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Email : editorijhess@gmail.com

Formulation And Antioxidant Activity Testing Of Ethanol Extract Moisturizing Gel From Kesum Leaves (*Polygonum Minus* Huds.) Using The DPPH (2,2-Diphenyl-1-Picrylhydrazyl) Method

Windy Marcella[1)], Bangkit Riska Permata[2)], Annie Rahmatillah[3)]
[1,2,3)] Bachelor of Pharmacy Study Program, Faculty of Health Sciences, Duta Bangsa University, Surakarta

*Corresponding Author
Email : Windymarcella11@gmail.com

Abstract

Free radicals are unstable molecules that can cause cell damage and play a role in premature aging and various skin disorders. One way to inhibit the effects of free radicals is through the use of topical preparations containing antioxidants. Kesum leaves (Polygonum minus Huds) are known to contain bioactive compounds, particularly flavonoids and phenolics, which have the potential to act as natural antioxidants. This study aims to formulate kesum leaf ethanol extract into a moisturizing gel preparation and evaluate its physical quality and antioxidant activity using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method. This study was an experimental study with variations in the concentration of kesum leaf ethanol extract, namely F1 (1%), F2 (2%), and F3 (3%). The evaluation of the physical quality of the gel included organoleptic testing, homogeneity, pH, Viscosity and spreadability. Antioxidant activity was expressed as the IC_{50} value. The results showed that all gel formulations met the physical quality requirements for preparations. The IC_{50} values of the gel preparations in F1, F2, and F3 were 169.556 ppm, 150.759 ppm, and 125.396 ppm, respectively, while the positive control showed an IC_{50} value of 44.792 ppm. An increase in the concentration of kesum leaf ethanol extract in the gel formulation showed a tendency to increase antioxidant activity. Formula F3 had the best antioxidant activity among the gel formulations tested. Thus, kesum leaf ethanol extract has potential as an antioxidant agent.

Keywords: Kesum Leaves, Moisturizing Gel, Antioxidants, Ic_{50}, Dpph.

INTRODUCTION

Free radicals are unstable molecules that can cause cell damage and play a role in premature aging and various skin disorders (Hana *et al*., 2024). According to the Indonesia Cancer Care Community, in 2018, there were 6,170 cases of non-melanoma skin cancer and 1,392 cases of melanoma skin cancer among Indonesians (Nurlitasari *et al*., 2022), one of the contributing factors being frequent exposure to ultraviolet radiation.

Human skin is the outermost organ of the body that functions as a protector against various environmental influences such as pollution, ultraviolet (UV) radiation, and microorganisms (Sari *et al*., 2023). According to Kaffah (2020), damage caused by exposure to ultraviolet rays is largely associated with the production of ROS (Reactive oxygen species) at excessive exposure levels, which induces a complex molecular cascade and can activate inflammation, thereby accelerating physiological aging and causing characteristic epidermal degeneration. In their daily lives, humans often engage in various outdoor activities that expose their skin to ultraviolet (UV) rays from the sun. Therefore, to minimize the adverse effects of ultraviolet rays, preventive measures are needed, one of which is the use of preparations containing antioxidants.

Various forms of cosmetic preparations with antioxidant efficacy have been developed as alternatives to protect the skin from the harmful effects of free radicals caused by exposure to ultraviolet (UV) rays. Gel preparations have several advantages over other topical preparations, including the ability to release active ingredients well, being easy to clean with water, and having good spreadability on the skin surface (Wahidah *et al*., 2024).

Recently, there has been an increase in interest in the use of natural ingredients in cosmetic products because they are considered safer and more environmentally friendly (Akmal, 2024). Various types of plants contain bioactive chemical compounds that have antioxidant properties. One plant that

has the potential to be used as a source of natural antioxidants is kesum leaves (Mulyati & Kurnijasanti, 2023).

Kesum leaves are a plant commonly found in West Kalimantan, where they are generally used by the community as a vegetable or cooking spice (Syari et al., 2022). Traditionally, within the community, this plant is also used as a medicine to treat various diseases such as treating intestinal worms, stimulating menstruation, treating scabies, preventing flatulence, overcoming stomach ulcers, accelerating postpartum recovery, and overcoming various hair problems such as nourishing, darkening, and removing dandruff (Syari *et al*., 2022).

