EFFECT OF COCAMIDOPROPYL BETAINE (CAPB) CONCENTRATION ON PHYSICAL CHARACTERISTIC OF BASIL LEAVES (*Ocimum basilicum* L.) ESSENTIAL OIL FACIAL WASH

Vania Santika Putri[1*], Verawati Hadi[1], Anita Dwi Nuryani[1], Ayu Ambarwati[1]
[1]Program Studi Diploma 3 Farmasi, Politeknik Indonusa Surakarta, Indonesia
**Corresponding Email: vaniaputri@poltekindonusa.ac.id*

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ABSTRACT

Atopic dermatitis or often called eczema is a chronic inflammatory skin disorder that often occurs around the face, legs and arms. Decreased skin barrier function can increase the spread of bacteria on the skin surface, especially *Staphylococcus aureus*. This study aimed to formulate facial wash preparations of basil leaf essential oil using varying concentrations of cocamydopropyl betaine (CAPB) as a surfactant and foam booster. The basil leaf essential oil facial wash was formulated into three formulas with varying concentrations of cocamydopropyl betaine (CAPB), namely F1 (8%), F2 (9%), and F3 (10%). Physical evaluation included organoleptic observations, homogeneity, pH, foam height, and viscosity. Based on the results of organoleptic and homogeneity evaluations, the three facial wash formulas are homogeneous, white in color, and have a distinctive basil smell, with an increasingly watery consistency from F1 to F3, while the pH in the range 4.97 - 5.26, the height foam test of the three formulas was 37–42 mm, and the viscosity was in the range of 2647,1 - 3516,5 cPs. Variations in the CAPB concentration used in the facial wash formulas have a significant effect on the resulting pH and viscosity values, where the higher the CAPB concentration used, the lower pH and viscosity values of the facial wash. However, an increase in CAPB concentration in the facial wash formula (8 %, 9 %, and 10 %) did not have a significant effect on the foam height of the basil leaf essential oil facial wash.

Keywords: Facial Wash, Basil Leaf Essential Oil, Cocamydopropyl Betaine

INTRODUCTION

Atopic dermatitis, often called eczema, is a chronic inflammatory skin disorder that is common in children and adults and is characterized by dry skin, itching, and a red rash that comes and goes and generally occurs around the face, legs, and arms (Drucker *et al.*, 2017; Mastraftsi *et al.*, 2022). Patients with atopic dermatitis generally have skin that is relatively drier and more sensitive than normal skin due to damage to the skin barrier. A decrease in skin barrier function can increase the spread of bacteria on the skin surface, especially *Staphylococcus aureus*, which can worsen the disease (Schmid *et al.*, 2022). Therefore, Prevention strategies for patients with atopic dermatitis on their faces should be implemented using an antibacterial preparation such as a facial wash that is practically used daily and does not cause skin irritation and can reduce the spread of *Staphylococcus aureus* bacteria in patients with atopic dermatitis in the face area.

Basil leaves (*Ocimum basilicum* L.) are plants that have great potential for use as antibacterial agents in topical preparations such as facial washes. Basil leaves, belonging to the *Lamiaceae* family, are plants that are easily found in Indonesia and

are often consumed by people as a food ingredient (Kumalasari and Andiarna, 2020). Basil leaves are known to have various pharmacological activities, including antimicrobial, anti-inflammatory, antioxidant, anticancer, immunomodulatory, and antirheumatic activities (Stanojevic *et al.*, 2017; Ahmed *et al.*, 2019; Kumalasari and Andiarna, 2020). The chemical compounds contained in basil include essential oils, flavonoids, flavonol glycosides, fatty acids, and phenolic acids. The essential oil components of basil leaves mainly consist of chavicol, terpenoids, and eugenol (Shahrajabian *et al.*, 2020). The contents of the terpenoids linalool (51.52 - 74.73%) and methyl-chavicol (2.49 - 18.97%) are known to have an important role in the antibacterial activity of basil leaf essential oil (Stanojevic *et al.*, 2017). Basil leaf essential oil is known to have antibacterial activity against *Staphylococcus aureus* and Escherichia coli, with a minimum kill concentration (KBM) of 0.5% v/v and 0.25% v/v (Cahyani, 2014). According to previous research, the use of basil leaf essential oil as an active substance with concentrations of 6% and 8% in gel preparations showed strong antibacterial activity against *Staphylococcus aureus* with a inhibition zone of 10.0 ± 2.25 mm and 12.0 ± 3, respectively (Turrohmah and Shoviantari, 2021). Therefore, basil leaf essential oil can be used as an active substance in facial wash preparations and has the potential to act as an antibacterial agent against *Staphylococcus aureus.*

