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Penentuan Nilai Sun Protection Factor (SPF) pada Lotion Fraksi Buah Pinang (Areca catechu L)

Determination of Sun Protection Factor (SPF) in Areca catechu L. Fruit Fraction Lotion

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ABSTRACT / ABSTRAK

Areca catechu L. (betel nut) is known to contain bioactive compounds, particularly flavonoids and phenolics, which have potential antioxidant and photoprotective properties. These activities make it a promising natural ingredient for sunscreen formulations. This study aimed to determine the Sun Protection Factor (SPF) and evaluate the antioxidant activity of a lotion formulated with the Areca catechu L. fruit fraction. SPF was measured in vitro using a UV–Vis spectrophotometer, antioxidant activity was assessed using the DPPH method, and the physical stability of the lotion was evaluated. The results indicated that formulation F3 exhibited the highest SPF value of 24.82, categorized as ultra-protection. This formulation also demonstrated strong antioxidant activity, with an IC50 value of 5.075 mg/L. Phytochemical screening of the Areca catechu L. fraction confirmed the presence of phenolic and flavonoid compounds, supporting the observed photoprotective activity. Physical stability evaluation revealed that the Areca catechu L. fraction lotion maintained good stability and desirable physical characteristics throughout testing. These findings suggest that lotion formulated with Areca catechu L. fraction has strong potential as a natural sunscreen product, providing high-level protection and significant antioxidant activity, particularly in formulation F3.

Keywords: *Antioxidant, Areca catechu L., Lotion, Sun Protection Factor.*

Pinang (Areca catechu L.) diketahui mengandung senyawa bioaktif, terutama flavonoid dan fenolik, yang berpotensi berperan sebagai antioksidan dan agen fotoprotektif. Aktivitas tersebut menjadikannya kandidat bahan alami untuk formulasi tabir surya. Penelitian ini bertujuan menentukan nilai Sun Protection Factor (SPF) serta menilai aktivitas antioksidan lotion yang diformulasikan dengan fraksi pinang. Penelitian dilakukan menggunakan pengukuran SPF secara in vitro dengan spektrofotometer UV–Vis, uji aktivitas antioksidan menggunakan metode DPPH, serta evaluasi stabilitas fisik lotion. Hasil penelitian menunjukkan bahwa formula F3 memiliki nilai SPF tertinggi, yaitu 24,82, yang dikategorikan sebagai perlindungan ultra. Formula ini juga menunjukkan aktivitas antioksidan yang kuat dengan nilai IC50 sebesar 5,075 mg/L. Skrining fitokimia terhadap fraksi pinang mengonfirmasi keberadaan senyawa fenolik dan flavonoid yang mendukung aktivitas fotoprotektif tersebut. Evaluasi stabilitas fisik menunjukkan bahwa lotion fraksi pinang memiliki kestabilan dan karakteristik fisik yang baik selama pengujian. Dengan demikian, lotion berbasis fraksi Areca catechu L. menunjukkan potensi yang kuat sebagai produk tabir surya alami dengan perlindungan tinggi dan aktivitas antioksidan yang signifikan, terutama pada formula F3.

Kata kunci: Antioksidan; areca catechu l., lotion, sun protection factor.

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INTRODUCTION

Plants constitute an abundant source of biologically active compounds that exert significant effects on human skin (Menaa, 2014). As the outermost organ of the human body, the skin functions as a primary barrier against exogenous and endogenous factors capable of inducing various adverse biological responses. One of the most prominent risk factors for skin damage is exposure to ultraviolet radiation (UVR), which continues to receive growing attention in dermatology due to the rising incidence of both acute and chronic skin reactions. Prolonged exposure to solar ultraviolet radiation contributes not only to premature skin aging but also to increased risks of basal cell carcinoma, squamous cell carcinoma, and melanoma (Gromkowska-Kępka et al., 2021).

