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Modification of Anti-acne Bawang Dayak (*Eleutherine bulbosa* (Mill.) Urb.) Cream to *Propionibacterium acnes*

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ABSTRACT

Bawang dayak is one of the traditional medicines in Central Kalimantan, used to treat acne vulgaris. Previous research reported that a cream made with bawang dayak extract's active ingredient could inhibit *Propionibacterium acnes*' growth. However, bawang dayak has a pungent odor that causes discomfort, where the cream separates after 3 days of storage, which decreases its potency. This study aims to improve the quality of the anti-acne cream formulation of bawang dayak extract from previous studies with the addition of cinnamon, honey, and peppermint. The modified formula of bawang dayak extract cream was evaluated and tested for its antibacterial activity *in vitro*. The results showed an increase in the organoleptic test, especially the smell, which gave a more comfortable fragrance than the previous formula. The pH measurement of the cream shows the results suitable for topical applications. However, the homogeneity observations show that all the formulas are homogeneous, seen from uniform colors but contain coarse grains. The antibacterial activity test of all cream formulations against *P. acnes* showed inhibition zone diameter between 14.85 and 17.10 mm, all of which were moderate and larger than previous studies. It can be concluded that the modification of the cream formula with the active ingredient of bawang dayak extract showed an increase in the inhibition zone against *P. acnes* and improved organoleptic properties.

Key words: Acne, Bawang dayak, cream, *Propionibacterium acnes*

INTRODUCTION

Acne vulgaris or acne is a skin condition that causes noninflammatory symptoms such as blackheads or inflammatory lesions such as papules, pustules, and nodules.^[1] There are many acne causes, including bacteria such as *Propionibacterium acnes*, fats, skin oils, and hormone levels changes. Acne due to *P. acnes* infection generally

occurs in the skin area of the face, chest, and back. *P. acnes* is a Gram-positive bacteria with anaerobic properties and is found in hair follicles and skin pores.^[2] In addition, *P. acnes* is usually found in prepubertal young children, whose colonization increases from adolescence to twenties, when sebaceous gland function begins to mature.^[3,4]

Bawang dayak (*Eleutherine bulbosa* [Mill.] Urb) is one of the traditional medicinal plants in Central Kalimantan, which is used to treat various diseases, including acne. Based on previous research, the cream formulation with the active ingredient of bawang dayak's ethanol extract can inhibit *P. acnes*' growth. However, bawang dayak has a pungent odor that causes discomfort to its users. Furthermore, the formulation of the tested cream was reported separately

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after 3 days of storage, which may reduce *P. acnes*' inhibitory potential.^[5,6] This study aims to improve the quality of the anti-acne cream formulation of bawang dayak extract from previous studies. In this study, the cream formulation from previous studies was modified with the addition of honey, cinnamon, and peppermint to make the cream formulation more stable and improve its organoleptic properties, mainly to disguise the smell of bawang dayak. Besides, the antibacterial activity of honey, cinnamon, and peppermint is also known to support the cream formulation because it has antibacterial activity.^[7,8]

METHODS

Plants materials and sample collection

The plant part used is the farmer collected bulbs of bawang dayak in Sei Gohong, Bukit Batu, Palangka Raya, Central Kalimantan. Specimens were prepared and sent for determination to the Indonesian Institute of Sciences Research Center for Biology.

Preparation of bulbs extract

The extract was prepared by cutting the bulbs and drying in the sun no later than 10 in the morning. A grinding machine mashed dry bulbs until a coarse powder is obtained. The powder was extracted by percolator with 96% ethanol, and once the process has finished, all extracts were concentrated in a rotary evaporator.

Formulation preparation

The formulation components used are listed in Table 1. These components consist of the oil phase (stearic acid, adeps lanae, and paraffin liquid) and the water phase (triethanolamine, nipagin, peppermint, and distilled water). Each phase was heated up to 55°C until melted. Bawang dayak ethanol extract is then dissolved in distilled water, added with cinnamon powder dissolved in warm water, and then filtered. The mixture was put into the water phase and stirred until it was homogeneous in the mortar,

then gradually added to the oil phase and stirred until a cream base was formed. Finally, honey was added and stirred a little at a time until homogeneous.

Evaluation of cream

Organoleptic properties

The cream was observed for color, odor, and appearance.

