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ANTI-ACNE FACIAL WASH FORMULATION FROM RED BETEL LEAF EXTRACT (*PIPER CROCATUM RUIZ & PAV*)

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Abstract

Acne can be caused by dust, sweat, and dirt that stick to the skin, forming blackheads. When blackheads become infected with bacteria, inflammation can occur. Therefore, it is essential to maintain good skin hygiene. One way to do this is by using natural ingredients with antibacterial properties. Red betel leaf is known to have antibacterial activity. This study aims to create a facial wash using red betel leaf extract that exhibits antibacterial properties against Propionibacterium acnes. The red betel leaf was extracted using the maceration method. Antibacterial testing was conducted against Propionibacterium acnes bacteria using the suitable diffusion method with a combination of red betel leaf extract at 10%, 15%, and 20%. The study found that facial wash products containing extract concentrations of 10%, 15%, and 20% demonstrated good physical stability, meeting the requirements of SNI-19-4380-1996 for pH, viscosity, specific gravity, and foam height. Additionally, the products showed potent antibacterial activity against Propionibacterium acnes bacteria, with inhibition zones of 29.0 mm, 32.6 mm, and 35.3 mm for the 10%, 15%, and 20% concentrations, respectively.

Keywords: antibacterial;facial wash;propionibacterium acnes;red betel

Introduction

People in Indonesia from the past until now still use plants as a treatment because they are seen as more secure, and the side effects are much smaller. Red betel leaf is one of the plants that can ensure skin health. Red Betel Leaf *(Piper crocatum Ruiz & Pav)* has antibacterial activity because several compounds work by changing the characteristics of bacterial cell proteins. As a result, the bacterial cell wall's permeability increases, leading to the bacteria's lysis. Red Betel leaf extract contains chemical compounds such as alkaloids, flavonoids, tannins, and essential oils that have potential as antibacterials.[1] These compounds can overcome skin problems that many people experience, namely acne.

Acne can be caused by the formation of excess sebum deposited in the follicles, so the skin pores are clogged with fat deposits. Dust, sweat, and dirt eventually make the fat deposits turn black; otherwise, they are known as blackheads. Blackheads with

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bacterial infection create inflammation, namely acne.[2] *Propionibacterium acnes* is the primary organism in the process of inflammatory lesions in acne, where its growth increases due to increased sebum production. This bacteria must be inhibited to reduce inflammation.[3] Using facial wash, cleaning the facial skin to avoid impurities, sweat, and bacteria. [4,5]

Facial wash or liquid facial soap is a mild facial cleanser and functions to maintain skin hygiene. According to SNI 16-4380-1996 concerning facial skin cleansers, an excellent facial liquid soap must meet the requirements for safe use. They have a good appearance, pH between 4.5-7.8, specific gravity between 0.925-1.05, and viscosity between 3,000-50,000 cps. The public uses liquid soap more widely because it is more effective and practical.[6] Many formulations have been made as ordinary soaps with antibacterial activity.[7–9]

As in Agusta WR's research, an antibacterial liquid soap preparation was made. Red Betel leaf extract inhibited the growth of Staphylococcus aureus bacteria.[10] In Umami Zaitul's research, a liquid soap preparation was made as an antiseptic, and it was found that red betel leaf extract had inhibition against Staphylococcus aureus.[11]

In research conducted by Desmanova et al., solid soap preparations were made, and the results showed that the content of triterpenoid compounds, flavonoids, and tannins showed activity as antibacterials that could fight several gram-positive and harmful bacteria.[1] Also, the research of Syafriana et al. showed the results of ethanol extract of Red Betel leaves having antibacterial activity on Propionibacterium acnes, which was shown through the formation of diameter inhibition (DDH) at concentrations of 10%, 15%, 20%, and 25%. The minimum inhibitory concentration (KHM) test results were 10%.[12]

Based on the above research, Red Betel leaf extract has antibacterial activity and can inhibit bacterial growth. Therefore, this research aims to make a new facial wash formulation from red betel leaf extract that is stable and has antibacterial activity against Propionibacterium acnes.

The results of this study are expected to be useful for researchers and the community. It can add insight and knowledge about the utilization of plants and add to the science in the field of cosmetics and pharmacy about using natural ingredients as anti-acne.