Antioxidants play an essential role in mitigating oxidative damage to the skin and are particularly relevant in counteracting free radicals generated by UV exposure. Various plant-derived antioxidants have demonstrated the ability not only to neutralize free radicals but also to enhance skin defense mechanisms and promote tissue regeneration (Michalak, 2022). This has encouraged the exploration of natural compounds with photoprotective properties as complementary or alternative agents to conventional sunscreens.

Areca nut (Areca catechu L.) contains a diverse array of phytochemicals, including alkaloids, polyphenols, flavonoids, tannins, fatty acids, triterpenes, and steroids. Among these constituents, flavonoids and phenolic compounds are recognized for their strong antioxidant potential, particularly through their hydroxyl groups that donate electrons to stabilize free radicals and inhibit radical chain reactions (Sun et al., 2024; Liu & Chang, 2023). Beyond their antioxidative capacity, the active compounds in areca nut have been reported to exert several pharmacological effects, including anti-inflammatory, anti-tumor, anti-bacterial, anthelmintic, and anti-viral activities (Liu & Chang, 2023). These characteristics position Areca catechu L. as a promising natural source for the development of skin-protective agents.

The potential photoprotective effect of Areca catechu L. is increasingly highlighted as sunlight—particularly ultraviolet radiation—accelerates skin aging and triggers inflammatory responses (Weng et al., 2022). The effectiveness of a sunscreen formulation is commonly evaluated using its Sun Protection Factor (SPF), which reflects the minimum dose of UV radiation required to induce erythema (Suhendra et al., 2019; Sapiun et al., 2022; Cahyani & Erwiyani, 2021). While SPF traditionally depends on UV-blocking agents, increasing evidence indicates that antioxidants can substantially enhance photoprotection, especially when incorporated into sunscreen formulations (Ebrahimzadeh et al., 2014; Kusumorini & Zulkarnain, 2024). This suggests that integrating plant-derived antioxidants into sunscreen preparations may provide improved defense against UV-induced skin damage (Haerani et al., 2018; Ebrahimzadeh et al., 2014).

Previous studies have reported promising antioxidant activity in Areca catechu L. In a study evaluating young and old areca nut samples, the strongest antioxidant activity was observed in mature samples, suggesting their potential application as sunscreen agents (Nurul Hidayah et al., 2019). Similarly, research by Nofa Putriani (2020) demonstrated that the extract and fractions of areca nut fruit skin exhibit sunscreen activity, with the ethyl acetate fraction showing particularly high SPF values. Given the increasing need for natural and effective photoprotective agents, as well as the encouraging evidence of antioxidant and SPF potential in

Areca catechu L., further investigation is warranted to strengthen its scientific basis and explore its application in topical formulations.

MATERIALS AND METHODS

Study Design

This study employed a laboratory-based experimental design consisting of four major stages: (1) preparation of Areca catechu L. simplicia, (2) extraction and fractionation of the ethanol extract, (3) formulation of lotion containing the ethyl acetate fraction, and (4) evaluation of physicochemical properties, sun protection factor (SPF), and antioxidant activity using the DPPH radical scavenging method. All experimental procedures were performed in triplicate to ensure reproducibility.

Materials

The materials used included aquadest, stearic acid, areca nut (Areca catechu L.) collected from Baubau City, Southeast Sulawesi, ethanol 70% and 96%, n-butanol, n-hexane, chloroform, ethyl acetate, glycerin, cetyl alcohol, concentrated HCl, methyl paraben, olive oil, Tween 80, magnesium powder (PT Chemindo Multi Indosukses, Indonesia), $FeCl_3$, Mayer's reagent, and Dragendorff's reagent (Sigma-Aldrich, St. Louis, USA). All reagents were of analytical grade.

Preparation of Simplicia

Fresh areca nuts were washed under running water, manually sorted to remove debris, and sliced into small pieces. The samples were dried in a hot-air oven at 50 °C until a constant weight was achieved, following the procedure described by Haerani et al. (2018). The dried material was then ground into fine powder using a mechanical grinder and stored in airtight containers.

