BIOLOGY, MEDICINE, & NATURAL PRODUCT CHEMISTRY ISSN 2089-6514 (paper)
Volume 14, Number 2, October 2025 | Pages: 1379-1384 | DOI: 10.14421/biomedich.2025.142.1379-1384 ISSN 2540-9328 (online)

Formulation of an Anti-acne Cream Containing Ethanolic Extract of *Purslane* (*Portulaca oleracea*)

Isna Lailatusholihah*, Dina Alva Prastiwi, Afiatun Ni'mah, Yudhistira
Department of Chemistry, Sekolah Tinggi Analis Kimia Cilegon
Jalan Lingkar Selatan KM 1.7, Cilegon 42411, Indonesia.

Corresponding author*
isnalailatusholihah@gmail.com

Manuscript received: 18 September, 2025. Revision accepted: 21 November, 2025. Published: 15 December, 2025.

Abstract

Portulaca oleracea (*purslane*) is a medicinal plant known for its antibacterial potential due to the presence of bioactive compounds such as saponins, tannins, flavonoids, and alkaloids. This study aimed to formulate an anti-acne cream containing the ethanol extract of *P. oleracea* and to evaluate its antibacterial activity against *Staphylococcus aureus*. The extract was obtained through maceration using 96% ethanol, and antibacterial testing was performed using the well diffusion method. The results showed that the ethanol extract demonstrated antibacterial activity, with the highest effect observed in formulation F3, which produced an inhibition zone of 13 mm (strong category). F3 also exhibited desirable physicochemical characteristics, including a spreading diameter of 6.5 cm, viscosity of 14,340 cP, and pH of 5, all of which complied with standard requirements. These findings indicate that *P. oleracea* ethanol extract has potential as an active ingredient in topical anti-acne formulations.

Keywords: Cream Anti-acne; Portulaca oleracea; Antibacterial Activity; Ethanolic Extract.

INTRODUCTION

The prevalence of acne in developing countries ranges from 40% to 80%, with 80–85% of adolescents affected and cases continuing to rise annually. A 2019 study involving 66 *Acne vulgaris* patients at Abdul Moeloek Hospital reported that 69.7% were female and 30.3% were male (Sibero et al., 2020). Acne has been shown to negatively affect quality of life, with 30–50% of patients experiencing psychological distress and reduced self-esteem due to its impact on appearance (Pariury et al., 2021).

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous unit, associated with hyperkeratinization, excess sebum production, and microbial colonization, particularly by *Cutibacterium acnes* (formerly *Propionibacterium acnes*), *Staphylococcus epidermidis*, and *Staphylococcus aureus* (Pariury et al., 2021). *S. aureus* is a Gram-positive pathogenic bacterium commonly colonizing the respiratory tract, oral cavity, urinary tract, nasal mucosa, and skin, and is implicated in infections such as meningitis, abscesses, and acne (Damayanti et al., 2022). While multiple endogenous and exogenous factors—including androgenic hormones, psychological stress, genetic predisposition, dietary habits, and climate—contribute to acne pathogenesis, colonization by *S. aureus* is recognized as an aggravating factor in the inflammatory process (Sifatullah & Zulkarnain, 2021).

Conventional acne management frequently involves the administration of antibiotics with anti-inflammatory and antibacterial activity. However, indiscriminate use of antibiotics has led to the emergence of antimicrobial resistance, highlighting the importance of exploring phytopharmaceutical alternatives with fewer adverse effects (Wardania et al., 2020). Purslane (*Portulaca oleracea*) is a medicinal plant with reported antibacterial activity, attributed to its secondary metabolites such as saponins, tannins, flavonoids, alkaloids, and glycosides (Purwanto et al., 2021; Nabilah et al., 2023). Despite its bioactive profile, purslane is often regarded as a weed, making it readily available and sustainable as a raw material for potential anti-acne formulations.