Basil leaf essential oil has been widely used in the formulation of cosmetic and medicinal preparations such as gels, ointments, creams, lotions, and bath soaps, which have different functions and pharmacological activities. However, there has been no research related to the formulation of antibacterial facial wash preparations that utilize the potential of basil leaf essential oil as an active substance to inhibit the growth of *Staphylococcus aureus* bacteria and do not contain ingredients that can irritate the skin, such as SLS and fragrances. Most facial wash products on the market still use ingredients that irritate the skin, such as sodium lauryl sulfate (SLS) and fragrances, so there is a risk of causing skin irritation and can even increase the severity of atopic dermatitis (Agarwal *et al.*, 2023). Additionally, most face washes can cause facial skin, which can make the skin on the face even drier. The facial wash formulation used in this study used cocamidopropyl betaine (CAPB) as a surfactant and foam booster. CAPB is an amphoteric surfactant that is safer for use in skin-cleansing preparations than SLS. Amphoteric or zwitterionic surfactants such as CAPB have high foam stability and low toxicity to the skin and eyes (Gholami *et al.*, 2018). Therefore, it is necessary to investigate the effect of varying concentrations of CAPB as a surfactant and foam booster on the physical properties of basil leaf essential oil facial wash preparations.

RESEARCH METHODS

Equipment and Materials

Materials

The research materials used include basil leaf essential oil (*Ocimum basilicum* L.) was obtained from Happy Green which already has a Certificate of Analysis (CoA) (211208/177272), stearic acid (Merck), cetyl alcohol (Merck), virgin coconut oil (VCO) (BrataChem), butylated hydroxytoluene (BHT) (Sigma Aldrich), nipagin (Sigma Aldrich), nipasol (Sigma Aldrich), glycerin (BrataChem), propylene glycol (BrataChem), carbopol 940 (Sigma Aldrich), cocamidopropyl betaine (CAPB) (Sigma Aldrich), triethanolamine (TEA) (Merck), Na-EDTA (Sigma Aldrich), citric acid (Sigma Aldrich), aquadest (BrataChem).

Equipment

The equipment used in this research included analytical scales Durascale type JF2004, stopwatches, pH meter Ohause type ST300, waterbath Faithful type DK-98-IIA, and Brookfield viscometer Biobase type NDJ-8S.

Research Procedure

1. Basil Leaf Essential Oil Facial Wash Formula

Table I. Basil Leaf Essential Oil Facial Wash Formula

Component	Formula (%)		
	F1	F2	F3
Basil leaf essential oil	8	8	8
CAPB	8	9	10
Stearic acid	5	5	5
Cetyl alcohol	2,5	2,5	2,5
VCO	2	2	2
BHT	0,05	0,05	0,05
Gycerin	3	3	3
Propylene glycol	15	15	15
KOH	0,8	0,8	0,8
Carbopol 940	0,5	0,5	0,5
Nipasol	0,2	0,2	0,2
Nipagin	0,2	0,2	0,2
TEA	2	2	2
Na-EDTA	0,1	0,1	0,1
Citric acid	2	2	2
Aquadest	Ad 100	Ad 100	Ad 100

Note:
F1 : Facial wash formula with CAPB 8%
F2 : Facial wash formula with CAPB 9%
F3 : Facial wash formula with CAPB 8%

2. Formulation of Basil Leaf Essential Oil Facial Wash

All ingredients were weighed according to three facial wash formulas. Carbopol 940, a gelling agent, was first swollen with warm water and left for 24 hours. Oil phases, such as stearic acid and cetyl alcohol, were placed in a porcelain cup and melted on an electric stove. Subsequently, VCO, nipasol, and BHT were added to the oil phase mixture. The oil phase mixture was sequentially added to the developed carbopol, nipagin, KOH which had been dissolved in distilled water, and TEA in a warm mortar until the mixture was homogeneous. The mixture was then added to CAPB, Na-EDTA, citric acid, and the remaining distilled water, and stirred until homogeneous. The facial wash base mixture was left at room temperature and basil leaf essential oil was added to the facial wash container.

