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Original Research Article

Pharmacognostic Study of Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb.) and its Clay Mask Against Acne-Causing Bacteria

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ABSTRACT

Previous studies have shown that the ethanolic extract of Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb.) can inhibit acne-causing bacteria. Therefore, this study aims to conduct a pharmacognostic evaluation of Bawang Dayak and make a clay mask for acne vulgaris. Bawang Dayak bulbs were extracted using a percolator with 96% ethanol. The qualitative test is carried out using several methods, including the identification of organoleptic, macroscopic, microscopic, and chemical compounds with thin-layer chromatography. Furthermore, the physical and microbiology test was conducted on the clay mask using the disc diffusion technique against acne-causing bacteria. The result showed the physico-chemical parameters of bulbs as 8.67% loss on drying, 0.21% foreign organic matter, 13.31% water-soluble, 10.52% alcohol soluble, 0.53% total ash, 0.85% acid insoluble ash, and 1.67% water-soluble ash. The qualitative test of the phytochemical compound showed the presence of alkaloids, flavonoids, saponins, tannins, and catechols. The best eluent TLC for the ethanolic extract was n-hexane: ethyl acetate (8:2) or ethyl acetate: ethanol: water (8:2:1). Furthermore, the clay mask has moderate activity against *S. aureus* and *S. epidermidis* and weak activity against *P.acnes*. Conclusively, pharmacognostic studies on Bawang Dayak simplicia bulbs met the set parameters, and the clay mask of Bawang Dayak inhibits acne-causing bacteria.

***Keywords*:** Acne, Bawang Dayak, Clay Mask, *Eleutherine bulbosa*, Pharmacognostic.

Introduction

Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb.) is one of the medicinal and beneficial plants from Central Kalimantan, Indonesia. It is also found in Africa and Asia, such as the Indian peninsula.[1] The pharmacognostic study is the first step in the standardization of drugs or cosmetics derived from plants. Furthermore, the identification and quality of materials are essential prerequisites for ensuring quality that contributes to the safety and efficacy of a product.[2] According to the WHO, macroscopic and microscopic images of a medicinal plant are the first step to ensure its identity and purity.[3] Based on the literature search, several pharmacognostic studies have been carried out on Bawang Dayak from three locations, namely, South, Central, and East Kalimantan[4]. This study differs from others because Bawang Dayak is obtained from a specific location in Central Kalimantan, cultivated independently, and tested for determination at the Indonesian Institute of Sciences Research Center for Biology. Empirically, the bulbs are used as a treatment for cancer, hypertension, diabetes, antibacterial, and also as natural cosmetics.[5-6] Previous studies have shown that the ethanolic extract of this plant can inhibit acne-causing bacteria, such as *S. aureus*, *S. epidermidis*, and *P. acnes*.[7-9] It has also been processed into cream preparations, which has gone through a series of formulation modification experiments, primary irritation test with animals and human using the human patch test method.

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The experimental results showed that the cream Bawang Dayak does not cause significant irritation in the test animals or humans.[10-13] Therefore, this study aims to identify the pharmacognostic investigation of Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb.). It also aims to make a new product, specifically a clay mask with the same purpose as the previous studies, which is expected to produce a series of anti-acne treatments from the main materials Bawang Dayak.

Materials and Methods

Plant Collection and Identification

Bawang dayak (Figure 1) were collected at Jalan Cendrawasih II UPT. Km.38 Kelurahan Sei Gohong, Kecamatan Bukit Batu in Palangka Raya, Central Kalimantan Indonesia, on September 2021. It was authenticated by Dr. Joeni Setijo Rahajoe from the Indonesia Institute of Sciences, Research Center for Biology, Bogor (2119/IPH.1.01/If.07/VIII/2018).

Pharmacognostic study

A pharmacognostic study was conducted using leaves and bulbs plant, including organoleptic, macroscopic, and microscopic examinations, thin layer chromatographic tests of ethanolic extract and its fractions.