Methods

Instrument

The equipment used in this study were universal pH, vernier, spatel, glass funnel, ose wire, test tube (Pyrex), measuring cup (Pyrex), stirring rod, dropper pipette, Erlenmeyer (Pyrex), analytical balance (Kern®analytical balance), petri dish, incubator (Memmert®), electric stove (Maspion), filter paper, vaporizer cup, viscometer (Brookfield), furnace (Ceramic Fiber Muffle Furnace®), mortar and pestle, autoclave (Allamerican), rotary evaporator (IKA®RV 10 basic), glass jar (Pyrex), water bath (Memmert®), tweezers, micropipette (Microlit), stirrer (Dragon Lab).

Materials

The materials in this study are Red Betel leaves. Aquadest (Daya Chemical), 96% technical ethanol (Daya Chemical), 70% technical ethanol (Daya Chemical), mueller hinton agar (Nitra Kimia), 0.9% physiological NaCl (Daya Chemical), dimethyl sulfoxide (Daya Chemical), olive oil (CV. Medan Kimia), potassium hydroxide 25% (Daya Chemical), sodium carboxyl methyl celulose (Daya Chemical), sodium lauryl sulfate (CV. Medan Kimia), butyl hydroxy anisole (PT. DPH), stearic acid (PT. DPH), citric acid (PT. DPH).

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Test Bacteria

The test bacteria used were *Propionibacterium acnes*, obtained from the Parasitology Laboratory of the Faculty of Medicine, University of Indonesia.

Manufacture of Facial Wash

Table 1. Red Betel Leaf Extract Facial Wash Formula

Materials	Basis	F1 (%)	F2 (%)	F3 (%)
Red betel leaf extract	0	10	15	20
Olive oil	15	15	15	15
KOH	8	8	8	8
Na-CMC	0,5	0,5	0,5	0,5
SLS	0,5	0,5	0,5	0,5
Stearic acid	0,25	0,25	0,25	0,25
BHA	0,5	0,5	0,5	0,5
Aquadest	ad 100 mL	ad 100 mL	ad 100 mL	ad 100 mL

Facial liquid soap begins with manufacturing the soap base; Table 1 shows the best soap base optimized for 28 days and then includes red betel leaf extract with a concentration of 10%, 15%, and 20%. The concentration was obtained from preliminary tests. Furthermore, all ingredients are weighed first. Olive oil is placed in a porcelain petri dish, and potassium hydroxide (KOH) is added to the oil while heated until a soap base is formed. The soap base is added with enough distilled water and Na-CMC, which was previously developed through hot distilled water, stearic acid, SLS, and BHA alternately, by stirring until homogeneous. Next, enter the red betel leaf extract and stir until homogeneous. After homogeneous facial liquid soap, add distilled water to a volume of 100 mL and put it into a container. The preparation of facial liquid soap of red betel leaf ethanol extract is matched through each concentration. Furthermore, the evaluation test of facial liquid soap of red betel leaf ethanol extract was carried out through organoleptic tests, pH, viscosity, specific gravity, and foam height.[13,14]

Evaluation of Preparations

Organoleptic Observation

Organoleptic tests are physical tests of liquid soap, including odor, shape, and color.[15]

pH Measurement

The pH measurement was carried out using a pH meter, weighing as much as 1 g of facial wash with an active substance concentration of 10%, 15% and 20% and then dissolved with 10 ml of distilled water, after which the pH was measured using a pH-meter. The pH of the preparation that meets the criteria for skin pH is 4.5-7.8 (SNI 16-4380-1996).

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Viscosity Measurement

Measurements were made using a Brookfield Viscometer. A preparation of 100 g of liquid facial soap was put into the container, and spindle number 3 was installed at a rotation speed of 10 rpm and then run. Measurements were taken three times for each preparation. The viscosity results were recorded after the viscometer showed a stable number.[15]

Specific Gravity Weighing

The pycnometer was cleaned with acetone, dried, and weighed. Put water into the pycnometer and weigh, then weigh the pycnometer containing the soap.[15]

Foam Height Measurement

Facial wash was taken as much as 1 ml, put into a test tube, then added distilled water to 10 ml, shaken by flipping the test tube, and immediately measured the height of the foam formed.[15]

Antibacterial Activity Testing of Red Betel Leaf Extract Facial Wash

The method used to test antibacterial activity is the well diffusion method. 200 µL of each test bacterial suspension was put into a sterile petri dish, then 20 mL of Mueller Hinton Agar (MHA) medium, which was still liquid and gently homogenized. After the medium had solidified, holes were punched, and the wells were aseptically removed from the petri dish, forming wells used in the antibacterial test. 50 µL of the test sample was added to each well. Petri dishes were incubated at 37℃ for 18-24 hours. The diameter of the inhibition formed in a clear zone around the wells was measured using a caliper.

