

ALOE VERA GEL *FACIAL WASH* PREPARATION FORMULATION (*Aloe vera L.*) AND GREEN BETEL LEAF EXTRACT (*Piper betle L.*) WITH CARBOPOL CONCENTRATION VARIATIONS

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ARTICLE INFORMATION

Received: 23 February 2026

Revised : 17 March 2026

Accepted: 27 April 2026

DOI:

KEYWORDS

Facial Wash Gel, Aloe Vera L, Piper Betle L, Carbopol 940, Viscosity, pH.

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A B S T R A C T

Aloe Vera (*Aloe vera L.*) **Background** and green betel leaves (*Piper betle L.*) are two types of plants that have great potential in skin care, especially as active ingredients in facial wash gel preparations. *Aloe vera* (*Aloe vera L.*) contains bioactive compounds such as polysaccharides, vitamins C and E, as well as enzymes that act as antioxidants, anti-inflammatories and natural moisturizers while green betel leaves (*Piper betle L.*) It contains flavonoids, tannins, saponins and essential oils such as eugenol and caviacol that have antibacterial activity. **The purpose of the study** was to determine the effect of variations in Carbopol 940 concentration on the physical characteristics of facial wash gel preparations containing aloe vera (*Aloe vera L.*) and green betel leaf (*Piper betle L.*). Three formulas are made with Carbopol concentrations of 1% (F1), 1.5% (F2), and 2% (F3). Evaluation was carried out on organoleptic parameters, pH, foaming power, and viscosity. **The results** showed that increased Carbopol concentrations caused changes in texture to become thicker, color to be more intense, and pH increased. The formulas F2 and F3 have a pH that corresponds to the SNI standard (4.5–8.0), while F1 is below that limit. The strength of the foam decreases as the viscosity increases, but all formulas remain within the acceptable stability limits of the foam. The highest viscosity is found in F3, indicating a very viscous gel, while F1 has the lowest viscosity but is still up to standard. F2 is in the middle, with a balanced viscosity, not too liquid and not too viscous, so it is considered the most optimal in terms of comfort and stability of the shape of the preparation. **The conclusion** that this study proves that variations in Carbopol concentrations have a significant influence on the physical properties of gel preparations including organoleptic tests, viscosity, pH and foaming power. Increased concentrations of Carbopol tend to result in higher gel viscosity, thus affecting the overall characteristics of the gel. Thus, the selection of the right Carbopol concentration is essential to obtain gel preparations with optimal physical quality.

INTRODUCTION

The skin functions as a body's protector against exposure to environmental pollution, especially facial skin which is more susceptible to UV rays. This exposure can trigger various skin problems, such as the appearance of wrinkles, signs of aging, acne, and enlarged pores, so skin care is very important. Aloe vera is known as a *medical plant* or *master healing plant* because it has various benefits, including as anti-inflammatory, antifungal, antibacterial, and plays a role in accelerating cell regeneration (Wardaniati & Islami, 2020).

The skin is the largest organ as well as the outer layer of the human body that is flexible and soft, and acts as the first line of defense against various threats from the external environment such as germs, viruses and bacteria (Riandari, 2017). Facial skin health is a major concern for women. One of the cosmetic preparations for facial skin care in skincare products is gel. Gel is a semi-solid preparation, which is a suspension of inorganic particles, for topical use (Sawitri *et al.*, 2024).

The face is an area of skin that is more often the center of attention compared to other parts of the skin. Disorders that arise on the skin of the face can affect health as well as appearance, thus having an impact on a person's confidence level. Skin problems that often appear in the facial area include acne, wrinkles and signs of aging. One of the triggering factors for skin damage is exposure to free radicals, which can cause various dermatological disorders such as decreased elasticity, the appearance of fine lines, dull skin, rough texture, and acne. (Marlina *et al.*, 2022).

Having soft and smooth facial skin is the dream of many people, especially women. To keep facial skin clean from dirt, regular maintenance is required through the cleaning process. Facial cleansing can be done with various products, such as *cleansing milk*, *cleansing cream*, cleansing or refreshing solutions, and special facial soaps known as *facial washes*. If you only use water, facial cleansing is not optimal because water is not able to remove oil and dirt thoroughly. Therefore, facial cleansing products are needed so that the sticking dirt can be lifted while helping to remove dead skin cells (Rohmani *et al*, 2022).

