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Formulation and Stability Evaluation of Natural Shower Gel Containing Piper Betle Hydrosol and Whiteten™

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ABSTRACT

The growing interest in natural-based personal care products has encouraged the development of innovative cosmetic formulations, including shower gels. This study aimed to formulate and evaluate the physical stability of a shower gel containing *Piper betle* L. leaf hydrosol and WhiteTen™, a botanical-derived brightening complex. The product was prepared through a four-phase process using ingredients such as Sodium Laureth Sulfate, Cocamidopropyl Betaine, PEG-40 Hydrogenated Castor Oil, Menthol, and preservatives, with the pH adjusted to 5.5–6.5. The formulation was evaluated for its organoleptic properties, pH, viscosity, spreadability, rinseability, foam height, and stability under accelerated storage conditions using six temperature cycling periods. The results showed that the shower gel demonstrated stable physical characteristics, including suitable viscosity, good foaming capacity (60 - 80 mm), ease of rinsing (10 seconds), and consistent pH values across different storage temperatures. The incorporation of WhiteTen™ contributed to the product's brightening potential, enhancing its value as a multifunctional cosmetic. No significant changes were observed in physical appearance or performance after stability testing, indicating that the formulation is stable and suitable for further development as a safe, natural, and functional skincare product.

Key words: Shower gel, *Piper betle*, WhiteTen, formulation, stability evaluation.

INTRODUCTION

The skin is one of the most vital organs of the human body, serving as the primary barrier against various external disturbances and stimuli (Tranggono & Latifah, 2007). As the first line of defense against pathogens, maintaining skin health is essential to prevent infections. Skin infections may be caused by bacteria, viruses, fungi, protozoa, and other minor groups such as mycoplasma, rickettsia, and chlamydia. Among these microorganisms, Staphylococcus aureus is the most dominant bacterium found on human skin (Notobroto et al., 2005). According to Madigan, S. aureus is associated with several conditions including boils, acne, pneumonia, meningitis, and arthritis. Most infections caused by S. aureus are characterized by pus formation (Dimpudus, 2017).

In recent years, the "back to nature" lifestyle has become increasingly popular, as public trust in natural ingredients has grown due to their perceived safety compared to synthetic chemicals. Indonesia's rich biodiversity supports the development of cosmetic and skincare products based on natural ingredients (Zelika et al., 2018).

Betel leaf (*Piper betle* L.) is a traditional medicinal plant that has long been used in Indonesian herbal remedies, particularly its leaves (Anggun, 2021). According to Akbar et al. (2019), betel leaf contains various active compounds such as saponins, flavonoids, tannins, and triterpenoids. Flavonoids are known to damage bacterial cell membranes irreversibly (Anggun, 2021), while phenolic compounds in green betel leaves can denature bacterial proteins and increase microbial membrane permeability (Loisa, 2019).

WhiteTen™ is a natural-based skin-brightening active ingredient formulated from a combination of plant extracts. It is designed to deliver brightening effects through safe and non-irritating biological mechanisms. Its composition includes ten bioactive agents such as niacinamide, acetyl glucosamine, Centella asiatica extract (containing madecassoside), Morus alba bark extract, Camellia sinensis leaf extract, and Pyrus malus fruit extract. These compounds act synergistically to inhibit skin pigmentation, reduce inflammation, and gradually enhance skin brightness (BioSpectrum, 2022).

One of the cosmetic dosage forms that can be used to maintain skin health is soap. Soap is a cleansing formulation derived from the reaction of a weak acid and a strong base, used to remove oils and dirt (Hernani, 2010). Depending on their function and physical form, soaps may include hand soap (liquid), laundry soap (cream or powder), body soap (solid or liquid), and household cleaning soap (Wijana et al., 2005).

Liquid soap offers several advantages over solid soap, such as consumer preference and easier, more profitable manufacturing processes. With the increasing diversity of ingredients used in soap formulations, manufacturers are striving to develop products that are economical, hygienic, safe for health, easy to produce, readily available, and have good market value. In addition to using natural and safe ingredients, liquid soaps are often designed to provide added benefits such as a soft skin feel, moisturizing effects, antibacterial activity, and pleasant fragrance during use (Rosmainar, 2021).

Physical stability testing of a formulation is essential to ensure that the product retains its quality parameters during storage. Physical instability in liquid soap formulations is indicated by phase separation (coalescence) and other physical changes. To assess formulation stability in a shorter time frame, accelerated stability testing—such as the cycling test—can be employed (Sativareza et al., 2021).

Based on the aforementioned background, this study aims to investigate whether a combination of betel leaf extract and WhiteTen™ can be formulated into a stable liquid body soap, and to evaluate its physical stability. The findings of this research are expected to contribute to the development of cosmetic products that are natural, safe, and aligned with the preferences of modern consumers.