3. Evaluation of Physical Properties of Basil Leaf Essential Oil Facial Wash
   a. Organoleptic Test
      The goal of organoleptic testing is to examine the physical characteristics of the preparation, which are perceptible to the human eye and sense of smell. Three basil leaf essential oil facial wash formulas were evaluated for color, odor, and consistency.
   b. Homogeneity Test
      The homogeneity test was carried out by spreading the facial wash preparation thinly on two pieces of glass and then observing whether coarse grains were present in the thin layer. Facial wash preparations were considered homogeneous if no coarse grains were visible.
   c. pH Measurement

pH measurement aims to determine the degree of acidity or alkalinity of the formulated facial wash preparation. pH measurements were carried out using a previously calibrated pH meter. The measurement was carried out by dipping the pH meter electrode into each facial wash formula, and the pH value of the preparation automatically appeared on the pH meter.

d. Height of Foam Test
The purpose of the foam test is to determine whether face wash preparation can produce foam. The test was carried out by dissolving 1 gram of the preparation in 10 mL of distilled water in a test tube, followed by shaking until foam formed, and leaving it for approximately 15 minutes. Next, the foam height was measured.

e. Viscosity Test
The viscosity test aims to determine the consistency of the facial wash preparation, which influences the ease of pouring during the application. Viscosity testing was carried out using a Brookfield viscometer by placing the preparation in a glass beaker and then measuring the viscosity of the preparation using spindle number 3.

DATA ANALYSIS

Analysis of organoleptic and homogeneity data in this study was carried out descriptively, while pH, height of foam, and viscosity data were analyzed using the *Statistical Program for Social Science* (SPSS) software.

RESULTS AND DISCUSSION

1. Organoleptic Test

The organoleptic test was carried out visually using human senses. The aspects observed included the color, smell, and texture of the facial wash preparation. The organoleptic observations of basil leaf essential oil facial wash preparations are presented in **Table II**.

Table II. Organoleptic Test Results for Facial Wash Basil Leaf Essential Oil

Formula	Hasil Uji Organoleptik		
	Color	Smell	Consistency
F1	White	Typical basil essential oil	Semi-solid liquid
F2	White	Typical basil essential oil	Semi-solid liquid
F3	White	Typical basil essential oil	Semi-solid liquid

Organoleptic observations of the three formulas for facial washes with the essential oil of basil leaves indicate that the preparations have a similar color and scent, both white and distinct from basil. This is because ingredients other than CAPB are used in the formulations, along with the same concentration of essential oil. CAPB is an amphoteric surfactant with a generally colorless clear liquid (Gholami *et al.*, 2018). Therefore, increasing the concentration of CAPB in the facial wash did not result in a significant color change in the preparation. The texture of the facial wash preparation showed a decrease in consistency and viscosity from F1 to F3 due to the increase in the CAPB concentration used.

2. Homogeneity Test

The purpose of the homogeneity test was to determine whether the final preparation was homogeneous, as demonstrated by the homogeneous color and lack of coarse grains

(Turrohmah and Shoviantari, 2021). The results of the homogeneity test for the facial wash preparations of basil leaf essential oils are shown in **Table III**.

Table III. Results of Homogeneity Test for Basil Leaf Essential Oil Facial Wash

Formula	Homogeneity Result	Note
F1	Homogeneous	There are no coarse grains and homogeneous color
F2	Homogeneous	There are no coarse grains and homogeneous color
F3	Homogeneous	There are no coarse grains and homogeneous color

Based on the results of the homogeneity evaluation carried out on all basil leaf essential oil facial wash formulas, it is evident that all formulas, F1, F2, and F3, are homogeneous, characterized by the absence of grains or coarse particles in the facial wash preparations, and the color of the resulting preparations is even and homogeneous. These findings demonstrate that a uniform face wash preparation may be performed despite the variations in the CAPB concentration in each formula, which were 8%, 9%, and 10%.