Aloe vera (*Aloe vera* Linn.) belongs to the Liliaceae family and is native to Africa. This plant can thrive in tropical areas with sandy soil conditions and relatively little water requirements, so its growth is relatively fast and easy. It is estimated that aloe vera began to be introduced to Indonesia in the 17th century. Currently, more than 350 varieties of aloe vera have been crossed. This plant is popularly known as "*The Miracle Plant*" because of its wide uses, and has been traditionally used in various countries such as China, Congo, and America, for example to treat wounds, treat hair loss, tumors, hemorrhoids, and be used as a laxative. The content of active compounds such as aloin, emodin, gum resin, and essential oils provides a variety of important benefits for human health and life. (Marhaeni, 2020).

Aloe vera (*Aloe vera* L.) Not only is it known as an ornamental plant, but it has also been widely used as a raw material in the manufacture of drugs and cosmetic products. This plant has various properties, including functioning as an antiseptic, softening, and maintaining skin moisture. Its contents include lignin or cellulose compounds, various vitamins such as A, B1, B2, C, D, E, K, as well as important minerals such as calcium, iron, sodium, and potassium. (Rinaldi *et al.*, 2023). *Aloe vera* (L.) *Burm.f.*) plays a role in maintaining skin moisture so that it does not dry out easily. *Aloe vera soothing gel* preparations are effective in helping to restore skin hydration, provide a sense of comfort and soothing effect on skin that experiences redness or irritation, so that skin conditions return to normal while preventing dryness (Sinaga *et al.*, 2023).

Indonesia is known as a country that has an abundant diversity of herbal plants. One of the plants that is quite popular among the public is the green betel leaf (*Piper betle* L.). This plant is included in the 13 types of plants with the highest antibacterial activity. The main content of green betel leaves is essential oil, in which there are phenol compounds as active components with antibacterial properties (Kusuma *et al.*, 2017).

Green betel is one of the species of the betel plant itself, which has a natural extract and has been used since ancient times to treat various diseases. Green betel leaf (*Piper betle* L.) contains chemicals including: Flavonoids, carvarol, alkaloids, eugenol, glusides and saponins that can inhibit the growth of fungi. In addition, green betel leaves are a traditional medicine that has an antibiotic effect. Green betel leaves have an antibiotic effect so that the content or extract of betel leaves can inhibit the growth of microorganisms that are parasitic to other organisms (Djufri *et al.*, 2024).

Aloe vera and green betel leaves are two types of plants that have great potential in skin care, especially as active ingredients in facial wash gel preparations. *Aloe vera* contains bioactive compounds such as polysaccharides, vitamins C and E, as well as enzymes that act as antioxidants, anti-inflammatories, and natural moisturizers. Its skin-soothing properties and its ability to accelerate cell regeneration make it ideal for sensitive and acne-prone skin (Sawitri *et al.*, 2024). On the other hand, green betel leaves contain flavonoids, tannins, saponins and essential oils such as eugenol and kavicol which have antibacterial activity against *Propionibacterium acnes* and *Staphylococcus epidermidis*, the two main bacteria that cause acne (Maria *et al.*, 2024). The combination of these two extracts is expected to produce synergistic effects, where aloe vera helps to retain moisture and repair irritated skin, while green betel leaves actively work as an antibacterial and sebum controller. Thus, formulations that combine these two plants can increase the effectiveness of facial cleansing while providing more comprehensive skincare benefits.

Various forms of formulations have been developed for *facial wash* preparations, with gel as one of the options. The high water content in gel preparations provides benefits in maintaining skin hydration (Yurisca, 2023).

One of the factors that plays an important role in the formulation of *facial wash gel* is the use of *gelling agents*. This gelling material is a polymer with a high molecular weight that is composed of a series of molecules and polymer winding bonds so that it is able to provide viscosity to the preparation. The type and concentration of *gelling agents* greatly determine the physical characteristics of the gels produced (Hamka *et al*, 2023).

