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Research Article

Crescentia cujete L. Extract as a Substitution Alternative of Oxybenzone in Sunscreen Cream

Sunscreen Krim Ekstrak Crescentia cujete L. Sebagai Alternatif Pengganti Oxybenzone

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Abstract

The use of natural ingredients in sunscreen products is increasingly developed due to safety and eco-friendliness compared to synthetic agents. Therefore, this study aimed to evaluate the physical properties and SPF values of cream formulations containing leaf and fruit extract of Crescentia cujete L. The experimental method included cream formulation, SPF evaluation in vitro using UV-Vis spectrophotometry, and physical quality testing comprising organoleptic, homogeneity, emulsion type, spreadability, adhesion, pH, and viscosity. The results showed that formulation with leaf extract had the highest SPF value of 15.60 (medium protection category), indicating the potential of Crescentia cujete L. leaf as active ingredient in herbal-based sunscreen cream.

Keywords: Crescentia cujete L; sunscreen cream; SPF; oxybemzone; physical quality

Abstrak

Penggunaan bahan alam sebagai tabir surya mulai banyak dikembangkan karena dinilai lebih aman dan ramah lingkungan dibandingkan bahan sintetik. Penelitian ini bertujuan untuk mengevaluasi mutu fisik dan nilai SPF dari krim ekstrak daun dan buah Crescentia cujete L. Metode penelitian dilakukan secara eksperimental melalui formulasi sediaan, uji mutu fisik (organoleptik, homogenitas, tipe emulsi, daya sebar, daya lekat, pH, viskositas), dan pengujian nilai SPF secara in vitro menggunakan spektrofotometri UV-Vis. Hasil menunjukkan bahwa formulasi ekstrak daun memiliki nilai SPF tertinggi, yaitu 15,60 (kategori proteksi sedang). Dengan demikian, daun Crescentia cujete L. berpotensi dikembangkan sebagai bahan aktif krim tabir surya berbasis herbal.

***Kata kunci**: Crescentia cujete L; krim tabir surya; mutu fisik; oksibenzon; SPF,*

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1. Introduction

Indonesia is a tropical country located along the equator, with high levels of sun exposure throughout the year [1]. The phenomenon of global warming has increased exposure rate by causing the thinning of ozone layer, which plays an important role in filtering ultraviolet (UV) radiation [2]. Therefore, high penetration of UV rays to the earth surface triggers various skin diseases such as wrinkles, dry skin, hyperpigmentation, premature aging, inflammation, and the risk of cancer [2]. Prolonged exposure to carcinogenic UVA and UVB rays contributes significantly to the increase in the incidence of skin cancer, which ranks third in Indonesia after cervical and breast cancer, with a prevalence of approximately 5.9%–7.8% in hospitals [3] [4]. A study at Sanglah General Hospital in Denpasar during the period 2015–2020 recorded 41 cases of skin cancer. The type with high dominance was Basal Cell Carcinoma (43.9%), followed by melanoma (24.4%), and Squamous Cell Carcinoma (21.9%), particularly among individuals who work outdoors and are frequently exposed to sunlight on the face [5].

In response to the dangers of UV rays, the WHO recommends the use of sunscreen (Sun Protection Factor, SPF) as a protective measure, where regular application of 2 mg/cm² reduces skin cancer risk by approximately 40% [6]. However, some sunscreen products on the market contain chemicals such as oxybenzone that disrupt the endocrine system, cause allergic reactions, and pollute marine ecosystems through the process of coral bleaching ≥ 10% of all coral reefs worldwide [7]. This shows the need for developing natural-based sunscreen from plant that is safer for humans and the environment.