Figure 1: Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb)

Furthermore, the physico-chemical identification test was conducted to determine foreign matter content, loss on drying, total, water-soluble, and acid-insoluble ash, as well as water and alcohol-soluble. [14-15]

Preparation of Ethanolic Extract of Bawang Dayak
The fresh bulbs of Bawang Dayak were washed, cleaned, and dried in an oven at 40-60ºC.[16] The dried bulbs were ground, powdered, and 96% ethanol was extracted by percolation, which is a continuous process where the fresh solvent constantly replaces the saturated solvent.[17] The extract was concentrated in a rotary evaporator.

Formulation Preparation of Clay Mask Bawang Dayak
In this study, 60g of clay mask was prepared, and each material was weighed according to the formula, as shown in Table 1. Subsequently, a clay mask was made by dissolving 15 ml each of bentonite and nipagin in hot water and left for 15 minutes. The combination is placed in a mortar, followed by the addition of xanthan gum, which is ground until homogeneous. Glycerin and the ethanolic extract of Bawang Dayak were added and ground until homogeneous and oleum rosae was added for odoring. The clay mask was tested for its physical properties.

Microbiology Test of Clay Mask Bawang Dayak to acne-causing bacteria
The clay mask of the ethanolic extract was evaluated for in vitro antibacterial activity against acne-causing bacteria, such as *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Propionibacterium acnes*, using the disc diffusion method. Afterward, 10 mL of the McFarland 0.5 standard was placed into sterile tubes. The bacterial suspension was prepared by diluting colonies in sterile normal saline and adjusting the turbidity to 1-2x10^8 CFU/mL, according to McFarland 0.5 standard.[18-19] A sterile cotton swab was soaked in a standardized bacterial suspension and used to inoculate a Mueller-Hinton agar plate uniformly. The discs dipped in the Bawang Dayak clay mask were then set on the plates, then incubated at 37°C for 24 hours. The diameter of the generated zone of inhibition was measured in millimeters using a caliper. As a comparison, clay masks available on the market are used (acxxx).

Table 1: Clay Mask Formulation of Ethanolic Extract Bawang Dayak

Materials	Quantity
Ethanolic extract of bawang dayak	5% (5,000 mg)
Kaolin	18,000 mg
Bentonite	4,000 mg
Glycerin	8,000 mg
Methyl paraben	100 mg
Xantan gum	500 mg
Rose oil	2 ml
Aquadest	ad 60,000 mg

Results and Discussion

Pharmacognostic study
Standardization is a guaranteed process that ensures constant and predetermined parameter values. Specified and non-specified criteria are required to ensure that the active chemicals in simplicia are consistent and accountable. Furthermore, the standardization of a crude drug is an integral part of establishing its correct identity. Before any crude drug can be included in an herbal pharmacopoeia, pharmacognostic parameters and standards must be established.[20] The plants' identity and quality were determined by macroscopic and microscopic investigation before other analyses because their morphological identification was lost after they were dried and pulverized.[21] The pharmacognosy studies showed that the macroscopic characters of Bawang Dayak are characterized by a single leaf in the form of a ribbon and green, and its tip and base are spiky with a flat edge. Meanwhile, the bulbs are ovoid, and their surfaces are smooth, red, and odorless (Figure 2). Microscopically, the identification fragments of the leaves and bulbs are trichomata, stomata, epidermis, a crystal of calcium oxalate, and vessel, as shown in Figure 3. The physico-chemical or non-specific parameters showed a drying loss of 8.67%, consistent with the standards set by the Food and Drug Supervisory Agency of the Republic of Indonesia (BPOM RI), which is less than 10%.[22] Drying loss was determined to maintain the simplicia's quality because it was linked to the growth of molds or fungi, as well as volatile substances. A lower water content results in the growth of less mold, fungus, and enzymatic reactions that can degrade the product's quality. [23] The bulbs contain 0.53% total ash, 0.28% acid-insoluble ash, and 0.29% water-soluble ash, as shown in Table 4. The higher the total ash content obtained, the higher the mineral content contained in the simplicia.[24] Acid insoluble ash content reflects mineral or metal contamination that is insoluble of acid in simplicia.

