant efficacy when natural extracts are incorporated. Successful applications have been reported using extracts such as *Paederia foetida* (Eka et al., 2022), areca seed (*Areca catechu*) (Dwi Mulyani et al., 2023), red spinach (*Amaranthus*

tricolor) leaves (Welly et al., 2022), and mangrove (*Avicennia marina*) leaves (Hasibuan et al., 2024).

Despite its promising properties, the application of *C. sappan* extract in peel-off gel mask formulations remains underexplored. Therefore, the aim of this study was to formulate and evaluate a peel-off gel mask containing *C. sappan*extract, with a focus on its physical characteristics and antioxidant activity. This formulation is expected to serve as a natural, effective skincare solution by maximizing the antioxidant potential of *C. sappan* in a user-friendly topical preparation.

2. Methods

2.1 Materials and Equipment

The materials used in this study included *C. sappan* (secang) wood, 96% ethanol (Merck), sodium carboxymethyl cellulose (CMC-Na), polyvinyl alcohol (PVA), propylene glycol, vitamin C, and 1,1-diphenyl-2-picrylhydrazyl (DPPH).

The instruments employed were a rotary evaporator (Heidolph), standard laboratory glassware (Pyrex), pH meter (Hanna Instruments pH 210 Microprocessor), viscometer (Brookfield DV-I Prime), and UV-Vis spectrophotometer (Shimadzu UV-1240 Mini).

2.2 Extraction of *C. sappan* Wood

Secang wood was extracted by maceration. The wood powder was soaked in 96% ethanol at a ratio of 1:10 (w/v) for 72 hours. The extract was filtered and concentrated using a rotary evaporator until a thick extract was obtained (Tanzaq et al., 2019).

2.3 Formulation of Peel-Off Gel Mask

The peel-off gel mask was formulated using *C. sappan* extract at concentrations of 2.5%, 5%, and 7.5%, as shown in **Table 1**. The gel base consisted of polyvinyl alcohol (PVA), sodium carboxymethyl cellulose (CMC-Na), and propylene glycol. PVA and CMC-Na were dispersed in distilled water heated to 80°C until fully swollen. Afterward, propylene glycol was added and the mixture was stirred until homogeneous. The ethanol extract of *C. sappan* was then incorporated gradually into the base while stirring, and distilled water was added to reach 100% total weight. The final mixture was stirred continuously to ensure uniformity (Cahyani et al., 2025).

Table 1. Composition of Peel-Off Gel Mask Formulations Containing *C. sappan* Extract

Ingredient	Formula I (%)	Formula II (%)	Formula III (%)
C. sappan extract	2.5	5.0	7.5
Sodium CMC (CMC-Na)	1.26	1.26	1.26
Polyvinyl alcohol (PVA)	6.74	6.74	6.74
Propylene glycol	4.0	4.0	4.0
Distilled water (ad)	100	100	100

2.4 Evaluation of Physical Characteristics

The physical characteristics of the peel-off gel masks were evaluated to assess their suitability as topical cosmetic formulations. Organoleptic properties including color, odor, and consistency were observed visually, while homogeneity was examined by spreading a small sample of the gel on a glass slide to check for uniform dispersion of components (Syam et al., 2021).

The pH of each formulation was measured by immersing the electrode of a calibrated digital pH meter into the gel and recording the stabilized value (Andini et al., 2017). Viscosity was determined using a Brookfield viscometer equipped with spindle number 64, operated at a speed of 1 rpm. A viscosity range of 2000–50000 cps is considered acceptable for peel-off gel masks (SNI 16-4399-1996).

To evaluate spreadability, 0.5 g of the formulation were placed at the center of a glass plate, then covered with another glass plate of known weight. The diameter of the spread was measured, and additional weight was added incrementally until the diameter stabilized. Adhesiveness was assessed by placing a 0.25 g sample between two glass slides, applying a 100 g load for five minutes, and measuring the time it took for the plates to separate after load removal (Syam et al., 2021).

The drying time was tested by applying 0.1 gram of gel to a 2.5 × 2.5 cm area on the inner forearm. The time required for the film to dry completely at room temperature was recorded. An ideal drying time for peel-off gel masks ranges from 15 to 30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity Test Using DPPH Method

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging method. Initially, the maximum

absorbance wavelength (λmax) of the DPPH solution (30 µg/mL) was determined using a UV-Vis spectrophotometer within the 400–800 nm range. The optimal reaction time was also established by reacting a 1:1 volume ratio of vitamin C (as the standard antioxidant) with the DPPH solution and measuring the absorbance over a 60-minute period.

Each sample (0.05 g) was dissolved in methanol and diluted to 50 mL. From this stock solution, working concentrations of 60, 70, 80, 100, and 120 µg/mL were prepared. Equal volumes of the sample solution and DPPH solution (30 µg/mL) were mixed, incubated at room temperature for the predetermined optimal time, and their absorbance measured at the previously identified λmax. The same procedure was applied to vitamin C standard solutions at concentrations of 2, 4, 6, 8, and 10 µg/mL.

The percentage inhibition of DPPH radicals was calculated for each concentration, and the IC_{50} value—the concentration required to inhibit 50% of the DPPH radicals—was determined by linear regression analysis of the inhibition percentage versus sample concentration (Maharani et al., 2022).

2.6 Data Analysis

The evaluation of the peel-off gel mask formulations was conducted using descriptive analysis. Observational data such as organoleptic characteristics and homogeneity were assessed qualitatively. Physical parameters including pH, viscosity, spreadability, adhesiveness, and drying time were compared across formulations to identify trends related to increasing concentrations of *C. sappan* extract. Similarly, antioxidant activity data were interpreted by comparing the IC_{50} values of each formulation. The significance of observed changes was discussed in terms of their relative magnitude and consistency rather than based on formal statistical tests.

3. Results and Discussion

3.1 Physical Characteristics of Peel Off Gel Mask Containing *C. sappan* Extract

Caesalpinia sappan has traditionally been recognized for its therapeutic properties, including antibacterial, anti-inflammatory, antidiabetic, and antioxidant effects. The ethanol extract of *C. sappan* contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone, which contribute to its strong antioxidant profile (Ngamwonglumlert & Devahastin, 2023). In this study, peel-off gel mask formulations containing *C.*

sappan extract at concentrations of 2.5%, 5%, and 7.5% were developed and evaluated for their physical properties.

The organoleptic and homogeneity observations showed that all formulations had a consistent orange color, a characteristic *C. sappan* odor, and a smooth, thick consistency. Each gel was visually homogeneous, indicating even distribution of ingredients throughout the formulation.

Figure 1 illustrates the physical properties of the three formulations. The pH values decreased slightly as the extract concentration increased. This trend is attributed to the acidic nature of *C. sappan* extract (Muslimin et al., 2024), which becomes more influential as the proportion of extract rises. The viscosity of the gels increased progressively with extract concentration, affecting other parameters such as spreadability, adhesiveness, and drying time. A higher viscosity reduced spreadability but enhanced adhesiveness and prolonged the drying time. These relationships are evident in the trends presented in Figure 1.

Such changes in physical characteristics are consistent with the structural influence of extract constituents and the thickening effect they exert in the gel base. Although no statistical tests were applied, the consistent trends across all parameters support the influence of *C. sappan* extract concentration on the physical performance of the peel-off mask.

