Indonesian Journal of Cosmetic
E-ISSN: 3026-3352

Effect of Various Concentration on Physical Parameter of Feminine Hygiene Sweet Basil Leaf Extract (*Ocimum Basilicum*) : Foam Stability and Height Evaluation Studies

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ABSTRACT
Sweet basil or Kemangi (*Ocimum basilicum*) is known not only for its distinct aroma or flavor but also its therapeutic potential. Due to phytochemical ingredients, sweet basil has become a promising material for cosmetics and personal care industries such as feminine hygiene. This study aims to investigate the effect of various concentrations on foam stability from sweet basil leaf extract feminine hygiene. Simplisia was extracted using Ultrasonic Assisted Extraction and formulated into feminine hygiene with various extract concentrations from 20%, 25%, 30%, 35% and 40% w/v. Each formula was evaluated on height evaluations and foam stability using simple measurement, analyzed with Kruskal-Wallis test and Mann-Whitney test, respectively. The results were statistically significant (P value < 0.05) for each parameter between formula I (20%) and formula III (30%). These findings suggest that various concentrations of kemangi extract can be optimized to maintain the parameters.
Key words: sweet basil, feminine hygiene, foam stability, foam height evaluation

INTRODUCTION

Sweet basil (*Ocimum basilicum*), known locally as kemangi, is one of Indonesia's traditional medicinal plants and has shown promising potential in the cosmetics and personal care industry. It contains eugenol, flavonoids, and saponins, which contribute to its antimicrobial and antifungal properties (Mei et al., 2020). Flavonoids are known to inhibit the growth of *Candida albicans*, a common fungal pathogen that causes vaginal infections (Cindy, 2017). Due to its rich content of bioactive compounds, sweet basil holds significant potential for development in feminine hygiene products.

According to data from the Indonesian Food and Drug Authority (BPOM), the number of registered feminine hygiene products made from natural ingredients, specifically

those containing sweet basil extract-remains limited. Out of a total 394.936 products with keyword '*sabun kewanitaan*' none contain sweet basil extract or '*kemangi ekstrak'* (cekbpom.go.id). It's a great opportunity to develop feminine hygiene containing sweet basil extract. Generally, the quality of these products (feminine hygiene) is assessed not only based on their antibacterial activity but also on physical parameters such as foam height and foam stability. These two parameters serve as key indicators of cleansing effectiveness. Adequate foam height reflects the surfactant's ability to generate sufficient cleansing action, while foam stability indicates the durability of foam during application, particularly in humid or sensitive areas (Rosmaniar et al., 2021).

Based on limited availability of natural-based feminine hygiene products in the current market, coupled with promising bioactive potential of *Ocimum basilicum* and importance of ensuring quality parameters, this study was conducted to investigate the foam stability and foam height of feminine hygiene products and evaluate the statistical significance between each formulation.

MATERIAL AND METHODS

This research aimed to examine the effect of various concentrations of sweet basil leaf (Ocimum basilicum) extract on the foam height and stability of feminine hygiene. This research involved several stages, including formulation development, sweet basil leaf extraction, phytochemical screening, cleaning of tools and material, feminine hygiene preparation, and testing of foam height and stability. These steps were carried out to determine whether variations in extract concentration had a significant effect on the performance of the feminine hygiene.

Material

The equipment used in this research included an evaporating dish, parchment paper, test tubes (pyrex), digital scales, measuring cylinders (pyrex), spatula, beakers (pyrex), glass stirring rod, water bath, dropper, stove, blender, and ultrasonic devices.

The material used consisted of sweet basil leaf extract (Ocimum basilium), propylene glycol, (PT. Brataco), Sodium lauryl sulfate (Barca Medica), cetyl alcohol (Multi Ja Kimia x Malaysia), Adeps lanae (Kimia Jaya Abadi), Cera flava (PT. Brataco), citric acid (Kimia Market), distilled water (Poltekkes Tanjung Karang), and 96% ethanol (Ir Kimia).