(A) (B) (C)

Figure 2: The macroscopic character of Bawang Dayak, leaves (A), bulbs (B), and Flowers (C)

Table 2: Organoleptic of Bawang Dayak

Plant parts	Color	Odor	Flavor
Leaves	Green	Specific	Bitter
Bulbs	Red	Specific	Bitter

Table 3: The qualitative phytochemical compound of simplicia Bawang Dayak bulbs

The phytochemical compound of simplicia	Reactor	Result
Alkaloids	Mayer	+
	Dragendroff	+
Flavonoids	Gas of NH_3	+
Saponins	H_2O	+
Steroids	Liebermann Burchard	-
Tannins	HCl 0,5 N	-
	$FeCl_3$ 1 N	+
	H_2SO_4	+
Cathecols	Vanili 10%	+
Starch	I_2 0,1 N	-
Aleurone	I_2 0,1 N	-

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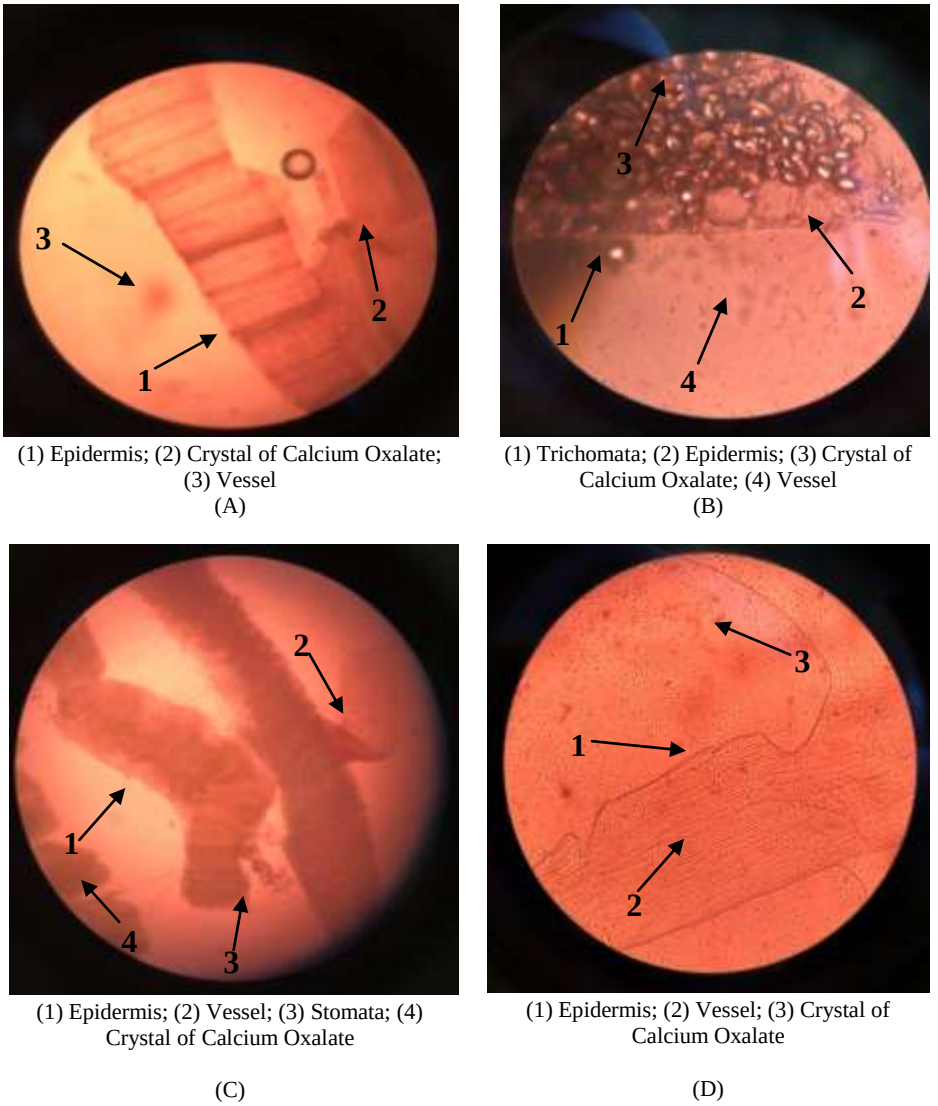