Previous studies have evaluated the potential of plant such as ethanol extract of avocado seeds and pumpkin flesh (SPF 2.15–14.52) [7], mahogany seeds (SPF up to 39.037) [8], as well as tamarind leaf [9], moringa leaf (SPF 8.54–23.34) [10], jackfruit epicarp (SPF 8,94–23,96, and black grapes (low SPF) [11]. However, there is still limited information on other potential local plant, including *Crescentia cujete* L., known locally as berenuk/majapahit. This plant contains bioactive compounds, including flavonoids, phenolics, and vitamin C, which act as antioxidants and natural photoprotective agents [12]. The leaf has also shown strong biological activity, while the fruit contains high levels of vitamin C, suggesting suitability for sustainable natural cosmetic raw materials [13]. Despite the potential, there is no comprehensive study comparing the physical qualities and SPF valuesof cream preparations using *Crescentia cujete* L. leaf and fruit extract. Differences in bioactive content between the two plant parts can produce various UV protection effects. This shows the need to determine the optimal plant part as an active ingredient in natural sunscreen. Additionally, comparison of two types of emulsions, namely water-in-oil (W/O) and oil-in-water (O/W), is an important aspect in sunscreen formulation [14]. W/O emulsion system generally produces a more water-resistant occlusive layer and is suitable for outdoor use, while O/W has a lighter texture, easy absorption, and comfortable daily use [15]. Therefore, evaluation of these two systems is essential to obtain formulation with good physical stability and optimal UV protection effectiveness.

Based on the description above, this study aims to develop formulation and evaluate the physical quality and SPF value

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of sunscreen cream using *Crescentia cujete* L. leaf and fruit extract. The results are expected to produce a high SPF value and maximum protection against the harmful effects of UV rays, thereby promoting the development of safe and environmentally friendly herbal cosmetics.

2. Research Method

2.1. Tools and Materials

The tools used in this study included various laboratory equipment such as a rotary evaporator, Brookfield Viscometer (Ametek-DV2T), waterbath (Memmert WNB 45), and UV-Vis spectrophotometer (Shimadzu UV-1900i). Meanwhile, the ingredients used were *Crescentia cujete* L. leaf and fruit extract, 96% ethanol (pro analysis-Merck), cera alba (pro analysis-Sigma), liquid paraffin (technical-Brataco), Tween (pro analysis-Merck), propylene glycol (pro analysis-Merck), nipasol (pro analysis-Sigma), nipagin (pro analysis-Sigma), oleum rosae (cosmetic grade-Brataco), and distilled water (pro analysis-Brataco). Other ingredients included cetyl alcohol (pro analysis-Sigma), lanolin (pro analysis-Sigma), stearic acid (pro analysis-Sigma), TEA (triethanolamine) (pro analysis-Sigma), glycerin (pro analysis-Sigma), and α-tocopherol (pro analysis-Sigma).

2.2. Preparation of Simplisia Leaf and Fruit of *Crescentia cujete* L.

Fresh *Crescentia cujete* L. leaf and fruit samples were cleaned with running water, drained, and dried naturally in a shaded area. After drying, the samples were ground into a fine powder and sieved through an 80-mesh sieve. The leaf and fruit powders were stored separately in tightly closed containers to maintain quality.

2.3. Extraction of *Crescentia cujete* L. Leaf and Fruit

Extraction was carried out using the maceration method with 96% ethanol in a 1:6 ratio of material to solvent. A total of 500 g of powdered medicinal plants was soaked for 72 hours with occasional shaking. This was followed by light shaking three times daily for dissolution of active compounds [16], filtering, and re-maceration for 24 hours. The filtrate was evaporated using a rotary evaporator to produce a thick extract of *Crescentia cujete* L. leaf and fruit.

2.4. Qualitative Testing of Secondary Metabolite Compounds

2.4.1 Flavonoids

The test was performed by adding 0.1 N NaOH solution to the sample. The formation of a red, orange, or violet color showed the presence of flavonoids [16].

2.4.2 Phenolics

The extract was reacted with a 1% $FeCl_3$ solution, and formation of a green or dark blue color showed the presence of phenolic compounds [17].

