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Formulation and Determination of Tannin and Flavonoid Levels of Anti-Acne Gel Formulation from Red Betel Leaf Extract (*Piper crocatum*)

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Abstract: Acne is a common skin condition that often occurs among teenagers and adults aged 18-23 years. Acne can be triggered by several factors, genetic, psychological, weather, stress, cosmetics, and bacterial infections. Red betel leaf contains phytochemical compounds, namely tannins and flavonoids, which function as antibacterial agents. The formulation of anti-acne gel is designed by varying the concentration extract, F0 (0%), F1 (10%), F2 (15%), and F3 (20%), to determine the best anti-acne gel formulation. Red betel leaf extract (RBLE) is tested for tannin and flavonoid levels using the UV-Vis Spectrophotometer test method. The gel preparation is examined, including organoleptic testing, pH testing, homogeneity testing, and spreading testing. The research results show that RBLE has a tannin content of 4.7056% and a flavonoid content of 0.0934%. The results of the anti-acne gel preparation study meet the requirements for organoleptic properties, pH, homogeneity, and spreading. Based on the results of various extract concentrations, satisfactory results are obtained, with formulations F2 and F3 meeting the requirements.

Keywords: *Acne; Gel; Ethanol Extract; Red Betel Leaf Extract*

1. INTRODUCTION

The healthy condition of the skin significantly contributes to one's self-confidence; when the skin is unhealthy, it can affect self-perception and become a health issue that needs attention [1].One part of the skin that needs attention to cleanliness and health maintenance is the facial skin. Maintenance of hygiene behaviour, especially on facial skin, is described through the awareness and initiative taken by individuals to maintain cleanliness and health and prevent disease [2]. One problem that arises when facial skin hygiene is not maintained is the occurrence of acne. Acne is a common skin disorder found among both teenagers and adults, with an average prevalence in the age range of 18-23 years [3]. Acne is an accumulation of overly active sebaceous gland on the skin that are clogged with dirt and become infected due to the presence of bacteria such as *Staphylococcus aureus* and *Propionibacterium acnes* [4], [5]. Acne can be triggered by several factors including genetic, psychological, weather, stress, diet, cosmetics, and bacterial infections.

In addressing acne problems, the most preferred dosage form by consumers is in the form of a gel preparation [6]. The advantage of gel preparations is that they are non-sticky and also evaporate quickly, facilitating the efficient delivery of medication to the skin, allowing acne to dry quickly [7].

The solubility of the extract in the gel formulation might affect skin penetration since it influences the rate of active component absorption by the skin. The better the extract dissolves in the gel formulation, the more the formulation can enter the skin layers.

Red betel leaf (*Piper crocatum*) is one of the potential plants empirically known to have efficacy in curing various diseases [8]. Red betel leaves have also been used in cosmetics including hand antiseptic gels, peel-off masks, clay masks, sheet masks, lip balms, and loose powders. Red betel leaf is a plant belonging to the *Piperaceae* family [9]. Red betel leaves (*Piper crocatum*) contain phytochemical compounds such as essential oils, alkaloids, saponins, tannins, and flavonoids with antioxidant and antibacterial activities [10]. Flavonoids can form complex compounds with extracellular proteins that have bacterial cell membrane integrity [11]. The mechanism of action of flavonoids as antimicrobials can be divided into 3 categories: inhibiting nucleic acid synthesis, inhibiting cell membrane function, and inhibiting energy metabolism [12].

2. MATERIALS AND METHODS

2.1. Material

The material utilized in this study is red betel leaves obtained from Lubuk Minturun, Padang, Indonesia. Carbopol (Lubrizol, USA), TEA, Methyl Paraben, Propilenglikol, Aquadest. This research was conducted in the Chemistry Laboratory of the Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang.

