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LITERATURE REVIEW

ANTIBACTERIAL POTENTIAL OF DAYAK ONION BULB EXTRACT (*Eleutherine sp*) AS A TREATMENT FOR ACNE VULGARIS: A LITERATURE REVIEW

(POTENSI ANTIBAKTERI EKSTRAK UMBI BAWANG DAYAK (Eleutherine sp) SEBAGAI PENGOBATAN ACNE VULGARIS: TINJAUAN PUSTAKA)

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ABSTRACT

Acne vulgaris is a common skin disorder that can significantly affect quality of life. Although conventional antibiotic treatments are commonly used, herbal alternatives such as *Eleutherine sp.* (Dayak onion) bulb extract may offer therapeutic options for acne vulgaris. This study is a literature review that evaluates the antibacterial activity of Dayak onion bulb extract against bacteria that cause acne vulgaris. The search was conducted in the *ScienceDirect*, *PubMed*, *Google Scholar*, and *Garuda* databases, focusing on in vitro studies published in the last 10 years. Of the 8 articles analyzed, Dayak onion bulb extract was effective against *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Propionibacterium acnes*. The best antibacterial activity was obtained from extracts at high concentrations with several methods. Temperature and incubation duration also affected the results. Active compounds such as flavonoids, alkaloids, triterpenoids, steroids, and tannins contributed to the antibacterial effectiveness of this extract. Dayak onion bulb extract showed strong antibacterial effectiveness, making it a potential alternative for treating *acne vulgaris*. This extract as an additional therapy offers a safe option as a natural *acne vulgaris* treatment solution.

Keywords: acne *vulgaris*, antibacterial, *Eleutherine*

ABSTRAK

Acne vulgaris adalah gangguan kulit yang sering terjadi dan dapat memengaruhi kualitas hidup secara signifikan. Meskipun pengobatan antibiotik konvensional umum digunakan, alternatif herbal seperti ekstrak umbi bawang dayak (Eleutherine sp) dapat menjadi pilihan terapi herbal acne vulgaris. Penelitian ini merupakan tinjauan literatur yang mengevaluasi aktivitas antibakteri ekstrak umbi bawang dayak terhadap bakteri penyebab acne vulgaris. Penelusuran dilakukan di database ScienceDirect, PubMed, Google Scholar, dan Garuda, dengan fokus pada studi in vitro yang diterbitkan dalam 10 tahun terakhir. Dari 8 artikel yang dianalisis, ekstrak umbi bawang dayak terbukti efektif melawan Staphylococcus aureus,

Staphylococcus epidermidis, dan Propionibacterium acnes. Aktivitas antibakteri terbaik diperoleh dari ekstrak pada konsentrasi tinggi dengan beberapa metode. Suhu dan durasi inkubasi juga mempengaruhi hasilnya. Senyawa aktif seperti flavonoid, alkaloid, triterpenoid, steroid, dan tanin berkontribusi pada efektivitas antibakteri ekstrak ini. Ekstrak umbi bawang dayak menunjukkan efektivitas antibakteri yang kuat, menjadikannya alternatif yang potensial untuk mengobati acne vulgaris. Penggunaan ekstrak bawang dayak sebagai terapi tambahan menawarkan pilihan yang aman sebagai solusi pengobatan acne vulgaris dari bahan alami.

Kata kunci: acne vulgaris, antibakteri, eleutherine

INTRODUCTION

Acne vulgaris is a common inflammatory condition of the pilosebaceous units, typically affecting the face, chest, and upper arms.[1] Accounting for an estimated 9.4% of the global population in 2010, acne vulgaris ranked as the eighth most common disease worldwide.[2] Globally, it is estimated to affect around 231.2 million individuals, with 117.4 million new cases reported, leading to an estimated loss of 5.0 million healthy life years, an increase of approximately 48% since 1990.[3] Acne vulgaris may heal over time, but the resulting scars can persist and cause substantial psychosocial distress, including embarrassment, social isolation, and reduced self-confidence.[1]

Building on the understanding of acne's scope and impact, its pathogenesis involves four major bacterial phyla: Actinobacteria, Firmicutes, Proteobacteria, and Bacteroidetes. Of these, *Propionibacterium acnes*, *Staphylococcus aureus*, and *Staphylococcus epidermidis* are primarily associated with pus formation.[4] To manage acne vulgaris, topical antibiotics such as erythromycin, clindamycin, minocycline, and dapsone are used, as they exert both antibacterial and anti-inflammatory effects.[5]