2.5. Quantitative Testing of Secondary Metabolites

2.5.1 Flavonoids

A total of 200 mg of the extract was dissolved in 70% ethanol, reacted with 2% $AlCl_3$, and 120 mM potassium acetate. After a 1-hour incubation, the absorbance was measured at 435 nm using a UV-Vis spectrophotometer [18][19].

2.5.2 Phenolics

A total of 100 mg of the extract was dissolved in methanol, reacted with Folin-Ciocalteu reagent and 20% Na_2CO_3, then measured at a wavelength of 750 nm [20].

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2.6. Cream Formulation

Cream was formulated using one type of emulsion, an O/W formulation. Initially, all ingredients were weighed according to the composition in Table 1, followed by separate melting of oil and water phases at ±75°C. The two phases were gradually mixed until homogeneous, added with distilled water until the formation of a stable and uniform cream.

2.7. Physical Quality Testing

All physical quality tests in this study were conducted with three replications for each sample. This replication aimed to ensure the reliability and consistency of the test results, ensuring high levels of accuracy and precision. Repeated testing also served to minimize the possibility of random errors that could occur during the measurement process. Therefore, the physical quality test results presented are the average values from three replications.

2.7.1 Organoleptic Test

Color, odor, and appearance of cream were assessed to ensure the consistency of the preparation [22].

2.7.2 Homogeneity Test

Cream was applied to a glass slide and observed for the presence of coarse particles. Based on the results, cream was considered homogeneous when there were no large particles [22].

2.7.3 pH Test

The measurement of pH value was performed using a calibrated pH meter, and the results were recorded.

2.7.4 Spreadability Test

A 500 mg of cream was subjected to a load of 500 g for 1 minute, followed by measuring the spread diameter.

2.7.5 Viscosity Test

Viscosity was measured using a Brookfield Viscometer, and results were shown in cP.

2.7.6 Adhesiveness Test

A 100 mg of cream was placed between two glass slides, pressed, and the separation time was measured to assess adhesiveness.

Table 1. Formulation of O/W phase cream preparations

Ingredients	Formulation [21]	
	Composition	Function
Extract	5%	Active Ingredient
TEA	2%	Emulgator
Cetyl alcohol	2%	Base
Lanolin	1%	Base
α-tocopherol	0,05%	Antioxidant
Stearic acid	7,5%	Emulgator
Glycerin	10%	Emollient
Nipagin	0,2%	Preservative
Nipasol	0,02%	Preservative
Distilled water (aquadest)	Added until 100%	Solvent

Table 2. Ultraviolet Index Values [23]

SPF	Protection Category
2 – 10	Low
15 – 25	Medium
30 – 50	High
≥ 50 / 50 +	Very High

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2.8. Determining SPF Values

SPF values are determined in vitro using a UV-Vis spectrophotometer at a wavelength of 290–400 nm with 1 nm intervals. The UV index categories or values are shown in Table 2. The resulting transmittance (%T) values are used to calculate SPF based on the Mansur equation [23], as follows:

$$SPF = \frac{\sum_{290nm}^{400nm} E\ x\ I\ x\ d}{\sum_{290nm}^{400nm} E\ x\ I\ x\ T\ x\ d}$$

$\sum_{290nm}^{400nm}$ was summation over the ultraviolet wavelength range of 290–400 nm. E (*Erythemal effect spectrum*) was the effectiveness of UV radiation in producing erythema (skin redness). I (*Solar spectral irradiance*) was the intensity of solar radiation at each wavelength. T (*Transmittance*) was the fraction of UV radiation transmitted through the sunscreen formulation. d ($\Delta\lambda$) was wavelength interval (nm).