Extraction Procedure

A total of 1,900 g of powdered simplicia was macerated using 70% ethanol. The maceration process was conducted for 3 × 24 hours at room temperature (25–27 °C) with periodic stirring every 6 hours. The filtrate was collected using Whatman No. 1 filter paper and then evaporated using a rotary evaporator at 45 °C to obtain a thick ethanol extract. The extraction yield was calculated using the formula (Sapiun et al., 2022):

$$Extraction\ yield\ (\%) = \frac{the\ weight\ of\ extract\ (g)}{the\ weight\ of\ sample\ (g)}\ x\ 100\%$$

Ethyl Acetate Fraction Making

The thick ethanol extract was dissolved in a mixture of 100 mL of 96% ethanol and 100 mL of distilled water. Fractionation was conducted using a separating funnel. First, n-hexane was added, shaken for 3–5 minutes, and allowed to separate into two layers. The n-hexane layer (upper phase) was removed. This process was repeated three times. The remaining aqueous layer was subsequently partitioned with ethyl acetate using the same procedure (three repetitions). The combined ethyl acetate fractions were concentrated using a rotary evaporator at 45 °C and stored as the ethyl acetate fraction. The fraction yield was calculated as:

$$Fraction\ yield\ (\%) = \frac{the\ weight\ of\ fraction\ (g)}{the\ weight\ of\ extract\ (9)}\ x\ 100\%$$

Phytochemical screening

Flavonoids (Shinoda Test)

Two milliliters of the ethyl acetate fraction were mixed with 0.05 g of magnesium powder and 1 mL of concentrated HCl. A positive reaction was indicated by the appearance of red, orange, or dark yellow coloration.

Phenolics (Ferric Chloride Test)

One gram of the extract was dissolved in 10 mL of ethanol and treated with 1–2 drops of $FeCl_3$ solution. A color change from light green to blue-black indicated the presence of phenolic compounds.

The Areca Fruit Fraction Lotion Making Procces

The lotion was formulated using three concentrations of the active fraction: 3.5% (F1), 6.0% (F2), and 9.5% (F3). The oil phase (cera alba, cetyl alcohol, stearyl alcohol, liquid paraffin, propyl paraben, Span 80) and the water phase (ethyl acetate fraction, Tween 80, distilled water, methyl paraben, propylene glycol, glycerin, Na-EDTA) were separately heated to 70 °C using a hotplate with magnetic stirring.

The water phase was slowly added to the oil phase under continuous stirring until a homogenous emulsion was formed. Additional distilled water was incorporated to adjust the final volume to 100 g. The lotion was stored in airtight containers prior to physical evaluation (Haerani et al., 2018). A complete formulation for each lotion variant is presented in Table 1.

Tabel 1. The Formula of **Areca Fruit Fraction Lotion** (Areca catechu L.)

Ingredient	Formula			Function
	F1	F2	F3	
Areca Nut Fraction	3.5	6.0	9.5	Active compound
Tween 80	7.5	7.5	7.5	Stability agent
Span 80	10	10	10	Emulsifying agent
Cetyl Alcohol	2	2	2	Stiffening agent
Stearyl Alkohol	2	2	2	Stiffening agent
Liquid Paraffin	10	10	10	Emollient
Glycerin	10	10	10	Humectant
Propylene glycol	15	15	15	Humectant
Methyl Paraben	0.18	0.18	0.18	Preservative
Propyl paraben	0.02	0.02	0.02	Preservative
Na. EDTA	0.1	0.1	0.1	Chelating agent
Aquades ad	100	100	100	Solvent

F1 formula lotion concentration 3.5%
F2 formula lotion concentration 6.0%
F3 formula lotion concentration 9.5%

Evaluation of physical properties of Areca nut Lotion

Organoleptic Test

The lotion was examined for its color, odor, and texture under normal lighting conditions.

Homogeniety Test

A thin layer of lotion was spread on a glass slide and visually inspected to evaluate the presence of coarse particles or phase separation.