Based on chemical identification tests of kesum leaves conducted by Kartikasari *et al* (2022), it was proven that 70% ethanol extract of kesum leaves contains several beneficial compounds such as alkaloids, tannins, steroids, flavonoids, triterpenoids, and glycosides. Various literature indicates that natural ingredients containing phenolic compounds have high antioxidant activity because phenolic compounds can form stable phenoxy radicals during the oxidation process (Syaron *et al*., 2020). This means that phenolic compounds play a role in capturing harmful free radicals and forming non-reactive phenoxy radicals, thereby preventing cell damage or further oxidation (Hardyasar *et al*., 2016).

Further research on the antioxidant activity of this plant shows that 96% ethanol extract of kesum leaves has very high antioxidant activity, with an IC_{50} value of 10.526 ± 0.075 ppm (category < 50 ppm) (Kartikasari *et al*., 2023). This value is close to the IC_{50} value of vitamin C, which is a very strong antioxidant (Cair *et al*., 2024).

Considering the very high antioxidant potential of kesum leaves and the importance of moisturizers in skin care, this study was conducted to formulate a moisturizing gel containing kesum leaf ethanol extract and to evaluate its antioxidant activity using the DPPH method. This method was chosen because of its simple, easy, fast, and sensitive nature, requiring only a small sample (Abiwa & Anggo, 2020).

RESEARCH METHODS

Types and Methods of Research

This study is an experimental study involving treatment and observation of the effect of varying concentrations of ethanol extract of kesum leaves formulated in a moisturizing gel on the physical characteristics of the gel and its antioxidant effectiveness, which was tested using the DPPH (2,2-diphenyl-1-picrylhydrazil) method. The stages of this research included plant collection, simplisia processing, simplisia standardization, extraction, extract standardization, phytochemical screening, extract antioxidant activity testing, moisturizing gel formulation, physical evaluation of preparations, and antioxidant activity testing of preparations.

Extract Production

Harvesting kesum leaves (*Polygonum minus* Huds) used as herbal medicine involves collecting leaves that are not too old, specifically leaves located near the top of the plant, approximately 5-8 leaves below the top (Eivifania *et al*., 2020). The cleaned kesum leaves are dried using a drying oven at a temperature of 40-50°C until they become dried medicinal ingredients. Drying is carried out at a controlled temperature to prevent damage to bioactive compounds, especially phenolic and flavonoid components which are thermolabile (Pongsapan *et al*., 2024). After the drying process is complete, the leaves are cooled at room temperature and stored in tightly sealed containers to prevent moisture absorption from the air. A total of 500 grams of keisum leaf powder (*Polygonum minus* Huds) was macerated using 70% ethanol solvent with a ratio of 1:5 between the herb and the solvent. The maceration was then carried out for 3 days and remastering was carried out over two days. The Kesum leaf (*Polygonum minus* Huds) extract was then filtered using flannel cloth and filter paper. The filtrate was then filtered and evaporated using a rotary evaporator to obtain a concentrated extract rich in bioactive compounds at a temperature of 40-60°C and controlled above a water bath (Sari *et al*., 2025).

Formulation of Moisturizer Gel Containing Ethanol Extract of Kesum Leaves

Carbopol is balanced with aqua in mortar. Methyl paraben is dissolved in glycerin and stirred until dissolved. The kesum leaf extract is stirred by adding propylene glycol until the texture becomes soft and homogeneous. The carbopol is stirred first by adding TEA little by little until it forms a gel base. Add the mixture of glycerin and methyl paraben to the gel base while stirring until homogeneous. Add the remaining propylene glycol to the base mixture and stir until homogeneous. Mix the extract into the gel base and stir until homogeneous. Add the remaining aquades little by little.