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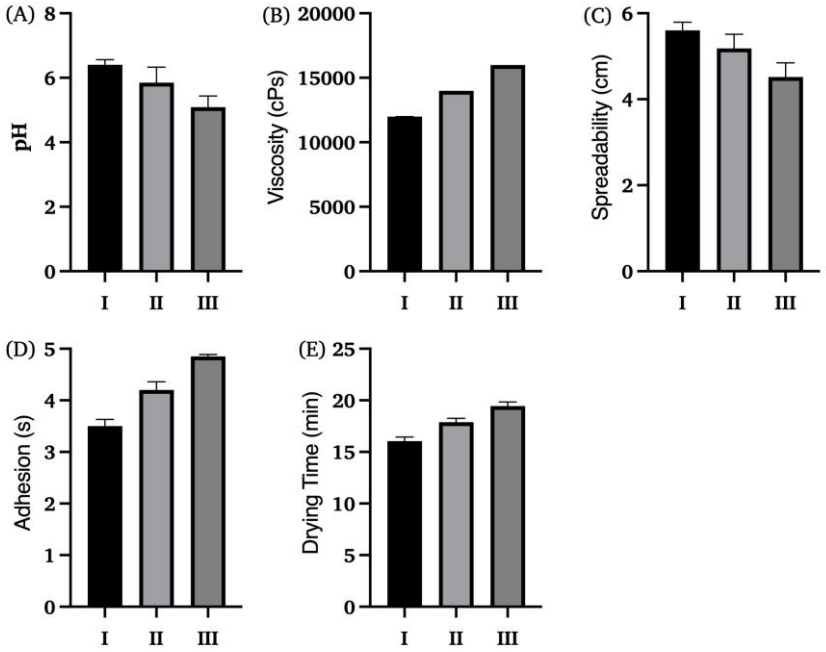

Figure 1. Physical characteristics of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%): (a) pH, (b) viscosity, (c) spreadability, (d) adhesiveness, and (e) drying time.

3.2 Antioxidant Activity of Peel-Off Gel Mask Containing *C. sappan* Extract

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH free radical scavenging assay. All formulations demonstrated strong antioxidant capacity, with IC_{50} values within the range of 50–100 µg/mL, indicating effective radical scavenging potential.

As shown in **Figure 2**, the IC_{50} values decreased with increasing extract concentration: 88.71 µg/mL for Formulation I (2.5%), 81.58 µg/mL for Formulation II (5.0%), and 79.04 µg/mL for Formulation III (7.5%). This trend suggests that higher concentrations of *C. sappan* extract contribute to enhanced antioxidant performance, likely due to increased levels of flavonoid compounds such as brazilin.

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Although statistical testing was not applied, the progressive decrease in IC_{50} values clearly indicates the influence of extract concentration on antioxidant activity. These results are consistent with the literature, which identifies *C. sappan* as a potent natural antioxidant source (Tanzaq et al., 2019). Compared to its pure extract IC_{50} value of 74.44 µg/mL, the formulated gels retained high antioxidant potential. However, when compared to vitamin C (IC_{50} = 3.04 µg/mL), the formulations were less potent, which is expected given the superior radical scavenging efficiency of pure ascorbic acid.

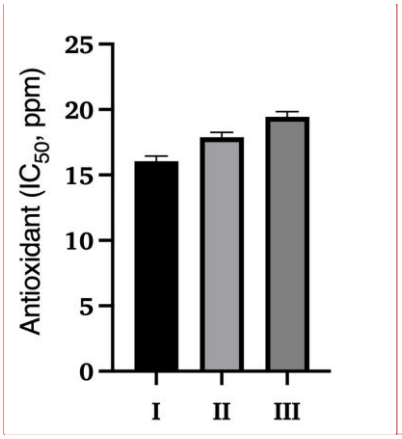

Figure 2. IC_{50} values of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%).

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4. Conclusion

This study demonstrated that peel-off gel masks containing *C. sappan* extract can be effectively formulated using polyvinyl alcohol, sodium carboxymethyl cellulose, and propylene glycol as base components. Increasing the extract concentration from 2.5% to 7.5% affected the physical properties of the formulation by increasing viscosity, adhesiveness, and drying time, while decreasing pH and spreadability. All formulations exhibited strong antioxidant activity, with IC_{50} values ranging from 88.71 to 79.04 µg/mL, indicating that higher extract concentrations enhance antioxidant performance. Overall, the 7.5% extract formulation showed the most favorable combination of physical characteristics and antioxidant activity, supporting its potential as a natural, effective peel-off gel mask for skin health applications.

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BUKTI KORESPONDENSI CONFIRMATION OF REVISION – FIGURE 2 ADJUSTMENT AND UNIT CORRECTION

Formulation and Characterization of Peel-Off Gel Mask Containing Secang (*Caesalpinia sappan* L.) Wood Extract with Strong Antioxidant Activity

Formulasi dan Karakterisasi Masker Gel Peel-Off Mengandung Ekstrak Kayu Secang (*Caesalpinia sappan* L.) dengan Aktivitas Antioksidan yang Kuat

Intan Martha Cahyani[1*], Tan Tanando Tanzaq[1], Ruth Ditya Agustina[1], Kemala Endar Setiawati[1]
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Abstract

Secang (*Caesalpinia sappan* L.) wood contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan chalcone, which act as primary and secondary antioxidants. Antioxidants are substances that can inhibit oxidation reactions by neutralizing free radicals. Enhancing the antioxidant potential of *C. sappan* wood can be achieved by developing a topical dosage form. Peel-off gel masks are an ideal form due to their ability to improve skin health and provide ease and comfort in application. This study aimed to formulate a peel-off gel mask containing *C. sappan* extract and evaluate its physical properties and antioxidant activity. The formulations were prepared using 2.5%, 5%, and 7.5% extract with sodium carboxymethyl cellulose, polyvinyl alcohol, and propylene glycol as the base. The resulting masks were assessed for physical characteristics (pH, viscosity, spreadability, adhesiveness, and drying time) and antioxidant activity using the DPPH method. The results indicated that increasing the extract concentration significantly ($p < 0.05$) increased viscosity, adhesiveness, and drying time, while decreasing pH, spreadability, and IC_{50} value. All formulations demonstrated strong antioxidant activity (IC_{50} between 50–100 µg/mL), with IC_{50} values of 88.71 µg/mL, 81.58 µg/mL, and 79.04 µg/mL, respectively.

Keywords: *Caesalpinia sappan*, peel-off gel mask, formulation, antioxidant, physical characterization

Abstrak

Kayu secang (*Caesalpinia sappan* L.) mengandung senyawa flavonoid seperti brazilin, 3'-O-metilbrazilin, sappanin chalcone, dan sappan chalcone yang berfungsi sebagai antioksidan primer maupun sekunder. Antioksidan merupakan senyawa yang mampu menghambat reaksi oksidasi dengan menetralkan radikal bebas. Upaya peningkatan potensi antioksidan kayu *C. sappan* dapat dilakukan melalui pengembangan sediaan topikal. Masker gel peel-off merupakan bentuk sediaan yang sesuai karena dapat menjaga kesehatan kulit sekaligus memberikan kenyamanan dan kemudahan saat pemakaian. Penelitian ini bertujuan untuk merumuskan dan mengevaluasi masker gel peel-off yang mengandung ekstrak kayu *C. sappan* berdasarkan karakteristik fisik dan aktivitas antioksidannya. Formulasi dibuat dengan konsentrasi ekstrak 2,5%, 5%, dan 7,5% menggunakan natrium karboksimetil selulosa, polivinil alkohol, dan propilen glikol sebagai basis gel. Evaluasi dilakukan terhadap parameter fisik (pH, viskositas, daya sebar, daya lekat, dan waktu kering) serta aktivitas antioksidan menggunakan metode DPPH. Hasil menunjukkan bahwa peningkatan konsentrasi ekstrak secara signifikan ($p < 0,05$) meningkatkan viskositas, daya lekat, dan waktu kering serta menurunkan pH, daya sebar, dan nilai IC_{50}. Seluruh formula menunjukkan aktivitas

antioksidan yang kuat (IC_{50} antara 50–100 µg/mL), dengan nilai IC_{50} berturut-turut sebesar 88,71 µg/mL, 81,58 µg/mL, dan 79,04 µg/mL.

