

Formulation, Characteristics of Physical Quality, and Evaluation of Sun Protection Factor Value of Transparent Soap with Red Betel Leaf Extract

Formulasi, dan Karakteristik Mutu Fisik serta Evaluasi Nilai Sun Protection Factor Sabun Transparan Ekstrak Daun Sirih Merah

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Abstract

The sun emits ultraviolet radiation and can produce free radicals. If these free radicals continue to come into contact with the skin excessively, they can damage cells and eventually cause cancer. Sun Protection Factor (SPF) is a substance that protects the skin from ultraviolet rays. The capacity of a product to shield the skin is indicated by its SPF rating. Soap is a type of formulation that individuals frequently utilize. Red betel leaf extract can protect the skin from the harmful effects of free radicals and is expected to increase the soap's ability to protect the skin from exposure to sunlight and maintain skin health. The methods include making transparent soap, testing physical quality, and determining the sun protection coefficient at various red betel leaf ethanol extract concentrations. The result is a transparent black-green soap with a pH of 9, a foam height of 57-65 mm, and a water content of <15%. At a concentration of ethanol extract of 0%, the SPF value is 3, and the SPF values are 7.5 (10%), 12.28 (30 and 50%), 18.2 (70%), and 25 (90%). From this information, it can be inferred that clear soap created with red betel leaf extract possesses excellent physical attributes and effectively protects against sun exposure.

Keywords: Red Betel Leaf, *Piper Crocatum*, Transparent Soap, Physical Quality, SPF.

Abstrak

Matahari memancarkan radiasi ultraviolet dan dapat menghasilkan radikal bebas. Jika radikal bebas ini terus bersentuhan dengan kulit secara berlebihan, maka dapat merusak sel dan akhirnya menyebabkan kanker. Sun Protection Factor (SPF) merupakan zat yang melindungi kulit dari sinar ultraviolet. Kemampuan suatu zat dalam melindungi kulit dinyatakan dengan angka SPF-nya. Sabun adalah bentuk sediaan yang digunakan orang sepanjang waktu. Ekstrak daun sirih merah yang memiliki kemampuan melindungi kulit dari pengaruh buruk radikal bebas diharapkan dapat meningkatkan kemampuan sabun dalam melindungi kulit dari paparan sinar matahari serta menjaga Kesehatan kulit. Metode yang digunakan meliputi pembuatan sabun transparan, pengujian mutu fisik, dan penentuan koefisien perlindungan sinar matahari pada berbagai konsentrasi ekstrak etanol daun sirih merah. Hasilnya adalah sabun transparan berwarna hitam-hijau, memiliki pH 9, tinggi busa 57-65 mm, dan kadar air <15%. Pada konsentrasi ekstrak etanol 0% nilai SPF sebesar 3, dan nilai SPF 7,5 (10%), 12,28 (30 dan 50%), 18,2 (70%), dan 25 (90%). Dari data tersebut dapat disimpulkan bahwa sabun transparan berbahan dasar ekstrak daun sirih merah mempunyai kualitas fisik dan sifat perlindungan terhadap sinar matahari yang baik.

Kata Kunci: Daun Sirih Merah, *Piper Crocatum*, Sabun Transparan, Mutu Fisik, SPF.



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Introduction

Exposure to sunlight benefits the body, one of which is that apart from being anti-bacterial, it is also a source of vitamin D, which strengthens bones by increasing calcium absorption. [1]. However, too much sun exposure can negatively impact the body, particularly the skin, since sunlight has ultraviolet rays that can create free radicals. Free radicals can damage the body's cells, resulting in various health issues, including premature skin aging and skin cancer. [2]. To avoid the harmful impacts of too much sun exposure, a material must stop or lessen ultraviolet (UV) rays from hitting the skin. [3]. This material is commonly known as sunscreen, a light-protecting agent that safeguards the skin by reflecting or absorbing UV rays; apart from that, a substance can also act as an antioxidant that can reduce oxidation reactions from free radicals. [4]. The use of sunscreen with chemicals (chemical filters) can cause photoallergies. (5) Therefore, the use of natural ingredients as photoprotective agents is necessary.