3. Results and Discussion

3.1. *Crescentia cujete* L. Leaf and Fruit Extract

Crescentia cujete L. leaf and fruit extract showed diverse secondary metabolite contents relevant to photoprotective potential. Phytochemical analyses from previous studies reported that *Crescentia cujete* L. leaf contained flavonoids, phenolics, tannins, saponins, alkaloids, and steroids. These compounds are groups of bioactive compounds with high antioxidant and UV-absorbing activity [22]. Flavonoids such as quercetin, rutin, and other flavonol derivatives possess chromophore groups (C=O and C=C) capable of absorbing UV-A and UV-B radiation through a π-electron delocalization mechanism, thereby enhancing the effectiveness of natural sunscreen. The presence of tannins and phenolics also enhances the antioxidant potential through proton donation and free radical scavenging mechanisms, which improves photochemical stability of the extract [23].

Crescentia cujete L. fruit showed complex chemical profile. As reported in previous studies, *Crescentia cujete* L. fruit extract contained flavonoids (flavones and flavanones), phenolics, saponins, and several organic acids such as citric acid, tartaric acid, and crescentic acid [24]. These organic acid compounds have the potential to increase skin permeation by modifying the microenvironmental pH, while acting as stabilizing agents in cream formulations. Additionally, fruit antioxidant activity is enhanced by the presence of aromatic hydroxyl groups in phenolic compounds that act as strong electron donors. Other results show that non-polar leaf fractions produce steroid compounds such as stigmasta-5,22-dien-3-ol. These compounds are capable of increasing occlusive properties and help in the formation of a protective layer in topical preparations [25]. Aromatic phenolic compounds and reactive carbonyl components contribute to antioxidant activity and radical stability, which support UV protection of the formulation products. Similarly, a previous study identified several key flavonoids in *Crescentia cujete* L. extract through LC-MS analysis, including quercetin, rutin, diosmin, acacetin-7-rutinoside, and kaempferol-3-O-rhamnoside [16]. The compounds show strong absorption patterns in UV-A and UV-B ranges, particularly through π→π* and n→π*, transitions, explaining the extract's potential as a natural photoprotective agent. The study also

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confirmed the presence of phenolic compounds and tannins through phytochemical tests. The results suggest that the extract photoprotective mechanism operates through UV-absorbing capacity and antioxidant activity [24].

3.2. Qualitative and Quantitative Tests of Secondary Metabolite Compounds

Qualitative secondary metabolite testing of *Crescentia cujete* L. leaf and fruit showed that both plant parts were positive for flavonoids and phenolics, as indicated by characteristic color changes in each test (Figures 1a–1d). In flavonoids test using $AlCl_3$ reagent, a yellow-orange color appeared due to chelate complex formation between the Al^{3+} ion and the aromatic carbonyl or hydroxyl group of the flavonoid [27]. Meanwhile, the phenolic test using $FeCl_3$ produced a blue-black color through the formation of a phenolate–Fe^{3+} complex, a typical reaction of phenolic compounds [26].

The color intensity in leaf samples appeared stronger than in fruit, showing higher concentrations of flavonoids and phenolics. This was in line with the results that *Crescentia cujete* L. leaf contained total phenolics of 15–32 mg GAE/g and total flavonoids of 10–21 mg QE/g. The values were higher than the fruit, which ranged from 8–18 mg GAE/g for phenolics and 5–12 mg QE/g for flavonoids [28]. Physiologically, leaf synthesize more phenolics and flavonoids, serving as organ directly exposed to UV radiation. Therefore, leaf require natural photoprotection mechanisms through UV absorption and antioxidant activity [28].

Previous studies reported that *Crescentia cujete* L. leaf extract contained flavonoids such as quercetin, rutin, diosmin, acacetin-7-rutinoside, and kaempferol-3-O-rhamnoside based on LC-MS analysis [16]. These compounds have strong absorption peaks in the 250–380 nm range, playing a role in antioxidant and photoprotective activities [29]. Other studies have shown that *Crescentia cujete* L. leaf and fruit contain major phenolics, saponins, and flavanones, contributing to the extract strong antioxidant activity [22].

Based on the quantitative analysis in Table 3, *Crescentia cujete* L. leaf extract contains 29.014% total phenolics and 20.963% total flavonoids. Meanwhile, the fruit extract contains 16.788% phenolics and 15.647% flavonoids. This difference shows that leaf has a higher capacity for secondary metabolite biosynthesis, particularly phenolics and flavonoids.