Previous investigations on ethanol extracts of medicinal plants, such as *sungkai* leaves, demonstrated concentration-dependent antibacterial activity against *C. acnes* and *S. aureus*, with higher extract concentrations producing larger inhibition zones. Furthermore, Maidawati (2022) confirmed the presence of phytochemical classes including phenolics, flavonoids, coumarins, alkaloids, saponins, and terpenoids in *sicerek* extracts using Fourier Transform Infrared (FTIR) spectroscopy. FTIR spectroscopy provides a characteristic infrared absorption spectrum of the

purslane extract, enabling identification of chemical bonds and functional groups. These spectral fingerprints serve as a qualitative chemical profile, supporting the validation of phytoconstituents prior to formulation studies. Therefore, this research investigates the formulation of an anti-acne cream containing ethanol extract of purslane (*P. oleracea*) against *S. aureus*, aiming to elucidate its antibacterial potential, provide supporting chemical evidence, and assess its prospective value as a phytopharmaceutical candidate.

MATERIALS AND METHODS

Study Area

This research was conducted at the Laboratory of Sekolah Tinggi Analis Kimia Cilegon. The materials used were purslane (*Portulaca oleracea*), distilled water, benzoic acid, stearic acid, *Staphylococcus aureus* culture, 96% ethanol, glycerin, tetracycline, nutrient agar, nutrient broth, propylene glycol, cetyl alcohol, triethanolamine (TEA), 2N HCl, $MgSO_4$, KBr, 1% H_2SO_4, 1% $BaCl_2$, and 0.9% NaCl. The instruments used in this study included a rotary evaporator, Fourier Transform Infrared (FTIR) spectrophotometer, Brookfield viscometer, incubator, analytical balance, hot plate, pH meter, micropipette, spatula, pipette, test tubes, watch glass, sterile absorbent cotton, Petri dishes, vernier caliper, inoculating loop, graduated cylinder, beakers, and Erlenmeyer flasks.

Procedures

*Sample Preparation of Purslane (*Portulaca oleracea*)*

A total of 5 kg of purslane was washed under running water to remove impurities. The whole plant was cut into small pieces and air-dried at room temperature until completely dry. The dried simplicia was then separated, pulverised into powder, and stored in a container protected from direct sunlight to prevent degradation of active compounds (Sari et al., 2021).

Preparation of Purslane Ethanolic Extract

Extraction was carried out using the maceration method. A total of 600 g of dried purslane powder was macerated with 3600 mL of 96% ethanol for five days, with stirring once daily. The extract was filtered, and the filtrate was concentrated using a rotary evaporator at 40 °C to obtain a viscous ethanolic extract (Sari et al., 2021).

Flavonoid Identification

Two millilitres of purslane extract were added into a test tube, followed by 0.5 g of $MgSO_4$ powder and 2 mL of 2N HCl. The formation of an orange to red colour indicated the presence of flavonoids (Johannes et al., 2023).

Fourier Transform Infrared (FTIR) Analysis

Functional group analysis of purslane extract was performed using FTIR spectroscopy (Shimadzu 8400S). The solvent was removed by freeze-drying prior to analysis. The process involved freezing the extract at –25 °C, followed by drying at –50 °C under 5 mPa vacuum. Potassium bromide (KBr) was added before FTIR measurement to obtain spectra representing the characteristic functional groups of the extract.

Preparation of Purslane Extract Cream

The cream was formulated using the fusion method. The oil phase was prepared by heating cetyl alcohol and stearic acid in a water bath, while the aqueous phase was prepared separately by dissolving benzoic acid in distilled water, followed by the addition of glycerin, propylene glycol, and triethanolamine (TEA). Both phases were heated to 70 °C to ensure complete melting and then combined gradually in a mortar with continuous trituration until a homogenous cream was obtained. Purslane extract was incorporated into the base at different concentrations (0, 8, 12, and 16% v/v). The formulations are shown in Table 1 (Novianti & Wirnawati, 2024).

Table 1. Formulation of Purslane Extract Cream.

Ingredients	Function	Formulation (mL)			
		F0	F1	F2	F3
Purslane extract	Active agent	0	8	12	16
Stearic acid	Emulsifier	12	12	12	12
Cetyl alcohol	Thickening agent	0.5	0.5	0.5	0.5
Propylene glycol	Co-emulsifier	3	3	3	3
Triethanolamine	Emulsifier	1.5	1.5	1.5	1.5
Glycerin	Humectant	5	5	5	5
Benzoic acid	Preservative	0.2	0.2	0.2	0.2
Distilled water	Solvent	77.8	69.8	65.8	61.8

Evaluation of Purslane Extract Cream

pH Determination

The pH of the cream was measured using a universal pH meter. According to SNI 16-3499-1996, the acceptable pH range for topical preparations is 4.5–8 (Chandra et al., 2022).