Plants that are known to have the ability to act as sunscreen include caramunting fruit. [6], balakka fruit [7], tamarind leaves [8], and tamarind peel [9], while plants that have antioxidant properties include jamblang leaves [10] Kuok lime leaves [11], cocoa pod husk [12] and Red betel leaves [13] Apart from that, betel leaves can also be used as a diuretic. [14], antidiabetic [15–17], antibacterial (18,19), wound healer burnt (20), is also known to have antioxidant properties [13]. This plant is well known to the general public and is found in many parts of Indonesia, so its use must be developed.

Plants with antioxidant properties can also function as sunscreens because they contain conjugated double bonds in flavonoid compounds. These bonds cause a molecule to undergo electronic transitions and absorb radiation in the ultraviolet region. [13,21,22]. Flavonoids that are included in transparent soap are expected to have the ability to act as sunscreen, which can protect the skin from the harmful effects of exposure to sunlight.

Transparent soap is a form of solid soap popular with the public. Apart from its neat and attractive shape because it looks transparent, this soap has softer foam than other solid soaps. [23]. The incorporation of red betel leaf extract in transparent soap for this research seeks to provide sunscreen advantages from red betel leaves, which can protect the skin from sun exposure while maintaining hydration, as the foam is mild, preventing skin dehydration even with frequent use.

Experimental Section

Materials

The materials used in this research were coconut oil, stearic acid, glycerin, sucrose, NaOH (Merc), ethanol 96% p.a (Merc), and cocamide-Dea.

Apparatus

The apparatus used in this research is glass beakers (pyrex), measuring flasks (pyrex), stir sticks, watch glasses, analytical scales (Kern), rotary evaporators (B-one), lens tissue (Rowa), and UV-Vis (Thermo-Scientific) spectrophotometers.

Research Procedures

The procedures carried out in the research consisted of several stages, namely:

- 1) Produced red betel leaf extract
Red betel leaves were dried away from direct sunlight, crushed into powder, and extracted through the maceration technique. [24] With a 96% ethanol solution. Afterward, the macerate was evaporated until a concentrated extract was obtained.
- 2) Made transparent herbal soap from red betel leaf extract
Made transparent soap from red betel leaf extract began with making a transparent soap base by heating coconut oil (30 g), stearic acid (15 g), 30% NaOH (18 ml), glycerin (24 ml), sucrose solution (45 g sucrose in aqua dest 30 ml), ethanol (52 ml), and cocomide-Dea (5 ml) at a temperature of 60-70°C. Once the mixture is hot and liquefied, stir until smooth. Each 35 g of the solution was mixed with 1 ml of liquid red betel leaf (10, 30, 50, 70, 90% thick red betel leaf extract in 96% ethanol), stirred the solution until evenly mixed, then pour the solution into a mold and left the solution to harden.
- 3) Evaluation of the physical quality of transparent herbal soap with red betel leaf extract
 - a. Organoleptic test
Testing was done by observing the soap preparation's color, shape, and aroma. [25].
 - b. pH test
One gram of soap was combined with 10 milliliters of distilled water, and then the pH was measured using a calibrated pH meter. The requirement pH range for soap is from 9 to 11 [26].
 - c. Foam height test
A total of 1 g of soap was placed in a test tube, and then 10 mL of distilled water was poured in before shaking the test tube by flipping it over. After that, the foam height generated was measured, and after 5 minutes, the foam height was rechecked. To determine good foam stability, the foam should reach a height exceeding 9.5 cm within that period, and the foam height should be between 1.3-22 cm.
- 4) Water content test
The soap was weighed about 5 (five) g then heated in the oven at 105°C for 60 minutes, then cooled and weighed again [26].
- 5) Assessment of the sun protection factor (SPF) value of transparent soap containing red betel leaf extract
The soap weighed as much as 1 g is then put into a beaker glass, dissolved using 96% ethanol, and put into a 50 mL measuring flask, adding ethanol to the limit mark. Pipetted as much as 7.5 mL and put into a 25 mL measuring flask, 96% ethanol was added to obtain a concentration of 3000 ppm. Furthermore, the absorbance is measured using a UV-visible spectrophotometer, and the sample absorbance is measured using a wavelength of 290-320 nm with an interval of 5 (five) nm. The process was done with three measurements (triple), and the SPF value was calculated using the Mansyur formula.