3. pH Measurement

The purpose of pH testing is to determine the acidity and alkalinity levels of the facial wash preparation that has been made, in order to determine the safety of the preparation when applied to facial skin. The results of the pH measurement for the basil leaf essential oil facial wash preparation are shown in Figure 1.

Based on the pH measurement results, all basil leaf essential oil facial wash

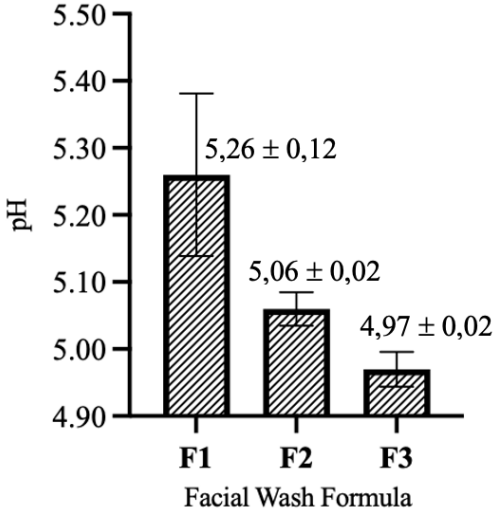

Figure 1. pH Measurement Results for Basil Leaf Essential Oil Facial Wash Preparations

formulas had a pH in the range of 4.97 – 5.26. This demonstrates that the facial wash preparation made from basil leaf essential oil meets the skin's pH requirements, which range from 4.5 to 6.5 (Turrohmah and Shoviantari, 2021). pH is an important parameter in making topical preparations, if the pH of the preparation is too high it can cause the skin to become drier and scaly, whereas the pH of the preparation is too low compared to the pH of the skin it can cause skin irritation (Marlina, 2020). In addition, human skin generally has a relatively acidic pH, which is an important factor in protection against microorganisms, and the soap preparation used can neutralize the body's protective coat, which acts as a barrier against bacteria (Tarun *et al.*, 2014). Facial cleansing preparations, such as facial washes that are too alkaline, can damage the acid mantle and disrupt the lipid lamellae in the epidermal layer of the skin. These disorders can cause skin dryness due to high trans-epidermal water loss, which can increase the risk of irritation and allergies (Mendes *et al.*, 2016).

The pH measurement results of the three basil leaves essential oil facial wash formulas showed a decrease from F1 to F3. This was because of the increasing concentration of CAPB used from F1 to F3. Based on the results of the statistical analysis, the pH measurement results of the three facial wash formulas using one-way ANOVA showed a sig. 0.008 (<0.005), which means that variations in the CAPB concentration used in the basil leaf essential oil facial wash formula had a significant effect on the pH value of the three facial wash preparation formulas. The higher the concentration of CAPB used in the facial wash, the lower the pH of the preparation.

4. Height of Foam Test

The foam height test was performed to determine the ability of the facial wash to produce foam. The height of foam is one of the important parameters in evaluating facial wash preparations, because generally, the presence of foam produced in facial wash preparations is preferred by consumers or the community. The results of the facial wash foam test for basil leaf essential oil are shown in Figure 2.

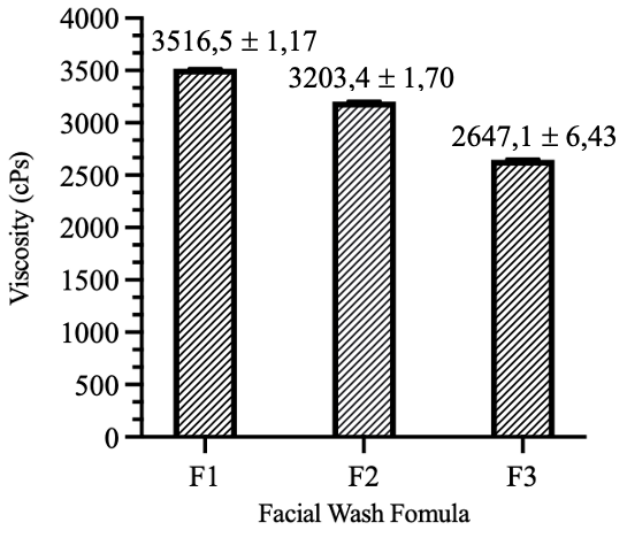

Figure 2. Foaming Power Test Results for Basil Leaf Essential Oil Facial Wash Preparations