MATERIAL AND METHODS

Material

The ingredients used in the formulation of this shower gel were: distilled water (aquadest, pharmaceutical grade), disodium ethylenediaminetetraacetic acid (Na_2EDTA, technical grade), allantoin (technical grade), betel leaf (*Piper betle* L.) hydrosol (cosmetic grade), sodium laureth sulfate (SLES, cosmetic grade), cocamidopropyl betaine (CAPB, cosmetic grade), Comperlan® (cocamide DEA, cosmetic grade), PEG-40 hydrogenated castor oil (cosmetic grade), menthol (cosmetic grade), WhiteTen™ (cosmetic active), fragrance (IFRA-compliant, cosmetic grade), DMDM hydantoin (preservative, cosmetic grade), and citric acid (cosmetic grade).

Methods

Preparation of Shower Gel

The shower gel formulation was carried out in four main phases. In the aqueous phase, 59.00 g of distilled water was placed in a clean beaker and stirred using a magnetic stirrer. Disodium EDTA (0.10 g) and allantoin (0.30 g) were added sequentially, with moderate stirring and gentle heating at 40–50 °C to ensure complete dissolution. Once dissolved, 1.00 g of *Piper betle* leaf hydrosol was added and stirred until homogeneous. In the surfactant phase, 13.00 g of sodium laureth sulfate was added slowly to minimize foaming, followed by 17.00 g of cocamidopropyl betaine and 3.00 g of Comperlan®, with continuous stirring until a uniform mixture was obtained. The active and additive phase was prepared separately by dissolving 1.00 g of menthol in 1.00 g of PEG-40 hydrogenated castor oil, then incorporating it into the main formulation. This was followed by the addition of 1.00 g

WhiteTen™ and 1.00 g Preal Consentrat, mixed thoroughly until uniform. In the final phase, 0.40 g of DMDM hydantoin was added as a preservative. The pH was then adjusted to the target range of 5.5–6.5 using either 10% citric acid or 10% sodium hydroxide. After allowing the foam to settle, sodium chloride (up to 2%) was added gradually if necessary to adjust the viscosity. The completed formulation was stored in a sealed container for further evaluation.

Table 1. The Formula of *Piper betle* L. Shower Gel

Ingredient	Function	Concentration (% w/w)
Aqueous Phase		
Distilled Water (Aquadest)	Solvent	59.10
Disodium EDTA (Na_2EDTA)	Chelating agent	0.10
Allantoin	Skin soothing agent	0.30
Piper betle Leaf Hydrosol	Natural antibacterial agent	1.00
Surfactant Phase		
Sodium Laureth Sulfate (SLES)	Primary surfactant	13.00
Cocamidopropyl Betaine (CAPB)	Co-surfactant	17.00
Comperlan®	Foam stabilizer	3.00
Active and Additive Phase		
PEG-40 Hydrogenated Castor Oil	Solubilizer/emulsifier	1.00
Menthol	Cooling agent	1.00
WhiteTen™	Skin brightening agent	1.00
Fragrance	Perfume	1.00
Preal Consentrat	Conditioning agent	1.00
Preservative and Final Adjustment		
DMDM Hydantoin	Preservative	0.50
Citric Acid (10% solution)	pH adjuster	q.s. to pH 5.5–6.5

Physical Evaluation of the Show Gel Formulations

The physical properties of the shower gel formulation were evaluated through several tests, including organoleptic observation (color, odor, and consistency), pH measurement, viscosity test, spreadability test, rinsability test, and stability assessment.

Organoleptic Evaluation

Organoleptic evaluation was conducted by visually and olfactorily observing 0.5 g of serum placed on a clean watch glass. Parameters assessed included color, odor, texture, and taste, which are essential for determining consumer acceptability (Kumar et al., 2021).

pH Measurement

The pH was measured using universal pH strips by diluting 1 g of serum in 10 mL distilled water. The pH value was compared to a standard chart, and values between 4.5 and 6.5 were considered suitable for topical application (Abd et al., 2020).

Viscosity Measurement

Viscosity was measured using a Brookfield Viscometer (NDJ-8S) at 25 ± 2 °C, with spindle no. 64 at 100 rpm. Approximately 30 mL of each serum was analyzed, and viscosity was expressed in millipascal-seconds (mPa·s) (Rahman et al., 2022).

Spreadability Test

Spreadability was evaluated by sandwiching 0.5 g of serum between two glass plates and placing a 125 g weight on top. After 1 minute, the diameter of the spread serum was measured in two perpendicular directions and averaged (Sahoo et al., 2019).