Spreadability Test

A 0.5 g sample was placed between two glass plates. A 100 g weight was applied for 1 minute, after which the diameter of the spread was measured. Acceptable spreadability ranged between 5–7 cm.

pH Test

The pH was measured using a calibrated digital pH meter (buffer solutions pH 4.7 and pH 10). The acceptable range for topical lotion was 4.5–8.0.

Stability Test (cycling test)

Samples were stored at 4 °C for 24 hours and then at 40 °C for the next 24 hours, representing one cycle. A total of three cycles were performed. After each cycle, the organoleptic properties, pH, and viscosity were re-evaluated.

Determination of SPF value of Areca nut Fraction lotion

A 0.1 g sample of lotion was dissolved in 10 mL of 96% ethanol to prepare a 10,000 ppm solution. Absorbance was measured at wavelengths ranging from 290–320 nm at 5 nm intervals using a UV–Vis spectrophotometer, with 96% ethanol as the blank. SPF was calculated using the formula:

$$SPF = CF \times \sum 320\ EE(\lambda) \times I(\lambda) \times A(\lambda)$$

where CF is the correction factor, EE(λ) is the erythemal effect spectrum, I(λ) is the solar intensity, and A(λ) is the absorbance.

DPPH Radical Scavenging Assay

A stock solution of DPPH (10 mg in 100 mL ethanol) was prepared. Absorbance was measured at the maximum wavelength (approximately 517 nm). A 1000 mg/L test solution was prepared by dissolving 10 mg of sample in ethanol.

Aliquots of 0.05, 0.10, 0.15, 0.20, and 0.25 mL of the test solution were mixed with 2 mL DPPH solution and ethanol to a final volume of 5 mL. The mixtures were incubated for 30 minutes in the dark before absorbance measurement. Radical scavenging activity (%) was calculated using:

$$I\% = \left[\frac{(absorbance\ of\ blank\ -\ absorbance\ of\ sample)}{absorbance\ of\ blank}\right] x\ 100$$

The IC_{50} value was determined by linear regression of inhibition percentage (y) versus sample concentration (x).

Data Analysis

All quantitative data were analyzed using OriginPro 2024. Results were expressed as mean ± standard deviation. Linear regression was used to determine IC_{50} values, while comparisons among lotion formulations were analyzed using one-way ANOVA with a significance level of $p < 0.05$.

RESULTS

Extraction and Fractionation of Areca Nut

A total of 1,900 grams of Areca catechu simplicia obtained from the Sorawolio area of Baubau City were extracted using 70% ethanol. The maceration process yielded 247 grams of crude extract, corresponding to a soaking percentage of 13.00%. Fractionation of this crude extract produced 78 grams of ethyl acetate fraction, representing an impregnation percentage of 31.58%.

Phytochemical Screening

Phytochemical screening revealed the presence of flavonoids and phenolic compounds in the areca nut extract. The Shinoda test produced a red coloration, indicating a positive reaction for flavonoids, while the ferric chloride test yielded a blackish-green color, confirming

the presence of phenolic compounds. These secondary metabolites are recognized as antioxidant constituents with photoprotective potential against UV exposure. This finding aligns with Farida Larit et al., who reported that phenolic and flavonoid levels significantly influence antioxidant activity and play a vital role in protecting cells from free radical–induced damage, including UV radiation, smoke, and pollution.

Sun Protection Factor (SPF) Value Results based on Wavelength

The SPF values obtained from wavelength-based measurements indicated that all lotion formulas containing the areca nut fraction exhibited photoprotective capacity (Figure 1). Formula 3 (9.5% fraction) demonstrated the highest SPF value, followed by Formula 2 (6%) and Formula 1 (3.5%).