Kata Kunci: *Caesalpinia sappan*, masker gel peel-off, formulasi, antioksidan, karakteristik fisik

1. Introduction

Air pollution has increased significantly in recent years, with levels rising by up to 20%, and has been identified as a major contributor to various health problems due to prolonged exposure (Wahdaningsih et al., 2015). One of the primary mechanisms through which pollution causes harm is oxidative stress, a condition arising from an overproduction of free radicals in the body. These reactive species can damage biological molecules, highlighting the importance of antioxidants in neutralizing free radicals and preventing oxidative damage, particularly in the skin (Widowati, 2011).

Flavonoids are natural compounds widely recognized for their antioxidant properties. They are capable of scavenging a variety of free radicals, including hydroxyl, peroxide, alkoxyl, superoxide anions, singlet oxygen, and hydrogen peroxide (Utari, 2017). One promising source of flavonoids is the wood of secang (*Caesalpinia sappan* L.), which contains active constituents such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone. These compounds act as both primary and secondary antioxidants. Among them, brazilin has shown particularly strong antioxidant activity, reportedly exceeding that of synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) (Sugiyanto et al., 2013). In previous studies, the extract of *C. sappan* demonstrated strong antioxidant potential with an IC_{50} value of 74.44 µg/mL (Tanzaq et al., 2019).

Facial masks are among the most popular cosmetic products for skin care. However, traditional mask types are often considered less practical due to lengthy application and removal processes. Peel-off gel masks have emerged as a more efficient alternative, offering ease of use, user comfort, and the ability to deliver active ingredients effectively without requiring rinsing (Rahmawanty et al., 2015). Furthermore, peel-off gel formulations have been shown to enhance antioxidant efficacy when natural extracts are incorporated. Successful applications have been reported using extracts such as *Paederia foetida* (Eka et al., 2022), areca seed (*Areca catechu*) (Dwi Mulyani et al., 2023), red spinach (*Amaranthus*

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Despite its promising properties, the application of *C. sappan* extract in peel-off gel mask formulations remains underexplored. Therefore, the aim of this study was to formulate and evaluate a peel-off gel mask containing *C. sappan*extract, with a focus on its physical characteristics and antioxidant activity. This formulation is expected to serve as a natural, effective skincare solution by maximizing the antioxidant potential of *C. sappan* in a user-friendly topical preparation.

2. Methods

2.1 Materials and Equipment

The materials used in this study included *C. sappan* (secang) wood, 96% ethanol (Merck), sodium carboxymethyl cellulose (CMC-Na), polyvinyl alcohol (PVA), propylene glycol, vitamin C, and 1,1-diphenyl-2-picrylhydrazyl (DPPH).

The instruments employed were a rotary evaporator (Heidolph), standard laboratory glassware (Pyrex), pH meter (Hanna Instruments pH 210 Microprocessor), viscometer (Brookfield DV-I Prime), and UV-Vis spectrophotometer (Shimadzu UV-1240 Mini).

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The peel-off gel mask was formulated using *C. sappan* extract at concentrations of 2.5%, 5%, and 7.5%, as shown in **Table 1**. The gel base consisted of polyvinyl alcohol (PVA), sodium carboxymethyl cellulose (CMC-Na), and propylene glycol. PVA and CMC-Na were dispersed in distilled water heated to 80°C until fully swollen. Afterward, propylene glycol was added and the mixture was stirred until homogeneous. The ethanol extract of *C. sappan* was then incorporated gradually into the base while stirring, and distilled water was added to reach 100% total weight. The final mixture was stirred continuously to ensure uniformity (Cahyani et al., 2025).

Table 1. Composition of Peel-Off Gel Mask Formulations Containing *C. sappan* Extract

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Sodium CMC (CMC-Na)	1.26	1.26	1.26
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The drying time was tested by applying 0.1 gram of gel to a 2.5 × 2.5 cm area on the inner forearm. The time required for the film to dry completely at room temperature was recorded. An ideal drying time for peel-off gel masks ranges from 15 to 30 minutes (Silvia et al., 2021).

2.5 Antioxidant Activity Test Using DPPH Method

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging method. Initially, the maximum

absorbance wavelength (λmax) of the DPPH solution (30 µg/mL) was determined using a UV-Vis spectrophotometer within the 400–800 nm range. The optimal reaction time was also established by reacting a 1:1 volume ratio of vitamin C (as the standard antioxidant) with the DPPH solution and measuring the absorbance over a 60-minute period.

Each sample (0.05 g) was dissolved in methanol and diluted to 50 mL. From this stock solution, working concentrations of 60, 70, 80, 100, and 120 µg/mL were prepared. Equal volumes of the sample solution and DPPH solution (30 µg/mL) were mixed, incubated at room temperature for the predetermined optimal time, and their absorbance measured at the previously identified λmax. The same procedure was applied to vitamin C standard solutions at concentrations of 2, 4, 6, 8, and 10 µg/mL.

The percentage inhibition of DPPH radicals was calculated for each concentration, and the IC_{50} value—the concentration required to inhibit 50% of the DPPH radicals—was determined by linear regression analysis of the inhibition percentage versus sample concentration (Maharani et al., 2022).

2.6 Data Analysis

The evaluation of the peel-off gel mask formulations was conducted using descriptive analysis. Observational data such as organoleptic characteristics and homogeneity were assessed qualitatively. Physical parameters including pH, viscosity, spreadability, adhesiveness, and drying time were compared across formulations to identify trends related to increasing concentrations of *C. sappan* extract. Similarly, antioxidant activity data were interpreted by comparing the IC_{50} values of each formulation. The significance of observed changes was discussed in terms of their relative magnitude and consistency rather than based on formal statistical tests.

3. Results and Discussion

3.1 Physical Characteristics of Peel Off Gel Mask Containing *C. sappan* Extract

Caesalpinia sappan has traditionally been recognized for its therapeutic properties, including antibacterial, anti-inflammatory, antidiabetic, and antioxidant effects. The ethanol extract of *C. sappan* contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone, which contribute to its strong antioxidant profile (Ngamwonglumlert & Devahastin, 2023). In this study, peel-off gel mask formulations containing *C.*

sappan extract at concentrations of 2.5%, 5%, and 7.5% were developed and evaluated for their physical properties.

The organoleptic and homogeneity observations showed that all formulations had a consistent orange color, a characteristic *C. sappan* odor, and a smooth, thick consistency. Each gel was visually homogeneous, indicating even distribution of ingredients throughout the formulation.

Figure 1 illustrates the physical properties of the three formulations. The pH values decreased slightly as the extract concentration increased. This trend is attributed to the acidic nature of *C. sappan* extract (Muslimin et al., 2024), which becomes more influential as the proportion of extract rises. The viscosity of the gels increased progressively with extract concentration, affecting other parameters such as spreadability, adhesiveness, and drying time. A higher viscosity reduced spreadability but enhanced adhesiveness and prolonged the drying time. These relationships are evident in the trends presented in Figure 1.

Such changes in physical characteristics are consistent with the structural influence of extract constituents and the thickening effect they exert in the gel base. Although no statistical tests were applied, the consistent trends across all parameters support the influence of *C. sappan* extract concentration on the physical performance of the peel-off mask.