(1) Epidermis; (2) Crystal of Calcium Oxalate; (3) Vessel
(A)

(1) Trichomata; (2) Epidermis; (3) Crystal of Calcium Oxalate; (4) Vessel
(B)

(1) Epidermis; (2) Vessel; (3) Stomata; (4) Crystal of Calcium Oxalate

(C)

(1) Epidermis; (2) Vessel; (3) Crystal of Calcium Oxalate

(D)

Figure 3: The microscopic character of Bawang Dayak, longitudinal section of bulbs (A); cross-section of bulbs (B); longitudinal section of leaves (C); cross-section of leaves (D)

Table 4: The physico-chemical parameters of simplicia Bawang Dayak bulbs

The physico-chemical parameters	% w/w
Loss on drying	8.67
Foreign organic matter	0.21
Water soluble	13.31
Alcohol soluble	10.52
Total ash	0.53
Acid insoluble ash	0.28
Water soluble ash	0.29

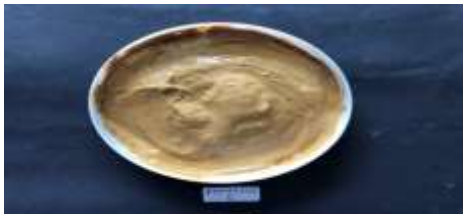

Figure 4: Clay mask of Bawang Dayak

It is also one of the parameters for measuring the amount of cleanliness in a product's processing. According to Materia Medika Indonesia, the acceptable acid-insoluble ash percentage is less than 1% and less than 8% for total ash.[25] Furthermore, the foreign organic matter determines the purity of a simplicia and its potential contamination by foreign organic matter. The results showed that the simplicia has 0.21% foreign organic matter, 13.31% water soluble, and 10.52% alcohol soluble.

The phytochemical compound of simplicia has metabolite content of alkaloids, flavonoids, saponins, tannins, and catechols, as shown in Table 3. Alkaloids possess the properties of broad-spectrum antibiotics but with fewer adverse reactions and a low tendency to drug resistance. Previous studies show that natural alkaloids can disrupt the bacterial cell membrane, affect DNA function, and inhibit protein synthesis.[26] Furthermore, flavonoids were reported to inhibit bacterial growth by reducing adhesion and biofilm formation, porin on the cell membrane, permeability, and pathogenicity, as well as suppressing nucleic acid synthesis.[27-28] Antimicrobial properties were also found in saponins, tannins, and catechols, each with its mechanism.[29-35] Another study showed that the bulbs of *Eleutherine sp.* have antioxidant, antibacterial, and anti-inflammatory properties, which promote wound healing. [36]

TLC of *E. bulbosa* extract was performed using silica gel F254 as a stationary phase. The eluent for phytochemicals profiling was obtained using different solvents at various proportions, as shown in Tables 5 and 6.