Methods

Formulation Design

Table 1. Formulation design (Trilestari et al., 2016)

Material	F0 (base)	F1 (20%)	F2 (25%)	F3 (30%)	F4 (35%)	F5 (40%)
Sweet Basil leaf extract	0	3 g	3.75 g	4.5 g	5.25 g	6 g
Propylene glycol	0.6 g	0.6 g	0.6 g	0.6 g	0.6 g	0.6 g
Sodium lauryl sulfate	1.5 g	1.5 g	1.5 g	1.5 g	1.5 g	1.5 g
Cetyl alcohol	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g
Adeps lanae	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g
Cera flava	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g
Citric acid	0.0375 g	0.0375 g	0.0375 g	0.0375 g	0.0375 g	0.0375 g
Distilled water	15 ml	15 ml	15 ml	15 ml	15 ml	15 ml

Preparation of Simplicia

Fresh sweet basil leaves were collected from the local market in Way Kandis. The leaves were separated from the stems and washed thoroughly under running water to remove any adhering dirt or impurities. The cleaned samples were then dried under direct sunlight for two days as part of the sun drying process. Once dried, the leaves underwent a dry sorting process to remove any remaining undesirable materials. The dried simplicia was subsequently stored in a sealed container under appropriate conditions until further use.

Preparation of Simplicia

A total of 500 grams of dried sweet basil simplicia was weighed. The sample was macerated using 96% ethanol as the solvent, in a ratio of 7.5 times the weight of the simplicia. The mixture was then placed in an ultrasonic bath for 45 minutes at room temperature. After sonication, the extract was filtered using filter paper to separate the liquid extract from the residue. The resulting filtrate was transferred into a beaker glass and concentrated using a water bath to obtain a thick extract.

Qualitative analysis of Flavonoids

A qualitative analysis for flavonoid content was performed using colorimetric method. Approximately 10 mg of sweet basil leaf extract was dissolved in 5 mL of ethanol, followed by the gradual addition of ferric chloride ($FeCl_3$) solution. The formation of a color change, which may appear as blue, purple, green, red, or black, was interpreted as a positive indication of the presence of flavonoid compounds. If no visible color change was observed after the addition of up to 20 drops of $FeCl_3$ solution, the sample was considered negative for flavonoids (Indonesian Journal for Health Sciences, 2020).

Qualitative analysis of Saponin

A total of 0.5 grams of sweet basil leaf extract was mixed with 5 mL of distilled water and vigorously shaken. The presence of saponins was indicated by the formation of a stable froth or foam on the surface of the solution (Indonesian Journal for Health Sciences, 2020).

Qualitative analysis of Alkaloid

The presence of alkaloid compounds was qualitatively assessed using Dragendorff's reagent. A measured 0.5 g of *Ocimum basilicum* extract was solubilized in 5 mL of distilled water and subjected to filtration. Subsequently, 2 mL of the filtrate was treated with several drops of Dragendorff's reagent. The emergence of an orange to reddish-brown precipitate was interpreted as a positive indication of alkaloidal constituents, consistent with previously established methodologies (Gul et al., 2017).

Qualitative analysis of Tannin

Tannin constituents were evaluated through a ferric chloride reaction. A total of 0.5 g of the plant extract was suspended in 5 mL of distilled water and filtered. To 2 mL of the resulting solution, a few drops of 1% $FeCl_3$ were added. The development of a blue-black or green-black coloration signified a positive response, indicative of hydrolyzable and condensed tannins (Ammar et al., 2020).

Qualitative analysis of Polyphenol

Polyphenolic content was determined using a colorimetric assay based on iron complexation. Two milliliters of extract solution were mixed with 2 mL of 1% $FeCl_3$

solution. The appearance of a dark green, bluish, or purplish hue was considered a positive reaction for the presence of polyphenolic groups (Ammar et al., 2020; Gul et al., 2017).

Qualitative analysis of Triterpenoid

Triterpenoid compounds were identified through the Liebermann–Burchard reaction. A sample of 0.5 g of the extract was dissolved in 2 mL of chloroform, followed by the addition of 2 mL of acetic anhydride. Then, 1–2 drops of concentrated sulfuric acid were carefully layered. The formation of a reddish-brown or purplish interface was indicative of the presence of triterpenoids, as per standard qualitative screening protocols (Herawati et al., 2021).