Given the need for alternative acne treatments, Dayak onion (*Eleutherine bulbosa* (Mill.) Urb.) is a member of the Iridaceae family that naturally grows in the forests of Kalimantan and is widely distributed across the region, including West Kalimantan.[6] The bulb is the most commonly utilized part of *Eleutherine bulbosa*, used in various forms such as fresh, dried, pickled, or powdered preparations. Traditionally, the Dayak people have used these bulbs as herbal medicine to treat a wide range of ailments.[7] *Eleutherine bulbosa* has been shown in several studies to possess diverse bioactive properties, including anticancer, antibacterial, and antioxidant activities.[8–11] Novaryatiin *et al.* reported that the ethanol extract of *Eleutherine bulbosa* exhibits antibacterial activity against common acne-associated bacteria such as *S. aureus*, *S. epidermidis*, and *P. acnes*.[12] These findings

have prompted further investigation into the potential of *Eleutherine bulbosa* extract as a herbal treatment for acne and its evidence-based efficacy.

MATERIALS AND METHODS

This review focuses on assessing the antibacterial potential of Dayak onion (*Eleutherine bulbosa*) bulb extract for the treatment of acne vulgaris. Articles were identified through database searches in ScienceDirect, PubMed, Google Scholar, and Garuda using the keywords *'Eleutherine' AND 'antibacterial' OR 'antimicrobial' AND 'acne' OR 'acne vulgaris' AND 'Staphylococcus aureus' OR 'Staphylococcus epidermidis' OR 'Propionibacterium acnes'*. Only full-text *in vitro* studies published between 2014 and 2024 in either English or Indonesian were included. The selection process is presented in Figure 1.

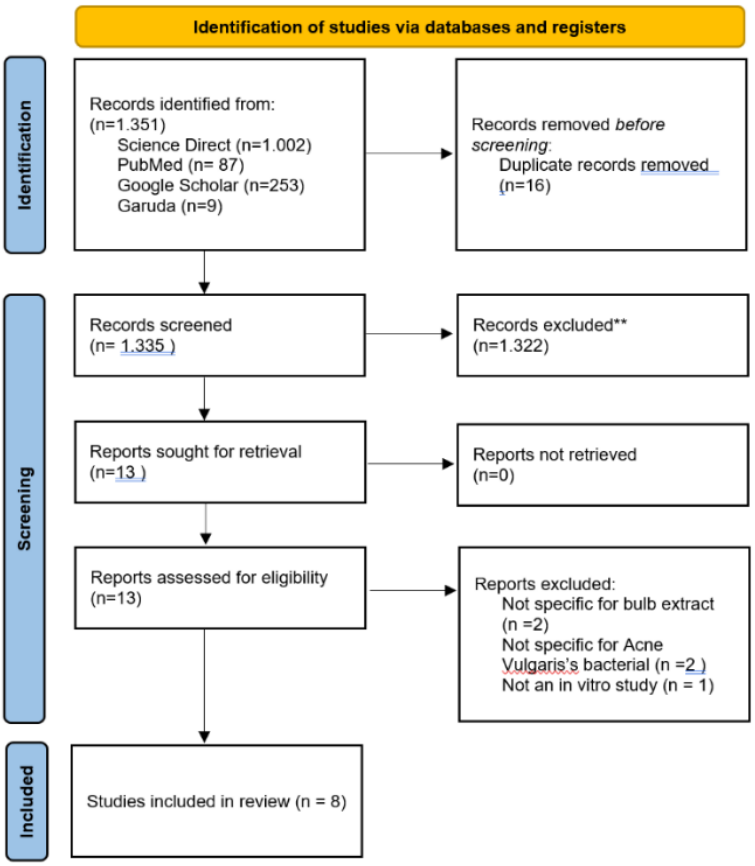

Figure 1 Results of article selection.