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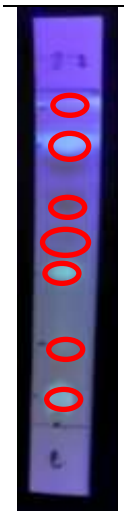
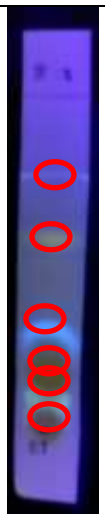
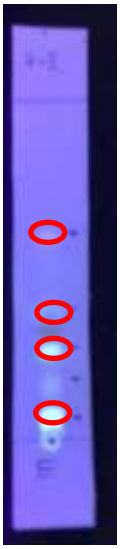
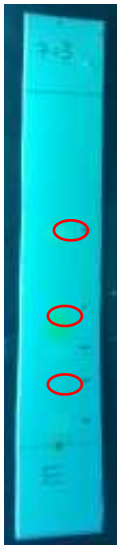
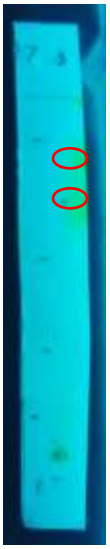
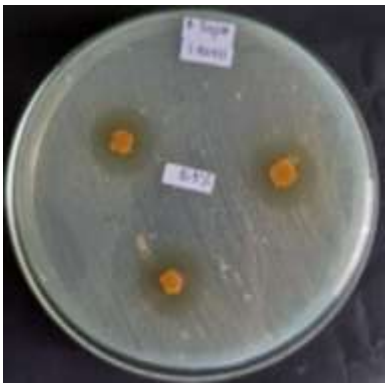
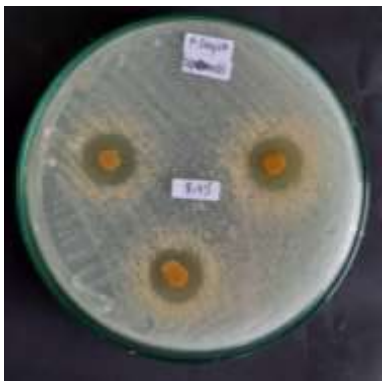
Table 5: TLC profile using n-hexane: ethyl acetate

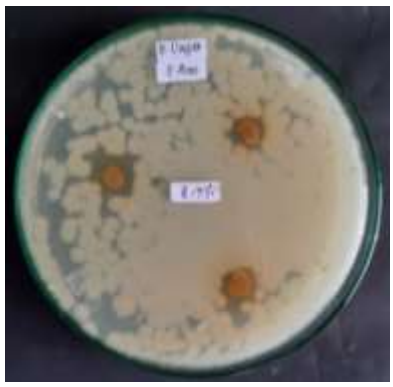
n-hexane: ethyl acetate	Ethanolic extract of Bawang Dayak				Ethyl acetate fraction of Bawang Dayak			
	366 nm	Rf	254 nm	Rf	366 nm	Rf	254 nm	Rf
8:2		0.10 0.17 0.24 0.47 0.57 0.85 0.95		0.51 0.55 0.69		0.10 0.20 0.30 0.58 0.68 0.75		0.36
7:3		0.21 0.38 0.47 0.73		0.25 0.36 0.49		0.11 0.30 0.55 0.88		0.62 0.70



Staphylococcus aureus



Staphylococcus epidermidis



Propionibacterium acnes

Figure 5: Zone of inhibition the clay mask Bawang Dayak

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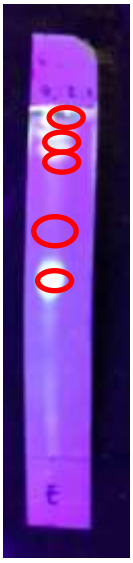
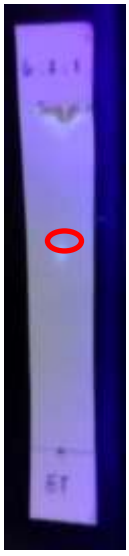
Table 6: TLC profile using ethyl acetate: ethanol: water

ethyl acetate	Ethanolic extract of Bawang Dayak				Ethyl acetate fraction of Bawang Dayak			
:ethanol :water	366 nm	Rf	254 nm	Rf	366 nm	Rf	254 nm	Rf
10:2:1		0.35 0.41 0.75 0.88		0.49 0.96		0.40 0.80 0.92		0.41 0.96
8:2:1		0.10 0.40 0.65 0.77 0.92		0.34		0.78 0.92		0.62 0.90
6:2:1		0.50 0.65 0.85 0.90 0.94		0.56 0.97		0.58		0.60 0.97