Foam Height Test

The foam height test was conducted to evaluate the foaming ability and stability of the liquid soap formulation. A total of 1 mL of the shower gel was placed into a test tube, followed by the addition of 5 mL of distilled water. The mixture was then shaken vigorously by hand for 20 seconds. The resulting foam height was measured using a ruler and expressed in millimeters (mm). A good foam height for liquid soap formulations typically ranges between 13 and 220 mm (Siregar et al., 2021).

Rinsability Test

The rinsability test aims to evaluate the ease with which the formulation can be removed from the skin surface after application, reflecting user comfort and water usage efficiency during use. Following the spreadability test, the area of skin covered with the shower gel was rinsed under running water at room temperature. The time required for the formulation to be completely removed from the skin surface was recorded using a stopwatch (Rieger, 1997).

Stability Test

Stability testing was conducted by storing the samples under two controlled temperature conditions: low temperature (4–8 °C) in a refrigerator and high temperature (40 °C) in an incubator oven. Each cycle consisted of 24 hours at low temperature followed by 24 hours at high temperature. This cycle was repeated for six consecutive times, resulting in a total testing period of 12 days. Parameters observed during and after each cycle included changes in color, odor, homogeneity, pH, and viscosity. This method follows the accelerated stability protocol known as the cycling test, which is commonly used to predict the physical stability of cosmetic and pharmaceutical preparations in a shorter time frame (Siregar et al., 2021).

RESULT AND DISCUSSION

Natural bath soap is formulated through a saponification reaction involving fats or oils and alkaline substances such as potassium hydroxide (KOH) or sodium hydroxide (NaOH), producing soap and glycerin as the main products (BSN, 2016; Widiastuti & Maryam, 2022). This process yields carboxylate salts (soap) and is fundamental to the formation of cleansing agents. Common additives such as fragrances, colorants, vitamins (e.g., vitamin E), brightening agents, exfoliants, and antiseptics are frequently incorporated to enhance skin benefits and product functionality (Nurharjawasi, 2023). WhiteTen™ has potential as a skin-brightening agent through its mechanism of action, which involves inhibiting the distribution of melanin pigments to keratinocyte cells, thereby contributing to a more even and brighter skin tone (BioSpectrum, 2022).

In this formulation, betel leaf (*Piper betle* L.) hydrosol was employed as a natural active ingredient. Betel leaf is rich in bioactive compounds including eugenol, chavicol, and hydroxychavicol, which exhibit antibacterial properties against pathogens such as *Staphylococcus aureus* and *Escherichia coli*. These microorganisms are commonly associated with skin infections and irritation, particularly when hygiene is not adequately maintained (Raharjo, 2020).

The shower gel formulation was subjected to a series of physical property evaluations, including organoleptic observation, pH measurement, foam height test, viscosity test, spreadability test, and rinsability test. The organoleptic test was conducted to assess the physical characteristics of the formulation, such as color, odor, and appearance. The organoleptic evaluation of the shower gel formulation containing *Piper betle* leaf hydrosol and WhiteTen™ revealed that the product exhibited a white pearl color, a fresh and floral aroma, a thick and homogeneous texture, and a gel-like consistency. These characteristics indicate acceptable physical aesthetics, which are important for consumer appeal and product acceptance in cosmetic applications.

The pH value of the formulated shower gel was measured on days 0, 6, and 12 to assess its stability over time. The results showed that the pH remained constant at 5.5 throughout the observation period. According to Fadzil (2016), an ideal pH range for topical formulations is between 4.5 and 6.5 to prevent skin irritation. As presented in Table 2, the pH values of formulations were consistently measured at an average of 5.5, indicating suitability for topical application.

Table 2. pH Value of the Shower Gel During Storage

Day	pH
0	5.5
6	5.5
12	5.5

The viscosity test aimed to evaluate the thickness or flow properties of the shower gel, which influences spreadability and application comfort. Measurement was carried out using a Brookfield viscometer. The selection of spindle type and rotation speed was adjusted to the formulation's consistency. The spindle was immersed in the serum sample until the immersion level was adequate, and the device was activated to record the viscosity (Rahman et al., 2022). Based on the results shown in Table 3 the viscosity profile of the shower gel formulation under three different temperature conditions: 25°C (room temperature), 40°C (elevated temperature), and 5°C (low temperature). The purpose of this evaluation was to assess the stability of the formulation’s viscosity in response to environmental variations during storage and use.