(a) **(b)** **(c)** **(d)**

a yellow-orange color : flavonoid positive
blue-black color : phenolic positive

Figure 1. Qualitative test of flavonoid compounds in leaf (a) and fruit (c); phenolics in leaf (b) and in fruit (d)

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High phenolics are important because the aromatic-hydroxyl groups can experience repeated oxidation-reduction reactions. This mechanism makes phenolics effective in scavenging free radicals and preventing DNA damage from UV exposure. Elevated flavonoids also enhance photoprotective potential because of the π–π* conjugation system that enables strong absorption at UVA–UVB wavelengths (280–380 nm), particularly in quercetin, kaempferol, and rutin [30]. These results are supported by other studies showing that plants with phenolics >20% have elevated antioxidant activity and SPF values, as reported for *Mangifera casturi* extract. With phenolics of 29.014% and flavonoids of 20.963%, *Crescentia cujete* L. leaf extract is categorized as plant with excellent photoprotective capacity.

3.3 Physical Quality Test

The physical quality test for the *Crescentiaf cujete* L. leaf and fruit cream preparations can be seen in Table 4.

3.3.1 Organoleptic Test

Organoleptic test was conducted to assess the visual and sensory characteristics of cream preparations, such as color, odor, and shape, which are initial indicators of physical quality and consumer acceptability. The evaluation results showed that all cream preparations from *Crescentia cujete* L. leaf and fruit had a semi-solid (cream) form, suitable for easy topical application. Generally, O/W formulation produce lighter and faster-absorbing preparations [29]. This is because oil molecules are dispersed in the water phase, causing looser intermolecular interactions that lead to lighter and faster-spreading cream. The mechanism is influenced by interfacial tension, surfactant polarity, and particle distribution within the colloidal system [32]. The results of organoleptic test of cream are shown in Figure 2.

Table 3. Percentage of secondary metabolite compounds

Secondary Metabolites	Flavonoid Content (%)	Phenolic Content (%)
Leaf	20.963	29.014
Fruit	15.647	16.788

Table 4. Physical quality test of *Crescentia cujete* l leaf and fruit extract cream.

Cream Terms Value [31]	Types of Physical Quality Evaluation	*Crescentia cujete L.* Extract	
		Leaf	Fruit
Organoleptic	Color	Light green	Yellowish white
	Odor	Typical *Crescentia cujete* L. leaf	Typical fruit of *Crescentia cujete* L.
	Shape	Semi-solid (cream)	Semi-solid (cream)
Homogeneous	Homogeneity	Homogeneous	Homogeneous
5 - 7 cm	Spreadability (cm)	5.3	5.2
4 – 15 seconds	Adhesion (seconds)	8.23	8.21
4,5 – 6,5	pH	6.256	5.982
2000 – 50.000 cPs	Viscosity	4120	4502

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Cream color is often influenced by the type of active ingredient used. In this study, cream made from *Crescentia cujete* L. leaf extract showed a light green color, indicating the presence of high levels of chlorophyll and flavonoids. Chlorophyll contributes to the green color through a porphyrin ring system with a Mg^{2+} ion at its center. Meanwhile, flavonoids such as quercetin and kaempferol have chromophore groups (C=O and conjugated aromatic rings), imparting a yellow-green color to the solution [33].

In comparison, cream made from fruit extract showed a yellowish-white color, related to phenolics, tannins, and other less pigmented compounds [30]. This color stability also shows that phenolics oxidation, a reaction typically triggered by the enzyme polyphenol oxidase (PPO) or free radicals, has not occurred, causing cream darkening [31]. Furthermore, there was a distinctive odor according to the part of the plant used. The presence of this natural odor shows that essential oils or aromatic organic compounds are maintained. In the type of O/W emulsion, the odor of natural ingredients disappears more quickly because volatile compounds are more easily released from the water phase into the air [34]. In line with the analysis, the results of organoleptic test showed that all cream formulations had good aesthetic quality and initial stability suitable for development as a topical preparation, particularly in the form of sunscreen.