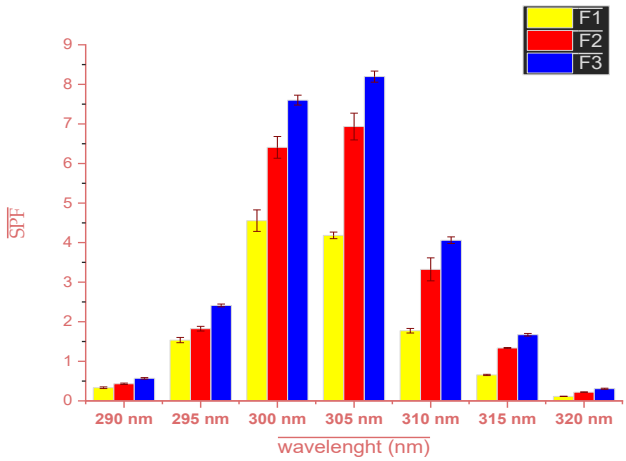

Figure 1. Sun Protection Factor (SPF) Value Results based on Wavelength
F1= SPF Value of Areca Nut Fraction Lotion Formula 3.5 %
F2= SPF Value of Areca Nut Fraction Lotion Formula 6 %
F3= SPF Value of Areca Nut Fraction Lotion Formula 9.5 %

Result Sun Protection Factor (SPF) Value

Evaluation of SPF for each lotion formula showed that Formula 3 achieved the highest SPF value of 24.82, categorized as “ultra protection.” Formula 2 showed an SPF of 20.48 (ultra protection), while Formula 1 showed an SPF of 13.15 (maximum protection). These values are illustrated in Figure 2a. Classification aligned with Sapiun et al. (2022), who categorize SPF 8–15 as maximum protection and SPF ≥15 as ultra protection.

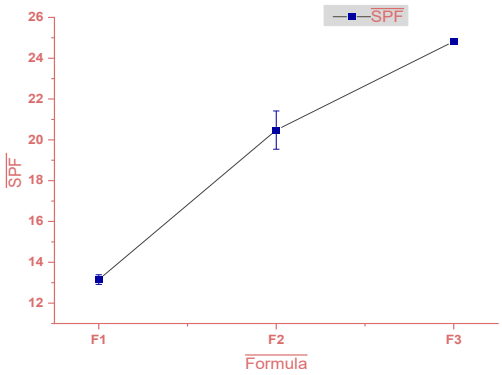

Figure 2a. Sun Protection Factor (SPF) Value of Areca Nut Fraction Lotion
F1= Formula Areca Nut Lotion Fraction 3.5% with SPF value 13.15
F2= Formula Areca Nut Lotion Fraction 6 % with SPF value 20.48
F3= Formula Areca Nut Lotion Fraction 9.5 % with SPF value 24.82

Result Antioxidant Test Areca nut Fraction Lotion

The antioxidant test results (Figure 2b) demonstrated that the lotion formulations exhibited radical-scavenging activity. Formula 3 had the strongest antioxidant capacity, with an IC_{50} value of 5.075 mg/L, followed by Formula 2 (8.17 mg/L) and Formula 1 (13.87 mg/L). These findings indicate that higher concentrations of the areca nut fraction yield stronger antioxidant effects, consistent with the SPF results.