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Staphylococcus aureus *Staphylococcus epidermidis* *Propionibacterium acnes*

Figure 6: Zone of inhibition the clay mask available on the market (acxxx)

Each combination was analyzed using a light UV at a wavelength of 254 nm and 366 nm.[37-38] The results showed that the best eluent for good separation ethanolic extract was a compound with more non-polar eluent content, namely n-hexane: ethyl acetate (8:2) or ethyl acetate: ethanol: water (8:2:1), as shown in Tables 5 and 6. The phenolic compounds were detected when sprayed with $FeCl_3$, which changed the spot to black on several plates. However, spraying using Dragendorff's reagent did not change the spot, hence, no alkaloid content was found. [39]

Evaluation test of Clay Mask Bawang Dayak
Organoleptic appearance
The result showed that the clay mask of Bawang Dayak is semi-solid with brown color, and the addition of rose oil made a good smell. In addition, the observed clay mask was homogenous, as indicated by the uniform color (Figure 4).

pH Observation
The clay mask of Bawang Dayak was found to have a pH of 6. The pH of the skin and topical treatments should be the same. Furthermore, topical products should be acidified, with pH ranging from 4 to 6. [40]

Spreadability and adhesion test
There are no special conditions for the adhesion and dispersion of clay mask preparation, but the most important factor is the ease of use. According to Syamsidi et al. (2021), the range of specifications for the spreadability of a good clay mask is 2-5 cm. [41] The spreadability of the clay mask in this study was good at 2.41±0.26 cm with adhesion average > 30".

Antibacterial Activity of Clay Mask Bawang Dayak
Previous studies have shown that Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb) can inhibit acne-causing bacteria, such as *S. aureus*, *S. epidermidis*, and *P. acnes*.[7-9] Furthermore, the ethanolic extract was made into cream preparations[10-13], showing good inhibitory abilities against acne-causing bacteria. In this study, it was developed in the form of a new product, namely a clay mask, to overcome acne vulgaris. The result showed that the clay mask has moderate activity against *Staphylococcus aureus* and *Staphylococcus epidermidis*, but it was weak in *Propionibacterium acnes*, as shown in Table 7. Furthermore, Shahbazi (2017) classified inhibition activity into three levels based on the differences in the diameter of the zone, namely weak (<12 mm), moderate (12–20 mm), and strong activity (>20 mm).[42] The clay mask has an excellent inhibitory ability compared to a similar product on the market (acxxx), which does not have inhibition activity against *S. aureus* and *P. acnes*. It also has a smaller inhibition zone than *S. epidermidis* compared to the clay mask developed in this study, as shown in Table 8.

Table 7: Inhibition zone diameter of the clay mask Bawang Dayak against acne-causing bacteria

Bacteria	Inhibition zone diameter (mm) ± SD	Activity classification
Staphylococcus aureus	17.3 ± 1.3	Moderate activity
Staphylococcus epidermidis	15.0 ± 0.5	Moderate activity
Propionibacterium acnes	7.1 ± 1.1	Weak activity

Table 8: Inhibition zone diameter of the clay mask available on the market (acxxx) against acne-causing bacteria

Bacteria	Inhibition zone diameter (mm) ± SD	Activity classification
Staphylococcus aureus	0 ± 0	No activity
Staphylococcus epidermidis	4.8 ± 4.1	Weak activity
Propionibacterium acnes	0 ± 0	No activity

Conclusion

Conclusively, the pharmacognostic studies on Bawang Dayak simplicia bulbs met the set parameters. The best eluent for the ethanolic extract was n-hexane: ethyl acetate (8:2) or ethyl acetate: ethanol: water (8:2:1), and the clay mask excellently inhibits acne-causing bacteria. Further studies are recommended to identify the specific compounds that have antibacterial activity in *Eleutherine bulbosa* bulbs.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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