BUKTI KORESPONDENSI CONFIRMATION OF REVISION – FIGURE 2 ADJUSTMENT AND UNIT CORRECTION

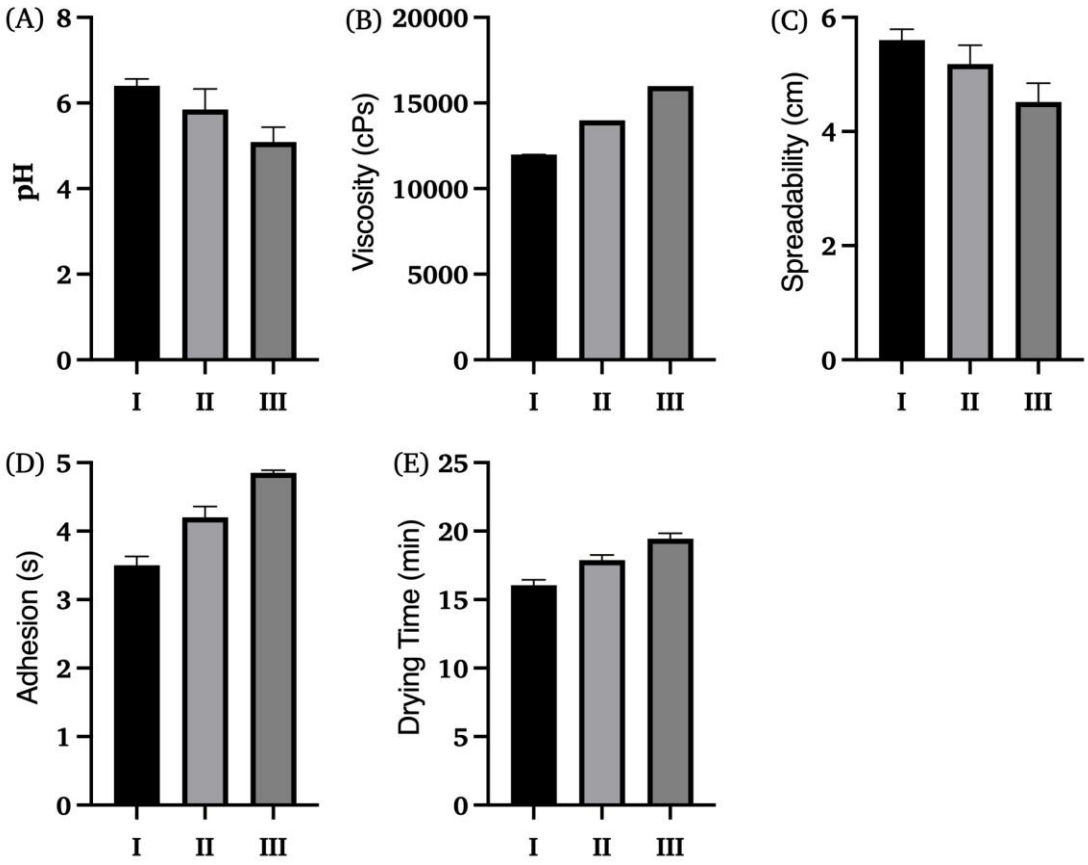

Figure 1. Physical characteristics of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%): (a) pH, (b) viscosity, (c) spreadability, (d) adhesiveness, and (e) drying time.

3.2 Antioxidant Activity of Peel-Off Gel Mask Containing *C. sappan* Extract

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH free radical scavenging assay. All formulations demonstrated strong antioxidant capacity, with IC_{50} values within the range of 50–100 µg/mL, indicating effective radical scavenging potential.

As shown in **Figure 2**, the IC_{50} values decreased with increasing extract concentration: 88.71 µg/mL for Formulation I (2.5%), 81.58 µg/mL for Formulation II (5.0%), and 79.04 µg/mL for Formulation III (7.5%). This trend suggests that higher concentrations of *C. sappan* extract contribute to enhanced antioxidant performance, likely due to increased levels of flavonoid compounds such as brazilin.

BUKTI KORESPONDENSI CONFIRMATION OF REVISION – FIGURE 2 ADJUSTMENT AND UNIT CORRECTION

Although statistical testing was not applied, the progressive decrease in IC_{50} values clearly indicates the influence of extract concentration on antioxidant activity. These results are consistent with the literature, which identifies *C. sappan* as a potent natural antioxidant source (Tanzaq et al., 2019). Compared to its pure extract IC_{50} value of 74.44 µg/mL, the formulated gels retained high antioxidant potential. However, when compared to vitamin C (IC_{50} = 3.04 µg/mL), the formulations were less potent, which is expected given the superior radical scavenging efficiency of pure ascorbic acid.

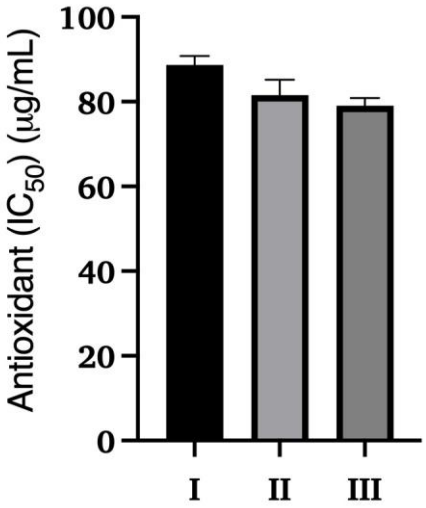

Figure 2. IC_{50} values of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%).

4. Conclusion

This study demonstrated that peel-off gel masks containing *C. sappan* extract can be effectively formulated using polyvinyl alcohol, sodium carboxymethyl cellulose, and propylene glycol as base components. Increasing the extract concentration from 2.5% to 7.5% affected the physical properties of the formulation by increasing viscosity, adhesiveness, and drying time, while decreasing pH and spreadability. All formulations exhibited strong antioxidant activity, with IC_{50} values ranging from 88.71 to 79.04 µg/mL, indicating that higher extract concentrations enhance antioxidant performance. Overall, the 7.5% extract formulation showed the most favorable combination of physical characteristics and antioxidant activity, supporting its potential as a natural, effective peel-off gel mask for skin health applications.

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Formulation and Characterization of Peel-Off Gel Mask Containing Secang (*Caesalpinia sappan* L.) Wood Extract with Strong Antioxidant Activity

[Formulasi dan Karakterisasi Masker Gel Peel-Off Mengandung Ekstrak Kayu Secang (*Caesalpinia sappan* L.) dengan Aktivitas Antioksidan yang Kuat]

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ABSTRACT

Secang (*Caesalpinia sappan* L.) wood contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan chalcone, which act as primary and secondary antioxidants. Antioxidants are substances that can inhibit oxidation reactions by neutralizing free radicals. Enhancing the antioxidant potential of *C. sappan* wood can be achieved by developing a topical dosage form. Peel-off gel masks are an ideal form due to their ability to improve skin health and provide ease and comfort in application. This study aimed to formulate a peel-off gel mask containing *C. sappan* extract and evaluate its physical properties and antioxidant activity. The formulations were prepared using 2.5%, 5%, and 7.5% extract with sodium carboxymethyl cellulose, polyvinyl alcohol, and propylene glycol as the base. The resulting masks were assessed for physical characteristics (pH, viscosity, spreadability, adhesiveness, and drying time) and antioxidant activity using the DPPH method. The results indicated that increasing the extract concentration significantly ($p < 0.05$) increased viscosity, adhesiveness, and drying time, while decreasing pH, spreadability, and IC_{50} value. All formulations demonstrated strong antioxidant activity (IC_{50} between 50–100 µg/mL), with IC_{50} values of 88.71 µg/mL, 81.58 µg/mL, and 79.04 µg/mL, respectively.