Results

Table 2. Activity Test Results of Red Betel Leaf Extracts

Bacteria Name	**Concentration**		
	10%	15%	20%
Propionibacterium acnes	29,3 mm	33,0 mm	36,0 mm

Table 3. Organoleptic Evaluation Results

Products	**Odor; Shape; Color**			
	F0	**F1(10%)**	**F2(15%)**	**F3(20%)**
Day 0	TB; K; P	BK; K; HT	BK; K; HT	BK; K; HT
Day 7	TB; K; P	BK; K; HT	BK; K; HT	BK; K; HT
Day 14	TB; K; P	BK; K; HT	BK; K; HT	BK; K; HT
Day 21	TB; K; P	BK; K; HT	BK; K; HT	BK; K; HT
Day 28	TB; K; P	BK; K; HT	BK; K; HT	BK; K; HT

Description:
TB = odorless
BK = smelled distinctive
HT = dark green
K = thick
P = White

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Table 4. Results of pH Evaluation

Preparations	pH				
	Day 0	Day 7	Day 14	Day 21	Day 28
F0	5,65	5,64	5,65	5,6	5,6
F10%	5,52	5,53	5,5	5,5	5,49
F15%	5,51	5,52	5,5	5,51	5,5
F20%	5,48	5,4	5,4	5,41	5,39

Table 5. Viscosity Evaluation Results

Preparations	Viscosity (cps)				
	Day 0	Day 7	Day 14	Day 21	Day 28
F0	3500	3500	3500	3500	3500
F10%	4000	4000	4000	3900	3900
F15%	4600	4600	4600	4500	4500
F20%	5000	5000	5000	4900	4900

Table 6. Specific gravity evaluation results

Preparations	Day 0	Day 7	Day 14	Day 21	Day 28
F0	1,00 g/mL	1,00 g/mL	1,00 g/mL	1,00 g/mL	1,00 g/mL
F10%	1,02 g/mL	1,02 g/mL	1,02 g/mL	1,02 g/mL	1,02 g/mL
F15%	1,02 g/mL	1,02 g/mL	1,02 g/mL	1,02 g/mL	1,02 g/mL
F20%	1,03 g/ml	1,03 g/mL	1,03 g/mL	1,03 g/mL	1,03 g/mL

Table 7. Results of Foam Height Evaluation

Preparations	Day 0	Day 7	Day 14	Day 21	Day 28
F0	3 cm	3 cm	3 cm	3 cm	3 cm
F10%	3 cm	3 cm	3 cm	3 cm	3 cm
F15%	3 cm	3 cm	3 cm	3 cm	3 cm
F20%	3 cm	3 cm	3 cm	3 cm	3 cm

Table 8. Activity Test Results of Anti-acne Facial Wash Preparations of Betel Leaf Extracts

Bacteria Name	Preparations	Zone of Inhibition (mm)
Propionibacterium acnes	F0	-
	F10%	29,3
	F15%	32,6
	F20%	35,3

Discussion

A preliminary test of the activity of ethanol extract of Red Betel leaves (Piper ornatum N.E.Br.) against Propionibacterium acnes bacteria with concentrations of 10%, 15%, and 20% was conducted. The test was conducted triplo; the results (Table 2) showed that the ethanol extract of Red Betel leaves had antibacterial activity with an average inhibition zone diameter of 29.3 mm for 10% concentration, 33 mm for 15% concentration, and 36 mm for 20% concentration. The greater the concentration of the

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extract, the greater the inhibition. This is due to triterpenoid, flavonoid, and tannin compounds that work by changing the characteristics of bacterial cell proteins.[13,16–18] As a result, the bacterial cell wall's permeability increases, leading to the bacteria's lysis.[1] Furthermore, the minimum inhibitory concentration is tested from the results of the lowest concentration with antibacterial activity. The results showed that at concentrations of 1% - 9%, there was bacterial growth. While at a concentration of 10%, there is no bacterial growth. The 10% extract concentration already has antibacterial activity against Propionibacterium acnes bacteria, characterized by the absence of bacterial growth on the media in the cup.[12]

Organoleptic observations were made on the physical appearance of the preparation to determine the absence of changes, including color, odor, and shape.[4] Organoleptic observations (Table 3) show that all formulas, including the F0 and F10%, F15%, and F20% formulas, did not change in color, fragrance, or texture during storage.