Table 1. Formulation of Ethanol Extract Moisturizing Gel from Kesum Leaves (Polygonum minus Huds)

Bahan	Concentration of Materials (%)				Uses
	F0	FI	FII	FIII	
Extract	0	1	2	3	Active ingredient
Carbopol	0,75	0,75	0,75	0,75	Gel Base
Glycerin	5	5	5	5	Humectant
Propylene glycol	10	10	10	10	Humectant
TEIA	1	1	1	1	Alkalizing
Methylparaben	0,1	0,1	0,1	0,1	Preservative
Aquadeist	50 ml	50 ml	50 ml	50 ml	Solvent

Physical Evaluation of Moisturizing Gel Products

The ethanol extract moisturizing gel preparation was subjected to several physical quality evaluations, including organoleptic properties, homogeneity, pH, viscosity, and spreadability.

Antioxidant Activity Test

The DPPH stock solution was prepared by dissolving 10 mg of DPPH in p.a. methanol to a volume of 100 mL to obtain a concentration of 100 ppm, then diluted by taking 40 mL of the solution and adding 60 mL of p.a. methanol to obtain a 40 ppm DPPH solution. The stock solutions of kesum leaf extract, quercetin, moisturizer gel preparation, and positive control (commercial moisturizer gel) were each prepared by dissolving 10 mg of sample in p.a. methanol to a volume of 100 mL to obtain a concentration of 100 ppm. The maximum wavelength was determined using a UV-Vis spectrophotometer in the range of 400–800 nm against a 40 ppm DPPH solution. The operating time was determined by testing a 40 ppm DPPH solution by measuring the absorbance every minute for 60 minutes. The antioxidant activity of the extract and quercetin was tested by making variations in concentration of 2, 4, 6, 8, and 10 ppm from the stock solution. The antioxidant activity of the kesum leaf moisturizing gel and the control moisturizing gel was tested by making variations in concentration of 20, 40, 60, 80, and 100 ppm from the stock solution. Then, 2 mL of each solution was taken and mixed with 2 mL of 40 ppm DPPH, incubated according to the operating time, and then measured for absorbance using a UV-Vis spectrophotometer at the maximum wavelength.

RESULTS AND DISCUSSION

Simplisia Yield

Table 2. Yield of Kesum Leaf Extract

Bobot awal simplisia (gr)	Bobot ekstrak (gr)	Rendemen %
500	76,63	15,326

Phytochemical Screening

Table 3. Phytochemical Screening of Kesum Leaf Extract

Testing	Test Results	Description
Alkaloid Test (Wagner)	Brown Sediment	-
Alkaloid Test (Mayer)	White Sediment	+
Alkaloid Test (Dragendrof)	orange	+
Flavonoids	orange	+
Tannins	Dark blue	+
Steroids	Dark green	+
Saponins	There is foam	+

Organoleptic Test Results for Kesum Leaf Extract Moisturizing Gel Preparations

Table 4. Organoleptic Gel Moisturizer with Kesum Leaf Extract

Parameters	Formula			
	F0	F1	F2	F3
Color	White	Light brown	Dark chocolate	Dark brown
Smell	Characteristic kesum leaves	Characteristic kesum leaves	Characteristic keisum leaves	Characteristic kesum leaves
Texture	Semi-solid	Semi-solid	Seimi Solid	Semi-solid

Results of Physical Quality Evaluation of Moisturizing Gel with Kesum Leaf Extract

Table 5. Physical Quality Evaluation of Moisturizing Gel with Kesum Leaf Extract

Parameters	Formulas			
	F0	F1	F2	F3
Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous
pH	7,53	5,44	4,97	4,57
Viscosity	8243	7536	5794	2221
Spreadability	4,82	6,01	6,62	7,03

Antioxidant Activity Results of Kesum Leaf Extract and Quercetin

Table 6. Antioxidant Activity of Kesum Leaf Extract and Quercetin

Sample	Concentration (ppm)	% Inhibition	IC_{50}
Kesum Leaf Extract	2	0,967	28,892
	4	2,419	
	6	7,258	
	8	10,645	
	10	15,483	
Quercetin	2	44,516	5,562
	4	47,58	
	6	49,516	
	8	54,838	
	10	57,096	

Antioxidant Activity Results of Kesum Leaf Extract Moisturizing Gel Preparation

Table 7. Antioxidant Activity of Kesum Leaf Moisturizing Gel

Sample	Concentration (ppm)	% Inhibition	IC_{50}
F1	20	5,483	169,556
	40	10,483	
	60	14,516	
	80	20,483	
	100	31,129	
F2	20	23,87	150,759
	40	25,483	
	60	33,548	
	80	33,354	
	100	40,483	
F3	20	29,032	125,396
	40	33,225	
	60	37,58	
	80	40,967	
	100	44,838	