The equation was:

$$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times A(\lambda)$$

Information:

CF: Value correction factor 10

EE: Erythmogenic effect of radiation on wavelength (λ)

I: Simulated spectrum of solar rays (λ)

A: Absorbance value at wavelength (λ)

Results and Discussion

Making betel leaf extract employs the maceration technique as it is the easiest and most appropriate method for materials that are not hard, like leaves and flowers. The selected solvent was 96% ethanol since it is polar, allowing it to dissolve all components found in the sample. The liquid extract was subsequently concentrated with a rotary evaporator until a dense, reddish (blackish-red) extract was achieved.

The dense extract was subsequently made into clear soap with different levels of red betel leaf extract (10, 30, 50, 70, 90%). The outcomes of producing clear soap from red betel leaf extract are illustrated in Figure 1.

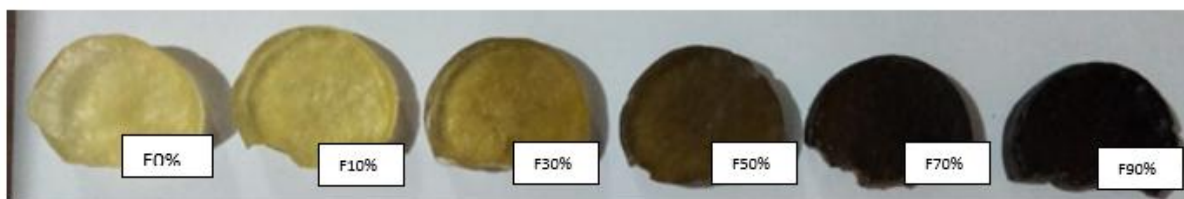


Figure 1. Transparent Soap with Red Betel Leaf Extract

The clear soap made from red betel leaf extract is see-through, and the clarity decreases as the concentration of extract increases. The clear soap produced is subsequently assessed for its physical properties. The findings from the sensory assessment of the clear soap infused with red betel leaf extract are displayed in Table 1.

Table 1. Organoleptic test results for transparent soap with red betel leaf extract

Formulas	Color	Form	Aroma
F 0%	Clear	Transparent Solid	No aroma
F 10%	Green	Transparent Solid	Specific
F 30%	Green	Transparent Solid	Specific
F 50%	Blackish Green	Solid, somewhat transparent	Specific
F 70%	Blackish Green	Solid, somewhat transparent	specific
F 90%	Blackish Green	Solid, somewhat transparent	specific

Organoleptic assessments were conducted to produce a distinctive solid soap that showcases an attractive color, a pleasant fragrance, and a convenient shape. (27). In this case, the color is derived from the extract of red betel leaves. Adding red betel leaf extract, the soap's shade darkens, and its clarity diminishes, while the scent, typical of betel leaves, stays the same. Transparent solid soap seems more luxurious and expensive than other solid soaps. At the same time, the distinctive aroma of the extract used shows the natural ingredients used and seems more natural.

The findings from the pH assessment indicate that the pH remains compliant with SNI 3532:2021 standards for solid bath soap (9-11). Determination of pH value aims to avoid soap products that can irritate the skin. Soap pH below the required pH will cause skin irritation, while soap pH above the required pH will cause dry skin.(28). Table 2 displays the pH test outcomes for transparent soap containing red betel leaf extract.