ABSTRAK

Kayu secang (*Caesalpinia sappan* L.) mengandung senyawa flavonoid seperti brazilin, 3'-O-metilbrazilin, sappanin chalcone, dan sappan chalcone yang berfungsi sebagai antioksidan primer maupun sekunder. Antioksidan merupakan senyawa yang mampu menghambat reaksi oksidasi dengan menetralkan radikal bebas. Upaya peningkatan potensi antioksidan kayu *C. sappan* dapat dilakukan melalui pengembangan sediaan topikal. Masker gel peel-off merupakan bentuk sediaan yang sesuai karena dapat menjaga kesehatan kulit sekaligus memberikan kenyamanan dan kemudahan saat pemakaian. Penelitian ini bertujuan untuk merumuskan dan mengevaluasi masker gel peel-off yang mengandung ekstrak kayu *C. sappan* berdasarkan karakteristik fisik dan aktivitas antioksidannya. Formulasi dibuat dengan konsentrasi ekstrak 2,5%, 5%, dan 7,5% menggunakan natrium karboksimetil selulosa, polivinil alkohol, dan propilen glikol sebagai basis gel. Evaluasi dilakukan terhadap parameter fisik (pH, viskositas, daya sebar, daya lekat, dan waktu kering) serta aktivitas antioksidan menggunakan metode DPPH. Hasil menunjukkan bahwa peningkatan konsentrasi ekstrak secara signifikan ($p < 0,05$) meningkatkan viskositas, daya lekat, dan waktu kering serta menurunkan pH, daya sebar, dan nilai IC_{50}. Seluruh formula menunjukkan aktivitas antioksidan yang kuat (IC_{50} antara 50–100 µg/mL), dengan nilai IC_{50} berturut-turut sebesar 88,71 µg/mL, 81,58 µg/mL, dan 79,04 µg/mL.

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1. INTRODUCTION

Air pollution has increased significantly in recent years, with levels rising by up to 20%, and has been identified as a major contributor to various health problems due to prolonged exposure (Wahdaningsih et al., 2015). One of the primary mechanisms through which pollution causes harm is oxidative stress, a condition arising from an overproduction of free radicals in the body. These reactive species can damage biological molecules, highlighting the importance of antioxidants in neutralizing free radicals and preventing oxidative damage, particularly in the skin (Widowati, 2011).

Flavonoids are natural compounds widely recognized for their antioxidant properties. They are capable of scavenging a variety of free radicals, including hydroxyl, peroxide, alkoxyl, superoxide anions, singlet oxygen, and hydrogen peroxide (Utari, 2017). One promising source of flavonoids is the wood of secang (*Caesalpinia sappan* L.), which contains active constituents such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone. These compounds act as both primary and secondary antioxidants. Among them, brazilin has shown particularly strong antioxidant activity, reportedly exceeding that of synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) (Sugiyanto et al., 2013). In previous studies, the extract of *C. sappan* demonstrated strong antioxidant potential with an IC_{50} value of 74.44 µg/mL (Tanzaq et al., 2019).

Facial masks are among the most popular cosmetic products for skin care. However, traditional mask types are often considered less practical due to lengthy application and removal processes. Peel-off gel masks have emerged as a more efficient alternative, offering ease of use, user comfort, and the ability to deliver active ingredients effectively without requiring rinsing (Rahmawanty et al., 2015). Furthermore, peel-off gel

formulations have been shown to enhance antioxidant efficacy when natural extracts are incorporated. Successful applications have been reported using extracts such as *Paederia foetida* (Eka et al., 2022), areca seed (*Areca catechu*) (Dwi Mulyani et al., 2023), red spinach (*Amaranthus tricolor*) leaves (Welly et al., 2022), and mangrove (*Avicennia marina*) leaves (Hasibuan et al., 2024).

Despite its promising properties, the application of *C. sappan* extract in peel-off gel mask formulations remains underexplored. Therefore, the aim of this study was to formulate and evaluate a peel-off gel mask containing *C. sappan*extract, with a focus on its physical characteristics and antioxidant activity. This formulation is expected to serve as a natural, effective skincare solution by maximizing the antioxidant potential of *C. sappan* in a user-friendly topical preparation.

2. METHOD

2.1. Materials and Equipment

The materials used in this study included *C. sappan* (secang) wood, 96% ethanol (Merck), sodium carboxymethyl cellulose (CMC-Na), polyvinyl alcohol (PVA), propylene glycol, vitamin C, and 1,1-diphenyl-2-picrylhydrazyl (DPPH).

The instruments employed were a rotary evaporator (Heidolph), standard laboratory glassware (Pyrex), pH meter (Hanna Instruments pH 210 Microprocessor), viscometer (Brookfield DV-I Prime), and UV-Vis spectrophotometer (Shimadzu UV-1240 Mini).

2.2. Extraction of *C. sappan* Wood

Secang wood was extracted by maceration. The wood powder was soaked in 96% ethanol at a ratio of 1:10 (w/v) for 72 hours. The extract was filtered and concentrated using a rotary evaporator until a thick extract was obtained (Tanzaq et al., 2019).

2.3. Formulation of Peel-Off Gel Mask

The peel-off gel mask was formulated using *C. sappan* extract at concentrations of 2.5%, 5%, and 7.5%, as shown in **Table 1**. The gel base consisted of polyvinyl alcohol (PVA), sodium carboxymethyl cellulose (CMC-Na), and propylene glycol. PVA and CMC-Na were dispersed in distilled water heated to 80°C until fully swollen. Afterward, propylene glycol was added and the mixture was stirred until homogeneous. The ethanol extract of *C. sappan* was then incorporated gradually into the base while stirring, and distilled water was added to reach 100% total weight. The final mixture was stirred continuously to ensure uniformity (Cahyani et al., 2025).

Table 1. Composition of Peel-Off Gel Mask Formulations Containing *C. sappan* Extract

Ingredient	Formula I (%)	Formula II (%)	Formula III (%)
C. sappan extract	2.5	5.0	7.5
Sodium CMC (CMC-Na)	1.26	1.26	1.26
Polyvinyl alcohol (PVA)	6.74	6.74	6.74
Propylene glycol	4.0	4.0	4.0
Distilled water (ad)	100	100	100

2.4. Evaluation of Physical Characteristics

The physical characteristics of the peel-off gel masks were evaluated to assess their suitability as topical cosmetic formulations. Organoleptic properties including color, odor, and consistency were observed visually, while homogeneity was examined by spreading a small sample of the gel on a glass slide to check for uniform dispersion of components (Syam et al., 2021).

The pH of each formulation was measured by immersing the electrode of a calibrated digital pH meter into the gel and recording the stabilized value (Andini et al., 2017). Viscosity was determined using a Brookfield viscometer equipped with spindle number 64, operated at a speed of 1 rpm. A viscosity range of 2000–50000 cps is considered acceptable for peel-off gel masks (SNI 16-4399-1996).

To evaluate spreadability, 0.5 g of the formulation were placed at the center of a glass plate, then covered with another glass plate of known weight. The diameter of the spread was measured, and additional weight was added incrementally until the diameter stabilized. Adhesiveness was assessed by placing a 0.25 g sample between two glass slides, applying a 100 g load for five minutes, and measuring the time it took for the plates to separate after load removal (Syam et al., 2021).

The drying time was tested by applying 0.1 gram of gel to a 2.5 × 2.5 cm area on the inner forearm. The time required for the film to dry completely at room temperature was recorded. An ideal drying time for peel-off gel masks ranges from 15 to 30 minutes (Silvia et al., 2021).

2.5. Antioxidant Activity Test Using DPPH Method

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging method. Initially, the maximum absorbance wavelength (λmax) of the DPPH solution (30 µg/mL) was determined using a UV-Vis spectrophotometer within the 400–800 nm range. The optimal reaction time was also established by reacting a 1:1 volume ratio of vitamin C (as the standard antioxidant) with the DPPH solution and measuring the absorbance over a 60-minute period.

Each sample (0.05 g) was dissolved in methanol and diluted to 50 mL. From this stock solution, working concentrations of 60, 70, 80, 100, and 120 µg/mL were prepared. Equal volumes of the sample solution and DPPH solution (30 µg/mL) were mixed, incubated at room temperature for the predetermined optimal time, and their absorbance measured at the previously identified λmax. The same procedure was applied to vitamin C standard solutions at concentrations of 2, 4, 6, 8, and 10 µg/mL.