Gelling agents can be derived from natural gum, resins, or synthetic materials in the form of hydrocolloids used in gel formulations to maintain the consistency of liquids and solids in a homogeneous gel form. This substance functions as a hydrocolloid that is able to increase viscosity while maintaining the stability of the preparation. The ideal characteristics of gel-forming are that it is easy to apply to the skin, does not cause a sticky feeling, is comfortable to use, and does not cause irritation. The types of *gelling agents* vary, including semi-synthetic polymers such as cellulose derivatives (e.g. methyl cellulose) and synthetic polymers such as Carbopol (Thomas *et al.*, 2023).

Carbopol is one of the most commonly used *gelling agents* in formulations. This gelling agent should be inert, safe, and not react with other components in the preparation. Carbopol 940 is a type of *gelling agent* that is commonly used in cosmetic products because it has high compatibility and stability, is non-toxic when applied to the skin, and spreads easily on the surface of the skin. In the form of a fine powder, Carbopol 940 is widely used in cosmetics and personal care products as a gel-former. Its functions include holding solid particles in liquids, preventing separation in emulsions, and controlling the viscosity of products. In its use, the characteristics of *the gelling agent* need to be adjusted to the form of the preparation, because the higher the viscosity produced, the stronger the gel structure formed (Rowe *et al.*, 2009).

Carbopol 940 is one of the synthetic *gelling agents* that is widely used in the formulation of gel preparations, including *facial wash* gel, because it is able to form a clear gel, has high viscosity, and is effective in low concentrations between 0.5% to 2%. The concentration of Carbopol greatly affects the physical properties of the preparation such as viscosity, pH, homogeneity and dispersibility, so the selection of the right concentration is important to produce a stable preparation that meets quality standards. Various studies have proven that increasing Carbopol concentrations can increase viscosity, but can also decrease pH values and dispersibility (Sawitri *et al.* 2024., Diyana *et al.* 2024., Ramadeni *et al.* 2023., Wulandari & Ermawati, 2024). For example, a formula with Carbopol 2% produces a stable preparation with high viscosity such as in tomato, kersen leaf, and binahong extract preparations (Ramadeni *et al.* 2023., Wulandari & Ermawati, 2024). However, the 1% concentration is also reported to produce preparations with the best stability in ingredients such as telang flower and yellow pumpkin (Sawitri *et al.* 2024., Diyana *et al.*, 2024). Formulations with a concentration of 1.5% even give optimal results in homogeneity and viscosity tests, as shown in studies of preparations from papaya leaves (Tubagus *et al.*). In addition, Carbopol 940 shows advantages over *other gelling agents* such as HPMC and Na-CMC in terms of stability and consumer acceptability (Ulinuha *et al.*, 2024). Therefore, the variation in the concentration of Carbopol 940 is an important aspect that needs to be further researched in the development of *facial wash* gel preparations based on natural ingredients.

METHODOLOGY

Data Type

This type of research is a type of laboratory experimental research, namely making aloe vera facial wash gel (*Aloe Vera L.*) and green betel leaf extract (*Piper betle L.*) Using the maceration method by meeting the physical properties test of the preparation by varying the concentration of carbopol.

Time and Place

The implementation took place at the Pharmacy Laboratory of the Bina Husada Polytechnic and the Baubau Polytechnic which was held on July 9-17, 2025.

Tools and Materials

The tools used are aluminum foil, stirring rod, bunsen, blender, porcelain cups, glass funnels, measuring cups, chemical cups, tripods, gauze, analytical balances, pH meters, knives, horn spoons, viscometers and *bottle facial wash* containers. The ingredients used are aloe vera gel, green betel leaf extract, aquadest, carbopol 940, citric acid, glycerin, EDTA-4Na, nipagin, propylene glycol, sodium lauryl sulfate (SLS) and trietanolamine (TEA).

Working Procedure

Aloe Vera (Aloe vera L.) Sample Preparation

The preparation of aloe vera gel begins by choosing fresh aloe vera leaves (*Aloe vera*), then washed thoroughly and rinsed with sterile aqueducts. The outer skin of the leaves is peeled using a clean knife to remove the clear gel part inside, avoiding the yellow latex part. The gel obtained is weighed as much as 200 grams, then mashed using a blender until homogeneous. If needed, the gel is filtered using gauze to separate the coarse fibers. The gel that has been processed is ready to be used directly in the formulation process of facial wash gel preparations.