K (+)	20	46,29	44,792
	40	49,032	
	60	53,064	
	80	54,677	
	100	57,903	

DISCUSSION

Kesum leaf simplisia (Polygonum minus Huds) was macerated using 70% ethanol. The maceration process in this study was adapted from a study (Wahyudi & Minarsih, 2023) in which maceration was carried out for 3 days and remaceration for 2 days. The ratio between simplisia and solvent was 1:5, carried out at room temperature. During the maceration process, stirring was performed occasionally to ensure a balanced concentration of the extracted material so that it could be extracted more quickly in the solvent (Bani *et al*., 2023). After that, the filtrate was separated and the crude extract residue was remacerated using the same solvent ratio to obtain maximum extraction. All the filtrate from the maceration and remaceration processes was then combined and evaporated using a rotary evaporator at a temperature of 50 °C until a thick kesum leaf extract was obtained. The temperature used in the evaporation process should not be excessive. This is related to the nature of the compounds expected to be extracted from the maceration process, namely thermolabile compounds such as flavonoids, because excessive heat risks damaging these compounds (Syafriana & Puspitasari, 2024). After obtaining the concentrated kesum leaf extract, the extract yield was calculated. An extract can be considered good if the yield value produced is >10% (Saerang *et al*., 2023). The yield of the kesum leaf extract was 15.326%. Based on the extract yield results, the kesum leaf simplisia met the applicable quality criteria.

Phytochemical screening is an important method used to identify secondary metabolites in an extract, which is carried out qualitatively using specific reagents (Maharani *et al*., 2024). This screening technique can detect various groups of compounds such as flavonoids, alkaloids, tannins, saponins, and terpenoids, thus providing an initial overview of the phytochemical composition of an extract (Saputri *et al*., 2025). Based on research that has been conducted, it is known that kesum leaf extract contains alkaloids, flavonoids, saponins, tannins, and steroids. The presence of these secondary metabolites indicates the potential antioxidant activity of kesum leaf extract. Therefore, kesum leaves were selected as the active ingredient in the moisturizer gel formulation, which was made in three concentrations, namely 1% (F1); 2% (F2); 3% (F3). The purpose of this study was to determine the most effective concentration of avocado leaf extract as an antioxidant in the facial wash gel formulation. The evaluation included physical quality tests (organoleptic, homogeneity, pH, viscosity, and spreadability).

The purpose of organoleptic testing is to observe changes in the shape, color, and smell of the gel preparations (Rusli *et al*., 2021). Based on the organoleptic test results in the organoleptic test results table, it was found that formulation F0 was white, while F1 to F3 showed brown colors with increasing intensity as the concentration of kesum leaf extract increased. All formulations had the characteristic smell of kesum leaves and showed a soft texture. These results indicate that the addition of extract affects the color of the preparation but does not significantly alter the odor and texture of the gel.

The homogeneity test aims to ensure uniformity and the absence of clumping. Uniformity and good particle size contribute to increased stability of the preparation (*Rusli et al*., 2021). The homogeneity test can be fulfilled if the preparation has a uniform composition without any visible coarse particles (Thomas *et al*., 2023). Based on the results of homogeneity observations, it can be concluded that all formulations, namely F0, FI, FII, and FIII, show homogeneous conditions. This is indicated by the absence of coarse particles, clumps, or color differences in the preparation, so it can be concluded that the mixing process of the ingredients in each formulation has been carried out properly and produced a uniform gel preparation.