The percentage inhibition of DPPH radicals was calculated for each concentration, and the IC_{50} value—the concentration required to inhibit 50% of the DPPH radicals—was determined by linear regression analysis of the inhibition percentage versus sample concentration (Maharani et al., 2022).

2.6. Data Analysis

The evaluation of the peel-off gel mask formulations was conducted using descriptive analysis. Observational data such as organoleptic characteristics and homogeneity were assessed qualitatively. Physical parameters including pH, viscosity, spreadability, adhesiveness, and drying time were compared across formulations to identify trends related to increasing concentrations of *C. sappan* extract. Similarly, antioxidant activity data were interpreted by comparing the IC_{50} values of each formulation. The significance of observed changes was discussed in terms of their relative magnitude and consistency rather than based on formal statistical tests.

3. RESULTS AND DISCUSSION

3.1. Physical Characteristics of Peel Off Gel Mask Containing *C. sappan* Extract

Caesalpinia sappan has traditionally been recognized for its therapeutic properties, including antibacterial, anti-inflammatory, antidiabetic, and antioxidant effects. The ethanol extract of *C. sappan* contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone, which contribute to its strong antioxidant profile (Ngamwonglumlert & Devahastin, 2023). In this study, peel-off gel mask formulations containing *C. sappan* extract at concentrations of 2.5%, 5%, and 7.5% were developed and evaluated for their physical properties.

The organoleptic and homogeneity observations showed that all formulations had a consistent orange color, a characteristic *C. sappan* odor, and a smooth, thick consistency. Each gel was visually

homogeneous, indicating even distribution of ingredients throughout the formulation.

Figure 1 illustrates the physical properties of the three formulations. The pH values decreased slightly as the extract concentration increased. This trend is attributed to the acidic nature of *C. sappan* extract (Muslimin et al., 2024), which becomes more influential as the proportion of extract rises. The viscosity of the gels increased progressively with extract concentration, affecting other parameters such as spreadability, adhesiveness, and drying time. A higher viscosity reduced spreadability but enhanced adhesiveness and prolonged the drying time. These relationships are evident in the trends presented in Figure 1.

Such changes in physical characteristics are consistent with the structural influence of extract constituents and the thickening effect they exert in the gel base. Although no statistical tests were applied, the consistent trends across all parameters support the influence of *C. sappan* extract concentration on the physical performance of the peel-off mask.

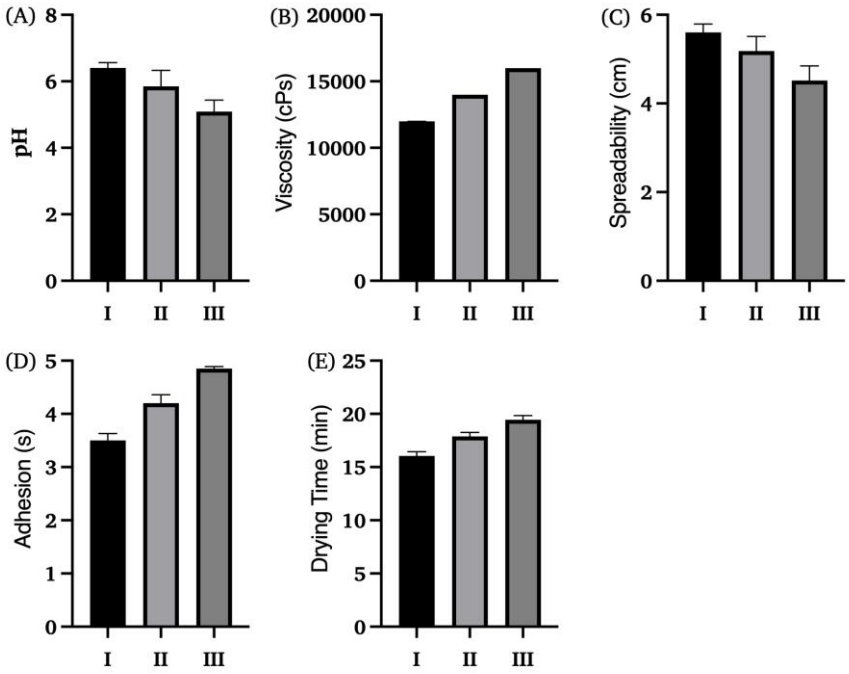

Figure 1. Physical characteristics of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%): (a) pH, (b) viscosity, (c) spreadability, (d) adhesiveness, and (e) drying time.

3.2. Antioxidant Activity of Peel-Off Gel Mask Containing *C. sappan* Extract

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH free radical scavenging assay. All formulations demonstrated strong antioxidant capacity, with IC_{50} values within the range of 50–100 µg/mL, indicating effective radical scavenging potential.

As shown in **Figure 2**, the IC_{50} values decreased with increasing extract concentration: 88.71 µg/mL for Formulation I (2.5%), 81.58 µg/mL for Formulation II (5.0%), and 79.04 µg/mL for Formulation III (7.5%). This trend suggests that higher concentrations of *C. sappan* extract contribute to enhanced antioxidant performance, likely due to increased levels of flavonoid compounds such as brazilin.

Although statistical testing was not applied, the progressive decrease in IC_{50} values clearly indicates the influence of extract concentration on antioxidant activity. These results are consistent with the literature, which identifies *C. sappan* as a potent natural antioxidant source (Tanzaq et al., 2019). Compared to its pure extract IC_{50} value of 74.44 µg/mL, the formulated gels retained high antioxidant potential. However, when compared to vitamin C (IC_{50} = 3.04 µg/mL), the formulations were less potent, which is expected given the superior radical scavenging efficiency of pure ascorbic acid.

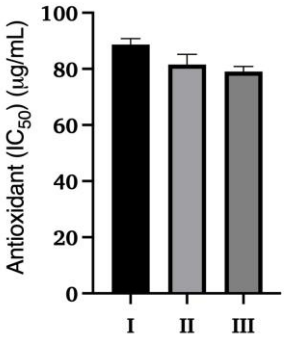

Figure 2. IC_{50} values of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%).

CONCLUSION

This study demonstrated that peel-off gel masks containing *C. sappan* extract can be effectively formulated using polyvinyl alcohol, sodium carboxymethyl cellulose, and propylene glycol as base components. Increasing the extract concentration from 2.5% to 7.5% affected the physical properties of the formulation by increasing viscosity, adhesiveness, and drying time, while decreasing pH and spreadability. All formulations exhibited strong antioxidant activity, with IC_{50} values ranging from 88.71 to 79.04 µg/mL, indicating that higher

extract concentrations enhance antioxidant performance. Overall, the 7.5% extract formulation showed the most favorable combination of physical characteristics and antioxidant activity, supporting its potential as a natural, effective peel-off gel mask for skin health applications.

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Formulation and Characterization of Peel-Off Gel Mask Containing Secang (*Caesalpinia sappan* L.) Wood Extract with Strong Antioxidant Activity

[Formulasi dan Karakterisasi Masker Gel Peel-Off Mengandung Ekstrak Kayu Secang (*Caesalpinia sappan* L.) dengan Aktivitas Antioksidan yang Kuat]

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ABSTRACT

Secang (*Caesalpinia sappan* L.) wood contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin chalcone, and sappan chalcone, which act as primary and secondary antioxidants. Antioxidants are substances that can inhibit oxidation reactions by neutralizing free radicals. Enhancing the antioxidant potential of *C. sappan* wood can be achieved by developing a topical dosage form. Peel-off gel masks are an ideal form due to their ability to improve skin health and provide ease and comfort in application. This study aimed to formulate a peel-off gel mask containing *C. sappan* extract and evaluate its physical properties and antioxidant activity. The formulations were prepared using 2.5%, 5%, and 7.5% extract with sodium carboxymethyl cellulose, polyvinyl alcohol, and propylene glycol as the base. The resulting masks were assessed for physical characteristics (pH, viscosity, spreadability, adhesiveness, and drying time) and antioxidant activity using the DPPH method. The results indicated that increasing the extract concentration significantly ($p < 0.05$) increased viscosity, adhesiveness, and drying time, while decreasing pH, spreadability, and IC_{50} value. All formulations demonstrated strong antioxidant activity (IC_{50} between 50–100 µg/mL), with IC_{50} values of 88.71 µg/mL, 81.58 µg/mL, and 79.04 µg/mL, respectively.