Homogeneity observed

The cream was observed on the glass object, the test was done by physical touch with hands; preparations should be had a homogenous composition.^[9,10]

pH observation

The pH of cream was being calculated by pH meter.^[11,12]

Spreadability test

As much as 0.5 g of cream is put into a circle 1 cm in diameter that has been marked on a glass plate, then a second glass is placed on it (in the middle between two horizontal glass plates) and left to stand for 5 min. A standard weight of 50 g was applied to the top plate for 1 min, and the diameter of the spread was measured. The same is repeated for 100 and 150 g of cream. The size of the spread is determined when the cream spread has a fixed diameter. Each formulation was tested three times.^[13,14]

Adhesion test

The adhesion test is carried out by applying 0.5 g of cream on one glass object with another glass object. The cream is applied between two glass objects and then pressed with a load of 1 kg for 1 min on the test instrument. After 1 min, the load is removed, and the time it takes for the second glass object to come off is recorded.^[15,16]

Evaluation of antibacterial activity by zone of inhibition by well-diffusion method

Dayak cream onion was evaluated for its antibacterial activity against *P. acnes* (ATCC 11827) with different

Table 1: Various cream formula of ethanolic extract bawang dayak

| Materials | Formula (mg) | | | |
|---------------------------------|--------------|----------|----------|----------|
| | F1 (5%) | F2 (10%) | F3 (15%) | F4 (20%) |
| Extract ethanol of bawang dayak | 1250 | 2500 | 3750 | 5000 |
| Cinnamon powder | 2500 | 2500 | 2500 | 2500 |
| Honey | 2000 | 2000 | 2000 | 2000 |
| Oil phase | | | | |
| Stearic acid | 5000 | 5000 | 5000 | 5000 |
| Adeps lanae | 750 | 750 | 750 | 750 |
| Paraffin liquid | 6250 | 6250 | 6250 | 6250 |
| Aqueous phase | | | | |
| Triethanolamine | 375 | 375 | 375 | 375 |
| Nipagin | 25 | 25 | 25 | 25 |
| Peppermint | 20 | 20 | 20 | 20 |
| Aquadest ad | 25,000 | 25,000 | 25,000 | 25,000 |

combinations of Dayak concentrations with the addition of cinnamon, honey, and peppermint.

Bacterial isolates were subcultured into nutrients. Bacterial cultures were standardized using the McFarland 0.5 standard after 24 h.^[17] The bacterial bioassay in this study was Mueller-Hinton agar (MHA). Sterilization is carried out using an autoclave.^[18,19] Plates containing MHA were prepared and bacterial strains inoculated with a cotton swab followed by clindamycin with concentrations ranging from 0.5%–4%, and then with a creamy formula applied to the empty disc. All plates were then incubated at 37°C for 24 h. The diameter of the drag zone is then calculated and recorded.^[20,21]

RESULTS AND DISCUSSION

Evaluation test of cream formula

Organoleptic appearance

The organoleptic test results showed a brown cream color, where the addition of cinnamon and peppermint caused the smell of bawang dayak to be less pungent [Figure 1].

Homogeneity observation

Observation of the cream showed that all formulations were homogeneous, indicated by the uniform color. However, the cream still contains coarse grain due to the addition of cinnamon powder. The formulation can be modified again, one of which is using cinnamon extract to replace the powder, so that the cream does not appear to have coarse grains.

pH observation

The pH observation showed that all cream formula was 6. The pH that suitable for topical applications is the same as the pH of the skin. Skin pH is naturally acidic, ranging between 4 and 6.^[22,23]

Spreadability and adhesion test

The spreadability test of all cream formulations showed that all formulations were easy to apply with an average

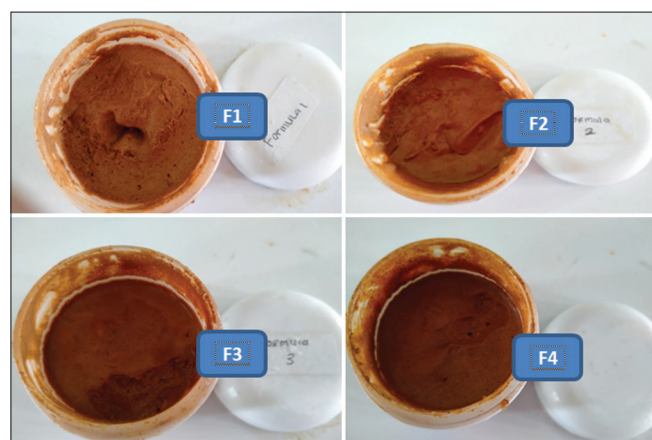


Figure 1: Various modification cream formulas

distribution of >5 cm. Adhesion tests from F1 to F4 are 3", 3", 5", and 8", respectively. The more bawang dayak extract shows stronger adhesion properties.