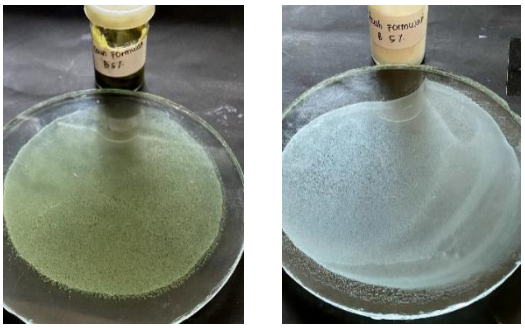
3.3.2 Homogeneity Test

All cream formulation made from leaf and fruit extract showed homogeneity, as presented in Figure 3. This indicated that the distribution of active ingredients and components within the preparation was without any lumps, phase separation, or visible particles. Homogeneity is an important parameter in the physical quality of topical preparations, which directly influences formulation stability and the uniformity of the active ingredient dosage for each application. Specifically, a homogeneous preparation ensures that the active compounds are evenly distributed throughout cream, ensuring consistent biological activity [35].



a light green color **(a)** a yellowish-white color **(b)**

Figure 2. Organoleptic test of cream with *Crescentia cujete* L. leaf (a) and *Crescentia cujete* L. fruit (b)



(a) **(b)**

Figure 3. Homogeneity test of cream with *Crescentia cujete* L. leaf (a) and *Crescentia cujete* L. hruit (b)

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Homogeneity is influenced by the stability of colloidal system, where the particle size of the dispersed phase must be uniform to prevent aggregation. At the oil-water interface, the interaction of surfactants reduces surface tension, allowing the formation of a stable adsorptive film, preventing coalescence and phase separation. Furthermore, the polar compatibility between the active ingredient and the carrier phase determines the solubility and distribution of molecules within the cream matrix. This ensures that the preparation remains stable and prevents gritting or phase separation [36].

3.3.3 pH Test

In topical formulation, pH is an important parameter that directly affects the stability of active ingredients, skin comfort, and the risk of irritation. The ideal pH range for cream is 4.5–6.5, corresponding to the natural pH range of human skin [33]. In this study, the results showed that cream formulation had pH values within the safe range of 6.256 and 5.982, for leaf and fruit, respectively. These values show that all formulations are sufficiently acidic and will not disrupt skin natural acid mantle, safe for long-term use. O/W formulations tend to reach a neutral pH due to the dominance of the aqueous phase [37]. Differences in pH can be influenced by the ionization of phenolics and flavonoids in extract, as these compounds release protons (H^+) at certain values, thereby lowering the system pH [38].

3.3.4 Spreadability Test

Spreadability is an important parameter in evaluating the physical quality of a topical cream. This test is related to ease of application, the efficiency of distributing active ingredients on skin surface, and comfort of use. Based on the results, formulations developed had a spreadability of 5.3 cm (leaf) and 5.2 cm (fruit). When compared to the physical quality standard for topical cream that ranges between 5–7 cm [31], these results still meet the recommended threshold. An extremely high spreadability value shows excessively low cream viscosity. This relation potentially make cream extremely runny and less adherent to the skin, thereby affecting the effectiveness of protection and the stability of active ingredients [39].