Kata kunci:
Caesalpinia sappan
Masker gel peel-off
Formulasi
Antioksidan
Karakteristik fisik

ABSTRAK

Kayu secang (*Caesalpinia sappan* L.) mengandung senyawa flavonoid seperti brazilin, 3'-O-metilbrazilin, sappanin chalcone, dan sappan chalcone yang berfungsi sebagai antioksidan primer maupun sekunder. Antioksidan merupakan senyawa yang mampu menghambat reaksi oksidasi dengan menetralkan radikal bebas. Upaya peningkatan potensi antioksidan kayu *C. sappan* dapat dilakukan melalui pengembangan sediaan topikal. Masker gel peel-off merupakan bentuk sediaan yang sesuai karena dapat menjaga kesehatan kulit sekaligus memberikan kenyamanan dan kemudahan saat pemakaian. Penelitian ini bertujuan untuk merumuskan dan mengevaluasi masker gel peel-off yang mengandung ekstrak kayu *C. sappan* berdasarkan karakteristik fisik dan aktivitas antioksidannya. Formulasi dibuat dengan konsentrasi ekstrak 2,5%, 5%, dan 7,5% menggunakan natrium karboksimetil selulosa, polivinil alkohol, dan propilen glikol sebagai basis gel. Evaluasi dilakukan terhadap parameter fisik (pH, viskositas, daya sebar, daya lekat, dan waktu kering) serta aktivitas antioksidan menggunakan metode DPPH. Hasil menunjukkan bahwa peningkatan konsentrasi ekstrak secara signifikan ($p < 0,05$) meningkatkan viskositas, daya lekat, dan waktu kering serta menurunkan pH, daya sebar, dan nilai IC_{50}. Seluruh formula menunjukkan aktivitas antioksidan yang kuat (IC_{50} antara 50–100 µg/mL), dengan nilai IC_{50} berturut-turut sebesar 88,71 µg/mL, 81,58 µg/mL, dan 79,04 µg/mL.

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1. INTRODUCTION

Air pollution has increased significantly in recent years, with levels rising by up to 20%, and has been identified as a major contributor to various health problems due to prolonged exposure (Wahdaningsih et al., 2015). One of the primary mechanisms through which pollution causes harm is oxidative stress, a condition arising from an overproduction of free radicals in the body. These reactive species can damage biological molecules, highlighting the importance of antioxidants in neutralizing free radicals and preventing oxidative damage, particularly in the skin (Widowati, 2011).

Flavonoids are natural compounds widely recognized for their antioxidant properties. They are capable of scavenging a variety of free radicals, including hydroxyl, peroxide, alkoxyl, superoxide anions, singlet oxygen, and hydrogen peroxide (Utari, 2017). One promising source of flavonoids is the wood of secang (*Caesalpinia sappan* L.), which contains active constituents such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone. These compounds act as both primary and secondary antioxidants. Among them, brazilin has shown particularly strong antioxidant activity, reportedly exceeding that of synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) (Sugiyanto et al., 2013). In previous studies, the extract of *C. sappan* demonstrated strong antioxidant potential with an IC_{50} value of 74.44 µg/mL (Tanzaq et al., 2019).

Facial masks are among the most popular cosmetic products for skin care. However, traditional mask types are often considered less practical due to lengthy application and removal processes. Peel-off gel masks have emerged as a more efficient alternative, offering ease of use, user comfort, and the ability to deliver active ingredients effectively without requiring rinsing (Rahmawanty et al., 2015). Furthermore, peel-off gel formulations have been shown to enhance antioxidant efficacy when natural extracts are incorporated. Successful applications have been reported using extracts such as *Paederia foetida* (Eka et al., 2022), areca seed (*Areca catechu*) (Dwi Mulyani et al., 2023), red spinach (*Amaranthus tricolor*) leaves (Welly et al., 2022), and mangrove (*Avicennia marina*) leaves (Hasibuan et al., 2024).

Despite its promising properties, the application of *C. sappan* extract in peel-off gel mask formulations remains underexplored. Therefore, the aim of this study was to formulate and evaluate a peel-off gel mask containing *C. sappan*extract, with a focus on its physical characteristics and antioxidant activity. This formulation is expected to serve as a natural, effective skincare solution by maximizing the antioxidant potential of *C. sappan* in a user-friendly topical preparation.

2. METHOD

2.1. Materials and Equipment

The materials used in this study included *C. sappan* (secang) wood, 96% ethanol (Merck), sodium carboxymethyl cellulose (CMC-Na), polyvinyl alcohol (PVA), propylene glycol, vitamin C, and 1,1-diphenyl-2-picrylhydrazyl (DPPH).

The instruments employed were a rotary evaporator (Heidolph), standard laboratory glassware (Pyrex), pH meter (Hanna Instruments pH 210 Microprocessor), viscometer (Brookfield DV-I Prime), and UV-Vis spectrophotometer (Shimadzu UV-1240 Mini).

2.2. Extraction of *C. sappan* Wood

Secang wood was extracted by maceration. The wood powder was soaked in 96% ethanol at a ratio of 1:10 (w/v) for 72 hours. The extract was filtered and concentrated using a rotary evaporator until a thick extract was obtained (Tanzaq et al., 2019).

Table 1. Composition of Peel-Off Gel Mask Formulations Containing *C. sappan* Extract

Ingredient	Formula I (%)	Formula II (%)	Formula III (%)
C. sappan extract	2.5	5.0	7.5
Sodium CMC (CMC-Na)	1.26	1.26	1.26
Polyvinyl alcohol (PVA)	6.74	6.74	6.74
Propylene glycol	4.0	4.0	4.0
Distilled water (ad)	100	100	100

2.3. Formulation of Peel-Off Gel Mask

The peel-off gel mask was formulated using *C. sappan* extract at concentrations of 2.5%, 5%, and 7.5%, as shown in **Table 1**. The gel base consisted of polyvinyl alcohol (PVA), sodium carboxymethyl cellulose (CMC-Na), and propylene glycol. PVA and CMC-Na were dispersed in distilled water heated to 80°C until fully swollen. Afterward, propylene glycol was added and the mixture was stirred until homogeneous. The ethanol extract of *C. sappan* was then incorporated gradually into the base while stirring, and distilled water was added to reach 100% total weight. The final mixture was stirred continuously to ensure uniformity (Cahyani et al., 2025).

2.4. Evaluation of Physical Characteristics

The physical characteristics of the peel-off gel masks were evaluated to assess their suitability as topical cosmetic formulations. Organoleptic properties including color, odor, and

consistency were observed visually, while homogeneity was examined by spreading a small sample of the gel on a glass slide to check for uniform dispersion of components (Syam et al., 2021).

The pH of each formulation was measured by immersing the electrode of a calibrated digital pH meter into the gel and recording the stabilized value (Andini et al., 2017). Viscosity was determined using a Brookfield viscometer equipped with spindle number 64, operated at a speed of 1 rpm. A viscosity range of 2000–50000 cps is considered acceptable for peel-off gel masks (SNI 16-4399-1996).

To evaluate spreadability, 0.5 g of the formulation were placed at the center of a glass plate, then covered with another glass plate of known weight. The diameter of the spread was measured, and additional weight was added incrementally until the diameter stabilized. Adhesiveness was assessed by placing a 0.25 g sample between two glass slides, applying a 100 g load for five minutes, and measuring the time it took for the plates to separate after load removal (Syam et al., 2021).