Qualitative analysis of Steroid

Steroidal constituents were detected using the classical Salkowski test. Approximately 0.5 g of the extract was dissolved in 2 mL of chloroform. To this, 2 mL of concentrated sulfuric acid was added along the inner wall of the test tube to form two layers. The appearance of a reddish, brown, or greenish ring at the interphase was taken as a presumptive indicator of steroidal compounds (Herawati et al., 2021).

Preparation of feminine hygiene Formulation

The oil phase, consisting of Adepts lanae, cera flava, and cetyl alcohol, was combined and melted. Separately, the aqueous phase, composed of sodium lauryl sulfate, propylene glycol, and a portion of distilled water, was also heated until fully dissolved. The melted oil phase was transferred into a mortar, and the aqueous phase was gradually added while continuously stirring at high speed to form an emulsion. Additional distilled water was slowly incorporated until the total volume reached 15 mL. Citric acid, pre dissolved in distilled water, was then added to adjust the pH to a range of 3–4. Finally, the sweet basil leaf extract was incorporated, and the mixture was stirred until a homogeneous formulation was achieved.

Evaluation of Foam Height and Stability

A test tube containing 10 mL of distilled water was prepared. Then, 1 mL of the feminine hygiene sample containing sweet basil leaf extract was added to the tube. The mixture was shaken vigorously for 20 seconds, and the initial foam height was measured using centimeters ruler immediately. After 5 minutes, the foam height was measured again to assess foam stability. Measurements were performed in ten replicates, and the results were expressed as mean ± standard deviation. The data were subsequently analyzed using appropriate statistical methods (Kruskal Wallis and Mann-Whitney).

RESULT AND DISCUSSION

Sweet basil leaves were extracted using 96% ethanol as the solvent through an ultrasonic-assisted extraction method at 40°C for 60 minutes. The process resulted in a yield of 8.8%, which does not meet the minimum yield requirement set by the Herbal Pharmacopoeia Indonesia Standard (yield more than 10%). To assess the success of the extraction, qualitative phytochemical screening was performed to identify the presence of secondary metabolites. The extract tested positive for both flavonoids and saponins, suggesting that the process was effective in isolating these bioactive compounds. Flavonoids are recognized for their antifungal activity, while saponins function as natural surfactants—both of which support the potential application of sweet basil extract in personal care product formulations. Other secondary metabolites were not examined, as this study specifically focused on the antifungal properties of flavonoids for the development of feminine hygiene and the role of saponins as surfactants in foam formation.

Foam formation was evaluated based on two key parameters: foam height and foam stability. Statistical analysis was conducted using Minitab software, employing the Kruskal–Wallis test for foam height evaluation and Mann-Whitney test for foam stability to assess the significance of differences among the formulations. The results indicated that variations in extract concentration had a significant effect on foam height, with a p-value of less than 0.05, confirming a statistically significant difference between the formulations. The result is shown in the table below.

Table 2. Kruskal Wallis Test for Foam Height Evaluation

Method	DF	H-value	P-value
Not adjusted for ties	5	30,05	0,000
Adjusted for ties	5	33,70	0,000

Table 3. Mann - Whitney for Foam Stability Fo

Method	H-value	P-value
Not adjusted for ties	124,00	0,0162
Adjusted for ties	124.00	0,0147

Table 4. Mann - Whitney for Foam StabilitY FI

Method	H-value	P-value
Not adjusted for ties	133,00	0,038
Adjusted for ties	133,00	0,033

Table 5. Mann-Whitney for Foam Stability FII

Method	H-value	P-value
Not adjusted for ties	177,00	0,385
Adjusted for ties	177.00	0,379

Table 6. Mann-Whitney for Foam Stability FIII

Method	H-value	P-value
Not adjusted for ties	146,00	0,002
Adjusted for ties	146.00	0,001