Antibacterial activity

Shahbazi (2017) classified antibacterial activity into three levels based on the differences in the diameter of the inhibition zone, consisting of weak (<12 mm), moderate (12–20 mm), and strong (>20 mm) activity.^[24] The inhibition test results showed that F1 had an inhibition zone diameter of 16.15 ± 0.45 mm, F2 = 14.85 ± 1.75 mm, F3 = 15.05 ± 1.45 mm, and F4 = 17.10 ± 0.8 mm [Figure 2 and Table 2]. The cream test results were then compared with the control, where the inhibition zone diameter of the modified cream formulation was still not as big as clindamycin. However, this cream formulation is still feasible to be developed because it has moderate inhibition zone activity [Figure 2 and Table 3].

Previous research reported that the preliminary phytochemical screening of the ethanol extract of bawang dayak contained metabolites in the form of flavonoids, saponins, alkaloids, and tannins.^[25] Flavonoids are potent antibacterial compounds against various types of bacteria. Their antibacterial activity can be caused by three mechanisms: Inhibition of energy metabolism, suppressing nucleic acids, and damage to the cytoplasmic membrane.^[26,27] Other antibacterial mechanisms of bawang dayak are also being tested: Eleutherol A, a flavonoid from bawang dayak, which is known to inhibit cell wall synthesis from bacteria.^[28] Alkaloids have antibacterial ability generally work through efflux pump inhibition activity. Most of the alkaloids are found to be bactericidal rather than bacteriostatic.^[29,30] One of the saponin antibacterial mechanisms is a decrease in the efficiency of glucose utilization in bacteria, affecting

Table 2: Inhibition zone diameter of the cream formulation

| Cream formulation | Inhibition zone diameter (mm) ± SD | Activity classification |
|-------------------|------------------------------------|-------------------------|
| F1 | 16.15 ± 0.45 | Moderate |
| F2 | 14.85 ± 1.75 | Moderate |
| F3 | 15.05 ± 1.45 | Moderate |
| F4 | 17.10 ± 0.8 | Moderate |

SD: Standard deviation

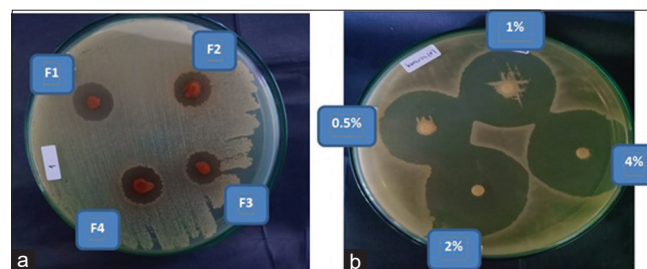


Figure 2: Zone of inhibition modification cream formulas (a); Zone of inhibition clindamycin (b)

Table 3: Inhibition zone diameter of clindamycin

| Concentration of clindamycin (%) | Inhibition zone diameter (mm)±SD | Activity classification |
|----------------------------------|----------------------------------|-------------------------|
| 0.5 | 40.20±1.9 | Strong activity |
| 1 | 43.40±0.8 | Strong activity |
| 2 | 45.10±0.7 | Strong activity |
| 4 | 47.60±0.6 | Strong activity |

SD: Standard deviation

their proliferation or growth and ultimately causing an antibacterial effect.^[31] Furthermore, several studies have shown that tannins have antibacterial properties, both Gram-negative and Gram-positive.^[32,33]

Apart from that, cinnamon also has vigorous antioxidant activity. Several studies have reported that cinnamon shows potential activity against acne-causing bacteria. This therapeutic effect is mainly due to the content of cinnamaldehyde. Cinnamaldehyde also has anti-inflammatory activity by blocking PGE2 production, suppressing synthesis, spreading inflammatory mediators, and reducing ROS release from immune cells.^[7,34] On the other hand, honey also plays a vital role in this cream formulation with its antimicrobial, anti-inflammatory, and immunomodulatory potential.^[35] The advantages of using honey tend to contribute to its antibacterial effects through high osmolarity, increased acidity (low pH), and the content of hydrogen peroxide (H₂O₂), which is toxic to many microbes.^[36,37]

CONCLUSION

Modification of bawang dayak's anti-acne cream formulation combined with cinnamon, honey, and peppermint made the inhibition zone diameter for *P. acnes* higher than without the combination of the three. However, the homogeneity test evaluation showed that the cream contained coarse grain due to cinnamon powder. Thus, this research can be further developed to increase the cream's homogeneity by replacing the cinnamon powder with its extract.

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Conflicts of interest

There are no conflicts of interest.

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