Sample Preparation of Green Betel Leaf (*Piper betle L.*)

Sample of green betel leaves (*Piper betle L.*) taken and weighed as much as 5 kg and wet sorting was carried out to remove the sticky dirt. Next, the sample is washed using running water until clean, drained, and then cut into small pieces to facilitate the drying process, after that, the sample is dried in the sun by coated with a black cloth until it reaches a dry condition. Dried simplicia is blended until smooth, then stored in a clean container.

Green Betel Leaf Extraction (*Piper betle L.*)

Green betel leaf powder is macerated using 70% ethanol solvent. A total of 500 grams of simplicia powder are poured with solvent liquid (± 5 L), Closed the jar and left for 7 days on the day the room temperature is protected from light while repeatedly stirring, the jar is completely covered with black duct tape. The sample is left to sit for 2-3 hours and then stirred to facilitate the process of transferring the mass of solid components into the solvent. The sample extract is transferred to a different container every 1×24 hours and then the pulp is squeezed and replaced with a new solvent, this process is carried out for 7 days. After 7 days, the extracts obtained are concentrated by evaporating using a rotary evaporator with a temperature of 50°C until a thick extract is obtained.

Aloe Vera Facial Wash Gel Formulation (*Aloe Vera L.*) and Green Betel Leaves (*Piper betle L.*) (Yuniarsih *et al.*, 2020).

Each ingredient is mixed with 80 ml of aquadest, 0.2 gr nipagin, 0.1 gr EDTA-4Na, 2 ml of glycerin and 1 ml of propylene glycol using a magnetic stirrer until homogeneous. Then 2.5 grams of SLS are added. Then heat the solution to 40°C. After that add perfume, 1 g of citric acid, aloe vera gel 8 ml and green betel leaf extract 2 ml. Add carbopol and TEA until homogeneous

Physical Evaluation of Aloe Vera Facial Wash Preparations (*Aloe Vera L.*) and Green Betel Leaves (*Piper betle L.*)

Organoleptic Tests

Organoleptic tests are carried out by looking directly at shape, color, smell and observing consistency (Pertiwi, 2019).

pH Test

pH measurement was carried out using a pH meter by dissolving 3 g of gel samples in 30 mL of aquadest, then the stable pH value shown by the tool was recorded. According to SNI 16-3499-1996, the ideal pH interval for skin preparations is 4.5–8.

Foam Power Test

A total of 1 mL of sample is put into a measuring cup, then aquadest is added until the volume reaches 10 mL. The solution is beaten for 20 seconds and the height of the formed foam is measured. After sitting for 5 minutes, the height of the final foam is measured again. The stability of the foam is calculated by the formula:

$$\text{Stabilitas busa (\%)} = \frac{\text{Tinggi busa akhir}}{\text{Tinggi busa awal}} = 100\%$$

Viscosity Test

Viscosity is measured using a Brookfield viscometer with an L4 spindle. A total of 100 mL of preparation is inserted until the spindle is submerged, then the tool is run at the specified speed until the reading is stable. According to SNI, the recommended viscosity range is 2,000–50,000 cPs. (Lestari *et al.*, 2021; Marhaba *et al.*, 2021).

RESULTS & DISCUSSION

This research has the goal of formulating a facial wash gel preparation with the active ingredient of green betel leaf extract (*Piper betle L.*) and aloe vera (*Aloe vera L.*), as well as evaluating the effect of variations in Carbopol concentrations in the gel base on the physical properties of the preparation. Four test parameters were performed: organoleptic, pH, foaming power, and viscosity.

The results of organoleptic tests showed that all formulas had a similar distinctive smell of extracts, and showed significant similarities in color and texture. The F1 formulation is dark green with a light gel texture, while F2 and F3 also show a dark green color with a thicker texture. Increased concentrations of Carbopol result in increased gel viscosity, which affects the visual appearance and characteristics of the preparation. The results of the organoleptic test can be seen in table 1.