RESULTS AND DISCUSSION

Table 1 Characteristics of each study

Author	Species	Method	Type of Extract/ Solvent	Results			
				Concentration/ Temperature/ Duration	*P. acnes* IZ (mm)	*S. epidermidis* IZ (mm)	*S. aureus* IZ (mm)
Novaryatiin *et al.* (2020)	*E. bulbosa*	Disk Diffusion	Clindamycin	0.2-1%	21,8 ± 0.9 - 27.6 ± 1.0	27.5 ± 1.3 - 35.0 ± 1.2	30.5 ± 1.1 - 38.7 ± 1.9
			Ethyl Acetate	1.25%	12.0 ± 2.1	13.6 ± 1.8	13.7 ± 2.3
				2.5%	13.5 ± 1.8	17.0 ± 1.4	16.9 ± 1.7
				5%	13.0 ± 1.1	17.7 ± 0.5	18.3 ± 2.5
				10%	13.8 ± 0.3	17.9 ± 0.4	20.7 ± 2.2
				20%	17.3 ± 2.1	20.4 ± 1.4	23.6 ± 2.3
			Chloroform	1.25%	5.8 ± 0.9	6.9 ± 1.9	9.5 ± 1.0
				2.5%	7.3 ± 0.5	7.9 ± 2.1	10.4 ± 0.6
				5%	9.4 ± 1.3	13.1 ± 2.1	12.0 ± 0.8
				10%	9.8 ± 1.7	13.2 ± 0.6	15.5 ± 0.2
				20%	10.6 ± 1.9	15.7 ± 0.9	18.4 ± 0.2
Chandra *et al.* (2023)	*E.americana Merr*	Well Diffusion	Doxycycline (30 µg/disk)	NA- CMC (24 h and 48 h)	30.78 ± 2.341 and 33.15 ± 1.986 (VS)		
				DMSO (24 h and 48 h)	18.85 ± 0.683 and 19.21 ± 0.238 (S)		
			NA-CMC	20% (24 h and 48 h)	8.21 ± 1.092 and 9.5 ± 1.586 (M)		
				25% (24 h and 48 h)	6.89 ± 1.160 and 8.912 ± 1.888 (M)		
				30% (24 h and 48 h)	5.74 ± 1.992 and 8.575 ± 3.035 (M)		

			DMSO	35% (24 h and 48 h) 40% (24 h and 48 h) 20% (24 h and 48 h) 25% (24 h and 48 h) 30% (24 h and 48 h) 35% (24 h and 48 h) 40% (24 h and 48 h)	8.71 ± 2.392 and 9.6 ± 1.810 (M) 10.12 ± 1.840 and 11.575 ± 1.694 (S) 15.48 ± 1.198 and 15.91 ± 1.625 (S) 13.68 ± 1.767 and 13.91 ± 1.986 (S) 12.71 ± 0.715 and 12.86 ± 0.935 (S) 14.1 ± 1.312 and 14.29 ± 1.433 (S) 13.71 ± 0.913 and 13.64 ± 0.785 (S)
Fitriyanti *et al.* (2023)	*E.americana Merr*	Well Diffusion	Doxycycline	30 µg/disk	22.4 ± 0.2 (VS)
			Ethanol	0.9375 % 1.875% 3.75% 7.5% 15% 30%	5.833 ± 0.404 (M) 6.433 ± 0.416 (M) 7 ± 0.1 (M) 7.666 ± 0.152 (M) 8.5 ± 0.264 (M) 9.566 ± 0.321 (M)
Pambudi *et al.* (2023)	*E.americana Merr*	Well Diffusion	Doxycycline (30 µg/disk)	(24 h and 48 h)	30.78 ± 2.341 and 33.15 ± 1.986 (VS)
			Ethanol	20% (24 h and 48 h) 25% (24 h and 48 h) 30% (24 h and 48 h)	8.21 ± 1.092 and 9.5± 1.586 (M) 6.89 ± 1.160 and 8.912 ± 1.888 (M) 5.74 ± 1.992 and 8.575 ± 3.035 (M)

				35% (24 h and 48 h)	8.71 ± 2.392 and 9,6 ± 1.810 (M)	
				40% (24 h and 48 h)	10.12± 1.840 11.575 ± 1.694 (S)	
Putri *et al.* (2020)	*E.americana Merr.*	Paper Disc Diffusion	Ciprofloxacin	5µg/50µl.		29.93 (S)
			Ethanol	20%		16.23 (S)
				40%		19.18 (S)
				60%		21.25 (VS)
Prayekti *et al.* (2022)	*E. palmifolia (L.) Merr*	*Kirby Bauer*	Clindamycin	2µg		48.16 ± 0.41
			Ethanol	40% (4°C)		25.33 ± 2.66
				40% (20°C)		32.5 ± 0.55
				40% (40°C)		29.83 ± 1.,6
Warsiti *et al.* (2018)	*E. palmifolia (L.) Merr*	Disk Diffusion	Vancomycin	30µg		17.83 ± 2.25
			Ethanol	25%		8.17 ± 0.29
				50%		10.67 ± 1.44
				75%		10.33 ± 1.53
				100%		12.33 ± 1.61
Fitriyanti *et al.* (2019)	*E. palmifolia Merr*	Well Diffusion	Erythromycin	15 mcg		48.857 ± 0.579 (VS)
			Ethyl acetate	0.9375 mg/ml		8.365 ± 0.579 (NA)
				1.875 mg/ml		9.369 ± 0.579 (NA)
				3.75 mg/ml		10.367 ± 0.585 (W)
				7.5 mg/ml		11.377 ± 0.579 (W)
				15 mg/ml		13.050 ± 1.004 (W)
				30 mg/ml		18.404 ± 0.579 (M)