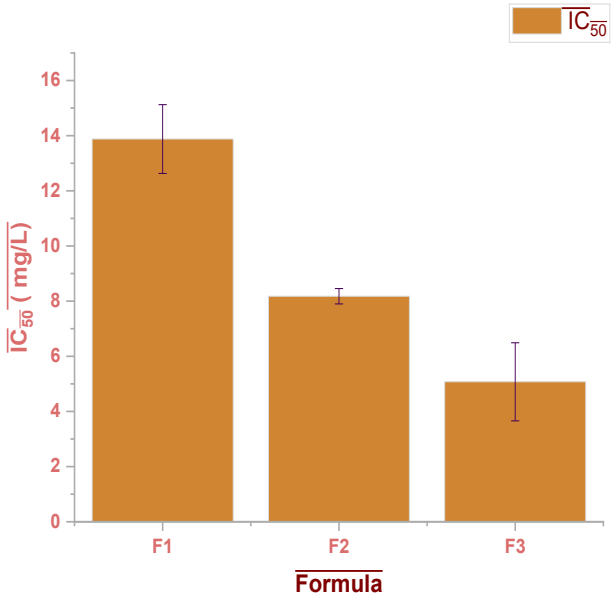

Figure 2b. Antioxidant Test Areca nut Fraction Lotion
F1= Formula Areca nut Fraction Lotion 3.5 %
F2= Formula Areca nut Fraction Lotion 6 %
F3= Formula Areca nut Fraction Lotion 9.5 %

Physical Stability Test Results of Areca Nut Fraction Lotion

The physical stability evaluation of the lotion formulations showed uniform organoleptic characteristics across formulas (Table 2). All formulations exhibited a homogenous lotion consistency without odor. Color intensity increased with higher fraction concentration, ranging from light cream (F1) to dark cream (F3). Spreading values ranged from 5.75 cm to 6.12 cm, and pH values were within skin-appropriate limits (5.01–5.10), indicating acceptable stability for topical application.

Table 2. Physical Stability Test of Areca Nut Fraction Lotion

Test	Formula		
	F1	F2	F3
Organoleptic			
Color	Light Cream	Cream	Dark Cream
Consistency	Lotion	Lotion	Lotion
Smell	Has no smell	Has no smell	Has no smell
Homogeneity	Homogen	Homogen	Homogen
Spreading (cm)	5.75	5.90	6.12
pH	5.10	5.06	5.01

DISCUSSION

The extraction and fractionation results confirm that ethanol extraction followed by ethyl acetate fractionation effectively isolates bioactive compounds from Areca catechu. The yields obtained demonstrate efficient extraction performance comparable to previous studies involving plant-based photoprotective agents. The presence of flavonoids and phenolics detected through qualitative phytochemical screening reinforces the plant's potential as a natural antioxidant and UV-protective source. As noted by Farida Larit et al., these compounds exhibit strong radical-scavenging activity that contributes to cellular protection against oxidative stress induced by UV radiation.

The SPF measurements demonstrate a concentration-dependent enhancement in photoprotective efficacy. Formula 3, with the highest concentration (9.5%), produced an SPF value of 24.82, placing it within the "ultra protection" category (Sapiun et al., 2022). This relationship aligns with the Lambert–Beer Law, where increased concentration of active compounds corresponds to higher absorbance in the UVB range (290–320 nm), resulting in enhanced SPF values. Similar patterns of concentration-dependent SPF enhancement have been documented in botanical extracts used as natural sunscreens (Ebrahimzadeh et al., 2014).

The antioxidant findings further support the photoprotective potential of the areca nut fraction. The lowest IC_{50} value in Formula 3 indicates the strongest radical-scavenging activity. This reinforces earlier evidence that phenolic and flavonoid compounds mitigate oxidative stress by neutralizing free radicals and preventing downstream cellular inflammation. As explained by Costa et al. (2015), unchecked free radical exposure activates pathways involving IκB-kinase and NF-κB, leading to the release of proinflammatory cytokines—TNF-α, IL-6, and IL-8—which inhibit collagen synthesis and promote photoaging. The potent antioxidant performance of Formula 3 thus supports its high SPF value and suggests broader dermatoprotective benefits.

The results of the physical stability test confirm that all formulations maintained acceptable parameters for topical application, including homogeneity, consistency, spreading ability, and pH levels compatible with the skin's acid mantle. Increasing concentration resulted in a darker cream color and slightly higher spreading capacity, but no instability was observed. These characteristics indicate that the formulations meet essential physicochemical requirements for cosmetic use.

Collectively, the findings demonstrate that the ethyl acetate fraction of Areca catechu possesses promising photoprotective and antioxidant properties, with efficacy increasing in line with concentration. Formula 3 (9.5%) emerged as the most potent formulation, offering ultra-level SPF protection and strong antioxidant capacity. These data support the potential development of areca nut–based natural sunscreen products and warrant further studies, particularly regarding safety, long-term stability, and in vivo photoprotective effectiveness.