Homogeneity Test
A small amount of cream was applied onto a glass slide. Homogeneous cream was indicated by the absence of visible particles or bubbles (Novianti & Wirnawati, 2024).

Spreadability Test
About 0.5 g of cream was placed on graph paper covered with a glass plate. Another glass plate was placed on top for 1 minute, followed by a 150 g weight. The spread diameter was measured, with the ideal spreadability for cream being 5–7 cm (Isrul et al., 2023).

Viscosity Measurement
Viscosity was determined using a Brookfield viscometer. The spindle was immersed up to the marked level, and measurements were taken after ~10 seconds. According to SNI 16-4399-1996, acceptable viscosity for cream formulations ranges from 2,000–50,000 cP (Chandra et al., 2022).

Antibacterial Activity Assay Against Staphylococcus aureus
Sterilisation
Culture media were sterilised using an autoclave at 121 °C for 15 minutes. Glassware was sterilised in a hot air oven at 160–170 °C for 1–2 hours, while forceps and inoculating loops were sterilised by flaming (Wangloan et al., 2025).

Preparation of Nutrient Agar (NA) Medium
A total of 28 g NA was dissolved in 1 L distilled water, heated until fully dissolved, then distributed into test tubes (±7 mL) and Petri dishes (±30 mL). The tubes were covered with cotton and aluminium foil, while the Petri dishes were sealed with brown paper. Media were sterilised in an autoclave at 121 °C and 1 atm for 15 minutes. Test tubes were solidified in a slanted position (Susanti et al., 2024).

Subculturing of Staphylococcus aureus
Staphylococcus aureus was streaked on slanted NA medium under aseptic conditions and incubated anaerobically at 35 °C for ~24 h (Susanti et al., 2024).

Preparation of Nutrient Broth (NB) Medium
A total of 1.3 g NB was dissolved in 100 mL distilled water, heated until dissolved, and sterilised by autoclaving at 121 °C and 1 atm for 15 minutes (Susanti et al., 2024).

Preparation of McFarland Standard Solution
A 1% H_2SO_4 solution (9.5 mL) was mixed with 0.5 mL of 1% $BaCl_2$ solution to obtain a turbid suspension equivalent to the McFarland standard (Setiawan et al., 2024).

Preparation of Bacterial Suspension
Colonies of *S. aureus* were collected using a sterile inoculating loop and suspended in 2 mL of 0.9% NaCl solution. The turbidity was adjusted to match the McFarland standard (Setiawan et al., 2024).

Positive and Negative Controls
Aquadest was used as the negative control, while tetracycline served as the positive control. The cream formulations were tested at concentrations of 0, 8, 12, and 16% v/v.
Antibacterial Assay Procedure
The antibacterial activity of the formulations was evaluated using the well diffusion method (6 mm diameter wells). Each well was loaded with 20 µL of cream samples, along with positive and negative controls. Plates were incubated at 37 °C for 18–24 h. The inhibition zones were measured as clear areas surrounding the wells, indicating antibacterial activity.

RESULTS AND DISCUSSION

Extraction of Purslane (*Portulaca oleracea*)
The extraction process was carried out using maceration with 96% ethanol as the solvent. After maceration, a dark green extract was obtained (Figure 4). The filtrate was concentrated using a rotary evaporator at 40 °C and 50 rpm, yielding an extract recovery of 9.04% from the initial sample weight.

This yield was higher than that reported by Sari et al. (2024), who obtained 7.04% using a similar extraction method. The variation in yield may be attributed to differences in evaporation temperature, as higher temperatures can increase the loss of volatile compounds. Technical differences in the maceration procedure, such as multi-stage processing or variations in extraction time, may also contribute to discrepancies in yield.