Table 1. Organoleptic Test Results

Formulation	Color	Smell	Texture	Picture
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F1	Dark green	Typical green betel leaf extract	Mild gel	
F2	Dark green	Typical green betel leaf extract	Gel is somewhat thick	
F3	Dark green	Typical green betel leaf extract	Thick gel	

pH measurement is carried out using a pH meter to determine the acidity level of each *facial wash* gel preparation. The results showed that the F1 formulation had a pH of 4.00, F2 of 6.32, and F3 of 6.84. Based on the SNI 16-4399-1996 reference regarding the quality requirements of facial cleansers, a good and safe pH for the skin ranges from 4.5 to 8.0 because the pH of normal human facial skin tends to be slightly acidic, which is around 4.5 to 5.5. Thus, formulations F2 and F3 are within the recommended pH range and are safe to use. In contrast, the pH of F1 is slightly below the standard lower limit, which means it risks causing mild irritation, especially on sensitive skin or when used continuously. The results of the pH test can be seen in table 2.

Table 2. pH Test Results

Formulation	pH value	Information
F1	4,00	Not eligible
F2	6,32	Qualify
F3	6,84	Qualify

Foam power and stability tests are performed to determine the ability of the preparation to produce and maintain foam after shake. The F1 formulation produced the highest initial foam of 17 mm, with a final foam of 15.5 mm after 5 minutes of observation, resulting in a foam stability of 91.18%. The F2 and F3 formulations have foam stability of 88.96% and 86.21%, respectively. These results show that the entire formula is able to retain foam well, as all three have stability above 85%. The stability of the foam decreases as the concentration of Carbopol increases, which leads to increased viscosity and impacts the inhibition of formation as well as the resistance of the foam. However, all formulas still qualify as effective facial cleansing preparations. The results of the foam power test can be seen in table 3 below.

Table 3. Foam Power Test Results

Formulation	And so it was early (mm)	Final Foam (mm)	Foam Stability (%)
F1	17	15,5	91,18%
F2	16,3	14,5	88,96%
F3	14,5	12,5	86,21%

Based on the viscosity provisions for gel preparations in SNI 16-4399-1996, the ideal viscosity values for topical cosmetic preparations are in the range of 2,000 to 50,000 cP, it is important to achieve an ideal consistency and texture, which affects the comfort of use and the effectiveness of the product. Too low a viscosity will make the product too diluted and difficult to apply, while too high a viscosity will make it too thick and difficult to remove from the packaging or spread on the skin (Anelia Marhaba *et al.*, 2021). The results of the study show that all formulas are within the range of the standard. F3 has the highest viscosity of 6979 cP, indicating a very viscous gel, while F1 has the lowest viscosity of 2918 cP but still meets the standard. F2 is in the middle, with a balanced viscosity of 3343 cP, not too liquid and not too viscous, so it is considered the most optimal in terms of comfort and stability of the preparation form. The results of the viscosity test can be seen in the following table 4.

Table 4. Viscosity Test Results

Formulation	Spindle Speed (rpm)	Viscosity (cP)
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F1	60	2918
F2	60	3343
F3	60	6979

CONCLUSION

Based on the results of the study, it can be concluded that in the results of the organoleptic test there is a color similarity of the three formulas, namely in F1 it is dark green with a light gel texture, while F2 and F3 show a dark green color with a thicker texture. The results of the viscosity test showed that the F3 formulation had the highest viscosity of 6979 cP, while F2 was 3343 cP and the viscosity of F1 was 2918 cP. The pH test F1 produced the highest initial foam of 17 mm, with a final foam of 15.5 mm after 5 minutes of observation, resulting in a foam stability of 91.18%. The F2 and F3 formulations have foam stability of 88.96% and 86.21%, respectively. The pH test showed that the F1 formulation had a pH of 4.00, F2 pH of 6.32 and F3 pH of 6.84. 2. Variations in Carbopol concentrations exert a significant influence on the physical properties of gel preparations including organoleptic tests, viscosity, pH and foaming power. Increased concentrations of Carbopol tend to result in higher gel viscosity, thus affecting the overall characteristics of the gel. Thus, the selection of the right Carbopol concentration is essential to obtain gel preparations with optimal physical quality.

ACKNOWLEDGMENTS

The author would like to express his deepest gratitude to his beloved parents for their endless prayers, affection, support, and sacrifices. Without their blessing and encouragement, the author would not have been able to complete this scientific article well.

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