CONCLUSIONS

The concentration of areca nut extract in the lotion directly influences its SPF value. Formula F1 exhibits an SPF of 13.15, while Formula F2 shows an SPF of 20.48, and Formula F3 demonstrates an SPF of 24.82, indicating that higher concentrations result in better protection. The antioxidant activity of the lotion increases with the concentration of areca nut fraction. Formula F1, with the lowest concentration, has an IC50 of 13.87 mg/L, while F2 shows an IC50

of 8.17 mg/L, and F3, with the highest concentration, demonstrates an IC50 of 5.075 mg/L. This indicates that higher concentrations of areca nut fraction enhance protection against UV rays.

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REFERENCES

Ahmad, K., Hafeez, Z. B., Bhat, A. R., Rizvi, M. A., Thakur, S. C., Azam, A., & Athar, F. (2018). Antioxidant and apoptotic effects of Callistemon lanceolatus leaves and their compounds against human cancer cells. Biomedicine & pharmacotherapy = Biomedecine & pharmacotherapie, 106, 1195–1209. https://doi.org/10.1016/j.biopha.2018.07.016)72

Bailore, N. N., Sarojini, B. K., & Harshitha, K. R. (2022). Fabrication and Determination of the Sun Protection Factor and Ultraviolet Protection Factor for Piscean Collagen/Bischalcone Derivative (B1) Composite Films with Wide-Range UV Shielding. ACS Omega, 7(32), 27876–27885. https://doi.org/10.1021/acsomega.2c00772

Costa, S. C. C., Detoni, C. B., Branco, C. R. C., Botura, M. B., & Branco, A. (2015). In vitro photoprotective effects of Marcetia taxifolia ethanolic extract and its potential for sunscreen formulations. Revista Brasileira de Farmacognosia, 25(4), 413–418. https://doi.org/10.1016/j.bjp.2015.07.013

Dewi, S. T. R., Karim, D., & Damaris, D. (2020). Identifikasi Kandungan Daun Nggorang (Salvia occindentalis Sw) Menggunakan Spektrofotometer GC-MS. Media Farmasi, 16(2), 244. https://doi.org/10.32382/mf.v16i2.1806

Dwi Mulyani, A., Rahayu, P., Aini, N., Purnamasari, D., Mulyani, A. D., Farmasi, J., & Mulyani, A. D. (2023). Formulasi dan Evaluasi Mutu Fisik Sediaan Masker Gel Peel-Off Ekstrak Biji Pinang (Areca Catechu L.) Sebagai Antioksidan How to cite (APA 6 th Style). Areca Catechu L.) Sebagai Antioksidan. Indonesian Journal of Pharmaceutical (e-Journal), 3(3), 2775–3670. https://doi.org/10.37311/ijpe.v3i3.22033

Ebrahimzadeh, M. A., Enayatifard, R., Khalili, M., Ghaffarloo, M., Saeedi, M., & Charati, J. Y. (2014). Correlation between sun protection factor and antioxidant activity, phenol and flavonoid contents of some medicinal plants. Iranian Journal of Pharmaceutical Research, 13(3), 1041–1048.

Gromkowska-Kępka, K. J., Puścion-Jakubik, A., Markiewicz-Żukowska, R., & Socha, K. (2021). The impact of ultraviolet radiation on skin photoaging — review of in vitro studies. Journal of Cosmetic Dermatology, 20(11), 3427–3431. https://doi.org/10.1111/jocd.14033

Haerani, A., Chaerunisa, A. Y., & Subranas, A. (2018). Artikel Tinjauan: Antioksidan untuk kulit. Farmaka, 16, 135–151.