Overall, the 9.04% recovery obtained in this study indicates that the extraction process was relatively efficient and suggests the potential presence of a higher concentration of active compounds compared to previous reports.

Figure 1. A dark green extract.

Phytochemical Screening and FTIR Analysis of Purslane Ethanol Extract

The phytochemical test of the ethanol extract of purslane showed a colour change from orange to brick-red, indicating a positive result for flavonoids. This finding is consistent with the study of Johannes et al. (2023), which also reported the presence of flavonoids and other secondary metabolites such as alkaloids, saponins, and tannins in purslane stem and leaf extracts. Both studies highlight flavonoids as one of the dominant secondary metabolites in purslane.

Flavonoids are known to exhibit diverse biological activities, including antimicrobial effects through inhibition of nucleic acid synthesis in bacteria, as well as antioxidant, anti-inflammatory, and cytotoxic properties. These bioactivities support their potential application as active constituents in herbal-based therapeutic formulations.

FTIR Spectral Analysis of Purslane Ethanol Extract

The FTIR spectrum of the ethanol extract of purslane, as presented in Figure 6, confirmed the presence of flavonoid compounds, as indicated by several characteristic absorption bands. A broad and intense band observed at 3398.57 cm^{-1} corresponds to hydroxyl (–OH) stretching vibrations. Aromatic ring structures were further confirmed by absorption peaks at 1647.21 cm^{-1} and 1516.05 cm^{-1}, attributed to C=C stretching in aromatic systems, along with C–H out-of-plane bending vibrations detected at 865.33 cm^{-1} and 823.03 cm^{-1}.

Additionally, the peak at 1718.58 cm^{-1} suggests the presence of a carbonyl (C=O) functional group, while an absorption band at 1246.02 cm^{-1} is assigned to C–O stretching vibrations. These spectral features are consistent with the functional groups typically associated with flavonoids, supporting the results obtained from the phytochemical screening.

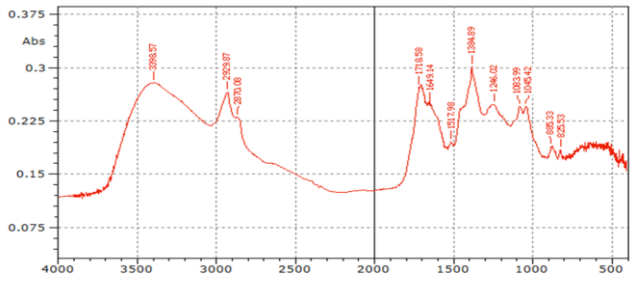

Figure 2. The FTIR spectrum of the ethanol extract of purslane.

This finding is consistent with the study of Saxena et al. (2021) on *Portulaca oleracea*, which reported similar absorption bands, namely at 3362.20 cm^{-1} for the hydroxyl (–OH) group, 1640 cm^{-1} for the carbonyl (C=O) group, 1300–1000 cm^{-1} for the C–O group, 848.35 cm^{-1} for aromatic C–H, and 1600 cm^{-1} for aromatic C=C, which are characteristic of flavonoid compounds. These similarities support the validity of the present data and strengthen the assumption that flavonoids play a crucial role in the potential biological activities of purslane.

Cream Preparation and Characterization

The purslane extract cream was formulated using the two-phase fusion method with a total volume of 100 mL for each preparation. The fusion method is a technique in which all or selected components are melted and then cooled while being continuously stirred until a homogeneous preparation is formed (Nurrahman et al., 2022). In this formulation, the oil phase consisted of stearic acid and cetyl alcohol. Stearic acid acted as a structure-forming agent and emulsifier, whereas cetyl alcohol served to increase viscosity and provide a smoother texture to the cream.

The aqueous phase consisted of distilled water as the solvent, benzoic acid as a preservative to prevent microbial growth, and glycerin and propylene glycol as humectants to maintain skin moisture. In addition, triethanolamine (TEA) was used to form and stabilise the oil-in-water emulsion system.

Ethanol extract of purslane was incorporated as the active ingredient into the cream base in three different volume-to-volume (v/v) concentrations: F1 (8 mL), F2 (12 mL), and F3 (16 mL) within a total 100 mL formulation. The final preparations produced homogeneous and stable creams that did not separate, with a smooth texture that spread easily when applied to the skin. The results of the cream preparation are shown in Figure 3.