The purpose of conducting a pH test on the formulation is to determine whether the resulting gel is acceptable to the skin or not, given that the pH requirement for skin is 4.5-6.5 (Feladita *et al*., 2021). Topical formulations should have a pH close to that of the skin in order to diffuse properly. A pH that is too alkaline can cause dry skin, while a pH that is too acidic has the potential to cause irritation (Thomas *et al*., 2023). The results of pH testing on moisturizer gel preparations for Formula 0 had a pH of 7.53. Formula I had a pH of 5.44. Formula II had a pH of 4.97 and formula III had a pH of 4.57. Based on the test results, the FI-FIII formulations have pH values within the physiological pH range of the skin (4.5–6.5). The decrease in pH in each formulation is thought to be related to the increase in the concentration of the acidic kesum leaf extract. This is in line with research conducted by (Kartikasari & Masykuroh, 2024), which shows that an increase in the concentration of kesum leaf extract in mouthwash preparations causes a decrease in pH value, due to the contribution of acidic compounds contained in the extract to the preparation system.

Viscosity testing was conducted to determine the viscosity level of the gel that had been made and to determine the effect of increasing the extract on the viscosity of the preparation. A good viscosity value in gel preparations is in the range of 500–10,000 m.Pas (Rahmatullah *et al*., 2020). Based on the test results, the viscosity of the preparation decreased with increasing extract concentration, which was thought to be caused by the interaction of extract components and changes in pH due to the presence of phenol groups in the extract. This decrease in pH causes gel mass contraction, making the liquid easier to move and reducing the consistency of the formulation (Thomas *et al*., 2023). Based on the viscosity values obtained for formulations F I, F II, and F III, they fall within the acceptable gel viscosity range.

Spreadability testing was conducted to determine the evenness of the gel when applied to the skin (Rusli *et al*., 2021). A good spreadability value in gel preparations ranges from 5-7 cm. Based on the test results, all formulas (F0–FIII) showed an increase in spreadability as the load increased from 50 g to 150 g. Formula F0 had the lowest spreadability (4.82 cm), indicating a thicker gel consistency, while FI, FII, and FIII showed higher spreadability, with FIII being the highest (7.03 cm). This difference indicates that variations in formulation composition, particularly the addition of active ingredients, affect the flow properties and viscosity of the gel. Thus, FI, FII, and FIII affect the criteria for good spreadability because they are still within the spreadability range as required (5-7 cm).

Before testing antioxidant activity, wavelength measurement must first be performed. This wavelength measurement is done to determine the optimal wavelength at which the test compound absorbs light maximally so that absorbance measurements can be performed with high sensitivity and accuracy (Al Kausar *et al*., 2023). The maximum wavelength is measured in the wavelength range of 400-800 nm. Based on the results of measurements using a UV-Vis spectrophotometer, the maximum wavelength of DPPH (2,2-diphenyl-1-picrylhydrazyl) was determined to be 515 nm with an absorbance value of 0.620. This wavelength value was also used as the control absorbance. The measurement of the control solution absorbance aims to determine the initial absorbance of DPPH before adding samples or standards (Muliasari *et al*., 2023). After obtaining the maximum wavelength, the operating time is determined. The determination of the operating time aims to ensure that the measurement is carried out at the right time when the reaction between the sample and the reagent has been completed, so that the absorbance measurement results are accurate (Priyadi *et al*., 2025). In this study, the operating time was used as a reference to determine how long the sample should be incubated after reacting with DPPH. The operating time measurement was carried out at 1-minute intervals for 60 minutes (Winata *et al*., 2023).

In this study, quercetin was used as a positive control for the antioxidant value of the extract. Quercetin was used as a positive control in this study because this compound belongs to the flavonoid group, which is widely found in plants and is known to have strong antioxidant activity, both by inhibiting the chain reaction of free radicals and by directly neutralizing free radicals (Ayuba *et al*., 2023). For the gel preparation itself, a commercial moisturizing gel was used as the positive control

to validate the effectiveness of the product being tested compared to products already available on the market.

Based on antioxidant testing of kesum leaf extract, the IC50 value of kesum leaf extract was 28.892 ppm. These results indicate that kesum leaf extract has very strong antioxidant activity. The antioxidant value of the extract obtained is in line with previous research conducted by (Kartikasari *et al*., 2023), which found that kesum leaves have very high antioxidant activity, with an IC_{50} value of 10.526 ppm in extraction using 96% ethanol. Based on antioxidant testing of quercetin, an IC_{50} value of 5.562 ppm was obtained. These results indicate that quercetin has very strong antioxidant activity. The antioxidant activity of quercetin is higher than that of the extract because quercetin is a pure compound that is specifically effective in suppressing free radicals (Firdausia *et al*., 2023). Meanwhile, the extract is a mixture of various compounds, so the concentration of active compounds is lower.