The drying time was tested by applying 0.1 gram of gel to a 2.5 × 2.5 cm area on the inner forearm. The time required for the film to dry completely at room temperature was recorded. An ideal drying time for peel-off gel masks ranges from 15 to 30 minutes (Silvia et al., 2021).

2.5. Antioxidant Activity Test Using DPPH Method

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging method. Initially, the maximum absorbance wavelength (λmax) of the DPPH solution (30 µg/mL) was determined using a UV-Vis spectrophotometer within the 400–800 nm range. The optimal reaction time was also established by reacting a 1:1 volume ratio of vitamin C (as the standard antioxidant) with the DPPH solution and measuring the absorbance over a 60-minute period.

Each sample (0.05 g) was dissolved in methanol and diluted to 50 mL. From this stock solution, working concentrations of 60, 70, 80, 100, and 120 µg/mL were prepared. Equal volumes of the sample solution and DPPH solution (30 µg/mL) were mixed, incubated at room temperature for the predetermined optimal time, and their absorbance measured at the previously identified λmax. The same procedure was applied to vitamin C standard solutions at concentrations of 2, 4, 6, 8, and 10 µg/mL.

The percentage inhibition of DPPH radicals was calculated for each concentration, and the IC_{50} value—the concentration required to inhibit 50% of the DPPH radicals—was determined by linear regression analysis of the inhibition percentage versus sample concentration (Maharani et al., 2022).

2.6. Data Analysis

The evaluation of the peel-off gel mask formulations was conducted using descriptive analysis. Observational data such as organoleptic characteristics and homogeneity were assessed qualitatively. Physical parameters including pH, viscosity, spreadability, adhesiveness, and drying time were compared across formulations to identify trends related to increasing concentrations of *C. sappan* extract. Similarly, antioxidant activity data were interpreted by comparing the IC_{50} values of each formulation. The significance of observed changes was discussed in terms of their relative magnitude and consistency rather than based on formal statistical tests.

3. RESULTS AND DISCUSSION

3.1. Physical Characteristics of Peel Off Gel Mask Containing *C. sappan* Extract

Caesalpinia sappan has traditionally been recognized for its therapeutic properties, including antibacterial, anti-inflammatory, antidiabetic, and antioxidant effects. The ethanol extract of *C. sappan* contains flavonoid compounds such as brazilin, 3'-O-methylbrazilin, sappanin, and chalcone, which contribute to its strong antioxidant profile (Ngamwonglumlert & Devahastin, 2023). In this study, peel-off gel mask formulations containing *C. sappan* extract at concentrations of 2.5%, 5%, and 7.5% were developed and evaluated for their physical properties.

The organoleptic and homogeneity observations showed that all formulations had a consistent orange color, a characteristic *C. sappan* odor, and a smooth, thick consistency. Each gel was visually homogeneous, indicating even distribution of ingredients throughout the formulation.

Figure 1 illustrates the physical properties of the three formulations. The pH values decreased slightly as the extract concentration increased. This trend is attributed to the acidic nature of *C. sappan* extract (Muslimin et al., 2024), which becomes more influential as the proportion of extract rises. The viscosity of the gels increased progressively with extract concentration, affecting other parameters such as spreadability, adhesiveness, and drying time. A higher viscosity reduced spreadability but enhanced adhesiveness and prolonged the drying time. These relationships are evident in the trends presented in Figure 1.

Such changes in physical characteristics are consistent with the structural influence of extract constituents and the thickening effect they exert in the gel base. Although no statistical tests were applied, the consistent trends across all parameters support the influence of *C. sappan* extract concentration on the physical performance of the peel-off mask.

3.2. Antioxidant Activity of Peel-Off Gel Mask Containing *C. sappan* Extract

The antioxidant activity of the peel-off gel mask formulations was evaluated using the DPPH free radical scavenging assay. All formulations demonstrated strong antioxidant capacity, with IC_{50} values within the range of 50–100 µg/mL, indicating effective radical scavenging potential.

As shown in **Figure 2**, the IC_{50} values decreased with increasing extract concentration: 88.71 µg/mL for Formulation I (2.5%), 81.58 µg/mL for Formulation II (5.0%), and 79.04 µg/mL

for Formulation III (7.5%). This trend suggests that higher concentrations of *C. sappan* extract contribute to enhanced antioxidant performance, likely due to increased levels of flavonoid compounds such as brazilin.

Although statistical testing was not applied, the progressive decrease in IC_{50} values clearly indicates the influence of extract concentration on antioxidant activity. These results are consistent with the literature, which identifies *C. sappan* as a potent natural antioxidant source (Tanzaq et al., 2019). Compared to its pure extract IC_{50} value of 74.44 µg/mL, the formulated gels retained high antioxidant potential. However, when compared to vitamin C (IC_{50} = 3.04 µg/mL), the formulations were less potent, which is expected given the superior radical scavenging efficiency of pure ascorbic acid.

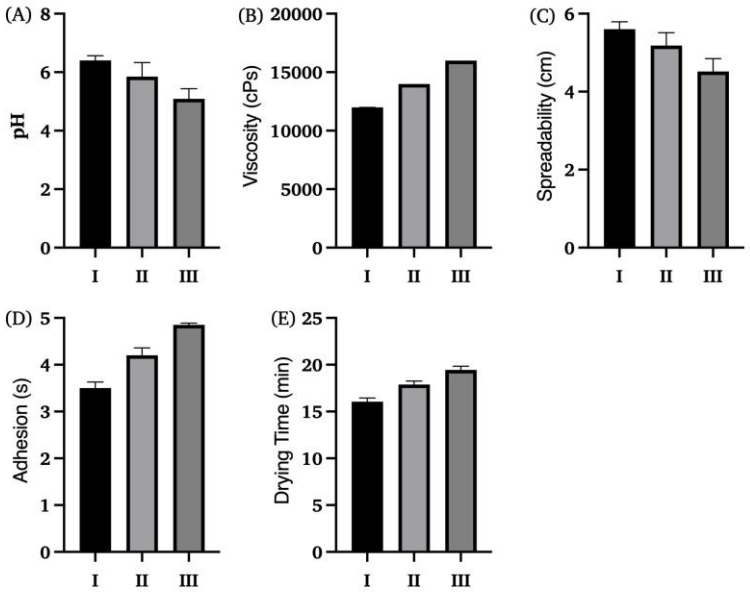

Figure 1. Physical characteristics of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%): (a) pH, (b) viscosity, (c) spreadability, (d) adhesiveness, and (e) drying time.

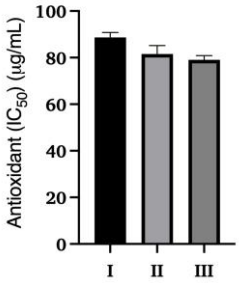

Figure 2. IC_{50} values of peel-off gel mask containing *C. sappan* extract in Formulation I (2.5%), Formulation II (5.0%), and Formulation III (7.5%).

CONCLUSION

This study demonstrated that peel-off gel masks containing *C. sappan* extract can be effectively formulated using polyvinyl alcohol, sodium carboxymethyl cellulose, and propylene glycol as base components. Increasing the extract concentration from 2.5% to 7.5% affected the physical properties of the formulation by increasing viscosity, adhesiveness, and drying time, while decreasing pH and spreadability. All formulations exhibited strong antioxidant activity, with IC_{50} values ranging from 88.71 to 79.04 µg/mL, indicating that higher extract concentrations enhance antioxidant performance. Overall, the 7.5% extract formulation showed the most favorable combination of physical characteristics and antioxidant activity, supporting its potential as a natural, effective peel-off gel mask for skin health applications.

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