Figure 3. Purslane (Portulaca oleracea) ethanolic extract cream.

pH Evaluation

The pH test was conducted to assess the compatibility of the formulation with the physiological pH of the skin. The results showed that F0 (cream base) had a pH of 6, whereas F1, F2, and F3 exhibited an identical pH of 5. These values fall within the range specified by the Indonesian National Standard (SNI 16-4399-1996), namely 4.5–8.0, and are also consistent with the normal skin pH range of 4.5–7.5 (BSN, 1996). Thus, the measured pH values (pH 5) indicate that all three cream formulations complied with the required acidity criteria for topical preparations.

Homogeneity Evaluation

The homogeneity test was performed visually, and the results (Figure 9) showed that F1, F2, and F3 exhibited a uniform physical appearance without coarse particles, clumps, or phase separation. In addition, no entrapped air bubbles were observed in the system. These findings indicate that all formulations possessed good homogeneity, in accordance with the criteria for topical preparations as described by Novianti & Wirnawati (2024).

Spreadability Evaluation

The spreadability test was conducted to assess the ability of the cream to spread upon application to the skin. The results presented in Table 3 indicate that F0 exhibited a spread diameter of 3.0 cm, while F1, F2, and F3 showed spread diameters of 5.2 cm, 6.2 cm, and 6.5 cm, respectively.

Based on these results, formulations F1, F2, and F3 fulfilled the spreadability criteria for topical preparations, which range from 5–7 cm (Isrul et al., 2023; Setiawan et al., 2024). In contrast, F0 (the base cream without extract) did not meet the requirement due to its excessively high viscosity, which resulted in limited spreadability. This finding confirms the inverse correlation between viscosity and spreadability, as previously described by Chandra et al. (2022).

Viscosity Evaluation

The viscosity test revealed a decreasing trend in viscosity with increasing concentrations of purslane extract. The average values from duplicate measurements are presented in Table 2, showing that formulations F1–F3 were within the ideal viscosity range for topical preparations as specified by SNI 16-4399-1996 (2,000–50,000 cP). In contrast, F0 exceeded the upper limit due to the absence of extract, resulting in an overly dense cream base.

This finding is consistent with the spreadability test results, which demonstrated the inverse relationship between viscosity and spreadability. Higher viscosity reduces the ability of the cream to spread, requiring greater pressure to achieve adequate distribution on the skin (Chandra et al., 2022).

Table 2. Viscosity of Purslane Ethanolic Extract Creams.

Formulation	Viscosity (cP)
F0	418.800
F1	29.220
F2	16.620
F3	14.340

Antibacterial Activity Test of Cream Formulations

The antibacterial activity of purslane ethanolic extract cream formulations was evaluated against *Staphylococcus aureus* using the well diffusion method. Antibacterial activity was determined by measuring the inhibition zone diameter (mm) formed around the wells (Table 4).

Table 4. Inhibition Zone Diameter of Purslane Ethanolic Extract Creams against *Staphylococcus aureus.*

No.	Sample	Inhibition Zone (mm)	Category
1.	F1	8,5	Moderate
2.	F2	12	Strong
3.	F3	13	Strong
4.	Tertrasiklin (+)	29	Very Strong
5.	Akuades (-)	0	None

According to Yusrina et al. (2022), antibacterial activity is classified based on inhibition zone diameters as shown in Table 5.

Table 5. Antibacterial Activity Classification Based on Inhibition Zone Diameter.

Diameter (mm)	Activity Strength
≤ 5 mm	Weak
6-10 mm	Moderate
>11-20 mm	Strong
>20-30 mm	Very Strong

Based on Table 4, formulation F1 demonstrated moderate antibacterial activity (8.5 mm), while F2 and F3 exhibited strong activity with inhibition zones of 12 mm and 13 mm, respectively. The positive control (tetracycline) produced a very strong inhibition zone of 29 mm, whereas the negative control (aquadest) showed no inhibitory effect (Figure 4).