Based on the results of antioxidant activity testing of moisturizer gel preparations as indicated by the IC_{50} value, it was found that formula F1 had an IC_{50} value of 169.556 ppm, formula F2 had an IC_{50} value of 150.759 ppm, formula F3 had an IC_{50} value of 125.396 ppm, and the positive control had an IC_{50} value of 44.792 ppm. The IC_{50} value indicates the concentration of the sample needed to reduce 50% of free radicals, so the smaller the IC_{50} value, the higher the antioxidant activity (Manao *et al*., 2024). Based on the classification of antioxidant strength, commercial moisturizing gels are categorized as very strong, F1 and F2 are categorized as weak, while F3 is categorized as moderate. The difference in IC_{50} values between formulas shows that an increase in the concentration of active ingredients in the formulation affects the increase in antioxidant activity. Thus, it can be concluded that formula F3 is the optimal formulation among the test preparations because it has the highest antioxidant activity compared to other formulas, even though its potential activity is still below the positive control (commercial moisturizer). Increasing the extract concentration from 1% to 2% and 3% showed a tendency for increased antioxidant activity. This was demonstrated by the extract's increased ability to suppress free radicals as the number of active compounds contained in the test solution increased. The higher the extract concentration, the more antioxidant compounds are available to donate electrons or hydrogen atoms, thereby increasing the effectiveness of free radical scavenging (Rahmatillah *et al*., 2025). This condition indicates a proportional relationship between the increase in extract concentration and the resulting antioxidant activity.

CONCLUSION

Based on the research results obtained, it can be concluded that: Kesum leaf extract (Polygonum minus Huds) was successfully formulated into a gel preparation with good physical characteristics. The Kesum leaf extract moisturizing gel preparation showed antioxidant activity based on the DPPH method with IC_{50} values of F1 = 169.556 ppm, F2 = 150.759 ppm, and F3 = 125.396 ppm, which is classified as weak to moderate activity. Based on the study of antioxidant activity formulation content, the strongest activity was found in formula 3 because it had the smallest IC_{50} value (125.396 ppm), thus showing the highest antioxidant activity compared to other formulas.

REFERENCES

Abiwa, N. A., & Anggo, S. (2020). Potensi Ekstrak Rumput Laut (E*ucheuma cottoni*) Sebagai Antioksidan. *Jurnal Farmasi Juli*, *12*(1), 36–41.

Aiyuba, D. S. (2023). Uji Aktivitas Antioksidan Ekstrak Metanol Daun Ramania (B*ouea macrophylla Griffith* .) Menggunakan Metode DPPH Antioxidant Activity Test of Methanol Extract of Ramania Leaf (*Bouea macrophylla Griffith* .) Using the DPPH method. *Jurnal Surya Medika*, *8*, 81–87.

Akmal, Y. (2024). Pemanfaatan Bahan Alam Dalam Kosmetika Tradisional Dan Keamanannya. *Jurnal Tata Rias*, *14*(02), 49–58.

Al kausar, R., Eka Putra, S. A., & Tutik. (2023). Hubungan Kadar Flavonoid Dengan Aktivitas Antioksidan Pada Daun Jambu Air (Syzygium aqueum) dan Daun Kelor (Moringa Oleifera) Menggunakan Spektofotometri UV-VIS. *Jurnal Analisis Farmasi*, *8*(2), 170–187.

Bani, A. A., Amin, A., Mun'im, A., & Radji, M. (2023). Rasio Nilai Rendemen dan Lama Ekstraksi Maserat Etanol Daging Buah Burahol (S*telecocharpus burahol*). *Makassar Natural Product Journal*, *1*(3), 176–184.

Cair, M., Masaenah, E., & Putri, D. A. (2024). Pengujian Aktivitas Antioksidan Pada Ekstrak Etanol Daun Afrika (*Gymnanthemum amygdalinum* Del .) Dengan Metode DPPH Terhadap Sediaan Sabun. *Pharmamedica Journal*, *9*(1), 88–96.