Table 7. Mann-Whitney for Foam Stability FIV

Method	H-value	P-value
Not adjusted for ties	127,00	0,104
Adjusted for ties	127.00	0,098

Table 8. Mann-Whitney for Foam Stability FV

Method	H-value	P-value
Not adjusted for ties	128,00	0,089
Adjusted for ties	128.00	0,084

The purpose of the foam stability test is to assess the ability of foam to remain intact over time, as an indicator of surfactant performance. The test is conducted by measuring the height of foam in a calibrated test tube and observing how much foam volume is retained after a specific period. Foam stability is defined as the percentage of the initial foam volume that remains after five minutes, reflecting the resistance of bubbles to collapse. According to Dragon et al. (1969), foam is considered stable if it retains between 60% and 70% of its initial volume after five minutes. Based on observational data and calculations, the foam stability values for formulations FIII, FIV, and FV were 97.12%, 91.08%, and 95.09%, respectively, while formulations FI and FII showed values of 92.67% and 91.98%. All five formulations met the minimum foam stability requirement, demonstrating good foam retention characteristics.

The observed foam stability across all formulations can be attributed to the physicochemical characteristics of the surfactants and their interaction with other formulation components. Although foam is inherently unstable and tends to collapse over time, its persistence is influenced by several factors, including surfactant concentration, temperature, salinity, and the presence of oils or other additives. In this study, the high foam stability observed—exceeding 90% in all tested formulations—suggests that the surfactant system was effective in maintaining bubble integrity over the five-minute evaluation period. This finding aligns with Belhaj (2014), who reported that increased surfactant concentration generally enhances foam stability by reducing surface tension and reinforcing the liquid film around bubbles. Additionally, the absence of destabilizing agents, such as high oil content, may have further contributed to the high foam retention observed in the formulations.

The high foam stability observed in all formulations may be attributed not only to the concentration of saponins but also to their inherent amphiphilic structure, which enables them to function as natural surfactants. Saponins consist of a hydrophobic aglycone (sapogenin) core and one or more hydrophilic sugar chains. In aqueous environments, these molecules orient at the air–water interface, effectively reducing surface tension and facilitating the formation of stable foam films. Additionally,

saponins can form micellar aggregates that entrap air, contributing to both foam generation and stabilization (Cheok et al., 2014; Price et al., 1987).

Although flavonoids are not classically surface-active, they may indirectly enhance foam properties. Owing to their polyphenolic structure, flavonoids can form hydrogen bonds with hydroxyl groups present in saponins or with surrounding water molecules within the foam matrix. These interactions may reinforce the interfacial film surrounding air bubbles, thereby increasing its cohesiveness and elasticity. Furthermore, π–π stacking between the aromatic rings of flavonoids may contribute to stabilizing the microstructure of the foam (Aguiar et al., 2013; Xie et al., 2015).

The proposed mechanism thus involves: (1) adsorption of saponin molecules at the gas–liquid interface to create a surfactant film, (2) micelle formation that captures air bubbles, and (3) hydrogen bonding and π–π interactions involving flavonoids that strengthen the film and resist bubble coalescence. These synergistic molecular interactions underpin the high foam stability observed across the tested formulations.

CONCLUSION

This study demonstrated that varying concentrations of *Ocimum basilicum* leaf extract significantly influenced the foam height and stability of feminine hygiene formulations. Among the tested formulations, FI and FIII showed statistically significant differences, while F_0, FII, FIV, and FV exhibited no significant variation. These findings suggest that the functional properties of the product can be optimized through precise control of extract concentration. The incorporation of *O. basilicum* extract offers a promising approach for developing plant based, eco friendly personal care products with enhanced performance characteristics. Further investigations are recommended to isolate the active constituents responsible for these effects and to evaluate their long term stability and dermatological safety in commercial formulations.

ACKNOWLEDGEMENT

The authors would like to thank the Department of Cosmetics Engineering, Institut Teknologi Sumatera, South Lampung, Lampung, and the Akademi Farmasi Cendikia Farma Husada, Bandar Lampung, Lampung, for their support and collaboration in facilitating this research.

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