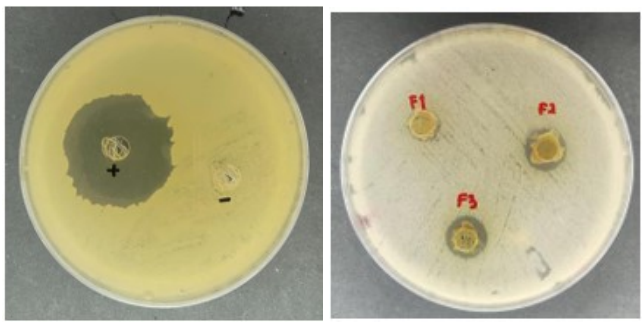

Figure 4. Antibacterial Activity of Anti-Acne Cream Formulations with Ethanolic Extract of *Portulaca oleracea.*

The positive control served as a reference standard to validate the assay system and confirm test accuracy, while the negative control verified that the solvent itself had no antibacterial effect. Overall, the results indicate that purslane ethanolic extract cream possesses antibacterial activity against *S. aureus*, with activity increasing in line with extract concentration. These findings are consistent with Yusrina et al. (2022), who reported that higher extract concentrations correlate with larger inhibition zones due to the presence of greater amounts of bioactive compounds. Moreover, Rasidah et al. (2019) noted that flavonoids exhibit antibacterial activity against *S. aureus*, supporting the role of

flavonoids as active constituents in purslane extract creams.

CONCLUSIONS

This study demonstrated that *purslane* ethanolic extract (*Portulaca oleracea*) can be formulated into an anti-acne cream with effective antibacterial activity against *Staphylococcus aureus*. The highest activity was observed in formulation F3, which showed a strong inhibition zone (13 mm), a spreadability value of 6.5 cm, a viscosity of 14,340 cP, and a pH of 5, all of which complied with topical formulation standards.

Acknowledgment: The authors would like to acknowledge Kemenristekdikti for providing research funding. Appreciation is also extended to the Sekolah Tinggi Analis Kimia Cilegon for supporting this study with laboratory facilities, as well as assistance in data collection and processing.

Authors' Contributions: Isna Lailatusholihah designed the study. Isna Lailatusholihah, Dina Alva Prastiwi, Afiatun Ni'mah and Yudhistira carried out the laboratory work. Dina Alva Prastiwi analyzed the data. Isna Lailatusholihah wrote the manuscript. All authors read and approved the final version of the manuscript.

Competing Interests: The authors declare that there are no competing interests.

Funding: The authors would like to acknowledge Kemenristekdikti for providing research funding.

REFERENCES

Chandra D, & Rahmah R. (2022). Uji fisikokimia sediaan emulsi, gel, emulgel ekstrak etanol goji berry (Lycium barbarum l.). Jurnal Farmasi Dan Kesehatan 11(2): 219–228

Damayanti SP, Mariani R, & Nuari DA. (2022). Studi Literatur : Aktivitas antibakteri daun binahong (Anredera cordifolia) terhadap Staphylococcus aureus. Jurnal Farmasi Sains Dan Terapan 9(1): 42–48

Isrul M, Hasanuddin S, Dewi C, & Alimasi A. (2023). Uji Kestabilan fisik krim antijerawat ekstrak etanol daun sagu (Metroxylon sagu Rottb) dan uji aktivitas bakteri terhadap Propionibacterium acnes dan Staphylococcus epidermidis. Jurnal Mandala Pharmacon Indonesia 9(1): 148-160.

Johannes E, & Sjafaraenan S. (2023). Uji sitotoksik dan fitokimia fraksi n-heksan ektrak batang dan daun krokot Portulaca oleracea. Jurnal Biologi Makassar 8(2): 81–87

Maidawati M. (2022). Identifikasi dan analisis senyawa metabolit sekunder ekstrak daun sicerek (Clausena excavata). Jurnal Penelitian Dan Pengkajian Ilmiah Eksakta 1(2): 98–104

Nabilah L, Dewanti FD, Koentjoro Y, & Tarigan PL. (2023). Respon macam pupuk terhadap pertumbuhan, hasil dan omega-3 pada tanaman krokot (Portulaca oleracea L.). Agro Bali: Agricultural Journal 6(3): 840–851

Novianti EP, & Wirnawati W. (2024). Formulasi sediaan krim anti jerawat ekstrak etanol daun sungkai (Peronema Canescens Jack) dan uji aktivitas terhadap bakteri Propionibacterium acnes dan Staphylococcus aureus. Jurnal Global Ilmiah 1(10): 489-498.