The pH test is one of the quality requirements of liquid soap. Liquid soap is in direct contact with the skin and can cause problems if the pH does not match the skin's pH. The amount of alkali in each formula is the same, so the pH meter test uses a universal pH so that the pH test results in the four formulas produced have no difference (Table 4) and meet the requirements of an excellent facial liquid soap.[14]

Viscosity testing was carried out to see the viscosity of soap base preparations and preparations that had been added to various concentrations of extracts during 28 days of storage, measuring viscosity using a Brookfield Viscometer spindle number 3 and a speed of 10 rpm. From the observation results for 28 days, it can be seen that the viscosity (Table 5) of all facial liquid soap formulas increases according to the increase in extract concentration in the formulation. The soap base has the lowest viscosity due to the absence of added extract. Formula 1 has a low viscosity with 10% extract, and Formula 3 has the highest viscosity by adding 20%. However, the face liquid soap of red betel leaf ethanol extract decreased during 28 days of storage and was still within the range of SNI requirements. According to the data obtained, all formulas, either with or without red betel leaf ethanol extract, are by the SNI for facial soap cleansers.[19]

Specific gravity testing was carried out to determine the specific gravity of liquid soap preparations and the effect of the ingredients used in the formulation on the specific gravity of the soap produced. According to SNI, the specific gravity of liquid soap is 0.925-1.05 g/mL. From the observations obtained (Table 6), the specific gravity of the soap base is 1.00 g/mL, the 10% concentration formula is 1.02 g/mL, the 15% concentration formula is 1.02 g/mL, and the 20% concentration formula is 1.03 g/mL. The data is obtained from the average value results so that the 10% formula and 15% formula look like they have the same results. The greater the concentration of extract in each formula, the greater the specific gravity.[20,21] All concentrations have a specific gravity of liquid soap that is by the standards set by SNI.

The foam height test was conducted to see the foam power produced by the liquid soap. From the observation (Table 7), the foam height of the soap base is 3 cm, the 10% formula is 3 cm, the 15% formula is 3 cm, and the 20% formula is 3 cm. The foam height produced by all formulas is the same because the formulation contains foam stabilizers.[22]

The results of testing the antibacterial activity of facial wash with 10%, 15%, and 20% concentration of Red Betel leaves. Shows antibacterial activity with a clear zone around the well. Facial wash with 10% extract concentration provides an inhibition zone of 29.0 mm, 15% extract concentration provides an inhibition zone of 32.6 mm, 20% extract concentration provides an inhibition zone of 35.3 mm, and the base does not provide an inhibition zone. The higher the extract concentration, the greater the inhibition zone produced. This is due to the content of triterpenoid, flavonoid, and tannin compounds that work by changing the characteristics of bacterial cell proteins. As a

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result, the bacterial cell wall's permeability increases, leading to the bacteria's lysis.[1,16] So the higher the extract content in the preparation, the greater the compound content and the more effective it is as an anti-acne facial wash.[1,17,18] The results obtained are categorized as strongly inhibiting because the inhibition zone results are more than 10 mm. No inhibition <6; weak 6-10 mm; moderate 11-20 mm; strong >21-30 mm. The test resulted in a zone of inhibition with a strong inhibition category because the facial wash formulation contains Red Betel leaf extract, which is used as an active substance and has antibacterial activity against Propionibacterium acnes bacteria.[12]

Conclusion

Red betel leaf extract can be made into facial wash preparations with extract concentrations of 10%, 15%, and 20%, which have good physical stability according to the requirements of SNI-19-4380-1996. Based on the results of antibacterial activity tests against Propionibacterium acnes bacteria with extract concentrations of 10%, 15%, and 20%, the inhibition zones produced were 29.0 mm, 32.6 mm, and 35.3 mm, respectively, including in the strong category >21-30 mm.

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