Notes:
IZ : Inhibition Zone
h : Hours
Inhibition Zone Category:
NA : No Activity
W : Weak
M : Moderate
S : Strong
VS : Very Strong

Factors Influencing the Antibacterial Activity of Dayak Onion Extract

1. Concentration

The antibacterial activity of Dayak onion bulb extract increases with higher concentrations, as reflected by larger inhibition zones. Higher concentrations correspond to greater amounts of active compounds, thereby enhancing the extract's ability to inhibit or kill bacteria.[13] The antibacterial activity of Dayak onion extract against *S. aureus* varied with concentration and solvent type. The highest inhibition zone recorded was 23.6 ± 2.3 mm at 20% concentration. The ethyl acetate extract (30 mg/mL) showed 18.40 ± 0.58 mm, the 100% extract yielded 12.33 ± 1.61 mm, and the 60% ethanol extract achieved 21.25 mm.[12–15] For *S. epidermidis*, the 20% ethyl acetate extract exhibited the highest antibacterial activity, with an inhibition zone of 20.4 ± 1.4 mm. Against *P. acnes*, various preparations yielded different results: the 20% ethyl acetate fraction produced 17.3 ± 2.1 mm, the 20% ethanol extract with DMSO achieved 15.48 ± 1.20 mm, the 30% ethanol extract resulted in 9.57 ± 0.32 mm, and the 40% ethanol extract produced 11.58 ± 1.69 mm.[12,16–18]

In addition, the choice of solvent significantly impacts the extract's efficacy. The 20% Na-CMC solvent produced inhibition zones of 8.21 ± 1.09 mm and 9.50 ± 1.59 mm, whereas the 20% DMSO solvent yielded larger inhibition zones of 15.48 ± 1.20 mm and 15.91 ± 1.625 mm.[16] Dayak onion bulb extract prepared with DMSO (96% ethanol) exhibited greater antibacterial activity than the 0.5% Na-CMC (5% ethanol). The higher viscosity of Na-CMC likely hindered the dispersion of active compounds, whereas DMSO enhanced their solubility and stability.[14,16]

2. Method

Novaryatin et al. reported that maceration with 96% ethanol followed by percolation using the ethyl acetate fraction produced the largest antibacterial inhibition zone of 23.6 mm at a concentration of 20% concentration.[12] In contrast, Fitriyanti et al. found that maceration using ethyl acetate at an extract concentration of 30 mg/ml resulted in the greatest antibacterial activity against *Staphylococcus aureus*, with an inhibition zone of 18.404 mm.[13] Chandra et al. further noted that DMSO extraction through maceration yielded stronger antibacterial effects, with a 15.91 mm inhibition zone at a 20% concentration against *Propionibacterium acnes*. Maceration is particularly useful for

preserving heat-sensitive compounds, including flavonoids, present in Dayak onion bulbs.[14,16]

When tested using the disk diffusion method, the 96% ethanol extract inhibited *Staphylococcus aureus* with zones measuring 12.33 mm at 100% and 23.6 ± 2.3 mm at 20%, suggesting a concentration-dependent variation in antibacterial activity.[12,14] Meanwhile, the well diffusion method produced the largest inhibition zone of 18.404 mm at a concentration of 30 mg/ml against *Staphylococcus aureus*, and a maximum inhibition zone of 15.91 mm at 20% concentration against *Propionibacterium acnes* after 48 hours of incubation.[13,16] Compared to the disk diffusion method, the well diffusion method tends to produce larger inhibition zones as it allows the extract to diffuse more homogeneously and evenly within the agar medium.[16,17]