Krishnamoorthy, K., & Subramaniam, P. (2014). Phytochemical Profiling of Leaf, Stem, and Tuber Parts of Solena amplexicaulis (Lam.) Gandhi Using GC-MS . International Scholarly Research Notices, 2014, 1–13. https://doi.org/10.1155/2014/567409

Kusumorini, N., & Zulkarnain, A. K. (2024). Formulation of a Lotion with Ethanol Extract of Curcuma manga Val. as a UV B Sunscreen and Activity Test by UV-Vis Spectrophotometry. Indonesian Journal of Pharmacy, 35(3), 521–530. https://doi.org/10.22146/ijp.9583

Larit, F., León, F., Benyahia, S., & Cutler, S. J. (2019). Total phenolic and flavonoid content and biological activities of extracts and isolated compounds of Cytisus villosus pourr. Biomolecules, 9(11). https://doi.org/10.3390/biom9110732

Liu, P. F., & Chang, Y. F. (2023). The Controversial Roles of Areca Nut: Medicine or Toxin? International Journal of Molecular Sciences, 24(10). https://doi.org/10.3390/ijms24108996

Menaa, F. (2014). Skin Anti-Aging Benefits of Phytotherapeutics-based Emulsions. Pharmaceutica Analytica Acta, 05(09), 3–5. https://doi.org/10.4172/2153-2435.1000e168

Michalak, M. (2022). Michalak M. Plant-Derived Antioxidants: Significance in Skin Health and the Ageing Process. Int J Mol Sci. 2022;23(2):8–12. International Journal of Molecular Sciences, 23(2), 8–12.

Mu'nisa, A., & Muflihunna, A. (2023). Analisis GC-MS (Gas Chromatography - Mass Spectrometry) Ekstrak Etanol Ekstrak Actinopyga Echinites di Pesisir Pantai Puntondo Kabupaten Takalar. 2246–2250.

Salsabila, S., Rahmiyani, I., & Sri Zustika, D. (2021). Nilai Sun Protection Factor (SPF) pada Sediaan Lotion Ekstrak Etanol Daun Jambu Air (Syzygium aqueum). Majalah Farmasetika, 6(Suppl 1), 123. https://doi.org/10.24198/mfarmasetika.v6i0.36664

Sapiun, Z., Achmadi, N., Imran, A. K., Muindar, M., Buana, W. A. A., Nur, M. U., Hartati, H., Kamba, V., Slamet, N. S., Ysrafil, Y., & Rifai, Y. (2022). Determination of Sun Protection Factor Lotion of Pulai Stem Extract (Alstonia scholaris (L.) R.Br). Open Access Macedonian Journal of Medical Sciences, 10(A), 833–840. https://doi.org/10.3889/oamjms.2022.9131

Sari, M. S., Ridwan, A., Mardina, V., Putri, K. A., Alfajar, B., & Wibowo, S. G. (2020). Skrining Potensial Pinang Aceh (Areca catechu L.) Sebagai Elevator Transporter GLUT4 dan Fitokonstituen Antiproliferatif Sel Kanker. Herbal Medicine Journal, 3(1), 6–11.

Shukla, R., Banerjee, S., & Tripathi, Y. B. (2018). Antioxidant and Antiapoptotic effect of aqueous extract of Pueraria tuberosa (Roxb. Ex Willd.) DC. On streptozotocin-induced diabetic nephropathy in rats. BMC Complementary and Alternative Medicine, 18(1), 1–11. https://doi.org/10.1186/s12906-018-2221-x

Suhartono, S., Soraya, C., & Shabira, P. (2023). Antibiofilm activity of neem leaf (Azadirachta indica A. Juss) ethanolic extracts against Enterococcus faecalis in vitro. Dental Journal, 56(2), 98–103. https://doi.org/10.20473/J.DJMKG.V56.I2.P98-103

Sun, H., Yu, W., Li, H., Hu, X., & Wang, X. (2024). Bioactive Components of Areca Nut: An Overview of Their Positive Impacts Targeting Different Organs. Nutrients, 16(5). https://doi.org/10.3390/nu16050695.