3.3.5 Viscosity Test

Viscosity is an essential parameter in cream formulation that affects physical stability, application comfort, and the effectiveness of active ingredient delivery. The ideal viscosity value for topical cream preparations is generally in the range of 2000–50,000 cPs [40]. Based on the measurement results, cream formulations from both leaf and fruit extract showed viscosity values that met quality standards, namely 4120 cPs (leaf) and 4502 cPs (fruit). These values show that cream has sufficient viscosity to maintain shape on skin, while still being easy to spread during application. The difference in viscosity between leaf and fruit formulations was very small, showing that the emulsion system does not significantly affect viscosity. This shows successful adjustments to the composition of emulsifying ingredients, such as surfactants or gelling agents [29]. Viscosity stability also shows that the dispersion system between the phases in cream has been optimally formed, without coalescence or phase separation affecting the texture. Generally, viscosity is influenced by the strength of chemical interactions between the phases, particularly the attractive forces of

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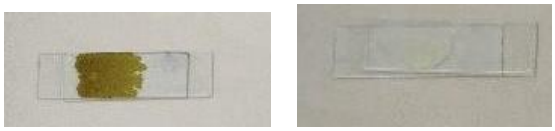
surfactants and the gel network formed in the emulsion system. Active compounds such as flavonoids can act as natural co-surfactants to stabilize the emulsion structure, thereby maintaining stable viscosity [41].

3.3.6 Adhesion Test

Adhesion is an important parameter in assessing the ability cream to remain on skin surface for a certain period after application. The ideal adhesion value ranges from 4 to 15 seconds, showing the balance in cream ability to adhere without causing excessive stickiness [42].

As shown in Figure 4, all formulations had adhesive strengths that met quality standards, namely 8.23 seconds (leaf) and 8.21 seconds (fruit). These values show that cream has sufficient adhesive capacity to adhere to skin, thereby supporting the effectiveness of active ingredients in the preparation. The cream adhesive strength is influenced by the rheological properties and chemical interactions within the emulsion matrix, including the formation of water-polymer network and intermolecular attractions between components. Phenolics and flavonoids in the extract also contribute through the ability to form hydrogen bonds, which increase the cohesion of the continuous phase [43].



(a) **(b)**

Figure 4. Adhesion test of cream with *Crescentia cujete* L. leaf (a) and *Crescentia cujete* L. fruit (b)

3.4. SPF Values of *Crescentia cujete* L. Leaf and Fruit Extract Cream

The results show that cream preparation containing *Crescentia cujete* L. leaf extract has SPF value of 15.60 in the medium protection category. Meanwhile, cream from the fruit extract shows SPF value of 11.05, which is included in the low protection category. The difference is most likely caused by the higher content of active compounds such as flavonoids and phenolics in the leaf compared to fruit. These compounds have activity as natural sunscreen agents because of the ability to absorb UV rays [44]. The phenomenon is related to the chemical structure, where flavonoids have conjugated aromatic rings (π–π) and carbonyl groups capable of undergoing electron transitions when exposed to UV radiation, thereby increasing absorbance and SPF values. Additionally, phenolic compounds contribute through the mechanism of absorption and capture of free radicals formed due to UV exposure [45]. Compared to previous studies, these results show a higher photoprotective potential than leaf containing 5% betel leaf (SPF 6.45) [46] and 5% basil leaf (SPF 8.73). The results show that *Crescentia cujete* L. leaf extract, when used at comparable concentrations, has superior UV protective effectiveness. This is due to the synergistic action of flavonoids, tannins, and phenolics in protecting skin from the harmful effects of sunlight.

Table 5. SPF values of *Crescentia cujete* L. leaf and fruit extract cream preparations

Cream Preparation	SPF Value	Protection Category
Crescentia cujete L. Leaf	15.60	Moderate
Crescentia cujete L. Fruit	11.05	Low

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4. Conclusion

In conclusion, *Crescentia cujete* L. leaf and fruit extract cream has physical qualities that meet preparation standards. These include spreadability (5–7 cm), adhesion (4–15 seconds), pH (4.5–6.5), and viscosity (2,000–50,000 cPs). The leaf cream preparation has the highest SPF value of 15.60, categorized as moderate protection. The active compounds, such as flavonoids and phenolics, in leaf play a significant role in providing higher photoprotective activity than fruit. Therefore, *Crescentia cujete* L. leaf has the potential to be an alternative to oxybenzone.

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