2.2. Extraction Method

This extraction method refers to the study conducted by Rosari et al., 2021. Fine powder of red betel leaves weighing 200 grams was extracted using 70% ethanol at a ratio of 200 grams to 2 liters (1:100). The maceration process was carried out in glass jars for 3x24 hours. All the macerates were collected and concentrated using a rotary evaporator to obtain the extract, which was then placed in a water bath to thicken the extract. The yield of RBLE obtained from 2 liters was 48.7704 grams. Based on the research findings [13], the anti-acne gel formula with a concentration of 15% black betel leaf extract resulted in the best anti-acne gel preparation. All anti-acne gel formulations did not cause irritation, indicating that the anti-acne gel is safe for use. Therefore, this study will utilize an innovative approach by using different concentrations of RBLE compared to the aforementioned study, namely the use of RBLE concentrations of F1 (10%), F2 (15%), and F3 (20%). The innovation in extract concentration aims to determine whether reducing or increasing the concentration of extract in the previously studied anti-acne gel formula will yield better results, or if the 15% extract concentration remains the most effective.

2.3. Determination of Tannin And Flavonoid

The test for tannin and flavonoid content utilizes the UV-Vis spectrophotometry technique. The qualitative testing of flavonoids and tannins is conducted using the tube method. The presence of flavonoid compounds is indicated by a yellow color change after the addition of Mg powder and concentrated HCl. The presence of tannins is indicated by a color change in the extract from green to dark green after the addition of FeCl3 [14].

2.4. Formulation of Anti-Acne Gel with RBLE

Table 1. Formulation of Anti-Acne Gel with RBLE

Material	Formulation (%)			
	F1	F2	F3	Control
RBLE	10	15	20	-
Carbopol	2	2	2	2
Triethanolamine (TEA)	2.5	2.5	2.5	2.5
Methyl Paraben	0.2	0.2	0.2	0.2
Propilenglikol	15	15	15	15
Aquadest ad	100	100	100	100

The process of making the anti-acne gel involves several stages. The first stage is to prepare the equipment and materials, where the required materials are weighed accordingly. Next, Carbopol is dispersed in distilled water at a temperature of 70℃, then 2.5% TEA is added, followed by dissolving 0.2% methylparaben in 15% propylene glycol. The dissolved methylparaben is then added to the gel base and stirred until homogeneous. Subsequently, RBLE is added according to the predetermined formulations F1 (10%), F2 (15%), and F3 (20%). The final stage involves testing the gel preparation, including pH testing, organoleptic testing, homogeneity testing, and spreading power testing.

2.5. pH Testing

The determination of the formulation's pH is conducted using a universal pH indicator that is dipped into the diluted gel sample. After being completely immersed, the universal pH indicator paper is observed for color changes and matched with the universal pH standard. The pH of the gel formulation should be in accordance with the pH of the skin, which is 4.5 – 6.5 [15].

2.6. Organoleptic Testing

Organoleptic assessment of the anti-acne gel involves the direct observation of its form, color, and odor. The gel typically appears clear with a semi-solid or thick consistency [16].

2.7. Homogeneity Testing

Homogeneity testing is conducted by evenly and thinly applying 0.1 g of the gel formulation onto a glass slide. Another glass slide is then placed on top and pressed together. The test formulation should exhibit a homogeneous structure with no coarse particles present [15].

2.8. Spreadability Testing

The spreadability test is performed by placing 1 gram of gel in the center of a petri dish, then applying a 150-gram weight and waiting for 1 minute. The spread of the gel is measured by the diameter of the gel spread from two sides. Good spreadability of the formulation typically falls between 5-7 cm [13]

3. RESULTS AND DISCUSSION

3.1. Determination of Tannin and Flavonoid Levels

Table 2. Analysis Results of Tannin and Flavonoid Levels in RBLE

Analyte of Interest	Result (100 gr sample)	Test Method
Tanin	4.7056%	UV-Vis Spectrophotometry
Flavonoid	0.0934%	

The identification results of tannins and flavonoids in this study showed positive results containing tannins and flavonoids. The determination of tannin and flavonoid levels in RBLE was conducted using the UV-Vis spectrophotometer test method. The levels of tannins and flavonoids in RBLE were found to be 4.7056% for tannins and 0.0934% for flavonoids. This research was conducted to determine the best formula for anti-acne gel formulations of RBLE through 4 formulations. The difference between these four formulations lies in the concentration of RBLE used (Table 1). In formulation F0, no RBLE was used, in formulation F1, red betel leaf extract was used at a concentration of 10%, in formulation F2, RBLE was used at a concentration of 15%, and in formulation F3, RBLE was used at a concentration of 20%.