Based on the results of the evaluation of foam height, all the facial wash formulas of basil leaves had foam heights in the range of 37–42 mm. This showed that all facial wash formulas, F1, F2, and F3, met the height of foam requirements according to the SNI, which is 13–220 mm (SNI, 1996). The height of the foam produced by the three

facial wash formulas increased from F1 to F3, although the value was not significant. The increase in foam in facial wash preparations was influenced by the addition of CAPB as a surfactant. In addition to lowering the interfacial tension between the oil and water phases, the CAPB surfactant serves as a foam booster in face wash preparations by enhancing foaming power (Marhaba *et al.*, 2021). Statistical analysis performed using the one-way ANOVA test yielded a significance value of 0.652 (>0.05), which indicated that there was no significant difference in the foaming power of the three facial wash formulas. Increasing the CAPB concentration used in the formula (8%, 9%, and 10%) did not significantly affect the foaming power produced by the three basil leaf essential oil facial wash formulations.

5. Viscosity Test

The viscosity test aims to determine the viscosity level of the facial wash preparation, which affects the ease of preparation to be poured when applied. The viscosity test results for the basil leaf essential oil preparations are shown in Figure 3.

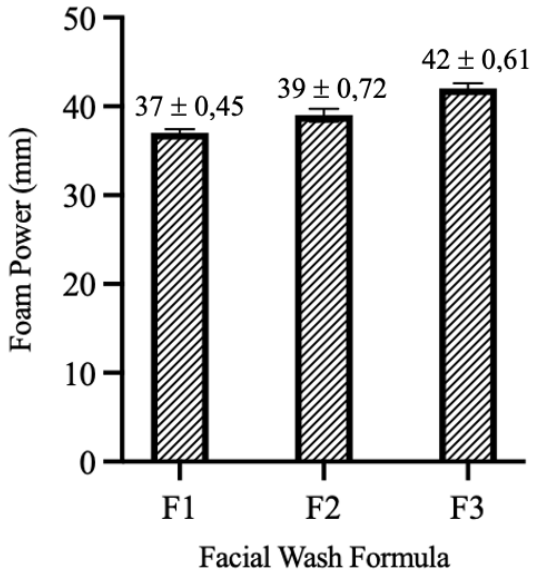

Figure 3. Basil Leaf Essential Oil Facial Wash Viscosity Test Results

Based on the results of the viscosity test, the three basil leaf essential oil facial wash formulas were in the range 2647.1 - 3516.5 cPs. These results indicate that the viscosity of the three facial wash formulas meet the viscosity requirements for liquid soap preparations because they have viscosity values in the range of 500-20,000 cPs (Komala *et al.*, 2020). Increasing the concentration of CAPB used in the facial wash formula causes a decrease in the viscosity of the preparation, so that the consistency of the resulting facial wash becomes thinner. This could be because CAPB is a surfactant that is presented in the form of a clear liquid; therefore, if the concentration used is greater, it can cause the viscosity of the preparation to decrease. Statistical analysis using the Kruskal–Wallis test showed a significance value of 0.027 (<0.05), which indicates that there is a significant difference between the viscosity values of the three facial wash formulas. Increasing the CAPB concentration (8%, 9%, and 10%) used in the facial wash has a significant effect on the viscosity values produced by the three basil leaf essential oil facial wash preparation formulas.

CONCLUSION

All basil leaf essential oil facial wash formulas formulated with varying concentrations of CAPB, namely F1 (8%), F2 (9%), and F3 (10%), met all physical test parameters of the preparation, including organoleptic tests, homogeneity, pH, height of foam, and dosage viscosity. Variations in the CAPB concentration used in the facial wash formula have a significant effect on the resulting pH and viscosity values; the higher the CAPB concentration used, the lower the pH and viscosity of the facial wash preparation. However, an increase in CAPB concentration in the facial wash formula did not have a significant effect on the foaming power of basil leaf essential oil facial wash preparations.

SUGGESTION

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