Evifania, R. D., Apridamayanti, P., & Sari, R. (2020). Uji parameter spesifik dan nonspesifik simplisia daun senggani *(Melastoma malabathricum L .)* Specific and nonspecific parameter test of simplicia of senggani *(Melastoma malabathricum L .) leaves*. *6*(1), 17–20.

Feladita, N., Junova, H., & Anatasia, I. (2021). *Formulasi Sediaan Gel Moisturizer Anti-Aging* Ekstrak Kulit Bawang Merah *(Alliium cepa L .) Sebagai Antioksidan*. *4*(1), 93–106.

Firdausia, R. S., Sholehah, K., Kurniasih, I., Diani, A., & Rusmeilina, R. (2023). Analisis Potensi Antioksidan Daun Kayu Bulan *(Pisonia alba Span .)* sebagai Agen Anti Penuaan dini. *11*(1), 22–28.

Hana, U. R., Sujono, T. A., Farmasi, F., & Muhammadiyah, U. (2024). *Tinjauan Literatur : Aktivitas Antioksidan Biji Kedelai Hitam 3*(4), 453–464.

Hardyasar, S., Suryanto, E., & Wewengkang, D. S. (2016). Aktivitas Antioksidan Fraksi Fenolik Dari Empulur Batang Sagu Baruk (*Arenga microcarpa*). *Jurnal Ilmiah Farmasi*, *5*(2).

Kaffah Silmi, A. W. (2020). Open Acces. Pengaruh Cokelat *(*Theobrona Cacao L.*)* Terhadap Kesehatan Kulit, *01*(03), 109–116.

Kartikasari, D. (2022). Uji Fitokimia Daun Kesum (*Polygonum minus* Huds.) Dari Kalimantan Barat *Jurnal Insan Farmasi Indonesia*, *5*(April). https://doi.org/10.36387/jifi.v5i1.912

Kartikasari, D., Mulyani, A. I., & Ridha, A. (2023). Potensi Tabir Surya Spray Ekstrak Etanol Daun Kesum*(Polygonum minus* Huds*.) 3*, 542–552.

Kartikasari, D., & Masykuroh, A. (2024). Formulasi *Moutwash* Ekstrak Etanol Daun Kesum. *Jurnal Komunitas Farmasi Naional*, *04*, 718–733.

Maharani, S., Meilina, R., Dina, P., Kulla, K., & Rezeki, S. (2024). Skrining Fitokimia Senyawa Metabolit Sekunder dan Standarisasi Akar Manis *(Glycyrrhiza glabra L .)*

Manao, M., Malem, R., & Karo, B. (2024). Uji Aktivitas Antioksidan dari Fraksi Etil Asetat Ekstrak Metanol Daun Kerai Payung (*Filicium decipiens*) A. *Jambura Journal Of Health Science And Research*, *6*(NO.3), 306–318.

Muliasari, H., Hanifa, N. I., Hajrin, W., & Andanalusia, M. (2023). Jurnal Biologi Tropis Determination of Antioxidants by DPPH Scavenging Activity of *Ashitaba Herb (Angelica keiskei) Methanol Extract*.

Mulyati, S., & Kurnijasanti, R. (2023). Efek Protektif Ekstrak Etanol Daun Kesum *(Polygonum minus)* Terhadap Jumlah Sel Leydig Mencit yang Dipapar Kadmium Klorida.

Nurlitasari, D. A., Magdalena, R., Nur, R. Y., (2022). Performance Analysis of Skin Cancer Classification System Using Convolutional Neural Network. *5*(2).

Pongsapan, D. A., Prayoga, K. D., Hisan, K. A., Rambi Glory, E. S., Edy, J. H., & Abdullah, S. S. (2024). Uji Kandungan dan Aktivitas Antioksidan Ekstrak Daun Leilem *(Clerodendrum minahassae)* Sebagai Kandidat Zat Aktif Sunscreen.

Priyadi, A., Rahman, F., & Sartika, A. (2025). *Original Article: Comparison of maceration and soxhlet extraction on the total phenolic content of ethanol extract of betel leaves (Piper betle L .) using visible spectrophotometry* .. *8*(1), 550–563.