3.2. pH Test

Table 3. Results of pH Test of RBLE Anti-Acne Gel

Formulation	Range pH	pH
F0	4.5-6.5	6
F1		5
F2		5.5
F3		6

The anti-acne gel formulation containing RBLE was tested for pH using universal pH paper with the aim of determining the pH level of the anti-acne gel. The required pH range for skin is 4.5-6.5. Formulation F0 (base without the addition of red betel leaf extract) and F3 had the highest pH at 6 but still fell within the standard pH range. The pH value for formulations F1 and F2 of the anti-acne gel was 5.5. Therefore, it can be concluded that the anti-acne gel containing RBLE has a pH value within the standard range for skin pH.

3.3. Organoleptic Test

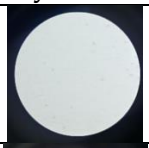
Table 4. Results of Organoleptic Test

Formulation	Organoleptik		
	Consistency	Color	Aroma
F0	Thick	Transparent	Characteristic of Base
F1	Thick	Light Brown	Characteristic of Red Betel Leaf
F2	Thick	Brown	Characteristic of Red Betel Leaf
F3	Thick	Dark Brown	Characteristic of Red Betel Leaf

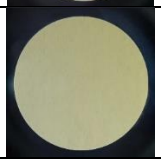
The results of the organoleptic test for the consistency of formulations F0, F1, F2, and F3 showed a thick consistency. The best color among the formulations was observed in formulation F3 (dark brown). Additionally, the most distinctive aroma was found in formulation F3 (characteristic scent of the extract).

3.4. Homogeneity Test

Table 5. Results of Homogeneity Test

Formulation	Analysis Results
F0	
F1	

continued Table 5…

F2	
F3	

The anti-acne gel formulation with RBLE was tested for homogeneity using a microscope to determine the level of homogeneity. The test preparation shows a homogeneous arrangement with no coarse particles present in the preparation. Formulations F0 (base without the addition of RBLE), F1, F2, and F3 showed homogeneity.

3.5. Spreadability Test

Table 6. Results of Spreadability Test of RBLE Anti-Acne Gel

No	Formulation	Spreadability
1	F0	6.1 cm
2	F1	6.7 cm
3	F2	6.3 cm
4	F3	6.8 cm

The anti-acne gel formulation with red betel leaf extract was tested for its spreadability by placing 1 gram of gel in the center of a petri dish, then applying a 150-gram weight and waiting for 1 minute. The spread of the gel was measured by the diameter of the gel spreading from two sides. The ideal spreadability for the formulation is between 5-7 cm. The spreadability of the anti-acne gel in formulation F0 was 6.1 cm, formulation F1 was 6.7 cm, formulation F2 was 6.3 cm, and formulation F3 was 6.8 cm. It can be concluded that the least spreadability was found in formulation F0, while the widest spreadability was found in formulation F3.

4. CONCLUSION

The extract of red betel leaves (Piper crocatum) can be formulated as an anti-acne gel that meets the requirements for anti-acne gel formulations with formulations F1 10%, F2 15%, and F3 20%. Based on the results of the research, discussion, and conclusions outlined above, the formulation with the highest evaluation and in accordance with the standard for anti-acne gel is formulations F2 and F3. Based on the above research results, the researcher suggests for further research to conduct stability testing of the anti-acne gel formulation of RBLE and to add other suitable ingredients for acne facial skin care.

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