3. Temperature and Incubation Duration

Temperature and incubation duration influence the antibacterial activity of Dayak onion extract against bacteria associated with acne vulgaris. Prayekti et al. reported that 20 °C was the optimal temperature for the 40% ethanol extract, producing an inhibition zone of 32.5 ± 0.55 mm against *Staphylococcus aureus*.[19] According to Novaryatiin et al. and Warsiti et al., testing was performed at 37 °C for *P. acnes*, *S. aureus*, and *S. epidermidis*.[12,14] A decrease in temperature of 4–8 °C can reduce antibacterial activity by approximately half due to increased water content, whereas temperatures above 50 °C can lead to the degradation of active compounds, including flavonoids, tannins, and phenols.[19] Several studies employed 24- and 48-hour incubation periods, with results indicating that 48 hours yielded stronger antibacterial activity. This can be attributed to Gram-positive bacteria reaching the stationary phase after approximately 28 hours, while Gram-negative bacteria reach it between 18 and 24 hours.[16,17]

Antibacterial Mechanisms of Active Compounds in Dayak Onion Extract Against Acne Vulgaris

Qualitative phytochemical analysis of the extract indicated the presence of several bioactive compounds in Dayak onion bulbs, including flavonoids, phenols, alkaloids, triterpenoids, steroids, saponins, and tannins.[7,13,16,18] Shi et al. found that the bulbs of *Eleutherine bulbosa* contain the highest levels of phenolics and flavonoids and demonstrate stronger antioxidant activity than the leaves and flowers.[9] Flavonoids have been identified as highly effective antibacterial compounds, primarily by damaging the bacterial membrane and affecting cell wall permeability through DNA interactions.[7] Due to their lipophilic properties,

flavonoids non-specifically damage the cell membranes of Gram-positive bacteria by disrupting the phospholipid layer, decreasing membrane fluidity, and impairing membrane integrity.[20] Phenols are highly effective against Gram-positive bacteria, as the presence of peptidoglycan and the absence of an outer membrane allow them to compromise the cell wall, inhibit enzymes, disrupt ribosomal translation, and affect DNA integrity.[21] Triterpenoids exert antibacterial effects by damaging porins in the bacterial cell wall, reducing permeability, and inhibiting bacterial growth.[7] Alkaloids suppress bacterial growth by damaging cellular proteins and increasing membrane permeability, leading to leakage of intracellular contents and gradual bacterial death.[12] Steroids compromise the integrity of the bacterial cell membrane, rendering the cells fragile and leading to lysis (cell death). Meanwhile, tannins disrupt cell permeability, resulting in growth inhibition or bacterial death.[7]

Toxicity and Safety Profile of Dayak Onion Extract

Research on the toxicity and safety of Dayak onion extract has been conducted *in vivo*, including clinical trials of topical formulations. Ardhany et al. reported that a 1-gram application of the cream caused no skin irritation in rabbits, confirming its safety.[22] Another study reported that patch tests on 20 human volunteers using a 96% ethanol solution of Dayak onion extract cream (*Eleutherine palmifolia*) at concentrations of 5% and 20% caused no skin irritation. Although mild itching was occasionally observed, it was considered negligible, confirming the extract's safety for topical use.[23] Additionally, Agustin et al. demonstrated that acne gel formulated with Dayak onion extract, having a skin-compatible pH, is both effective against acne and safe for use.[24]

Development of Topical Formulations of Dayak Onion Extract for Acne Vulgaris

Research by Ardhany et al. showed that a cream formulated with 10% Dayak onion extract and emulsifying agents such as stearic acid and triethanolamine was the most stable, satisfying quality criteria with a pH of 6 and a viscosity of 32,000 cPs. This formulation was not only effective against acne but also maintained the unique Dayak onion aroma.[22] Similarly, Kartikasari et al. found that a peel-off gel mask containing 4% Dayak onion extract and 13% PVA exhibited optimal viscosity (3,833 cPs), balanced pH (6), rapid drying time, and good spreadability (5.815 cm), making it suitable for topical application.[25]

CONCLUSION

Dayak onion bulb extract (*Eleutherine* sp.) shows significant antibacterial activity against bacteria that cause acne vulgaris. Its effectiveness

depends on extract type, concentration, temperature, and method, with ethanol and ethyl acetate extracts demonstrating the strongest inhibition at higher concentrations. Containing active compounds such as flavonoids and alkaloids, this extract represents a promising alternative for the treatment of acne vulgaris.

CONFLICT OF INTEREST

The author declares conflicts of interest in this study.

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