Nurrahman A, Susanti R, & Tajudin T. (2022). Formulasi dan uji aktivitas antibakteri sediaan krim ekstrak daun kunyit (Curcuma domestica val) terhadap Staphylococcus aureus atcc 25923. Pharmaqueous: Jurnal Ilmiah Kefarmasian 4(1): 28-40.

Pariury JA, Herman JPC, Rebecca T, Veronica E, & Arijana IGKN. (2021). Potensi kulit Bali (Citrus maxima Merr) sebagai antibakteri Propionibacterium acne penyebab jerawat. Hang Tuah Medical Journal 19(1): 119-131

Purwanto A. (2021). Aktivitas antibakteri in-vitro ekstrak etanol beberapa jenis tanaman krokot (Portulaca sp). Agri-Tek: Jurnal Ilmu Pertanian, Kehutanan dan Agroteknologi 22(1): 1-5.

Rofidah A, Maulida HJ, Al Shofura NR, Rolita NN, Hidayah U, & Faisal F. (2024). Uji potensi senyawa antimikroba pada daun sirih hijau (Piper betle) secara difusi sumuran dan difusi paper disk. Era Sains: Jurnal Penelitian Sains, Keteknikan dan Informatika 2(1): 8-14

Sari SM, Dewi AM, Safitri EI, & Nuria MC. (2021). Aktivitas antibakteri ekstrak etanol herba krokot (Portulaca oleracea l.) dari beberapa metode ekstraksi. Pharmacy: Jurnal Farmasi Indonesia (Pharmaceutical Journal of Indonesia) 18(1): 34-44.

Saxena S & Rao PB. (2021). Comparative GC-MS and FT-IR analysis of Portulaca oleracea L. and Portulaca quadrifida L. leaf extracts. Pharma Innov J, 10(12), 40-48

Setiawan A, Islamiyati D, & Safitri E. (2024). Formulasi sediaan krim ekstrak daun kecombrang (Etlingera elatior) dan uji efektivitas antibakteri terhadap Staphylococcus aureus Tambusai 5(3):6199-6213.

Sibero HT, Putra I, & Anggraini DI. (2019). Tatalaksana terkini Acne vulgaris. JK Unila Jurnal Kedokteran Universitas Lampung 3(2): 313-320

Sifatullah N, & Zulkarnain. (2021). Jerawat (Acne vulgaris): review penyakit infeksi pada kulit. Prosiding Biologi Achieving the Sustainable Development Goals 19–23

Susanti DA, Hidayati S, Firdaus AW, Pangesti DY, & Milyunier FMP. (2024). Pengaruh perbedaan metode ekstraksi terhadap uji aktivitas antibakteri ekstrak etanol biji ketumbar (Coriandrum sativum) pada Staphylococcus aureus. Jurnal Farmamedika (Pharmamedika Journal) 9(1): 97-104

Wangloan MS, Yuliastri WO, & Ridwan BA. (2025). Skrining fitokimia dan uji aktivitas antibakteri fraksi n-heksan, etil asetat dan air pada daun keji beling (Strobilanthes crispa) terhadap bakteri Staphylococcus epidermidis dan Pseudomonas aeruginosa. Jurnal Pharmacia Mandala Waluya 4(2): 82-93.

Wardania AK, Malfadinata S, & Fitriana Y. (2020). Uji aktivitas antibakteri penyebab jerawat Staphylococcus epidermidis menggunakan ekstrak daun ashitaba (Angelica keiskei). Lumbung Farmasi: Jurnal Ilmu Kefarmasian 1(1): 14-19

Yusrina C, Fitriyanti F, & Liana FH. (2022). Uji efektivitas antibakteri ekstrak metanol daun ramania (Bouea macrophylla griffith) terhadap bakteri Staphylococcus aureus. Pharmacoscript 5(2): 212–224.