Rahmatillah, A., Rohmana, V. M., Mahendra, A. D., & Puspita, M. Dela. (2025). *The Comparison of*

Antioxidant Activity of Ethanol Extract of Fruit , Seeds and Leaves of Yellow Pumpkin (Cucurbita moschata D .) using the DPPH (2 , 2-Diphenyl-1-Picrylhydrazyl) Method.

Rahmatullah, S., Agustin, W., & Kurnia, N. (2020). Formulasi dan Evaluasi Sediaan Gel Hand Sanitizer Sebagai Antiseptik Tangan Dengan Variasi Basis Karbopol 940 dan Tea CHMK *Pharmaceutical Journal.* 189–194.

Rusli, D., Amelia, K., & Gading, S. (2021). Formulasi dan Evaluasi Sediaan Gel Ekstrak Daun Kelor *(Moringa Oleifera Lam .)* Dengan Variasi NaCMC Sebagai Basis. *1*, 7–12.

Saerang, M. F., Edy, H. J., & Siampa, J. P. (2023). Formulasi Sediaan Krim Dengan Ekstrak Etanol Daun Gedi Hijau*(Abelmoschus manihot L .)* Terhadap *Propionibacterium acnes*. *12*, 350–357.

Sari, N., Adriman, Z., & Pradistha, A. (2023). *Majalah Ilmiah Resmi Perhimpunan Dokter Spesialis Kulit Dan Kelamin Indonesia (PERDOSKI) Volume*, *50*(4).

Sari, T. N., Azkia, A., Prastyka, D., Tempati, G. J., Syahjiah, L., Nadila, & Nita, S. R. (2025). Perbandingan Metode Ekstraksi Panas dan Ekstraksi Dingin *Journal of Innovation Research and Knowledge*, *5*(3), 3515–3528.

Saputri, D. T., Rahmatillah, A., & Pratama, K. J. (2025). Profiling Metabolit Sekunder Ekstrak Etanol 50% Daun Bambu Duri (*Bambusa blumeana*). *Prosiding Seminar Informasi Kesehatan Nasional.*, *2012*, 5–10.

Syari, J. P., Sungkawa, H. B., & Ratnawaty, G. J. (2022). Air Perasan Daun Kesum *(Polygonum minus Huds)* Menghambat Pertumbuhan Candida albicans. *6*(3), 88–93.

Syaron, P., Sientje, M., Irma, L., & Kimia, P. (2020). Uji Senyawa Fitokimia dan Aktivitas Antioksidan Tanaman Patah Tulang *(Euphorbia tirucalli L .)*. *9*(2), 64–69.

Syafriana, V., & Puspitasari, L. (2024). Total Flavonoid dan Aktivitas Antibakteri Infusa Daun Sempur *(Dillenia suffruticosa (Griff . Ex Hook f . & Thomson) Martelli*

Thomas, N. A., Tungadi, R., Latif, M. S., & Sukmawati, M. E. (2023). *P*engaruh Konsentrasi Carbopol 940 Sebagai Gelling Agent Terhadap Stabilitas Fisik Sediaan Gel Lidah Buaya *(Aloe Vera)*.

Wahidah, S., Ayu, G., & Saputri, R. (2024). Formulasi dan Uji Stabilitas Sediaan Gel Ekstrak Etanol Daun Asam Jawa *(Tamarindus indica L .)* dengan Variasi Gelling Agent. *10*(2), 508–518.

Wahyudi, A., & Minarsih, T. (2023). Pengaruh Ekstraksi dan Konsentrasi Etanol terhadap Kadar Flavonoid Total dan Aktivitas Antioksidan Ekstrak Jahe Emprit (*Zingiber officinale var*. Amarum) Effect. *Indonesian Journal of Pharmacy and Natural Product*.

Winata, H. S., Faisal, H., Andry, M., Naziyah, S., Nasution, A., Farmasi, S., Studifarmasi, P., & Farmasi, F. (2023). Uji kadar total polifenol buah asam kandis (Garcinia xanthochymus Hook.f.ex T.Anderson) dengan metode spektrofotometri UV-VIS dan LCMS. *Journal of Pharmaceutical and Sciences*.