Table 3. Viscosity Test Results of Shower Gel at Various Temperatures

Temperature (°C)	Viscosity (cP)
25	5,400
40	5,200
5	5,600

At 25°C, the viscosity was measured at 5,400 cP, which falls within the ideal range for shower gel products—sufficiently thick to maintain its gel consistency while remaining easy to spread. At an elevated temperature of

40°C, the viscosity slightly decreased to 5,200 cP, yet remained within acceptable limits, indicating no significant liquefaction or destabilization. Meanwhile, at 5°C, the viscosity increased to 5,600 cP, as expected due to decreased molecular mobility at lower temperatures; however, the product did not freeze and retained its physical stability. These findings indicate that the shower gel formulation demonstrates excellent viscosity stability across various temperature conditions, supporting its physical robustness during storage and practical use. This is consistent with previous studies which emphasize that temperature variations can influence the rheological properties of semi-solid cosmetic products, but a stable formulation should maintain acceptable viscosity within a defined temperature range (Martí-Mestres & Nielloud, 2002; Tadros, 2010).

Table 4. The Foam Height Test Results of Shower Gel

Time (minutes)	Foam height (mm)
0	80
5	60

The foam height test was conducted to evaluate the ability of the shower gel to generate and maintain foam. Initially, the formulation produced a foam height of 80 mm, indicating a rich and satisfactory foaming capacity. After 5 minutes, the foam height slightly decreased to 60 mm, which is considered a minimal change (table 4). This suggests that the foam remained stable over time and did not collapse significantly. The observed foam height falls within the acceptable range for liquid soap products, which is typically between 13–220 mm according to national standards (SNI 06-4085-1996), confirming that the formulation possesses adequate foaming performance and stability suitable for consumer use.

The spreadability test was conducted to evaluate the ability of shower gel to spread when applied to the skin. A good spreadability is indicated by a spread diameter of 5–7 cm (Mardhiani et al., 2018). The spreadability test showed that approximately 0.5 grams of the shower gel formed a spread diameter of about 1 cm when applied to the skin surface. This indicates that the formulation has a good ability to be evenly distributed across the skin, providing ease of application. In the rinsability test, the formulation was easily removed from the skin under running water at room temperature within approximately 10 seconds, leaving no greasy or slippery residue. These results align with the findings of Oliveira et al. (2014), who reported that an ideal bath formulation should be rinsed off in under 15 seconds and should not leave any sticky or slippery sensation on the skin after use. Therefore, the formulated shower gel in this study exhibits desirable sensory performance and user comfort.

Tabel 5. Physical Stability Evaluation of Shower Gel Formulation Before and After Accelerated Storage

Parameter	Before Storage	After 6 Cycles of Storage (12 Days)	Description
Color	Light green, uniform	No change	No discoloration observed
Odor	a fresh and floral aroma	Unchanged	No unpleasant or rancid odor
Texture	Homogeneous gel	Homogeneous gel	No phase separation or sedimentation
pH	5.5	5.5	Within acceptable pH range (5.5–6.5)
Viscosity	5,200 – 5,600 cP	5,200 – 5,600 cP	still acceptable
Sediment/Phase	None	None	Stable, no instability observed

The stability of the shower gel formulation was evaluated through an accelerated storage test involving six cycles of temperature fluctuation between 4–8 °C (refrigerator) and 40 °C (oven incubator), each maintained for 24 hours, over a total of 12 days. Parameters observed included changes in color, odor, consistency, sediment formation, and phase separation. Before and after accelerated storage, physical stability was monitored. A well-formulated shower gel is considered to meet physical quality requirements if no significant changes are observed before and after the accelerated storage period (Awaluddin et al., 2022). In this study, the shower gel demonstrated excellent stability under stress conditions. Throughout all six cycles, no observable changes were found in appearance, aroma, or texture, and the formulation remained homogeneous without signs of instability. These results on table 5 confirm that the shower gel maintains acceptable physical stability under fluctuating storage conditions, fulfilling the quality criteria for cosmetic products (ICH, 2003; BPOM, 2014; Siregar et al., 2021).

CONCLUSION

The formulated shower gel containing hydrosol extract of *Piper betle* L. leaves and WhiteTen™ as a brightening agent exhibited desirable physical and functional properties that comply with cosmetic quality standards. The formulation maintained a stable pH (5.5), which is compatible with normal skin pH, and demonstrated suitable viscosity under various storage conditions (5°C, 25°C, and 40°C). It also showed good spreadability and rinseability, ensuring ease of application and efficient removal with water. The foam height was within the acceptable range based on SNI standards, reflecting its cleansing performance. The inclusion of WhiteTen™, a botanical-based brightening complex, contributes to the potential added value of the product for skin radiance enhancement. Accelerated stability testing over six temperature cycling periods revealed no significant changes in color, odor, texture, or viscosity, confirming the product's physical stability. Thus, this shower gel formulation is considered physically stable, functionally effective, and suitable for further development as a natural and multifunctional cosmetic body care product.

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