Table 2. pH test results for transparent soap with red betel leaf extract

Formulas	Week to					SNI requirements
	0	1	2	3	4	
F 0%	9,71	9,31	9,32	9,31	9,3	9-11
F 10%	9,7	9,62	9,51	9,39	9,35	
F 30%	9,64	9,53	9,47	9,35	9,35	
F 50%	9,59	9,56	9,43	9,35	9,3	
F 70%	9,58	9,51	9,35	9,32	9,27	
F 90%	9,52	9,47	9,35	9,3	9,25	

The assessment outcomes for foam height are presented in Table 3. A crucial factor in evaluating soap quality is the foam that is generated. Foam in soap serves the purpose of eliminating oil or grease from the skin. Excessive foam can lead to dryness of the skin. When the skin loses its natural oils, it becomes more prone to irritation, as these oils play a protective role. The outermost layer of the skin is referred to as the skin barrier, and one of its components is oil. Oil contributes to a more robust skin barrier, preventing bacteria and

microorganisms from easily penetrating the body (29). The observations of foam height from each formulation yielded varying outcomes, but all conformed to the foam height standards specified in SNI 3532:2021 for solid bath soap, which range from 13-220 mm.

Table 3. Test results for transparent soap foam height of red betel leaf extract

Formulas	Ho (mm)	Hs (mm)	Difference (Ho-Hs)	SNI requirements (mm)
F 0%	68	11	57	13- 220
F 10%	63	4	59	
F 30%	73	11	62	
F 50%	70	6	64	
F 70%	71	9	62	
F 90%	70	5	65	

Information:

Ho = Initial foam height,

Hs = High foam after 5 minutes

Test findings concerning the moisture level of clear red betel leaf extract soap indicated that the moisture level fell under 15%, which aligns with SNI 3532:2021 standards for solid bath soap (moisture content < 15%). Water content testing is carried out to determine the amount of water in the soap. Soap that has much water will diminish faster when applied. On the other hand, soap with less water can extend its lifespan. However, the length of time soap is stored can affect the hardness of the soap because the water content in the soap decreases over time.(30). The results of testing the water content of red betel leaf extract transparent soap can be seen in Table 4.

Table 4. Test results for the water content of transparent soap from red betel leaf extract

Formulas	Water content (%)	SNI requirements (%)
F 0%	14, 37	< 15
F 10%	12,17	
F 30%	13,48	
F 50%	13,95	
F 70%	12,33	
F 90%	14,20	

The findings from assessing the SPF value of soap made from transparent red betel leaf extract indicate that the SPF ranges from extra to ultra, which varies between 7.5 and 25. Table 5 displays the results of the SPF value calculations.

Table 5. Calculation results of the SPF value of transparent soap with red betel leaf extract

Formulas	SPF value	Category
F 0%	3	Minimal
F 10%	7.513165	Extra
F 30%	12.28769	Maximum
F 50%	12.28769	Maximum
F 70%	18.2095	Ultra
F 90%	25.82126	Ultra

Based on the information in Table 5 above, it is evident that transparent soap containing ethanol extract from red betel leaves at a 0% concentration has an SPF rating of 3, classified as minimum. The F10% variant has an SPF rating of 7, categorized as extra, while both F30% and F50% boast the same SPF rating of 12, classifying them as maximum. The F70% and F90% concentrations have SPF ratings of 18 and 25, respectively, placing them in the ultra category (>15). This SPF rating indicates how well the transparent red betel leaf

extract soap can shield the skin from sun exposure. The higher the SPF value, the greater the protection against sunlight provided.

Protection against sun exposure is due to the presence of flavonoid compounds, which, in addition to functioning as antioxidants, also protect against UV-B rays and prevent cell death, thereby protecting DNA from dimerization and damage. (31). The conjugated double bonds in flavonoid compounds cause a molecule to undergo electronic transitions and absorb radiation in the ultraviolet region. (32).

Conclusions

Based on the information provided, one can gather that red betel leaf extract is suitable for creating transparent soap with excellent physical properties, namely having a dense, transparent shape, a distinctive aroma of betel leaves, and a pH range of 9-11, foam height of 57-65. mm, and water content less than 15%. Transparent soap with red betel leaf extract has the potential as a sunscreen with an SPF value in the extra category 7.5 (F10%), maximum 12.28 (F30 and 50%) to ultra 18 and 25.8 (F70 and F90%). Evaluation of the SPF value of red betel leaf extract transparent soap produces an extra category of 7.5 (F10%), a maximum of 12.28 (F30 and 50%) to ultra 18 and 25.8 (F70 and F90%).

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